Ann. Anim. Sci., Vol. 10, No. 2 (2010) 179–186

MATERNAL RESPONSIVENESS OF SOWS HOUSED IN TWO FARROWING ENVIRONMENTS MEASURED IN BEHAVIOURAL TESTS*

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Abstract

The aim of the study was to assess the maternal responsiveness of sows housed in two farrowing environments: three-part farrowing crate and Danish-type farrowing pen, allowing free movement of the sows. The behaviour of 24 sows (12 in crates and 12 in pens) on the parturition day and within two days of farrowing was observed with regard to the resting phase. In addition, each sow was subjected to three behavioural tests, which showed that sows housed in the farrowing pen were more sensitive to sounds of the piglets in danger. Stronger reaction was also found after the isolation of piglets from the mother. There were no statistically significant differences in behaviour during the resting phase, although sows in the farrowing crate spent more time lying on the side and sitting than sows housed in Danish-type farrowing pen. Statistically higher frequency of postural changes (dangerous to piglets due to crushing) was found in sows housed in farrowing crates.

Keywords: sows, maternal responsiveness, farrowing crates and pens, lying down and rolling behaviour, behavioral tests

Farrowing crates were developed largely to counteract the problem of high piglet mortality and since the 1960s there has been a strong worldwide trend to house the farrowing sow in crates of various designs (Barnett et al., 2001). The study carried out by Weary et al. (1996) showed that crushings are the main reason for piglet loss during the first few days after farrowing. In this study the behaviour of 20 sows and their litters kept in farrowing crates and in pens was compared. In total, 24 piglets were killed by maternal crushing during the study (4 in farrowing crates and 20 in pens). However, in the opinion of Arey (1993) further reduction of piglet loss rate (below 10%) becomes harder and therefore the main emphasis should be moved from improving constructions which limit the free locomotion of the sow to the de-

*This work was financed from statutory activity, project No. 3203.

velopment of the solutions which enable sows to express natural behaviour. Fraser (1990) also concludes that although it would be unwise to suggest that crates do not prevent deaths, the degree of reduction is difficult to estimate and may be considerably lower than an uncritical reading of the literature would indicate. In addition, recent welfare considerations have led to increased interest in loose-housing systems for parturient and lactating sows (Damm et al., 2005).

Soon after birth, neonates participate actively in teat localization and suckling and influence the caregiving behaviour of their mother by communicating their needs (Nowak et al., 2000). These situations may be potentially dangerous for piglets because they can be crushed by the mother. Interactions between mother and young are very important for the survival of neonates and the mental state of the mother. This state can also influence rearing results. Previous studies showed that the inability to express natural maternal behaviour causes increased nervousness and higher activity levels before parturition, which can increase crushing (Nowicki et al., 2004) or aggressive behaviour towards their newborn piglets (Bugnacka et al., 2007). In the opinion of Wechsler and Hegglin (1997), sensitivity of sows to the sounds of crushed piglets is an individual trait and more sensitive sows crush a lower number of piglets. At this point, it should be asked whether the construction and design of farrowing environment should limit the possibility of expressing maternal instinct while reducing the risk of piglets being crushed (farrowing crate) or should allow full expression of maternal behaviour, thus naturally minimizing losses of piglets (farrowing pen). Hendricks et al. (1998) report that in practice, breeders lean towards the first solution because most of the sows in European countries farrow in crates.

Taking above information into account it was decided to observe the behaviour of sows potentially dangerous for piglet survival in straw-bedded pens (which enable free movement and contact with piglets) and straw-bedded farrowing crates and to assess the maternal responsiveness of sows in such environments using behavioural tests.

Material and methods

Twenty-four-hour behavioural observations were carried out at the experimental unit belonging to the Department of Swine Breeding at the University of Agriculture in Krakow. The building was mechanically ventilated and heated to 18°C. The study involved 24 Polish Landrace × Polish Large White primiparous sows. The gilts were chosen for the experimental treatments based on the analogue principle taking into consideration first parity, body weight and body condition of the sows. Approximately on day 105 of gestation the sows were moved into two farrowing environments:

– three-part farrowing crate with straw bedding – 12 sows,

– farrowing pen (Danish-type with a separate part for piglets) covered with plenty of straw – 12 sows.

The duration of farrowing was 231 and 236 minutes in farrowing crates and farrowing pens, respectively. The average litter size (piglets born alive) was 10 in farrowing crates and 10.43 in farrowing pens.

The 24-hour behavioural observations were made from day of parturition (day 0) to day 2 after farrowing using closed-circuit colour camera with IR lamp (which enabled night observation without additional light) and time-lapse digital video recorder. The video data obtained was marked on a previously prepared ethogram taking into account sows' time budget spent on different activities. The percentage of time spent on lying laterally (on the side), sternally (on the belly), and sitting on the hind quarters was noted. The average time taken to lie down in three farrowing environments and number of rolling behaviours were measured. Additionally, the total frequency of postural changes was recorded. No crushings were found during the experiment because of the observation and prevention in very dangerous situations.

Each sow was tested with three behavioural tests.

Test procedure:

Test 1. Previously recorded as mp3 file, a 15 sec. squeak of the crushed piglet was played through the speakers inside the pen or crate of the sow when the sows were lying. The wireless transmission of sound and remote video observation were used so there was no influence of staff presence in the experimental room. The reaction of the sow was observed within 30 seconds of playing the squeak. The following scale of reaction was used: 0 – no reaction of the sow, 1 – slight movement of the sow's head, 2 – rise of the head, 3 – rise of the front legs, 4 – quick rise of the whole body and quick lying down, 5 – rise of the whole body, the sow keeps a lookout for piglets, sniffs out.

Test 2. Squeak of the crushed piglet was played when the sow was changing the body position from standing to lying. Scale used: 0 – the sow quickly lies down, 1 – the sow stops lying and stands up after a short while, 3 – the sow stands up quickly.

Test 3. The observation of the sow reaction to:

a) isolation of the piglet in farrowing crate or pen (possible visual contact)

b) short (about 5-minute) removal of all piglets from the farrowing environment (no contact with piglets). The scale which was used to assess the maternal responsiveness in test 3a and 3b: 0 – no reaction, the sow does not stand up, does not look around, 1 – the sow looks around during lying down, 2 – the sow stands up, looks around but after a while lies down, 3 – the sow stands up immediately, looks around, 4 – the sow stands up immediately, intensively looks around, starts to be aggressive and nervous.

Tests 1 and 2 were performed during 3 days after farrowing at 1 p.m. and test 3 after a week from parturition at 9 a.m. (part 3a) and 1 p.m. (part 3b).

The behavioural data obtained was analysed statistically using the U-Mann-Whitney test. The mean values obtained from behavioural tests were analysed using Student's t-test.

Results

The total time spent on resting in farrowing environments compared did not differ significantly; however, slightly longer resting time was found in sows housed in farrowing crates (Table 1). The largest difference was observed on farrowing day

(2.4%) and on the next two days (0.92% and 1.32%, respectively). The resting time of sows housed in all farrowing accommodations slightly increased on the first day after farrowing. The time spent lying on the belly was shorter in farrowing crates, but the differences were not significant. The time spent on sitting was longer in sows housed in farrowing crates on the first and second day after farrowing and the differences were statistically significant (P<0.05).

Table 1. Resting phase of sows housed in three farrowing environments (24 h = 100%)

Housing	Trait	Subsequent days of observation (0 = day of parturition)		
		0	1	2
Farrowing crate	Total resting	88.66	94.64	93.93
	Lying on the side	80.86	91.67	91.03
	Lying on the belly	7.27	2.83	2.72
	Sitting	0.53	0.14 a	0.18 a
Farrowing pen	Total resting	86.26	93.72	92.61
	Lying on the side	76.04	90.27	88.38
	Lying on the belly	9.52	3.37	4.14
	Sitting	0.70	0.08 a	0.09 a

Means in columns marked with the same letters differ statistically significantly, P<0.05.

Table 2. Average time taken to lie down, number of rolling behaviours and frequency of posture changes performed by sows housed in three farrowing environments

Housing	Trait	Subsequent days of observation (0 = day of parturition)		
		0	1	2
Farrowing crate	Time taken to lie down (s.)	16.68	15.33	14.67
	Number of rolling behaviours	11.46	9.94	10.02
	Frequency of posture changes	79.00 a	28.23	31.42 a
Farrowing pen	Time taken to lie down (s.)	13.98	14.26	11.28
	Number of rolling behaviours	10.92	9.23	9.96
	Frequency of posture changes	64.26 a	24.75	24.62 a

Means in columns marked with the same letters differ statistically significantly, P<0.05.

On all days of observation, shorter time taken to lie down was noted in sows housed in farrowing pens compared to farrowing crates (Table 2), but the differences were not statistically significant. The number of rolling behaviours on the day of parturition was highly similar in all sow groups observed. It decreased slightly on the day after farrowing. During that day the highest number of rolling behaviours was found in sows housed in farrowing crates, but the differences were also not significant. The amount of these movements increased in all observed sows on the second day after parturition, but there were still no statistically significant differences found on this day. The total frequency of postural changes was significantly (P<0.05) higher on parturition day in sows housed in crates vs. pens. After parturition it decreased in both sow groups observed, but it was still the highest in sows

housed in crates. Statistically significant (P<0.05) differences were also found on the second day after farrowing.

The results of the behavioural test 1 performed on the first three days after farrowing show that the reaction of sows housed in pens was stronger (Table 3). Sows in pens raised the whole body and observed the farrowing accommodation more often than sows in crates. The differences in behaviour were confirmed statistically on the second and third days of observation.

Table 3. The reaction of sows to the played squeak of the piglet (max. 5 points)

Housing	Subsequent days after farrowing		
	1	2	3
Farrowing pen	4.02 ± 0.81	4.28 a ± 0.86	4.34 a ± 0.98
Farrowing crate	3.97 ± 0.79	3.74 a ± 1.05	3.86 a ± 1.40

Means in columns marked with the same letters differ statistically significantly, P<0.05.

During test 2, the recorded vocalization of a crushed piglet was played while the sow was changing the position from standing to lying (Table 4). The result of that test also shows higher maternal responsiveness of sows in farrowing pens. These sows more often stopped lying down and raised their bodies after a while or even immediately. However, no statistical differences were found for this test.

Table 4. The reaction of sows to the squeak of the crushed piglet played when the sow was changing the body position from standing to lying (max. 3 points)

Housing	Subsequent days after farrowing		
	1	2	3
Farrowing pen	2.34 ± 1.07	2.39 ± 0.79	2.42 ± 0.66
Farrowing crate	2.11 ± 1.24	1.97 ± 0.79	2.06 ± 0.86

The results of test 3 show that the reaction to isolation of piglets (only sight contact was possible) in sows housed in farrowing pens was stronger (Table 5). The differences were statistically significant (P<0.05).

Table 5. The reaction of sows to isolation of the piglet in farrowing crate or pen (possible visual contact) (max. 4 points)

Housing	Values
Farrowing pen	3.12 a ± 0.71
Farrowing crate	2.58 a ± 1.31

Means in columns marked with the same letters differ statistically significantly, P<0.05.

Table 6. The reaction of sows to short (about 5 minute) removal of all piglets from the farrowing environment (no contact with piglets) (max. 4 points)

Housing	Values
Farrowing pen	3.68 a ± 0.88
Farrowing crate	3.18 a ± 1.34

Means in columns marked with the same letters differ statistically significantly, P<0.05.

The complete isolation of piglets from their mother during 5 minutes resulted in a strong reaction of sows in both farrowing environments compared (over 3 points according to the scale used), but statistically stronger maternal responsiveness ($P<0.05$) was found in sows housed in pens (Table 6).

Discussion

Postural time budget was affected by the housing system. More position changing, and more sitting may be interpreted as indicating discomfort (Harris and Gonyou, 1998). In our study, these behaviours were characteristic of sows housed in farrowing crates. Such a configuration of time spent on these behaviours can be risky for piglet survival, because higher frequency of postural changes and excessive nervousness of sows may result in a greater number of crushings (Nowicki et al., 2004). In the present experiment sows housed in farrowing crates also spent more time sitting than sows housed in pens. These results are in agreement with observations made by Jarvis et al. (1997) and Nowicki and Klocek (2006).

In the opinion of Damm et al. (2005) there is quite a good understanding of lying down behaviour in sows and its association with risk of piglet crushing. Quick lying has previously been interpreted as indicating sow comfort but what is good for the sow's welfare is detrimental for piglets because it may lead to more crushing due to piglets' inability to avoid the quickly descending sow (Harris and Gonyou, 1998). Weary et al. (1998) showed that almost 90% of the piglet crushings were caused by lying down from standing position and rolling from lying on the udder to lying on the side. In our study the shortest lying down time was found in sows housed in farrowing pens. However, the differences were not significant. In a study by Harris and Gonyou (1998) also the time taken to lie down varied with the type of farrowing accommodation and was the shortest in penned sows. This could indicate that the risk of piglets being crushed is higher in pens but our earlier (Nowicki and Klocek, 2006) and present results concerning rolling behaviour seem to not fully confirm this thesis.

Contrary to lying down only little is known about rolling behaviour, the factors that can affect it and its association with piglet crushing (Damm et al., 2005). In our study the amount of rolling behaviour was slightly higher in crated sows than in penned sows. In a study by Weary et al. (1998) also the number of rolling behaviours differed according to farrowing accommodation. Sows housed on concrete floors rolled less from lying on their side to lying on the udder than sows on plasticized floor. The findings of Andersen et al. (2005) indicate that sows called "non-crushers" (sows which did not crush piglets) showed a tendency for fewer rollover movements during resting in the first 2 h of parturition than "crushers". Damm et al. (2005) hold that it is unrealistic to completely prevent rolling because it is connected with suckling attempts initiated by the piglets. However, the results from Herskin et al. (1998) suggest that provision of nest material may be an efficient way of reducing the risk associated with rolling, because nest material can modify this behaviour or has some

other property that reduces risk of crushing, e.g. a cushioning effect. Similar results were obtained in a previous preliminary study (Nowicki and Klocek, 2006). Moreover, sows housed on slatted floors showed more abnormal behaviour (Nowicki et al., 2003). Bugnacka et al. (2007) demonstrated that sows housed in crates were more aggressive to their newborn piglets and also more nervous during parturition than sows housed in Danish pens.

Maternal ability is a very individual feature. Therefore, the fact that almost no direct breeding for good maternal abilities has been conducted while most of breeders suffer from crushings and nursing problems is very striking.

Summing up it should be emphasized that although housing in pens resulted in shortening of lying down time, the number of rolling behaviours and the frequency of postural changes, which are most dangerous for piglet survival, were lower in pens than in crates. Nevertheless, further observations concerning the actual effect of these behaviours on piglet survival are necessary. Moreover, the tests of maternal responsiveness could help to assess the maternal responsiveness of sows after first parturition regardless of actual results of rearing piglets by the sow, which could help breeders to eliminate sows with poor maternal abilities.

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Accepted for printing 22 IV 2010

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Opiekuńczość loch utrzymywanych w dwóch typach kojców porodowych określana na podstawie testów behawioralnych

STRESZCZENIE

Celem badań było określenie opiekuńczości loch utrzymywanych w dwóch typach kojców porodowych: trzyczęściowym oraz duńskim zmodyfikowanym, umożliwiającym lochom swobodne poruszanie się. Obserwowano zachowanie 24 loch (12 utrzymywano w kojcu trzyczęściowym – typ Meprozet, kolejne 12 w kojcu umożliwiającym swobodne poruszanie się) w dobie porodu oraz kolejnych dwóch dniach, biorąc pod uwagę fazę odpoczynku. Ponadto każda z loch poddana została trzem testom behawioralnym. Testy wykazały, że lochy utrzymywane w kojcach duńskich były bardziej wrażliwe na dźwięki wydawane przez prosięta w niebezpieczeństwie. Stwierdzono także silniejszą reakcję loch w odpowiedzi na izolację prosiąt od matki. Nie stwierdzono statystycznie istotnych różnic w zachowaniu podczas fazy odpoczynku, jakkolwiek lochy w kojcach trzyczęściowych spędziły więcej czasu leżąc na boku i siedząc niż maciory utrzymywane w kojcach duńskich. Statystycznie istotnie wyższą częstotliwość zmian form zachowania (sprzyjającą przygnieceniom) odnotowano u loch utrzymywanych w kojcach trzyczęściowych.