Fetal development in hyper-prolific sows

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Abstract 564 (A. Strathe, T.S. Bruun, C. Amdi)

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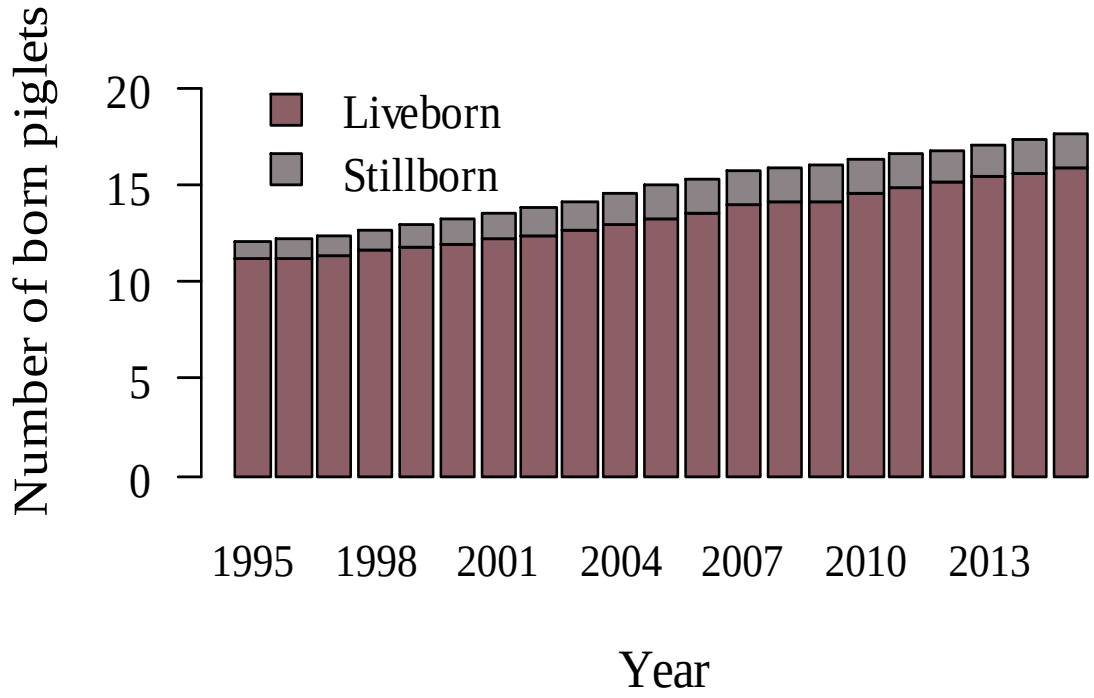
Agenda

- Background
- Slaughter trial
  - Material and methods
  - Results on sow level
  - Results on fetal level
- Conclusion
- What is next?

Background

Continuous increase in litter size in Danish sows



2017:
Liveborn: 16.9 piglets
Stillborn: 1.8 piglets

Source: Seges.dk

Background

- **Increasing litter size -> increased number of small/IUGR piglets**

-> Increased mortality in IUGR piglets

Year	2017	2016	2015	2014
Mortality untill weaning, %	13.6	13.3	13.4	13.6
Liveborn, piglets per litter	16.9	16.3	15.9	15.6

Source: Seges.dk

IUGR = Intrauterine growth restricted

Background

- We can make more of the small piglets survive……
- BUT… It takes a lot of work and resources to do so.

- **SO it would be better if we could decrease the number of small/IUGR piglets at birth!!**

Project: Feed4Life (2018 to 2021)

Slaughter trial on gestating

- **The aims were to gain new knowledge on:**
  - Fetal development in sows with high litter size
  - How early can we detect differences in fetal size within the litter
    → when does the damage happen??
  - What defines small versus large fetuses?

Animals

- 47 parity 4-9 sows from a commercial farm
- Criteria for entering trial:
  - Above 16 total born in previous litter
  - Culling reason should not be reproductive failure
- Landrace x Yorkshire sows mated with Duroc semen (DanBred)
- Euthanization and removal of reproductive tract at commercial slaughter house
- Slaughtered at day 28, 33, 45, 50, 56 of gestation

Registrations and measurements

Sow level	Fetus level
Blood sample before slaughter (IGF-1, Progesterone)	Weight of fetus
Weight + width of empty uterus	Sex of fetus
Litter size (live and dead fetuses)	Weight, length and area of placenta
Number of corpus lutea	Length of umbilical cord
	Weight of organs (brain, liver, intestine, stomach, kidneys, spleen, lungs, heart)
	Placement in uterine horns
	Histology of umbilical cord, placenta and endometrium of smallest, largest and medium pig in litter

Results – sow level

Day	28	33	45	50	56
Parity	7.5	6.5	6.5	5.6	6.0
Number of sows	9	10	9	8	11

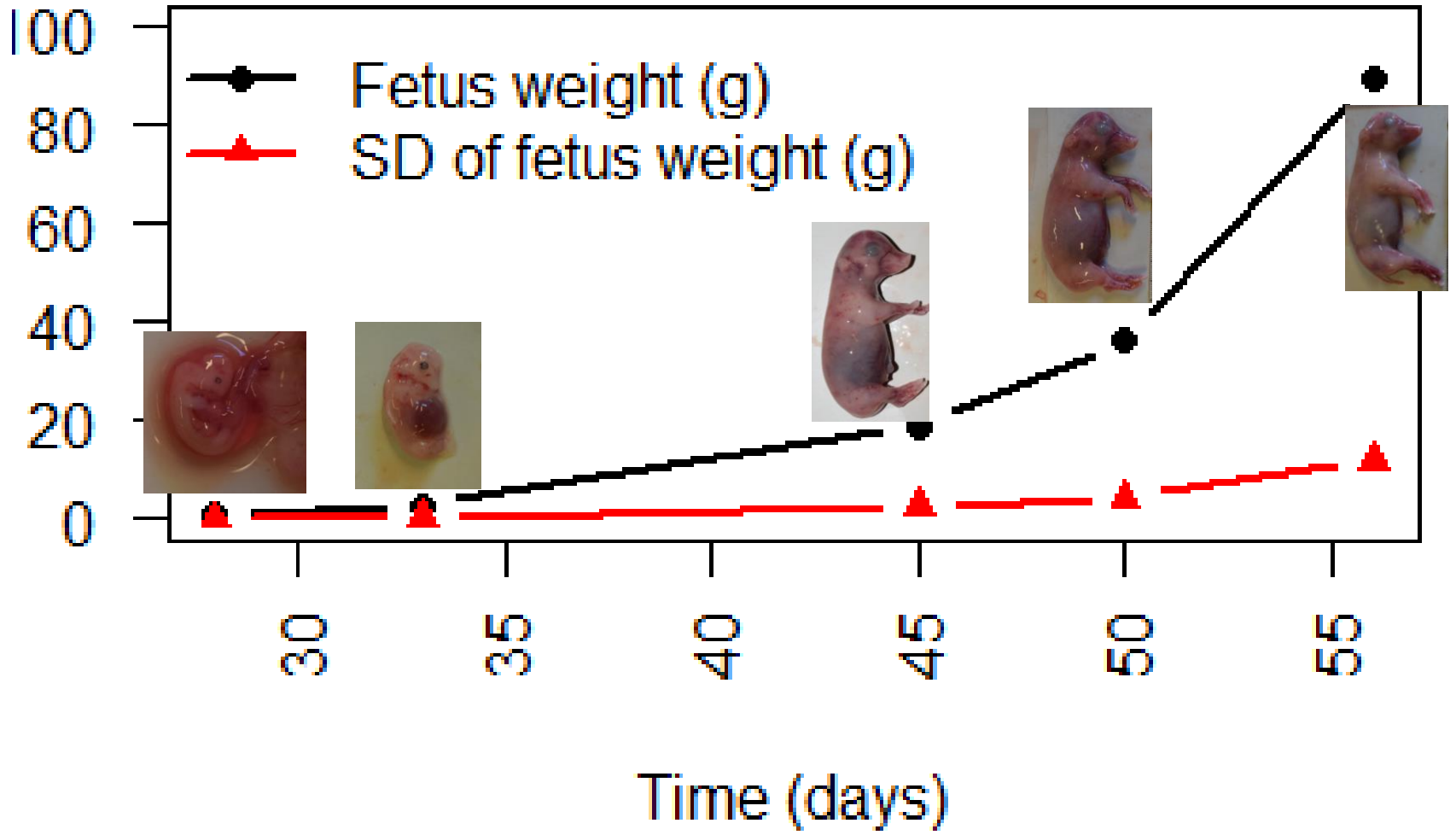
Average fetus weight

- Average fetal weight is increasing
- The within-litter SD is increasing

Day	28	33	45	50	56
Fetal weight, g	0.82	2.76	18.8	36.3	89.5
S.D. fetal weight, g	0.17	0.44	2.59	4.31	11.9

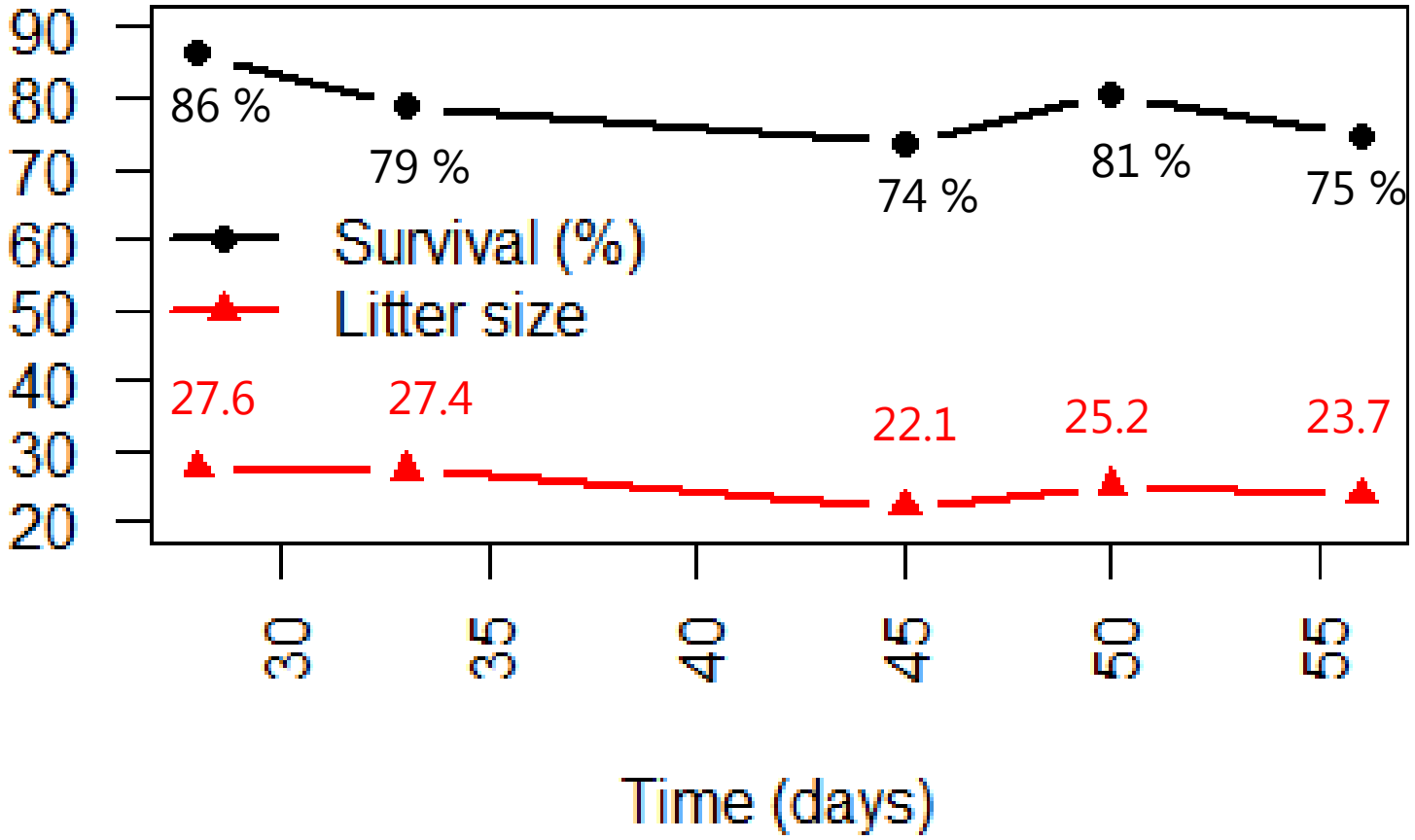
So variation can be detected as early as day 28

Average fetus weight



Litter size and survival rate

- Litter size decreases slightly
- Survival rate decreases



Correlations sow level – litter size

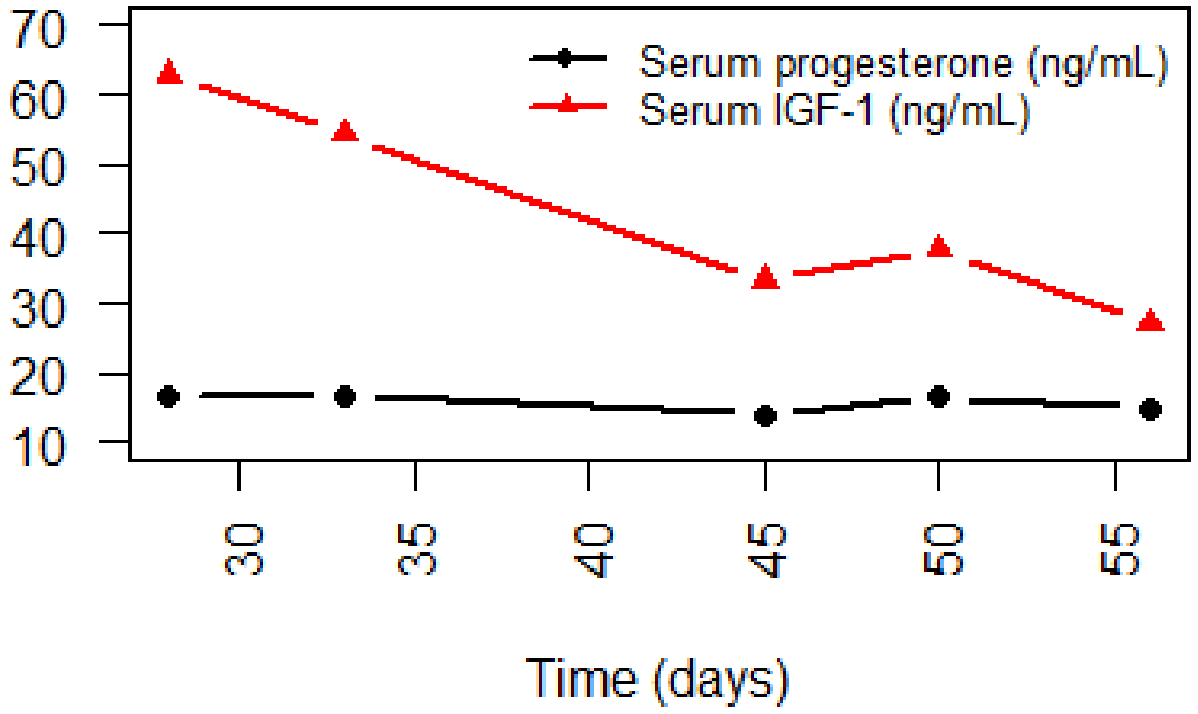
- **Litter size is <u>not</u> correlated with:**
  - Total weight of litter (r=-0.04)
  - Serum IGF-1 (r=0.00)
  - Average placenta weight of the sow (r = -0.18)
  - Average fetus weight of the sow (r = -0.19)

- **Litter size <u>is</u> correlated with:**
  - Number of corpus lutea (r= 0.46)
  - Serum progesterone (r=0.31)

Serum IGF-1 and progesterone

- Progesterone is unchanged
- IGF-1 decreases

(decrease in feed allowance and Lys konc. From d 28)



Correlations sow level – IGF-1 and progesterone

- **Serum IGF-1 was correlated with:**
  - Total weight of the litter (r = -0.72)
  - Average fetus weight of the sow (r = -0.72)
  - Average placenta weight of the sow (r = -0.66)

Low weight ⟺ High IGF-1

- **Serum Progesterone was correlated with:**
  - Litter size (r = 0.31)

What impacts the fetus weight?

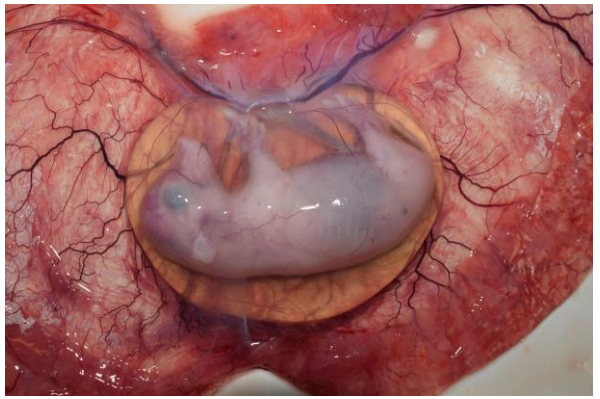
Placenta weight, length and area?

Length of umbilical cord (day 45, 50 and 56)?

Effect of sex?

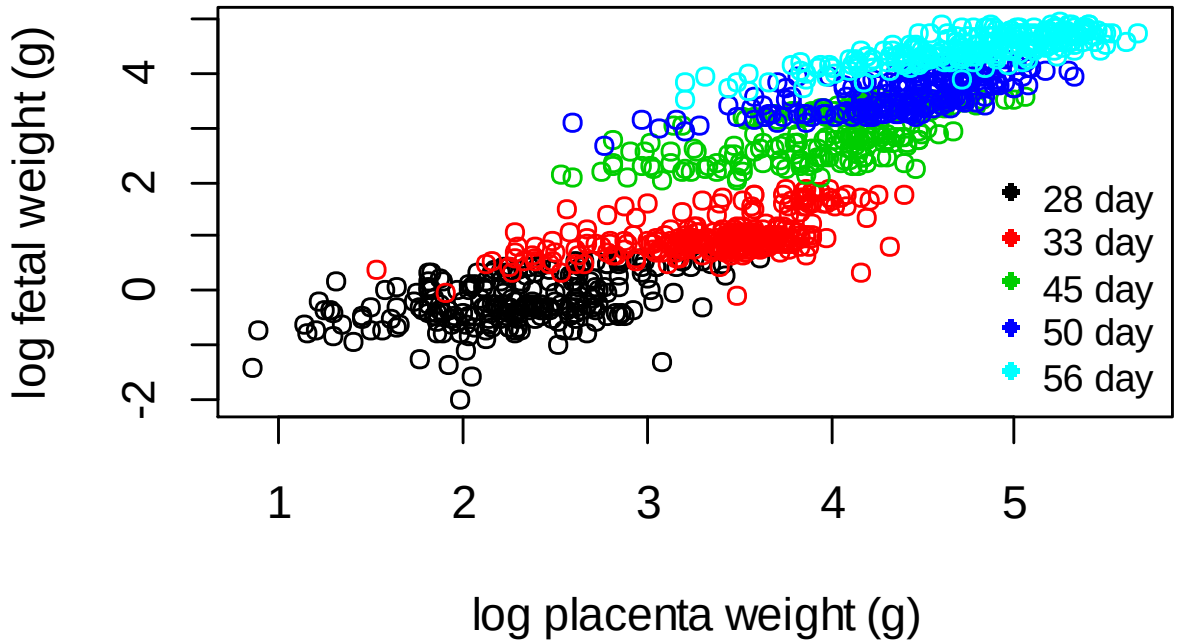
Effect of placement in uterus?

Effect of neighbours in the uterus?



Fetus weight- effect of placenta weight

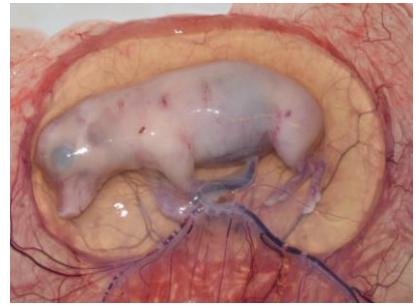
- Small fetuses ⟷ lighter placentas



Day 28	Day 33	Day 45	Day 50	Day 56
r=0.45	r=0.53	r=0.65	r=0.67	r=0.80

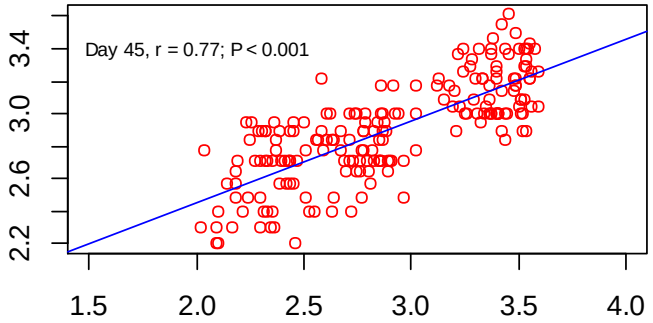
Fetus weight – effect of umbilical cord length

- High fetus weight (g) ⟷ Longer umbilical cord

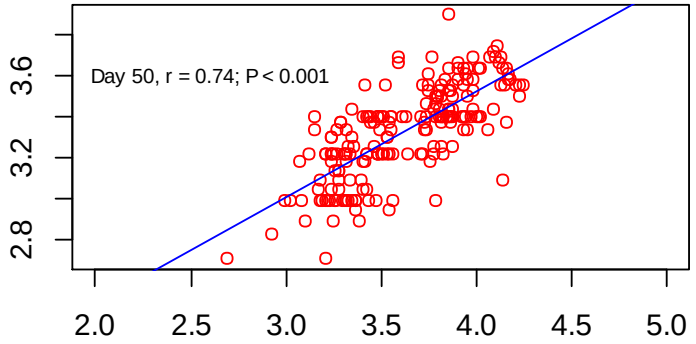


Log length umbilical cord (mm)

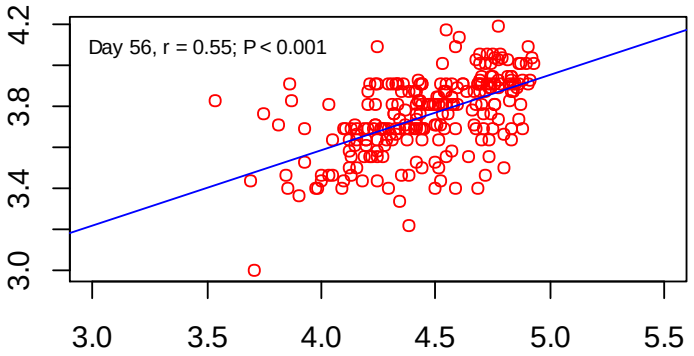
Day 45 (r=-0.77)



Day 50 (r=-0.74)



Day 56 (r=-0.55)



Log fetal weight (g)

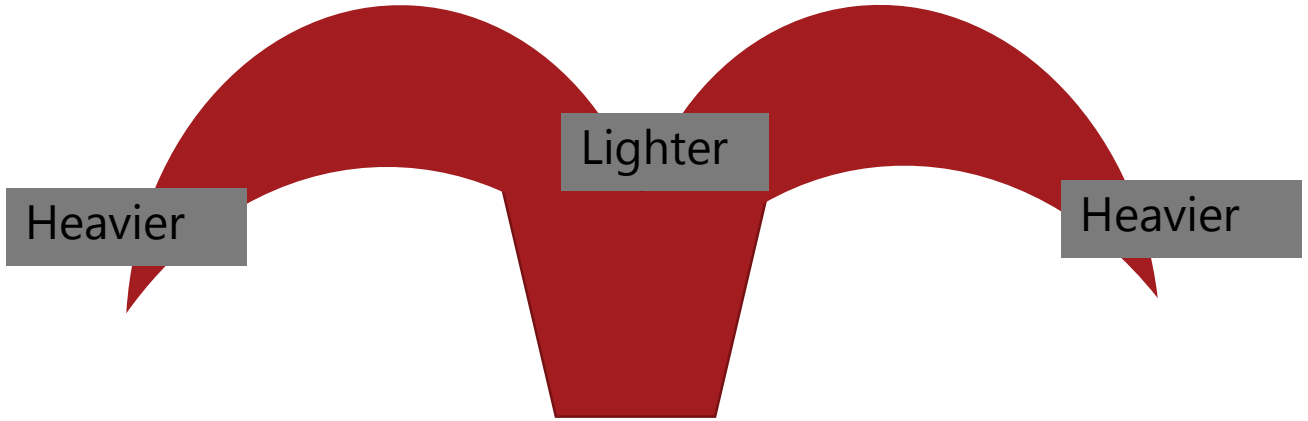
Effect of sex and sex of neighbours on fetus weight

- **Tendency for male fetuses being heavier than female fetuses (Day 45 to 56).**

- **Effect of sex of neighbours: Tendency for effect on day 56**
  - **It might have a negative effect on fetus weight if laying next to male fetuses**

Effect of uterine position on fetus weight

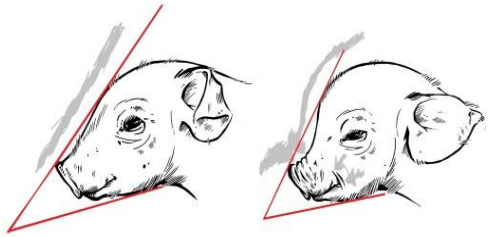
- No effect of uterine position at day 28, 33, 45 and 50
- Effect of position at day 56 -> larger fetuses -> uterine crowding



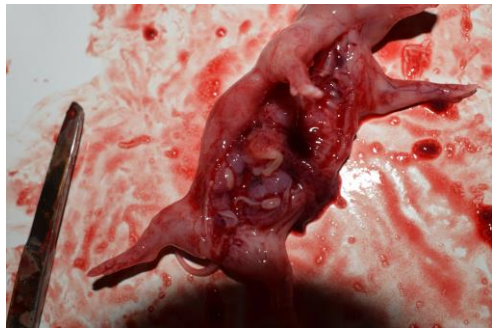
What characterizes small versus large fetuses?

- At birth the relative size of some organs in IUGR piglets are changed

  ➡ higher prioritization or compromized growth during gestation.



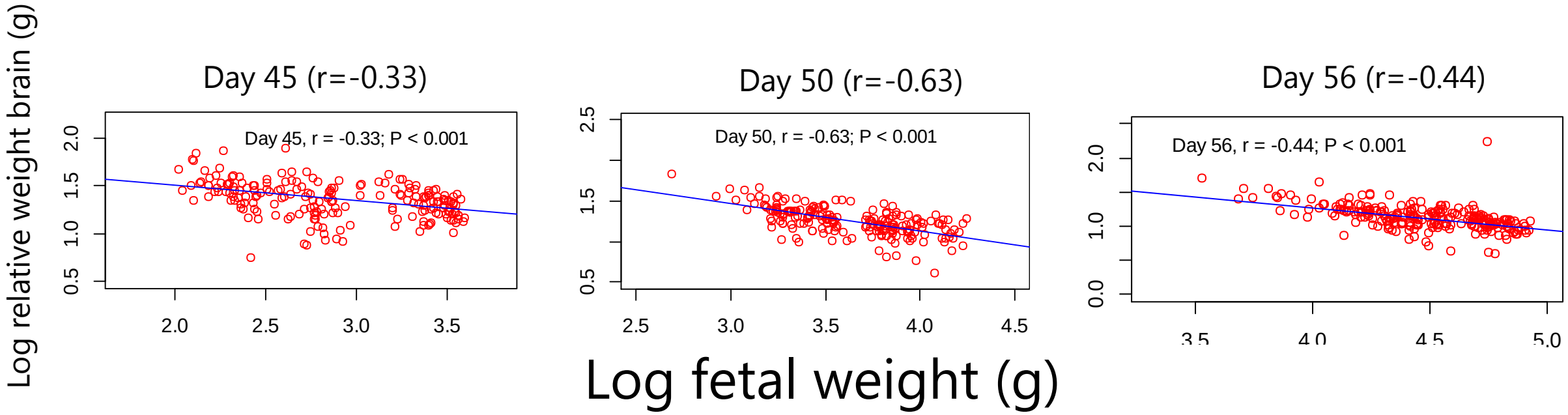
Source: Hales et al. 2013



Can these changes be detected already in early gestation?

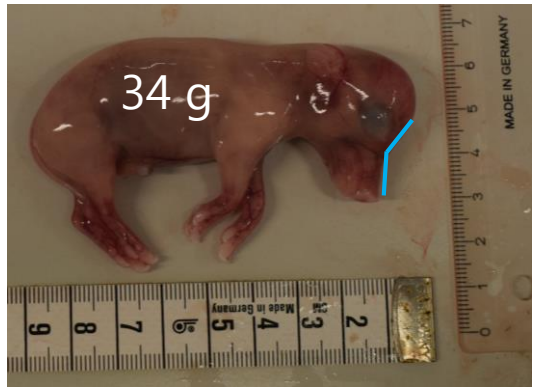
Fetus organ size – brain

- **Small fetuses have relatively <u>larger brains</u> (from day 45) -> the brain is prioritized**



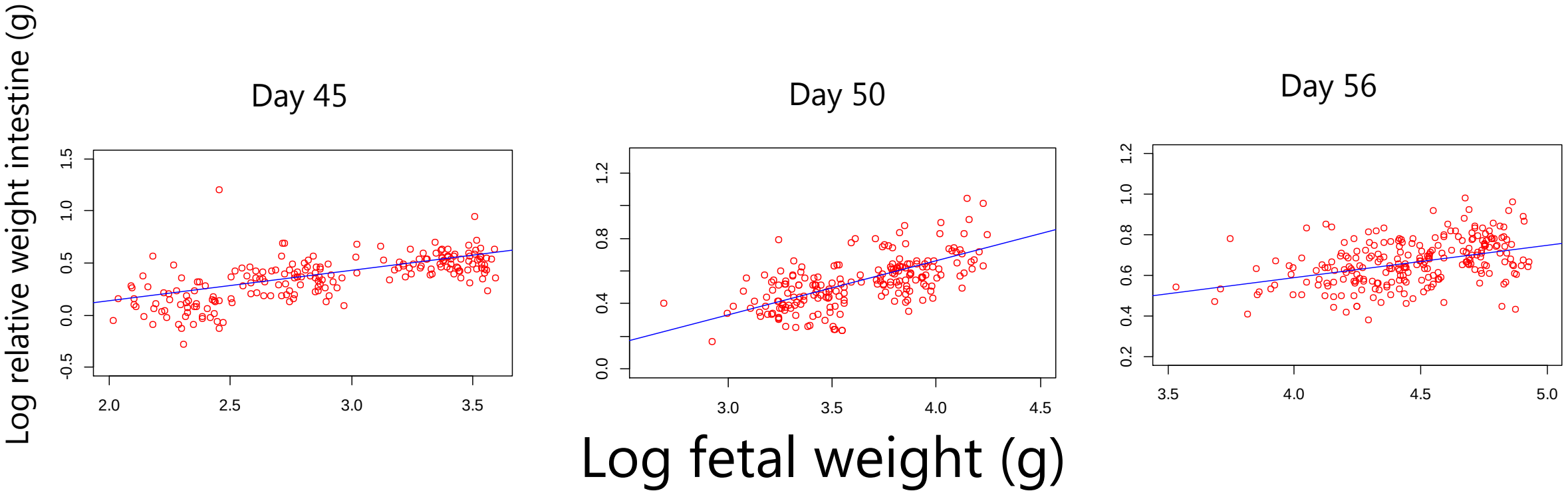
Larger brains ⟶ Changed head shape

- Day 56
- Litter size: 25



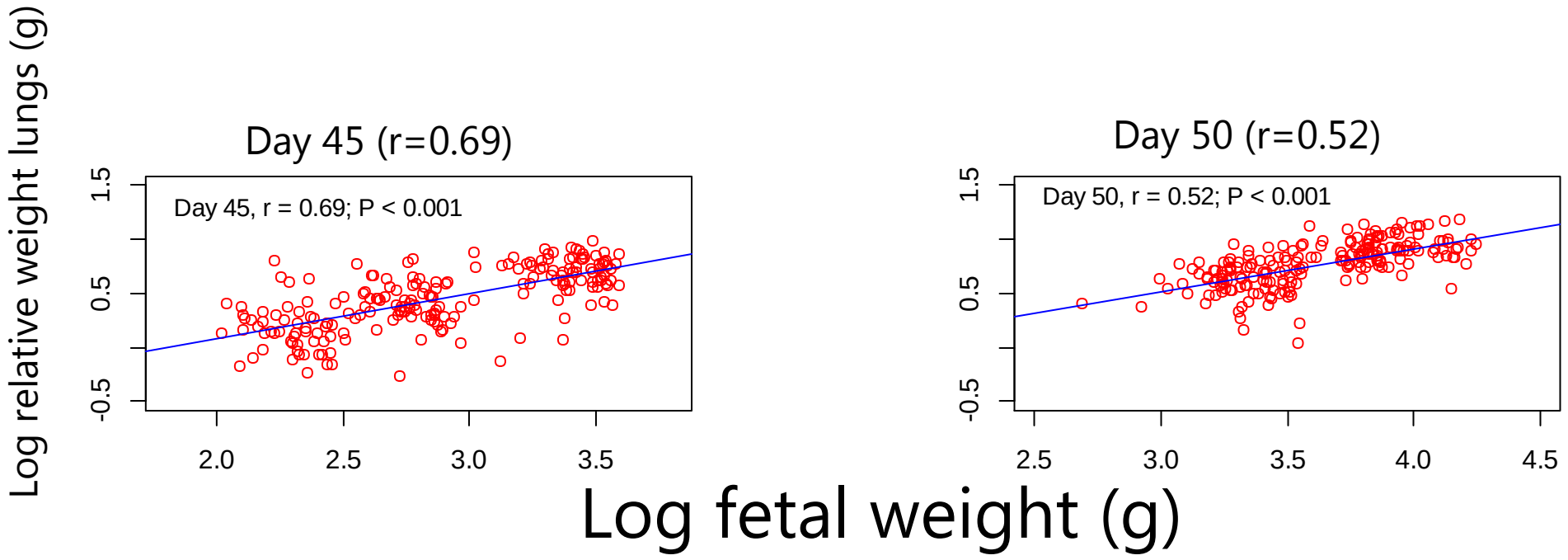
Fetus organs- Intestine

- **Relatively <u>smaller intestine</u> in small fetuses (Day 45 to 56)**



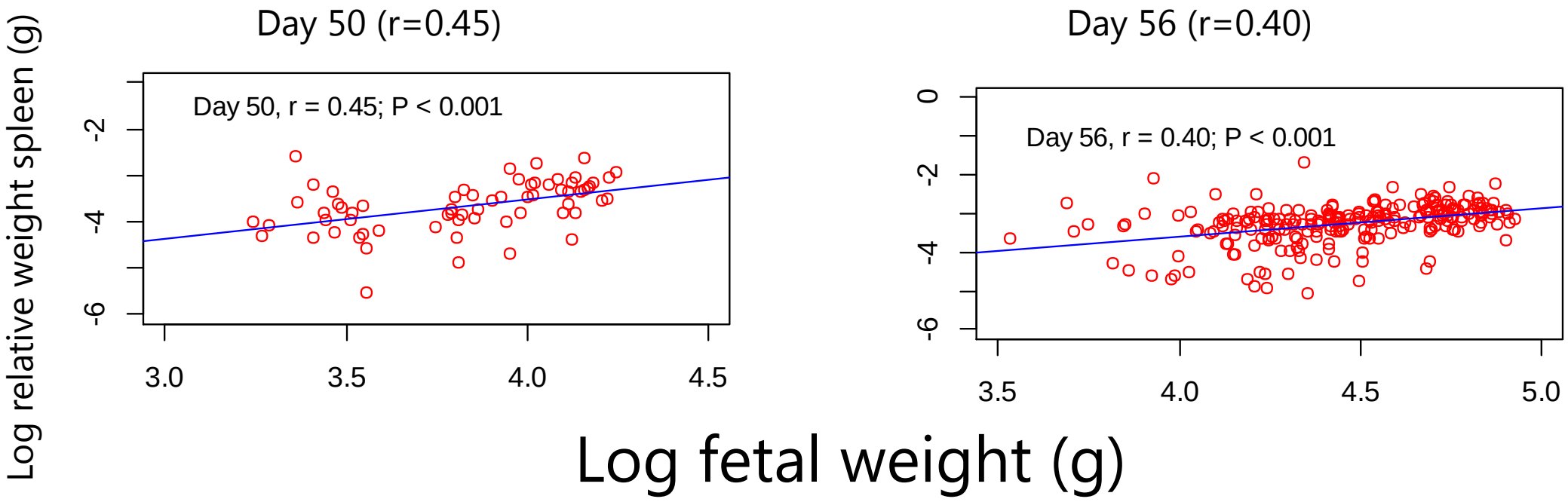
Fetus organ size - Lungs

- **Relatively <u>smaller lungs</u> in small fetuses (Day 45 and 50)**



Fetal organ size - Spleen

- **Relatively <u>smaller spleen</u> in small fetuses (Day 50 and 56)**



Conclusions

- The organ development is altered in small compared to large fetuses

- Small fetuses have smaller placentas and shorter umbilical cords
  -> nutrient supply is compromized
  -> **placental development is key to understand why some fetuses are small**

- Variation in fetal weight within the litter is detected very early
  -> **nutritional intervention must be initiated from mating (or earlier?)**

What is next?

- Feeding trials to increase fetal weight -> fewer very small piglets at farrowing??
  - Vitamins, fatty acids and antioxidants

QUESTIONS?

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AND IS A COOPERATION BETWEEN DLG, SEGES AND UNIVERSITY OF COPENHAGEN

Fetus organs

- **Relatively larger liver in small fetuses (Day 45, r=-0.19)**
- **Relatively larger kidneys in smal fetuses (Day 50)**
- **Relatively larger heart in small fetuses (Day 33 to 56)**
- **Relatively larger stomach at day 33, but relatively smaller at day 45 in small fetuses.**