Litter birth weight phenotype and its influence on embryonic and placental development at day 30 of gestation

Julia Linck Moroni, Stephen Tsoi, Irene Wenger, Patrick Charagu, Michael Dyck
University of Alberta, Hendrix Genetics, Regina, Canada

Key points:

- In every herd there is a population of sows that produce low birth weight piglets independent of the litter size
- The litter birth weight phenotype (LBWP) is a sow-related phenotype
- Low LBWP sows show delayed embryonic and placental development on day 30 of gestation

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The low litter birth weight phenotype (LBWP) in sows represents a major issue for the swine industry. The ability to select against this trait in sow lines could be strategically directed towards increasing production efficiency of the breeding herd. The aim of this study was to understand biological processes associated with the LBWP in order to improve overall breeding efficiency, lifetime productivity and number and quality of pigs weaned per sow.

Analyses were conducted on reproductive data from a purebred Large White (LW) maternal line (Hendrix Genetics), to identify sows (>2 parities) with a repeatable high or low LBW phenotypes (top 12% and bottom 12% of the population), with >7 up to 22 total number born (Figure 1). A total of 40 sows were selected (n=20 High LBW and n=20 Low LBW) and bred on their second estrus following altrenogest withdrawal (Matrix™, Merck AH, Kenilworth, NJ). Sows were euthanized on day 28-30 of gestation (day 29.15 ± 0.6) and samples of placenta, endometrium, and embryos collected. Total number of embryos (TNE), embryonic weight (EW), number of viable embryos (VE), and crown-rump (CRL) measurements were recorded, along with the ovulation rate (OR) and allantochorionic fluid volume (AFV), as a measurement of placental volume.

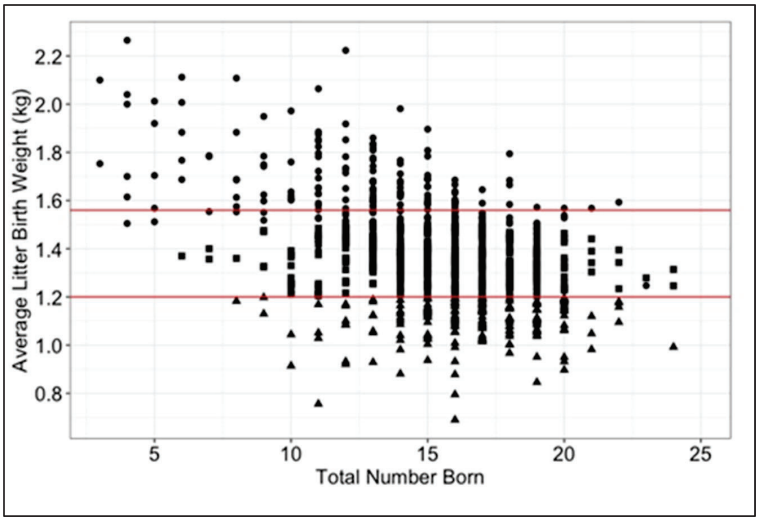

Figure 1. Relation between total number born and birth weight for Large White sows, where >1.56 kg represents High LBWP (•), 1.55 to 1.21 kg represents Medium LBWP (■) and <1.2 kg represents Low LBWP (▲).

No significant difference was detected ($P > 0.05$) in OR, TNE and number of VE on day 30 of gestation between groups (OR: 26.8 ± 1.06 vs. 25.6 ± 1.06, TNE: 19.8 ± 1.12 vs. 19.5 ± 1.19, VE: 16.6 ± 1.37 vs. 16.4 ± 1.37), for high and low LBWP, respectively. Although the embryo size (CRL) did not differ ($P > 0.05$) between groups (High LBWP: 21.34 ± 0.34 vs. Low LBWP: 21.38 ± 0.34 mm), EW had a borderline non-significant difference between groups (High LBWP: 0.88 ± 0.04 g vs. Low LBWP: 0.80 ± 0.05 g, $P=0.10$) and AFV was significantly lower ($P < 0.03$) in low LBWP sows compared to high LBWP sows (High LBWP: 149 ± 9.39 vs. Low LBWP: 131 ± 9.82 mL).

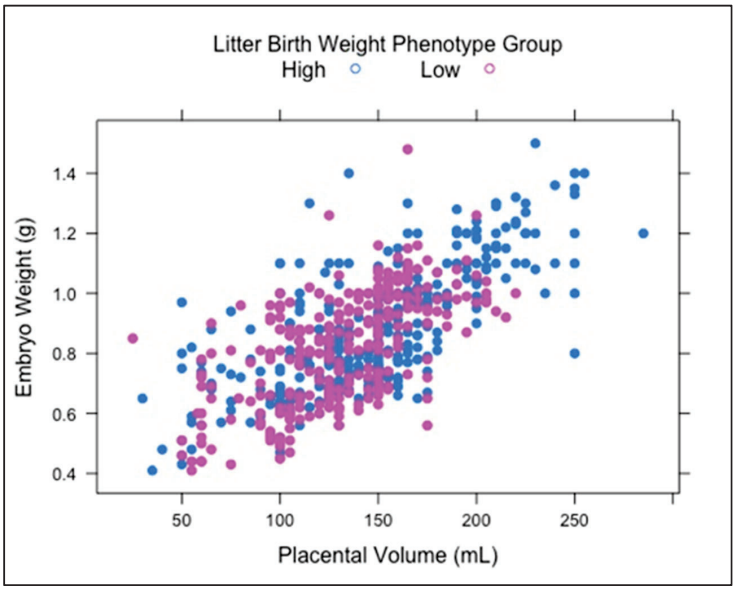

Figure 2. Correlation between placental and embryonic weight at day day 30 of gestation, $R^2 = 0.46$; $P < 0.001$.

These results suggest that low LBWP phenotype sows exhibit delayed embryonic and placental development on day 30 of gestation relative to high LBWP phenotype sows. The hypothesis is that a compromised intrauterine environment on low LBWP sows drives the lower embryonic weight and consequent lower piglet birth weight (Figure 2). Gene expression analysis from reproductive tissues and embryos will be performed to identify biological processes and candidate genes involved in the high and low LBWP phenotypes.