Struggling to survive: early life challenges in relation to the backtest in pigs

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ABSTRACT: Intensively reared piglets may face many early life challenges and these may affect behavior. The objective of this study was to examine the relationship between piglets' early life circumstances and their behavioral response in a backtest. Here, 992 piglets of 14 d of age were subjected to a backtest, in which they were restrained for 1 min in a supine position. The number of struggles in the backtest was assessed in relation to data on ADG, BW, BW relative to litter mates, teat order, litter size, and health. Piglets that had a lower ADG from birth until the test day were struggling more (b = -2.4 g ADG/struggle; P = 0.03). Also, piglets with a lower BW at 14 d of age tended to respond more actively in the backtest (b = -0.03 kg/struggle; P = 0.08). The response to the backtest was unrelated to ADG from birth until weaning, birth weight, weaning weight, teat order, litter size, and health. ADG and BW were unrelated to the variation of backtest responses within the litter. The weak though significant relationship suggests that smaller, slower-growing piglets more actively respond to a challenge, either because piglets born with such a behavioral response were better able to survive, or because piglets adapted their behavioral response to their physical condition.

Key words: coping style, early life, health, growth, pig, stress

INTRODUCTION

Piglets often grow up in a competitive social environment and face many early life challenges, such as painful interventions and early weaning (Robert et al., 1999; Weary et al., 2006; Rutherford et al., 2013). These challenges may especially affect smaller piglets, which may suffer from injuries and undernourishment (Milligan et al., 2001; Rutherford et al., 2013). A lack of a steady and nourishing early environment can greatly impact behavioral and physiological development (e.g., Anisman et al., 1998; Sih, 2011) and may alter personality (Carere et al., 2005; Biro and Stamps, 2008). For instance, in times of feed scarcity, animals may develop a more proactive behavioral strategy (Carere et al., 2005). The possibility of adapting adequately to a situation, e.g., behavioral flexibility, but also a diversity of behavioral styles within a group, may be beneficial to adapting to environmental challenges (Hessing et al., 1994; Koolhaas et al., 2007; Dingemanse et al., 2010).

In piglets, structural behavioral differences may be reflected in the backtest (e.g., Hessing et al., 1993; Bolhuis et al., 2005). Proactive responders in this test may, for example, be more rigid in their (aggressive) behavior, whereas passive responders seem more flexible (e.g., Bolhuis et al., 2005; Melotti et al., 2011). When socially challenged, piglets may alter their behavioral response (van Erp-van der Kooij et al., 2003a). The response of piglets in the backtest previously showed weak, but inconsistent, associations with ADG (e.g., Ruis et al., 2000; van Erp-van der Kooij et al., 2003b; Cassady, 2007; Spake et al., 2012). We hypothesized that piglets with a disadvantage in early life, such as a low BW or impaired health, would show a more proactive behavioral response in the backtest. This was studied by examining the relationship between piglets’ early life circumstances in terms of health, weight, growth, litter uniformity, litter size and teat order, and their response in a backtest.

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**MATERIALS AND METHODS**

All procedures were approved by the Animal Care and Use Committee of Wageningen University (protocol 2010055), and approval was then adopted by the Animal Care and Use Committee of the University of Groningen, as this committee was connected to the experimental farm.

**Animals and Housing**

A total of 1,153 piglets were life born out of 80 litters from a total of 65 sows (Topigs-20, a Landrace × Large White cross), which were serviced by a total of 24 boars (Tempo, a synthetic line of Large White). Farrowing took place over 5 consecutive batches between August 2011 and September 2012 on the experimental farm of TOPIGS BV, Beilen, The Netherlands. The trial was part of a larger study on indirect genetic effects for growth, whereby two contrasting groups of high and low social breeding value were formed (described in Camerlink et al., 2013). The genetic contrast did not affect any of the backtest parameters described here (Reimert et al., 2013) and is not further discussed.

Sows were housed in conventional barren farrowing crates where the sow is locked between bars during the entire farrowing period. The temperature in the farrowing house was 25.0 ± 0.02°C. Sows within a batch farrowed within 6 d of each other. Two sows were lost to follow-up due to a uterus prolapse, and their piglets were excluded from the trial.

Cross-fostering was applied only if a litter consisted of more than 14 piglets. Milk replacer was only provided when the sow had insufficient milk for the litter (20% CP, 20% crude fat, 1.7% Lys). Dry creep feed (15.2 ME MJ/kg, 21% CP, 8.5% crude fat, and 1.6% Lys) was provided from 7 d after birth until 3 wk of age and then replaced by piglet pellets (10.6 ME MJ/kg, 15.5% CP, 5.5% crude fat, and 1.2% Lys), which were given until weaning at 4 wk of age. Piglets had continuous access to a nipple drinker. Before 5 d of age each piglet was given an anticoccidial agent (Baycox; Bayer, Diegem, Belgium; 0.1 cc) and an iron injection (Pig-Ironject; Dopharma B.V., Raamsdonkveer, the Netherlands; 0.5 cc), and antibiotics (Naxcel; Pfizer Limited, Kent, UK; 0.2 cc). All piglets kept intact tails and teeth. Male piglets were castrated under CO₂/O₂ anesthesia around 5 d of age. In case of infection or disease, piglets received Penject 30 (0.1 cc/kg body weight) during 3 d. Skin wounds were treated with an antimicrobial spray (Chlortetracycline). All treatments, including reason of treatment, were recorded. To enable recognition of piglets, piglets received a number on their back with commercially available black hair dye for humans. Here, each piglet was held while a number was firmly drawn on its back with a small brush. The piglet was retained for a few minutes until the hairs had slightly dried. The hair dye smeared a little once the piglet was able to move freely with litter mates, but the smeared dye disappeared after a few hours while the number remained visible up to 2–7 d. When the dyed number became too vague, the hair dye was reapplied. Due to tests and measurements, piglets were, on average, shortly handled 3 times a wk. Piglets were euthanized when they had a congenital malformation or illness or injury that they did not recover after treatment.

**Body Weight and Health**

Piglets were individually weighed at d 1 (day of birth) and around d 14 and 27. Besides absolute body weight (BW), a relative BW was determined to compare weights within litter as a measure of litter uniformity. Relative BW was calculated as the actual weight of the piglet minus the average weight within the litter. Average daily gain in g/d was calculated by the weight gain over a period divided by the number of days, calculated from actual day of birth of each piglet.

Once a week, in addition to the daily routine checks, individual piglets were scored for vitality, body condition, and diarrhea. The vitality score indicated either no vitality problems (score 1), vitality problems which did not require lifesaving treatment (score 2), or life-threatening situations, such as diseases and disorders, that can cause death (score 3). Body condition score indicated fat (backbone not palpable; score 0), normal condition (score 1), or lean (score 2) and was adapted from methods used in sows (Muirhead and Alexander, 1997; Scott et al., 2009). Diarrhea was visually scored weekly as absent or present for each piglet. For analyses, all weekly scores were averaged per individual into one score for each of the three variables.

**Backtest**

A total of 992 piglets (Fig. 1) of 14 ± 0.5 d of age were subjected to a backtest. The backtest was performed according to the procedure of Hessing et al. (1993) and has been described in detail in Melotti et al. (2011). Briefly, piglets were held in a supine position for 1 min to observe their behavioral response. The number of struggles (also referred to as escape attempts), the number of vocalizations, and latency times until the first struggle and vocalization were recorded. The backtest was performed by 2 experimenters who were trained to handle the pig in the same manner and by 1 observer who counted vocalizations and latencies.

The variation in backtest responses within a litter was approximated by a sliding scale from 0 to 100. Zero indicated that either 100% of the piglets within a litter did not struggle (all 0 struggles) or 100% of the piglets struggled (all > 0 struggles), reflecting little variation.
within a litter. One hundred reflected maximum variation within the litter, whereby 50% of the piglets did not struggle, and 50% of the piglets did struggle. The values between 0 and 100 indicated the varying percentages of piglets did or did not struggle.

**Teat Order**

Teat order, i.e., the location of each piglet at the udder of the sow, was recorded at 3 different suckling bouts, divided over the second wk of life. The location of each piglet on the udder was noted by recording the individual piglet number and the teat number. Anterior teats received number 1, and each following teat was incrementally numbered, up to a maximum of 9 teats on each teat line, based on Hemsworth et al. (1976) and Ruis et al. (2000). Dysfunctional teats were recorded, but not included, in the numbering. It was noted on which side a sow was lying and whether piglets were in the upper or lower row of teats.

**Statistical Analyses**

Data were analyzed with SAS 9.2 (SAS Inst. Inc., Cary, NC). Variables were checked for normality and, if required, square root or logarithmically transformed. Data are presented as untransformed means ± SEM.

If an animal did not struggle or vocalize during the backtest, the latency times were set at maximum (60 s). The raw data of the number of struggles was skewed toward the left tail of the distribution (Fig. 2), but the residuals of the 4 backtest variables approached normality (Shapiro-Wilk test). The residuals were obtained by testing the 4 backtest variables in a general linear model that contained batch as a fixed effect. The residuals of the 4 variables showed strong correlations ($r_p = 0.51–0.75$; all $P < 0.001$). Therefore, in line with other studies, only the number of struggles was considered for further analysis (van Erp-van der Kooij et al., 2003b; Cassady, 2007).

Teat order was consistent across observations ($r_p = 0.83–0.86$; $P < 0.001$), and observations were therefore averaged per piglet. To enable equal comparison between sows with a different litter size, the teat order was expressed into categories. Here, the udder was divided into anterior, middle, and rear by dividing the maximum number of piglets on a row of teats by 3. Piglets were categorized into this teat order rank based on their average teat order.

The relationships between the number of struggles in the backtest and the piglet characteristics (BW, ADG, relative BW, vitality score, BCS, antibiotic treatment, diarrhea, and teat order rank) was analyzed in 2 different ways.

The first model (model 1) was a mixed model (Proc MIXED) with “number of struggles” as the dependent variable and the piglet characteristics entered singly as independent variables to test their effects on the backtest response of the piglets. Litter size, sex, and being cross-fostered were independent effects, and sow, nested within batch, was included as the random effect. Interactions that were relevant to the research question were explored and, if significant, also tested in the second model.

The second model (model 2) was applied to enable extra examination of the relationship between backtest behavior and other pig characteristics while correcting for sex, litter size, cross-fostering, and batch, which were likely to affect the piglet characteristics. The continuous variables (BW, ADG, relative BW, vitality, BCS, and diarrhea) were analyzed with Proc MIXED, whereas a generalized mixed model (Proc GLIMMIX) was used to analyze the antibiotics treatment (binary distribution, logit link) and teat order rank (multinomial distribution, glogit link). Piglet characteristics were entered as dependent variables, and the “number of struggles,” sex, litter size, being cross-fostered, and batch were in-
Early Growth and Backtest Response in Pigs

1.5 g, leading up to an average weaning weight of 7.9 ± ADG, all at any period during lactation, related to the weight (model 2, backtest as independent variable) was tested as fixed effect in model 2. Thereafter, within-litter variability, piglets had an ADG of 240 ± kg (range 0.4–2.7 kg). From birth until the day of the backtest (d 14), piglets had an ADG of 210 ± 1.7 g, and occurrence of diarrhea (P = 0.86). The number of struggles in the backtest was influenced by both biological sow and actual nursing sow (as random effect, both P < 0.001). The within-litter variation of the backtest response or its interaction with the number of struggles did not relate to any of the tested dependent variables (Fig. 4). In other words, health did not depend on the variety of backtest responses within a litter.

All models were run once with the biological sow to determine the effect of genetics and once with the nursing sow (although often the same as biological sow) to determine the relationship with the sows’ rearing capacity. Both options gave similar outcomes, and because biological sow had the best model fit, results were presented based on biological sow. The number of struggles was fitted both linearly and quadratically into the models to determine the best curve, but the linear fit gave the best model estimates.

The within-litter variation with regard to the backtest response was first analyzed on pen (litter) level to determine the effect of within-litter variability of backtest responses on (average) litter traits (GLM Procedure without random effect). Thereafter, within-litter variability, and its interaction with the number of struggles, was tested as fixed effect in model 2.

RESULTS

The statistical model that enabled correction for weight (model 2, backtest as independent variable) resulted in similar significance values as in model 1, where backtest was the dependent variable. Reported P-values originate from model 2, unless otherwise specified.

Table 1. Descriptive statistics of health measurements (N = 1,150), with the ADG in g (mean ± SEM) for d 1–14 of age for each category

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Piglets (%)</th>
<th>ADG (d 1–14)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Vitality score</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Good</td>
<td>74.8</td>
<td>221 ± 2</td>
</tr>
<tr>
<td>Impaired</td>
<td>23.9</td>
<td>178 ± 4</td>
</tr>
<tr>
<td>Life-threatening</td>
<td>1.3</td>
<td>105 ± 46</td>
</tr>
<tr>
<td><strong>Body condition score</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fat</td>
<td>10.8</td>
<td>274 ± 14</td>
</tr>
<tr>
<td>Normal</td>
<td>78.6</td>
<td>214 ± 2</td>
</tr>
<tr>
<td>Lean</td>
<td>10.6</td>
<td>130 ± 5</td>
</tr>
<tr>
<td><strong>Diarrhea</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>91.5</td>
<td>210 ± 2</td>
</tr>
<tr>
<td>Yes</td>
<td>8.5</td>
<td>207 ± 6</td>
</tr>
<tr>
<td><strong>Antibiotics treatment</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>96.3</td>
<td>212 ± 2</td>
</tr>
<tr>
<td>Yes</td>
<td>3.7</td>
<td>163 ± 9</td>
</tr>
</tbody>
</table>

Piglets that had a lower ADG between birth and the day of the backtest (d 14) showed a higher number of struggles (b = -2.4 g ADG/struggle; t(984) = -2.14; P = 0.03; Fig. 3). This relationship was not apparent in the ADG from birth until weaning (P = 0.15). The number of struggles tended to relate to the BW measured at the day of the backtest (b = -0.03 kg/struggle; t(986) = -1.74; P = 0.08), but not to BW at birth (P = 0.78) or at weaning (P = 0.21). The number of struggles was unrelated to the relative BW (relative BW d 1 P = 0.56; d 14 P = 0.14; and d 24 P = 0.31). The association between BW and the number of struggles may relate to the litter size, but litter size did not interact with number of struggles, nor did it influence performance.

The number of struggles was unrelated to the litter size at d 14 (P = 0.24), sex (P = 0.20), and cross-fostering (P = 0.15; P-values originate from model 1). The number of struggles was unrelated to the health measurements, i.e., body condition (P = 0.93), vitality (P = 0.36), antibiotic treatment (P = 0.15), and occurrence of diarrhea (P = 0.86). The number of struggles in the backtest was influenced by both biological sow and actual nursing sow (as random effect, both P < 0.001). The within-litter variation of the backtest response or its interaction with the number of struggles did not relate to any of the tested dependent variables (Fig. 4).

In total, 1,153 piglets were live born (Fig. 1), with an average number of 15.1 live born piglets per sow (range 3–21). Mortality was 12.8%, of which 9 piglets were euthanized. A total of 74 piglets (6.1%) were cross-fostered. The average birth weight was 1.3 ± 0.01 kg (range 0.4–2.7 kg). From birth until the day of the backtest (d 14), piglets had an ADG of 210 ± 1.7 g, and from birth until weaning, piglets had an ADG of 240 ± 1.5 g, leading up to an average weaning weight of 7.9 ± 0.05 kg (range 2.4–12.9 kg). Most piglets had no vitality problems (mean score 1.3 ± 0.01) and had a normal body condition (mean score 1.1 ± 0.01; Table 1). This was also reflected in the percentage of piglets with (visible) diarrhea, of which 75% originated from 14 litters, and the few antibiotic treatments (Table 1). Body weight, relative BW (i.e., BW minus average litter weight), and ADG, all at any period during lactation, related to the BCS, the vitality score, and antibiotic treatment (all P < 0.001; Table 1), with smaller and slower growing piglets being thinner, less vital, and receiving antibiotics more often compared to heavier piglets. BW and ADG, at any time period, were unrelated to the occurrence of diarrhea.

**General Health and Weight**

**RESULTS**

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**Backtest**

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The anterior teats were mostly occupied by heavier piglets, while the rear teats were occupied by lighter and slower-growing piglets (for all BW and ADG, \( P < 0.001 \)). This relationship was strongest for the relative birth weight, whereby piglets that occupied the anterior teats were at birth, on average, 80 g heavier than the litter average (\( P < 0.001 \)). Teat order class was unrelated to the number of struggles in the backtest (\( P = 0.55 \)) and to the variation of the number of struggles on litter level (\( P = 0.53 \)). There was no interaction between the number of struggles and the relative BW at birth for the location at the udder (\( P = 0.88 \)).

**DISCUSSION**

We hypothesized that early life conditions of piglets would relate to their response in the backtest, whereby piglets with a disadvantage in early life, such as a low BW or impaired health, would show a more proactive response. Piglets with a lower ADG and BW around the test day responded slightly more proactively, but the response in the backtest did not relate to ADG and BW measured at other moments or with other early life conditions such as health, teat order, or litter characteristics.

**Backtest in Relationship to ADG and BW**

Piglets that had a lower ADG from birth until the test day (d 14) responded more proactively during the backtest, which was reflected in a higher number of struggles or escape attempts during the test in which the piglet was restrained on its back. Also, piglets with a lower BW at the test day tended to respond more actively. This is in line with other studies that reported that piglets with a lower ADG during lactation and a low BW at d 21 of age showed a higher activity during the backtest, but associations were weak as well (van Erp-van der Kooij et al., 2003b; Velie et al., 2009; Spake et al., 2012). There seems to be an overall inconsistency in the direction of the relationship (Table 2); in some studies, an active backtest response has been associated with a high ADG in piglets (Ruis et al., 2000; van Erp-van der Kooij et al., 2003b; Cassady, 2007). From an evolutionary perspective, an active or bold behavioral strategy has been mostly associated with a higher ADG (Stamps, 2007; reviewed in Biro and Stamps, 2008). Proactive behavior may coincide with increased risk taking in foraging, consequently, acquiring more food and thus resulting in a higher ADG, but also a higher predation risk (Stamps, 2007).

The inconsistency in findings both within and between studies (summarized in Table 2) might be related to the moment of measuring performance (BW or ADG). The life stage and, with that, the (social) context and stability of the environment may exert different effects on growth (Naguib et al., 2011; English et al., 2014). A steady environment, which is rather familiar and predictable, might be best for animals that show a proactive response, whereas an unpredictable environment would be easier to deal with for the more flexible reactive responders (Geverink et al., 2004; Reimert et al., 2013). Also, group composition has been shown to affect performance in pigs, with heterogeneous groups, i.e., groups of pigs with diverging responses in the backtest, achieving a higher ADG during the finishing period than homogeneous groups (Hessing et al., 1994).

The strength of the relationship between the backtest and ADG was 2.4 g less ADG per struggle, which in clearly proactive responding piglets, e.g., 4–7 struggles, would be associated with approximately 9.6–16.8 g less ADG compared to piglets that did not struggle during the backtest. The size of this effect is small and may by itself be of limited biological significance compared to the total ADG (here, 210 g). However, the magnitude is comparable to effects of amongst others disease, e.g., diarrhea may reduce ADG by 8 g, and infections may reduce ADG by 21 g (Johansen et al., 2004).

The backtest response was not significantly related to birth weight, suggesting that weight at birth was not determinative of the behavior at d 14. It might be that small piglets with a proactive response were more likely to survive, for example, due to more rigid aggressive behavior (Bolhuis et al., 2005; Melotti et al., 2011) or, perhaps, adopted this response to survive, whereas other
small piglets did not and died. Weight relative to the litter average was not related to the backtest response, which may elucidate that being small compared to litter mates is different from being small in general. This would point out that the response in the backtest would be rather affected by malnutrition or competition for nutrition than by being low in rank (D’Eath and Lawrence, 2004). Animals that suffered from malnutrition, or had to compete more, may adopt a more proactive coping style or respond more aggressively (pigs: D’Eath and Lawrence, 2004; Parus major: Carere et al., 2005), which might explain the effect that we observed in the current study. It is unknown whether the association between backtest response and ADG in the first 2 wk of life reflects a causal relationship, and, if so, it is also hard to disentangle cause and effect.

**Early Life Conditions**

We hypothesized that the response in the backtest may also be related to early life conditions other than ADG, such as health, but this hypothesis could not be confirmed. The general health of the piglets was good, resulting in very little variation in the health measurements, which might explain why no relationship was found. Rank order at the teats did not relate to the backtest response in this study, whereas Ruis et al. (2000) ascribed a higher ADG of piglets with an active backtest response to their successful competition for the anterior teats. Litter size did not influence or interact with the backtest response in its effect on ADG, even though litter size may have a marked effect on behavior and competitiveness (Mendl and Paul, 1991). The variation of behavioral responses within the litter was unrelated to BW, ADG, and health in this study, albeit a positive effect of a varied group composition regarding behavior, as reflected in coping styles, has been suggested in several animal species (reviewed by Koolhaas et al., 2007; Bergmüller and Taborsky, 2010; pigs: Hessing et al., 1994).

**Maternal Effects**

The sow explained a notable part of the response, which is in line with the heritability of the backtest response (h² = 0.53; Velie et al., 2009). Also the intrauterine environment of the sow (Baxter et al., 2008), the milk production, and the (nursing) behavior (Valros et al., 2002) may have contributed to the behavioral and physiological development of the offspring. Six percent of the piglets were cross-fostered. This did not result in significant differences in the backtest response, although pigs may have changed their response after cross-fostering (van Erp-van der Kooij et al., 2003a).

**Use of the Backtest**

The backtest has been mostly studied in relation to piglet behavior and physiology and its correlation with other behavioral tests. The correlation with other behavioral tests, or the lack thereof, has been criticized, and it remains debatable whether the test can reflect coping styles or personality traits (Jensen et al., 1995; Spake et al., 2012). Nevertheless, the backtest has shown to be informative with respect to other behavioral and physiological characteristics of pigs (e.g., Bolhuis et al., 2003; Geeverink et al., 2004; Reimert et al., 2013, 2014). The test may, in a relatively simple manner, generate a clear behavioral response and give indications on the behavioral flexibility in piglets (e.g., Bolhuis et al., 2004). The amount of studies that found a relationship between the backtest response and ADG or BW indicates that there is a true relationship between the backtest and performance traits. However, as this study also points out, the causality is unclear, and age or environmental circumstances

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Table 2. Studies that report a significant relationship between the backtest response and ADG or BW, reflected in phenotypic correlations (r) or beta estimates (b). HR = high resister (many struggles) and LR = low resister (no or few struggles).  

<table>
<thead>
<tr>
<th>Direction</th>
<th>Measurement</th>
<th>N</th>
<th>Test age</th>
<th>Relationship with test</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Negative</strong></td>
<td>ADG suckling</td>
<td>812</td>
<td>10 d</td>
<td>b = -3.42 g</td>
<td>van Erp-van der Kooij et al. (2003b)</td>
</tr>
<tr>
<td></td>
<td>ADG suckling</td>
<td>766</td>
<td>7–14 d</td>
<td>r = -0.19</td>
<td>Velie et al. (2009)</td>
</tr>
<tr>
<td></td>
<td>ADG suckling</td>
<td>575</td>
<td>6 d; 13 d</td>
<td>r = -0.24</td>
<td>Spake et al. (2012)</td>
</tr>
<tr>
<td></td>
<td>BW d 21</td>
<td>766</td>
<td>7–14 d</td>
<td>r = -0.19</td>
<td>Velie et al. (2009)</td>
</tr>
<tr>
<td></td>
<td>BW d 21</td>
<td>575</td>
<td>6 d; 13 d</td>
<td>r = -0.19</td>
<td>Spake et al. (2012)</td>
</tr>
<tr>
<td></td>
<td>ADG d 20–76</td>
<td>150</td>
<td>6–10 d; 13–17 d</td>
<td>Piglets with 8 vs. 2 struggles: -131 g</td>
<td>Cassady (2007)</td>
</tr>
<tr>
<td></td>
<td>ADG wk 52–53</td>
<td>72</td>
<td>10 d; 17 d</td>
<td>HR vs. LR: -350 g</td>
<td>Geeverink et al. (2004)</td>
</tr>
<tr>
<td><strong>Positive</strong></td>
<td>ADG suckling</td>
<td>150</td>
<td>6–10 d; 13–17 d</td>
<td>Piglets with 8 vs. 2 struggles: +120 g</td>
<td>Cassady (2007)</td>
</tr>
<tr>
<td></td>
<td>BW wk 4</td>
<td>128</td>
<td>2–4 d, 4 wk</td>
<td>HR vs. LR: +1.06 kg</td>
<td>Ruis et al. (2000)</td>
</tr>
<tr>
<td></td>
<td>BW wk 10</td>
<td>128</td>
<td>2–4 d, 4 wk</td>
<td>HR vs. LR: +1.9 kg</td>
<td>Ruis et al. (2000)</td>
</tr>
<tr>
<td></td>
<td>ADG fattening phase</td>
<td>812</td>
<td>17 d</td>
<td>b = 3.93 g ADG</td>
<td>van Erp-van der Kooij et al. (2003b)</td>
</tr>
</tbody>
</table>
during an age period seem to affect type of relationship. The backtest may still be informative with respect to behavioral and physiological characteristics in pigs, which may, for example, aid formation of groups (e.g., Ruis et al., 2002; Hessing et al., 1994). The backtest might, however, be limited in its practical application to, for example, improve production performance (e.g., Ruis et al., 2002; van Erp-van der Kooij et al., 2003b; Velie et al., 2009).

CONCLUSIONS

Piglets with a lower ADG from birth until d 14 and a lower BW at d 14 slightly struggled more in the backtest. The association between the response in the backtest and ADG was weak but significant. The response in the backtest was unrelated to other measures on weight and growth, teat order, and measures on health. The results suggest that smaller, slower-growing piglets more actively respond to a challenge, either because piglets born with such a behavioral response were able to survive or piglets adapted their behavioral response to their physical condition.

LITERATURE CITED


