

Seasonality's influence on sheep welfare: insights from farms in marginal areas

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Sheep are a species commonly considered well adapted to be farmed in marginal areas. From an environmental perspective, extensive farming in these rural areas can lead to a more sustainable farming system, increasingly valued by consumers. However, pasture productivity, the primary resource for animal feeding in this context, as well as the availability of resources such as shade and water, is dependent on climatic condition, significantly impacting animal welfare, production, and the quality of derived food products. The aim of this study was to describe how seasonal climatic changes affect the welfare of sheep farmed in marginal areas, defined in the experimental design as land with limited agricultural potential, characterised by economic infeasibility or physical constraints (e.g., poor soil fertility, steep slopes, rocky terrain) that preclude conventional crop cultivation. The welfare of six flocks of sheep raised in marginal areas was monitored using the AWIN welfare assessment protocol adapted for extensive systems. A total of 72 sheep (12 for each flock) were individually monitored by trained evaluators using 24 animal-based measures for two consecutive years (2023-2025) during summer and winter seasons. The proportion of each score of animal-based indicators was calculated, and generalized linear models with a binomial distribution were used to analyze the seasonal effects, and pairwise comparisons were conducted with Sidak correction to adjust for multiple comparisons. Good feeding showed moderate seasonal variation, with 50% of animals scoring BCS=3 in both summer 2023 and winter 2024, slightly decreasing to 47.4% in summer 2024, and increasing to 63% in winter 2025, although differences were not statistically significant ($p = 0.413$). In winter, sheep more frequently showed dirty and wet fleece and hoof overgrowth compared to summer. Hoof overgrowth was especially high in summer 2023 (62.8%) and winter 2025 (91.3%) compared to other seasons ($p < 0.001$), with significant differences between summer 2024 and winter 2025 ($p = 0.024$). Fleece cleanliness was poorer in summer 2023 (71.1%) compared to winter 2024 and 2025 ($p < 0.001$ and $p = 0.022$), suggesting that climatic conditions and seasonal management (e.g. trimming, shearing) can affect sheep welfare. Faecal soiling was also more prevalent in winter seasons (2024: 57.1%, 2025: 78.3%) compared to summer seasons (2023: 41.7%, 2024: 43.9%) ($p = 0.002$), possibly influenced by reduced pasture quality or dietary changes during winter, which may negatively affect gut health. Respiratory problems were also more frequent in winter 2025 compared to previous seasons ($p = 0.002$), further highlighting the impact of colder conditions on sheep health in extensive systems. Interestingly, eye lesions were observed in 25% and 12.3% of animals during summer 2023 and 2024, respectively, compared to 5.7% and 6.5% in winter 2024 and 2025 ($p = 0.028$), likely due to increased insect activity and other environmental irritants during warmer months. These results reveal differences in the welfare condition of sheep raised in marginal areas, highlighting the importance of identifying possible risk factors associated with climatic and environmental conditions. This project is funded by the Italian Ministry of Health (GR-2021-12374382).

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