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Effects of piglet enrichment on sow skin lesions and behavior before and after tail docking and castration

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Commercially housed pigs face multiple welfare challenges, such as painful husbandry procedures or a lack of environmental enrichment. We evaluated sow behavior in response to piglets experiencing tail docking and castration. Our second objective was to assess the effects of environmental enrichment for piglets on sow teats and skin lesions. Shortly before farrowing, three commercially available piglet toys and a jute bag were installed in 12 farrowing stalls. Eleven farrowing stalls were not equipped with any enrichment. Sows were provided *ad libitum* access to water, and they were hand-fed to appetite two times daily (7 a.m. and 3 p.m.) in 0.90-kg increments. All piglets were tail-docked, and males were surgically castrated at 7 days of age. Sow behavior was recorded by cameras mounted on the ceiling from 5 to 7 p.m. a day before processing and on the processing day. The videos were watched continuously by two observers in BORIS. The differences in pre- and post-processing sow behaviors were tested using a paired t-test. All sows were inspected for teat inflammation, scabs, wounds, splits, and missing teat tips before farrowing and at the end of lactation. Data were analyzed using the SAS GENMOD procedure with a Poisson distribution. Sows were inspected for skin lesions using the Welfare Quality® Assessment protocol at 6, 14, and 19 days post-farrowing and analyzed using the SAS GLIMMIX procedure with multinomial distribution. All sows decreased feeding ($p = 0.001$) and standing ($p = 0.045$) after piglets were tail-docked and/or castrated. Sows whose piglets did not have enrichments also decreased nosing stall structure ($p = 0.01$) and posture change ($p = 0.04$). No other sow behaviors changed in relation to piglet processing ($p > 0.05$). Similarly, enrichments for piglets had no significant effect on sow teat or skin lesions. In conclusion, this is the first study reporting that tail docking and surgical castration may have negative effects on sow behavior. Additionally, these findings contribute to the growing body of literature that, from an animal welfare perspective, tail docking and surgical castration should be refined or avoided.

KEYWORDS

environmental enrichment, swine welfare, painful husbandry procedures, neonatal piglet, sow teat lesions

Introduction

In the first few days of life, most piglets in commercial production undergo one or more painful husbandry procedures. These may include teeth clipping, tail docking, and/or castration. These procedures are often conducted without analgesic or anesthetic drug usage for pain relief, even though they are painful for the piglet (Sutherland et al., 2010; Tallet et al., 2019; Marchant-Forde et al., 2014). The main reason for teeth clipping is to reduce the risk of injuries to sows' teats caused by fights and displacements that occur in piglets to establish teat order (Chou et al., 2022). Tail docking and surgical castration are performed to reduce tail biting and boar taint, respectively (Hay et al., 2003; Zonderland et al., 2010).

For the welfare of group-housed animals, such as pigs, it is not only relevant what an individual pig feels but also the extent to which its conspecifics are affected by its pleasure or distress. This process is called emotional contagion, a simple form of empathy (Preston and De Waal, 2003; Reimert et al., 2013). Animals may become distressed by receiving signals from conspecifics that are frightened or in pain (Edgar et al., 2012). In pigs, negative emotional contagion was confirmed while animals were watching a conspecific undergoing a stressful event such as restraint (Goumon and Špinka, 2016) and electric shock (Zhang et al., 2023) or after a conspecific had been socially isolated and exposed to negative handling (Reimert et al., 2017). Therefore, piglets experiencing painful husbandry procedures may negatively affect their dam's welfare. To date, only two research teams (Fu et al., 2019; Prunier et al., 2004) have assessed sow welfare after piglets have undergone teeth clipping and tail docking. Prunier et al. (2004) reported that sows with teeth-clipped piglets were more restless, defined as increased standing-up events. Fu et al. (2019) reported that teeth clipping decreased sow avoidance behavior toward piglets. However, tail docking had no effect on sow behavior (Fu et al., 2019). To date, there has been no published research evaluating the potential effects of surgically castrated piglets on the sow's welfare. Furthermore, sows could alter their behavior to provide piglets with social support. Social buffering is the process by which the presence of affiliative social partners mitigates stress responses (Kiyokawa and Hennessy, 2018). There are two ways through which distress responses can be buffered: through the mere presence of other conspecifics (i.e., passive social buffering) or their active behaviors, such as consolation, i.e., active social buffering (Scheiber et al., 2005; Wu, 2021).

Environmental enrichment (EE) is the modification of a barren captive-environment to improve the biological functioning of animals (Newberry, 1995). Research shows that EE can have numerous positive effects on pig welfare, including improved emotional states (Douglas et al., 2012), reduced aggression (Haigh et al., 2019), and a lower incidence of ear and body lesions (Bučková et al., 2022). So far, only one research team has assessed sow welfare by providing piglets with access to EE in their home pen (Lewis et al., 2006). The authors reported that either shredded paper or fiber rope did not change sow behavior, but the sows whose piglets had access to enrichments tended to have fewer teat lesions. The latter finding implies that EE may be a feasible alternative to teeth clipping, a procedure performed to decrease sow teat damage and piglet facial injuries (Chou et al., 2022).

Therefore, this study had two objectives: 1) to evaluate changes in sow behavior after piglets have been tail-docked and castrated, hypothesizing that sow behavior would be altered after tail docking and castration due to negative emotional contagion and/or active social buffering; and 2) to assess if providing piglets with continuous access to EE improves sow welfare, hypothesizing that sows whose piglets had EE would have a lower incidence of teat and skin lesions.

Materials and methods

The research protocol was approved by the Iowa State University Institutional Animal Care and Use Committee (IACUC-23-113).

Animals and housing

Data were collected from September 2023 to March 2024 at the Iowa State University Allen E. Christian Swine Teaching Farm in Ames, IA. A total of 23 sows (12 Hampshire × Duroc × Berkshire, 6 Duroc, 3 Berkshire, 1 Yorkshire, and 1 Yorkshire × Landrace) were enrolled in six batches. Average parity and litter size were 3.78 ± 3.4 and 6.69 ± 2.65 (SD), respectively. Sows were housed in farrowing stalls with plastic slatted flooring ~3 days before expected parturition. The total stall area measured 2.0 m × 1.7 m. The center sow area measured 2.0 m × 0.6 m, and the creep area measured 2.0 m × 0.55 m on either side of the sow. One heat lamp was provided in the left creep area. Farrowing stalls were distributed across two farrowing rooms (seven stalls per room) in a negative-pressure mechanically ventilated barn where the temperature was set at 21.1°C. Sows were provided *ad libitum* access to water via one 2-cm nipple, and they were hand-fed to appetite two times daily (7 a.m. and 3 p.m.) in 0.90-kg increments. All diets were prepared by a commercial feed mill (Key Cooperative, Gilbert, IA, USA) and composed primarily of corn, soybean meal, and dried distillers' grains and nutrients formulated to meet lactating sow nutrient requirements. The trial was completed when all litters were weaned. The average weaning age and litter size were 21.4 days ± 1.6 (SD) and 6.5 ± 2.7 (SD), respectively.

Experimental design

The farrowing stall containing the sow was the experimental unit. Sows were assigned to either enriched (n = 12) or standard (n = 11) stalls. Enriched (E) farrowing stalls consisted of four physical enrichment items: the Nature piglet biting ring (polylactic acid obtained from sugar cane and reinforced with wood fibers, approx. 18 cm in diameter; Figure 1), biting ball (natural rubber, approx. 5 cm in diameter; Figure 1), burlap sack (approx. 193 × 48 cm; Figure 2), and Easy Fix® Luna 50 toy (natural rubber, approx. 15 × 15 × 15 cm; Figure 2). The enrichment items

FIGURE 1
The Nature piglet biting ring (on the left) and biting ball (on the right) provided to piglets in enriched pen. Source: Bučková et al. (2022).

were provided primarily to piglets, but the Easy Fix® Luna 50 toy and the Nature piglet biting ring were also accessible to the sows. The burlap sack was attached to the pen wall, while other enrichments were hung using a chain or rope at a piglet's eye/snout level. The enrichments were checked daily and adjusted if needed. Standard (S) stalls were not equipped with any physical enrichment items.

Experimental procedures

Tail docking and castration

Tail docking and castration followed the farm's standard operating procedures. Briefly, all piglets were tail-docked and males castrated between 8 a.m. and 9 a.m. at 7 days of age. On the processing day, a cart was used to move piglets from the same litter out of the farrowing room into the processing room and then back to their sows. Piglets were inverted and hand-restrained during tail docking. Tails were docked by a clipper. During castration, male piglets were inverted and restrained by their hind legs. The scrotum was incised using a scalpel to externalize the testes with two vertical incisions above each testicle, and the spermatic cord was cut near the inguinal canal. Iodine was applied to the testis surgical site and the docked tail. Piglets' teeth were left intact. No anesthetic or analgesic agent was used for pain relief. Processing took approximately 2 min per piglet. At the time of processing, there were 57 males and 75 females.

Behavior

Sow behavior was recorded continuously using Sony HD Handycam cameras (Model HDR-CX440, San Mateo, CA, USA) mounted on the ceiling so that one camera captured one farrowing stall. Cameras were inspected and reset daily, and secure digital cards were switched out every 72 h. Sow behaviors were collected from the videos between 5:00 p.m. and 7:00 p.m. a day before processing and on the processing day. This time was selected to minimize disruptions to the sows' natural behavior. The videos were watched by two observers using focal continuous sampling in BORIS (Friard and Gamba, 2016). The observers could not be masked to housing treatment but were not told which videos were recorded before/after processing. Lying, standing, active nursing time, and feeding were recorded as states in seconds. All other behaviors were recorded as point events (Table 1). Inter-observer reliability was calculated using approximately 9% of video recordings in BORIS. Cohen's Kappa varied between 0.88 and 0.97. Approximately 5% of video recordings were re-watched to calculate intra-observer reliability in BORIS. Cohen's Kappa varied at 0.88–0.94 and 0.75–0.98 for the first and second observers, respectively.

Teat lesions

All sows were visually inspected (Table 2) by a single researcher ~1 day before farrowing and ~1 day before piglets were weaned. If teats could not be accessed, the sow's belly was gently stroked to encourage her to change posture. If stroking did not help, the inspection was conducted later the same day once the sow's belly was exposed.

Skin lesions

Sows were visually inspected for skin lesions that were categorized as scratches or wounds on days 6, 14, and 19 post-farrowing by one trained researcher standing outside of the farrowing stall. The skin lesion assessment was based on the Welfare Quality® Assessment protocol for pigs. Briefly, the sow's body was divided into five separate regions: ears, front, middle, hindquarters, and legs. Each region was assigned a skin lesion score of 1 to 3 (Table 3). To assign a score, a scratch longer than 2 cm or a wound less than 2 cm was considered as one lesion. Two parallel scratches with up to 0.5-cm space between them were considered one lesion. A bleeding wound between 2 and 5 cm, or a healed wound of more than 5 cm, was considered five lesions. A deep and open wound of more than 5 cm was considered 16 lesions. Only one side of the sow's body was assessed (the one with a more optimal view for observation). The scratch length assessment was visually conducted.

Statistical analysis

Distribution analyses were run (PROC UNIVARIATE) for all dependent variables (except for skin lesions) to check data normality. If the data did not achieve quasi-normal distribution, they were transformed. If there was a significant effect of any independent variable, post-hoc analyses were used to determine treatment differences (the Tukey–Kramer test was applied). All data were analyzed in SAS® Studio.

FIGURE 2
Easy Fix® Luna 50 toy (on the left), and a burlap sack (on the right) provided to piglets in enriched pen. Source: Bučková et al. (2022).

Behavior

The final data set consisted of 19 sows (n = 10 E and 9 S). The behavior of one S sow was not collected because she had a fever on the observation days. Data on the remaining three sows (2 E and 1 S) were not included in the analysis because no videos were obtained on one observation day (likely due to a power failure at the farm). Additionally, approximately 18 min of video recording a day before processing was not watched in one E sow because of accidental litter merging. Behaviors recorded as states were converted from seconds to minutes. A cube root transformation was performed on feeding and positive piglet interactions because they did not achieve quasi-normal distribution. The changes in the behaviors after piglet processing were calculated as a difference between post- and pre-processing behaviors. First, separate generalized linear mixed models (proc mixed in SAS) were run for each behavior to check the potential effect of these variables: housing treatment, parity, litter size, and percentage of males per litter. Breed was initially included as a random effect in all generalized linear mixed models (GLMMs), but its estimate was 0, which resulted in model instability. Therefore, this random effect was removed. Additionally, batch was removed from the lying and nursing model because of an instability issue, and generalized linear models (GLMs) were run. If there was no significant effect of housing treatment, the t-test was run for all sows. If the effect of housing was significant, the behavior was analyzed in two models, separating the housing treatment. Next, t-tests (PROC TTEST in SAS) were run to test if the behaviors significantly changed after piglet processing. Bar biting, tongue playing, negative piglet interactions, sitting, and enrichment interactions were rare, so they were not statistically analyzed.

Teat lesions

A new variable called "teat issues" was created by summing all teat conditions. The number of teat issues before parturition and at the end of lactation was calculated. Teat issues before parturition minus teat issues at the end of the study resulted in one teat issue value per sow, which was then used in the statistical analysis. Data were analyzed using the SAS GLIMMIX procedure with a Poisson distribution. Enrichment treatment (E vs. S) was a fixed effect, and litter size and sow parity were included as covariates. Breed (Hampshire × Berkshire × Duroc/Berkshire/Yorkshire/Duroc) was included as a random factor. Initially, batch (1 to 6) was also included as a random factor, but the covariance parameter estimate was 0, so it was removed to avoid issues with model instability and inflated test statistics.

Skin lesions

For statistical analysis, lesions were classified according to Table 4. Due to human error, skin lesions were recorded 8 and 20 days (instead of 6 and 19 days) post-farrowing in three sows. These values were discarded, and only one correct measurement (obtained on day 14 post-farrowing) underwent statistical analysis for each of these animals. The effects of EE for piglets on sow skin lesions were analyzed using GLMM (SAS GLIMMIX procedure with multinomial distribution and cumulative logit link function). Sow skin lesion score was included as a

TABLE 1 Behaviors observed in sows before and after piglets were tail-docked and castrated.

Category	Behavior	Definition
Stereotypical and abnormal behaviors	Bar biting	Manipulating the bars with the teeth.
	Tongue playing	Champing with tongue repetitively out of the mouth (Zonderland et al., 2004).
	Nosing stall structure	Back and forth and/or hitting motions with the nose or face on the bars, ground, or feeder/drinker without feeding or drinking (Nowland et al., 2019).
Social behavior	Positive piglet interaction	Sow gently noses, nudges, or nuzzles piglet (Nowland et al., 2019).
	Negative piglet interaction	Sow intentionally lunges for, tries to snap at, or bite piglet (Nowland et al., 2019).
Maintenance	Lying	Sow is lying laterally or ventrally (Nowland et al., 2019).
	Sitting	Front legs straight and back end on the floor (Nowland et al., 2019).
	Standing	Upright, with all feet on the floor (Nowland et al., 2019).
	Posture change	Sow changes position from standing to sitting to lying or vice versa (Nowland et al., 2019).
	Active nursing time	When 50% or more of the litter are actively massaging an udder or seeking a teat (Nowland et al., 2019).
		Seeking is defined as an attempt to find a teat by walking and pushing other piglets (Hay et al., 2003).
	Drinking	Manipulating the nipple (Zonderland et al., 2004).
	Feeding	Sow's head is over the edge of the feeder and is pointed down into the feeder, which can include eating, sniffing, or interacting with the feed.
Enrichment interactions	The Bite Rite toy interaction	Sow purposely sniffs, licks, nudges, or bites/chews on the Bite Rite toy.
	The Easy Fix toy interaction	Sow purposely sniffs, licks, nudges, or bites/chews on the Easy Fix toy.

dependent variable; enrichment treatment, day (6, 14, and 19), and the interaction between treatment and day were the fixed effects. Covariates were batch, breed, litter size, and parity.

Results

Parity, litter size, and percent of males in the litter did not affect the observed behaviors ($p > 0.05$). Due to insufficient variability in the data, the treatment effect was not estimable for nursing and lying. S and E sows significantly differed in nosing stall structure ($F_{1,10} = 6.46$, $p = 0.03$) and posture change ($F_{1,10} = 5.08$, $p = 0.048$; Figure 3). Nosing stall structure (mean post- minus pre-processing difference = −2.56, CL −4.36 to −0.75, DF = 8, $t = -3.26$, $p = 0.01$) and posture change (mean −2, CL −3.92 to −0.08, DF = 8, $t = -2.4$, $p = 0.04$) were only decreased in S sows after piglet tail docking and castration. E sows did not change either nosing stall structure ($t = 0$, $p = 1$) or posture change ($t = 0.40$, $p = 0.70$). Piglet processing decreased feeding (mean −1.21, CL −1.86 to −0.56, DF = 18, $t = -3.9$, $p = 0.001$) and standing (mean −7.84, CL −15.49 to −0.18, DF = 18, $t = -2.5$, $p = 0.045$) in all sows. Positive piglet interactions ($t = -0.51$, $p = 0.62$), lying ($t = 0.22$, $p = 0.83$), active nursing time ($t = -0.57$, $p = 0.57$), or drinking ($t = -0.92$, $p = 0.37$) did not change in relation to piglet processing (Figures 4, 5).

Piglet EE did not decrease sow teat lesions ($F_{1,16} = 0.99$, $p = 0.35$, exponentiated means rates with confidence limits for E and S, respectively, 1.13 [−2.23 to − 2.48] and 0.54 [−1.81 to 2.88]). There was also no effect of sow parity ($F_{1,16} = 0.02$, $p = 0.88$), but sows with larger litters tended to have more teat lesions ($F_{1,16} = 4.02$, $p = 0.06$). The most common types of teat lesions were inflammation (37%) and scabs (33%). Other teat damage etiologies that occurred less frequently are teat tip missing 11%, bleeding wound 8%, split 7%, and missing teat 4%.

Enrichment treatment ($F_{1,35} = 2.58$, $p = 0.11$, odds ratio: 112) did not improve the sow lesion score. Day ($F_{2,35} = 0.67$, $p = 0.52$), enrichment treatment by day interaction ($F_{2,35} = 0.20$, $p = 0.82$), batch ($F_{5,35} = 0.71$, $p = 0.62$), breed ($F_{3,35} = 0.43$, $p = 0.74$), litter size ($F_{1,35} = 0.00$, $p = 0.99$), and parity ($F_{1,35} = 0.31$, $p = 0.58$) also did not affect sow lesion score.

Discussion

The main goal of this study was to assess the effects of piglet tail docking and castration on sow behavior. We found that processing did not change positive piglet interactions, lying, active nursing time, and drinking in sows. However, sow feeding and standing decreased, while nosing stall structure and posture change decreased only in S sows after piglets had been castrated and tail-docked. Changes in feeding and standing could indicate negative emotional contagion from piglets to sows, but because some other more indicative behaviors, such as positive piglet interactions, did not change, it may be more likely that feeding in sows only decreased in response to the changes in piglet behaviors after tail docking/castration. In the future, researchers should investigate if sows experience a more negative emotional state after piglets undergo painful husbandry procedures using more direct

TABLE 2 Teat damage evaluated in sows before farrowing and at the end of the lactation.

Lesion	Description
Scab	A dry, rough protective crust that forms over a cut or wound during healing wound
Bleeding wound	Fresh wound with blood
Split	Teat split in half
Teat tip missing	Tip of teat amputated
Inflamed	Presence of heat and inflammation, yellow in color
Teat missing	Entire teat amputated

Adapted from Lewis et al. (2006).

TABLE 3 Sow skin lesion scoring system based on Welfare Quality® Assessment protocol for pigs.

Score	Description
a	No visible skin injuries/up to 4 lesions visible
b	5 to 10 lesions visible
c	11 or more lesions visible

TABLE 4 Sow skin lesion classification adapted from Welfare Quality® Assessment protocol for pigs.

Score	Description
0	All body regions with individual score "a"
1	Any body region with an individual score "b" and/or a maximum of 1 body region with an individual score "c"
2	Two or more body regions with an individual score "c"

assessment, e.g., cognitive judgement bias test (Harding et al., 2004). It remains unclear why nosing stall structure and posture change were only reduced in sows whose piglets did not have any EE. It could be a behavioral response to a change in piglet behavior after castration and tail docking, as the behavioral repertoire of S and E piglets was likely different. Our findings partially agree with those of Prunier et al. (2004) and Fu et al. (2019). While Prunier et al. (2004) observed that sows with teeth-clipped piglets stood up more frequently, they did not identify any other significant changes in sow behavior. Consistent with our findings, Fu et al. (2019) did not observe any changes in sow lying following piglet tail docking. In contrast to our results, however, they also reported no changes in standing or feeding behavior. These differences may be related to the combination of piglet husbandry procedures. In our study, males were both tail-docked and castrated, and teeth clipping was not conducted, while Prunier et al. (2004) and Fu et al. (2019) also focused on behavioral changes after teeth clipping. Further research on tail docking and castrating piglets should evaluate whether the negative behavioral changes reported in our study can be reduced through pain relief. Ultimately, the goal is to phase out painful

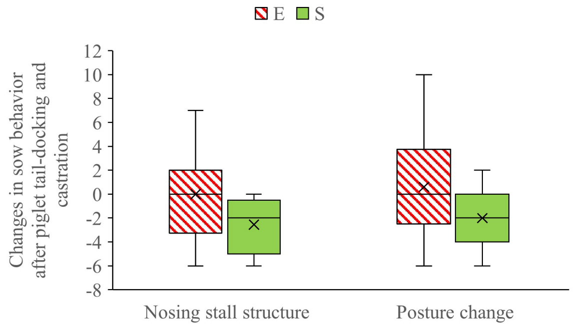

FIGURE 3
Changes in sow behaviors before and after piglets were tail-docked and castrated. Sows whose piglets did not have EE decreased nosing stall structure (P = 0.03) and posture change (P = 0.048) following piglet processing. Both behaviors are given as frequency. EE = environmental enrichment, E = sows whose piglets had EE, S = sows whose piglets did not have EE. N = 19 sows. The boxplots depict median, interquartile range, data range as whiskers, and outliers as circles.

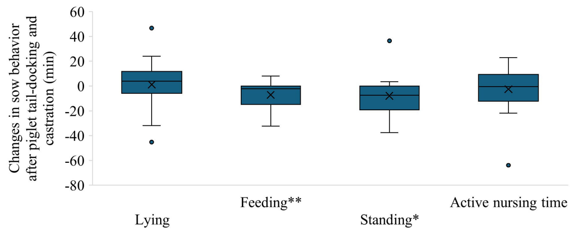

FIGURE 4
Changes in sow behaviors before and after piglets were tail-docked and castrated. Asterisks represent statistically significant differences between pre- and post-processing behaviors (*P ≤ 0.05, **P ≤ 0.01). Other behaviors did not change in relation to piglet processing (P ≥ 0.57). N = 19 sows. All values are back transformed. The boxplots depict median, interquartile range, data range as whiskers and outliers as circles.

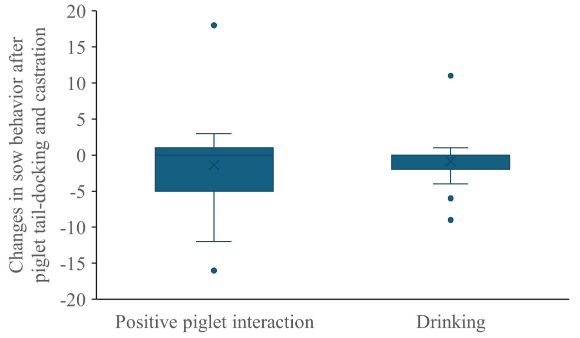

FIGURE 5
Changes in sow behaviors before and after piglets were tail-docked and castrated. Behaviors did not change in relation to piglet processing (P ≥ 0.37). N = 19 sows. Both behaviors are given as frequency (3B). All values are back transformed. The boxplots depict median, interquartile range, data range as whiskers and outliers circles.

procedures, but in the short term, continued research on strategies to refine current practices is needed, and providing practical support to farmers through extension efforts will be critical for successfully adopting sustainable practices (Adcock, 2021). In future studies, researchers should also measure sows' feed intake, distinguish between different feed-related behaviors, and assess longer-term effects to draw more precise conclusions for the industry. Additionally, more research is needed on social buffering in pigs. In our study, we did not find evidence of active social buffering in pigs because sows did not express more positive social interactions toward piglets. However, active social buffering was confirmed in other mammalian species; e.g., dairy calves spent more time in proximity and paid more attention to a conspecific in pain compared to a sham disbudded calf (Ede et al., 2020).

Our second objective was to evaluate the effects of piglet EE on sow teat and skin lesions. We found that enrichment did not affect these variables. In pigs, there have been numerous studies on the EE effects on skin lesions (Bučková et al., 2022; Vanheukelom et al., 2011; Bulens et al., 2016), but only Lewis et al. (2006) focused on piglet EE in relation to sow lesions. These findings are partially in agreement with our results because the authors reported that shredded paper or fiber rope provided to piglets did not reduce the total proportion of sows with at least one teat lesion. However, the authors reported that sows whose piglets had access to enrichments tended to have fewer teat scabs. One reason why the toys did not help to reduce lesions may be that the primary cause of lesions in our sows was not the piglets but the slatted flooring. Chou et al. (2022) identified six major risk factors for teat damage in sows: housing system (including flooring type), environmental enrichment, milk production, piglet management, presence or absence of teeth resection, and litter size. The risk of teat wounds also increased with an increase in litter size in our study. A possible explanation is that in larger litters, piglets may continue to fight and fail to establish a stable teat order. Therefore, the incidence of teat fighting, missed suckling, udder massage, and udder damage may increase over time (Chou et al., 2022; Kobek-Kjeldager et al., 2020). Another reason why sows in our study did not differ in lesions across treatments may be the type of EE provided to piglets. We mostly used items that were commercially available and fitted to the slatted housing system, but they did not fulfil all four EU recommendations on EE material (edible or feed-like, chewable, investigable, and manipulable; EU, 2016). EE items meeting all these qualities may be more attractive to pigs and/or result in better outcomes. Therefore, we recommend future research on the impact of various EE types used in different housing systems on sow lesions, especially on farms with larger litters whose teeth are not clipped.

In conclusion, commercially available toys and burlap bags did not reduce teat damage and the number of skin lesions in sows, but we provide evidence that piglet castration and/or tail docking may impair sow maintenance behavior.

Data availability statement

The datasets presented in this study can be found in online repositories. The names of the repository/repositories and accession number(s) can be found below: Figshare: https://figshare.com/articles/dataset/Data_on_sow_behavior_teat_and_skin_lesions/28746743?file=53482208.

Ethics statement

The animal study was approved by Iowa State University Institutional Animal Care and Use Committee (IACUC-23-113). The study was conducted in accordance with the local legislation and institutional requirements.

Author contributions

KB: Conceptualization, Data curation, Formal Analysis, Funding acquisition, Investigation, Methodology, Project administration, Supervision, Visualization, Writing – original draft. AN: Data curation, Investigation, Methodology, Writing – review & editing. LT: Data curation, Investigation, Methodology, Visualization, Writing – review & editing. KA: Data curation, Investigation, Visualization, Writing – review & editing. AJ: Funding acquisition, Methodology, Project administration, Writing – review & editing.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Generative AI statement

The author(s) declare that Generative AI was used in the creation of this manuscript. OpenAI (ChatGPT-4) was used for assistance with text editing and building statistical models.

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