Factor’s Influencing Piglet’s Pre-weaning Growth and Survival

R. Muns

Department of Obstetrics, Gynaeacology and Reproduction, Faculty of Veterinary Science, Chulalongkorn University, Bangkok, Thailand

Introduction

During the last decades, simultaneously with the increasing worldwide demand for high-quality pig meat products, pig production has suffered a great evolution facing different productive, management and welfare challenges. On one hand, genetic progress has been focussed in high prolific sows and high lean tissue deposition pigs. On the other hand, producers with more knowledge and skills run more technological farms with bigger herds, high pig production flow, and usually in multisite pig production systems; moreover, producers continuously aim their efforts on reducing production costs together with accomplishing consumer’s satisfaction. Sow’s environment and herd management aspects, such as feeding and health care, have also been improved (1).

Using historical data from some European countries as example, it can be seen that the average number of piglets born alive per farrowing, has increased from 9.5-10.3 in 1981 up to 11-14 piglets in 2011 (average from Denmark, Netherlands, France, United Kingdom, and Spain). Accordingly, the average number of piglets weaned per productive sow per year has increased from 8.3-9.0 in 1981 up to 9.5-12.2 piglets in 2011 (average from Denmark, Netherlands, France, United Kingdom, and Spain). Surprisingly, when the average pre-weaning mortality (PWM) is compared between 1981 and 2011, it results that it has persisted invariably at a high ratio (12.6% in 1981 and 13.3% in 2011). All the improvements achieved in number of piglets weaned are mainly due to increase in sows’ prolificacy but little on our capacity to reduce piglet mortality.

Piglet pre-weaning mortality

Although PWM can be due to infectious and non-infectious causes, management of the farrowing house is the most important aspect in enhancing pre-weaning survival rates (2). From a scientific point of view, piglet mortality is due to factors related to farm (e.g. modernity of facilities, all-in all-out management, site, colostrum supplementation and cross-fostering system, creep feeding, etc.), to sows (e.g. ease of farrowing, maternal behaviour, etc.), and to piglets (e.g. weight and vigour at birth, etc.). In addition to mortality, piglet’s growth performance during lactation is also an important factor for piglet’s long-term growth. Reduction of PWM would suppose both a welfare improvement and an increase in economic profitability of productive sows; on the other hand, improved weaning weight would enhance efficiency of the fattening period.

Pig is a polytocous species, such as mice or rabbit, with an evolutionary strategy to produce a large number of relatively undeveloped offspring. Thus, some early piglet mortality can be considered normal in pig (3). In this presentation, piglet PWM is considered a synonym of postnatal mortality or the proportion of piglets born alive which are not weaned. Therefore, to properly address pre-weaning mortality and our intervention on farm level, first is important to differentiate between prenatal and postnatal piglet mortality. Pre-partum stillbirths or mummies (stillbirths type I) and especially intra-partum stillbirths (stillbirths type II) should not be counted as PWM. A true intra-partum stillborn piglet is a piglet that did not get to breath and that also has the periculo still present on the hooves (dead piglets having lungs that do not float in water are considered stillbirth) (4,5).

The second step should be the identification of the causes of mortality, focusing in PWM. There is a major consensus or suggesting crushing as the major ultimate cause of dead with chilling and starvation as underlying causes (6, 7). There are also other minor non-infectious causes of dead such as congenital, low viability, or savaging by the sow. However, there is some amount of uncertainty about the reliability of farm diagnosis of cause of mortality, being the most common mistakes the incorrect diagnosis of stillbirths and overestimation of crushing (3).

As it has been previously presented, PWM averages 12-14%, but a high variation among farms for PWM exists. Farms with a PWM rate of 5 to 7% are not utopic (8). Almost 80% of the total piglet PWM occurs during the first week of lactation, with the 50% being concentrated in the first two days of life (9, 10) when piglets are more vulnerable. One singularity of piglet mortality is that it appears to be sex-biased. Although male piglets are usually born with higher body weight (BW) than females (6, 11), they are at greater susceptibility to causal mortality factors during lactation (6, 12). Baxter et al. (13) suggested that females would be investing energy resources towards specific physiological systems such as thermoregulation and immuno-competence, whereas males would be investing energy resources towards body size and body composition, predisposing male piglets to chilling, starvation and crushing.
Ultimately, colostrum intake will determine the survival and growth success of piglets. Colostrum is the only energy source available for the newborn piglet. Colostrum is a source of very digestible nutrients, immunoglobulins (IgG being the most important), hydrolytic enzymes, hormones and growth factors (14). Moreover, because of the epitheliochorial nature of sow’s placenta, preventing immunological transfer to foetuses during pregnancy, passive humoral protection to piglets can be only provided through colostrum during the first 12-24 hours of life. Piglet’s and sow’s characteristics are usually the main factors influencing newborn piglet’s colostrum intake and subsequent survival and growth. Nonetheless, there are other factors (e.g. environmental factors, sanitary status, human-animal interaction, etc.) that should also be considered when assessing piglet’s PWM.

**Piglet’s main factors influencing pre-weaning mortality**

Adaptation to the extra-uterine environment by the newborn piglet is a problematic process; piglets with small size, have limited body reserves, reduced physiological maturity and are immunologically underdeveloped at birth. They have to overcome respiratory, immunological, digestive, and nutritional challenges to survive (7), and also have to cope with a decrease in ambient temperature of 15-20°C (or 5-10°C in tropical climates) and compete with their siblings for sucking and teat stimulation. Non-infectious aetiological factors that intervene in piglet survival are due to interactions between the piglet and its environment, and piglet survival success depends, at a great extend, on factors such as birth BW, vitality, thermoregulation capacity and also on maternal factors in addition to the danger from environmental hazards (6). Although we are trying to present the most important factors affecting piglet performance and mortality from birth to weaning separately, the different factors influence piglet viability concomitantly. Indeed, they reflect physiological and physical characteristics of the newborn piglet, and are highly influenced by both dam and environmental conditions.

**Birth body weight:** Piglet birth weight is the most important factor determining early piglet survival and influencing its pre-weaning performance. Lower piglet birth weight is associated with both an increased risk of mortality and a reduced weight gain during lactation (15-19).

Piglets born with higher BW seem to be physiologically more mature at birth, thus more prepared to cope with extra-uterine environment. Indeed, different studies showed that piglets born with higher BW had higher rectal temperature 1 h or 2 hours after birth (7, 20, 21). Higher incidence of crushing have also been observed for piglets with light birth weight (22), suggesting that small piglets with increased hunger may spend more time close to the udder hence with more risk of mortality due to crushing (23). Piglets with low birth weight have a reduced ability to reach the udder and to compete for a teat, therefore, having lower colostrum intake (24, 25) and resulting in a low energy and IgG intake, thus leading to more chances of dying by starvation.

Not only piglet BW at birth influences piglet performance, but also BW variation within litter shows some controversial effect in the literature. On one hand, an increase in pre-weaning mortality with increased variation of birth weight within litter has been described (12, 26, 27). On the other hand, the increase in mortality with variability in weight have been attributed to a greater number of piglets with low BW rather to the variability in weight itself, suggesting that higher mortality of low BW piglets is more related to litter size rather than to the birth weight of their litter mates (11,15).

Furthermore, there is a marked large variation between litters for piglet weight gain during the first days after birth which suggests that must be additional piglet characteristics or indicators, different to the birth weight, also responsible for piglet survival and viability (20, 21).

**Neonatal vitality:** Vitality, vigour, or even measures of behaviour are often used in the literature to refer to newborn piglet strength. In most of the studies, vitality evaluations are recorded immediately after birth of the animals (using physiological and behavioural parameters), only one study used a behavioural score recorded after the end of farrowing to measure piglet’s vitality (16). In this presentation we define vitality as piglet strength. Vitality has mainly been considered, and also studied, as an indirect measure of the degree o intra-partum asphyxia suffered by piglets at birth.

Vitality seems to influence the performance of piglet’s early behaviour, thus it determines piglet’s final survival by influencing their ability to compete and stimulate a teat. Piglets with more vitality have shorter interval of time from birth to reach the udder and to first suckle (21, 28); besides, higher vitality has been associated to an improved early postnatal survival rate (20), up to 10 days after birth (19) and at weaning (16). Moreover, piglets showing more vitality have increased rectal temperature after birth (21). Muns et al. (16) also found that piglet’s vitality had a significant influence on their pre-weaning survival and BW gain.

**Thermoregulation ability:** As has been previously described, the decrease in environmental temperature experienced by the newborn piglet is probably the most immediate hazard that the animal has to face after abandoning the intra-uterine environment. Pigs are born with high surface/volume ratio due to its
small size, no fur and with very little adipose tissue to act as energy source (no brown fat). Furthermore, newborn piglets are wet with placental fluid. The ability of the newborn piglet to cope with the sudden decrease in ambient temperature (which easily results in a body temperature drop by about 2°C within the first 20 min of life) is decisive for its survival. In fact, when evaluating thermoregulatory ability, rectal temperature measured 2 h after birth is considered a good pointer for piglet success. Piglets that die during the postnatal period are usually characterized for being unable to sustain an optimum rectal temperature (approximately 37.9-38.3°C) during the first 24 hours of life (19, 20). Concurrently, a proper thermoregulation capacity will benefit colostrum intake by the piglet (28), and excessive heat loss during the first day will make piglets less viable thus, more predisposed to be crushed by the sow, more prone to starvation, or more susceptible of dying by disease (22).

**Sow’s main factors influencing pre-weaning mortality**

*Sow behaviour:* during peri-partum period (from 4 days before and up to 3 days after farrowing), sow might be stressed due to the new environment in the farrowing pen and the parturition process (29-31). Stress during the farrowing time increases duration of farrowing and decreases colostrum production thus, reducing the energy and IgG supply to piglets (3, 32). The stress of farrowing can also affect the behavior of the sow and lead to restlessness and even to aggressiveness increasing the risk of crushing piglets and preventing suckling (29). Maternal pre-natal stress can affect behavioural and physiological aspects of the offspring by altering their hypothalamic activity (30, 33, 34). In lactation phase, nursing behaviour is probably the most representative example of sow-piglet relation, relying in a complex communication system. Besides, essential suckling behaviour in domestic pig does not differ from wild boar. The onset of lactation (appearance of synchronous and cyclical nursing in piglets and the 5 phases for the regular nursing bouts as described by Fraser (35) is established once the continuous colostrum let-down has been progressively replaced by a cyclical milk let-down (36). Piglets suckle simultaneously in nursing bouts every 30-70 minutes, over 20 times a day (35). Sow maternal behaviour is obviously crucial since sows have to lie presenting the teats to the piglets. Moreover, sow’s grunts seems to be important in gathering the piglets at the udder prior to the beginning of a sucking bout, and it has also been observed that sow’s grunting rate responds to piglets’ rhythmic mechanical stimulation of the udder (35). Therefore, good mothering style, specifically postural movements and pre-lying behaviours (e.g. grunting, presenting the teats when lying, looking at the piglets, sniffing, or rooting away the piglets), are still an important precondition for high sow productivity. Indeed, inappropriate mothering style influences piglets’ behaviour, resulting in reduced milk intake, impaired growth, and also increasing the odds of being crushed (37-39). The reduction or inability to perform the mentioned maternal behaviours also impairs sows welfare (40).

Furthermore, crushing by the sow can be considered as failure to, or lack of, willingness to protect the offspring and also a failure to establish common maternal bonds (37). Another abnormal maternal behaviour directly affecting piglet mortality is sow’s piglet-directed aggression around farrowing, also known as savaging. Savaging is more likely to occur in gilts than in sows, though sows that savage as gilts have more odds to savage in their subsequent farrowing (41).

**Litter size:** As mentioned at beginning, number of piglets born alive per litter has been dramatically increased during the last decade thanks to genetic improvement on the litter traits. Selection for sows with increased litter size has resulted in a reduction in piglets BW, mainly due to a decreased uterine space for foetus development (15, 42) and with higher risk of PWM (43, 44). The increase in number of piglets born alive per litter is also correlated with a reduction in litter BW uniformity (45). Moreover, large litters are associated with a prolonged farrowing duration and higher risk of intra-partum hypoxia (25, 46). With high litter size also increases the number of fights at suckling, increasing the risk of starvation and crushing of the small piglets (47).

**Farrowing duration and intra-partum hypoxia:** long farrowing durations and long inter-birth intervals may increase the risk of intra-partum hypoxia, for a long farrowing can lead to uterine inertia in the sow. Uterine contractions reduce oxygenation to piglets and increase the risk of a broken umbilical cord (48). Thus, farrowing duration will strongly influence the presence of intra-partum stillbirths and newborn piglets vitality. Piglets born with birth intervals of > 30 min or born later in a long farrowing have higher incidence of rupture of the umbilical cord, detachment of the placenta and subsequent hypoxia (28). Uterine contractions in sows with long farrowing duration also reduce the oxygenation of prenatal piglets (46), reducing piglet’s vitality at birth (49).

**Colostrum and milk production:** sow capacity to produce colostrum and milk varies among animals. Colostrum is the first milk secret by the mammary gland, from around farrowing up to 12-24 hours (11) before its secretion becomes cyclic and nursery bouts start. Colostrum plays a key role in piglet’s thermoregulation, passive immunity acquisition and intestinal development (50). Sow colostrum yield varies between 2.5 and 5.0 kg in a litter of 8 to 12 piglets, and its highly variable among sows (51).
Colostrum yield is limited, associated with the use of body fat and protein reserve by the sow during late gestation, and is only slightly influenced by litter weight and piglet BW variability (50, 52).

It is suggested that insufficient milk production or lactation failure in sows might account for between 6 and 17% of PWM (6). Sow’s genetic potential, piglet’s intensity to stimulate or massage the udder and piglet’s capacity to empty the mammary gland are the main responsible for total milk yield (53). Besides, teats intensely suckled in the first lactation will have better development and will produce more milk in the second lactation (54). Furthermore, litter size, piglet vitality and amount of nursing bouts are positively related with milk yield (55, 56).

Reduction in milk yield or lactation failure may occur in hot conditions or heat stress. Assuming sow’s good health, such reduction of milk yield it is suggested to be related with a decrease of voluntary feed intake during lactation, mediated by the increase of leptin concentration, which would result in a reduction of nutrients available for lactogenesis. Concurrently, heat stress would also increase the proportion of blood flow irrigating skin capillaries to dissipate body heat, consequently reducing blood flow and nutrient supply to mammary gland, therefore increasing mammary gland inefficiency (Renaudeau et al., 2003).

Post-partum dysgalactia syndrome is a multifactorial process with a considerable prevalence among herds, causing lactation failure during the first days after farrowing. Late transferring of sows to farrowing facilities, ad libitum feeding during the first days of lactation, and dystocia are factors that have been observed to increase the odds for post-partum dysgalactia syndrome (57).

**Conclusion**

Birth BW is crucial for piglet’s future survival since it is usually a close reflection of piglet’s physiological maturity, and it critically determines piglet’s odds of success when competing for a teat. Moreover, vitality is a piglet’s characteristic mainly related to suckling behaviour showing positive correlation with piglet’s growth and survival. In addition, thermoregulation capacity is, after the onset of respiration, probably the most important physiological/metabolic capacity that the piglet has to develop after birth. Thermoregulation in the neonate piglet is sustained by different metabolic events, and is determined by different piglet characteristics together with early energy intake from colostrums’. On the other hand, a distressed dam will be more prone to farrowing problems resulting in intra-partum hypoxia, and it will perform more postural movements increasing both, the odds of crushing piglets and the number of nursing bouts interruptions. Moreover, modern breeds with increased litter size might influence birth BW of piglets since it is basically determined for the uterine capacity or placenta efficiency.

As a result, producers can basically deal with alterations and deviations of piglets birth BW (e.g. piglets born with low BW, high variability in litter BW, etc.) through management; since there is little leeway for action to modify birth BW. Besides, given the current restricted crate allocation for sows during farrowing and lactation, producers can basically influence sow’s maternal behaviour procuring a quiet and restful atmosphere/environment, and ensuring a proper assistance during farrowing to avoid a prolonged farrowing. Finally, although milk production capacity in sows is genetically determined, producers can slightly influence in mammary gland development and in milk composition through sows’ nutrition during gestation. Management of the piglets to maximize litter capacity to increase nursing frequency or enhance the completeness of gland emptying, and capacity to overcome high environmental temperatures during the hot seasons, are probably the main methods for helping to improve milk yield during lactation.

Considering the diversity of potential factors influencing newborn piglets survival and growth, a good diagnosis of causes of mortality in the farm will help veterinarians and producers to prioritize its management interventions on sow and piglets in order to increase pre-weaning performance.

**References**

31. Yun et al. 2015.
44. Nuntapaitoon and Tummaruk 2013. Proceedings 38th ICVS.