Potential to Improve the Survivability of Low Birth Weight Pigs & Realize a Full Value Market Hog

A comprehensive approach by the

K-State Swine Reproductive Physiology,

Muscle Biology, and

Swine Nutrition & Management labs

K-State Swine Day - November 20, 2014

K·STATE Research and Extension

Knowledge for Life

Research Progression

Collaboration at K-State

- Our goal is to further the development of management strategies and technologies to improve piglet survivability and ultimate value.

The most significant industry changes over the last 20 years

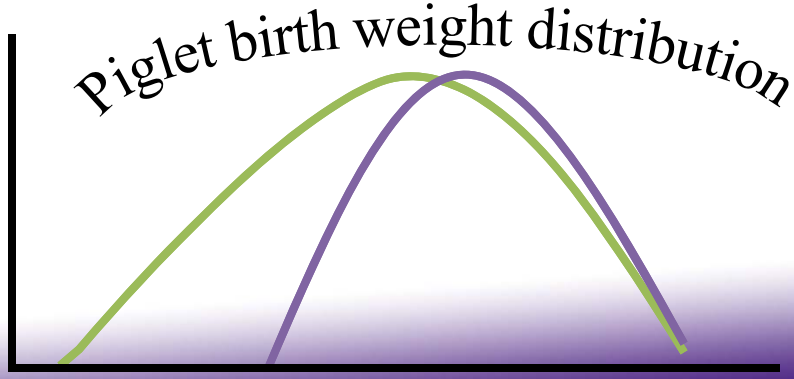
1. Genetics
2. Disease challenges
3. Export markets
4. Industry structure
5. Production facilities
6. Nutrition
7. Regulation
8. Consumer mind-set
9. Activist groups
10. New technology

Large litters

- Marked increase in litter size due to genetic selection
  - 28-30 PSY vs. 23 PSY just 10 years ago
- Continued selection for increased litter size to attain 40 PSY

Large litters...a problem?

- Genetic selection for increased litter size
- Larger litters = increased number of lighter birth weight pigs
  - Uterine capacity
  - Birth weight : muscle fiber number



Large litters...a problem?

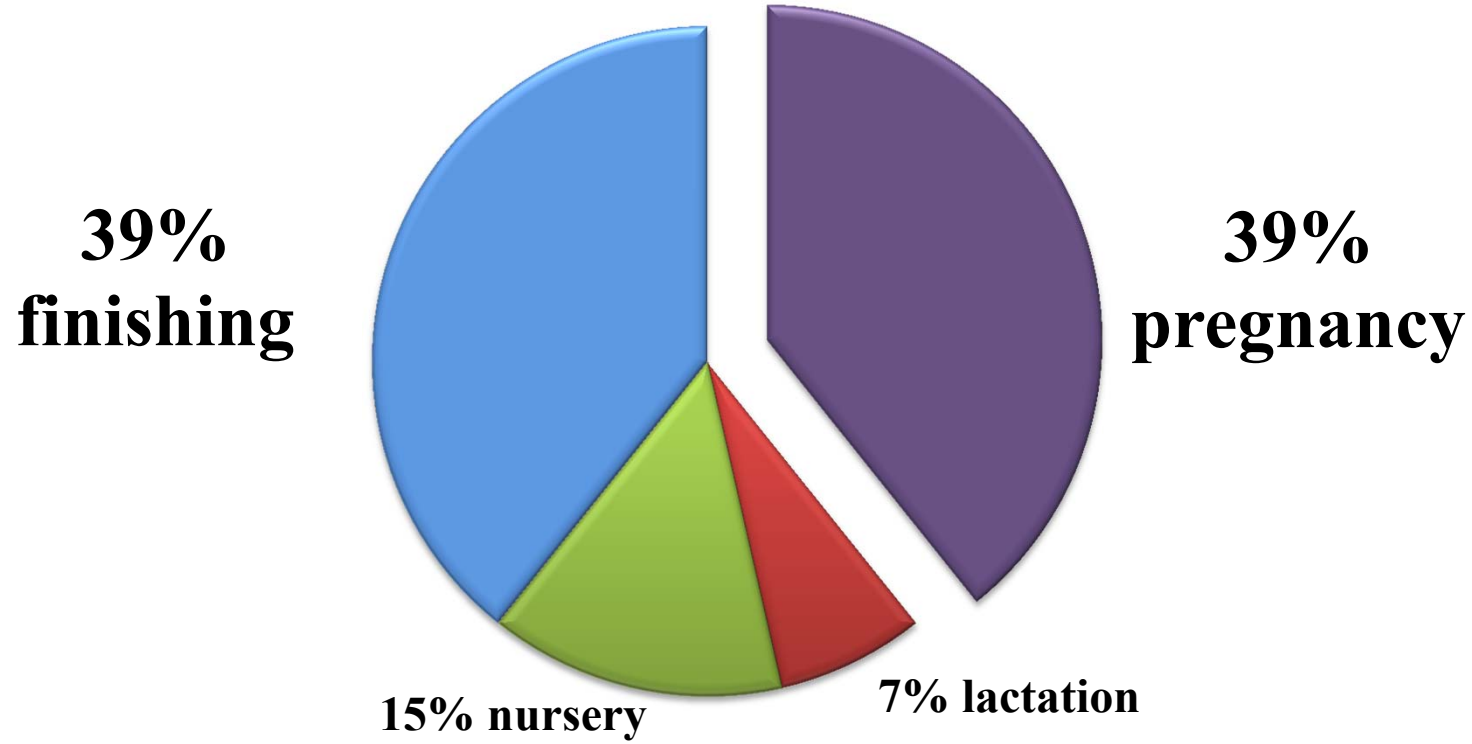
- Low birth weight pigs = higher cost of production
  - Lower pre-weaning survivability
  - Slower growth rate (ADG)
  - Less feed efficient
  - Reduced percentage lean

Fetal Programming

- The uterine environment programs physiology and determines phenotypes throughout postnatal life.

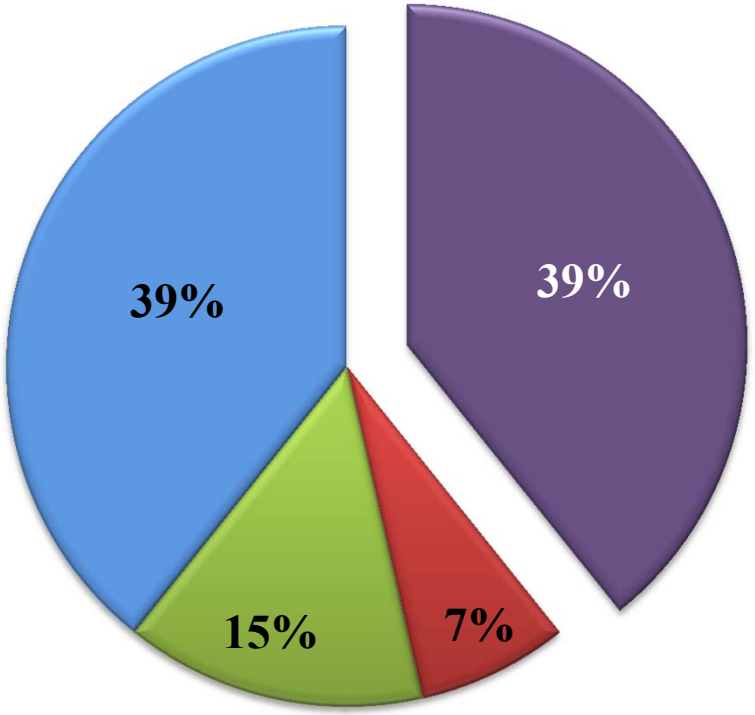
Percentage of Total Time to Market Spent in Each Phase of Pork Production From Conception to Harvest

The Uterine Environment Programs the Fetus



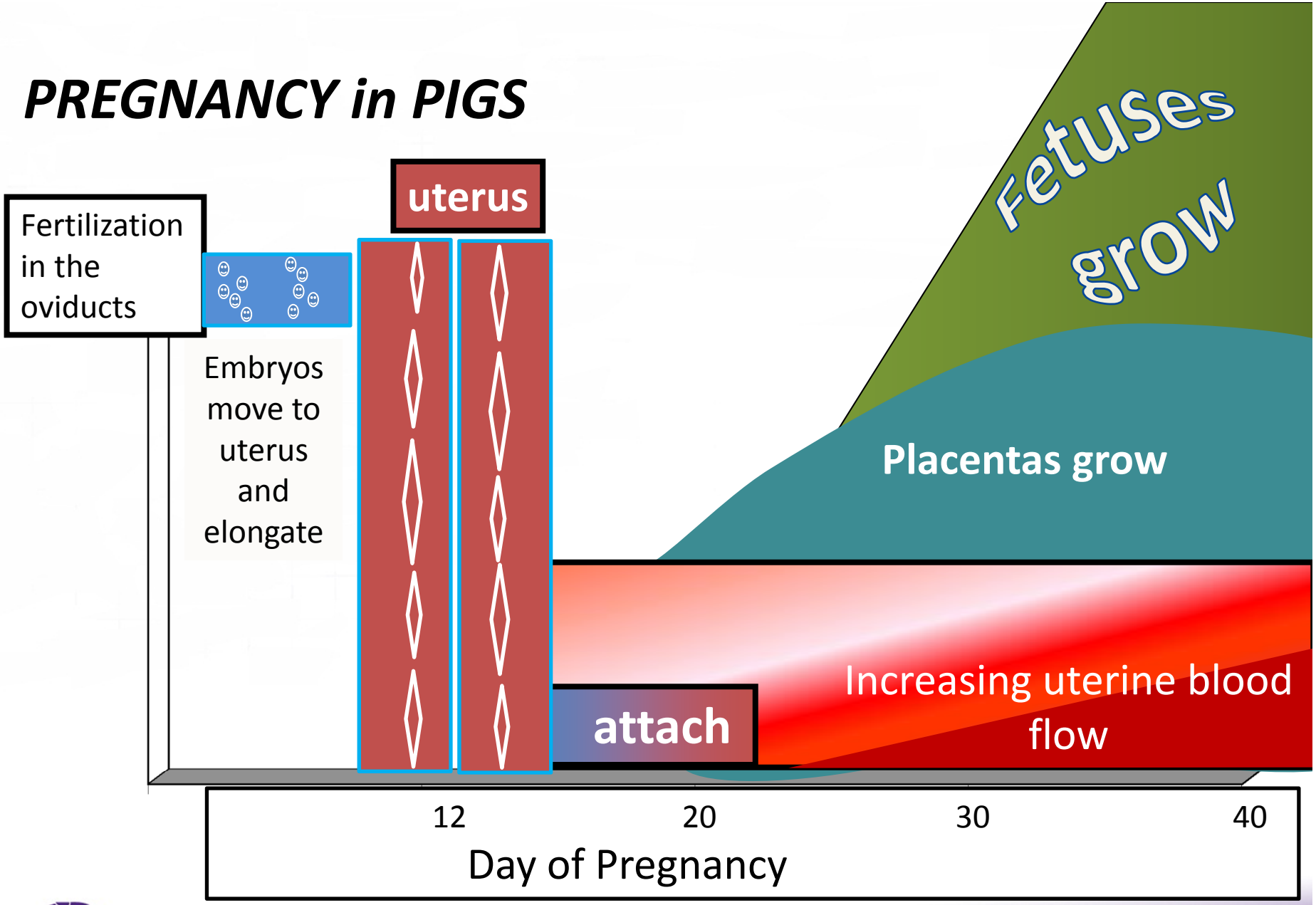
The uterine environment

programs the pig for:



- Feed Efficiency
- Carcass Composition
- Nutrient Partitioning
- Lean Muscle Accretion
- Disease Susceptibility
- Survivability
- Reproductive Performance
- Production Costs ($ vs. $$$$)

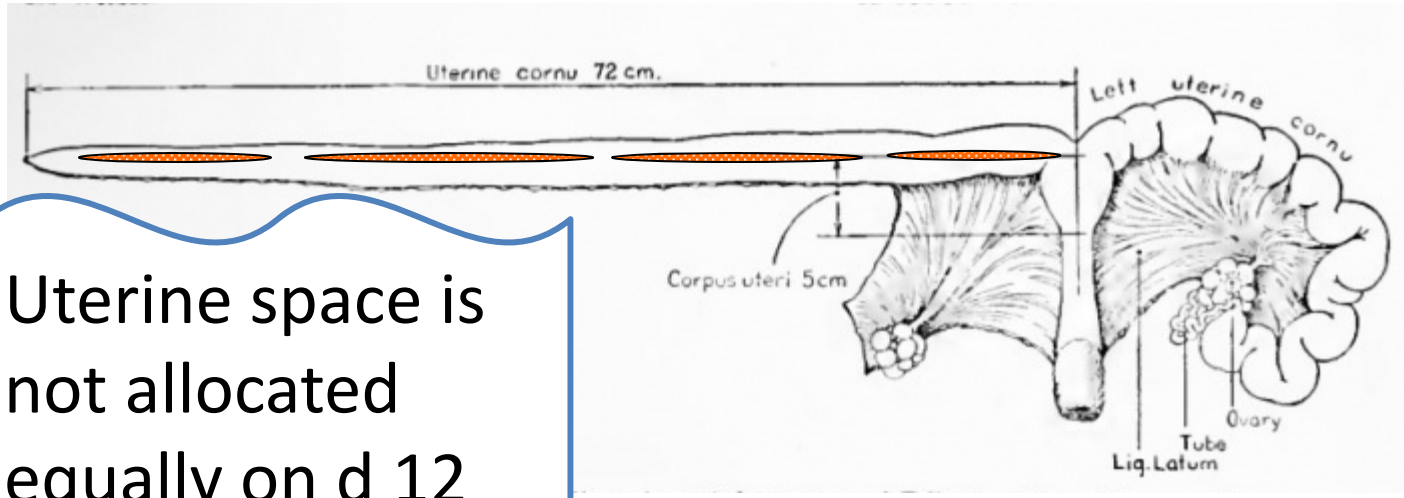
PREGNANCY in PIGS



K-STATE Research and Extension

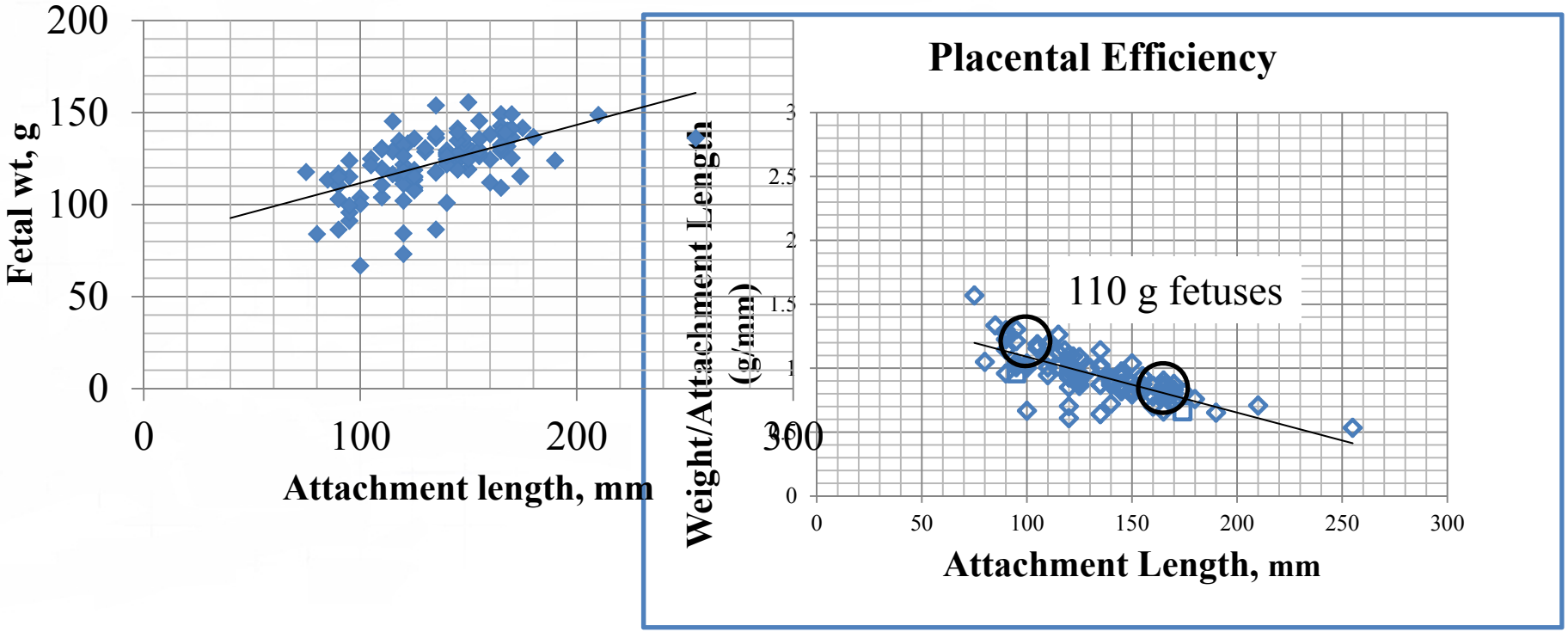
Knowledge for Life

Elongation secures uterine space.



Uterine space is not allocated equally on d 12

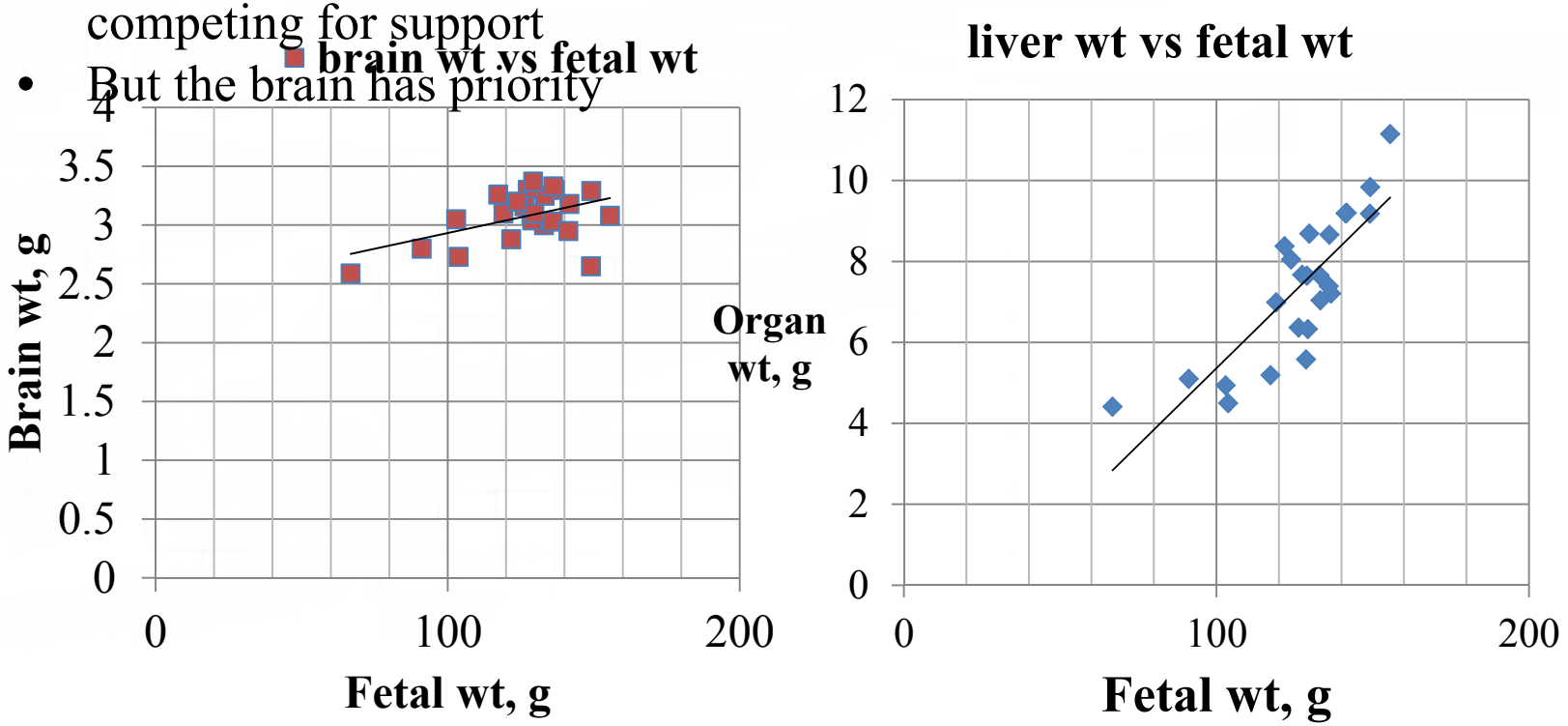
Fetal weight and attachment length, d 60



Unpublished data

Brain and Liver weights as related to Fetal Weight on day 60 of pregnancy

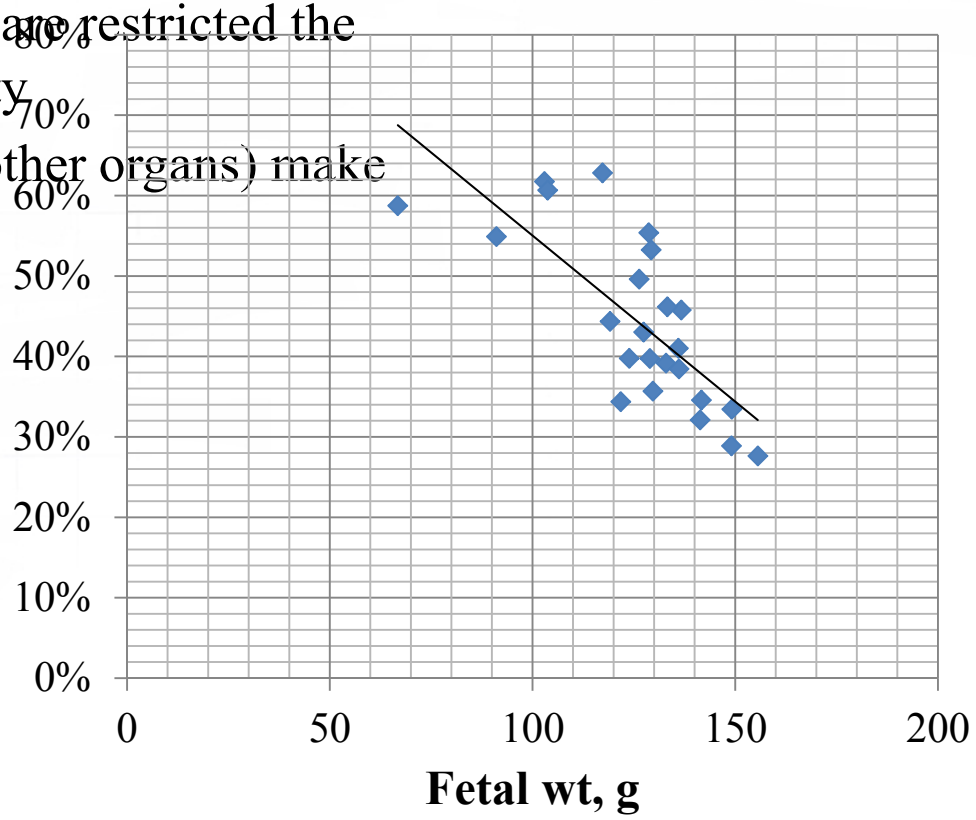
- Brain, liver and other organs are competing for support
- But the brain has priority



Unpublished data

Brain wt as a % of Liver wt at d 60

- When nutrients are restricted the brain has priority
- The liver (and other organs) make do with less

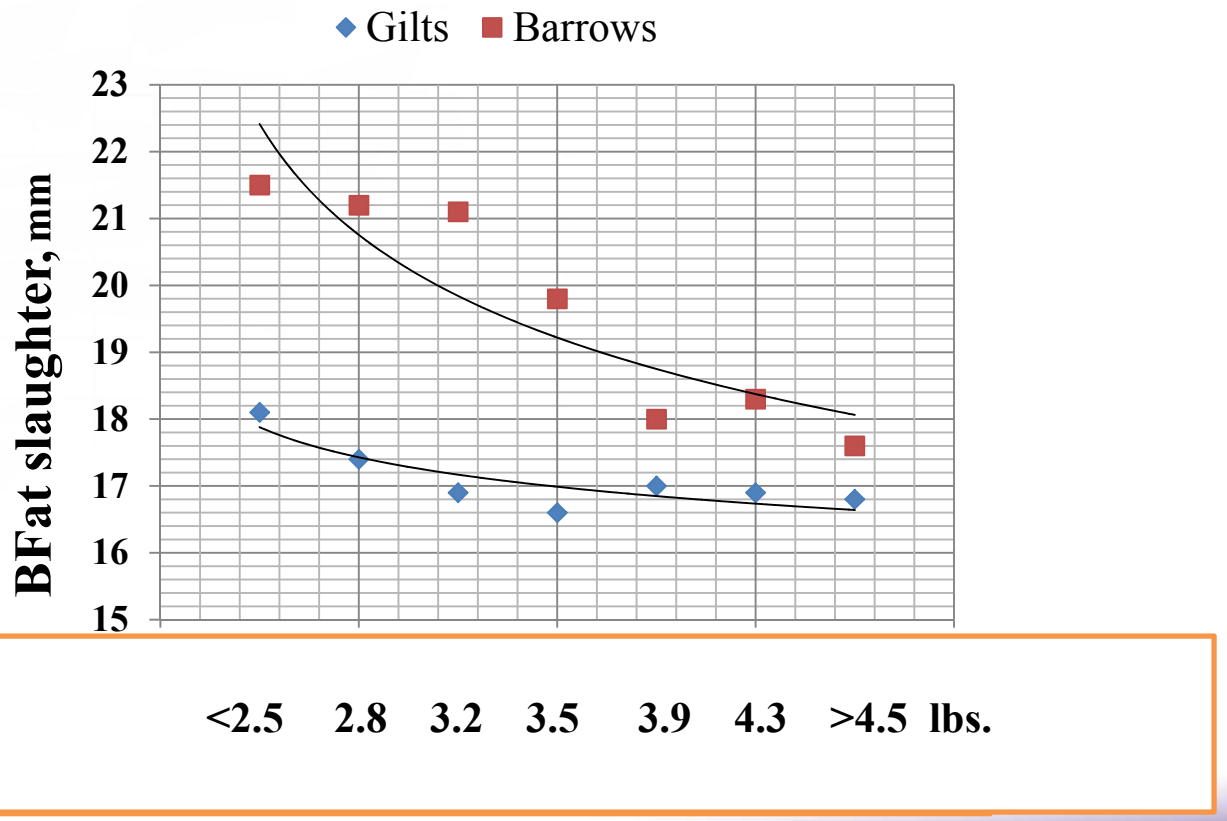


Unpublished data

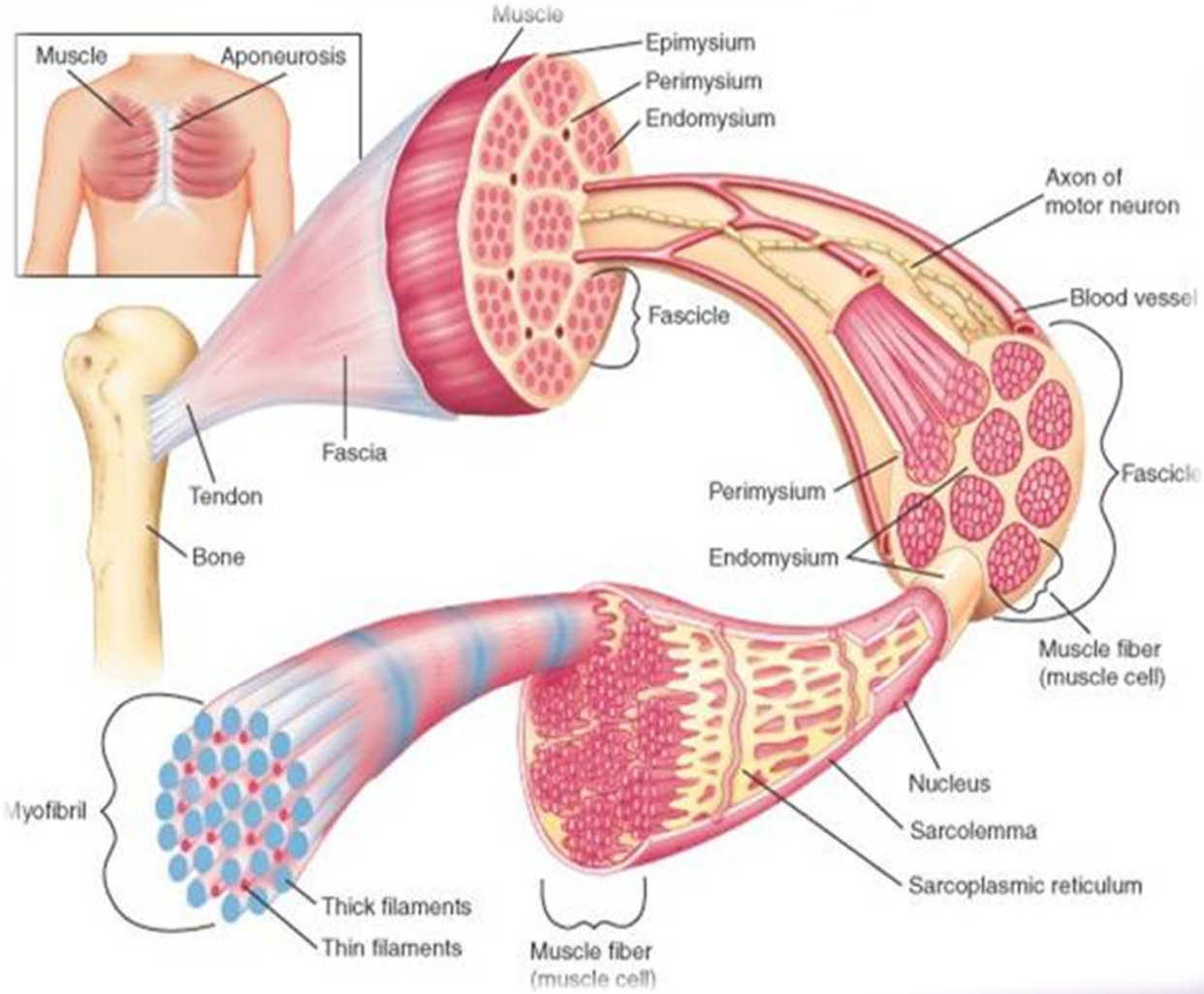
PREGNANCY in PIGS

- Uterine Capacity is LIMITED
- In utero environment programs the fetus

418 pigs
Bergstrom et al., 2011



Muscle Size

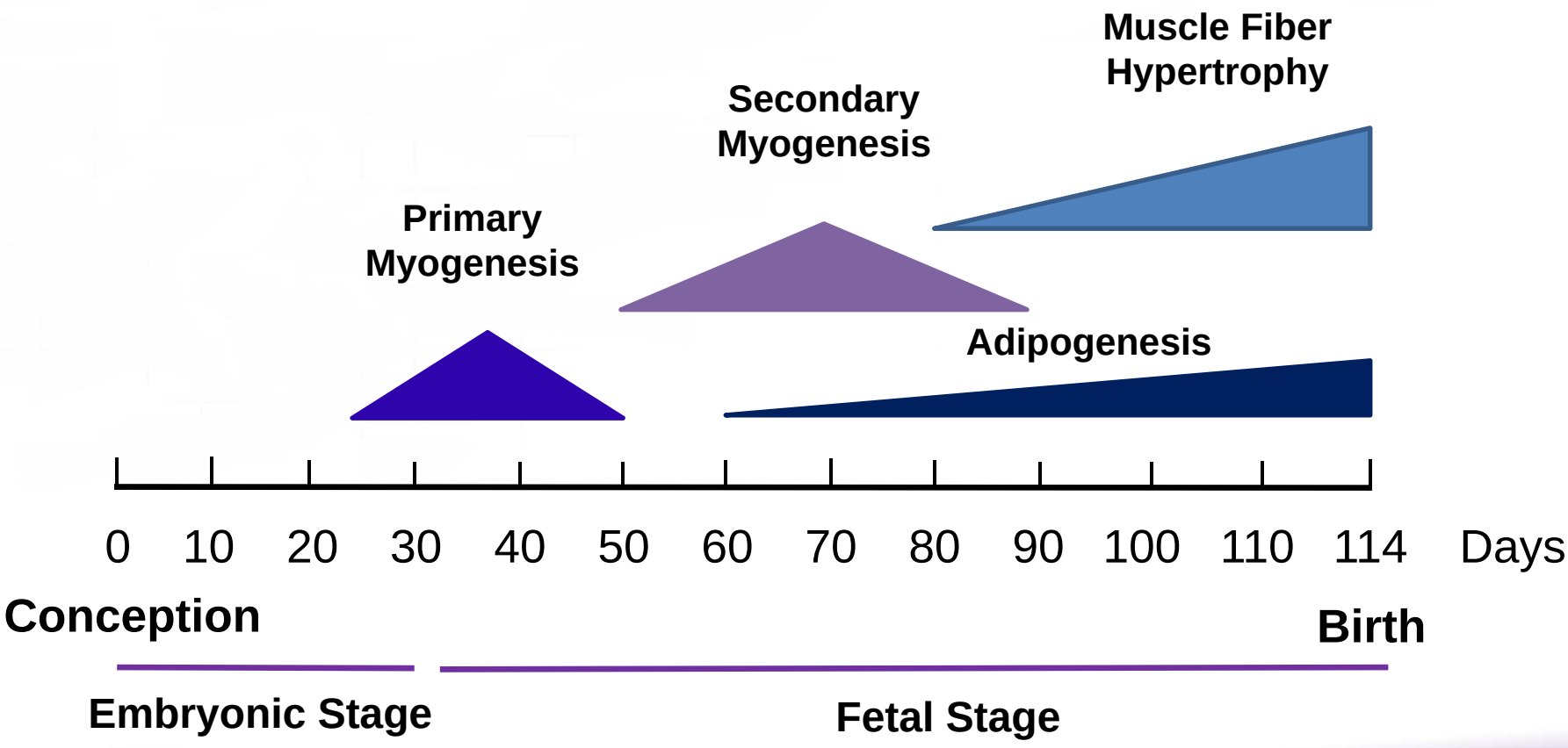

Muscle
Aponeurosis
Muscle
Epimysium
Perimysium
Endomysium
Axon of motor neuron
Blood vessel
Fascicle
Fascia
Tendon
Bone
Perimysium
Endomysium
Fascicle
Muscle fiber (muscle cell)
Myofibril
Thick filaments
Thin filaments
Muscle fiber (muscle cell)
Nucleus
Sarcolemma
Sarcoplasmic reticulum

Fetal Muscle Development

- Muscle Mass Equation

Ultimate Muscle Mass = Muscle Cell Number + Cell Enlargement

Fetal Muscle Development



Fetal Muscle Development

- What are the muscle differences between large and small?

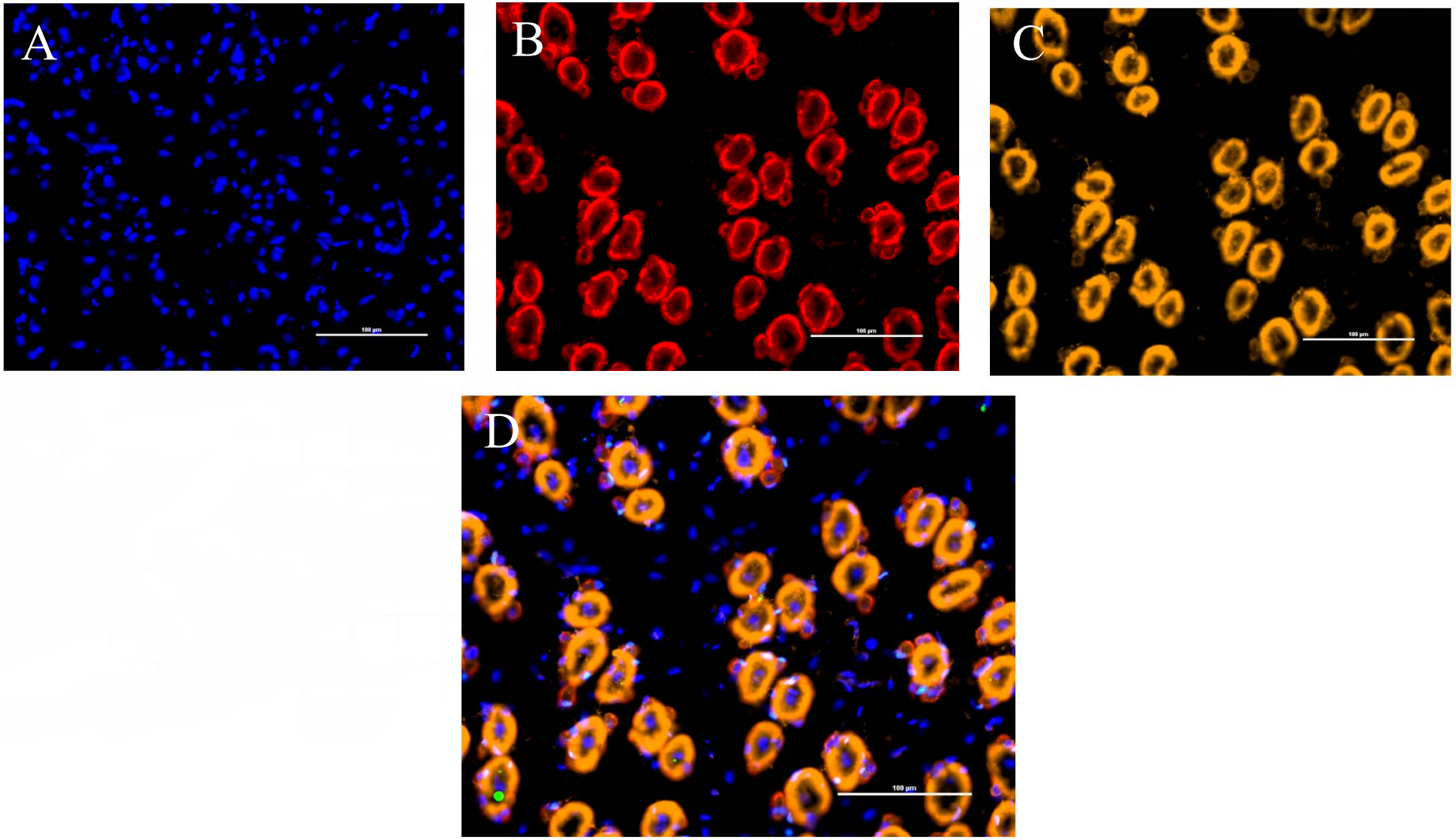
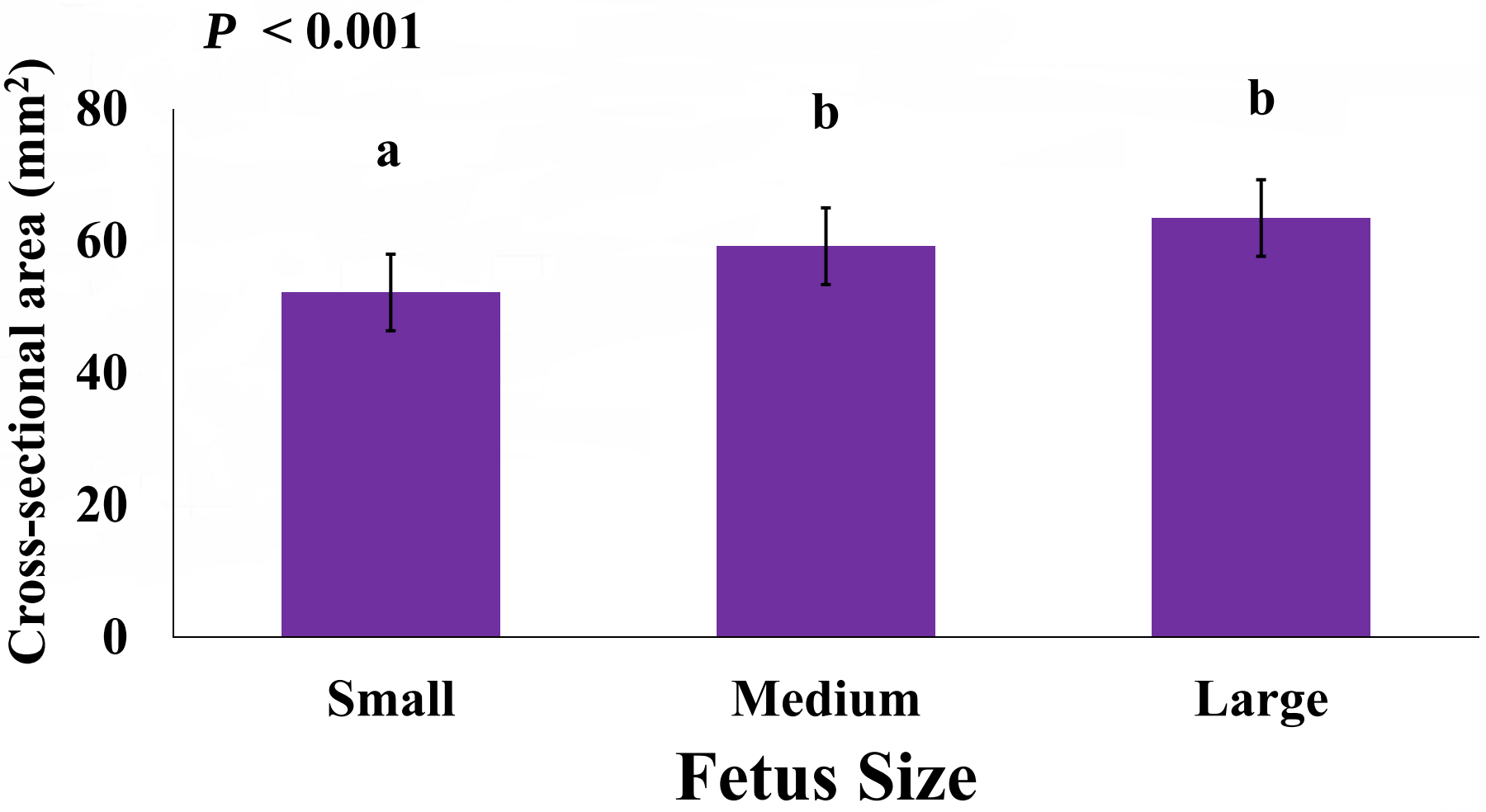
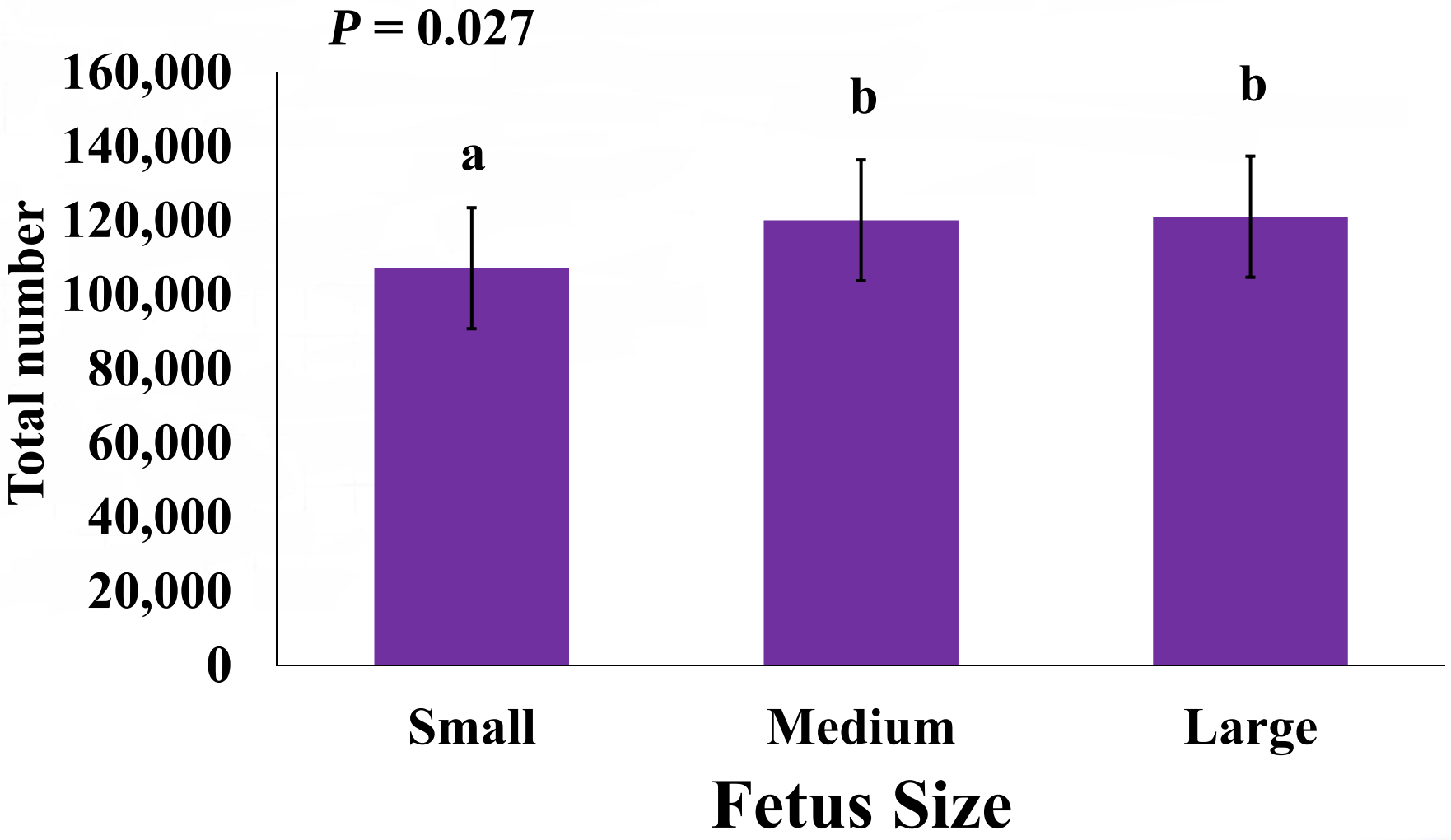


Figure 1. Cross section of *Longissimus lumborum* muscle of a porcine fetus at 60-days of gestation. A) Hoechst 33342; nuclei, B) Dystrophin, C) BAD-5; myosin heavy chain - 1, D) merged image. Scale bar = 100 μm.

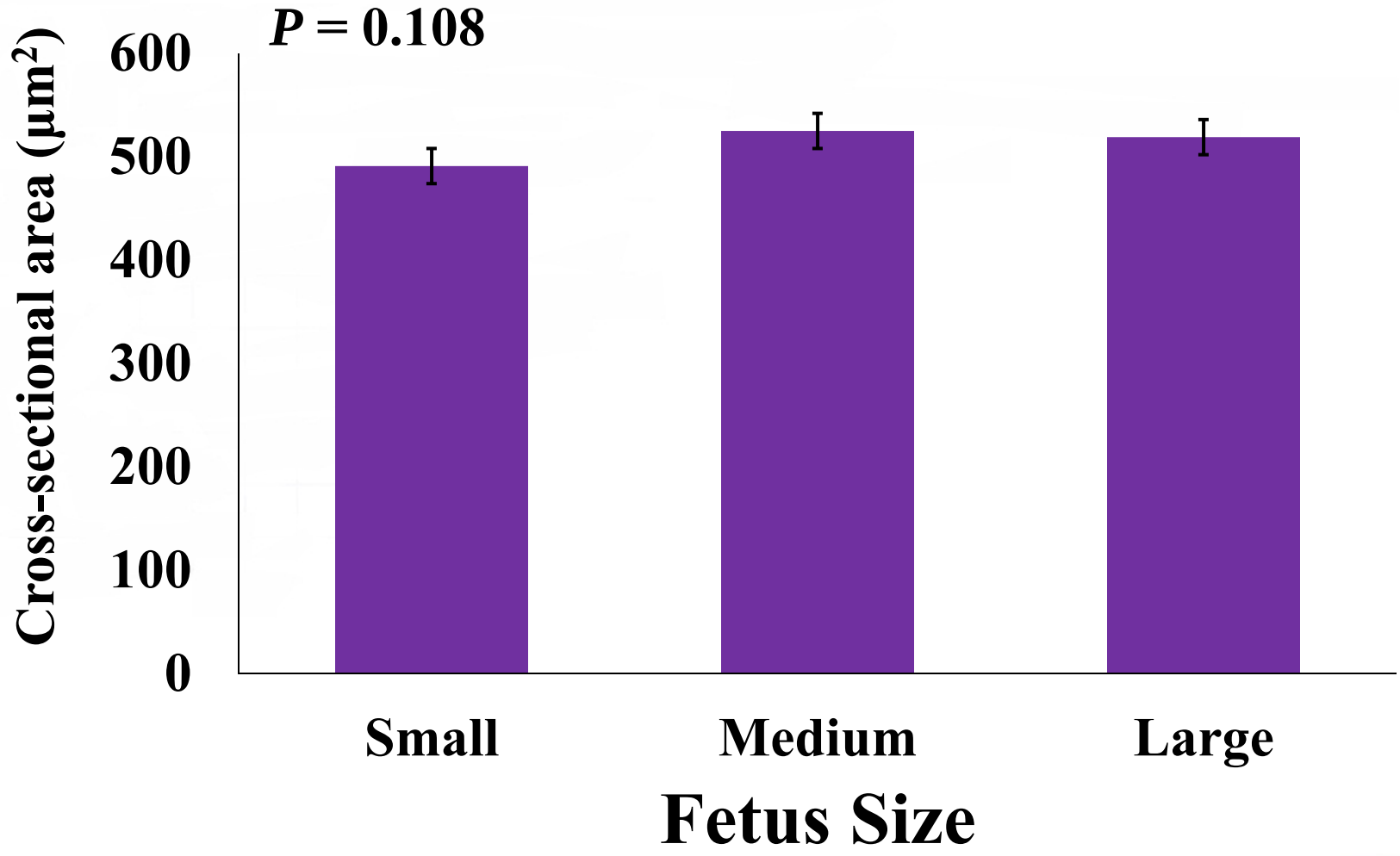
60-d Fetus Muscle Area



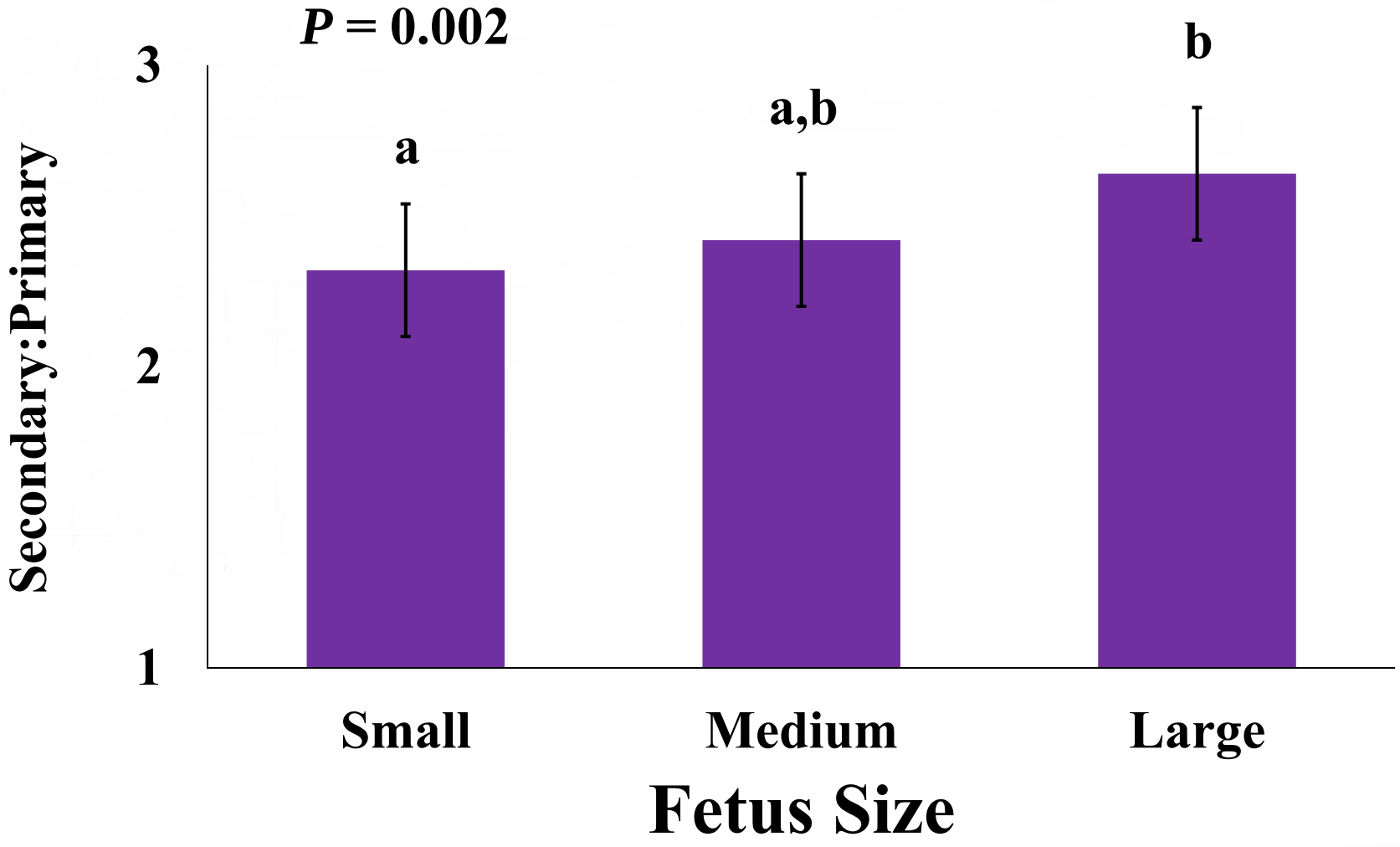
Primary Fiber Number



Primary Fiber Area



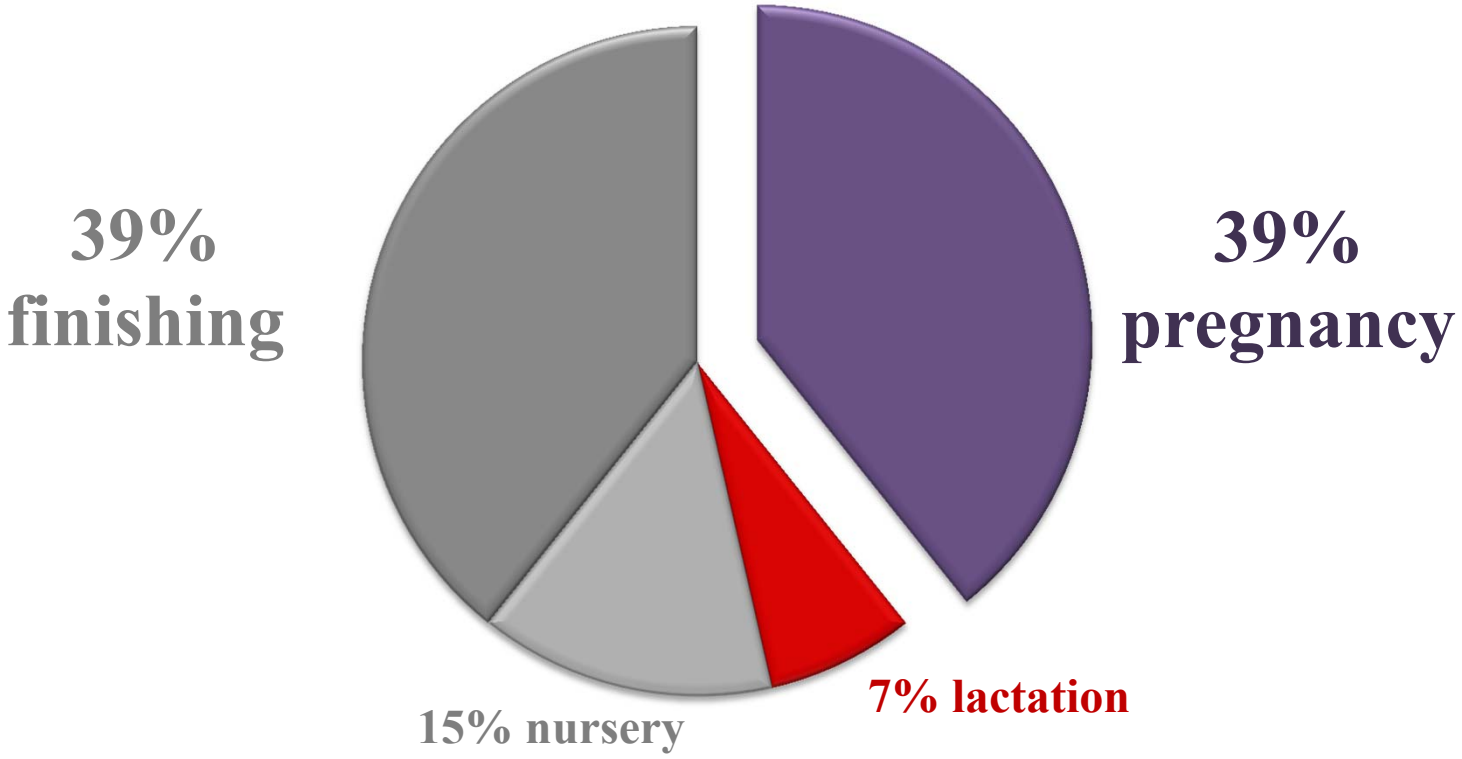
Secondary's per Primary



Fetal Muscle Development

- Can we manipulate the small to develop like a medium or large?

Percentage of Time in Each Phase From Conception to Harvest



Possible Impact Areas

- Maternal Nutrition
  - Bump feeding gilt litters
  - Lysine
  - Energy
  - Vitamin D
- Farrowing crate design?
- Post-farrowing
  - 24-hour care

High Impact Areas

- Post-farrowing (24/7)
  - Decrease heat loss/hypothermia
    - Towel-drying
    - Micro zones: warm and draft-free
  - Colostrum
    - Split suckling
    - Preliminary cross-fostering for small pigs, large litters
    - Colostrum dosing

Summary

- Prenatal development appears to be the rate-limiting constraint to successfully managed 40 PSY in commercial production systems

- Innovative technology that increases placental efficiency, fetal size, and muscle fiber number is imperative to overcome the inherent limitations of larger litters

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