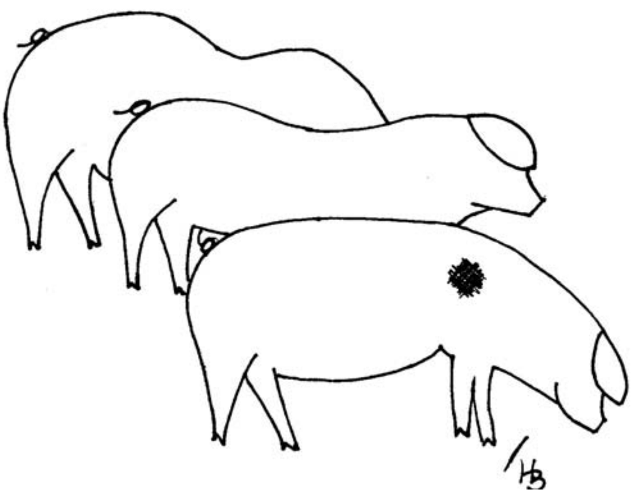
Institutionen för husdjursgenetik

Variation in back conformation and prevalence of ulcers on the shoulders

- a cohort study of related Swedish Landrace and Landrace * Yorkshire sows

by

Hanna Bradley



Handledare:

Nils Lundeheim **Examensarbete 270**

Maria Kihlberg **2005**

Institutionen för husdjursgenetik

Variation in back conformation and prevalence of ulcers on the shoulders

- a cohort study of related Swedish Landrace and Landrace * Yorkshire sows

by

Hanna Bradley

Agrovoc: **Sows, vertebrae, shoulder blade, genetic inheritance**
Övriga: **Kyphosis, back conformation, body condition score**

Handledare:
Nils Lundeheim (HGEN)
Maria Kilhberg (Quality Genetics)

Examensarbete 270
2005

TABLE OF CONTENTS

1. SAMMANFATTNING

I några smågrisproducerande besättningar i södra Sverige har en onormalt hög förekomst av så kallade ”knipta” smågrisar uppmärksammats. Detta är en sedan länge känd, men sporadiskt förekommande ryggdefekt där djuret har en deformation av ryggraden som ger en sänkning av rygglinjen bakom bogen samtidigt som ryggen längre bak är välvd uppåt. Deformationen sägs ibland likna formen på en gammaldags damcykel. Samtidigt har avelsföretaget Quality Genetics (QG) uppmärksammat/tvingats till en allt större utslagning av blivande avelsgaltar, med i övrigt goda avelsvärden, på grund av anmärkningar på ryggen. Detta har i första hand rört lantrasgaltar som haft en konkav ”hängande” rygglinje. Denna utslagning är kostsam både för QG och avelsuppfödarna, och QG föreslog därför en studie gällande rygghälsa och ryggstatus.

Studien har planerats av författaren i samråd med handledare vid SLU och Quality Genetics. Förekomst av bogsår hos suggor kom också att ingå i studien.

Under april 2004 besöktes sammanlagt 10 besättningar där exteriörbedömningar av suggor utfördes. Av dessa besättningar var 8 smågrisproducerande bruksbesättningar av varierande storlek. En besättning var avelsuppfödare av lantras och producent av hybridsuggor med lantras som moder, och en besättning producerade hybridsuggor med moderdjur som inköptes från den nämnda avelsbesättningen. De 8 bruksbesättningarna rekryterade sina suggor från antingen hybrid-besättningen eller avelsbesättningen. I juli 2004 besöktes galtstationen i Hörby, och exteriörbedömningar utfördes även där.

Exteriörbedömningsprotokollet innehöll fyra bedömningspunkter: Hull, Rygg, Knipt och Bogsår, med en bedömningsskala från ett till fem. Djurets Hull bedömdes som att en 1:a motsvarade en mager sugga och 5:a en överviktig. Punkten Rygg innebar att rygglinjens form bedömdes, från sidan av djuret. En 1:a betydde en hängande rygg och en 5:a en välvd rygg. En normalformad rygglinje betecknades som en 3:a. Punkten Knipt bedömdes ur så många vinklar som var praktiskt möjligt. Här bedömdes huruvida djuret hade tendenser till att vara knipt eller ej. En gris utan tendenser till att vara knipt bakom bogen betecknades som en 5:a och en kraftigt knipt gris bedömdes med en 1:a. Något sådant djur påträffades dock ej. Förekomst av bogsår bedömdes enligt följande koder: 1= inga sår, 2= skrapsår, 3=öppet sår, 4=böld, 5= ärrvävnad. Bedömningen gjordes på den sida som bedömdes vara värst drabbad.

Sammanställning och analys av insamlade data gjordes under hösten 2004 vid institutionen för husdjursgenetik, avdelningen för svinavel, SLU, Uppsala. Data för hybrid respektive lantrasdjur analyserades separat. Samma typ av analyser gjordes för båda grupperna. Totalt ingår cirka 1000 djur i undersökningen. Av dem är ungefär 270 lantrasdjur och 730 hybrider. Därtill kom 177 bedömda semingaltar.

Resultaten visar att ungefär 75 % av suggorna i båda grupperna inte har några tendenser till att vara knipta. 22 % har bedömts som en 4:a, vilket kanske ska ses mer som naturlig variation i exteriören än en sjuklig defekt. Vid analys av vad som skapar variation hade besättning och kullnummer signifikant inflytande för båda grupperna. Arvbarheten för bedömningen ”knipt” skattades till 0,2.

Vad gäller rygglinje hade fler av lantrassuggorna en sänkt eller hängande rygg: 11,4 % bedömdes med en 1:a eller 2:a jämfört med hybridsuggorna där 6,3 % bedömdes med motsvarande poäng. För både hybriddjuren och lantrasdjur observerades ett samband mellan

kullnummer och rygglinjen (LY***; L*). För hybridgruppen hade bruksbesättning och kullnummer signifikant inverkan på variationen gällande rygglinje. Motsvarande signifikanta samband kunde inte påvisas för lantrasdjuren, troligtvis på grund av för få observationer. Arvbarheten för rygglinje skattades till 0,1.

Av de undersökta djuren hade 6,4 % någon anmärkning gällande bogsår, det vill säga hade bedömts 2-5. En signifikant korrelation observerades mellan bogsår och kroppshull i båda grupperna: Tunna suggor hade mer av bogsår än feta suggor. Ett signifikant samband sågs också mellan kullnummer och bogsår i båda grupperna. En låg arvbarhet, 0,04, skattades för egenskapen, vilket indikerar att förekomst av bogsår till största delen miljörelaterad. Det faktum att förekomsten också varierade kraftigt mellan besättningarna stärker denna teori.

Överlag tycks rygghälsan hos hybridsuggor i bruksproduktion vara bra. Utslagningen av blivande avelsgaltar med ryggfel tycks löna sig så tillvida att problemen inte finns i bruksproduktionen. Ryggdefekter är ingen vanlig orsak till utslagning av hybridsuggor.

2. ABSTRACT

This study deals with two characters in pig conformation: status and health of the back and ulcers of the shoulder. The aim was to estimate prevalence and causes of variation for the characters focused. The effect of parity number, body condition score and reproductive stage was analysed.

A high prevalence of piglets with defect backs (kyphosis) has been noted in a few piglet-producing herds in the south of Sweden. These herds are all buying their crossbred Landrace-Yorkshire females from the same line of Landrace sows. At the same time, another back defect has been seen within the pure-bred Landrace population: "hanging" backs. A nickname for the symptom is "hammock". The breeding company Quality Genetics is today culling many prospective AI-boars because of remarks on the back and asked for an investigation on this problem.

In April 2004, in total 10 swine herds were visited: 8 piglet producers, one nucleus herd with breeding stock of Landrace and one producer of LY-females, who is buying their Landrace females from the above mentioned nucleus herd. In total, about 1000 sows where judged and scored on a scale from 1-5: exterior of the back; both kyphosis and hanging backs, body condition score and prevalence of ulcers on the shoulders. The sows' parity number was also noted.

Analysis of the collected data was performed at the Department of Animal Breeding and genetics, SLU, Uppsala during autumn 2004. The collected data was analyzed in two groups: Landrace sows and crossbred hybrids with Landrace as mother and Yorkshire as sire.

The result shows that about 75 % of the sows studied had no tendencies of kyphosis. 22 % was scored as a "4" which maybe should be seen more as a natural variation than a defect. In analysis of variance, herd and parity number influenced kyphosis score in both groups of sows. Estimated heritability for kyphos is 0.2.

Concerning line of the back, a higher proportion of the Landrace sows had a lowered back (11.4 %) compared with the hybrid sows (6.3 %). For the hybrid sows an effect of parity number on the line of the back was found. No clear trend was seen, but the back score was highest for sows in parity number 2, and lowest for gilts (parity number 0). In analysis of variance, significant influence could be found of herd and parity number for the hybrid sows, but not for Landrace. Estimated heritability for line of the back was 0.1.

Of the sows examined, 6.4 % had some remarks concerning ulcers on the shoulder. A significant correlation between ulcer score and body condition score was found, and also a significant association between parity number and ulcer score for both groups. A low heritability (0.04) was estimated, which indicates that ulcers of the shoulder are most of all environmentally induced. The fact that prevalence of ulcers differed between herds also support this theory. In one herd no sows with ulcers was found, and the worst had 15 % of sows with remarks.

Overall the back status and health seems to be good in the production herds. The culling of prospective sires with remarks on the back seems to be paying. Back problems are today not any of the foremost reasons for culling LY-hybrid sows in piglet producing herds.

3. EXPLANATION OF TERMS USED

Cartilage: (brosk)

Caudal: against tail (mot svansen, bakåt)

Cervical: neck, concerning neck (hals)

Cranial: against head (mot huvudet, framåt)

Dorsal: “Upside” against back (ryggsidan)

Epiphyses: Growth centra of skeletal bone (skelettdelarnas tillväxtcentra)

Foramina: Opening, Hole (hålighet)

Fovea: Small circular cavity, pit (liten cirkulär grop, gällande skelett)

Kyphosis: Hunchback (puckelrygg)

Lordosis: Swayback (svankrygg)

Lumbar: loin, hind-quarters (länd)

Ossification: Formation of bone tissue (benbildning)

Scapula: the bone of the shoulder (bogblad)

Thorax, thoracic: chest, concerning chest (bröstkorg)

Ventral: “Downside” against stomach and intestines (buksidan)

Vertebra: (ryggkota)

4. INTRODUCTION

Attention has been paid towards 2 different types of back defects occurring within the Swedish swine population. One of these defects is affecting piglets bred for fattening and the other primary affecting Landrace after the piglet stage.

A high prevalence of piglets with a back defect named kyphosis has been noted in a number of piglet producing herds in the south of Sweden. This defect is described as a dip behind the scapulae and a hump on the lumbar part of the back. These herds are all buying their replacement crossbred Landrace-Yorkshire females from the same line of Landrace sows. At the same time, the other back defect has been seen within the pure-breed Landrace: "hanging" backs. A nickname for this symptom is "hammock" (picture 1). The breeding company Quality Genetics owned by the farmers' slaughter organisation Swedish Meats, has paid attention to this problem, and asked for an investigation to be done.

Picture 1: Pure bred landrace boar with a "hanging back" photo: H-J Lennartsson, Quality Genetics

Decubital ulcers of the shoulder is a phenomenon sometimes occurring in intensive swine production (Davies et al, 1996). Studies on prevalence and underlying causes have been made in both Denmark and USA (Davies et al, 1996; Cleveland-Nielsen et al, 2004), but hitherto not in Sweden. Ulcers can affect the animals health and welfare and is therefore of interest to investigate.

Earlier studies of the defect kyphosis have described the symptoms in piglets and growing pigs. The prevalence among sows has not earlier been investigated. In earlier studies, morphological changes in the vertebrae shape and epiphyses have been found in severe cases (Done & Gresham, 1998; Corradi, 2004). According to Penny & Walters (1986) the defect was primary seen in fast growing pigs. The causes of the defect are not fully clarified, but most studies suggest some kind of genetic predisposition.

According to Arvén (1980) a lowered back is said to be weaker than an arched or straight back. It is therefore of interest to investigate the prevalence of hanging backs among sows.

The aim of the study was to estimate prevalence, and analyse causes of variation, such as herd, age and the sow's stage in the reproduction cycle, for the characters studied. A literature review about the characters is also included in the study.

5. **LITERATURE REVIEW**

Phylogeny of the swine

Based on paleontological evidence the ancestor of the swine is placed in the Miocene epoch of about 40 million years ago. During this period pigs were present in Europe, India, East India and Africa.The swine is belonging to the phylum of *Chordata,* the class *Mammalia* and the order *Artiodactyla* (even-toed ungulates) which also embraces ruminants like cattle, deer and goats. Swine form a separate suborder, *Suiformes*, in the same group as hippopotamuses (*sv. flodhäst*) and peccaries (*sv. navelsvin*). The swine also belong to a infraorder: *Suina Tyassuidae*, chared with peccaries. The family is *Suidae* (swine) and there are 7 Genus. Domestic pigs of today are descendants of the European wild pig, Genus *Sus scrofa* (Pond & Mersmann, 2001).

Description of the breeds studied: Landrace, Yorkshire and Hampshire

Information presented in "Regler för införande av djur i stambok över avelssvin, Sveriges grisproducenter".

Swedish Landrace

The Swedish Landrace is used in crossbreeding with Yorkshire for production of crossbred sows, which are used as mothers in production of pigs for slaughter. The color is pure white, the ears are hanging and the head is small and "nobel". The legs are gracile and the rear legs are slanted under the body. The loin shall be wide with short well-shaped hams. The body must be slightly pear-shaped.

Yorkshire

Yorkshire is used in crossbreeding with Landrace for production of crossbred sows. The color is white; the ears shall be upright and the head compact. The temper is slightly vivid. Within the breed two different types occur: one higher with a long elegant back, and a larger type with a wide back and well-developed hams.

Hampshire

Hampshire is primarily used as terminal sire breed for producing crossbred pigs for slaughter. The breeding goal includes strong animals with good longevity, high feed efficiency, high growth rate and a high meat percentage in the carcass. The color is black with a broad white band behind shoulder. The ears are upright and the type is dense. Hampshire shall be muscular with well-developed hams. The legs shall be rough and the whole body high. The line of the back shall be arched.

Presence of congenital defects

Swine has the highest prevalence of congenital defects of all domestic species. The most common defect in preweaned piglets are spray leg, cryptorchids and different types of hernias, (Straw et al, 1999). According to the Swedish litter recording scheme "suggkontrollen" about 7 % of the litters registered had some kind of congenital defect at birth, of them 85% (6 % of total recordings) were hernias. In a trial within a well-monitored purebred Yorkshire population, the proportion of litters with defects was about 15 % and one third of these were hernias. This indicates that the reporting to the sow register is insufficient (Simonsson et al, 1997). According to Straw (1999) reviewing a number of investigations concerning congenital defects in piglets, at least 2-3 % of all piglets born have some kind of congenital malformation.

Anatomy of back and shoulder

Morphology of vertebrae

Where no other author is mentioned, the source is Shively´s ”Veterinary anatomy”(1984)

The vertebral column keeps and protects the spinal cord. The vertebrae can be divided into five different sections, see figure 1, according to regional similarities: The *cervical vertebrae (neck)*, the *thoracic vertebrae* (belonging to the thorax) the *lumbar vertebrae* (the loin) and four *sacral vertebre*. The tail consists of the *caudal vertebrae*. The processes of vertebra often work as attachment for muscles. Small cavities (fossa) are carrying blood vessels and nerves.

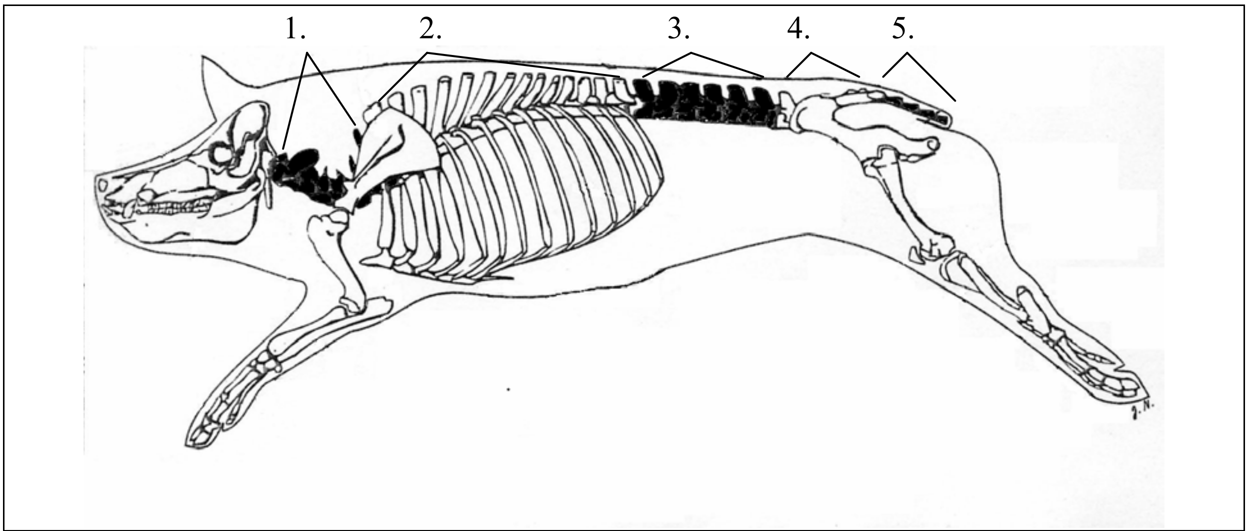


Figure 1: The framework of a pig. Sections of Vertebrae: **1.** *Cervical* **2.** *Thoracic* **3.** *Lumbar* **4.** *Sacral* **5.** *Caudal* Source: Pond & Mersmann (2001)

The first of the cervical vertebrae is called atlas and is atypical in several ways: the spinous process is absent, the body is poorly developed and the wings –transversal processes- are well developed. The second of the cervical vertebrae is called axis. In pigs it has a large process, which is limiting the mobility of the pig’s head. The third to the sixth cervical vertebrae have cranially projected transverse processes termed the *costal processes*. This is the cervical homologue to a rib. The seventh cervical vertebra has a fovea for attachment of the first pair of ribs. In pigs, the last cervical vertebra has a transverse foramina (hole) which is absent in all other domestic species.

The thoracic vertebrae are short and have short transverse processes but long spinous processes. In pigs, these are not completely ossified when slaughtered (market weights). Each vertebra carries a pair of ribs, which is connected against a small fovea. Most domesticated animal species has 13 number of thoracic vertebrae, but pigs normally have at least 14, and in long bodied breeds up to 17 thoracic vertebrae have been recorded.

The 6-7 lumbar vertebrae are characterized by long transverse processes (Shively, 1984), which in pigs can be extend as far as the pelvis is wide (Pond & Mersmann, 2001).

The 4 sacral vertebrae fuse to a single bony mass, which articulates with the wings of the ilia to form the sacroiliac joint.

The tail consists of 20 –23 caudal vertebrae. Most modern countries practice tail docking in newborn piglets, which removes most of the caudal vertebrae (Pond & Mersmann, 2001). Amputation of the tail is done 12-18 mm from the base of the tail (Straw, 1999).

The average feature of a vertebra can be seen in figure 2.

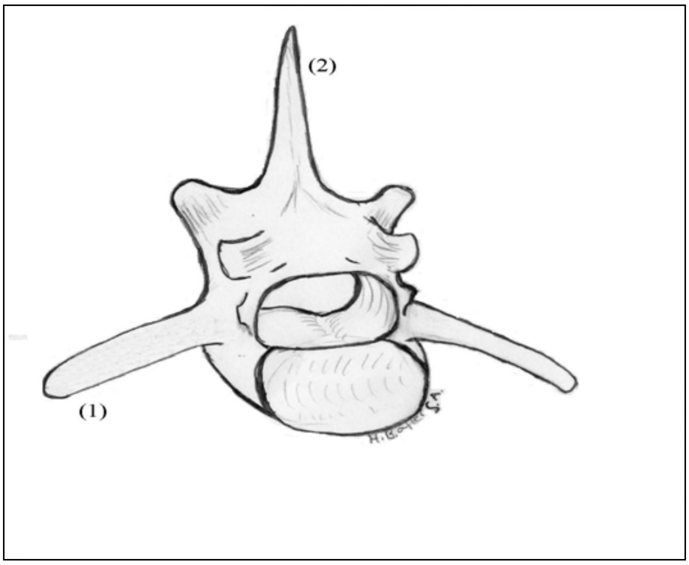


Figure 2: Vertebra with processes: transverse (1) and spinous (2)

Scapulae

The bone of the shoulder (*scapula*) is broader in the upper (dorsal) end and has a large process, (Pond & Mersmann, 2001) where musculus trapezius and musculus deltoideus attach (Shively, 1984). The tubercle of the process is relatively large and is an easily palpable landmark at roughly the midpoint of the scapula (Pond & Mersmann, 2001). The tubercle is distinct in pigs and horses, but poorly developed in other species (Shively, 1984).

Development and growth of the vertebral column

Ossification of various bones in the pig embryo occurs at different stages during the fetal development. The ossification of vertebrae starts approximately at day 36 and of the spinoid processes at day 63 (Pond & Mersmann, 2001).

The vertebrae are developed by ossification in the cartilage surrounding the notochord and forming the sides of the neural canal. There are five primary centers for ossification: one for each half of the arch, one for the centra of the vertebra body and two for the vertebral body's dorsal and cranial sides (the epiphyses). Growth takes place in three different directions: dorsal, to form the total vertebral arch, ventrolateral to provide the costal processes and medial to surround the notochord and establish the ventral body. Later in development secondary centers appears for the extremities of the spinous and transverse processes -except for the cervical region. In the pig the vertebral body part and the arch are united at birth with cartilage but ossificate and fuse during the first months. (Sisson & Grossman, 1975)

It appears that bone tissue develops faster in the back and shoulder regions compared to the ham and loin areas. It seems to be minor influence of breed, sex or nutrition on the proportion of bone in the carcass of the pig. By the age of 28 weeks the sacral vertebrae are proportionally more developed than the lumbar vertebrae, but both are more developed than the rest of the skeleton (Pond & Mersmann, 2001).

Kyphosis and lordosis

Human medicine

In human medicine, the definition of kyphosis is a forward (ventrally) curvature of the thoracic spine of 45 degrees or more (www.orthoseek.com/articles/scheuermann.html 2004-06-02). The commonly used name for the phenomena in human medicine is hunchback. (Norstedts engelsk-svenska ordbok) In lordosis, the spine is curved backward (dorsally) “swaybacked” (http://www.orthoseek.com/articles/scoliosis.html 2004-06-17) and often occur in the lumbar vertebra “loin” (Lindskog & Zetterberg, 1975).

Veterinary medicine, pigs

In pigs, cases of combined kyphosis and lordosis have been described. Both genetic influence and environmental factors are mentioned to be the cause.

Penny & Walters (1986)
From 1981 to 1983, 24 outbreaks were studied. The condition was not seen at birth, but became apparent between 3 weeks and one year of age. Most outbreaks were found in pigs intensively or semi-intensively housed indoors, and the most prevalent time for outbreak time was at weaning. Rapidly growing pigs were most frequently affected and the condition did not influence growth rate. Neither were there any complaints from the abattoir about carcass conformation. The affected animals got a marked dip in the back behind the scapulae, or as a hump in the anterior to mid-lumbar region, and in some case both. Most cases were categorized as mild and a few as severe.

Two pigs, both graded as severely affected, were anaesthetized for further investigations. When anaesthetized, the back of the pigs seemed less humped. When x-rayed, the younger animal showed no abnormality, but in the other pig, that was elder, the vertebral bodies in the humped area gave an impression of having shorter ventral than dorsal surfaces. At post mortem examination, no abnormalities could be found in the vertebral column.

Done & Gresham (1998)
Done and Gresham examined 2 cases of the phenomenon “humpy back”. In 1996 a multiplier unit reported a number of humpy backed pigs, received from a nucleus-breeding unit. Almost all affected pigs in the herd were males and the incidences were low from summer until

December when it suddenly increased. A post mortem examination of two pigs showed no gross lesions in the viscera or abnormalities in the skeletal musculature. The most affected pig had a slight difference in the lengths of the vertebrae. This included distortion of the vertebrae, enlargement of the central canal and ventral displacement in the intervertebral body space. A sagittal section of this pig showed that the vertebrae were slightly changed in conformation and significantly changed in orientation; giving the "humpy" look of the back. Generally, the epiphyses of the vertebrae were broader ventrally than dorsally. Both examined pigs had a pronounced dorsal rim on the scapula.

A bone mineral assay of both cases showed lowered content of calcium and phosphorus and slightly elevated rates of magnesium. This suggests that there can be a low rate of bone formation in the affected vertebrae or an enhanced removal of inorganic matrix. This was however not clarified.

Done et al (1999)
The affected farm was an outdoor farrowing unit with 350 sows. The condition of humpy backs was first seen in the winter of 1996/97 but disappeared spontaneously and was not investigated. In February 1998 it reappeared in the herd and about 30% of the produced weaners were destroyed as casualties and another 30-35% were less severely affected. Again the condition disappeared spontaneously.

The condition affected boars and gilts in equally proportions and was seen at 3-4 weeks of age, at weaning. None of the affected pigs recovered.

When radiography was made severe spinal malformations and presence of hemivertebra (hemi = half) was found. Instead of having the usual rectangle shape, the thoracic vertebrae were reduced to a V-shape. The vertebrae are normally formed from two ossification centers, one at each end of the bone. In this case only one center appeared to be functioning, which gave the vertebra a V-shaped body.

Corradi et al (2004)
Corradi *et al* also describe the scenario of hemivertebra. 20 pigs ageing from 4 to 15 weeks, born in different farms and of different breeds were studied. They were reared under conventional indoor conditions. The older pigs had more severe changes in the vertebras examined. In the pigs of 4-8 weeks of age, no changes could be seen when they were morphologically studied. In pigs of 10 weeks age there was a persistence of cartilage in the ventral portions of anterior and posterior epiphyseal growth areas. In some pigs between 13-15 weeks of age a shortening in the vertebral body was also seen. The vertebra appeared cuneiform and compressed. Cartilaginous tissue, which indicate reduction or absence of matrix calcification and limited or incomplete ossification areas were present, as well as degenerated and atrophic cartilage.

Causes of humpy backs

Riding behavior
Done & Gresham (1998) suggest that the condition can be caused by a rapid increase in the weight of the dorsal spinal musculature, or some kind of adverse environmental condition. In the case reported from UK in 1996, males were more frequently affected, which leads to the suspicion that the condition is associated with "riding" behaviour. The behavior leads to weakening of the spinal ligaments and partial displacements of the invertebral discs (Done et al, 1999).

Intensive housing & rapid growth
Penny & Walters (1986) also suggest managemental and environmental factors as causes for humpy backs. Stress factors such as transportation over long distances, excessive confinement at weaning and sudden attacks of diseases like a cold or pneumonia were suspected cause some cases.

Most cases have appeared in genetically improved populations, where animals were kept under intensive commercial production conditions with fast growth rate. In mild cases a recovery often occurred when the growth rate was reduced, e.g. by lowering the production intensity -the animals were exercised in a yard- and the feeding intensity was lowered. Penny & Walters (1986) conclusion is that no single factor should be blamed and that the condition has a multifactorial aetiology with a possible genetic predisposition.

Genetic origin
In the case described by Done et al (1999) the humpy backs were associated by a non-functioning ossification center in a vertebra, giving a V-shaped "half" vertebra and a dip in the line of the back. They considered it most reasonable that this phenomenon is under genetic control. The seasonal variation of the appearance in this case is a matter of guesses, but they put forward that a infection, probably viral, could affect major organogenesis before birth.

<u>Sheep</u>
Humpy backs caused of toxin
McLennan & Knights (2002) reported that consumption of plants and fruits of the Solanum genus, e.g. Potato bush or Potato weed could cause humpy backs in sheep. Sheep eat the fruit (berries) of this plant, which they find palatable. The toxin in Solanum plants causes when ingested a degeneration of the white matter in the spinal cord and degenerative changes in the brain. The symptoms are seen when the animals have to walk long distances. Affected sheep lag behind the mob and have difficulties moving their hind limbs. They walk with a short stilted gait and arched back. This usually occurs 6-10 weeks after spring or summer rainfall in sheep of good condition with full wool.

Health and welfare perspective

In severe cases of kyphosis, the cavity of the chest is diminished. This truly affects the pig's growth rate and general health (Hansson, 1978).

Prevalence at slaughter

During the late 70´s was kyphosis a raising problem, especially within the Yorkshire breed (Hansson, 1978; Simonsson et al,1997). Today, about 1 pig /month is found at the Uppsala abattoir (200,000 pigs slaughtered/year) with a defect so large that it is affecting the price to the producer. If the "dip" of the back is deeper than 5 cm the price paid to the producer is today reduced with 2 SEK/kg. The slaughtered body is banned with a "K" and at cutting, the body is released from back bones (Sandberg 2004, pers.mess.).

Conformation and exterior of the back related to other diseases

The contour of pigs back ought to be a straight line. A lowered back is said to be weaker than a straight or arched back. The exterior of the back can be linked to other problems; leg weakness is a common example. A long back can easier give leg weakness (Arvén, 1980). The opposite situation can also occur: A defect line of the back can be a secondary effect due to other diseases. One example of this is arthritis, caused by streptococcus or mycoplasma (Simonsson et al, 1997). When the joints are inflammated, the pig gets a rigid and trottery walk. This leads to crumbling of the back (Nielsen, 2004).

Ulcers of the shoulder

Decubital ulcers in humans are an important clinical health problem. Ulcers have been observed in Egyptian mummies and have remained a hard question in medical care. In humans decubital lesions arise because of immobility, underlying diseases, fever, bad nutritional status or moisture. To low depth of the soft tissue that covers bony body parts is an established risk factor. The primary cause of decubital ulcers is unrelieved pressure or shearing forces that result in ischemia (Davies et al, 1997) – lack of blood in a local area of the skin or subcutaneous tissues (Lindskog & Zetterberg, 1975).

Pigs are, compared to other domesticated species, more exposed to local pressure on the scapulae. This might be caused by the elevated tubercle on the pig scapula (Christensen et al, 2004).

In an epidemiological study, Davies et al (1996*b*) found that 8.3% of 1916 investigated sows had ulcers on the shoulders. Of the investigated sows, predominantly lactating sows were affected of ulcers. The prevalence of lesions was associated with time after farrowing, with a peak of prevalence between 11-20 days after partus (Davies et al, 1996*b*). In another study based on data from slaughter, 2.6% of the sows had this type of ulcers. In this study the prevalence differed between herds from 0.4% to 7.8% (Christensen et al, 2004).

Decubital ulcers in sows are regarded to have a multifactorial background (Davies et al, 1997). Recumbency and reduced activity seems to be risk factors, during parturition and in early lactation for example. Thin body condition seems to be another risk factor. Certain floor types seem not to influence the incidence of ulcers per see (Davies et al, 1996*b*), which also was confirmed by a Danish investigation (Christensen et al, 2004). Combined with other factors, like moisturised skin or those mentioned above, the type of floor can matter. Davies found a strong association between presence of ulcers on both side of the shoulders. This indicates, according to the authors, that the ulcers are related to risk factors on animal level.

They also found out that the prevalence of ulcers, scabs and scars of the shoulders increased with increased age of the sow.

In a study from 1997, Davies et al observed considerable healing between days 12 and 18 of lactation. This was before weaning, and indicates that the prevalence of ulcers was not simply a consequence of variation in the facilities, like floor type etc. The behavior of the sows plays an important role in this condition (Davies et al, 1997). Sows that are loose housed during gestation seem to have lower prevalence of ulcers during lactation. In loose housing, the sows can be more active, which gives more muscles and also more activation -less recumbence- during the lactation period (Christensen et al, 2004).

In the study by Davies et al (1996*a*) a farm was visited six times during 1995/96. All sows kept in farrowing crates by the time of each visit were examined. A higher prevalence of ulcers during July-August (USA) was found, compared with other periods of the year. The severity, measured in width of the ulcer had no variation according to season. The farm visited was using drip coolers during summer to cool lactating sows by evaporation. This kept the skin over the scapulae moisturized. Reduced activity during parturition and high temperatures, combined with the increased moisture was explained to contribute to the higher ulcer prevalence during summer (Davies et al 1996*a*).

According to Cameron (1984, cited by Straw et al, 1999) ulcers on the scapula, especially at the protuberant spine, establish on pigs in bad condition as pressure sores, when they are confined on solid or mesh floors. The cases are often combined with low feed intake. Cleveland-Nielsen et al (2004) studied risk factors for prevalence of decubital ulcers by post mortem inspections in 4 Danish abattoirs, combined with telephone interviews of the herd owners. They found 2 factors associated with increased prevalence of ulcers: keeping sows confined by tethering or in stalls, or having two staff persons working in the farrowing units instead of one. Sows kept loose are probably spending more time standing up and moving around than confined sows does. This gives them less time laying down and thereby reduced risk for establishment of ulcers and better recovery. The reason for higher ulcer-prevalence when two persons are working in the unit might be the result of these two persons also having other duties than the farrowing units. If only one person is handling the sows there might be a better continuity in the work, and the staff person is feeling more responsible for the sows.

Cleveland-Nielsen et al (2004) also points out three factors associated with decreased prevalence of decubital ulcers in a herd: Own gilts for replacement, routinely use of hospital pens, and production of pigs under certain high welfare requirements. They found hardly any variation in ulcer prevalence by type of flooring or slots.

In the Danish project ‘Superso’ exterior scoring has been performed during 2 years on females giving birth to 15000 litters. In this project the heritability for ulcers of the shoulders was estimated to less than 1% (Landsudvalget for Svin, Årsberetning 2003). Christensen et al (2004) found a lower prevalence of ulcers in sows of LYL, LYY and LYD –crossbreeds than LY and YL-sows.

Body condition score

The most important thing concerning body condition of sows is to avoid extremes in both directions. A thin and bony sow has no reserves of fat to cover the lack of energy that often arise during the first weeks of lactation. A thin sow also has difficulties to show oestrus. A fat sow will run the risk of agalacti and a prolonged parturition. Fat sows usually have a lower appetite after parturition, which results in high weight loss and the sow get skinny before semination (Simonsson et al, 1997).

Maes et al (2004) found a significant influence of reproductive stage and group of parity number on the back fat level in sows. When investigating body condition score in three herds (A-C) they found that thickness of the backfat increased in two of the three herds (A & C) during the period from day 80 of gestation until farrowing. During lactation the backfat decreased within all three herds. In two (A & C) herds the backfat was significantly effected by reproductive stage: the back fat levels were lower for sows with >2 parities. This was not significantly ensured for the third herd. The differences between the three investigated herds were probably caused by the different feeding strategies applied. Herd A and C were increasing the feeding intensity after half-time gestation whereas the herd B was feeding the same mount during the whole gestation period. The variation in back fat levels between sows were highest at weaning in all herds.

6. OWN STUDY

Background

Many prospective AI-sires with good breeding values for production and reproduction are today culled within Quality Genetics because of remarks on the back. During the winter and spring of 2004 a few piglet producers in the south of Sweden had experienced a high prevalence of piglets with kyphosis; "humpy backs". They also experienced that the mothers of these piglets in many cases had tendencies of kyphosis themselves. Quality Genetics therefore initiated and supported a study on the back status and defects of sows.

Interview with farmer
An introductory interview by telephone was made with the piglet producer that first brought up the problem with kyphosis. The producer meant that the symptom of kyphosis often was seen already in the pregnant gilts when they were brought to the farm –most often during early gestation. The symptom was more pronounced after about three weeks of lactation, when the sows in many cases have lost substantial body weight. Kyphosis of the piglets was seen at 1-4 weeks of age. The affected piglets were regarded to have lower growth rate and more diseases (e.g. arthritis) than piglets not affected by kyphosis. Often a whole litter is more or less affected and the producer suspected a strong inheritance of the symptom: affected sows have more often affected piglets.

Material and Method

Data Collection

Collection of data was made of one person (Hanna) during a 10 days period in April 2004. In total, 10 farms were visited, and the exterior conformation of females was scored. Of these, seven were piglet producers. One was producing Landrace-Yorkshire hybrids with Landrace as dam and one farm was a nucleus farm for Landrace who also produced Landrace-Yorkshire hybrids. The 10th farm was a sow pool. The piglet producing herds, including the sow pool, were all buying their replacement females (L*Y) from either the Landrace nucleus farm, or the hybrid-producing farm. All examined hybrid females were F1-crosses with Landrace as mother and Yorkshire as sire. These females are in this presentation called "LY-sows" or "LY-hybrids".

In total, approximately 1000 sows were examined according to the protocol presented in figure 3. In total, 730 of the sows where L*Y-hybrids and 270 were purebred Landrace. The investigated sows were in different stages of the reproduction cycle. Pregnant gilts were also included.

Body condition score: from behind, scale of 1 –5, where 1=thin, 5=obese
Back: from the side, scale of 1-5 where 1= hollow 5= arched, 3= straight, flat.
Kyphos: from the side, scale of 1-5 where 1= serious kyphosis ("ladies bike") 5= normal (straight, flat)
Ulcers of the scapula: Examination from sides, judge and note the worst side. 1= no wounds, fresh skin, 2=scratch, 3=fresh and open gash, cut, 4=abscess, 5= scar.

Ear number	Body condition Score	Back	Kyphos	Ulcers of the scapula	Year of birth	Number of parities

Figure 3: Protocol used for exterior examination in the study

AI-boars of Landrace, Yorkshire and Hampshire breed at Hörby AI-station were all examined on the same day in July 2004.

All animals were examined according to the protocol presented in figure 3.

During examination the sows were kept in either farrowing pens or were loose housed in groups on deep litter or concrete with straw bedding. Estimation of body condition score was made from behind or from the side of the sow. The line of the back was judged sitting on knee to see the back from the side and not from above. Signs of kyphosis were judged in almost the same way, but more effort and time was used for this scoring, and each animal was viewed from as many positions as possible. Ulcers of the shoulder were noted according to the score in figure 3. Wounds that were fresh and open were judged as worse than scrubs and scars, and abscesses were judged as the worst type of ulcer.

Data of the judged sows was recorded on paper form. Year of birth and parity number was either noted by hand in the protocol or captured from the herd-managing program PigWin in the 5 piglet producing herds where it was used. From the nucleus and multiplying herds, basic information on the sows was captured afterwards from the breeding organisation Quality Genetic´s database.

Data analysis

The recorded information was transferred to EXCEL-sheets. The statistic software program SAS (SAS Institute Inc., Cary, North Carolina, USA) was used for handling and analysing the data collected, including merging of data from PigWin and the QG-database with exterior data. SAS was used for statistical analysis. Associations between variables and factors were analysed by χ^2-tests, Fisher's exact test and by Spearman rank correlations. In the frequency analyses of ulcer score, two groups were formed: one group of no remarks (score =1) and one group with remarks (score 2-5). The data on AI-boars was only analysed according to breed.

The analyses were performed for three groups of data: Landrace-sows, LY-hybrids and boars. The three data sets were analysed separately, but with the same procedures. In the statistical analyses, parity number was arranged into 7 groups from 0 to 6: Gilts (pregnant) were assigned parity number 0. Sows with 6 or more litters born were grouped together, assigned parity number 6. When analysing frequency of back score three groups were formed: one group with a "low" back score (score= 1-2) one "normal" group (score=3) and one group with score of arched backs (score= 4-5). For the Landrace the parity numbers was arranged into 3 groups: Gilts, parity number 1-3, and parity numbers of 4 and higher.

Analysis of variance

To analyse the influence of certain factors on the examination scores, like herd or parity number on the variables, analysis of variance was performed. The GLM procedure in SAS software was used. The analyses of LY-sows were performed in two different sets: one for all sows, and one for the sows where data from the herd monitoring program PigWin was available.

In total, 721 LY-hybrid sows were examined and included in the analyses. Parity, herd, and birth herd (b_herd) were included as fixed effects in the model. The model was set as:

$$y = b\_herd + herd(b\_herd) + parity + residual$$

The Landrace sows were analysed according to the same model, excluding the effect of birth herd.

Analysis of data on LY-sows, where information from PigWin was available, was performed to investige the influence of stage of gestation. The data included 543 sows, with information on last farrowing date. From the analyses, 17 sows that had their last farrowing in the period June 2003 – November 2003 and 6 gilts were excluded.

Parity, herd, birth herd (b_herd) and last farrowing month (l_farr) were included as fixed effects in the model. The model was set as:

$$y = b\_herd + herd(b\_herd) + parity + l\_farr + residual$$

Estimation of heritability
The estimations of heritability were based on data from the hybrid sows only. A sire-model (PROC MIXED) was set up with birth herd, production herd and year of birth as fixed effects and sire (Yorkshire) as random effect. The estimated variance parameters (sire variance and error variance) were used to calculate the heritability. Since the progeny group of a sire included both full- and half-sibs, the estimated sire variance was multiplied by 3 instead of the conventional factor 4 in these calculations.

$$h^2 = \text{additive genetic variation / phenotypic variation}$$

Levels of significance are presented conventionally:
Ns (not significant): $p>0.05$
*: $0.01<p\leq0.05$
**: $0.001<p\leq0.01$
***: $p\leq0.001$

7. RESULTS

In total, 994 females and 178 boars were examined. Of the females, 272 were purebred Swedish Landrace and 721 were LY-hybrids (Landrace mothers and Yorkshire sires). Data on 558 of these hybrids could be found in the database of Quality Genetics, and thereby their pedigree could be identified.

Table 1. Levels of significance for the effects included in the statistical models (analysis of variance)

Variabel	Material	Birth herd	Production herd	Parity number	Last farrowing
Kyphosis	LY (all)	*	***	***	-
	LY (PigWin)	ns	ns	*	*
	L	-	*	*	-
Back	LY (all)	ns	***	**	-
	LY (PigWin)	*	**	ns	*
	L	-	ns	ns	-
Ulcers of scapula	LY (all)	ns	ns	*	-
	LY (PigWin)	ns	ns	ns	ns
	L	-	ns	ns	-
BCS	LY (all)	ns	***	***	-
	LY (PigWin)	ns	*	*	***
	L	-	**	ns	-

Kyphosis

The distribution of score for kyphosis for each group of sows are presented in figure 4 and table 2. No significant correlations (spearmans correlation test) between kyphosis-score and score for line of the back could be found.

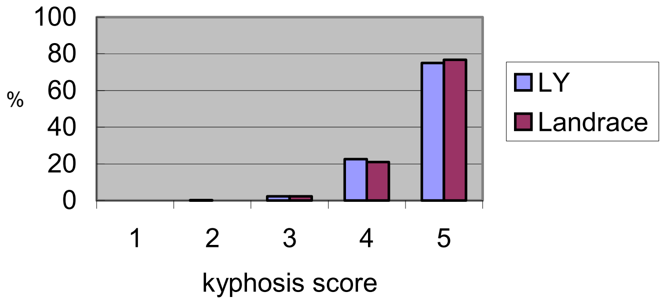


Figure 4. Distribution of kyphosis score for Landrace sows (287), and LY-hybrids (722)

.
Table 2. Distribution of score for kyphosis in purebred Landrace and LY-hybrids. Percentage within groups of sows (number within brackets)

Group of sows	Score of kyphosis				
	1	2	3	4	5
Landrace	0	0	2.2 % (6)	21.0 % (57)	76.8 % (209)
LY-hybrids	0	0.1 % (1)	2.2 % (16)	22.6 % (163)	75.0 % (541)

Significant positive correlations (+0.14) were found between kyphosis score and BCS for both groups of sows. Higher level of significance was found for the LY-hybrid group (***) compared with the Landrace group (*).

In the analysis of variance for the crossbred sows, herd of birth (*), production herd (***), BCS (*) and parity number (***) had significant influence. LSmeans differed between production herds (range from 4.4 to 4.9). In figure 5, LSmeans for kyphosis score as well as BCS are presented by parity number.

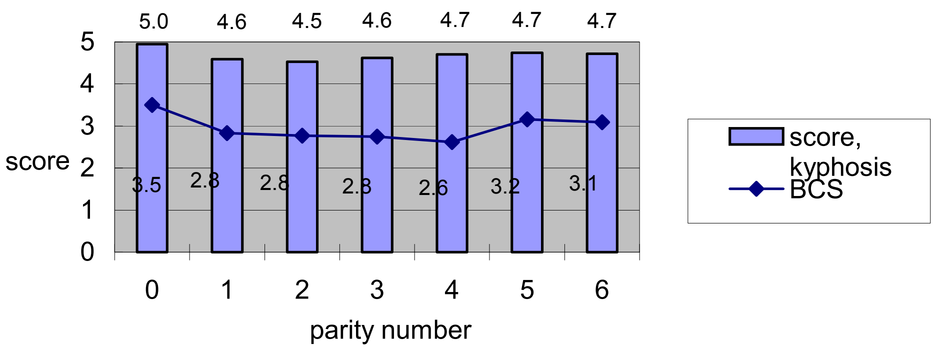


Figure 5. LSmeans of kyphosis score and BCS, for parity number. LY-hybrids

In the group of LY-hybrids for which PigWin-data was available, a significant influence of last farrowing month (*; figure 6), and parity number was found (*).

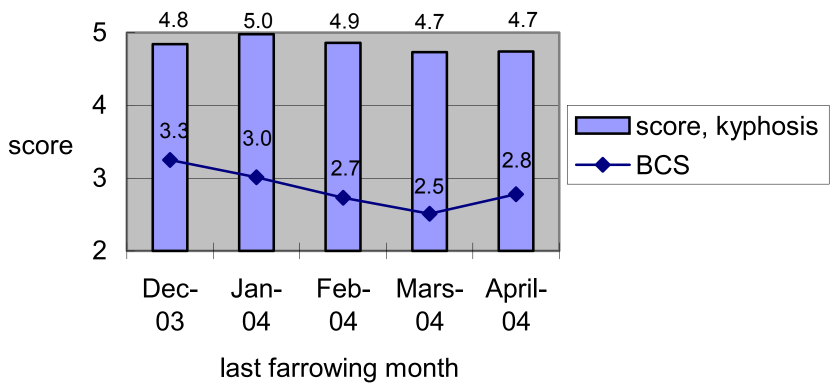


Figure 6. LSmeans of kyphosis and BCS in relation to month for last recorded farrowing (scoring in April-04)

For the Landrace sows, there was a significant influence of the nucleus or multiplier herd (*) and parity number (*) on kyphosis score.

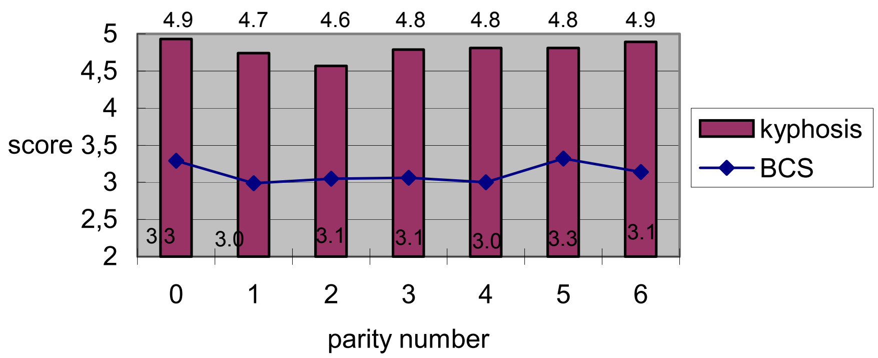


Figure 7. LSmeans of kyphosis score and BCS, for Landrace sows

The heritability for kyphosis score was estimated: $h^2_{kyphos} = 0.2$

Back

The distribution of back score points is presented in figure 8. For both groups of animals a predominant proportion is found in score 3.

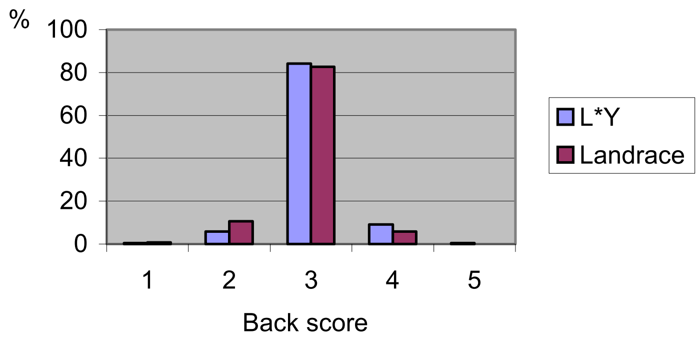


Figure 8. Distribution of back score, LY-hybrids and Landrace

Significant associations between parity number and back score were found: LY-hybrids (***; χ^2-testing) and Landrace (*; Fisher´s exact test).

No significant association was found between line of the back and BCS.

Table 3. Distribution of back score within parity number and group of sows. *Italics = hybrids*

	Back score 1-2	3	4-5	Distribution of parities (% of total, hybrids or all sows)
	Hybrids Landrace	*Hybrids* Landrace	*Hybrids* Landrace	
Parity number: 0	*14.0* 7.4	*81.4* 92.7	*4.7* 0.0	*11.9* 25.3
1	*2.3* 12.9	*91.4* 77.4	*6.5* 9.7	*25.8* 11.5
2	*5.9* 12.0	*75.0* 84.0	*19.1* 4.0	*21.1* 18.6
3	*8.1* 12.2	*82.8* 73.2	*9.1* 14.6	*13.8* 15.2
4	*4.4* 20.8	*88.4* 66.7	*7.3* 12.5	*9.6* 8.9
5	*7.0* 9.1	*93.0* 90.9	*0.0* 0.0	*6.0* 8.2
6+	*7.1* 12.1	*81.2* 84.9	*11.8* 3.0	*11.8* 12.3
Total:	*6.3* 11.5	*84.2* 82.9	*9.6* 5.6	*100* 100

In the analysis of variance of back score, production herd (***) and parity number (**) had significant influence for the group of LY-hybrids (figure 9).

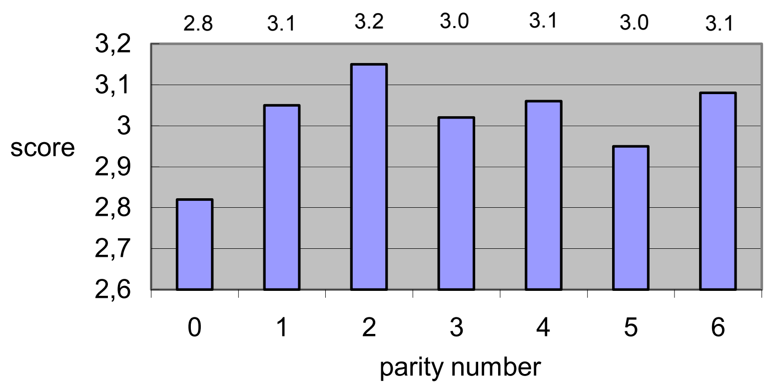


Figure 9. Lsmeans of back score in relation to parity number

Last farrowing month, describing the reproductive stage of the sow, had significant influence on the variation in back score. Sows that had farrowed in March had a significantly higher back score, compared with sows in other reproductive stages (figure 10).

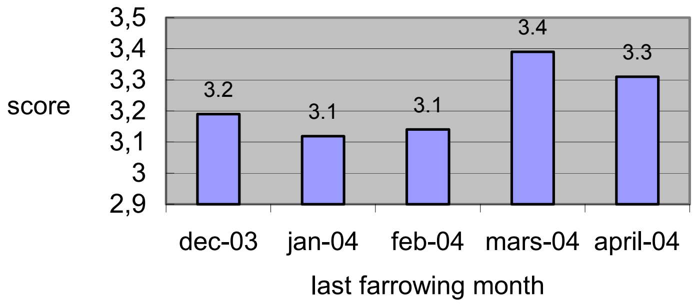


Figure 10. LSmeans of back score in relation to month of last recorded farrowing (LY-sows) (examination in April-04)

In the group of Landrace sows, no significant influence on the variation of back score could be found, neither of herd or parity number. In figure 11 the "age trends" for back score for both Landrace and LY-hybrids can be seen.

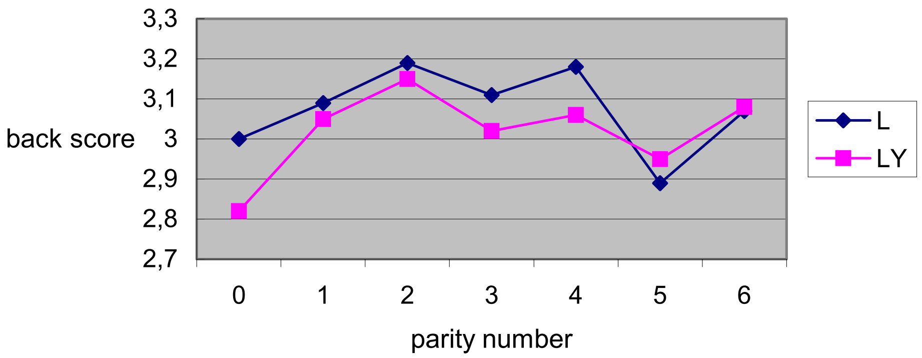


Figure 11: Lsmeans of back score for parity number, within group of sows

The heritability for back score was estimated: $h^2_{\text{line of the back}} = 0.10$

Ulcers of the shoulder

The distributions of different scores for the two groups are presented in table 4. Of all examined sows, 6.4% had some kind of remark considering ulcers or scars of the shoulder. When comparing Landrace sows and LY-hybrids, 11.8 % of the Landrace sows had a remark compared with 4.4% of the hybrids. For both groups of sows, significant (***) associations between Body Condition Score (BCS) and ulcers were found using Fisher's Exact test. Sows with a BCS of 2 or lower had higher ulcer score than sows with BCS of 4 or higher.

Table 4. Score of ulcers on the shoulder

Group of sows	Score of ulcers				
	1 No wounds	2 Scratch	3 Fresh and open gash, cut	4 Abscess	5 Scar
Landrace (n=272)	88.2 % (240)	1.5 % (4)	4.8 % (13)	1.5 % (4)	4.0 % (11)
LY-hybrids (n=722)	95.6 % (690)	1.1 % (8)	0.8 % (6)	0.4 % (3)	2.1 % (15)

The prevalence of ulcers differed between herds. One herd had no remarks at all (score 1 = 100%). In the herd with highest prevalence of remarks, 15 % of the sows had, or had had, some kind of ulcer or scars (score 2-5) and the majority of them were scores 3, 4 or 5. A significant influence of herd was found for both groups (*LY-hybrids, Fisher's Exact test; *Landrace χ^2-test).

Significant spearman correlations (***) were found between ulcers score and BCS for LY-hybrids (-0.2) and for Landrace (-0.3).

Significant influence of parity number on ulcers score was found for both groups of sows (Fisher's Exact test; Landrace sows: ***; LY-hybrids: *). Also, in the analysis of variance, a significant (*) influence of parity number on ulcer score was found for the LY-hybrids. Herd of birth, production herd or time from last farrowing had no significant influence. For the Landrace sows, no significant influences were found in the analyses of variance.

The heritability for ulcer score of the scapula was estimated: $h^2_{\text{ulcers}} = 0.039$

Body condition score

The mean Body Condition Score (BCS) was between 2.9 and 3.0 for all female groups, see table 5.

Table 5. Body condition score within groups of sows

Group of sows/gilts	Body condition Score
Landrace	2.9
LY-sows	3.0

By χ^2-testing, an association between BCS and parity number was found. Gilts and sows with parity number 5 or more seemd to have a higher proportion of BCS 4-5 and lower proportion of BCS 1-2 compared with sows in parities 1 to 4.

Table 6. Distribution of BCS within parity number and group of sows. *Italics = hybrids*

	BCS: 1-2	3	4-5	
	Hybrids Landrace	*Hybrids* Landrace	*Hybrids* Landrace	Distribution of parity number
Parity number: 0	*5.8*	*60.5*	*33.7*	*11.9*
	1.5	72.1	26.5	25.3
1	*17.2*	*70.4*	*12.4*	*25.8*
	22.6	77.4	0.0	11.5
2	*20.4*	*68.4*	*11.2*	*21.1*
	32.0	62.0	6.0	18.6
3	*25.3*	*61.6*	*13.1*	*13.8*
	24.4	73.2	2.4	15.2
4	*34.8*	*52.2*	*13.0*	*9.6*
	20.8	79.2	0.0	8.9
5	*4.7*	*65.1*	*30.2*	*6.0*
	27.3	63.6	9.1	8.2
6+	*12.9*	*55.3*	*31.8*	*11.8*
	18.2	69.7	12.1	12.3
Total:	*18.1*	*63.8*	*18.2*	*100*
	19.0	70.6	10.4	100

For the LY-sows, production herd, parity number and month of last farrowing had significant influence on the variation in BCS. The highest score was found for the gilts, and the lowest for the group of sows with 4 parities (figure 12). The sows that had farrowed the month before examination had the lowest BCS (figure 13).

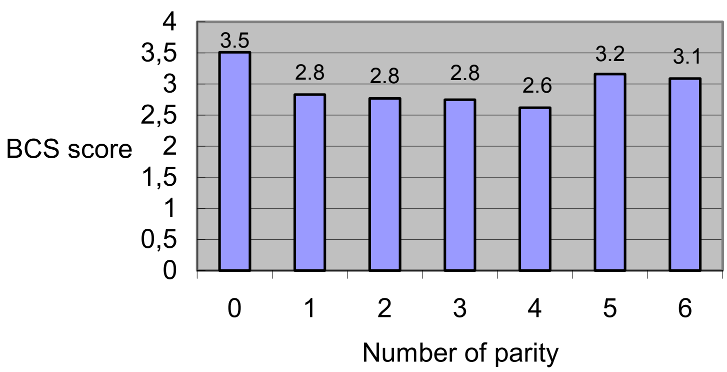


Figure 12. LSmeans of BCS for LY-hybrids by parity group

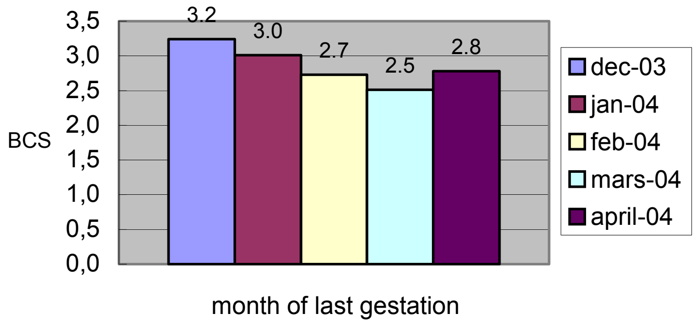


Figure 13: LSmeans of BCS for LY-hybrids in relation to last farrowing month (The sows were examined in April 2004)

In the group of Landrace sows, parity number had no significant influence on the variation of BCS, but the effect of herd was significant (**).

The heritability for BCS was estimated: $h^2_{BCS} = 0.4$.

Boar data

In total 13 Landrace, 15 Yorkshire and 149 Hampshire boars were examined. The average BCS for all boars were 3.2. The mean score for kyphosis was 4.99 – 2 boars were considered to be a "4". The mean for back score was 2.9. The distribution for this character between breeds is found in table 7. A significant association (**) between breed and score was found (Fishers Exact Test). The Landrace boars had a lower back score than boars of other breeds.

Table 7: AI-boars: percentage of back score within breed. Number of observations within brackets

Group of Boars	Line of the back, score				
	1	2	3	4	5
Landrace	7.7 % (1)	46.2 % (6)	46.2 % (6)	0	0
Yorkshire	0	6.7 % (1)	93.3 % (14)	0	0
Hampshire	0	13.4 % (20)	85.2 % (127)	1.3% (2)	0
Total	0.6 % (1)	15.3 % (27)	83.1 % (147)	1.1 % (2)	0

8. DISCUSSION

Methods used in the study

In this study only sows and boars were included. Piglets, fattening pigs (LY*Hampshire-crosses) and younger potential replacement gilts were left outside. It would have been of great interest to also include LY*H-pigs (the most common breed combination in Swedish fattening pig production) in the project. This would also have given the possibility to combine data recorded after slaughter with records made at examinations several times during lifetime, and to see if and how the back changed over time. In this project, one important aim was to analyse the genetic background (=heritability level) for back health and status. Since the pedigree of sows are generally easier to find than the pedigree of fattening pigs, it was most convenient to base the study on this type of data. This data was also good for estimation the association between age and the health and status of the back.

The author's limited experience of exterior judgement of pigs when this project started, might have influenced the accuracy of the study.

Humpy backs (kyphosis)

In descriptions of humpy-backed-cases two different types of the defect can be identified: One congenital and probably with a genetic origin and one with a possible genetic predisposition but environmental conditions being the primary cause. The outbreak that initiated this study differs from those cases described by Penny & Walters (1986) and Done & Gresham (1998). In this project a higher prevalence of other health disorders and a lower growth rate was, according to the herd manager, found among piglets with kyphosis,. The cases described by Penny & Walters (1986) and Done & Gresham (1998) show the opposite: often the thriving and fastest growing pigs were affected. The herds with pronounced humpy back problems in this study were keeping the sows with piglets loose housed from 14 days of lactation. It could be, that this is affecting piglets with kyphosis tendencies negatively. Pigs kept in loose housing are probably more active compared with piglets kept in conventional pens, and are thereby probably loading their back more. This can possibly lead to restricted mobility and pain. If so, the affected piglets get difficulties in competing for the feed (sow milk as well as piglet feedstuffs) and thereby get weaker.

In this study no morphological investigations of affected animals were performed. Done & Gresham (1998) found that the epiphyses of vertebrae in affected piglets were thicker ventrally than dorsally. Penny & Walters (1984) found the opposite: shorter ventral than dorsal surfaces of the vertebral bodies. Corradi et al (2004) found disturbed bone formation in the ventral parts of the vertebrae in 'humpy-back' piglets (< 15 weeks of age). These three cases all indicate that kyphosis is arising because some kind of defect in the vertebrae bone formation.

No information in literature has been found focusing on sows with symptoms of kyphosis. The result from this study shows that the prevalence of kyphosis is low. Gilts with signs of kyphosis are probably not recruited to be sows. The population of sows studied is therefore selected and not fully representative for the prevalence of kyphosis in an unselected group of sows. It would have been of interest to also investigate prospective replacement gilts.

A significant correlation (+0.14) was found between BCS and kyphosis, indicating that skinny sows have a somewhat higher prevalence of kyphosis. One explanation to this association could be that the shape of the neck and back is easier to see on a skinny sow.

The differences in score of kyphosis between herds are probably the effect of differences in time and strategies for culling.

In figure 5 differences in kyphosis score can be seen between parity groups. The gilts seem to have the lowest prevalence of kyphosis. It might be that gilts often are in good body condition, and the defect is therefore hard to recognize. After 2 farrowings the average kyphosis score is higher (better). This is probably an effect of that sows with kyphisis to a higher proportion already are culled. The good looking and healthy sows are those who are still left in the herd in higher age.

In figure 6 it can be seen that the sows that farrowed in March –one month before examination- to a higher proportion had tendencies of kyphosis than the others. These sows were probably lactating at the examination (and were more skinny) and the tendencies to kyphosis might be easier to see. Sows kept in individual farrowing pens are also easier to judge than sows being loose housed.

Back

The few reports focusing on the back of the pig which have been found, state that defect backs can cause secondary effects of higher importance than the back defect by itself. The most important effect is unhealthy loading pressure in the joints, which can lead to leg weakness symptoms.

It seems as if age does influence the back of the sows. This can be confirmed by the results presented in figure 12, showing that average back score is slightly decreasing when the sows get older (from parity number 2). In parity number 6 an improvement can be seen, probably caused by culling of defect sows. It should also be remembered that sows with more than 6 parities are grouped together in the analyses.

The influence of parity number was not significant in the Landrace data, probably because a too small size of the data.

The heritability for back score was estimated to 0.1. Maybe the back scoring should have been divided in two different characters: hanging and arched. There are probably different anatomical backgrounds why the backs get arched or hanging. Therefore it would have been of interest to estimate the heritability for the incidences of hanging backs and arched backs separately. The size of the present data set was however regarded to be too small for such analyses.

Ulcers of the shoulder

Cleveland-Nielsens (2004) survey on risk factors for Decubital Ulcers is made under Danish production conditions, and thereby not fully comparable with Sweden. Keeping sows confined during gestation and pregnancy is not allowed in Sweden. Ulcers are usually arising during the time of farrowing and lactation when the sow is spending much time lying on the floor and in the same time losing weight. The factors Cleveland-Nielsen found to affect the prevalence of ulcers all have something to do with handling and caring of the sows except the factor of “own gilts for replacement”.

Davies report from 1997 is discussing the sow’s behavior during the periparturient and early lactational period as an important factor for ulceration of the shoulders. The reasons for a certain behavior are however not discussed. Prolonged recumbence after parturition, is mentioned as a risk factor for ulcers and can reasonably be thought to be an effect of some kind of sickness. Then it is not the recumbence per see that is the trigger factor for Decubital wounds, but the sickness itself.

The Danish superso project (Landudvalget for svin, 2003) estimated the heritability for DUs to be lower than 1%. This points out that Decubital Ulcers in many ways is a question about management. The formation and anatomy of the scapula plays a role in the presence of ulcers(ref.). One might speculate that if also the shape and formation of the scapula bone are recorded, the potential for genetic improvement concerning DU's might increase. Christensen (2004) concluded that sows of LYL, LYY and LYD –crossbreed had a lower prevalence of ulcers. Herds with these breed combinations of sows are probably recruiting their own gilts, and thereby is it getting easier to select against prevalence of ulcers. Maybe are they also offering a better environment.

Since all sows in Sweden have the possibility to move around freely during gestation, and fixation is just temporary and of little use, we could expect less of ulcers on the shoulder than in the Danish projects referred to.

The percent of remarks at the shoulder differed between herds in this project from 0 % to 15 % and a significant association (***) between body condition score and ulcers score was found in both groups of sows (Landrace and LY-hybrids). This indicates that the presence of decubital ulcers of the scapulae in many ways is a matter of feeding and management, just as Cleveland-Nielsen (2004) found out. This is also confirmed by the low h^2 that was estimated.

Body condition score

Parity number seems to influence BCS. Older sows (parity number 5 or higher) seem to have higher BCS compared with sows in parities 1 to 4. The mean number of parities in Sweden before culling is 4.5 (Simonsson, 1997). Sows are generally loosing a bit of their body condition during lactation (Simonsson et al, 1997). It might be that sows that are not loosing in body condition during lactation will to a higher proportion come into heat after weaning, and stay in the herd for another parity.

The Landrace sows had a lower average BCS than the hybrid sows. This might partly be caused by the more "slimmy" appearance of the Landrace sows, but also the fact that one of the Landrace herds had had problems with their feeding system during a period just before the visit. The herd owner claimed that, because of this problem, more sows than normal were thin.

Boars

The exterior of prospective AI boars are judged by the technical staff of Quality Genetics in the quarantine before arrival to the AI-station. They are at that time approximately 7 months of age and thus not full-grown (Lennartsson, pers. mess., 2004). It is therefore hard to predict how the boars back will look like at mature body size. The turnover of the AI-boars is fast, and their genetic potential for longevity is therefore hard to predict on the animal it self.

The results are showing that the health and status of the back is over all good, but that there are some tendencies to "hanging backs" within Landrace. One base on which selection could be performed is to record back status of all ultrasonically tested animals (at 5 months of age) and include that information in the breeding value estimation.

Estimates of heritability

The values of heritability that were estimated in this study might be influenced by the incomplete structure of the data set. A sire model was applied because almost all hybrid sows judged had different mothers. If the number of judged hybrid sows had been larger, more related animals would hopefully been included. A study based on a larger data set, and the use of animal model methodology instead of a sire model, would probably have given more accurate estimates of heritability.

ACKNOWLEDGEMENTS

First of all, I would like to thank the farmers who let me in to their herds and came up with very interesting thoughts and questions.

My supervisor, Nils Lundeheim; thank you! Your knowledge, your patience and your intelligent mind… It has been an honour having you as a supervisor. You are GREAT!

Thanks to Maria Kihlberg, Quality Genetics, for bringing this subject up, helping me with contacts and getting started.

Thanks also to Hans-Johan Lennartsson, Quality Genetics, for lending me the picture (page 5)

Special thanks to my fellow students who also has been/ are writing their master thesis ("ex-jobb") at the department. Ann-Sofi, Fifi, Sofia & Maria: In the future, our friendship is what I primary will remember from this year.

At last, I would like to thank my dear parents Gerth and Ann-Sofie Bradley for always supporting me with encouraging words, faith and hughs (and money now and then… ☺) during my whole education time. What would I do without you?

REFERENCES

Internet

Landsutvalget for svin, Danske slagterier, Årsberetning 2003: Avl og Opformering. Superso s. 27. (http://www.danskeslagterier.dk/smcms/Landsudvalget_Svin/Index.htm?ID=266 2005-01-21)

McLennan, N., Knights, G., Livestock health: humpy back in sheep, Agency for Food and Fibre Sciences, Department of Primary Industries and Fisheries, Queensland Government (http://www.dpi.qld.gov.au/sheep/10034.html 2004-07-08)

Nielsen Okholm, E., Dyrlaege. Ph.d.. Mykoplasmaledbetaendelse –patogenese og diagnostik VetInfo nr. 0411 27/2-2004. Landsudvalget for Svin, Danske Slagterier (http://www.danskeslagterier.dk/smcms/Landsudvalget_Svin/Index.htm?ID=266 2005-01-21)

Orthoseek. (www.orthoseek.com/articles/scheuermann.html 2004-06-02)

Literature

Lindskog, B. I., Zetterberg B. L., 1975. (editors) Medicinsk terminologi, AB Nordiska Bokhandelns förlag, Stockholm

Pond, G. W., Mersmann H. J., 2001. (editors) Biology of the domestic pig, Cornell University Press

Shively, M. J., 1984. Veterinary anatomy: basic, Comparative and clinical, Texas A&M University Press

Sisson S., Grossman J. D., edited by Getty, R., 1975. The anatomy of the domestic animals. Volume 1 p. 25-26, W.B. Saunders company

Straw, B. E., D'allaire, S., Mengeling, W. L., Taylor, D. J., 1999. Diseases of Swine 8th edition, Blackwell Science

Articles

Arvén, K., 1980. Svinens kroppsbyggnad, benställningar och rörelser, *Rapport nr 43, Institutionen för husdjursförädling och sjukdomsgenetik,* SLU, Uppsala, 1980.

Christensen, G., Brogaard Petersen, L., Vestergaard, Kaj., Wachmann, H., 2004. Sammanhængen mellem visse besætningsfaktorer og skuldertrykning hos soer, *Landsudvalget for svin, Meddelse nr. 660,* 26.05.2004

Cleveland-Nielsen, A., Bækbo, P., Ersbøll, A.K., 2004. Herd-related risk factors for Decubital Ulcers present at post-mortem meat-inspection of Danish sows. *Prev. Vet. Med., 2004:64, 113-122.*

Corradi, A., Alborali, L., Passeri, B., Salvini, F., De Angelis, E., Martelli, P., Borghetti, P.,2004. Acquired Hemivertebrae in "humpy-backed" piglets. *Proceedings of the 18th IPVS Congress, Hamburg, Germany; Vol. 1, p357.*

Davies, P., R., Morrow, M., Deen, J., 1996.a. seasonality of shoulder ulcers in lactating sows. *Proceedings of the 14th IPVS Congress, Bologna, Italy 1996.*

Davies, P., R., Morrow, M., Miller, D.,C., Deen, J., 1996.b. Epidemiologic study of decubital ulcers in sows. *J Am Vet Med Assoc 1996;208 1058-1062*

Davies, P., R., Morrow, M., Rountree W., G., Miller, D., C., 1997 Epidemiologic evaluation of Decubital ulcers in farrowing sows. *J Am Vet Med Assoc 1997;210:1173-1178*

Done, S.,H., Gresham, A.,C., 1998. *Pig veterinary Journal, 1998:41 p. 134-139*

Done, S., H., Potter R.,A., Courtenay, A., Peissel, K., 1999. *The Pig Journal, 1999:43 p. 148-153*

Hansson, I. 1978. Deformerad rygg på svin defekt att beakta i avelsarbetet. *Svinskötsel 1978:1, p .*

Maes, D.G.D., Janssens, G.P.J., Delputte, P., Lammertyn, A., Kruif, de A., 2004. Back fat measurements in sows from three commercial pig herds: relationship with reproductive efficiency and correlation with visual body condition scores. *Livestock Production Science 91 (2004) 57-67.*

Penny, R.H.C., Walters, J.R., 1986. Veterinary Annual, 26, 128-132.

Sveriges grisproducenter: *Regler för införande av djur i stambok över avelssvin*. Sveriges grisproducenter - svinavelsföreningen 10533 Stockholm

Personal message

Jonsson, Håkan, National Board of Agriculture (Jordbruksverket), 55182 Jönköping, 2004-10-15.

Lennartsson, Hans-Johan, Quality Genetics HB, 24482 Kävlinge, 2004

Sandberg, Leif, Swedish Meats, 75105 Uppsala, 2004-10-29