Applied Animal Behaviour Science 159 (2014) 29–33

Contents lists available at ScienceDirect

Applied Animal Behaviour Science

journal homepage: www.elsevier.com/locate/applanim

Nest building and posture changes and activity budget of gilts housed in pens and crates

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ARTICLE INFO

Article history:
Accepted 23 July 2014
Available online 1 August 2014

Keywords:
Nest building
Maternal behaviour
Piglet mortality
Farrowing environment

ABSTRACT

The aim of the present work was to study nest building, posture changes and the overall activity budget of gilts in pens vs. crates. Twenty-three HB gilts (high piglet survival day 5) and 21 LB gilts (low piglet survival day 5) were video recorded from day 110 in pregnancy to four days after farrowing in either a farrowing pen or farrowing crate. The gilts were provided with 2 kg of chopped straw daily from day 113 of pregnancy until farrowing in both environments. Nest building and other activity measures of the sows were analysed using continuous sampling the last 12 h before the first piglet was born until 8 h after the birth of the first piglet. There was no significant effect of the sows breeding value on any of the sow behaviours. Sows housed in pens spent significantly more time nest building than crated sows from 4 to 12 h prepartum ($P < 0.05$). Crated sows spent more time sitting ($P < 0.01$), chewed more frequently on pen fittings ($P < 0.001$) and showed a higher frequency of quick flops when entering a resting position after farrowing ($P < 0.05$), but had a lower number of posture changes ($P < 0.05$) after farrowing.

In conclusion, provision of a similar amount of straw does not compensate for the lack of space in the crate compared to the pens. Sows in pens spent more time nest building from 4 to 12 h post partum compared to crated sows, and crated sows showed more behaviours related to frustration and restlessness.

1. Introduction

Piglet mortality varies greatly between sows within the same herd, and this variation can partly be explained by the maternal behaviour of the sow (e.g. Wechsler and Hegglin, 1997; Ahlstrøm et al., 2002; Andersen et al., 2005). For example, sows with few crushed piglets have longer duration of lying down movements (e.g. Burri et al., 2009), and have more nose contact with the piglets around posture changes (e.g. Andersen et al., 2005). These sows are less active during the last hours before farrowing and the early stages of lactation (e.g. Jarvis et al., 1999; Andersen et al., 2005). There are also differences in their nest building behaviour; sows with few crushed piglets display a higher nest building activity (Wischner et al., 2009), longer bouts of nest building and more elaborate nest building behaviour during the last 12 h before farrowing compared to sows with a higher number of crushed piglets (e.g. Cronin and van Amerongen, 1991; Andersen et al., 2005; Pedersen et al. (2008))

The farrowing crate was introduced to reduce piglet mortality, but is criticised for severely reducing the welfare of the sow. According to the Norwegian Regulation for Animal Welfare, all lactating sows must be kept in a loose house farrowing pen, but in most other European countries, the use of farrowing crates is still accepted. Some

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http://dx.doi.org/10.1016/j.applanim.2014.07.002

studies report higher piglet mortality due to crushing in pens than in crates (Cronin and Smith, 1992; Cronin et al., 1996), while others report similar mortality in both types of housing (e.g. Weber et al., 2007; Pedersen et al., 2011). A recent study in 112 breeding English pig farms also reviled that there was no significant difference in mortality of live born piglets between crates, indoor pens with confinement only at the time of birth and outdoor arcs (Kilbride et al., 2012). Nest building activity typically starts earlier in the pens, is more elaborate and has a longer duration than in the crate (e.g. Damm et al., 2003; Thodberg et al., 2002), and there is less activity in the last period prior to farrowing in the pen compared to in the crate (e.g. Damm et al., 2003). The farrowing crate has several negative effects on maternal behaviours (e.g. Arey and Sancha, 1996; Jarvis et al., 2001), including restricting the nest building activity (e.g. Hansen and Vestergaard, 1984; Blackshaw et al., 1994; Jarvis et al., 1997; Damm et al., 2003), more stereotypies and a higher heart rate prior to farrowing (e.g. Damm et al., 2003). According to Jarvis et al. (2001), penned gilts were standing and walking more, performed more substrate-directed behaviours and had lower pre-parturient levels of ACTH and cortisol than crated gilts, irrespective of whether straw was available or not. In fact, straw did not have any stress physiological effect in their study. This underlines that sufficient space is crucial in the nest building phase when the sow becomes more restless. The gilts in the present study were selected for either high or low piglet survival at day 5 (Su et al., 2007), but no differences were found between these two breeding lines with respect to piglet mortality or most causes of mortality (Pedersen et al., 2011), which could be due to low heritability of piglet survival. Thus we did not expect to find any major differences between these genetic lines regarding nest building activity or activity budget in the present study either, but breeding line still had to be kept as a treatment group because this was a part of the original experimental set-up (Pedersen et al., 2011).

The aim of the present work was to study nest building, posture changes and the overall activity budget of gilts in pens vs. crates.

2. Materials and methods

2.1. Experimental design

This experiment took place at the Research Centre Foulum in Denmark. During four farrowing batches, a total of 44 gilts were video recorded from day 110 in the pregnancy to four days after farrowing in either a farrowing pen or farrowing crate to document nest building behaviour and other sow behaviours. The data in this study is based on a larger study where farrowings were attended and blood samples and other measures were collected from the newborn piglets.

2.2. Animals and housing

The animals were Yorkshire × Danish Landrace gilts, which were inseminated in their second oestrus with semen from Duroc × Hampshire boars. The gilts were selected from a breeding herd with ongoing selection for number of live piglets until day 5. The breeding value for all gilts in the herd was known for several traits, amongst other piglet survival rate until day 5 (Su et al., 2007). For the present experiment, gilts were selected based on piglet survival rate to day 5 to represent two different breeding classes: high piglet survival until day 5 (HB) and low piglet survival until day 5 (LB). In this study a total of 23 HB and 21 LB gilts were used. Of the HB gilts, 12 were crated and 11 were kept in pens. Of the LB gilts, 11 were crated and 10 were kept in pens.

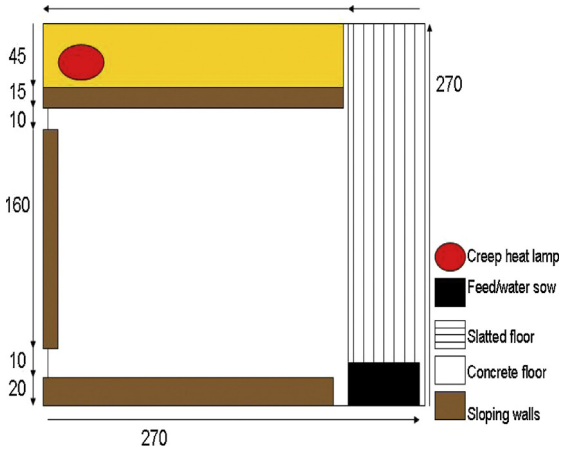

Fig. 1. The farrowing pen (all measures in cm).

The gilts were brought from the group housing gestation unit to their farrowing environment at day 110 in the pregnancy, 6 days before expected farrowing. The farrowing crate measured 4.7 m^2 in total of which the sow area was 1.5 m^2 and the creep area measured 0.8 m^2 (Fig. 1). The farrowing pen measured 7.3 m^2 in total, of which the sow area was 6.2 m^2 and the creep area measured 1.2 m^2 (Fig. 2). Temperatures in both environments were kept at 18–20 °C, and the surface temperature of the floor in the

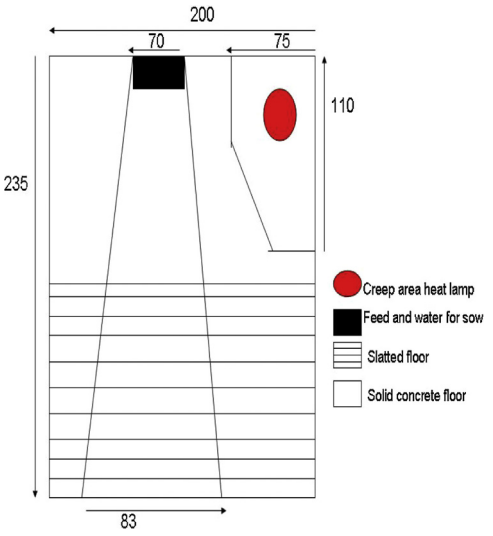

Fig. 2. The farrowing crate (all measures in cm).

creep area was kept at 30 °C in both environments. The gilts were given 2 kg of chopped straw daily from day 113 until farrowing. Hereafter they were given approximately 500 g chopped straw daily. The sows were fed close to ad libitum automatically at 7.30 am and 14.30 pm, and lights were kept on for 24 h to allow video recording.

2.3. Video recording and analysis

The sows were continuously video recorded from 6 days before until 4 days after farrowing. A video camera (TVCCD-14IR, Monacor, Bremen, Germany) was suspended over each pen and connected to a standard PC. The videos were analysed using the MSH Video software. All nesting activity and other behaviours of the sows were analysed by using continuous sampling the last 12 h before the first piglet was born, until 8 h after the birth of the last piglet. The following sow behaviours were recorded:

1. Walk/stand (Upright with all four feet on the floor)
2. Sit (Rear end on the floor with the two front feet on the floor)
3. Lie sternum (Lying on the udder with neither shoulder touching the floor)
4. Lie recumbent (Lying with udder exposed and one shoulder on the ground)
5. Nest building (Rooting with snout, digging/pawing, carrying)
6. Manipulating pen parts (Biting or pushing pen parts)
7. Quick flop (Flopping straight down from standing: after kneeling, a sow lets her hind quarters fall to one side, Wechsler and Hegglin, 1997).
8. Slow flop (Lying down vertically from a standing position. After kneeling, the sow lowers her hind quarters vertically or slightly inclined, Wechsler and Hegglin, 1997).
9. Sniffing piglets (Sow touches piglets within 30 s before a posture change)
10. Crushing piglet (A position change results in piglet being trapped underneath the sow)
11. Biting piglet (Sow bites a piglet)
12. Stepping on piglet (Sow steps on a piglet)

2.4. Statistical methods

The difference between sow breeding values and environments regarding all sow behaviours were analysed by a Genmod procedure (with Poisson distribution), using sow as the statistical unit. The model included the following class variables: breeding value (BV: HBV vs. LBV), environment (Crate vs. Pen), the interaction between breeding value and environment, and batch (1–4). Litter size was included as a continuous variable in the model.

The differences in timing of nest building between sows with and without crushed piglets in the two environments were analysed by a Wilcoxon Mann–Whitney U-test.

3. Results

The results on the impact of breeding value, farrowing environment and piglet characteristics on piglet mortality are reported in Pedersen et al. (2011).

3.1. Effect of breeding value and farrowing environment on sow activities

Before birth, crated sows spent less time nest building, more time sitting, chewed more frequently on pen fittings, and had more quick flops after birth when lying down than sows housed in pens (Table 1). Crated sows spent significantly less time nest building compared to the loose housed sows in period 2 ($z_{1,286} = 4.8$, $P < 0.05$), period 3 ($z_{1,286} = 17.6$, $P < 0.001$) and period 4 ($z_{1,286} = 5.1$, $P < 0.01$, Fig. 3), but period 1 (from 1 to 3 h prepartum) did not differ significantly between the environments.

Crated sows had fewer posture changes after birth than penned sows. There was no significant effect of breeding value on any of the activity measures (Table 1).

The amount of sniffing towards piglets did not differ between the two environments (Table 1), and time spent nest building was not related to the frequency of sniffing in any of the environments. There were no interactions between breeding value and farrowing environment with respect to any of the sow behaviours.

4. Discussion

Nest building activity was higher in the pens than crates, but only from 4 to 12 h prepartum and not the last 3 h before birth, which is expected because most sows will settle down in a resting position shortly before birth. Sows are highly motivated to perform nest building prior to farrowing, and a restriction in their ability to perform these behaviours have negative impact on sow welfare (Jensen and Toates, 1993; Damm et al., 2003). Physical restriction of behavioural expressions in the crates increase behavioural indicators of frustration such as stereotypies (e.g. Damm et al., 2003), and our results supports this finding as the crated sows spent more time chewing on pen fittings. Thus, although the crated and the penned sows in the present study had the same, limited amount of straw, the physical restriction in itself is likely to cause behavioural problems.

Sows that are restless shortly before farrowing are less protective in their maternal behaviour after farrowing, and tend to crush more piglets (e.g. Wechsler and Hegglin, 1997; Andersen et al., 2005). In the present study, the crated sows showed a higher frequency of unwanted behaviours such as chewing on pen fittings, sitting and quick flops when entering a resting position. There are also clear endocrine indicators that sow farrowing in crates are more stressed than sows in pens (e.g. Jarvis et al., 2001; Oliviero et al., 2008). Crated gilts have lower oxytocin levels and higher ACTH levels compared to loose housed gilts (Jarvis et al., 2001), and periparturient stress in sows inhibits oxytocin, which is detrimental to the maternal behaviour (Jarvis et al., 1997). Overall, we may thus state that it is stressful to confine the sows during farrowing and lactation. Confinement increase restlessness before

Table 1
Sow activities before and after farrowing (total time spent (min)/number of events) with respect to farrowing environment and breeding lines (means ± S.E.).

	Breeding value		Environment		Breeding value		Environment	
	HBV (n = 23)	LBV (n = 21)	CRATE (n = 23)	PEN (n = 21)	$\chi_{1,39}^2$	P-value	$\chi_{1,39}^2$	P-value
Walk/stand before (min)	64.9 ± 9.3	89.5 ± 12.8	84.9 ± 10.1	65.8 ± 12.1	2.8	ns	1.0	ns
Walk/stand after (min)	13.0 ± 3.0	13.2 ± 3.3	12.5 ± 3.1	13.7 ± 3.2	0.0	ns	0.2	ns
Sit before (min)	57.1 ± 7.6	51.6 ± 7.6	68.4 ± 6.6	39.4 ± 7.4	0.4	ns	8.1	<0.01
Sit after (min)	5.2 ± 1.6	4.9 ± 1.2	6.1 ± 1.1	4.0 ± 1.8	0.0	ns	0.8	ns
Lie sternum before (min)	132.2 ± 9.5	129.3 ± 14.5	125.7 ± 9.8	136.5 ± 13.8	0.0	ns	0.4	ns
Lie sternum after (min)	13.2 ± 5.2	16.6 ± 4.1	19.0 ± 5.5	10.0 ± 3.5	0.2	ns	1.4	ns
Lie recumbent before (min)	277.1 ± 19.7	264.7 ± 37.6	274.2 ± 20.8	268.9 ± 35.8	0.1	ns	0.0	ns
Lie recumbent after (min)	447.5 ± 9.4	450.1 ± 5.9	437.3 ± 9.4	461.1 ± 5.3	0.0	ns	4.0	0.05
Nest building (min) before	120.7 ± 14.0	127 ± 16.6	101.2 ± 12.6	148.8 ± 16.0	0.1	ns	5.5	<0.05
Number chew pen before	9.9 ± 2.9	10.8 ± 3.6	42.3 ± 4.9	2.2 ± 1.0	0.1	ns	14.0	<0.001
Number quick flop after	3.4 ± 0.9	4.6 ± 1.1	5.4 ± 1.1	2.3 ± 0.8	0.5	ns	4.7	<0.05
Number slow flop after	1.6 ± 0.4	2.2 ± 0.6	1.8 ± 0.3	1.9 ± 0.5	1.5	ns	0.1	ns
Number nosing after	4.8 ± 1.1	7.0 ± 1.2	5.04 ± 0.9	6.7 ± 1.4	1.8	ns	1.0	ns
Number Crush, bite, step[a] after	0.8 ± 0.2	1.7 ± 0.5	1.3 ± 0.3	1.0 ± 0.4	2.3	ns	0.4	ns
Posture changes before	186.4 ± 13.6	161.7 ± 10.5	173.3 ± 12.1	177.1 ± 13.5	0.1	ns	2.4	ns
Posture changes after	27.7 ± 3.4	27.2 ± 5.8	22.0 ± 3.8	32.8 ± 5.3	0.0	ns	5.7	<0.05

[a] The three behaviours merged together in analysis due to small sample sizes.

and after birth and reduce nest building and maternal motivation (Wechsler and Hegglin, 1997; Burri et al., 2009). Recent large scale tests on commercial farms also show that there is no longer beneficial regarding production results to have sows in crates compared to pens (e.g. Weber et al., 2007; Pedersen et al., 2011).

There were no behavioural differences between the two breeding lines in the present study. Clear differences in nest building behaviour and other sow behaviours between the breeding lines could only have been achieved if breeding for increased survival had a direct effect on the sow's behaviour. The results of the present study suggest that this is not the case.

The nest building material used in this study was 2 kg of chopped straw daily. Long-stemmed straw may occupy the sow more, but chopped straw is more practical for the manure system and is thus more labour efficient. It can be argued that 2 kg of chopped straw daily is insufficient to satisfy the sows' motivation and to build a satisfactory nest, and that an increased amount of a different nesting material could have resulted in clearer differences between the sows. To provide none or just a small amount of nest building material, such as what is common practise in most commercial farms, have negative effects on maternal behaviour (Cronin et al., 1996; Herskin et al., 1998; Thodberg et al., 2002)

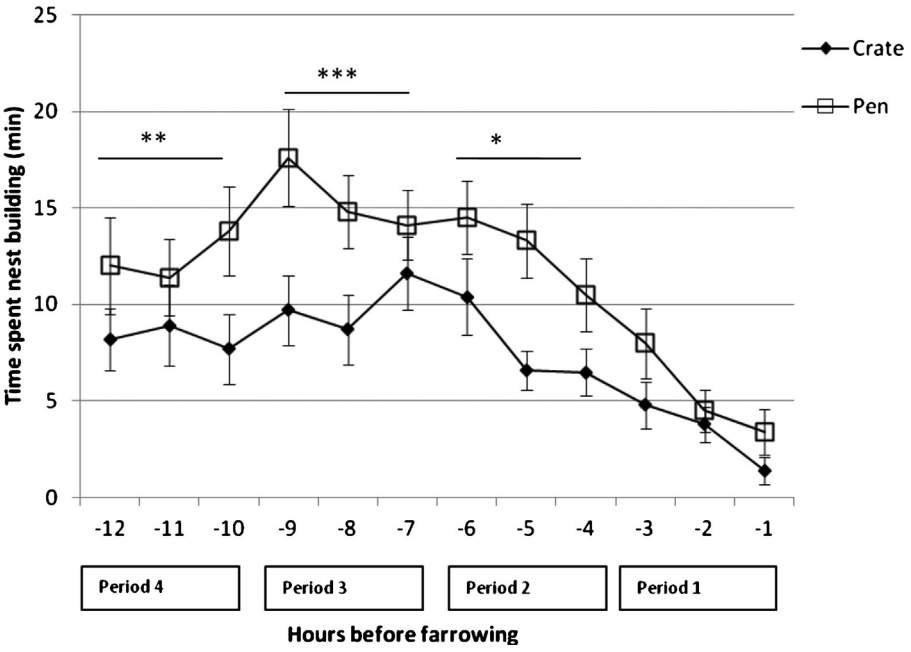

Fig. 3. Frequency of nest building the last 12 h before farrowing in pens and crates (mean ± S.E. per hour). Difference within period between treatments: $^{*}P < 0.05$, $^{**}P < 0.01$ $^{***}P < 0.001$.

as well as on sow and piglet health (e.g. Jarvis et al., 1999).

In conclusion, provision of a similar amount of straw does not compensate for the lack of space in the crate compared to the pens. Sows in pens spent more time nest building from 4 to 12 h post partum compared to crated sows, and crated sows showed more behaviours related to frustration and restlessness.

Conflict of interest

There is no conflict of interest regarding the present manuscript.

Acknowledgement

The authors wish to acknowledge Anders Vernersen, Dan Avl for providing the breeding values for gilts selected from the commercial breeding herds. The project was part of the 6th framework "Welfare Quality" program.

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