Phenotypic and genetic relationship between litter birthweight characteristics, indicators of intrauterine growth restriction and piglet survival

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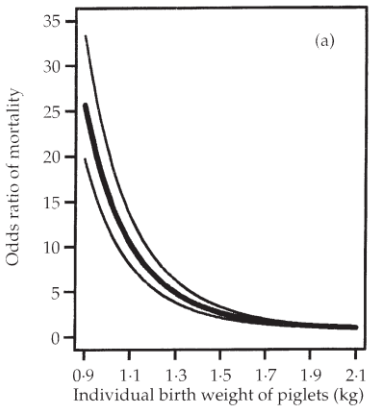
Risk factor for piglets

- Low birth weight piglets
  - Industry-wide push for selection of increased litter size in breeding herds
  - More piglets being born with reduced birth weight (Rutherford *et al*, 2013; Root *et al*, 2012)
  - More intra-litter birth weight variation (Rutherford *et al*, 2013; Baxter *et al*, 2013)

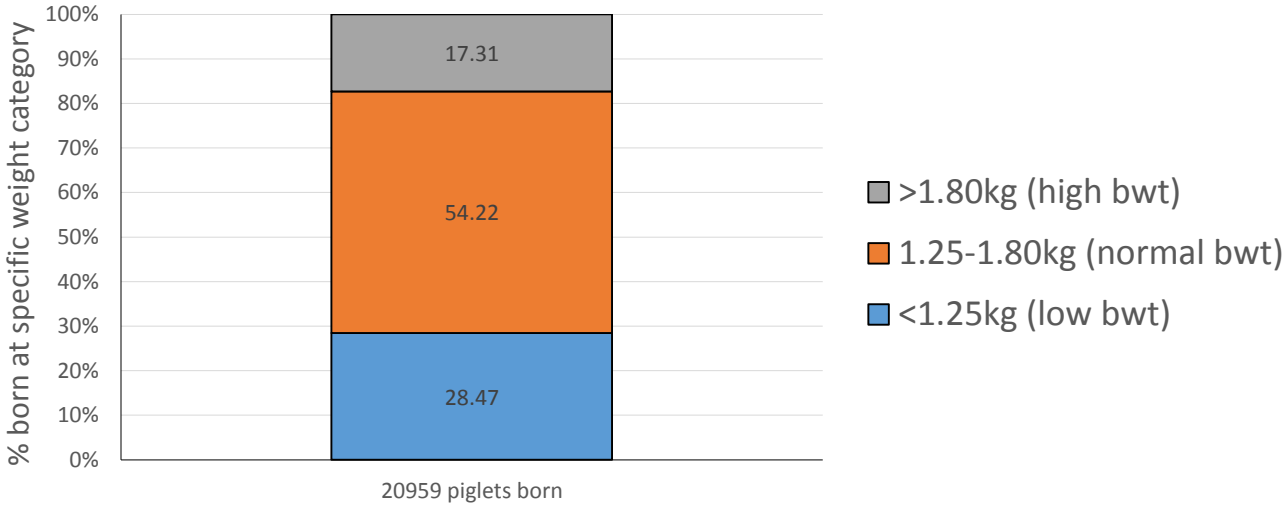
What is a low birth weight piglet?

- Meta-analysis study of risk focusing on piglet outcomes
  - Piglets with a birth weight ≤1.25kg are at a significant risk of impaired lifetime growth (Douglas *et al,* 2013)

Roehe & Kalm, 2000



Data from Multiplier herd 2016



More than just low birth weight?

- Low birth weight piglets may be:
  - Small for gestational age (SGA)
  - Intrauterine growth restricted/retarded (IUGR)

- Intrauterine growth restricted (IUGR) piglets typically identified by birthweight

- However, birthweight does not indicate whether a piglet has been exposed to IUGR during development

More than just low birth weight?

How to recognise IUGR?

- Chevaux *et al* 2010 developed scoring system for identifying IUGR piglets based on head morphology
  - 'Brain sparing' effects – prioritised brain development
  - Foetal adaptive reaction to placental deficiency

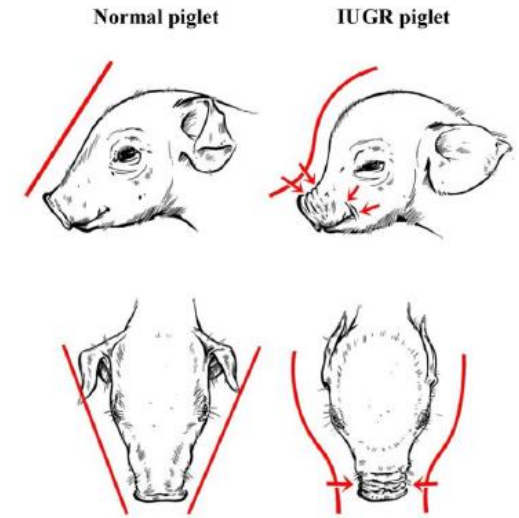
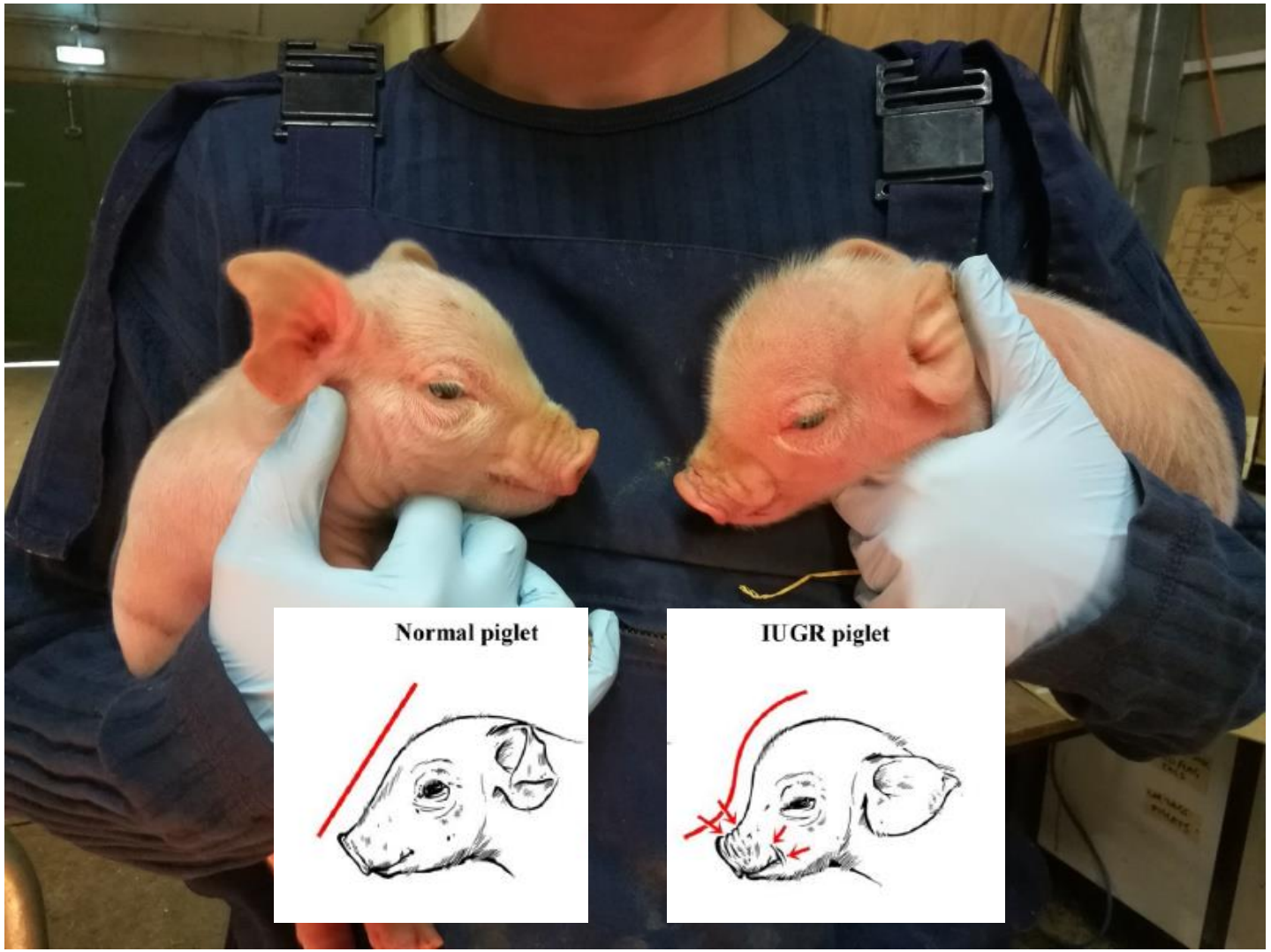


Figure 2. Illustrations of a normal (left) and a growth-restricted piglet (right). Criteria for growth restriction were 1) steep, dolphin-like forehead, 2) bulging eyes, and 3) wrinkles perpendicular to the mouth. IUGR = intrauterine growth restriction. See online version for figure in color.

Figure 1: *Dorso-ventral characteristics of normal (left), intermediate (middle) and IUGR (right) piglets*

Normal vs IUGR head shape

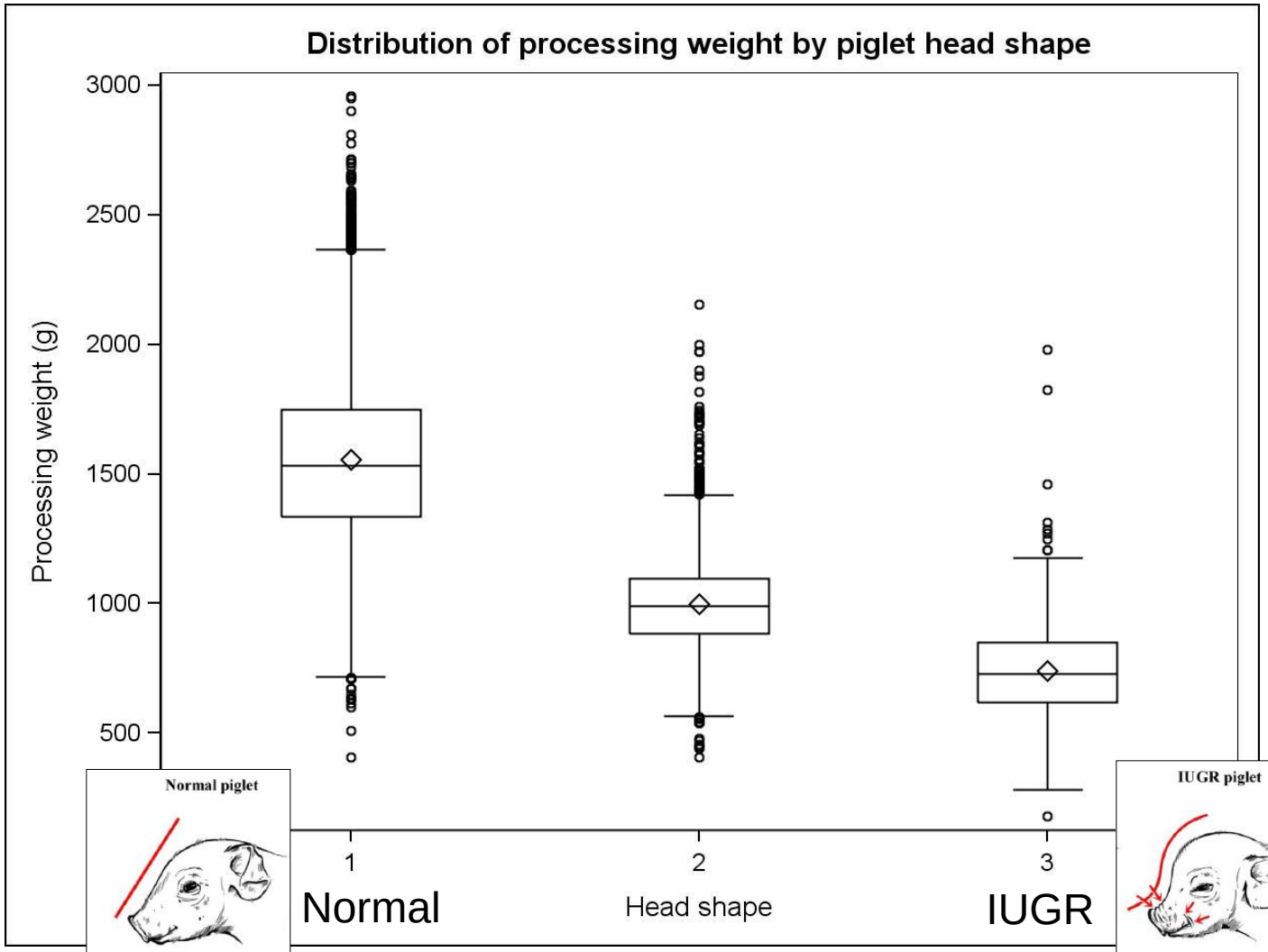


Data collection

- Data collection over 52 weeks
- Number of piglets – 21,159
  - Birth weight
  - Head shape
  - Cause of death (and date)
- 1,575 farrowings
  - 862 individual sows
  - Parity 1-6+

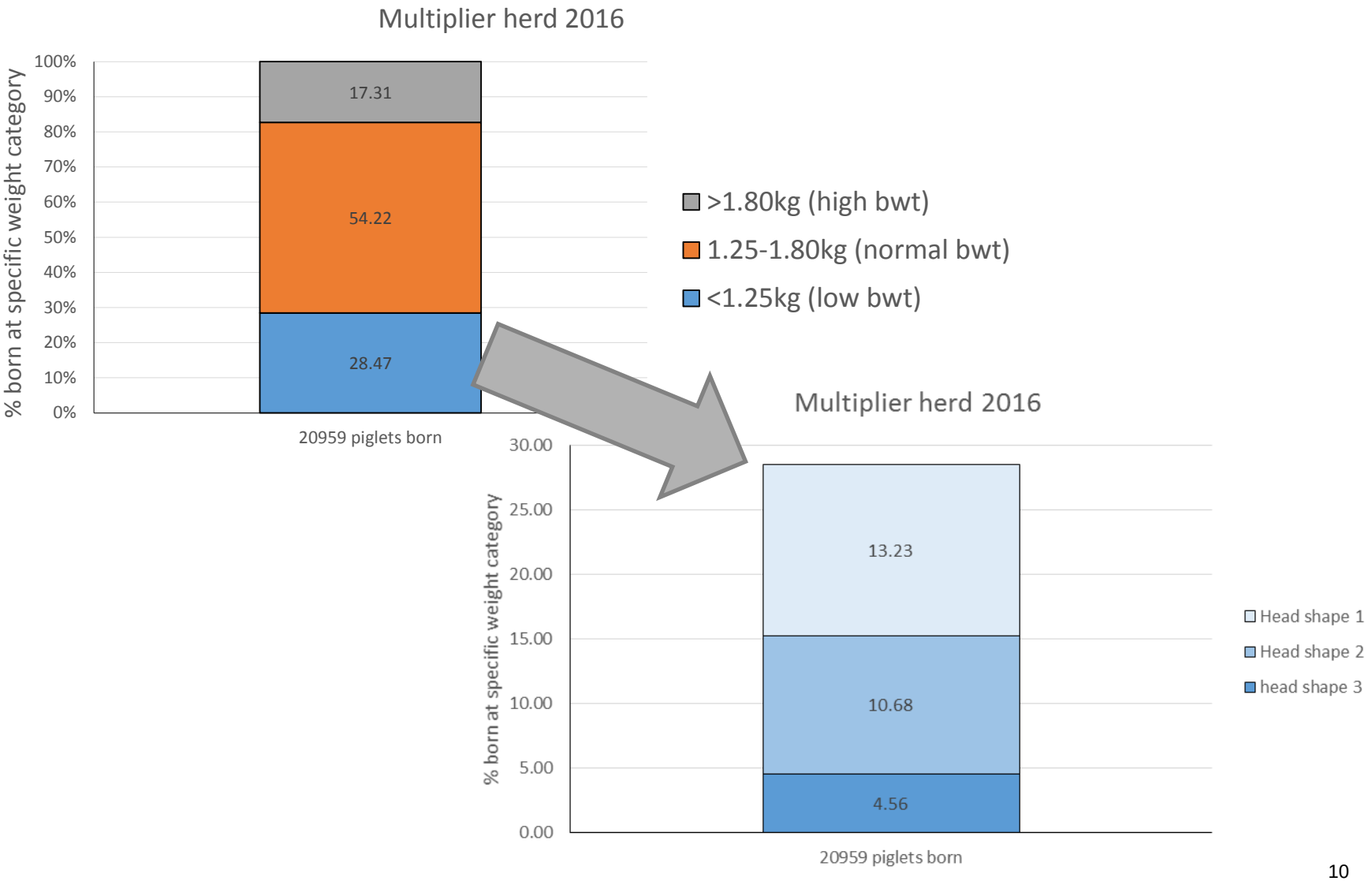
www2.sch.im/groups/livestockroadshows/revisions/498d3/4/

Birth weight – head shape



Slightly IUGR

What is a low birth weight piglet?



Genetic selection approach:

- Two approaches:

- **Piglet level selection:**
  - Select on piglet head shape at birth

	Head shape 0/1	Birth weight
Head shape 0/1	**0.05** ± 0.016	-0.62 ±0.008
Birth weight	-0.72 ± 0.09	**0.18** ± 0.040

!r ANIMAL ide.(DAM)

Genetic selection approach:

- Two approaches:

- **Piglet level selection:**
  - Select on piglet head shape at birth

- **Sow level selection:**
  - Select on the proportion of piglet head shapes at birth within a litter

  - Proportion of IUGR-head shape piglets – IUGR-PROP
  - Within litter average birth weight – avBWT
  - Within litter standard deviation of birth weight – sdBWT
  - Litter size at birth – Littersize
  - Proportion of litter surviving to processing – SURV-PROP

Genetic selection approach – 2

PROHEALTH

Sow level - selection on IUGR-PROP

	IUGR-PROP	avBWT	sdBWT	Littersize	SURV-PROP
IUGR-PROP	**0.19** ± 0.05	-0.52 ± 0.02	0.10 ± 0.02	0.23 ± 0.02	-0.18 ± 0.02
avBWT	-0.88 ± 0.07	**0.38** ± 0.07	-0.06 ± 0.03	-0.59 ± 0.02	0.26 ± 0.02
sdBWT	-0.23 ± 0.22	0.61 ± 0.17	**0.13** ± 0.05	0.19 ± 0.03	-0.08 ± 0.03
Littersize	0.63 ± 0.19	-0.62 ± 0.14	-0.53 ± 0.27	**0.11** ± 0.04	-0.11 ±0.03
Surv-PROP	-0.64 ± 0.25	0.85 ± 0.20	0.49 ± 0.32	-0.63 ± 0.29	**0.06** ± 0.04
Repeatability	0.19 ± 0.04	0.40 ± 0.03	0.17 ± 0.04	0.25 ± 0.03	0.17 ± 0.04

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Conclusions

- Piglet survival is phenotypically impaired by large litter size and low piglet birth weight (nothing new)
- IUGR has detrimental effects on survival – these are in addition to the influence of birth weight
- IUGR using head shape as a simple phenotypic marker is amenable to genetic selection
  - Selection at the **sow level** against IUGR could be highly effective in improving piglet survival
- Selection for lower proportion of IUGR in a litter has favourable genetic correlations with average birth weight and survival
  - However, the genetic correlation with litter size is unfavourable

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