

# Investigation of the use of meloxicam post farrowing for improving sow performance and reducing pain

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## Summary

**Objectives:** To determine the effects of meloxicam administered to sows shortly after parturition on nursing behaviour and piglet survival and growth.

**Materials and methods:** A total of 289 sows and their litters were used. Sows within 12 hours of farrowing were randomly allocated to receive either an intramuscular injection of meloxicam (extra-label) or a placebo. Researchers were blinded to treatment. All piglets were weighed within 12 hours of birth, at castration and tail-docking (5 to 7 days of age), and prior to weaning (19 to 21 days of age). Litters were categorized

as small, medium, and large. Additional measurements involving the sow, including position changes, rectal temperatures, and feed-intake scores, were performed on a smaller number of the study sows.

**Results:** There were no significant treatment effects on piglet mortality or growth rate. However, growth rate of pigs in medium-sized litters (11 to 13 pigs) tended to be better for sows treated with meloxicam than for sows given a placebo ( $P = .07$ ). Growth rate was positively correlated with weight at birth and at weaning ( $P < .001$ ) and negatively correlated with sow parity and litter size at birth ( $P < .001$ ). Piglet mortality was not

associated with treatment, but was associated with large litter size and light birth weight ( $P < .001$ ).

**Implications:** Meloxicam given to all sows post farrowing does not result in improved piglet survival and growth. Improved performance might be noted if only sows having difficult farrowings were treated. Further studies are required to confirm.

**Keywords:** swine, meloxicam, pain, parturition, neonatal mortality

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## Resumen - Investigación del uso del meloxicam post parto para mejorar el desempeño de la hembra y reducir el dolor

**Objetivos:** Determinar los efectos del meloxicam, administrado a hembras poco después del parto, en el comportamiento de lactancia y supervivencia y crecimiento del lechón.

**Materiales y métodos:** Se utilizó un total de 289 hembras y sus camadas. Las hembras se asignaron al azar, máximo de 12 horas después del parto, para recibir una inyección intramuscular de meloxicam (fuera de etiqueta) o un placebo. Los investigadores desconocían el tratamiento aplicado. Todos los lechones se pesaron máximo 12 horas después del nacimiento, al momento del castrado y corte de cola (5 a 7 días de edad), y antes del destete (19 a 21 días de edad). Las camadas se categorizaron como pequeña, mediana, y grande. Se realizaron medidas adicionales

referentes a la hembra, incluyendo cambios de posición, temperaturas rectales, y evaluación de consumo de alimento en un número menor del total de hembras en el estudio.

**Resultados:** No hubo efectos de tratamiento significativos en el índice de crecimiento o mortalidad del lechón. Sin embargo, el índice de crecimiento de los cerdos en camadas de tamaño medio (11 a 13 cerdos) tendió a ser mejor en los cerdos tratados con meloxicam que en los cerdos que recibieron el placebo ( $P = .07$ ). El índice de crecimiento se correlacionó positivamente con el peso al nacer y el peso al destete ( $P < .001$ ) y se correlacionó negativamente con la paridad de la hembra y el tamaño de la camada al nacer ( $P < .001$ ). La mortalidad del lechón no se asoció con el tratamiento, pero sí se asoció con la camada de tamaño grande y el peso ligero al nacer ( $P < .001$ ).

**Implicaciones:** El meloxicam administrado a todas las hembras después del parto no resulta en una mejora de crecimiento y supervivencia del lechón. Se podría notar una mejora en el desempeño si sólo se tratan a las hembras que tengan partos difíciles. Se requieren más estudios para confirmar estos hallazgos.

## Résumé - Étude sur l'utilisation post-parturition du meloxicam pour améliorer les performances des truies et réduire la douleur

**Objectifs:** Déterminer les effets du meloxicam administré à des truies peu de temps après la parturition sur le comportement d'allaitement ainsi que sur la survie et la croissance des porcelets.

**Matériels et méthodes:** Un total de 289 truies et leur portée ont été étudiées. Des truies ayant mis-bas depuis moins de 12 heures étaient réparties de manière aléatoire pour recevoir une injection intramusculaire soit de meloxicam (utilisation hors-homologation) ou d'un placebo. Le traitement était inconnu des chercheurs. Tous les porcelets étaient pesés dans les 12 premières heures suivant la naissance, au moment de la castration et du coupage de queue (5 à 7 jours d'âge), et avant le sevrage (19 à 21 jours d'âge). Les portées étaient catégorisées en petite, moyenne, et

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large. Des mesures additionnelles relatives à la truie, incluant les changements de position, les températures rectales, et les pointages d'ingestion de nourriture, ont été réalisées sur un nombre restreint des truies de l'étude.

**Résultats:** Aucun effet significatif du traitement n'a été noté sur la mortalité ou le taux de croissance des porcelets. Toutefois, le taux de croissance des porcelets dans les portées de taille moyenne (11 à 13 porcelets) avait tendance à être meilleur pour les truies traitées avec du meloxicam comparativement aux truies recevant le placebo ( $P = .07$ ). Le taux de croissance était corrélé positivement avec le poids à la naissance et au sevrage ( $P < .001$ ) et négativement avec la parité de la truie et la taille de la portée à la naissance ( $P < .001$ ). La mortalité des porcelets n'était pas associée avec le traitement, mais était associée avec des portées de large taille et un poids léger à la naissance ( $P < .001$ ).

**Implications:** Le meloxicam administré à toutes les truies post-parturition n'améliore pas le taux de survie et la croissance des porcelets. Une amélioration des performances pourrait être notée si seulement les truies ayant une parturition difficile étaient traitées. Des études supplémentaires sont nécessaires afin de confirmer le tout.

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**P**re-weaning mortality is an important issue in pig production, with more than 10% of live-born piglets dying before weaning and 80% of those in the first 3 days after birth.<sup>1</sup> Crushing of piglets by the dam is a major cause of this neonatal mortality, with losses estimated at 4.8% to 18% of all piglet mortality.<sup>2</sup> In addition to preventing accidental trauma, another important reason that the sow must quickly settle after parturition and begin to nurse is so that the piglets are able to consume colostrum for energy and immunity.

It is generally accepted that parturition in any species is a painful process, and even in species that give birth to litters of relatively small offspring there is potential for considerable pain to occur in the case of dystocia or small parity-1 sows farrowing large piglets.<sup>3</sup> Analgesics such as meloxicam, a relatively long-acting non-steroidal anti-inflammatory drug (NSAID), are licensed for food-producing animals in some countries, although at present use of meloxicam for sows is extra-label in Canada and in the United States. There is limited published research on the impact of analgesia after

parturition in sows. In cattle, Richards et al<sup>4</sup> found that administration of ketoprofen (an NSAID) at parturition is clinically advantageous when fetal membranes are likely to be retained, but found no other production or reproductive advantage to using ketoprofen. However, these authors suggested its routine use at calving might be justified on welfare grounds. Administering analgesics to sows at farrowing may alleviate pain and allow them to lie more restfully, and thus provide piglets more opportunity for colostrum intake without the risk of being crushed.

The objective of this trial was to determine the effect of meloxicam, administered to sows shortly after parturition, on nursing behavior and piglet survival and growth.

## Materials and methods

This study was approved by the University of Guelph Animal Care Committee in accordance with the Canadian Council of Animal Care Guidelines.

### Herd and facilities

This study was carried out on a 600-sow commercial swine operation between May 2011 and November 2011. The sows were Landrace × Yorkshire crossbreds, and the sires of the piglets were Duroc × Pietrain. All sows and litters were housed in fully slatted, mechanically ventilated farrowing rooms (four rooms containing 24 farrowing crates and one containing 12 crates). Heat pads were provided in the creep area of each crate. Apart from nursing, no additional diet was offered to piglets. Piglets had unlimited access to water nipples. Teeth clipping of piglets was not practiced. Rooms were filled in an all-in, all-out manner and were cleaned and disinfected between groups.

### Study design

This study involved 289 litters and 3006 piglets. Piglets received an injection of 200 mg of iron dextran and were ear notched within 12 hours of birth. Sows were alternately assigned to receive a single intramuscular (IM) injection of one of the following treatments within 12 hours of farrowing (time 0): 0.4 mg per kg of bodyweight of meloxicam (Metacam; Boehringer Ingelheim Ltd, Burlington, Ontario, Canada; extra-label use) or a similar volume of a placebo. The placebo contained 0.2 mg per mL propylparaben and 1.8 mg per mL methylparaben as preservatives. Treatment and placebo were in identical bottles identified as "A" or "B." The researchers were blinded to treatment during the trial. Piglets were individually weighed using a shipping

scale (DYMO Pelouze; Rubbermaid Commercial Products, Winchester, Virginia) within 12 hours of birth, at 5 to 7 days of age, and prior to weaning (19 to 21 days of age). The scale had a capacity of 68 kg and a resolution of 0.1 kg.

Mortality data were collected daily. Cross-fostering was carried out by the herdsmen in a small number of litters prior to treatment, but was not permitted after treatment and weighing. The number of live piglets present at the time of an observation was referred to as litter size.

### Additional measurements performed on a subset of sows

Twenty-four pairs of similarly aged sows that finished farrowing at about the same time, one treated and one control sow per pair, were chosen for a study to monitor posture. Small three-channel data loggers (HOBO Pendant G Acceleration Data Logger; Onset Computer Corporation, Pocasset, Massachusetts) were used to record posture for the first 24 hours after treatment, following the technique described by Ringgenberg et al.<sup>5</sup> Data loggers were attached to the right hind leg of the sow after treatment and set to record position at 5-second intervals. Each data logger was protected in a waterproof pocket and securely fastened with a self-adherent bandage and tape. Seven data loggers were dislodged, but complete records were obtained from 41 animals. For downloading the information, a coupler, an optical base station with USB interface, and the HOBOWare Pro computer program (Onset Computer Corporation) were used. Each data point was converted into an acceleration unit ( $g$ ) and a sow was recorded as "standing" when the X axis was  $\geq 0.59g$ ; otherwise, posture was recorded as "other." The outcomes calculated were the amount of standing time during the 24 hours and the mean duration of standing bouts (ie, the average number of minutes a sow remained standing during each standing bout in the 24-hour observation period).

Rectal temperatures were recorded for a total of 34 sows (approximately equal numbers of control and treatment sows) at time 0, 4 hours, and 24 hours. Temperatures were taken using a digital thermometer (MC-343HP; Omron, Lake Forest, Illinois). Feed intake of these 34 sows was recorded at 24 hours post treatment using a 1 to 3 scale (1 = ate nothing; 2 = feed partially consumed; 3 = all feed consumed).

## Statistical analysis

Descriptive statistics and quantitative statistical analysis were performed in Statistix (Statistix 10, Version 10.1; College Station, Texas). Each continuous variable was plotted and tested for normality using the Shapiro-Wilk test. The correlation among continuous variables was tested using pair-wise correlations. The simple association between continuous variables with treatment was evaluated with a two-sample *t* test when the variables were normally distributed and with the Wilcoxon rank sum test when the variables were not normally distributed. The simple association of continuous variables with categorical variables was analyzed with a one-way analysis of variance when the variables were normally distributed and with a Kruskal-Wallis test when the variables were not normally distributed. A chi-square test was used to determine the simple association between treatment and dichotomous or categorical variables. Fisher's exact test was used in cases where the expected values in the 2 × 2 table were < 5 in at least one of the cells. A *P* value of < .05 was considered significant, and *P* values between .05 and .10 were considered indicative of a trend and reported for the rectal temperature and posture data.

The association of piglets' average daily gain (ADG) with treatment, parity, litter size and weight at birth, and litter identity (ID) were analyzed using a mixed linear regression model. The interactions of treatment and parity, litter size, and weight were evaluated to determine any effect on ADG of treatment by these variables. In this model, treatment, parity, litter size at treatment, and weight at birth were considered fixed effects, and litter ID was modeled as a random intercept. Models were compared using the Akaike information criterion (AIC) and the Bayesian information criterion (BIC) value. Residuals were visualized after fitting the model to determine normality of residuals and the presence of unusual observations that would require further analysis.

The associations of pig mortality during the nursing period with treatment, parity, litter size and weight at birth, and litter ID were analyzed using a multilevel mixed effects logistic regression model. In this model, treatment, parity, litter size, and weight were considered fixed effects, and litter ID was modeled as a random intercept. The interactions of treatment and parity, litter size, and weight at birth were evaluated to determine

any effect of treatment by these variables on pig mortality. The AIC and BIC were used to select the models.

The association of rectal temperatures, difference in rectal temperatures, time standing, and average duration of standing bouts of sows with treatment, parity, and the interaction of treatment and parity were analyzed using linear regression models. A square-root transformation was performed on posture behavior variables in order for the residuals to meet the model assumptions of normality and homoscedasticity.

## Results

### Pig performance

Treatment was not significantly associated with growth rate (ADG), weight at birth, or weight at weaning (Table 1). Litter size at weaning was higher for sows treated with meloxicam, but litter size at birth also tended to be larger for the meloxicam group (Table 1). Growth rate and weight at birth and at weaning were normally distributed. Growth rate was positively correlated with weight at birth and at weaning ( $P < .001$ ) and negatively correlated with litter size ( $P < .001$ ).

Parity and litter size at birth were not normally distributed and were positively correlated. Therefore, for analysis, parity and litter size at birth were categorized. Three parity categories were considered: Parity 1-2 (86 sows and 899 piglets), Parity 3-5 (72 sows and 758 piglets), and Parity > 5 (130 sows and 1349 piglets). Litter size at birth

was categorized as follows: Score 1, < 11 pigs; Score 2, 11 to 13 pigs; and Score 3, > 13 pigs.

Parity was significantly associated with ADG. Piglets from sows within Parity 3-5 had better ADG (0.244 kg per day) than piglets from Parity 1-2 or Parity > 5 sows (0.228 and 0.230 kg per day, respectively;  $P < .001$ ). In addition, ADG was significantly different among all the categories of litter size ( $P < .001$ ). In general, ADG was lower in larger litters than in smaller litters. Because litter size and parity categories were highly associated, parity category and litter size were introduced into the model one at a time.

The multivariable mixed linear models were built using ADG or weight at weaning as dependent variables. The models with ADG had better AIC and BIC. The final mixed linear model included treatment, weight at birth, and the interaction of either treatment and parity or treatment and litter size. In both models, the interactions were not significant. However, the mixed model that included the interaction of treatment and litter size showed that piglets from the placebo group in litters of 11 to 13 pigs tended to gain less weight than pigs in that litter-size category in the meloxicam group ( $P = .07$ ). In all ADG models, weight at birth was significant. In addition, the significant random intercept in the model indicated that ADG varied significantly by litter.

Mortality was not associated with treatment ( $P = .36$ ). A total of 165 of 1565 pigs (10.54%) died in the meloxicam group and 167 of 1441 pigs (11.58%) died in the

**Table 1:** Mean (standard deviation) of piglet weights, average daily gain, and litter size for sows receiving either meloxicam or a placebo shortly after farrowing\*

	Meloxicam n = 1565	Placebo n = 1441	P
Initial piglet weight (kg)†	1.64 (0.37)	1.63 (0.35)	.24
Pig weight at weaning (kg)†	6.44 (1.50)	6.40 (1.52)	.50
ADG (kg)†	0.234 (0.06)	0.231 (0.07)	.23
Initial litter size‡	11.36 (1.94)	11.28 (2.20)	.09
Litter size at weaning‡	9.80 (1.89)	9.56 (1.85)	< .001

\* Within 12 hours of farrowing, sows received an intramuscular injection of a placebo or meloxicam (Metacam; Boehringer Ingelheim Ltd, Burlington, Ontario, Canada; 0.4 mg/kg body weight; extra-label use). Piglets were weighed within 12 hours of birth, at 5-7 days of age, and prior to weaning (19-21 days of age).

† Two-sample *t* test.

‡ Wilcoxon rank sum.



placebo group. However, the number of pigs that died was significantly different in sows from different parities ( $P < .001$ ). A total of 67 of 899 pigs (7.45%) died in litters of Parity 1-2 sows, 71 of 758 (9.36%) died in litters of Parity 3-5 sows, and 194 of 1349 (14.38%) died in litters of Parity > 5 sows. Mortality was also significantly associated with litter size at birth ( $P < .001$ ). A total of 64 of 872 pigs (7.33%) died in litters with < 11 pigs, 221 of 1864 (11.85%) in litters with 11 to 13 pigs, and 47 of 270 (17.40%) in litters with > 13 pigs. The final mixed multilevel logistic model included treatment, weight at birth, and the interaction of treatment and parity or treatment and litter size. In all models, the interactions with treatment were not significant. Weight at birth was significantly associated with mortality. In general, pigs with light birth weights or pigs from large litters were more likely to die ( $P < .001$ ). In addition, the significant random intercept in the model indicated that mortality varied significantly by litter.

No sows in the study showed clinical signs of illness such as mastitis or metritis, and no sows had a prolonged and difficult farrowing.

### Sow temperature, feed intake, and standing behavior

Sow rectal temperatures and differences in temperature were normally distributed. Rectal temperatures and differences in rectal temperatures were not significantly associated with treatment (Table 2). In these data, parity categories and feed intake were not associated with treatment ( $P = .44$  and  $P = .98$ , respectively).

The amount of time spent standing in the 24-hour observation period, as well as the average length of a standing bout in minutes, were not normally distributed and were significantly correlated ( $P < .01$ ). Treatment was not associated with the amount of time spent standing or the average length of a standing bout (Table 2).

Posture behavior by treatment group and parity category is summarized in Table 3. The regression model for average standing time showed that in general, sows in Parity > 5 had longer average standing times than sows in Parity 1-2 ( $P < .01$ ). No significant differences of treatment, parity group, or the interactions between treatment and parity were found in the regression model for average length of a standing bout.

## Discussion

The sow must become comfortable and begin to nurse soon after farrowing is complete. Most piglet mortality occurs within the first day of life.<sup>6</sup> It is very important for piglets to obtain colostrum within the first 24 hours after birth in order to obtain sufficient energy and adequate immunological protection.<sup>1</sup>

Starving piglets spend more time in close proximity to the sow in an attempt to increase their milk intake, but consequently are at a higher risk of being crushed.<sup>6</sup> Postpartum pain and inflammation might potentially interfere with a sow's ability to nurse, and so the administration of an NSAID like meloxicam might be expected to improve

**Table 2:** Mean values (standard deviation; SD) of rectal temperature and posture measurements for sows treated with either meloxicam or a placebo shortly after farrowing\*

	Meloxicam (n = 18)	Placebo (n = 16)	P
<b>Sow rectal temperature (SD) (°C)†</b>			
At treatment (time 0)	38.80 (0.60)	38.76 (0.57)	0.80
4-6 hours post treatment	38.78 (0.53)	38.90 (0.43)	0.51
24 hours post treatment	38.83 (0.74)	38.65 (0.54)	0.42
Difference 0-4 hours	-0.01 (0.39)	0.13 (0.52)	0.35
Difference 0-24 hours	0.038 (0.61)	-0.106 (0.40)	0.42
<b>Meloxicam (n = 20) Placebo (n = 21) P</b>			
<b>Posture behavior (SD)‡</b>			
Time standing per 24-hour period (hours)	1.04 (0.63)	1.28 (1.12)	.88
Duration of standing bout (minutes)	10.32 (11.20)	10.23 (8.40)	.96

\* Treatments described in Table 1. Matched pairs of sows were selected from a larger group on the basis of age similarity; researchers blinded to treatment. Posture behavior was recorded using small three-channel data loggers (HOBO Pendant G Acceleration Data Logger; Onset Computer Corporation, Pocasset, Massachusetts) attached to the hind leg of the sow, with position recorded at 5-second intervals.

† Two-sample *t* test.

‡ Wilcoxon rank sum.

**Table 3:** Mean (standard error) of posture behavior by treatment group (meloxicam or placebo post farrowing) and parity category effects\*

Parity categories	Time standing per 24 hours (hours)	Length of a standing bout (minutes)
<b>Meloxicam (n = 20)</b>		
Parity 1-2 (n = 7)	0.44 (0.18)	5.42 (1.76) <sup>a</sup>
Parity 3-5 (n = 2)	1.05 (0.21)	12.61 (4.13)
Parity > 5 (n = 11)	1.40 (0.15)	12.82 (4.36) <sup>b</sup>
<b>Placebo (n = 21)</b>		
Parity 1-2 (n = 6)	1.27 (0.40)	5.75 (0.87) <sup>a</sup>
Parity 3-5 (n = 4)	1.33 (0.58)	12.91 (7.54)
Parity > 5 (n = 11)	1.24 (0.34)	11.31 (2.33) <sup>b</sup>

\* Treatments described in Table 1. Posture behavior measurement described in Table 2.

<sup>ab</sup> Standing bouts were shorter in sows in Parity 1-2 than in sows in Parity > 5 ( $P < .01$ ; regression model)

sow comfort and result in better milking performance. However, in the present study, there was no advantage with respect to piglet growth or survival if the sow was treated with meloxicam shortly after she finished farrowing or was injected with a placebo.

Mainau et al<sup>7</sup> performed a similar study using only 24 sows per treatment group and reported no overall differences in growth or mortality of piglets between sows given meloxicam and sows given a placebo, but they did note that low-birth-weight piglets from multiparous sows had a better ADG in the meloxicam group than in the placebo group. In the present study, the one subset of litters which did tend to grow better if the sow was given meloxicam was the medium-sized litters (11-13 pigs). The explanation for why meloxicam might improve performance in this litter group and not in others is unclear.

Although there may not be a difference in performance between treatment and controls overall, it is possible that some sows may find the farrowing experience more stressful than others. Primiparous gilts are believed to experience more painful parturitions than multiparous sows due to their lack of experience and a higher degree of effort than in multiparous females.<sup>3</sup> Keller<sup>8</sup> found that meloxicam treatment of sows post partum improved piglet survival, noting that the difference in piglet survival was primarily in the subset of sows requiring manual assistance. In addition, the use of meloxicam to treat mastitis-metritis-agalactia (MMA) syndrome in sows has been shown to increase piglet weight gain and decrease preweaning mortality.<sup>9</sup> It should be noted that in Canada and the United States, use of meloxicam to treat a postpartum sow would be extra-label use of the product.

Unfortunately, in the present study, information regarding ease of farrowing and duration of farrowing was not recorded, so that this aspect could not be evaluated. No sows in the present study appeared to suffer from MMA or other illness. The results of this study indicate that there is no benefit in improved production performance from routinely injecting all sows with meloxicam after farrowing, but further studies are warranted to determine if the use of analgesia under certain circumstances, such as a difficult farrowing, would result in improved productivity and improved animal welfare. An additional weakness of the current study was that it was conducted in a commercial setting, and researchers did not always have control

of all aspects of management, for example some cross-fostering occurred prior to treatment and weighing, and this was not always recorded. It is possible that cross-fostering affected growth and survival and should have been prevented or at least controlled for in the analysis.

In the present study, sow rectal temperature, feed intake, and standing behavior were examined in a subset of sows to determine if there was evidence of improved animal comfort. In general, there were no significant differences between sows treated with meloxicam and those given a placebo. Unfortunately the sample sizes for these trials were small and possibly inadequate to determine a difference.

Mainau and Manteca<sup>3</sup> found that sows appear uneasy and restless during the 24 hours prior to parturition and spend most of their time (more than 82%) lying during the days around farrowing, with time spent lying increasing to at least 90% after farrowing. The present study found that sows spent 95% of their time lying whether or not they received meloxicam. In agreement with the present study, Haussman et al<sup>2</sup> reported that sows given an analgesic (butorphanol tartrate) every 6 hours until 3 days after farrowing had fewer position changes from 48 to 72 hours post partum, but not from farrowing to 48 hours, with no decrease in the rate of crushing over the 3 days.

Lying behaviour around farrowing may be affected by various factors that cannot be controlled with the administration of an analgesic. For example, Mainau et al<sup>10</sup> found that there are individual differences in activity levels between sows, with more marked variation from 1 day before until 1 day after farrowing. In addition, they found that human activity on the farm or environmental stress coincided with increased activity. This was not controlled for in the present study. In the present study, there was an interaction between parity and treatment, with the number of standing events or amount of time spent standing tending to be greater mainly in the third-parity group (oldest sows) among placebo-treated sows compared to the same parity group in the meloxicam-treated sows, suggesting that treated sows may have been more comfortable, but further work is needed to confirm this finding.

No ideal measurement of the effectiveness of pain control currently exists in pigs. Behavioural observations may be used in assessing pain, such as sow activity as discussed above,

but measurements tend to be subjective and there is much individual variation. Physiological indicators of pain may include responses of the sympathetic-adrenomedullary system, such as changes in heart rate and rectal temperature, or responses of the hypothalamic-pituitary-adrenocortical system, which may result in changes in cortisol levels.<sup>3</sup> Blood cortisol concentrations may be used as an objective indicator of stress and pain, but they may also become elevated as a result of stresses such as handling. Irrespective of the parturition environment, parturition is associated with increased plasma cortisol concentrations,<sup>11</sup> suggesting that it is a stressful and painful process.

A reduction in feed intake is commonly seen in sows after parturition, especially in primiparous sows, and could be attributed to pain.<sup>3</sup> The present study did not find a difference in feed intake between treatment groups. This is in agreement with Mainau et al.<sup>7</sup> In cattle, Proudfoot et al<sup>12</sup> found that cows undergoing a difficult calving did not differ in their feed intake in the first 24 hours after calving, compared to cows undergoing a normal calving. Feed intake during lactation is affected by a variety of factors, including season, lactation length, and genetic variation among individual sows.<sup>13</sup> It is important to consider factors such as feed delivery practices, environmental conditions, and individual-sow health status when interpreting information on feed intake during lactation.<sup>13</sup> This was not recorded in the current study.

At present, there are few North American farms where pain control is considered for the post-farrowing sow. The present study has found that routine use of meloxicam did not improve productivity. It is possible that among farrowing sows, some experience more pain and have more need for pain control than others. Further research should concentrate on examining the benefits of analgesia on this particular subset of animals, both with respect to improved productivity and also to determine if meloxicam is effective in reducing postpartum pain in these sows.

## Implications

- Under the conditions of this study, routine administration of meloxicam to all sows post farrowing does not result in improved piglet survival and growth.
- Further studies are warranted to determine if the use of analgesia under certain circumstances, such as a difficult farrowing, would result in improved productivity and improved animal welfare.

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## Conflict of interest

None reported.

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