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Group suckling cohesion as a prelude to the formation of teat order in piglets

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ABSTRACT

During the lactation period, piglets experience intense social interactions with their littermates until they establish a reliable teat order on the mother's udder. Here, we examined group suckling cohesion in piglet littermates, an order mechanism that refer to the maintenance of significantly similar inter-individual distances on the udder and operates prior to the establishment of teat order. We analysed the suckling positions of 160 piglets from 16 litters, the distances between individuals on the udder in each suckling, and the stability of their suckling positions during lactation. Teat order stabilised by day 10 (P_{Suck} = 0.62) and remained relatively stable (≈0.60) throughout the rest of lactation. Littermates tended to maintain significantly similar distances from one another on the udder throughout lactation [r = 0.30 (p < 0.05) to 1.00 (p < 0.0001)], although suckling stability remained incomplete. Partial analysis of suckling stability (examining each litter and period separately) revealed that the teat order did not always remain stable throughout lactation. However, group suckling cohesion was normally rigid and was unaffected by interruptions in teat order. Group suckling cohesion was an aspect of piglets' development of fixity on particular teats and thus was a part of the establishment of a teat order. Significantly higher mortality (71% of all recorded cases; p < 0.05) occurred in litters in which neither group suckling cohesion nor a stable teat order was established during the first days of lactation. Such litters were produced by sows with significantly lower parity (p < 0.05). A late start to suckling cohesion and a late establishment of teat order appear to compromise survival.

1. Introduction

The collective cohesive motion of large animal groups is a well-known social phenomenon and is apparent in the moving of fish schools, bird flocks, insect swarms, or ungulate herds. Individuals joined in large dynamic formations base their movement decisions on locally acquired cues such as the position (distance) and motion of neighbouring individuals (e.g. Couzin, 2009; Eriksson et al., 2010). Members generally benefit from aggregation and cohesion and have increased survival rates (because of reduced predation risk, more efficient foraging, etc.). However, not all collective behaviours are evolutionarily advantageous; some confer fitness benefits, but others are simply epiphenomena (Parrish and Edelstein-Keshet, 1999).

Neonatal piglets live in groups of approximately 10 siblings. After birth, they are exposed to a challenging social and physical environment. Piglet littermates share the same 'foraging' territory (the sow's udder), where social (including aggressive) interactions between them are intense and energetically costly. Littermates engage in intense fighting over teats immediately after birth (Hartsock and Graves, 1976; De Passillé and Rushen, 1989), even though sows normally have more functional teats

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than piglets. There is no evidence that some teats are intrinsically more productive than others; rather, teat productivity strongly depends on the body weight of the piglet that typically suckles from it (King et al., 1997; Skok and Škorjanc, 2013a), presumably because of the intensity of mammary gland stimulation.

Colostrum intake during the first 24–48 h is crucial. Colostrum provides piglets with maternal immunoglobulins and helps them develop passive immunity (see reviews by Rooke and Bland, 2002; Mellor and Stafford, 2004; Farmer et al., 2006), stimulates intestinal development (see review by Farmer et al., 2006), and enhances thermoregulatory ability (see reviews by Herpin et al., 2002; Mellor and Stafford, 2004; Farmer et al., 2006). Therefore, it is reasonable that competition between littermates for this limited resource occurs. Access to colostrum and milk is critical for survival; piglets must reach the udder soon after birth and continue to nurse successfully as the lactation period progresses (Alonso-Spilsbury et al., 2007). Despite the possible adaptive function of fighting in competition for limited colostrum, it is vital for littermates to quickly resolve teat disputes and establish a teat order (De Passillé et al., 1988; De Passillé and Rushen, 1989). Normally, piglets establish a relatively stable teat order after the first week of lactation (e.g. Puppe and Tuchscherer, 1999; Skok and Škorjanc, 2013a). This suckling order reduces conflicts among littermates and consequently increases the survival rate during lactation (Hartsock et al., 1977), a period with up to 25% mortality (Alonso-Spilsbury et al., 2007).

The most important part of littermates' socialisation, therefore, occurs on the sow's udder, where piglets first compete for access to teats, and later develop the teat order, which is the best-known aspect of suckling orderliness in neonatal piglets. When teat order is unstable, especially at the beginning of lactation, piglets' distribution on the sow's udder is random (Skok and Škorjanc, 2013a) and disorder during suckling ensues. Here, we have proposed that piglets rely on a mechanism that results in reduced intra-litter competition when teat order is not stable. We tested whether neonatal piglets maintain inter-individual distances (IIDs) when they change suckling positions on the sow's udder and whether they exhibit group suckling cohesion even before the teat order has stabilised. Furthermore, we tested whether suckling cohesion is independent of teat order formation; and we analysed differences in piglets' mortality, parity of sows, and litter size in relation to suckling orderliness.

2. Materials and methods

This study was performed according to the Slovenian Law, 2007 Regulating the Protection of Animals RS 510-05/91-1/58 and Guidelines for the Treatment of Animals (Association for the Study of Animal Behaviour, 2012).

2.1. Animals, housing, and management

Analysis of 16 litters was conducted at the Pig Research Centre (University of Maribor, Faculty of Agriculture and Life Sciences, Slovenia). Ten days before the expected date of parturition, sows were transferred into individual farrowing crates. The mean parity of sows was 4.1 (range 1–9). There were 160 piglets involved in the study, with a mean litter size of 10.0 and an average of 0.4 stillborn piglets per litter. Seven piglets died during observation, but their data were included in analyses up to the date of death.

Sows with piglets were housed in farrowing crates (4.5 m^2 in area, including 1.98 m^2 of plastic-coated perforated floor). Crates were of solid wooden sidewalls and equipped with a sow feeder and nipple drinker. During lactation, sows were fed 6.5 kg d^{-1} divided into two feeds. Sows had ad libitum access to water. Piglets had their own separate nipple drinker and a special area (0.5 m^2) containing an automatic, thermostatically controlled heating plate with a cover fitted with a 150-W infrared heating lamp. The lamp was permanently turned on within the covered area. The inside temperature was maintained at 33 °C, and the outside was regulated at 18–22 °C by a ventilation system. Efforts were made to minimise additional noise. Natural light entered through windows and was combined with artificial light (14 h of light; at least 40 lux). All farrowing crates were cleaned daily and were washed and disinfected before the start of the experiment (an 'all in–all out' system with simultaneous housing/vacating). Cross-fostering was not applied to any of the litters. During the lactation period, piglets had free access to water. Not before 10 days of age, by which time piglets have usually established a stable teat order, they were offered 'pre-starter' creep feed ad libitum in a feeding trough (30 cm × 10 cm).

2.2. Suckling observations

Large individual marks were painted on the backs of the piglets within 24 h postpartum and maintained throughout the experiment. The first observation occurred within 24 h after birth, and at least nine total observations were distributed evenly to the last day of lactation (day 28) when the experiment was completed. Three observations were conducted during the first week, and at least two observations were conducted in each subsequent week in the lactation period. Each observation lasted 3 h or longer until two consecutive successful sucklings were recorded. Piglets normally sucked up to four times during a single 3-h observation. The positions of piglets on the udder by teat number were recorded as they started sucking (i.e. at the time of milk let-down).

The sow's udder was described according to teat pairs (TPs). All sows had seven TPs (for a total of 14 teats), except for one sow with eight pairs (16 total teats), that were not injured or defective. The TPs were numbered 1–8 from the cranial to the caudal end of the body.

2.3. Analyses of suckling stability and suckling range

Suckling stability quantifies how often the same piglet return to the same teat pairs in subsequent sucklings. Suckling stability was calculated using an equation derived from the basic probability theory (Gotelli and Ellison, 2004), and it measures the probability that two entities randomly selected from a sample are the same or belong to the same category. In our case, suckling stability indicates the probability that any two piglets, drawn at random