# GENETIC ANALYSIS OF SOWS' REACTION TO A SCREAMING PIGLET, AND ITS RELATION TO PIGLET MORTALITY AND GROWTH

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## INTRODUCTION

The number of piglets weaned per sow is an economically important trait for pig producers. Most breeding programs include number of piglets born, or number born alive, to improve litter size at weaning. There are, however, unfavourable relationships between litter size at birth and survival during the pre-weaning period. To avoid an increasing problem with high pre-weaning mortality, we need to balance the selection for litter size at birth by also selecting for a trait that describes the sow's ability to take care of her litter. Piglet survival rate in itself has a low heritability. Genetic studies on survival from birth to weaning show estimated heritabilities averaging 0.05 (Rothschild and Bidanel, 1998). It is desirable to find a trait that is related to piglet survival, but less influenced by environmental variation. The most common causes of post-natal death in piglets are crushing by the sow and starvation. Both these causes of death are highly related to the behaviour of the sow. Earlier reports indicate that sows showing a strong response to the sound of a piglet distress call display less risky behaviour around their piglets early postpartum (Wechsler and Hegglin, 1997; Thodberg *et al*., 2002), and have fewer crushed piglets (Wechsler and Hegglin, 1997).

The aim of this study was to investigate the genetic background of how sows respond to the sound of a piglet screaming, and to estimate the phenotypic and genetic relationships between this behaviour trait and early piglet survival and growth.

## MATERIAL AND METHODS

**Data.** The piglet scream test was used to test sows' responsiveness towards a piglet distress call, as when it is being crushed under the sow (Thodberg *et al.,* 1998). The test was recorded during 2.5 years, 1999 to 2001, in 6 Swedish breeding herds and at Lövsta research station, Swedish University of Agricultural Sciences. On the farrowing day or the day after, as the sow was lying on her side but not nursing, the farmer quietly reached a small tape recorder into the pen and played back the sound of a screaming piglet to the sow during approximately 20 seconds. The sow's maximum response to the sound was recorded in four ordered categories as: no reaction, lying down and looking for the sound, sitting up, or standing up. Data on the scream test and on mortality was collected from 829 sows, with 1336 litters. These sows had 397 dams and 209 sires. All tested sows were pure-bred Swedish Yorkshire, housed in farrowing pens without crates during lactation. Cross-fostering was practised in the breeding herds, but not at the research station. Mortality was recorded as total mortality, including stillborn piglets, at day 4 (±1 S.D.), and as the number of piglets the farmers considered had died from crushing in the litters at day 4 after farrowing. Data on piglet growth rate was available from the research station and records on 1625 pure-bred litters born between 1990 and 2001 were used. Of these litters, 330 had information on the sows' reaction in the scream test. Mortality was analysed as % dead in total, including stillborn, at day 4 and as % crushed piglets at day 4. Growth was analysed as mean piglet growth rate in the litter from birth until 21 (±1 S.D.) days of age.

**Statistical analysis.** Response to the scream test, mortality and growth were analysed using a mixed linear animal model. The scream test was analysed together with each of the three traits total mortality, crushing and growth rate in a bivariate model. The model included fixed effects, the random effect of permanent environment (pe, sow), the random genetic effect of the sow (a) and a random residual effect (e). The model for the scream test included the fixed effects of herd (7 classes), parity (1,2,3,4, ≥ 5; 5 classes), litter size ( ≤ 5,6,7,….,18, ≥ 19; 15 classes) and the order the sows were tested in, when several sows were tested just after each other (first, second, third or later; 3 classes). For total mortality and crushing fixed effects of herd, parity, litter size, breed of the litter (pure- or crossbred; 2 classes), crossfostering (no crossfostering, piglets moved to the litter, or piglets moved from the litter; 3 classes), and the age at recording of the mortality (2-6 days; 5 classes) were included. The fixed effects included in the model for growth rate were parity and litter size. Phenotypic variance ($\sigma^2_P$) was defined as $\sigma^2_{pe} + \sigma^2_a + \sigma^2_e$. The heritabilities were calculated as $\sigma^2_a/\sigma^2_P$. Variance and covariance components were estimated using an AI-REML algorithm (Jensen *et al.*, 1997) in the DMU package (Madsen and Jensen, 2000).

## RESULTS

The total mortality rate, including stillborns, at day 4 after farrowing was 17%. Dead piglets occurred in 76% of the litters, crushed piglets in 43%. The average mean growth rate in the litter from birth until 21 days of age was 239 grams per day. In the scream test, 20% of the sows did nothing, 47% reacted by looking for the sound, 12% sat up and 21% stood up. There were quite large differences between farms in how responsive the sows were in the test. Gilts reacted stronger than older sows, except for sows of parity five and higher whose responses did not significantly differ from those of the gilts. If several sows were tested in the same stable, directly after each other**,** the sows tested first had stronger reactions than sows tested as number two. Variance components and heritabilities for the traits analysed are shown in Table 1

**Table 1. Genetic parameters for different sow traits, with standard errors given as subscripts**

| Trait | No. records | $\sigma^2_{pe}$ | $\sigma^2_a$ | $\sigma^2_e$ | $\sigma^2_P$ | $h^2$ |
|---|---|---|---|---|---|---|
| Scream test | 1336 | $0.20_{0.04}$ | $0.03_{0.03}$ | $0.71_{0.03}$ | 0.94 | $0.04_{0.03}$ |
| Total mortality (%)[A] | 1113 | $21.1_{8.23}$ | $15.9_{6.53}$ | $160.7_{7.41}$ | 197.8 | $0.08_{0.03}$ |
| Crushing (%)[A] | 1038 | $9.4_{4.39}$ | $7.3_{3.44}$ | $82.4_{3.86}$ | 99.2 | $0.07_{0.03}$ |
| Growth (g/day)[B] | 1625 | $227.4_{58.53}$ | $464.6_{74.38}$ | $1153.5_{37.27}$ | 1845.5 | $0.25_{0.04}$ |

[A]Percent dead piglets at 4 days after farrowing
[B]Mean growth rate in the litter from birth to 21 days of age

We found a heritability of 0.03 for response in the scream test. The phenotypic correlation between response in the scream test and both piglet mortality and growth rate were close to zero. The genetic correlations (± SE) were estimated to -0.81 (0.52), -0.87 (0.44) and 0.87 (0.42) between response in scream test and total mortality, crushing and mean growth rate respectively.

**DISCUSSION**

In a much smaller study in an experimental setting, Wechsler and Hegglin (1997) found a strong negative phenotypic correlation between response to a piglet scream and percent of crushed piglets in the litter. Thodberg *et al* (2002) found that sows showing a strong response in the scream test also show a lower frequency of activity during the first 24 hours after farrowing. A low level of activity immediately after farrowing is thought to be related to low risk of crushing (Wechsler and Hegglin, 1997). We found no phenotypic relationship between response in the scream test and early piglet mortality or growth. The genetic correlations were on the other hand strong and favourable. However, the estimated heritability for the simple version of the scream test we used was quite low, lower than the heritablilities estimated for the two mortality traits. Since there seem to be genetic variation for response in the scream test genetic progress is possible, even if the heritability is low. Given the favourable genetic correlations we found, selection on stronger response in the scream test is expected to lead to a genetic improvement in both early piglet mortality and growth. The test response cannot, however, be recorded earlier in the sow's life than information on mortality in her litter, and response in the test is also more complicated and more time consuming to record. Therefore it would be more efficient to select directly on piglet mortality and piglet growth, compared to using response in the scream test as a selection criterion.

**CONCLUSION**

There seems to be genetic variation in sows' response in the piglet scream test, and favourable genetic correlations between strong response in scream test and early piglet survival and piglet growth. The heritability for response in the scream test may, however, be too low to motivate the use of the test, as it was performed here, in a breeding programme.

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