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Low birth weight affects lifetime productive performance and longevity of female swine

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ABSTRACT

It is commonly known that large litter size leads to lower average birth weights, with more piglets born weighing <1 kg, resulting in a negative impact on piglet growth performance. Conversely, there are few studies showing the long-term impact of low birth weight on productive performance of female piglets selected for the breeding herd. The aim of this study was to evaluate the effects of birth weight on reproductive performance and longevity up to the third farrowing of Landrace x Large White crossbred gilts. For most variables, 835 gilts selected for breeding were included in the analyses. When the analysis concerned the number of days in the herd from birth onwards, data from 1495 females were analyzed. Gilts were retrospectively classified into eight classes of birth weight (BiW), with approximately 12.5% of gilts in each group. Overall, gilts were 196.8 ± 0.6 days old at first estrus manifestation, which occurred in 23.8%, 44.4% and 64.6% of gilts within 10, 20 and 30 days of boar exposure, respectively, with no difference ($P > 0.05$) among BiW classes. Age at puberty was similar among BiW classes in gilts that showed estrus within 30 d of boar exposure ($P \geq 0.428$), but PG600-gilts weighing 410–1160 g reached the puberty later than those weighing >1400 g ($P < 0.05$). Removal due to anestrous was higher ($P \leq 0.093$) in female piglets of 410–990 g (22.9%) compared with the other BiW classes (overall 9.6%). There were no differences among BiW classes in the first ($P=0.480$) and second ($P=0.400$) farrowing rate but piglets of 1000–1160 g and 1510–1610 g had lower third farrowing rate ($P=0.041$) than piglets weighing >1620 g. The total number of piglets born ($P=0.08$) and piglets born alive ($P=0.028$) were lower for the lightest BiW class in the first farrowing but they were similar among BiW classes in the second and third farrowing. The percentage of first-mated gilts that reached the third farrowing (68.7%) was not affected by BiW ($P > 0.05$). The third farrowing was reached at 627.4 ± 1.17 days of age on average, with no significant difference among BiW classes ($P=0.806$). Females born weighing less than 1 kg produced about 4.5 fewer piglets along three parities than the other BiW classes ($P \leq 0.05$). Female piglets weighing between 1.0 and 1.28 kg at birth were also negatively affected in terms of lifetime herd days, although to a less extent than those weighing less than 1 kg, in comparison with piglets weighing >1.28 kg. However, the number of herd days, from selection for entry into the breeding herd to the third farrowing or removal, was not different ($P=0.257$) among BiW classes. The results of this study show that low BiW (<1 kg) negatively influences the production of piglets and longevity of female swine.

1. Introduction

The high variability in birth weight of piglets has become a common event in the course of genetic selection for high prolific sows (Wolf et al., 2008). The production of large litters leads to a lower average birth weight, increasing the number of piglets born weighing less than 1 kg (Milligan et al., 2002; Quiniou et al., 2002; Almeida et al., 2014).

Low birth weight has a reported negative impact on growth performance of piglets (Beaulieu et al., 2010; Alvarenga et al., 2012), resulting in increased risk of mortality and culling (Wolf et al., 2008; Almeida et al., 2014). There is a scarcity of studies showing the impact of low birth weight on survival and growth development of female piglets designated for the breeding herd (Almeida et al., 2014; Magnabosco et al., 2015). The impact of weight gain, from birth to selection for breeding or to the first mating, on reproductive performance and longevity is reported in some studies (Kummer et al., 2006; Amaral Filha et al., 2010; Roongsitthichai et al., 2013). However, there is a lack of

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information about the relationship between birth weight and reproductive performance or longevity of female swine.

The aim of this study was to evaluate the effects of birth weight on reproductive performance, productivity and longevity up to the third farrowing in Landrace x Large White crossbred gilts.

2. Material and methods

All management and trial procedures for this study were approved by the CEUA-Ethical Committee of Animal Utilization/UFRGS (Universidade Federal do Rio Grande do Sul), process no. 23732.

2.1. Animals and location

The study was conducted during two years in a multiplier farm, with an inventory of 5,300 sows, located in the Santa Catarina State (27°16'58"S, 50°35'04"W, altitude 987 m), in southern Brazil.

Female piglets (Large White x Landrace crossbred gilts-DB 25-DanBred), born and housed at the same farm from birth onwards, were weighed at birth and followed until their third farrowing. All gilts were born to sows with parity orders (PO) ranging from 1 to 7 and were individually weighed within 12 h of birth on a digital balance (10 g of precision). A total of 1495 female piglets were recruited from 240 litters and data concerning their survival, growth performance and retention until the time of selection were reported previously (Magnabosco et al., 2015). In the present study, only the days in the herd, from the birthday onwards, will be presented for 1495 females, whereas for all the other variables, data of 835 females were included in the analyses, using the time of selection for entry into the breeding herd as the starting point of evaluation. All management procedures, performed from birth until selection of gilts, have been described elsewhere (Magnabosco et al., 2015).

2.2. Management of gilts from puberty stimulation until the first mating

Immediately after selection for breeding, the gilts were housed in groups of 12 to 15 animals in 3.80 × 4.00 m pens with partially slatted floors. Stimulus for puberty onset started when gilts were 170 days old on average, and it was provided through boar contact into the pens, once a day, for 10 min, every morning. The gilts were considered in estrus when they exhibited a standing reflex through back pressure in the presence of the boar. Cycling gilts were weighed and transferred to individual crates. The gilts were tested via the back-pressure method until 30 days after the onset of boar exposure (BE). Gilts that did not show estrus within 30 days of initial exposure to boars were defined as anestrous. These gilts received 400 IU equine chorionic gonadotropin (eCG)+200 IU human chorionic gonadotropin (hCG) (PG600; MSD-Animal Health) and were followed for another 30 days for estrus detection.

Gilts were inseminated at their second to fourth post-pubertal estrus and with a minimum of 130 kg body weight. The artificial insemination was performed at the onset of estrus (0 h) and then every 24 h until gilts were no longer in standing estrus. Gilts were inseminated with intracervical deposition of pooled semen doses containing 3×10^9 sperm cells diluted in BTS extender (Beltsville Thawing Solution-MINITUB, Minitub GmbH, Tiefenbach, Germany), which was stored at 15-18 °C for no more than 72 h.

2.3. Management of gilts from the first mating until the third farrowing

During pregnancy, gilts remained in individual crates (0.6 × 2.5 m) with partially slatted concrete floors, and were automatically fed twice a day (7:00 and 13:00 h) with a corn-soybean diet (3,220 kcal ME/kg, 14.0% CP and 0.65% lysine). From mating until 90 days of gestation, they received 1.8–2.8 kg feed/day, according to their body condition score and gestational phase (Young et al., 2004); from day 91 of gestation until transferring to the farrowing room (110 days), they received 3.3 kg feed/day. During lactation, the sows were housed in individual crates with full plastic slatted floors. Automatic feeders allowed the sows to have *ad libitum* access to a lactation diet (3,400 kcal ME/kg, 19.2% CP and 1.0% lysine). Water supply was provided *ad libitum* throughout the experimental period.

Farrowing was induced at 114 days of gestation using 0.06 mg prostaglandin F2-alfa analog (Dinoprost Tromethamine, Lutalyse; Pharmacia & Upjohn, México O.F., Mexico) through vulvar submucosa injections. In all farrowings, the number of piglets born alive, stillborn piglets, and mummified fetuses were recorded. Data concerning the reproductive performance up to the third farrowing were obtained from the farm database (AGRINESS S2 System, Florianopolis, Santa Catarina, Brazil).

2.4. Measurements and statistical analyses

All data were analyzed using the software Statistical Analysis System version 9.1 (SAS Inst. Inc., Cary, NC). Differences were considered significant at $P \leq 0.05$, and P-values between 0.06 and 0.10 were designated as a tendency. Throughout the text, numerical data are expressed as Least squares means (LS means) ± standard error of the mean (SEM), or in percentages, according to the variable type.

Initially, the effect of birth weight on the percentage of gilts showing estrus and farrowing was investigated as a continuous variable using logistic regression models (GLIMMIX procedure), but it was not statistically significant ($P > 0.05$). Next, birth weight was included as a categorical variable as reported by Magnabosco et al. (2015). It consisted of retrospectively classifying 835 gilts selected for breeding into eight classes of birth weight (BiW) ranging from low to high (1 denoting the lightest and 8 the heaviest class), with approximately 12.5% of gilts in each group. After excluding dead and culled gilts until the time of selection, the number of female piglets belonging to each class of BiW were the following: BiW 1 (410-990 g; $n=61$); BiW 2 (1000–1160 g; $n=93$); BiW 3 (1170–1280 g; $n=95$); BiW 4 (1290–1390 g; $n=110$); BiW 5 (1400–1500 g; $n=114$); BiW 6 (1510–1610 g; $n=117$); BiW 7 (1620–1770 g; $n=114$) and BiW 8 (1780–2400 g; $n=131$).

Data concerning age, weight and average daily gain (ADG) at first estrus and first mating, age at third farrowing, total number of piglets born and piglets born alive over three productive cycles, and the number of herd days were analyzed using the MIXED procedure. The number of days spent in the herd was estimated by the difference between the date of removal and the date of entry (Lucia et al., 2000), using as starting points the birth day (herd days from birth) or the date of selection (herd days from selection). For females that were not removed from the herd the end point for this calculation was the date of the third farrowing.

Percentages of gilts in estrus within 10, 20 and 30 days after BE, farrowing rates, percentages of females reaching the third farrowing and culling rates were analyzed using logistic regression models (GLIMMIX procedure). The removal reasons were grouped into four categories: reproductive, locomotor, others and death. Culls attributed to return to estrus, anestrous, abortion and failure to farrow were grouped into reproductive reasons. Sows culled due to lameness, injuries and leg unsoundness were grouped into locomotor disorders. The other reasons included sows removed due to diseases, poor body condition and low farrowing productivity.

The percentages of stillborn piglets and mummified fetuses were analyzed as having a binomial distribution using the GLIMMIX procedure.