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Abstract

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Keywords

Behavior, farrowing hut, outdoor, piglets

Disciplines

Agriculture | Animal Sciences | Behavior and Ethology

Comments

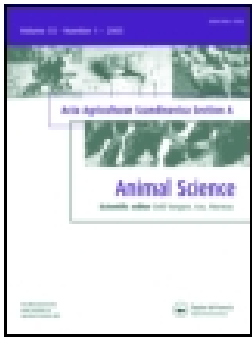
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ORIGINAL ARTICLE

Risky behaviors performed by the piglet 72 hours after parturition that can contribute to pre-weaning mortality when housed in farrowing huts

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Abstract

The objective was to compare the behavior of loose-housed outdoor litters that had one or more piglet mortalities (CR; $n = 4$) compared to litters where no mortalities occurred (NC; $n = 4$). The litter of piglets was observed using 10-min scan samples over 72 h from birth and individual piglets were continually observed 1 h prior to death. Postures, nursing, unknown, location within the hut, and vicinity to the sow were determined. There were no differences observed for any measures 1 h before a piglet's death. There were no differences for treatment or day by treatment over the 72 h for behaviors or vicinity to sow. There was a day effect with piglets becoming more inactive and nursing less often from d1 to d3. There was a day effect for vicinity to sow with piglets spending less time by the sow over the 3 d. Few behavioral differences were observed between treatments.

Keywords: Behavior, farrowing hut, outdoor, piglets.

Introduction

Allowing the dam increased mobility at the time of parturition may be detrimental for the well-being of her piglets, especially when the dam frequently alters her posture (Cronin & Cropley, 1991; Weary et al., 1996), if she is unresponsive to her piglets' distress calls (Hutson et al., 1991; Hutson, 1993) or does not nurse frequently (Jensen, 1988; Spinka et al., 1997). Edwards et al. (1994) and Marchant et al. (2000) reported that the sow's maternal qualities are important in a loose-housed farrowing system and that during the first 72 h immediately following farrowing, 75% of all pre-weaning mortality often occurs. However, the piglets' behavioral qualities in an outdoor hut are relatively unknown. Therefore, the

objective of this study was to compare the behavior of loose-housed outdoor litters that had one or more piglet mortalities within the first 72 h after parturition compared to those litters where no mortalities occurred.

Materials and methods

Housing and animals

This project was approved by the Texas Tech University Animal Care and Use Committee. A total of eight, parity three crossbred sows (Camborough-22, PIC USA, Franklin, KY) were obtained from a single source farm and were considered to have a high health status (negative for pseudorabies,

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[†]Dr. Julie Morrow died on 5th January 2003; however, she played a critical role in the completion of this work.

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brucellosis, porcine respiratory and reproductive virus syndrome, and *mycoplasma hyopneumonia*). Research was conducted over July 2000 at the Sustainable Pork FarmTM near Lubbock, TX, USA.

Sows remained outdoors during breeding, gestation, and farrowing. All sows were artificially inseminated and pregnancy checked four weeks later using real-time ultrasound. Pregnant sows were then moved into a gestation paddock. In the gestation, radial sows were kept in 16, 0.4 acre paddocks which had 24 sows per paddock. Within these gestation groups, sows were of mixed parity and were kept in the same social group through both the gestation and farrowing phases. Five days prior to scheduled farrowing, gestating sows were transferred to the farrowing paddock (eight sows per paddock and eight farrowing huts). Each farrowing paddock was 0.4 ha and contained one English style arc farrowing hut for each sow that had a metal fender, as previously described by Johnson and McGlone (2003). Sows were fed once daily (08:00 h), consisting of a sorghum-based diet (CP 16%; 1535 kcal ME/kg; lysine 0.95%). Depending on the stage of lactation, sows were provided 2–9 kg/d based on number of pigs nursed. Sows had ad libitum access to clean drinking water and a wallow. Every sow and her litter were observed 2 ×/d for health, dead piglets, or farrowing problems. Each day new straw was provided to the farrowing huts.

Climatic measurements

Temperatures were recorded in 10 min intervals by a weather station (Weather monitor II, Model 7440 Davis Instruments, Baltimore, MD) located on site. Over the trial, average temperature was 25.9°C, average relative humidity was 45.80%, resulting in a Temperature Humidity Index of 47.3. Average wind velocity was 26.7 km/h with a total rain precipitation of 0.3 cm, respectively.

Behavioral acquisition and treatments

Eight third parity crossbred sow (C-22, PIC[®], Henderson, TN) litters were used for behavioral comparisons for piglets in litters where mortalities occurred (CR; $n=4$) or were no piglet mortalities occurred (NC; $n=4$) over the first 72 h after parturition. Methodology as described by Johnson et al. (2007) was utilized in this experiment and the acquisition of all the behavioral measures for the 72-h period were conducted by one trained observer who viewed the tapes and entered data into a data sheet (Microsoft Excel[®]). The data sheet included; year, month, day, time, behaviors, postures, vicinity to sow, and location with the hut. For the 1 h prior

to a piglet dying, the same individual entered the data continuously into the Observer software (The Observer, V5, Noldus Information Technology, Wageningen, The Netherlands). The time of day was divided for the statistical analysis; light was defined as the hours from sunrise to sunset with dark being the remaining hours.

Piglet postures and nursing

Twenty piglets (from the four sows that killed a piglet over the first 72 h) were observed continuously comparing two treatments; piglets that were crushed (CR; $n=10$) and piglets that lived from the same litter over the same time period (NC; $n=10$) for all behaviors and postures 1 h preceding a piglet dying. The precise time that the piglets were laid upon by the sow was determined (using video and confirmed by later necropsy). The point for a piglet to be laid upon and not to get back up once the sow moved off that piglet became the end point for the 1-h observational window, from here the observer worked backwards to determine the behaviors and postures of all piglets that died. Three final categories were defined for the 1 h before a piglet's death: active, inactive, and suckling (Table I). For the 72-h period, the same two postures, suckling and an unknown category (Table I) were acquired using a 10-min sampling technique for eight litters.

Piglet vicinity to the sow

Piglet vicinity relative to the sow was collected 1 h prior to a piglet's death (CR; $n=10$, NC; $n=10$). By sow was defined as when a piglet was within one piglet body length from the sow. Not by sow was defined as when the piglet was more than one piglet body length from the sow. Three categories were utilized for piglets in determining the vicinity to the sow which were acquired over the 72 h; By sow, not by sow (as previously defined), and unknown (Table I).

Location within a hut

Four piglet locations within the farrowing hut were acquired for the 1 h prior to piglet mortality (continually) and over the 72 h (10-min scan sample). The hut was divided into four equally represented quadrants. *Front door: Quadrant 1:* quarter included the door to the farrowing hut. *Back door: Quadrant 2:* quarter of the farrowing hut opposite from the door, on the back wall of the hut. *Front no door: Quadrant 3:* quarter of the farrowing hut on the same wall as the door but not including the door. *Back no door:*

Table I. Description of piglet postures and behaviors when housed in an English style outdoor farrowing hut with a lactating sow in July 2000 (adapted from Hurnik et al. 1995).

	Definition
<i>Posture</i>	
Active	Summation of walking defined as any action while the piglet was upright and moving and standing defined as assuming or maintaining an upright position on extended legs but remaining stationary.
Inactive	Summation of sitting defined as most of the piglet's body weight and the posterior of their body trunk were in contact and supported by the ground and lying (lateral and sternum) defined as side contacting the ground or underside contacting the ground.
<i>Behavior</i>	
Suckled	Suckling duration was a collection of four phases, including an initial massage phase, a phase when the piglets stopped massaging, true suckling (which lasts for about 14 s while milk is ejected), and a final massage phase.
Unknown	Default was recorded if the video was unclear to record a behavioral or postural class for the piglet(s). This could include times when a piglet(s) were outside of the hut, buried in the straw or hidden by the sow.

Quadrant 4: quarter of the farrowing hut opposite *Quadrant 3* on the back wall.

Statistical analysis

All behavioral data were expressed as percentages and were subjected to a square root arcsine transformation process to achieve a normal distribution to meet one of the basic assumptions of the analysis of variance (ANOVA). Transformed data were analyzed using the PROC MIXED procedure in SAS (SAS Inst. Inc., Cary, NC) software for parametric data. The experimental unit was the farrowing hut (containing one litter) for the 72-h observation and the experiment unit was the individual piglet for 1-h period to a piglet dying. One hour before a piglet's death, the statistical model included the parameter of interest (piglet behaviors and postures, location, and vicinity to sow), treatment (CR or NC), and time (light or dark). A block of week was used (two weeks). There were no time by treatment interactions and this interaction effect was subsequently removed from the final model. The 72-h statistical model included the parameter of interest (piglet behaviors and postures, location, and vicinity to sow), treatment (CR or NC) and day (one, two, or three), and a repeated measures statement of day nested within sow. There were no day by treatment interactions and this interaction effect was subsequently removed from the final model. PDIFF was used to separate differences at a P -value of $P < 0.05$.

Results

One hour prior to piglet mortality

No differences ($P > 0.05$) were observed for suckling behavior or postures between treatments or for time of day (Table II), although there was a trend ($P = 0.07$) for activity levels for time of day with piglets spending less time active during the dark hours ($21.6 \pm 3.83\%$

Light vs. $14.7 \pm 4.76\%$ Dark). There were no ($P = 0.93$) treatment differences observed for time spent by the sow ($83.9 \pm 8.45\%$ CR vs. $82.8 \pm 8.45\%$ NC) or not by the sow ($16.07 \pm 8.45\%$ CR vs. $17.18 \pm 8.45\%$ NC). For time of day, there was a trend ($P = 0.07$) for piglets to spend more time close to the sow during dark hours ($71.3 \pm 7.10\%$ Light vs. $95.5 \pm 10.05\%$ Dark). There were no ($P > 0.05$) differences observed for a preferred location within the farrowing hut by piglets within the farrowing hut between treatments or for time of day (Table II).

Seventy-two hours after parturition

Five piglets died on d1, four died on d2, and one died on d3. Three piglets died over the night-time hours and seven died during day-light hours. No ($P > 0.05$) treatment differences were observed for any postures or suckling over the 72 h inside the farrowing hut (Table III). There were day differences ($P < 0.0001$) for the time piglets engaged in inactivity and suckling. Piglets became more inactive and suckled less over the three days after parturition (Table III). There was no ($P > 0.05$) treatment differences observed for time spent by the sow, not by the sow, or unknown. There were day differences ($P < 0.0001$) for vicinity to the sow, with piglets decreasing the time spent by the sow over the first three days after parturition (Table III).

There were no ($P > 0.05$) treatment effects observed for preferred time to be spent in a location quadrant of the farrowing hut, but there was a day effect ($P = 0.03$) for *Quadrant 2* with piglets increasing the amount of time spent in this location over the three successive days (Table III).

Discussion

One hour prior to piglet mortality

More focus has been placed on these risky behaviors performed by the sow and little attention has been

Table II. Piglet postures, behavior, and location least squares means (\pm SE) 1 h before a piglets death (CR; $n=10$) or did not loose a litter mate (NC; $n=10$) inside the farrowing hut in July 2000.

	Treatment ^a		Time ^b		P-values	
	CR	NC	Light	Dark	Treatment	Time
Posture (%)						
Active	21.1 \pm 5.41	15.5 \pm 5.41	21.6 \pm 3.83	14.7 \pm 4.76	0.55	0.07
Inactive	48.2 \pm 11.63	44.4 \pm 11.63	45.8 \pm 8.52	46.8 \pm 11.95	0.69	0.65
Behavior (%)						
Suckling	30.8 \pm 8.39	40.1 \pm 8.39	32.7 \pm 6.39	38.5 \pm 9.43	0.35	0.85
Quadrant (%) ^c						
Quadrant 1	12.7 \pm 8.02	23.6 \pm 8.02	21.4 \pm 6.74	14.8 \pm 9.53	0.37	0.57
Quadrant 2	35.3 \pm 8.72	16.8 \pm 8.72	16.8 \pm 7.17	35.4 \pm 10.01	0.20	0.15
Quadrant 3	35.9 \pm 11.08	30.9 \pm 11.09	42.9 \pm 9.16	23.9 \pm 12.82	0.76	0.24
Quadrant 4	16.2 \pm 8.66	28.6 \pm 8.66	18.9 \pm 7.28	25.8 \pm 10.30	0.36	0.59

^aPiglets that were crushed over the first 72 h of parturition were defined as CR. Piglets that lived from the same litter over the same time period were defined as NC.

^bLight was defined as the hours from sunrise to sunset with dark being the remaining hours.

^cQuadrant 1: quarter included the door to the farrowing hut. Back door: Quadrant 2: quarter of the farrowing hut opposite from the door, on the back wall of the hut. Front no door: Quadrant 3: quarter of the farrowing hut on the same wall as the door but not including the door. Back no door: Quadrant 4: quarter of the farrowing hut opposite Quadrant 3 on the back wall.

directed toward the piglets' behaviors and postures and how interactions with the sow may place them in a more risky situation. Comparing piglets that died to those that survived in this study did not indicate any suckling or postural differences in the 1 h before a piglet's death between the two treatments or for the time of day that may be able to help identify "risky" piglet behaviors that could impact pre-weaning mortality (Weary et al., 1996, 1998).

In this study, focusing at the piglet level, there was a trend for piglets to become less active during the darker hours (21–14%) in the 1 h before a piglet's death. Piglet suckling, postures, location, and vicinity to the sow 1 h prior to piglet's death did not differ between piglets within the same litter or across litters, respectively. Piglets from CR and NC litters for the time of day (day or night hours) did not show a preferred location within the farrowing hut that

Table III. Piglet postures, behavior, vicinity, and location least squares means (\pm SE) 72 h after parturition when housed in an outdoor farrowing hut in July 2000.

	Treatment ^a		Day ^b			P-value	
	CR	NC	One	Two	Three	Treatment	Day
Postures (%)							
Active	15.5 \pm 1.04	16.4 \pm 1.04	17.8 \pm 1.06	14.8 \pm 1.06	15.3 \pm 1.06	0.52	0.09
Inactive	55.4 \pm 2.60	53.2 \pm 2.60	40.3 \pm 2.09 ^a	59.7 \pm 2.09 ^b	62.9 \pm 2.09 ^b	0.59	<0.0001
Behavior (%)							
Suckling	26.3 \pm 2.42	27.9 \pm 2.42	39.9 \pm 2.18 ^a	23.1 \pm 2.18 ^b	18.1 \pm 2.18 ^c	0.69	<0.0001
Unknown (%) ^c	2.9 \pm 0.54	2.5 \pm 0.54	1.9 \pm 0.66	2.4 \pm 0.66	3.7 \pm 0.66	0.78	0.19
Vicinity (%)							
By sow	59.9 \pm 5.16	58.3 \pm 5.16	72.9 \pm 3.92 ^a	55.3 \pm 3.92 ^b	48.9 \pm 3.92 ^c	0.81	<0.0001
Not by sow	37.2 \pm 5.17	39.1 \pm 5.17	25.0 \pm 3.97 ^a	42.2 \pm 3.97 ^b	47.3 \pm 3.97 ^b	0.79	<0.0001
Unknown ^c	2.9 \pm 0.54	2.7 \pm 0.54	2.0 \pm 0.66	2.5 \pm 0.66	3.8 \pm 0.66	0.78	0.19
Quadrant (%)							
Quadrant 1	23.5 \pm 4.37	18.0 \pm 4.37	22.1 \pm 4.19	20.8 \pm 4.19	19.3 \pm 4.19	0.51	0.95
Quadrant 2	21.9 \pm 3.40	23.2 \pm 3.40	15.3 \pm 4.16 ^a	20.7 \pm 4.16 ^b	31.7 \pm 4.16 ^c	0.82	0.03
Quadrant 3	19.3 \pm 3.68	24.9 \pm 3.68	26.0 \pm 4.50	20.5 \pm 4.50	19.8 \pm 4.50	0.99	0.34
Quadrant 4	32.4 \pm 5.79	32.1 \pm 5.79	34.9 \pm 5.78	35.9 \pm 5.78	25.8 \pm 5.78	0.31	0.67
Unknown ^c	2.9 \pm 0.54	1.8 \pm 0.54	1.6 \pm 0.66	2.1 \pm 0.66	3.4 \pm 0.66	0.73	0.22

^aPiglets that were crushed over the first 72 h of parturition were defined as CR. Piglets that lived from the same litter over the same time period were defined as NC.

^bDay one, birth to 24 h of age; day two, 24–48 h of age; and day 3, 48–72 h of age.

^cDefault category was recorded if the video was unclear to record a behavioral class. This could include times when a piglet(s) were outside of the hut, buried in the straw or hidden by the sow. For groups there was no differences for behaviors ($P=0.19$), vicinity to the sow ($P=0.19$), or quadrant location ($P=0.22$) in unclear behaviors from the video recording with CR or NC piglets.

may have been considered more risky or conversely safer for piglet survival 1 h before a piglet's death. This maybe due to the piglets not preferring a given location within the farrowing hut or it could be attributed to the arbitrary division of the hut floor space into four equally represented quadrants. If the hut had been divided into smaller areas, perhaps a preferred lying area could have been identified.

Seventy-two hours after parturition

There were no differences at the piglet level between CR and NC litters, indicating that perhaps the risky behaviors and postures leading onto piglet pre-weaning mortality maybe connected more so to the behavioral repertoire performed by the sow in a loose-housed lactation environment (Weary et al., 1996, 1998; Marchant et al., 2001; Pedersen et al., 2006). Johnson et al. (2007) noted that sows that did not crush piglets in the first 72 h after parturition invested significantly more time in pawing the straw (5 min vs. 2 min) compared to those that crushed piglets when re-entering the farrowing hut. The authors noted that such a behavior may be useful in making sure that piglets' which were resting and covered are disturbed, which should in turn encourage those piglets to become active and move out of the way of a sow attempting to lie down. There were differences seen in the behavioral repertoire performed by piglets regardless of treatment over the three days after parturition, with piglets becoming more inactive (40–63%), spending more time away from their dam (25–42%), and the percentage of time engaged in suckling decreased (40–18%), respectively. Johnson et al. (2007) has reported a trend in suckling interval increasing from 36 min (d1) to 42 min on d2 and d3. Over the same time period, piglets engaged in suckling decreased over the three days (16 min d1 to 13 min d2 to 12 min d3) when sows are housed in an outdoor farrowing system. These findings are in agreement with those reported by Jensen (1988), Csermely (1994), Gotz (1991), and Puppe and Tuchscherer (2000). Over the 72 h, day affected the time piglets spent in Quadrant 2 regardless of treatment with this increasing over the three days. Quadrant 2 was the back of the farrowing hut directly behind the entrance door. It could be hypothesized that piglets preferred to lay there as cooling winds could come in through the ventilation window at the back and through the entrance door during this period of the year. However, one cannot extrapolate these results to other periods of the year.

In conclusion, regardless of treatment, outdoor-housed piglets engaged in less suckling, spent more time away from the sow, and increased their time in inactive related postures from d1 to d3 after parturition. Piglets showed a preference for spending more time in the quarter of the farrowing hut opposite from the door, on the back wall of the farrowing hut (Quadrant 2). Further studies evaluating sow and piglet behavior as it pertains to piglet crushing/mortality in outdoor farrowing systems are warranted by the results of this study.

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