Piglet use of the creep area—Effects of breeding value and farrowing environment

Guro Vasdal a,*, Inger Lise Andersen a, Lene Juul Pedersen b

a Norwegian University of Life Sciences, Department of Animal and Aquacultural Sciences, P.O. Box 5003, 1432 Ås, Norway
b University of Aarhus, Faculty of Agricultural Sciences, Research Centre Foulum, Dept. of Animal Health, Welfare and Nutrition, Blichers Allé 20, P.O. Box 50, DK-8830 Tjele, Denmark

ARTICLE INFO

Article history:
Accepted 29 May 2009
Available online 28 June 2009

Keywords:
Breeding value
Creep area
Farrowing environment
Piglet mortality

ABSTRACT

The objective of this study was to investigate piglet use of the creep area, comparing litters of sows with a high vs. low breeding value for piglet survival in the first 5 days postpartum, that were either housed in crates or individual pens during farrowing and lactation. Seventy-five Yorkshire × Danish Landrace sows were video recorded for 4 days after farrowing, and the analysis was conducted using instantaneous sampling every 10 min commencing 24 h after the birth of the first piglet for a period of 72 h. Breeding value for piglet survival had no effect on piglet use of the creep area or time spent in any location of the farrowing environment. Farrowing environment had significant effects on piglet location; during all days there were significantly more piglets in the creep area in the crates compared to the pens (P < 0.01), and this difference was larger at 24–48 h than at 49–72 h and at 73–96 h after birth (P < 0.05). Piglets in pens spent significantly more time resting near the sow, excluded nursing (P < 0.001), and this percentage decreased over time after farrowing (P < 0.001) in both the crates and the pens. In conclusion, piglet use of the creep area was higher in the crate compared to the pen particularly during the second day of life. This may partly be due to a much larger proportion of uncomfortable, slatted floor in the crates, and the shorter distance from the sow to the creep area in the crate.

1. Introduction

A significant proportion of the piglet mortality occurs within the first 2 days after farrowing (English and Morrison, 1984; Dyck and Swierstra, 1987; Andersen et al., 2005), and starvation and crushing by the sow may explain around 50–80% of these losses (e.g. Marchant et al., 2001). In addition to improving maternal abilities of the sows (e.g. Valros et al., 2003; Jarvis et al., 2005) and providing extended management around the time of farrowing (White et al., 1996; Andersen et al., 2007; Andersen et al., 2009), many farmers try to encourage the piglets to use the creep area when suckling is not in progress as soon as possible after farrowing. It is commonly assumed that minimizing the frequency and duration of piglets stay in the sow area reduces the risk of being crushed or trampled by the sow the first days after parturition, but at present this has not been documented.

There are many ways of making the creep area more attractive to the piglets (Morrison et al., 1983; Lay et al., 1999), but most importantly it should be a warm, dry and soft resting area (Ziron and Hoy, 2003) without draught, and that is easily accessible (Zhang and Xin, 2001). However, piglets prefer to lie next to an anaesthetized piglet in a cold area than alone in a warm area (Hrupka et al., 2000), which also illustrates a high motivation for piglets to lie close to other littermates regardless of temperature. Piglets prefer lying close to the sow for the first 2 days after farrowing despite unfavorable conditions in the sow area (Hrupka et al., 1998; Berg et al., 2006; Moutsen et al., 2007). At this age, piglets tend to use the creep area more in crates than pens (Blackshaw et al., 2009).
1994) and more in pens with slatted floor and no heat in the sow area than in pens with solid floor and heat in the sow area (Houbak et al., 2006; Moutsen et al., 2007). Piglets will increase their use of the creep area from day 3 (Hrupka et al., 1998; Berg et al., 2006) and there is a large variation in the use of the creep area between litters within the same herd (Andersen et al., 2007).

The large variation in the use of the creep area is interesting, and it has been suggested that the sow has an effect on piglet use of the creep area (Berg et al., 2006). For example mothers with good maternal skills may be more effective in gathering the piglets in a group when entering the nest and before she lies down. This may potentially reduce the risk of crushing. Individual differences in maternal behaviour may be more evident when the sow is able to move freely and interact with her piglets (e.g. Boe, 1993, 1994). Increased piglet survival may be achieved indirectly by selecting for optimal maternal behaviour (i.e. more attentive mothers) to prevent crushing or by selecting for piglet survival directly. However, when selecting sows based on their breeding value for piglet survival at day 5 such as in the present study, we do not know whether the improved survival is achieved through improved maternal skills, the prenatal environment, factors related to the birth process or a combination of many factors. If increased piglet survival is partly a result of improved maternal behaviour, we would expect to see some differences in sow and piglet behaviour between the two breeding lines.

The physical environment of the sow and litter has been given much research attention during the last 20 years and the debate concerning crates versus pens is still active, both with respect to the welfare of the sow (e.g. Blackshaw et al., 1994; Jarvis et al., 1997) and piglet mortality (e.g. Cronin and Smith, 1992; Weary et al., 1996b; Marchant et al., 2000; Weber et al., 2007). The restrictive farrowing crate has negative effects on sow health (Verhovsek et al., 2007), stress level during farrowing and lactation (Jarvis et al., 1997) and increases farrowing duration (Hansen and Vestergaard, 1984; Biensen et al., 1996). Some studies have reported higher piglet mortality due to crushing in pens than in crates (Cronin and Smith, 1992; Cronin et al., 1996), whereas others find similar results in both types of housing (e.g. Schmidt, 1992; Biensen et al., 1996; Cronin et al., 2000; Weber et al., 2007; Pedersen et al., 2008).

According to the Norwegian Regulation for Animal Welfare, all nursing sows must be kept in a loose house farrowing pen, but in Denmark and other countries, the use of farrowing crates is still accepted. Both in Norway and Denmark around 14–15% of all live born piglets die before weaning (Norsvins In-Gris Årsstatistik, 2005; Sloth and Bertelsen, 2007) and breeding for increased litter size is one of the major factors that cause higher mortality irrespective of the farrowing environment (e.g. Pedersen et al., 2006; Weber et al., 2007).

The aim of the present study was to investigate piglet use of the creep area in litters of sows with a high versus low breeding value for piglet survival until day 5, which were either housed in crates or individual pens during farrowing and lactation. Based on earlier findings (e.g. Blackshaw et al., 1994), we predicted that piglets born in crates would spend more time in the creep area than piglets born in pens. We also predicted that piglets born in pens would spend more time resting in contact with the sow during the first 3 days after birth than piglets born in crates.

2. Materials and methods

2.1. Experimental design

This experiment took place at the Research Centre Foulum in Denmark. During four farrowing batches in 2007, 75 gilts were video recorded from farrowing to 4 days after farrowing (0–96 h) in either a farrowing pen or crate to document piglet use of the creep area.

2.2. Animals

The sows were Yorkshire × Danish Landrace gilts, and they were inseminated in their second oestrus at around 210 days of age with semen from Duroc × Hampshire boars. Two breeding lines of sows were used in the experiment (Su et al., 2007): 43 HB gilts (high piglet survival until day 5) and 32 LB gilts (low piglet survival until day 5). Of the HB gilts, 24 were crated and 19 were kept in pens. Of the LB gilts, 19 were crated and 13 were kept in pens.

All piglets were marked with numbers immediately after birth. Birth assistance during farrowing was only given if more than 3 h had passed since the last piglet was born. No other assistance during the lactation period was given, and a piglet without any possibility to live due to injuries, starvation or hypothermia was euthanized by the staff.

2.3. Housing

During the gestation period the gilts were housed together in groups of 30 with automatic feeders. The gilts were brought to their farrowing environment at day 110 post-insemination, 6 days before expected farrowing. The farrowing pens measured 7.3 m² in total with 1.9 m² slatted floor and had solid sloping walls on three sides. The sow area was 6.2 m² and the creep area was 1.2 m² (Fig. 1).
The farrowing crates measured 4.7 m$^2$ in total with 2.3 m$^2$ slatted floor. The sow area was 1.5 m$^2$ and the creep area was 0.8 m$^2$ (Fig. 2). Temperatures in both environments were kept at 18–20°C, and the surface temperature in the creep area was kept at 30°C in both environments.

The creep area in both the pen and the crate was heated by a heat lamp in the roof of the creep area and the floor was covered with a 3–5 cm layer of chopped straw. Thus there would be no major differences in the attractiveness of the creep area. The sows were given 2 kg of chopped straw daily from day 113 until farrowing. The sows were fed automatically at 7.30 am and 14.30 pm. Lights were kept on for 24 h to allow video recording.

2.4. Behavioural observations

The sows were continuously video recorded for 4 days after farrowing. A video camera (TVCCD-14IR, Monacor, Bremen, Germany) was suspended over each pen and connected to a computer. The videos were analyzed using the MSH Video software (www.guard.lv), and all activity in the crates and pens was analyzed by using instantaneous sampling every 10 min from 24 h after the first piglet was born until 72 h had passed (96 h). This time period was selected because this is the time when piglet mortality is highest (e.g. Dyck and Swierstra, 1987).

The number of piglets observed in the following places was recorded: (1) In the creep area. (2) Resting together on the concrete floor with body contact. (3) Resting together on the slatted floor with body contact. (4) Resting alone without body contact. (5) Resting in contact with the sow when not suckling. (6) Active on the solid floor. (7) Active on the slatted floor.

2.5. Statistical methods

In the analysis, the litter was used as the statistical unit. The difference in activity between classes of breeding value, farrowing environment and days, were analyzed using a mixed model procedure in SAS software (Hatcher and Stephanski, 1994), including the following class variables and their interactions: batch (1–4), breeding value (high or low), farrowing environment of the sow (crates or pens) and hours after farrowing (24–48 h, 49–72 h or 73–96 h after birth of first piglet). Class variables or interactions with no significant influence on the model ($P < 0.10$) were removed from the final model. Sow nested within breeding value and farrowing environment was included as a random effect. The covariance structure of the repeated measurements on days was modeled using compound symmetry.

3. Results

3.1. Effects of breeding value on piglet location

The breeding value of the sow had no significant effect on time (% of the observations) spent in any part of the farrowing environment (Table 1) and there were no significant interactions between breeding value, environment or hours after farrowing.

3.2. Effects of farrowing environment and hours after farrowing on piglet location

There was a significant interaction between hours after farrowing and farrowing environment concerning the percentage of piglets resting in the creep area ($F_{2,126} = 7.2; P < 0.01$). During all days there were significantly more piglets resting in the creep area in the crates compared to the pens ($F_{1,66} = 15.70; P < 0.01$, Fig. 3).

<table>
<thead>
<tr>
<th>Breeding value</th>
<th>Environment</th>
<th>Breeding value</th>
<th>Environment</th>
<th>Interactions breeding value × environment</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Crate</td>
<td>Pen</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HBV</td>
<td>50.5 ± 2.1</td>
<td>49.0 ± 2.1</td>
<td>57.3 ± 1.7</td>
<td>39.5 ± 2.3</td>
</tr>
<tr>
<td>LBV</td>
<td>2.2 ± 0.4</td>
<td>1.4 ± 0.2</td>
<td>1.1 ± 0.3</td>
<td>2.7 ± 0.5</td>
</tr>
<tr>
<td>Rest solid floor</td>
<td>0.03 ± 0.02</td>
<td>0.02 ± 0.08</td>
<td>0.02 ± 0.01</td>
<td>0.04 ± 0.02</td>
</tr>
<tr>
<td>Rest slatted floor</td>
<td>0.4 ± 0.1</td>
<td>0.3 ± 0.1</td>
<td>0.1 ± 0.01</td>
<td>0.4 ± 0.1</td>
</tr>
<tr>
<td>Rest contact sow</td>
<td>19.8 ± 1.6</td>
<td>20.9 ± 1.8</td>
<td>14.3 ± 1.4</td>
<td>28.6 ± 1.6</td>
</tr>
<tr>
<td>Active solid floor</td>
<td>17.2 ± 1.1</td>
<td>17.5 ± 1.9</td>
<td>10.0 ± 0.6</td>
<td>27.5 ± 0.1</td>
</tr>
<tr>
<td>Active slatted floor</td>
<td>10.2 ± 0.9</td>
<td>11.1 ± 1.0</td>
<td>17.2 ± 0.7</td>
<td>1.5 ± 0.2</td>
</tr>
</tbody>
</table>
However, the difference between crates and pens was larger at 24–48 h (LS means differences; $t_{2,126} = 5.45$, $P < 0.0001$) than at 49–72 h (LS means differences; $t_{2,126} = 2.15$, $P < 0.05$) and at 73–96 h (LS means differences; $t_{2,126} = 2.28$, $P < 0.05$, Fig. 3). The percentage of piglets resting in contact with the sows when not nursing decreased over time after farrowing (24–48 h: 27.3 ± 2.0, 49–72 h: 18.3 ± 1.9, 73–96 h: 14.7 ± 1.9) ($F_{2,126} = 24.7; P < 0.001$). This percentage was significantly higher in pens compared to crates at all ages ($F_{2,126} = 17.6, P < 0.001$). The percentage of piglets being active on the solid floor was significantly higher in pens compared to crates ($F_{1,66} = 130; P < 0.001$) and this percentage was reduced over time ($F_{2,126} = 30.0, P < 0.001$). In contrast, the percentage of piglets being active on the slatted floor was significantly higher in crates compared to pens ($F_{2,66} = 129.5, P < 0.001$) with no significant effect of hours after farrowing.

Only a small percentage of piglets rested alone during the 3 days (24–48 h: 0.2 ± 0.1; 49–72 h: 0.2 ± 0.1; 73–96 h: 0.2 ± 0.4), with no effect of environment or breeding value. Few piglets rested together on the floor without contact with the sow during the 3 days (24–48 h: 2.3 ± 0.5; 49–72 h: 1.5 ± 0.5; 73–96 h: 1.6 ± 0.4) and there was no significant effect of neither environment nor breeding value.

4. Discussion

As predicted, the piglets spent less time in the creep area and more time resting in contact with the sow in the pen system compared to crates. A lower use of the creep area in pens where sows are kept loose has previously been documented (e.g. Blackshaw et al., 1994), and may be due to the increased ability of the sow to interact and communicate with the piglets. Piglets are highly motivated to stay close to the sow the first days after birth, and will not increase the use of the creep area until after days 2–3 (Hrupka et al., 1998; Berg et al., 2006). The fact that piglets in pens spend more time resting in contact with the sow other than when suckling, may pose a challenge for loose-housing of lactating sows, as more piglets in the sow area increases the risk of crushing (e.g. Weary et al., 1996a). However, according to Berg et al. (2006), there is no significant relationship between piglet use of the creep area or location in the pen and piglet mortality. Neither does the quality (i.e. heat conserving capacity) of the creep area seem to affect piglet mortality in commercial loose-housed sow herds (Andersen et al., 2007).

If this is the case, then work to improve the attractiveness and quality of the creep area may not help to improve piglet survival. However, more systematic, experimental work is needed before any conclusion can be made. It may be more important to focus on improving maternal skills, especially when sows are kept loose. This can be done by selecting for maternal behaviour directly. A heritability of 0.24 has been shown for a maternal care index including nest building, nursing and licking responses in mice (Chiang et al., 2002). Comparatively, few have tried to develop a similar index for maternal behaviour in pigs. Vangen et al. (2005) documented moderate heritability for sows’ reaction to piglets screams based on qualitative measures from questionnaires in commercial herds. Maternal behaviour can also be improved by offering a better farrowing environment, such as providing enough nest building material (Cronin et al., 1993; Herskin et al., 1998, 1999).

Traditionally, it has been assumed that more time spent away from the sow (i.e. in the creep area) excluded sucking would increase piglet survival, but in fact there is at present no documentation to support this. In our experiment we did not find any effects of the sows’ breeding value on the piglet use of the creep area. This effect could only have been achieved if breeding for increased survival had a direct effect on the sow’s maternal behaviour. Another important point is that we do not know specifically how much contact between the sow and piglet other than when sucking is optimal for piglet survival. Individual farrowing pens are based on the principle that the piglets should leave the sow and enter the creep area when the sow is not nursing, while under natural conditions and in group-housing, lactation systems it is the sow that leaves the piglets (Stolba and Wood-Gush, 1989; Stangel and Jensen, 1991; Pitts et al., 2002). In fact, increased time spent away from the piglets increased the sow’s responsiveness towards the piglets and increased piglet survival (Pajor et al., 2000; Pitts et al., 2002). This aspect should indeed be taken into consideration when developing future farrowing pens.

The creep areas in the two environments were both equipped with heat lamp and the same amount of straw, making the quality of the creep area equal. However, an important difference between the two environments was that in crates, half the total floor surface was slatted, whereas in the pen only 25% was slatted. The creep area in the crate may thus be perceived as more attractive compared to rest of the crate, due to the higher percentage of slatted floor area. Also, the horizontal bars next to the sow may interfere with the piglets’ opportunity to lie close to the sow’s udder where heat is provided. This may partly explain a larger use of the creep area in crates than pens. The different proportion of slatted floor vs. solid concrete floor also explains why piglets were more active on slats and less active on solid floor in crates than pens. Another factor that may influence the use of the creep area is the distance between the creep area and the most commonly used resting place for the sow in the pen (Zhang and Xin,
In crates, the distance from the resting sow to the creep is usually less than in a pen. Although the different qualities of the two types of pens may explain the different use of the creep area, impairing the quality of the sow area is not an acceptable solution to improve piglet's survival. Unless the quality and attractiveness of the creep area increases the use of this area and decreases piglet mortality, we should rather focus on the more direct, predisposing factors for piglet mortality, such as litter size (Pedersen et al., 2006; Weber et al., 2009), piglet characteristics (Pedersen et al., 2008), maternal behaviour (Chiang et al., 2002) and management (Andersen et al., 2007; Andersen et al., 2009; White et al., 1996).

In conclusion, sow breeding value did not affect piglet use of creep area. Piglet use of the creep area was higher in the crate than in pen system during the second, third and fourth day of life. This may be due to the larger proportion of uncomfortable, slatted floor in the crates and a shorter distance from the sow to the creep area in the crate.

References


