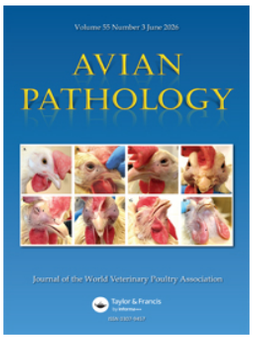

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Traumatic skin lesions in commercial broiler breeder hens: prevalence and development during the production period

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ABSTRACT

Traumatic skin injuries to the back, thighs and flanks are an emerging health and welfare issue in broiler breeder hens. This study is the first to investigate the prevalence, development and morphology of these injuries in breeder hens during their lifespan, including their effect on ovary activity, from week 20 and to end of the production eight commercial flocks were monitored at weeks 20, 25, 30, 40 and end of life (approximately 60 weeks). A transect walk was used to screen the flocks for traumatic skin injuries. The prevalence of injuries in broiler breeder hens varied greatly between flocks (range: week 20: 1–4 lesions, week 25: 2–36 lesions, week 30: 1–82 lesions and week 40: 8–177 lesions) and increased from 20 weeks of age to 30 and 40 weeks ($P = 0.03$ and $P = 0.054$, respectively). Investigation of culled hens at the end of lay, revealed very few fresh injuries, but scar tissue was a common finding. No traumatic skin injuries were observed in the roosters. Flocks with toe-clipped males had numerically fewer injuries than flocks with intact males. Furthermore, there was a weak negative correlation between the percentage of injured hens and the percentage of roosters in the flocks ($P = 0.04$). Fifty-five % of the hens with traumatic injuries that were submitted to *postmortem* examination at 25–40 weeks of age presented regression of the ovary and were not in lay. The subcutaneous lesions were far more severe than what could be detected by external inspection alone.

RESEARCH HIGHLIGHTS

- The prevalence of traumatic skin injuries varies greatly between farms with equal stocking density and the same breeder hybrid.
- The incidence rate is highest in the first half of the production period.
- Very few fresh injuries were observed at the end of lay.
- Flocks with toe-clipped males had numerically fewer injuries.
- Egg production was suppressed in 55% of hens with unhealed injuries.

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Introduction

In 2025, approximately 8.5 billion broiler chickens were hatched at commercial hatcheries in the European Union (Eurostat, 2025). These hatching eggs originated from highly specialized parent stock farms, where the main production outcome is fertilized eggs. A sustainable and high production of day-old broiler chicks depends on healthy breeder flocks with an adequate environment, high biosecurity, and optimal nutrition.

Several papers have addressed different health and welfare challenges in broiler breeder production, such as chronic stress and hunger due to feed restriction (Renema *et al.*, 2007; De Jong & Guémené, 2011; De Jong *et al.*, 2012), forced mating (van Emous & De Jong, 2013), male to female aggression (Millman *et al.*, 2000), footpad dermatitis (Kittelsen *et al.*, 2024), feather damage (Petek & Çavuşoglu, 2025), and keel bone fractures (Kittelsen *et al.*, 2023; Petek & Çavuşoglu, 2025). One emerging health and welfare challenge in broiler breeder hens, which is sparsely described in published studies, is traumatic skin lesions. These injuries may manifest as rounded lesions under the wings or as lacerations over the back, thighs and flanks. A traumatic skin lesion is distinctly different from other types of skin lesions, such as contact dermatitis or viral-induced lesions like fowlpox, in that it is inflicted by an acute external incident (Shawar *et al.*, 2009). The puncture of the skin enables bacteria to enter and colonize the subcutaneous tissue (Norton, 1997), which may exacerbate the lesion, leading to avian cellulitis (Radwan *et al.*, 2018) and/or sepsis.

Traumatic skin injuries may be caused by feather pecking and cannibalism (De Jong & Guémené, 2011) or sharp claws in both males and females (Shi *et al.*, 2019). However, the most documented risk factor is the males' behaviour; the broiler breeder males show an extremely high degree of aggressive sexual behaviour and a high number of forced matings (Millman *et al.*, 2000; van Emous & De Jong, 2013; Lupu *et al.*, 2025). Therefore, to prevent laceration to the females during mating, it is common practice in many countries to toe-clip the roosters (Fiks-Van Niekerk & De Jong, 2007; De Jong & Guémené, 2011). Directly after hatching, the outermost joint of the backward pointing toe of the breeder males is amputated (Fiks-Van Niekerk & De Jong, 2007; De Jong *et al.*, 2012; Riber, 2017).

The prevalence of traumatic skin lesions in broiler breeder hens has been increasing in Norway since the early 2020s (personal experience). To the authors' knowledge, there are no published papers reporting on the prevalence of these injuries at different ages during the entire production period of the breeders. In addition, there is little knowledge on the morphology of these injuries and how they affect reproduction, more specifically the follicle activity in the ovary.

This investigation arose from concerns raised by the Norwegian broiler breeder industry regarding an increasing incidence of traumatic skin lesions in broiler breeder hens. To gain more knowledge about the overall prevalence of traumatic skin lesions, the variations across flocks, and the development during the life of the birds, the aim of this paper was to investigate and describe the prevalence of traumatic skin injuries at different time-points during the commercial broiler breeder hen's life, as assessed during a transect walk in the barn (Vasdal *et al.*, 2022). An additional aim was to compare the extent of external versus subcutaneous infection by using *postmortem* examination. Finally, to assess the injury's effect on egg production, the birds' ovarian activity was evaluated by visual inspection of the size, shape, colour, and number of mature follicles.

Materials and methods

Birds and housing

The data were collected from January to December 2024. The study population consisted of eight commercial Ross 308 broiler breeder flocks, non-beak trimmed, located in the eastern and western parts of Southern Norway. Five of the flocks had males with intact toes, while in three of the flocks the males were toe-clipped. All eight breeder flocks consisted of approximately 7500 placed hens (range: 5030–7606) and 6.5–8.5% placed roosters, reflecting common differences between Norwegian broiler breeder farms. Mean bird density was 5.75 birds/m^2 (range 5.0–6.6) at week 20. All production barns were enclosed, fully insulated, with a mechanical ventilation system, no windows, and a concrete floor with fresh wood shavings, elevated slats (height: 30–60 cm, width: 2.4 m (range: 1.2–5.0 m)) with nest boxes, and round metal perches on the slats. The wood shavings were 5–15 cm deep in different areas of the barn. The light regime included 8 h of darkness per day in accordance with hybrid recommendations and the age of the birds. Air quality (CO_2 and NH_3) was recorded at each visit (Dräger X-am 5600, Drager, Lubek, Germany). All flocks were fed commercial pelleted feed. The rooster feed lines were situated in the litter area, and the hen feed lines either on the slatted area or in the litter area. Feed was provided once per day, in an amount according to the management guide of the breeding company and the age of the birds. Other management practices followed the recommendations from the breeding company and Norwegian regulations. Broiler breeders are not slaughtered in Norway; therefore, all flocks were culled on the farm with whole house CO_2 stunning at the age of 58–63 weeks. The flocks were visited five times each: at 20, 25, 30, and 40 weeks of age (woa), and finally at the end of the production period after culling.

Sampling method

Transect

The flocks were evaluated by direct observation during a transect walk at each age. A transect walk is a slow and systematic walk through all areas of the barn, where all visible injuries on the back, thighs, flanks, and under the wings were recorded in males and females (Vasdal *et al.*, 2022). A traumatic skin injury was described as bleeding or dark scabbing in the aforementioned areas, since blood and scabbing are easily seen by external, visible evaluation from a short distance. Completely healed scar tissue was not included in the transect, since this is difficult to assess without hands-on examination. The recording did not discriminate between injuries in the aforementioned anatomical areas. Only one skin injury per bird was recorded. Pecking injuries to the comb, wattle, head or neck were not included. The last visit was performed after the birds had been culled on farm with CO_2 in the barn; therefore, the transect was not used as an evaluation method at this age (see below).

Necropsy

During all visits, recently culled or dead hens with the injuries described were subjected to *postmortem* examination. The length of the external injury was recorded, along with the extent of the subcutaneous infection in centimetres. A subcutaneous infection was classified as bleeding, swelling, oedema, and/or caseous fibro-necrotic plaques. In addition, the ovaries were inspected to evaluate follicle numbers, size, shape, and colour. A bird in full lay was defined as having a follicle hierarchy of 4–5 follicles with round shape and yellow colour. During the last visit, at end of lay, a total of 100 culled birds were randomly selected for necropsy from different locations, ensuring sampling from both the litter and the elevated slats. The dead hens investigated at end of lay were examined for injuries, whether they were fresh/unhealed with bleeding and/or scabs or if the injuries were healed with visible scar tissue and/or adhesions. In addition, the ovary was evaluated, as described above.

Statistical analysis

Statistical analyses were performed using the software SAS 9.4 (SAS Institute, Cary, NC, USA). For the data collected during the transect walks, the statistical unit was flock by age. For the data collected during *postmortem* assessment, the unit was each bird assessed. The eight flocks followed in the study were each visited at five different ages, giving a total of 40 flock visits. Unfortunately, four of the visits could not be performed due to scheduling conflicts. Therefore, the final total of flock visits was 36. The data from the transect walk, with the number of hens observed with the defined injuries, were averaged for each flock and age. The effect of age on the number of birds observed with skin injuries was investigated using the mixed procedure model, with age as a fixed factor and flock ID as a random factor. The data fit the model assumptions, e.g. normal distribution of the residuals. *Post-hoc* analyses were performed with the Tukey's HSD test.

The data from the *postmortem* assessment of the relationship between the length of the skin injuries and whether the hens were in active egg production were analysed with a mixed model including active egg production as a fixed factor and flock ID as a random factor. Similarly, the GLIMMIX procedure was used to assess the relationship between injury severity category and egg production, with wound category as a fixed factor and flock ID as a random factor.

The relationship between the number of injured hens per age and the risk factors measured on farm was assessed using Pearson correlations. The risk factors included in the analyses were: percentage of roosters in the flock, CO_2 concentration (ppm) and NH_3 concentration (ppm).

Results

Prevalence of traumatic skin injuries in broiler breeder hens 20–40 weeks of age

Within the broiler breeder hens, there was a significant effect of age on the prevalence of injuries ($F_{3,14} = 4.03$; $P = 0.03$, Figure 1), with the number of skin injuries observed during a transect walk increasing from 20 woa to 30 and 40 woa ($P = 0.03$ and $P = 0.054$, respectively). Overall, no difference was found between the average number of injuries at 30 and 40 woa ($P > 0.05$), but there was a huge variation between the eight flocks in the overall prevalence and at the different ages. At week 20, the range was 1–4 injuries; week 25: 2–36 injuries; week 30: 1–82 injuries; and week 40: 8–177 injuries. In addition, there was a trending effect of toe-clipping of the males on the number of females observed with injuries during the transect walks ($F_{1,6} = 5.68$; $P = 0.054$), with toe-clipped flocks displaying an average of 4.43 ± 12.61 (LS means ± SE) injured hens across all ages compared to 42.96 ± 10.12 injured hens in the flocks not toe-clipped. Table 1 shows the results for each age visited; however, due to the large variation in number of injured hens per flock, there was no effect of the interaction between age and toe-clipping ($F_{3,15} = 2.04$; $P = 0.15$). No injuries to the back, thighs or flanks were observed in any roosters at any age.

There was no correlation between the number of injured hens observed during the transect walks and

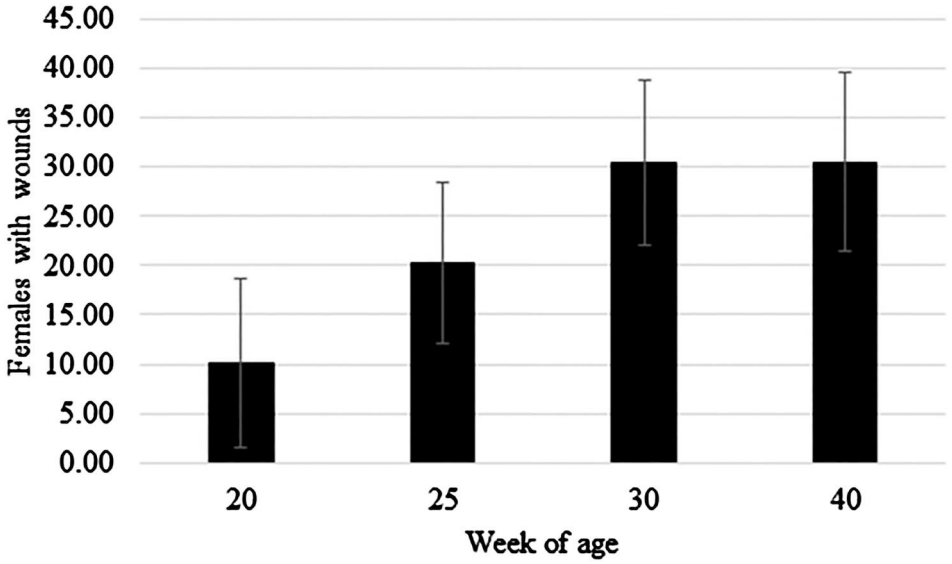

Figure 1. Average number and development of traumatic skin lesions in broiler breeder hens 20–40 weeks of age, on flock level.

the recordings of CO_2 or NH_3 in the air ($P = 0.71$ and $P = 0.27$, respectively). There was, however, a weak negative correlation between the number of injured hens and the percentage of roosters in the flock ($P = 0.04$, Figure 2). Table 2 shows the full descriptive statistics.

Morphology of the skin injuries, 25–40 weeks of age

In total, 27 hens with injuries were subjected to *post-mortem* examination. The average external length of the traumatic skin injuries in the 27 necropsied hens was 5.8 cm (range 2.0–11.0 cm). In the same birds the average length of the subcutaneous infection was 10.6 cm (range 5.0–20.0 cm), see Figure 3. Furthermore, splenomegaly was observed in 15 (55.5%) of the necropsied hens with skin injuries, while the remaining hens with injuries had normal spleens.

Prevalence of ovarian regression in hens with injuries, 25–40 weeks of age

Fifteen out of 27 necropsied hens with skin injuries had no normal ovarian activity (55.5%). There was no relationship between the length of the injuries and whether the hens presented with mature ovarian follicles indicative of active egg production ($F_{1,23} = 0.43$; $P = 0.52$). Hens with mature follicles had skin injuries with an average length of 5.3 ± 0.9 cm (LS means ± SE), compared to the hens not in active egg production which had an average skin injury length of 5.9 ± 1.0 cm (LS means ± SE). Likewise, there was no relationship between the subcutaneous length of injuries and the state of the ovarian follicles ($F_{1,23} = 1.49$; $P = 0.23$). Subcutaneous infection length was on average 11.57 ± 2.0 cm for the hens without active ovarian follicles compared to 9.1 ± 1.7 cm for the hens presenting normal follicles (LS means ± SE). Figure 4 shows a hen with traumatic skin injury and no mature follicles.

Prevalence of traumatic skin injuries in broiler breeder hens, end of production

Investigations at the time of depopulation were performed on dead birds, culled with CO_2 in the barn. The prevalence of scars in the 100 randomly selected hens per flock ranged from 4–27. These examinations revealed very few fresh injuries or scabs; almost all injuries presented as healed scars (Figure 5). Some birds with healed injuries had adhesions of the skin to underlying tissue.

At the time of depopulation, there was a significant relationship between the healing of the skin injuries and whether the hens were in active egg production

Table 1. Number of hens with traumatic skin injuries observed during the transect walk in toe-clipped versus not toe-clipped flocks across ages.

	Toe-clipped			Not toe-clipped			Statistics	
Week of age	LS means	SE	Range	LS means	SE	Range	T value	*P* value
20	2.00	18.50	1–4	1.40	18.48	0–2	−0.02	0.98
25	5.00	18.50	0–13	29.40	14.33	11–60	1.04	0.31
30	2.33	18.50	1–4	65.20	14.33	37–115	2.69	0.02
40	8.39	22.59	7–10	75.83	16.06	29–177	2.43	0.02

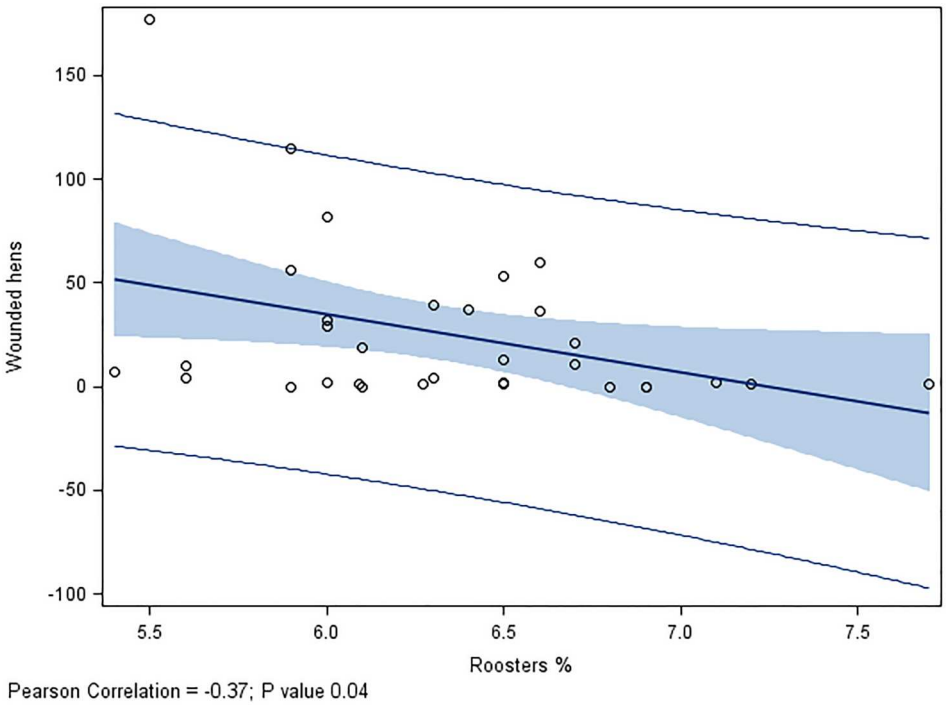

Figure 2. The correlation between percentage of injured hens and the percentage of roosters in the flock.

($F_{2,213} = 15.65$; $P < 0.0001$, Figure 2). The few hens with fresh injuries ($n = 10$) were significantly less likely to be in active egg production compared to hens with healed injuries ($n = 199$; odds ratio = 0.005; $P < 0.001$) or injuries that were healed with adhesions ($n = 12$; odds ratio = 0.049; $P = 0.005$). Of all hens with healed injuries, 97.5% were in active egg production at the time of depopulation.

Discussion

To the authors' knowledge, this is the first paper reporting prevalence and development of traumatic skin injuries during the life of broiler breeder hens. The results indicate that these injuries develop mainly in the first half of the production period. Injuries were present in all eight commercial broiler breeder flocks, with a considerable difference between flocks. Furthermore, necropsy results indicate that, in the acute stage, these injuries affected egg production in more than 50% of the hens.

Studies investigating the overall prevalence of traumatic skin injuries in flocks of commercial broiler breeder hens are sparse. In a Danish study investigating causes of mortality, lacerations were reported as a finding in 2.4% of the investigated dead hens during the entire production period (Naundrup Thøfner *et al.*, 2019). A recent study performed in a commercial broiler breeder flock found 3.3% of cases of trauma in hens stated to be caused by aggressive mating during the first 5 weeks of the production period (Lupu *et al.*, 2025). It must be mentioned that this number also included injuries to earlobes, combs, and heads, in contrast to our study, which only reported injuries to the thighs, back, and flanks. In addition, the study by Lupu *et al.* (2025) only included one breeder flock, whereas the results from our eight commercial flocks indicate that there are very large variations across farms and flocks, which suggests that studies investigating injuries in breeders must include an even larger study population than eight flocks.

The prevalence of traumatic skin injuries increased from week 20 until week 30 in the current study. The average results in week 40 were identical to week 30, but with large variations between flocks, which may indicate that the period from placement until 30 weeks of age is the most critical for the development of injuries. Investigations of culled birds at the end of lay support this finding. Very few fresh skin injuries were observed at the end of lay; the vast majority were healed injuries with scar tissue. The reason for the peak incidence rate at week 30 is not known. However, the first period during the production phase includes several stressful events for the birds: transport from the rearing facility, new housing, restricted feeding, new social structures, and sexual maturity, in addition to interaction with sexually mature males (Gregorio, 1994). Furthermore, Moyle *et al.* (2010) found that male aggression towards hens peaks at 28 woa, and rapidly declines thereafter (Moyle *et al.*, 2010). The same sharp incline in injury prevalence during the early stages of the production period was also found in a recent Romanian study (Lupu *et al.*, 2025). In addition, over-mating, which can lead to lacerations of females, occurs especially at the

Table 2. Correlation and descriptive statistics between the number of hens with injuries and environmental risk factors.

Variable	Pearson Correlation Coefficient	*P* value	Mean	Std Dev	Minimum	Maximum
Rooster (%)	−0.37	0.04	6.33	0.52	5.4	7.7
CO_2 (ppm)	0.07	0.71	2147.25	588.26	800	3500
NH_3 (ppm)	0.20	0.27	26.0	18.38	1	64

beginning of the laying period (van Emous & De Jong, 2013). It was rather striking that no lacerations or other traumatic skin injuries to the thighs, flanks and backs were found in the males, indicating that these injuries are a health and welfare problem solely for the breeder hen population. Skin tearing is also more common in broiler chicken females, compared to broiler chicken males, indicating a possible sex susceptibility due to the tensile strength of the skin (Granot *et al.*, 1991).

Several of the injuries observed in both live and dead birds were lacerations with skin retraction and exposure of the underlying connective tissue and muscles, as described by Lupu *et al.* (2025). An overall finding in all necropsied hens with injuries, regardless of the superficial size, was that there was a substantial degree of cellulitis under the skin. Cellulitis is defined as an acute diffuse and suppurative inflammation of the subcutaneous tissues (Norton, 1997). It appears as yellowish plaques of caseous and necrotic material, often associated with an *Escherichia coli* infection (Norton, 1997; Poulsen *et al.*, 2018; Radwan *et al.*, 2018). When the skin is torn apart, the underlying tissue is exposed to the environment, including the litter containing faecal material, especially when the hens dust bathe. In all hens necropsied at 25, 30, or 40 woa, the skin injuries were covered in dry scabs. The extent of the subcutaneous inflammation indicates that a visual evaluation of the size and dryness of the skin injury is unable to predict the size of the underlying infection. In several cases, the inflammation extended downwards to the hock joint. The extent of the subcutaneous infection may be the cause of suppressed egg production in some of the investigated birds, which may also be supported by the finding of splenomegaly in several birds. It is known that systemic infections may affect the birds' reproductive activity, but it has previously not been investigated to what extent traumatic skin lesions and subsequent infections affect ovarian activity in broiler breeder hens. The current study indicates that roughly 55% of the hens with traumatic skin injuries had regressed ovaries. It could be speculated whether this is due to the skin injuries or whether already sick hens are more prone to injuries, since they can be subjected to over-mating especially if they are lame or if the follicle regression was caused by the skin injuries and adjacent cellulitis. The number of investigated birds in this study was limited; therefore, the results should be interpreted with caution. If the

Figure 3. Subcutaneous infection with cellulitis on the thigh of a hen (30 woa) with a traumatic skin injury.

Figure 4. Hen (30 woa) with traumatic skin injury and no mature follicles.

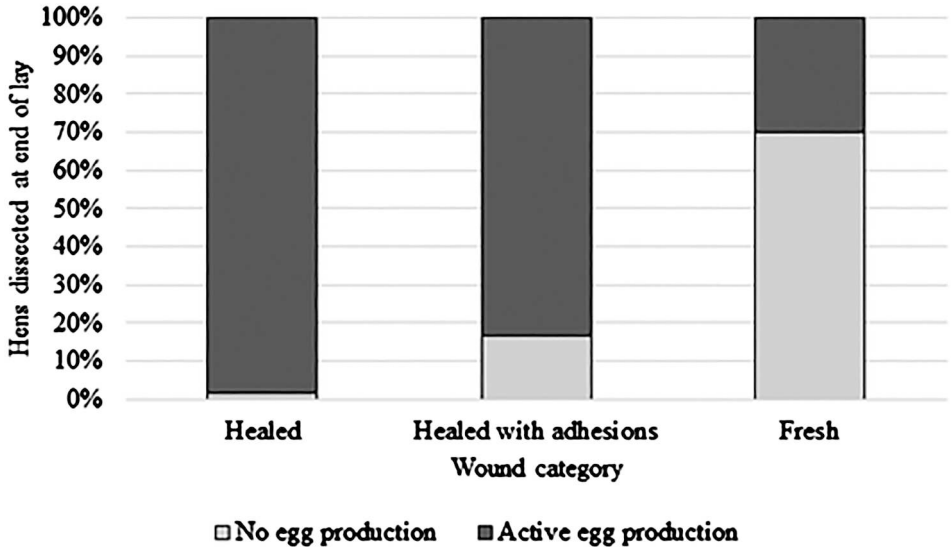

Figure 5. The association between the injury classification and ovary activity end of lay ($n = 221$ injured hens; Healed $n = 199$; healed with adhesions $n = 12$; fresh $n = 10$).

regression is caused by the skin injuries, we still do not know for how long the ovarian activity is suppressed, but investigations at the end of the production period revealed that almost all birds with completely healed injuries had normal ovarian activity at that age, indicating that normal ovarian activity can recover with time. In addition, future studies should investigate whether already sick or weak birds are more likely to get traumatic skin injuries.

Male behaviour and anatomy are significant risk factors for traumatic injuries in broiler breeder hens (Lupu *et al.*, 2025), due to the aggressiveness of the males (Millman, 1999), the number of forced copulations and the frequency of the matings, which is reported to be 5–10 times higher than necessary for fertilization of the eggs (van Emous, 2010). Therefore, it was surprising to find a weak negative correlation between the number of hens with skin injuries and the percentage of roosters in the current study. To prevent laceration of the hens during mating, it is standard practice in several countries to amputate the outermost joint of the backward facing toe of breeder males directly after hatch (Fiks-Van Niekerk & De Jong, 2007; De Jong *et al.*, 2012; Riber, 2017). Research has shown that poultry have nociceptors in the legs and that toe amputation may cause neuromas and pain (Gentle & Tilston, 2000; Gentle, 2011). Therefore, the broiler industry has investigated alternatives. Several solutions have been suggested, like alternative housing systems, no toe-clipping, reduced stocking density, breeding and increased environmental complexity (Riber, 2017), but little information is available on the effect of these alternatives on traumatic injuries in hens. In the current study, three of the farms had toe-clipped males, the rest had intact toes in all males. In the farms with toe-clipped males, the prevalence of traumatic skin injuries was numerically lower than in the remaining farms, which may explain some of the differences between the farms. This finding is in line with reports stating that the prevalence and severity of damage to the females escalate when the breeder males are non-mutilated (Riber, 2017). However, since the number of flocks was limited to only eight and the statistics show a trend rather than a definite effect ($P = 0.054$), we must take caution when interpreting these results. In addition, it must be emphasized that toe-clipping will not completely eliminate skin injuries, since injuries were found in all flocks, including the ones with toe-clipped males. This indicates that toe-clipping alone is not enough to prevent traumatic skin injuries in broiler breeder hens but perhaps has the potential to lower its prevalence. Further risk factors besides broiler breeder male anatomy and aggressive behaviour should be investigated in future studies. Additional risk factors that need to be explored in more detail are flock behaviour, mating behaviour, management practices to reduce stress, and the relationship between feather coverage and injuries, to name some.

In conclusion, this study focused on the prevalence, development, and pathology of traumatic skin injuries in broiler breeder hens. The results showed that the incidence rate was highest in the early weeks of the production period and that the prevalence of traumatic skin injuries in broiler breeder hens varied greatly between farms. The necropsies showed that, in most cases, the subcutaneous lesions were far more severe than what could be detected by external inspection of the skin injury alone. Furthermore, 55% of the hens with unhealed traumatic injuries that were submitted to *postmortem* examination at age 25–40 woa, had no mature follicles in the ovary. Further studies should include a larger study sample, both in terms of flocks and necropsied hens, and should explore causal factors in more detail.

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Disclosure statement

No potential conflict of interest was reported by the authors.

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