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Genetic association between leg conformation in young pigs and sow reproduction

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ABSTRACT

Lameness is an issue of concern in pig production due both to animal welfare and to economical aspects. Lame sows are believed to suffer from pain and stress which is reported to have a negative influence on reproduction. Leg conformation and locomotion traits in young animals are associated with the risk of lameness at higher age. The purpose of this study was to estimate the genetic parameters of leg conformation traits recorded at performance testing (around 5 months of age) and their genetic correlations with reproduction traits. Information on leg conformation traits from 123,307 pigs scored and on reproduction traits from 22,204 litters in the first and second parity from Swedish Yorkshire nucleus herds were available for genetic analysis. Eight conformation and locomotion traits, coming from the old or the new scoring system in Sweden, included old movement, old overall leg score, new movement, new toes quality, new front leg quality, new rear leg quality, standing-under-position syndrome and new overall score. Four reproduction traits were analyzed by parity: the number of total born piglets, the number of liveborn piglets, the number of stillborn piglets and weaning to service interval. Estimates of heritabilities and genetic correlations between traits were obtained using a multi-trait linear animal mixed model. The heritability estimates were low to moderate, ranging from 0.02 to 0.20 for conformation traits and from 0.06 to 0.10 for reproduction traits. Significant genetic correlations were found between new toes quality and new overall score and the number of liveborn piglets in the 1st parity (-0.35 and -0.31, respectively), indicating that sows with even toes and better overall leg score tend to have higher number of liveborn piglets. Old movement score showed significant correlations with number of total born and number of liveborn piglets in both parities (0.20 to 0.36) and with weaning to service interval in the 2nd parity (-0.35 ± 0.11). Similarly, standing-under-position syndrome was highly associated with number of total born and number of liveborn piglets in both parities (-0.54 to -0.35), indicating that sows with better movement and not suffering from standing-under-position syndrome are likely to have larger litter size and shorter interval to return heat after weaning. Heritabilities and significantly favorable genetic correlation estimates suggest the possibility of simultaneous improvement of both leg quality and reproduction performance by selecting on sound leg conformation and locomotion of young pigs.

1. Introduction

Lameness is not only a welfare issue of great concern but also a major source of economic loss in pig production.

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Lameness is likely to be associated with pain and distress. The general influence of stress on the reproduction of sows was reviewed by Einarsson et al. (2008). Stress is believed to have a negative influence on the reproductive cycle, resulting in lower number of ovulated eggs and higher risk for re-mating (Fitzgerald et al., 2012; Heinonen et al., 2006; Wischner et al., 2009). In addition, Jensen et al. (2007) found that lame boars, in spite of treatment with antibiotics for arthritis, have reduced daily weight gain compared with boars without lameness. Sows with leg weakness have a higher frequency of uncontrolled lying-down behavior, which probably causes higher risk of crushing the piglets, resulting in lower litter size at weaning (Heinonen et al., 2006; Pluym et al., 2013; Wischner et al., 2009). Also, leg weakness is reported as one of the most common reasons for premature culling of sows. From 9% to 13% of sows removed from commercial herds in Sweden, Finland and Denmark were done so due to lameness, as reported in several studies (Engblom et al., 2007; Heinonen et al., 2006; Jorgensen, 2003). Thus improving leg quality in pig herds is expected to increase profitability as well as animal welfare.

Lameness has several causes, including claw lesion, trauma, different manifestations of osteochondrosis, skin lesion and arthritis, as reviewed by Heinonen et al. (2013). Among these, osteochondrosis is probably the main contributing cause of leg weakness in pigs (Lundeheim, 1987; Jørgensen and Andersen, 2000). Osteochondrosis is a disorder of the joints due to a failure in the endochondral ossification of the articular cartilage and the growth plate, which is likely to cause deformation of the articular surface, leading to abnormal conformation and locomotion traits of affected animals. On the other hand, abnormal conformation and locomotion seem to increase the severity of osteochondrosis. For instance, Ytrehus et al. (2004) suggested that biomechanical pressure within joints may be involved in osteochondrosis development. Several studies have reported correlations between osteochondrosis and conformation and locomotion traits (Lundeheim, 1987; Jørgensen and Andersen, 2000; Luther et al., 2007). Koning et al. (2012) found significant genetic correlations between the prevalence and severity of osteochondrosis and several conformation traits and gait characteristics. They suggested that leg weakness caused by osteochondrosis can be predicted by exterior traits assessment; thus conformation and locomotion can be included in the breeding goal for selection for better leg quality. The association between conformation traits and production traits (e.g. growth rate, backfat thickness etc.) has been exploited in many studies, but not between conformation traits and reproduction traits. In fact, both conformation/osteochondrosis and reproduction traits have been included in genetic evaluations in almost all Nordic countries (Rydhmer, 2005). But the way these traits influence each other remains unclear. Our hypothesis is that inferior leg conformations can cause pain and distress to the sow, resulting in reduced reproduction. Thus selection for better leg conformations in a breeding program

Table 1
Description of conformation traits analyzed in this study.

Traits	Abbrev.	Range	Optimum	Description
Old movement	o_move	1–3	3	Movement 1=not good 3=excellent
Old overall leg score	o_all	1–3	3	Overall leg score 1=not good 3=excellent
New movement	n_move	1–7	4	Movement 1=stiff/rigid movement 4=excellent movement (like a cat) 7=winding movement
New toes quality	n_toes	4–7	4	Evenness of claw and space between claws (average score of four legs) 4=optimal: even claws and space between claws 7=severe: uneven claws and very narrow claws
New front leg quality	n_front	1–7	4	Front view and side view of front leg 1=too flexible: bow-legged stance; turn-in pastern (front view); sickle-legged pastern (side view); crooked knee 4=optimal: straight stance; straight pastern with toes face forwards (front view); intermediate pastern (side view); intermediate knee 7=too rigid: cow-legged stance; turn-out pastern (front view); post-legged pastern (side view); straight knee
New rear leg quality	n_rear	1–7	4	Side view and behind view of rear leg 1=too flexible: bow-legged stance; sickle-legged pasterns (side view); crooked hocks 4=optimal: straight stance; straight pastern (rear view); intermediate pasterns (side view); intermediate hocks 7=too rigid: cow-legged stance; turn-out pastern (rear view); post-legged pastern (side view); straight hocks
New standing-under-position	n_under	4–7	4	Center of gravity on rear legs 4=normal 7=severe: center of gravity behind feet
New overall score	n_all	1–6	1	Total assessment 1=excellent; 2=very good; 3=good; 4=average; 5=unsatisfactory; 6=failed