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Research paper

What makes a good mother? Maternal behavioural traits important for piglet survival

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ABSTRACT

The primary aim of our work was to find maternal behaviours important for piglet survival and to develop qualitative scores of those traits. Second, we studied the relationship between maternal behavioural scores, piglet mortality and the number of weaned piglets in sows of three different sow breeds (Norsvin Landrace (n = 12), Norsvin Duroc (n = 12) and crossbred Norsvin Landrace × Yorkshire (n = 14)). The following qualitative maternal behaviours were scored as follows: nest building activities prior to farrowing, sow communication (q_SC), and carefulness (q_SCR) on while sows were standing, moving and just before lying down. We also continuously recorded maternal care behaviors (nest building activities (c_NBA) and sow communication (c_SC; while standing/moving, before lying down) to test the relationship with the respective qualitative scores. There was a moderate positive correlation between the continuous measured c_NBA and the qualitative score for nest building q_NBA (r = 0.469) as well as between the qualitative score for communication, q_SC and the continuous, video-based measure of communication while standing, c_SC (r = 0.439), and the qualitative and quantitative scores similarly affected piglet survival. Since q_SC and q_SCR were highly correlated (r = 0.883), we tested the effect of those behavioural scores separately on production parameters (proportion of dead piglets and number of weaned piglets) using two models (model 1: q_NBA, q_SC; model 2: q_NBA, q_SCR), and compared their relative predictive accuracies using Akaike information criteria (AIC) and AIC weights. In models 1 and 2, piglet mortality decreased with higher q_NBA (P = 0.004; P < 0.001; respectively) due to less crushing (P < 0.001; P < 0.001, respectively) and, thus, more weaned piglets (P = 0.043; P = 0.035; respectively). Increases in both q_SC and q_SCR were associated with lower overall piglet mortality (P < 0.001; P < 0.001, respectively), fewer crushing incidences (P < 0.001; P = 0.002, respectively) and, therefore, more weaned piglets (P = 0.004; P = 0.030; respectively). Additionally, higher q_SC in model 1 was associated with a lower proportion of starved piglets (P = 0.002). Model 1 had better predictive accuracy than model 2 for all productive parameters. Our results demonstrated that our three defined maternal behaviour scores had a significant impact on piglet survival, and therefore we would like to proceed with testing of these scores in nucleus herds of Norsvin Landrace sows to further calculate heritabilities and potentially implement the most successful behavioural trait in the breeding program.

1. Introduction

Although the domesticated pig differs in productive and reproductive efficiency compared to its wild ancestor, their behavioural repertoires have remained similar, especially around parturition (e.g. Jensen, 1986; Gustafsson et al., 1999). A day or so before parturition, domestic and wild sows engage in nest preparation to provide shelter and warmth for the newborn piglets (Wood-Gush and Stolba, 1982; Jensen, 1993). From the onset of parturition, sows spend the majority of their time in the nest with the piglets (Stangel and Jensen, 1991). Social contact encourages sows to interact with their piglets, establishing mother-young bonds and providing warmth and nutrients from the udder (Fiala and Hurnik, 1983). Sows communicate with piglets through olfactory (sniffing), vocal (grunting) and tactile (nudging) cues (Jensen and Redbo, 1987), mainly during the first few days after parturition when piglet survival is most crucial (Andersson et al., 2011). It is well established that communication between sows and piglets is tightly synchronized during short nursing intervals (Algers and Jensen, 1985; Algers and Uvnäs-Moberg, 2007). However, less attention has been given to the significance of sow communication over longer periods between nursings. During that time, sows communicate while standing and lying, and the relative costs and benefits of sow-

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piglet contacts may help to explain why communication is performed more in some situations but less in others. We think that a sow's motivation to care for her offspring is likely to manifest in how she communicates with offspring during others activities, outside nursing bouts. Until now, previous studies have focused on sow communication before lying down because it is at this point that piglets are at higher risk of being crushed. However, the results of the effect of sow communication have been inconsistent regarding whether nosing or sniffing before lying down improves piglet survival (Marchant et al., 2001; Valros et al., 2003; Andersen et al., 2005; Pokorná et al., 2008). According to Melišová et al. (2011), sow communication should attract piglets to the sow without increasing mortality. In fact, the only logical explanation for the evolution of sow communication is to keep the piglets in close proximity and protect them from danger.

Piglet mortality is still a major welfare issue as approximately 15% of live born piglets die (Ocepek et al., 2016b) and crushing and starvation constitute more than 60% of all piglet deaths in loose-housed sows (e.g. Andersen et al., 2006; Vasdal et al., 2011). Both causes mainly occur during the first few days of life and increase in larger litters (Weary et al., 1998; Andersen et al., 2011; Vasdal et al., 2011). The sows highly motivated to nest build before parturition are more protective towards their piglets (Andersen et al., 2005; Yun et al., 2014). Differences in maternal care behaviours are likely to reflect different selection pressures (Knap and Merks, 1987; Canario et al., 2009) and primiparous sows appear to show better maternal behaviour skills than multiparous sows. Primiparous sows invest more in their present litter than more experience sows, because breeding goals have shifted the balance towards greater investment earlier in life (Ocepek et al., 2016b).

For maternal behaviour, the best method to obtain precise measures is from continuous video recordings. However, such methods are time consuming and costly. Under commercial conditions, we need to develop simple qualitative scorings of important maternal care behaviours and that is possible for the farmers to understand and implement in an efficient way into the breeding goals. Although many attempts have been made to develop valid scores of maternal behaviour characteristics, this has often been difficult due to methodological challenges related to how these traits are measured (Grandinson et al., 2002, 2003; Lovendahl et al., 2005; Vangen et al., 2005; Gäde et al., 2008). Thus, it is essential to understand the significance of sow communication (while standing and lying) for piglet survival and to develop and verify precise and simple direct measures of maternal behaviour (sow communication, sow carefulness), as well as for other maternal characteristics (e.g. nest building activities). Parity may be an important mediating factor affecting maternal behaviour, in addition to breed, since breeds have been subjected to different selection pressures for litter size. It is, thus, crucial to identify the relationships between maternal behavioural characteristics and piglet survival and to develop behavioural scores that can be used directly in the breeding program.

The primary aim of our work was to find maternal behaviours important for piglet survival and to develop qualitative scores of those traits. Second, we studied the relationship between maternal behavioural scores, piglet mortality and the number of weaned piglets in three different sow breeds (Norsvin Landrace, Norsvin Duroc and crossbred Norsvin Landrace × Yorkshire).

2. Material and methods

The present research was conducted in accordance with the Norwegian laws and regulations controlling experiments and procedures on live animals (Nara, 1998).

2.1. Experimental design

The experiment took place at the Pig Research Unit at the Norwegian University of Life Sciences. Sows with their litters (n = 38) from three different breed lines (purebred Norsvin Duroc (ND) sows (n = 12), purebred Norsvin Landrace (NL) sows (n = 12) and crossbreed Norsvin Landrace × Yorkshire (LY) sows (n = 14)) were evaluated for their maternal behaviour. Selection criteria were that sows were healthy and 6 sows per breed were primiparous and 6 were multiparous. Sows in the respective breed groups (ND, NL, LY) were with their first (n = 6, 6, 8), second (n = 5, 0, 1), third (n = 0, 4, 0), fourth (n = 1, 0, 3), fifth (n = 0, 1, 2), and sixth parity (n = 0, 1, 0).

2.2. Housing and management

Housing and management routines are described in detail in Ocepek et al. (2016a) and the feeding strategy is presented in Ocepek et al. (2016b). Except of farrowing assistance (if sows were restless for more than 3–4 h and had contractions for more than 1–2 h without any newborn piglets) and cross-fostering (when litter size exceeded the number of functional teats) no routines were carried out. Human intervention was kept to a minimum, allowing feeding, provision of nest-building material (i.e., straw in a hayrack) two days before expected birth of the piglets, providing new sawdust as bedding material twice a day, cleaning the pen, giving iron orally to each piglet on day one, providing peat to piglets on a daily basis and surgical castration when piglets were between 10 and 14 days of age.

2.3. Litter size at birth and weaning

All the live-born piglets were individually counted and marked. Some piglets had to be cross fostered from the litter when the number of piglets exceeded the number of functional teats. Litter size at birth was defined as the number of each sow's live-born piglets plus the number of piglets fostered on, minus the number of piglets fostered off. The number of weaned piglets was defined as the number of piglets present in the litter at weaning (35 days of age).

2.4. Post mortem examination of dead piglets

All piglets that died before weaning were examined at the Norwegian Veterinary Institute, Pathology Section to identify causes such as stillborn (based on whether the lung tissue would float in water), postnatal mortality (piglets that died after the farrowing and before weaning), starvation (no colostrum/milk in the stomach), and maternal crushing (physical signs of crushing).

2.5. Sow assessment

2.5.1. Sow behaviour

The sows were continuously video-recorded from 3 days before until 3 days after farrowing. Above each pen, a camera for video and audio recordings (Foscam FI9821W, 1280 × 720P, ShenZhen Foscam Intelligent Technology Co., Ltd., Shenzhen, China) was mounted. Data of nest building activities (c_NBA) and sow communication while standing (c_SC) and lying (c_SCL) were obtained in order to verify the respective qualitative scores of nest building (q_NBA) and sow communication (q_SC). From the videos, c_NBA were analysed (manipulating, rooting, pawing, carrying nest building material) 12 h before farrowing using instantaneous sampling with 5 min intervals. Communication with piglets initiated by the sow (sniffing, grunting, nudging) between nursings (communication during nursing was not documented) and while sows were either active (c_SC; standing, moving around or is about to lie down) or resting (c_SCL; lying) was recorded in the first 12 h after parturition and 12 h during the following day (0800–2000). Measures of c_NBA are presented as overall activities (total per 12 h), while c_SC and c_SCL as the mean occurrence per hour during both days.