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Effects of prepartum housing environment on abnormal behaviour, the farrowing process, and interactions with circulating oxytocin in sows

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ABSTRACT

We evaluated the effects on sows of prepartum housing environment on bar-biting (BB) behaviour prior to parturition, farrowing duration from first to tenth piglets, litter size, and circulating oxytocin (OT) concentrations during birth of the first five piglets. A total of 35 sows, approximately seven days before the expected parturition date, were housed in: (1) CRATE ($N = 11$): the farrowing crate closed (210 × 80 cm), with provision of a bucketful of sawdust, (2) PEN ($N = 12$): the farrowing crate opened, with provision of a bucketful of sawdust, and (3) NEST ($N = 12$): the farrowing crate opened, with provision of abundant nesting materials. All sows were crated without additional supply of nesting materials when parturition started. Plasma samples from farrowing sows were collected via an indwelling catheter at 0, 2, and 4 min, after delivery of each of the first five piglets to assess circulating OT concentrations. Prepartum BB behaviour was observed in sows for a 20 min period each hour, from 18 h prior to parturition to the birth of the first piglet. Farrowing intervals were monitored between birth of the first and fifth piglet, and duration was recorded until the tenth piglet was born. Prepartum sows in CRATE showed higher frequency and tendency for increased total duration in BB behaviour than in PEN or in NEST ($P < 0.05$, $P < 0.10$, respectively). Prepartum housing environment did not affect circulating OT concentrations in sows while the first five piglets were born, or piglet stillbirths ($P > 0.10$). Farrowing duration between birth of the first and tenth piglet was shorter in sows with prepartum confinement than for those not confined ($P < 0.05$). Average farrowing intervals during birth of the first five piglets tended to be shorter in sows crated prepartum compared with non-crated sows ($P < 0.10$). OT during prepartum was correlated with OT concentrations during farrowing ($r = 0.40$, $P < 0.0001$). However, circulating OT concentrations during both periods were not correlated with farrowing performance or duration. In conclusion, the provision of nesting materials, space or both prior to parturition could reduce BB behaviour in prepartum sows. However, crating at the beginning of parturition after housing in open-crates during prepartum could increase farrowing intervals and duration in sows, possibly due to additional stress induced by sudden confinement.

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1. Introduction

Active nest-building behaviour in prepartum sows is an important maternal instinct for parturition, lactation success, and welfare. This natural behaviour is initiated internally via a rise in hormone levels and stimulated externally via provision of appropriate nesting materials and space prior to parturition (Algers and Uvnäs-Moberg, 2007; Wischner et al., 2009; Yun et al., 2014).

Physiological stressors induced by parturition per se might be further increased by confining circumstances where natural behaviour prior to parturition is restricted (Lawrence et al., 1994, 1997; Jarvis et al., 1997, 2001). As a result, inhibiting the expression of prepartum nest-building behaviour could lead to increased levels of endogenous opioids (Zanella et al., 1996; Jarvis et al., 1997) and stereotypes in prepartum sows (Jensen, 1988).

Several studies revealed that elevated stressor levels induced by restricted nest-building behaviour, due to a lack of space or substrates prior to parturition, prolonged duration of farrowing in sows (Thodberg et al., 2002; Oliviero et al., 2008). Baxter and Petherick (1980) also showed that prohibiting nest-building behaviour in crated sows would lengthen farrowing intervals. The prolonged intervals may be induced by endocrine level changes, and result in increasing incidence of stillbirths. Fraser et al. (1997) and Jarvis et al. (2004), however, revealed inconsistent results for stillbirth rate when nesting materials, space, or both were provided for prepartum sows.

A number of studies showed that duration of farrowing had an impact on parturition performance in sows (Randall, 1972; Bille et al., 1974; Fraser et al., 1997; Pedersen et al., 2006). Oxytocin (OT), as a modulator of uterine or other muscle contractions during the parturition period (Taverne et al., 1979; Higuchi et al., 1986), could influence piglet birth intervals (Castrén et al., 1993; Lawrence et al., 1997; Jarvis et al., 2004; Oliviero et al., 2008). Circulating OT concentrations in sows increase near parturition, but could be affected by endogenous opioids (Lawrence et al., 1997). Thus, inhibiting the expression of prepartum nest-building behaviour could result in a decrease in OT concentrations in prepartum sows (Yun et al., 2013, 2014). Yet, to the best of our knowledge, there has been little research done to investigate the effect of prepartum housing environment per se on OT levels in farrowing sows, when the farrowing environment is standardized among treatments.

The aim of the present study was to study the effect of different housing environments in prepartum sows on abnormal behaviour, such as bar-biting (BB), and farrowing performance. We also investigated interactions among these factors and circulating OT concentrations during the expulsion period. All sows included in this study were crated during farrowing, in order to focus on the effect of the prepartum environment, while standardising other possible effects of post-partum environment.

2. Materials and methods

All experimental procedures performed in this study were approved by the Ethical Committee for Institutional Animal Use and Care of the University of Helsinki. The study was conducted from March to May 2011 on a commercial pig farm registered as an experimental research station, in Hyvinkää, southern Finland. Farrowing housing conditions and experimental designs were described in a previous study (Yun et al., 2013).

2.1. Animals and housing

A total of 35 crossbred sows (Finnish Yorkshire × Finnish Landrace; 12 gilts, 12 parity 2, and 11 parity 3 or 4) were housed in three different farrowing environments for approximately seven days before their expected parturition date. Animals were kept in a temperature-controlled room, where they were allowed ad libitum access to water from a nipple drinker, and were fed three times a day (08:30 h, 14:30 h and 19:30 h) via an automatic liquid feeding system. Each farrowing pen (230 × 210 cm), with concrete floor, contained conventional steel farrowing crates and wooden piglet shelters situated in one corner with a heat lamp suspended outside the shelter. Housing and diet conditions were detailed previously (Yun et al., 2013). All sows included in the experiment farrowed without human assistance or hormonal induction.

2.2. Experimental treatments

Sows were allocated to three treatments according to a randomized complete block design: (1) CRATE: 11 (4 parity 1, 4 parity 2, and 3 parity 3 or 4) sows were kept in a farrowing crate (210 × 80 cm) without the possibility to turn around, and with a bucketful of sawdust on the floor, (2) PEN: 12 (4 each parity 1, parity 2, and parity 3 or 4) sows were housed in a pen with the farrowing crate opened, and a bucketful of sawdust on the floor, 3) NEST: 12 (4 each parity 1, parity 2, and parity 3 or 4) sows were housed in a pen with the farrowing crate opened, and were provided with two bucketfuls of sawdust, a shredded newspaper, three bucketfuls of chopped straw, seven tree branches, and three natural sisal ropes, each of 50 cm length. All the nesting materials in the NEST treatment and the bucketfuls of sawdust in the CRATE and PEN treatments were replaced if they became soiled prior to parturition. All sows were crated without additional supply of NB materials, directly after the first piglet was born.

2.3. Sample collection and assays

All experimental sows were catheterized five days before their expected farrowing date with an indwelling ear vein catheter inserted using a nonsurgical catheterization procedure (Virolainen et al., 2005; Yun et al., 2013). Catheterization was conducted by trained researchers with an open treatment. Plasma samples were collected via the indwelling catheter 0, 2, and 4 min after each of the first five piglets were delivered. Concentrations of OT were measured using a porcine Oxytocin ELISA Kit (Genxbio Health Sciences Pvt. Ltd., India). Sensitivity of the plasma OT assay was 2.5 pg/ml. The intra- and inter-assay CVs were 7.6 and 11.5%, respectively.