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Research Paper

An Evaluation on Hoof Deformations in Ewes

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ABSTRACT: *The aim of this study was to determine the non-infectious hoof deformities of Norduz sheep in the pre-pasture period and to identify lame animals using the locomotion scoring scale. A total of 44 ewes aged 1-6 years constituted the animal material of the study. Hoof conformation characteristics were subjectively assessed by two observers. A total of 176 hooves were examined for toe length, heel shape, fetlock shape, claw shape, and claw splay in the study. A four-point scale was used for the locomotion test. The scores for toe length, heel shape, fetlock shape, claw shape, and claw splay were 1.40, 1.45, 0.89, 0.63, and 0.19, respectively. According to the 4-point locomotion test, 88.6% (score 0) of the sheep showed good walking characteristics by distributing the weight equally on all four feet, while 11.4% (score 1) walked with uneven steps. It can be said that the hoof deformations determined in Norduz sheep may be caused by the animals not going out to pasture, especially in winter months, remaining motionless in closed barns for a long time, and the ground structure.*

KEYWORDS: *Claw, Hoof, Locomotion, Sheep*

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I. INTRODUCTION

Approximately 90% of lameness, which causes great economic losses and is one of the most important health problems in livestock farming, consists of foot and hoof problems [1]. Untreated foot and nail problems negatively affect the welfare of animals, preventing them from walking, eating, and wandering around the pasture, as well as causing productivity losses and eventually culling [2].

The key aspect in the treatment and control of lameness is making an accurate diagnosis [3]. Whatever the etiology of lameness, the risk factors associated with its occurrence may be genetic or environmental, and there may be an interaction between them. The main environmental risk factors for lameness include season, physiological factors, breeding system, farm characteristics and housing conditions, improper foot care, malnutrition (lack of nutrients, unbalanced ratios, etc.), inadequate hygiene measures, and farmer carelessness [4]. Therefore, the farmer must be aware of the importance and consequences of lameness in the herd to implement any preventive measures against lameness predisposing factors [5].

Wet underfoot conditions were reported to be the most important environmental factor affecting hoof conformation in English sheep flocks [6]. Lewis and Green [7] reported that more farmers adopting "best practices" in ewes and lambs could result in reduced prevalence of lameness in lambs to <2%, reduced antibiotic use, and increased sheep welfare.

Damaged, deformed, or overgrown claws can directly or indirectly cause lameness [6]. Claw trimming is an important solution for lameness caused by claw overgrowth, one of the major welfare problems, but it is often applied too late. In dairy goats, claw size was strongly associated with the likelihood of claw deformity, and in the same animal, the length of the front claws and the number of deformed claws were associated with lameness [8]. Similarly, claw horn overgrowth was observed on almost all claws on Swiss dairy goat farms studied by Sailer et al. [9], and wall horn overgrowth on claws was reported to be difficult to prevent under communal housing conditions (outside in summer, inside in winter).

Gait scoring methods, which evaluate an animal's walking abilities using a numerical rating scale, are widely used for rapid detection and treatment of lame animals in a herd [10]. Phythian et al. [11] compared group-based and individual animal gait assessment methods in sheep. Field group assessment was found to be the most accurate method to measure lameness in most of the farms examined. However, depending on the

situation, field conditions, and sample size, this may not be possible, and individual gait assessment may provide a more feasible option.

An objective scoring scale based on a group of visual observations was developed for sheep by Kaler et al. [12]. According to the research results, this method was a highly reliable method for assessing locomotion in sheep by trained observers. In the study, in which a 5-point gait scoring system including the "uneven gait" category and a 4-point system was compared in Saanen goats, it was determined that the 5-point system was more sensitive than the 4-point system and allowed to predetermine a possible lameness. However, trained observers are required to detect uneven gait, which is difficult to distinguish from normal gait [10].

It has also been determined in some sheep breeds in Turkey that foot diseases and hoof deformities are important welfare and economic loss problems. In the sheep herds examined by Baran et al. [13], horn and hoof deformations took first place with 17.70% in the pasture period and 11.78% in the barn period. On the other hand, the average percentage of sheep with non-infectious hoof deformation was reported as 67.74% by Yurdakul [14] and 73.38% by Polat [15].

There are no studies investigating foot and hoof deformations in Norduz sheep, which is a native breed of Turkey. Therefore, the aim of this study was to determine the non-infectious hoof deformities of Norduz sheep in the pre-pasture period and to identify lame animals using the locomotion scoring scale.

II. MATERIALS AND METHODS

The experimental procedures were approved by Van Yüzüncü Yil University Animal Research Local Ethics Committee (reference no 2022/08-08). The study was carried out in the Research and Application Farm of Van Yüzüncü Yıl University (Van, Turkey) in the pre-pasture period of 2022. A total of 44 ewes aged 1-6 years constituted the animal material of the study.

Hoof conformation characteristics were subjectively assessed by two observers using the scale developed by Deeming et al. [16] (Table 1). Thus, a total of 176 hooves were examined for toe length, heel shape, fetlock shape, claw shape, and claw splay in the study. Except for the fetlock shape, all traits were scored on a 3-point ordinal scale (0, 1, and 2), and 0 was considered normal in all cases. Toe length from the coronary band to the toe tip was evaluated as no overgrowth, moderately overgrown, and severely overgrown. Heel shape was scored 0 if the coronet band was parallel to the ground, 1 if the coronet band was angled towards the ground, and 2 if the coronet band was angled sharply towards the ground. Fetlock was scored 0 if it was upright and straight and 1 if it was sloping towards the ground. In claw shape, the score was 0 if both claws were straight, 1 if one claw was bent either away or towards the midline of the hoof, and 2 if both claws were bent either away or towards the midline of the hoof. Looking at claw splay, the score was 0 if the claws were not splayed, 1 if the claws were moderately splayed and 2 if the claws were severely splayed.

Table 1: Hoof conformation traits [16]

Trait	Score		
	0	**1**	**2**
Toe length	No overgrowth (The toe's length is less than half that of the remainder of the hoof.)	Moderately overgrown (Toe length is longer than half but shorter than the total length of the hoof.)	Severely overgrown (Toe length exceeds the whole length of the rest of the hoof.)
Heel shape	Upright	Moderately dipped	Severely dipped
Fetlock shape	Upright and straight	Dipped towards the ground	
Claw shape	Both are straight	One is bent/twisted	Both are bent/twisted
Claw splay	No splayed	Moderately splayed	Severely splayed

A four-point scale developed by Angel et al. [17] was used for the locomotion test (Table 2). For this purpose, the sheep were allowed to walk at a distance of at least 4 full steps, and care was taken to keep the observers at an equal distance from the animals [10, 17].

Table 2: Description of a 4-point locomotion scoring system [17]

Score	Assessment criteria
Good (0)	Walks in a steady gait and distributes weight equally over all four feet.
Slightly Lame (1)	Uneven steps, however, it's unclear which limb or limbs are impacted.
Moderately Lame (2)	The injured limb or limbs are noticeable; the stride may be reduced, and the steps are uneven.
Severely Lame (3)	The sheep's mobility is so severely restricted that it regularly stops moving or lies down in obvious distress. When walking or standing, the affected limb or limbs can be held off the ground and easily recognized.

Frequency analysis was performed for foot conformation traits using the SAS statistical program [18]. In addition, the Pearson's correlation analysis was applied to determine the relationships among the traits.

III. RESULTS AND DISCUSSION

Descriptive statistics for live weight and hoof conformation traits in Norduz ewes are given in Table 3. The mean live weights of Norduz ewes were 62.11 kg. For toe length, the 176 feet that were studied in this study had an average score of 1.40, which ranged from 0 to 2. Deeming et al. [16], who found that excessive toe growth was the most common cause of hoof deformity in goats, reported that by comparing subjective scores and objective measurements of toe length, observers in the study were more accurate in giving a score of 0 compared to 1 or 2.

Table 3: Descriptive statistics for hoof conformation traits in Norduz ewes

Traits	n	Mean ±SE
Live weight (kg)	44	62.11±1.15
Toe length	176	1.40±0.05
Heel shape	176	1.45±0.05
Fetlock shape	176	0.89±0.02
Claw shape	176	0.63±0.06
Claw splay	176	0.19±0.03

SE: Standart Error

In the scoring made for heel shape and fetlock shape, 1.45 and 0.89 points were obtained, respectively. High and consistent reliability was obtained for subjective scores for heel shape and fetlock shape in dairy goats [16]. Using a scale ranging from 0-3 for sole and heel conformation, Best et al. [6] determined the average score as 1.36. In this study, claw shape and claw splay were scored as 0.63 and 0.19, respectively. Deeming et al. [16] reported that subjective scores of claw shape and claw splay in dairy goats were less reliable and observers needed further training in this regard.

The distribution of toe length according to front and hind hooves is given in Figure 1. The toe length of Norduz sheep, determined by measuring the front of the hoof, was better in the hooves of the front than in the hind. The frequency of sheep with normal toe length (score 0) was 8.5% and 5.6% in the front and hind hooves, respectively, while the frequency of severely overgrown toes (score 3) was 24.4% and 29.6%, respectively. Smith et al. [19] reported that overgrown hoof horns were not a sign of lameness but appeared after sheep became lame due to footrot. The length of non-deformed and overgrown deformed claws in Sanen and Alpine goats were 72.9 mm and 81.9 mm in the front claws and 76.7 mm and 80.9 mm in the hind claws, respectively [8].

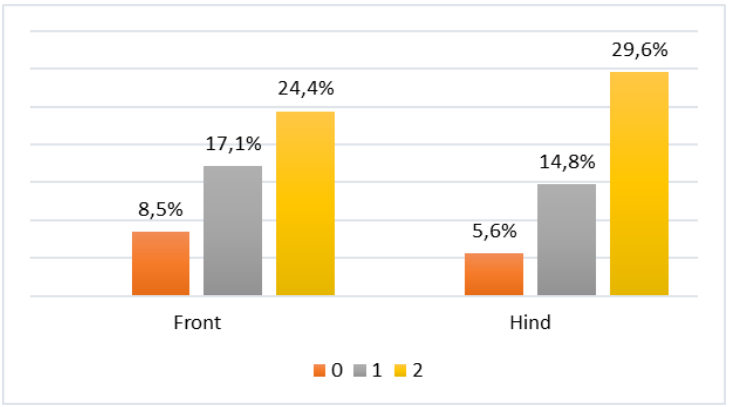

Figure 1: Distribution of toe length according to front and hind hooves

The frequency of normal heel shape evaluated according to the angle towards the ground was determined as 6.8% and 5.1% in the front and hind hooves, respectively (Figure 2). On the other hand, it was determined that the hind hoof was moderately or severely dipped at a higher frequency. Baran et al. [13] observed that the number of broken and cracked hooves was higher during the pasture season as sheep flocks walked long distances. Beak, corkscrew, and scissor-shaped hoof deformities were more common in sheep grazing on vegetation-rich pastures. High rates of overgrown toes and dipped heels were identified in New Zealand dairy goats, with the hind hooves more affected than the front hooves [20].

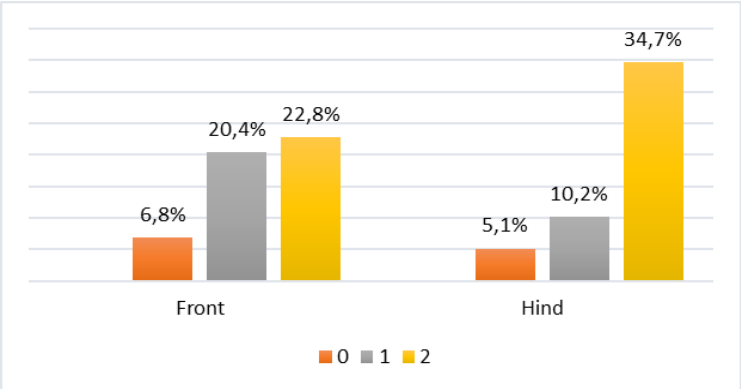

Figure 2: Distribution of heel shape according to front and hind hooves

The distribution of the fetlock shape according to the front and hind hooves is given in Figure 3. In the front and hind hooves, the frequency of those with an upright and straight fetlock shape (3.4% and 2.2%, respectively) was lower than those with a slope towards the ground (46.6% and 47.8%, respectively). Similar to the findings of this study, very few dipped fetlocks were detected in dairy goats [16].

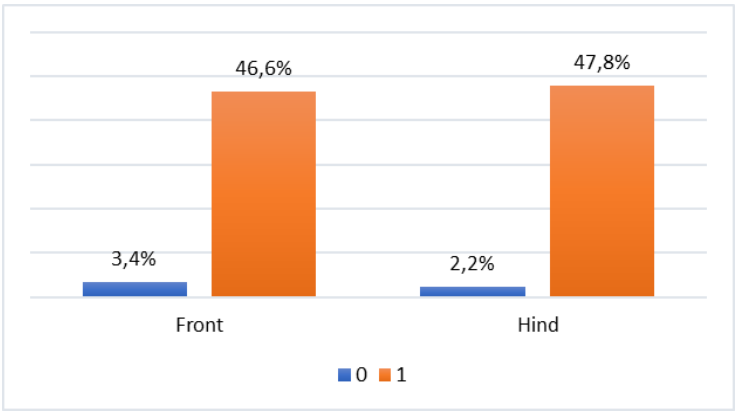

Figure 3: Distribution of fetlock shape according to front and hind hooves

The distribution of 0-scored hooves with both claws flat was 28.4% and 26.7% in the front and hind hooves, respectively. In contrast, the distribution of front and hind hooves with both claws bent was 6.3% and 10.8%, respectively (Figure 4). In contrast to the findings of this study, Deeming et al. [20] found a higher proportion of misshaped claws on the hind hooves compared to the front hooves in New Zealand dairy goats.

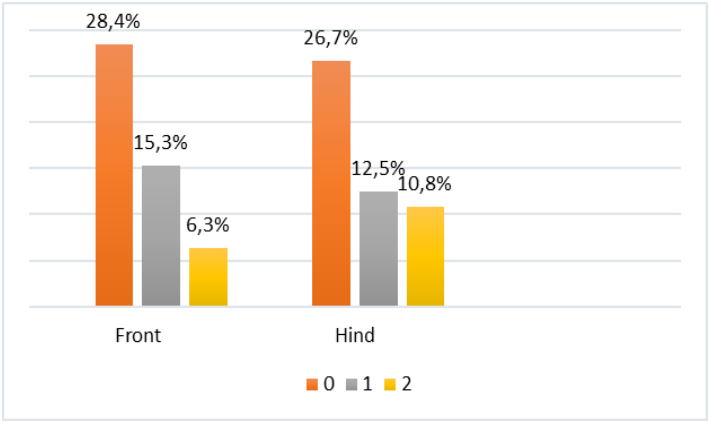

Figure 4: Distribution of claw shape according to front and hind hooves

The claw splay in Norduz ewes was found to be good (Figure 5). Only one ewe had severe claw splay in the front left foot, while the distribution of those with moderately splayed claw was 11.9% and 5.7% in the front and hind hooves, respectively. No effect of hoof trimming was observed for objectively measured claw splay distance at 13 months and 25 months in dairy goats [20].

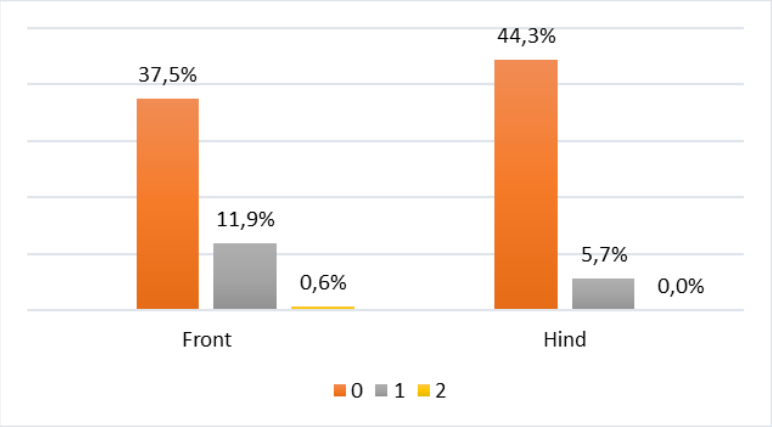

Figure 5: Distribution of claw splay according to front and hind hooves

According to the 4-point locomotion test, 88.6% (score 0) of the sheep showed good walking characteristics by distributing the weight equally on all four feet, while 11.4% (score 1) walked with uneven steps (Figure 6).

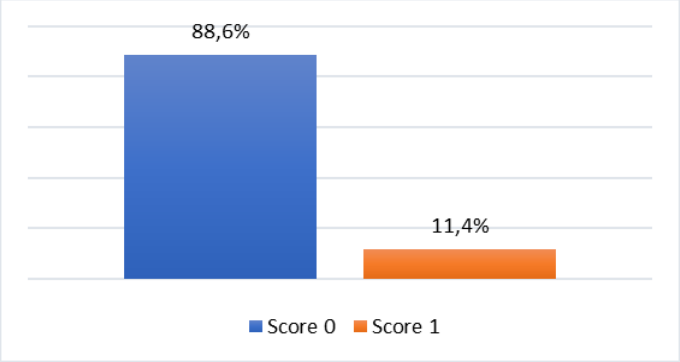

Figure 6: Locomotion (mobility) test

Kaler et al. [12] developed a seven-point movement rating scale in sheep ranging from 0 = normal locomotion to 6 = unable to stand/move. The study revealed that the locomotion scoring was reliable and could be a useful research tool for identifying and monitoring locomotion in individual sheep. Ajuda et al. [8] determined that the claw size of dairy goats affected the prevalence of deformation and severity of lameness, and the number of deformed claws affected the gait of the goats. In a study conducted on sheep in New Zealand, lameness severity was determined as grade 1 (mild) in 72.8% of the sheep, grade 2 (moderate) in 24.3%, and grade 3 (severe) in 3% of the sheep [21].

IV. CONCLUSION

It can be said that the hoof deformations determined in Norduz sheep may be caused by the animals not going out to pasture, especially in winter months, remaining motionless in closed barns for a long time, and the ground structure. For herd health and welfare, foot and hoof health checks should be carried out regularly in spring and fall periods. In case lameness is detected, the underlying causes should be determined quickly, and the necessary attention should be paid to barn conditions, ground structure, and hoof care.

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