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**Agroscope Liebefeld-Posieux ALP Research Station ALP**
Milk and meat production

# Formation and growth of secondary myofibers is impaired due to Intrauterine crowding

Pardo, C.E.[1-2], Koller-Bähler, A.[1] and Bee. G.[1]

[1] **Agroscope Liebefeld-Posieux, Research Station ALP, Posieux, Switzerland**
[2] **Department of Agricultural and Food Science, Zürich, Switzerland**

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# Introduction

## Intrauterine crowding

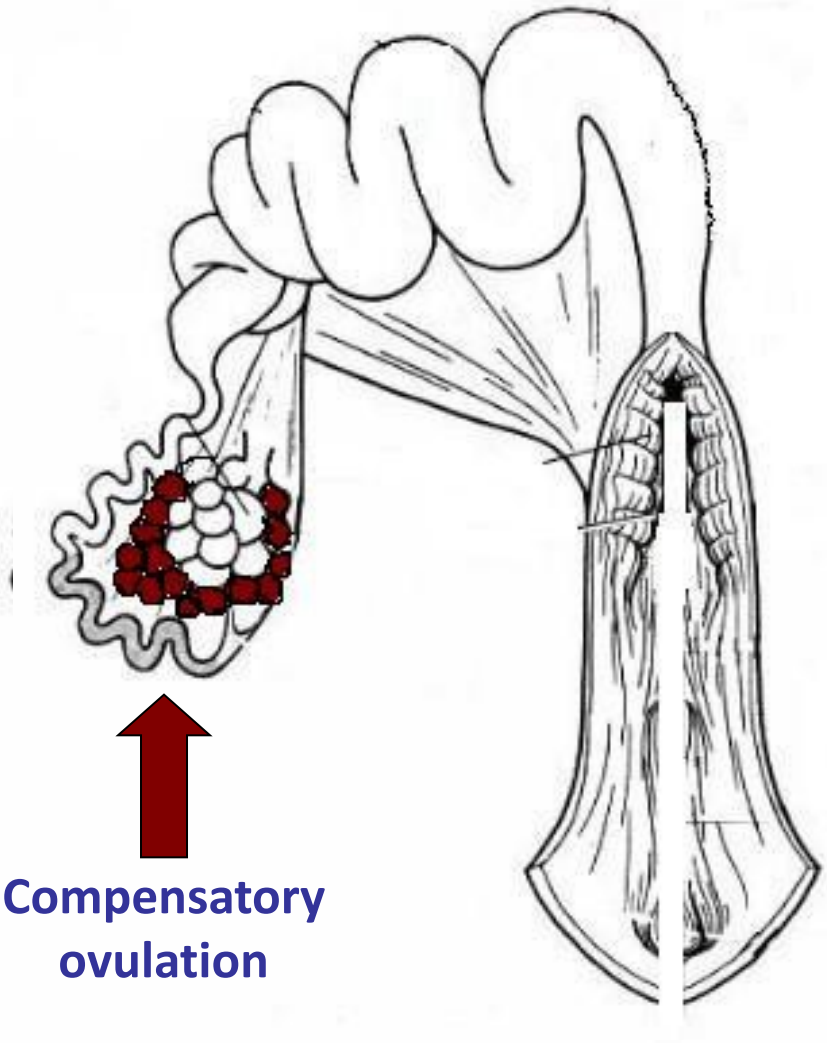
- Decreased embryonic and fetal survival
- Intrauterine growth retardation
  - Decreased birth weight (**BtW**)
  - Impaired myofiber hyperplasia of
    - *primary myofibers*
    - *secondary myofibers*

## Intrauterine crowding

- Unilateral ovariohysterectomy (**UHO**) was used to mimik intrauterine crowding

# Introduction

**UHO** = CROWDED environment



Compensatory ovulation

**UHO was performed in pre-pubertal gilts (~ 50 kg BW)**

# Introduction

## Intrauterine crowding

- Decreased embryonic and fetal survival
- Intrauterine growth retardation
  - Decreased birth weight (**BtW**)
  - Impaired myofiber hyperplasia of
    - *primary myofibers*
    - *secondary myofibers*

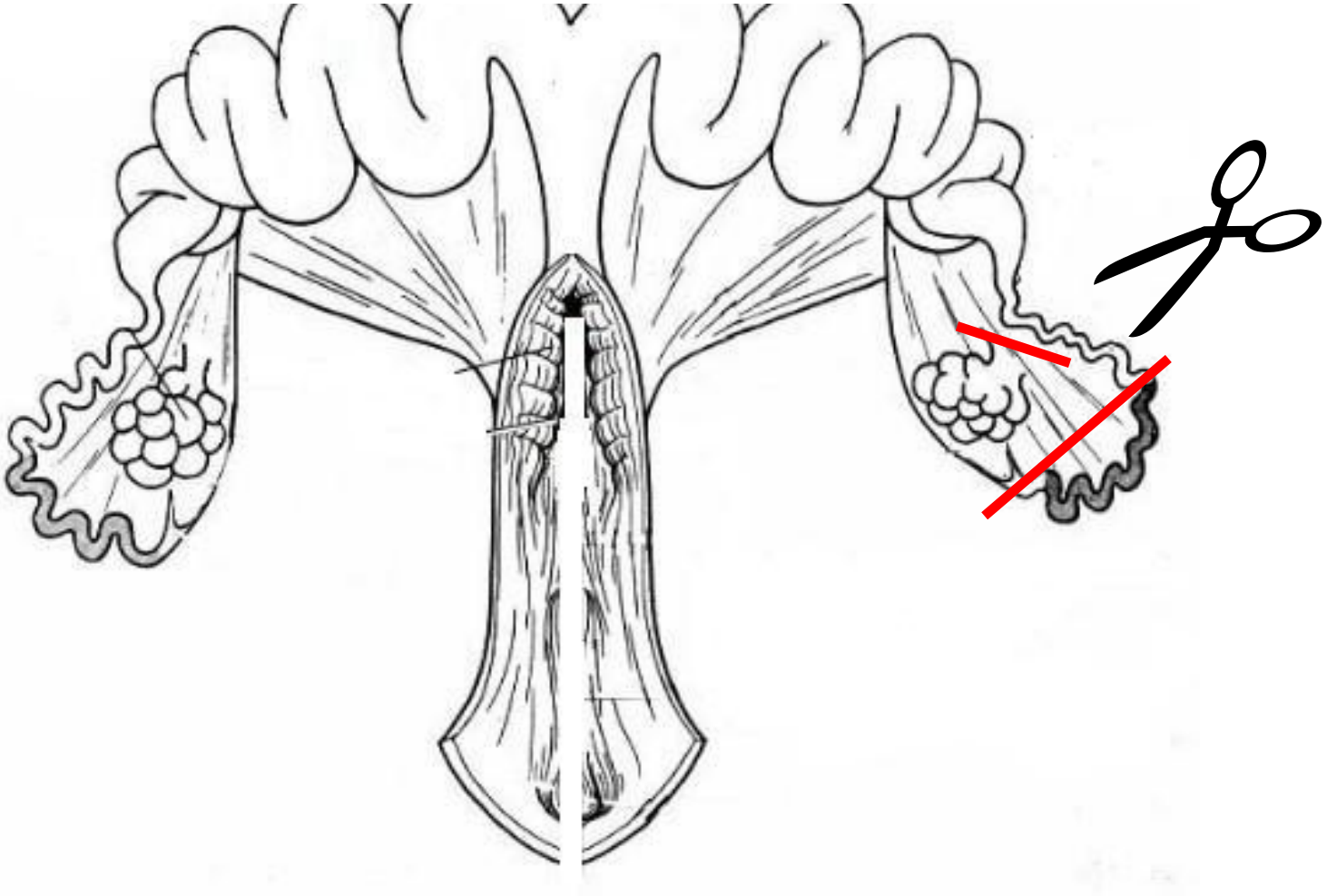
## Intrauterine crowding

- Unilateral ovariohysterectomy (**UHO**) was used to mimik intrauterine crowding
- Unilateral oviduct ligation (**OL**) was used to mimik an un-crowded intrauterine environment

# Introduction

**OL = UNCROWDED environment**

Ovulation rate unchanged BUT ONLY ½ of the ova are available for insemination in double of the intrauterine space



# Objectives

**Compare the effect of (extreme) differences in uterine space on**

- Fetal development
  - BtW
  - Organ weight

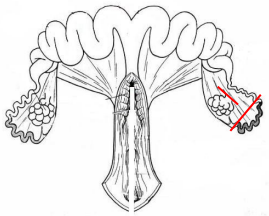
- Muscle development
  - Formation of primary and secondary myofibers
  - Myofiber size

# Experimental design

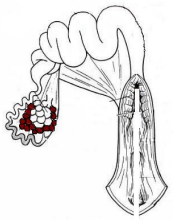
**17**

**Swiss Large White sows (parity 3)**

10 **OL**



7 **UHO**



**2 piglets/ litter/ gender**

- **Lightest BtW** **(L-BtW)**
- **Heaviest BtW** **(H-BtW)**

**L-BtW > 0.800** kg

# Data and sample collection and analysis

## Collection of data and samples at birth

- Litter size
- BtW of all piglets born

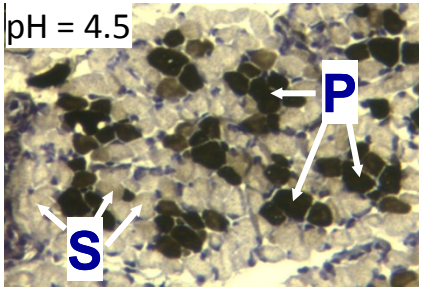
From the selected newborn piglets

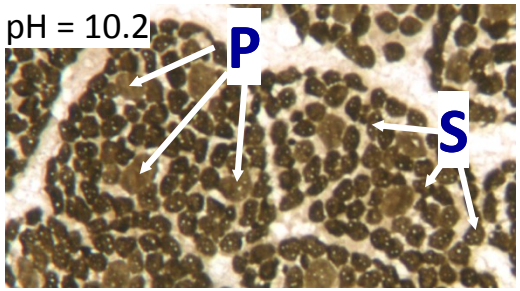
- Weight of the heart, kidney, liver, lung and spleen
- Weight of the brain

## Histological analyses in the LM

*(mATPase staining after pre-incubation at pH 4.5 and 10.2)*

- Number of primary and secondary myofibers
- S/P ratio
- Diameter of the primary and secondary myofibers



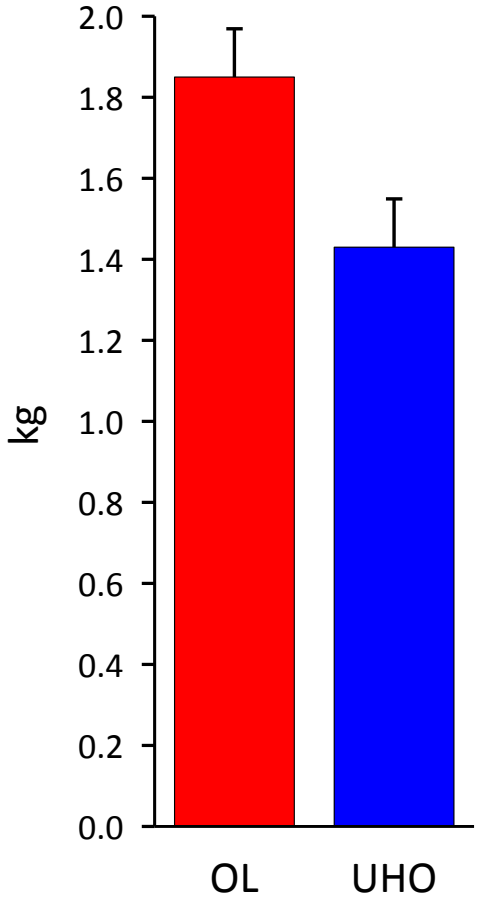



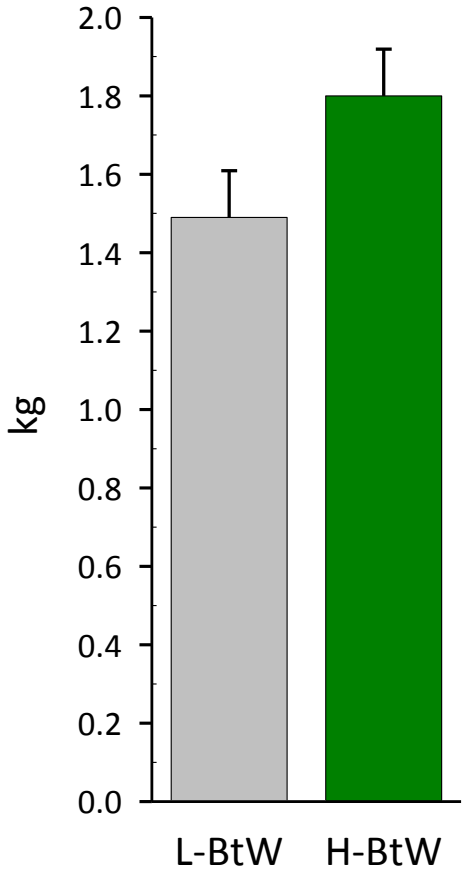
# Results Effect of crowding on sows performance

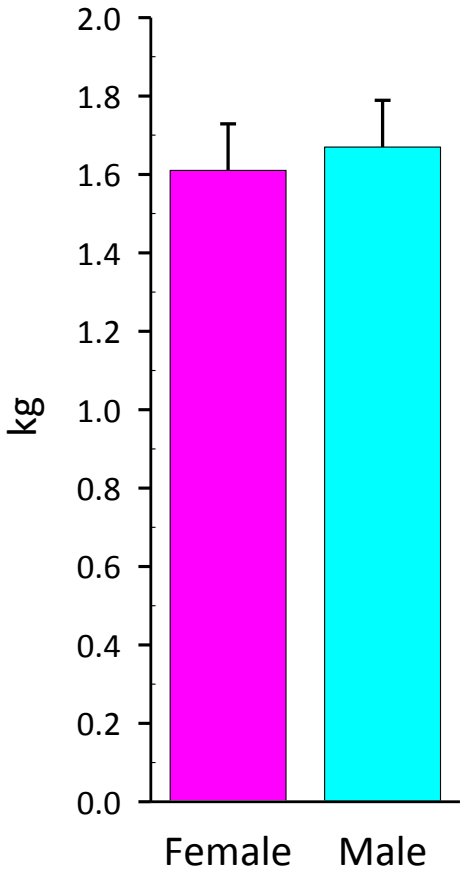
| Trait | Treatment OL | Treatment UHO | *P*-values |
|---|---|---|---|
| Litter size, n | **7.6** (± *0.43*) | **8.0** (± *1.18*) | 0.75 |
| Litter size per uterine horn, n | **3.8** (± 0.21) | **8.0** (± *1.18*) | < 0.01 |
| Birth weight, kg | | | |
| Total litter, kg | **1.84** (± *0.128*) | **1.33** (± *0.148*) | < 0.01 |
| Female, kg | **1.89** (± *0.142*) | **1.38** (± *0.163*) | < 0.01 |
| Male, kg | **1.80** (± *0.119*) | **1.38** (± *0.132*) | < 0.01 |
| Standard deviation in birth weight, kg | | | |
| Female, kg | **0.145** (± *0.030*) | **0.228** (± *0.027*) | 0.07 |
| Male, kg | **0.181** (± *0.069*) | **0.182** (± *0.073*) | 0.82 |

# Results

## BtW of selected piglets




**Trt,** ***P*** **< 0.01**
**BtW,** ***P*** **< 0.01**
Gender, *P* = 0.45

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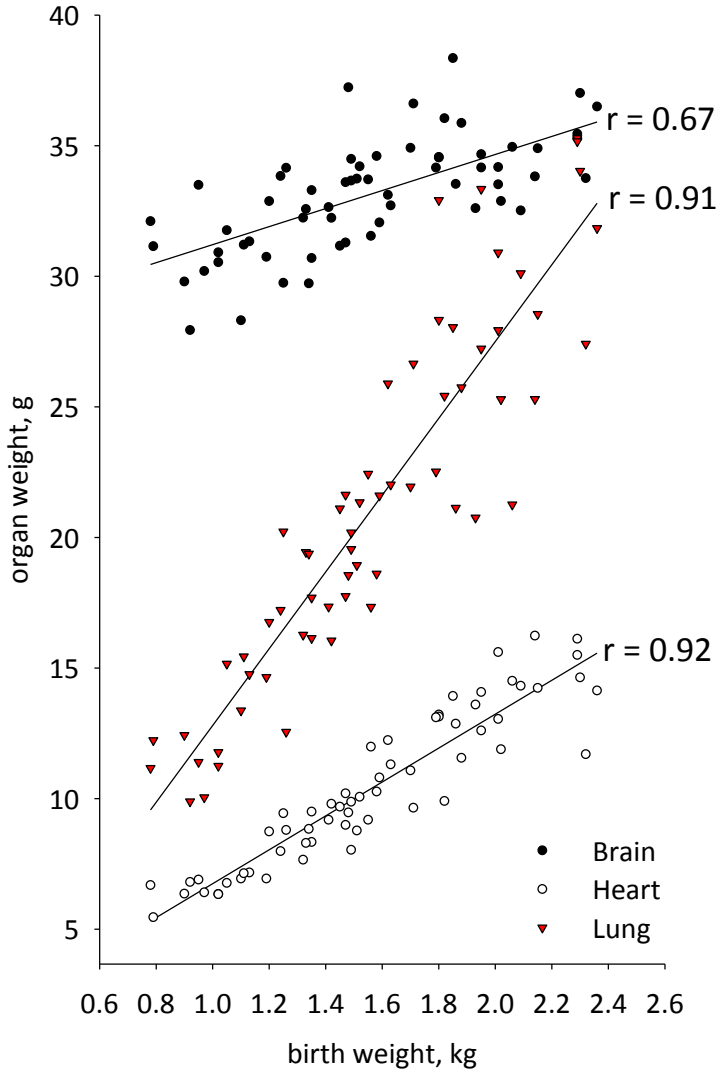
# Results

# Organ weight and BtW relationship



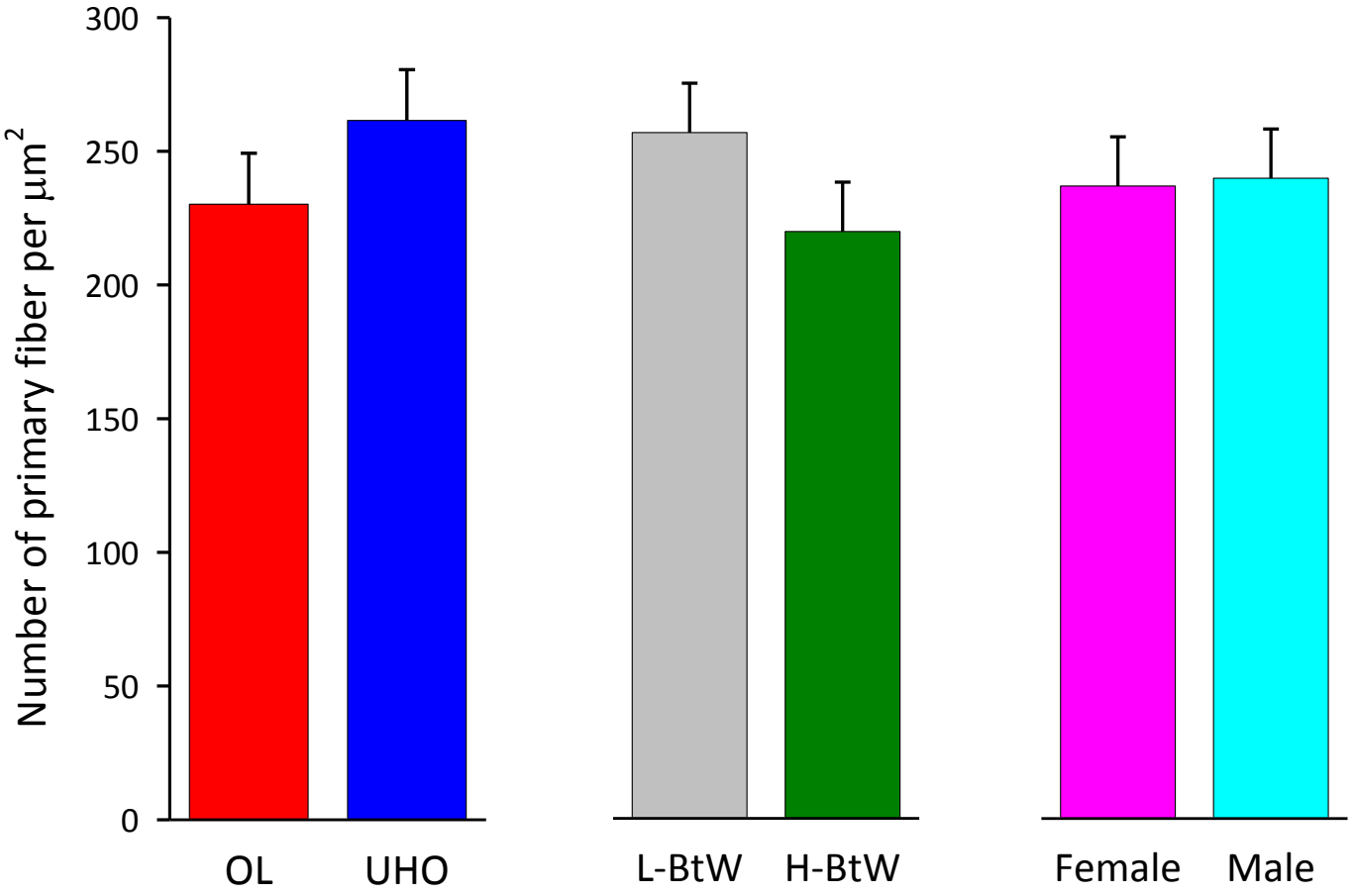
# Results

## Organ weights expressed per kg BtW

| | Sow treatment (Trt) | | BtW group (BtW) | | Sex | | | *P*-values | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Trait | OL | UHO | L | H | Female | Male | SEM | Trt | BtW | Sex |
| Liver, % | 2.64 | 2.59 | 2.57 | 2.67 | 2.65 | 2.59 | 0.144 | 0.65 | 0.36 | 0.55 |
| Heart, % | 0.67 | 0.68 | 0.68 | 0.67 | 0.67 | 0.68 | 0.022 | 0.40 | 0.42 | 0.48 |
| Kidney, % | 0.83 | 0.79 | 0.82 | 0.80 | 0.82 | 0.80 | 0.028 | 0.14 | 0.47 | 0.29 |
| Spleen, % | 0.10 | 0.09 | 0.09 | 0.09 | 0.09 | 0.10 | 0.003 | 0.24 | 0.96 | 0.16 |
| Brain, % | **1.92** | **2.52** | **2.42** | **2.02** | 2.25 | 2.20 | 0.152 | **< 0.01** | **< 0.01** | 0.66 |
| Brain: liver wt ratio | **0.75** | **1.03** | **0.99** | **0.79** | 0.90 | 0.88 | 0.109 | **< 0.01** | **< 0.01** | 0.79 |

# Results

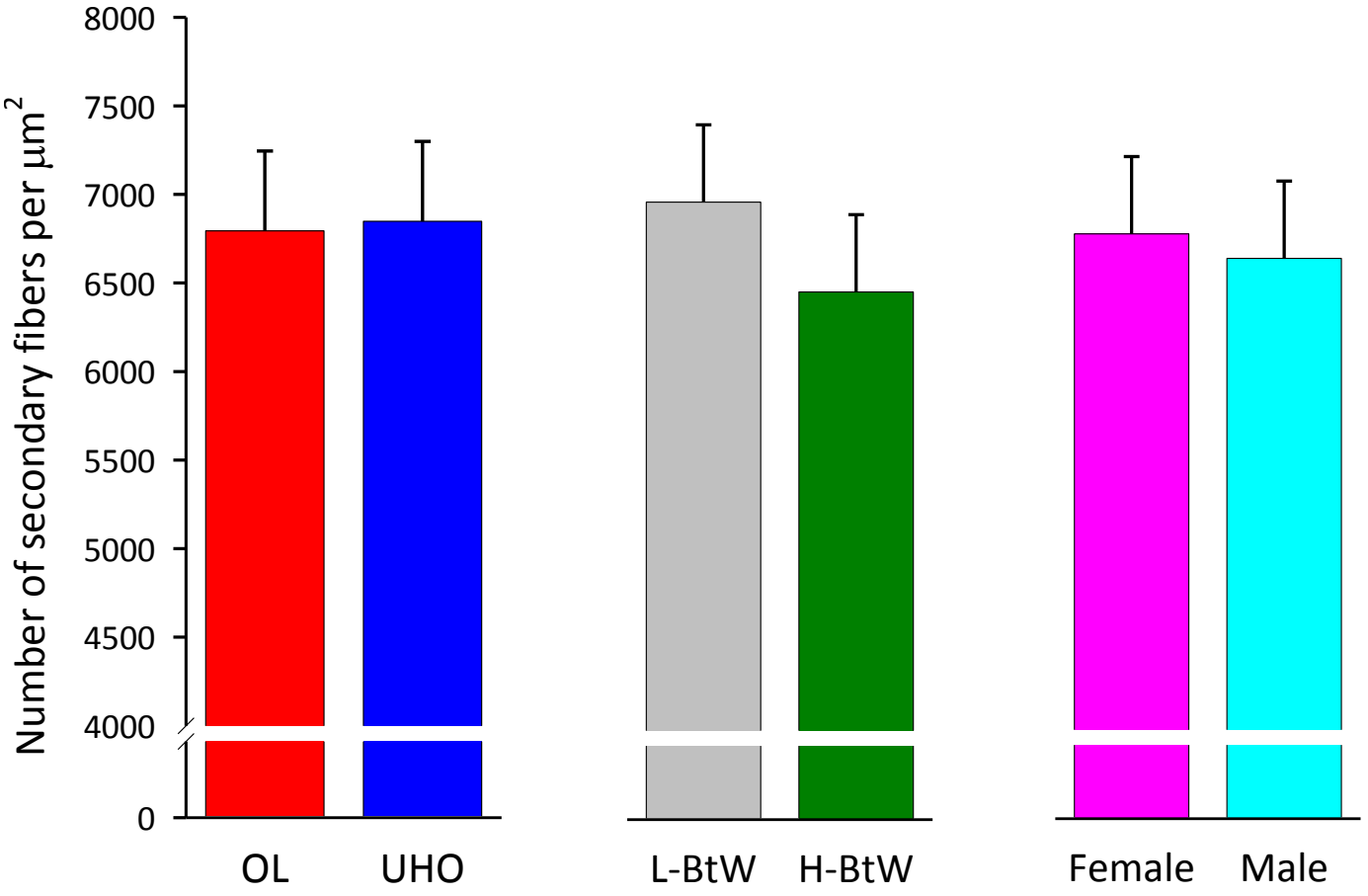
## Muscle fiber characteristics of the LM




Trt, $P = 0.13$
**BtW, $P = 0.06$**
Gender, $P = 0.88$

# Results

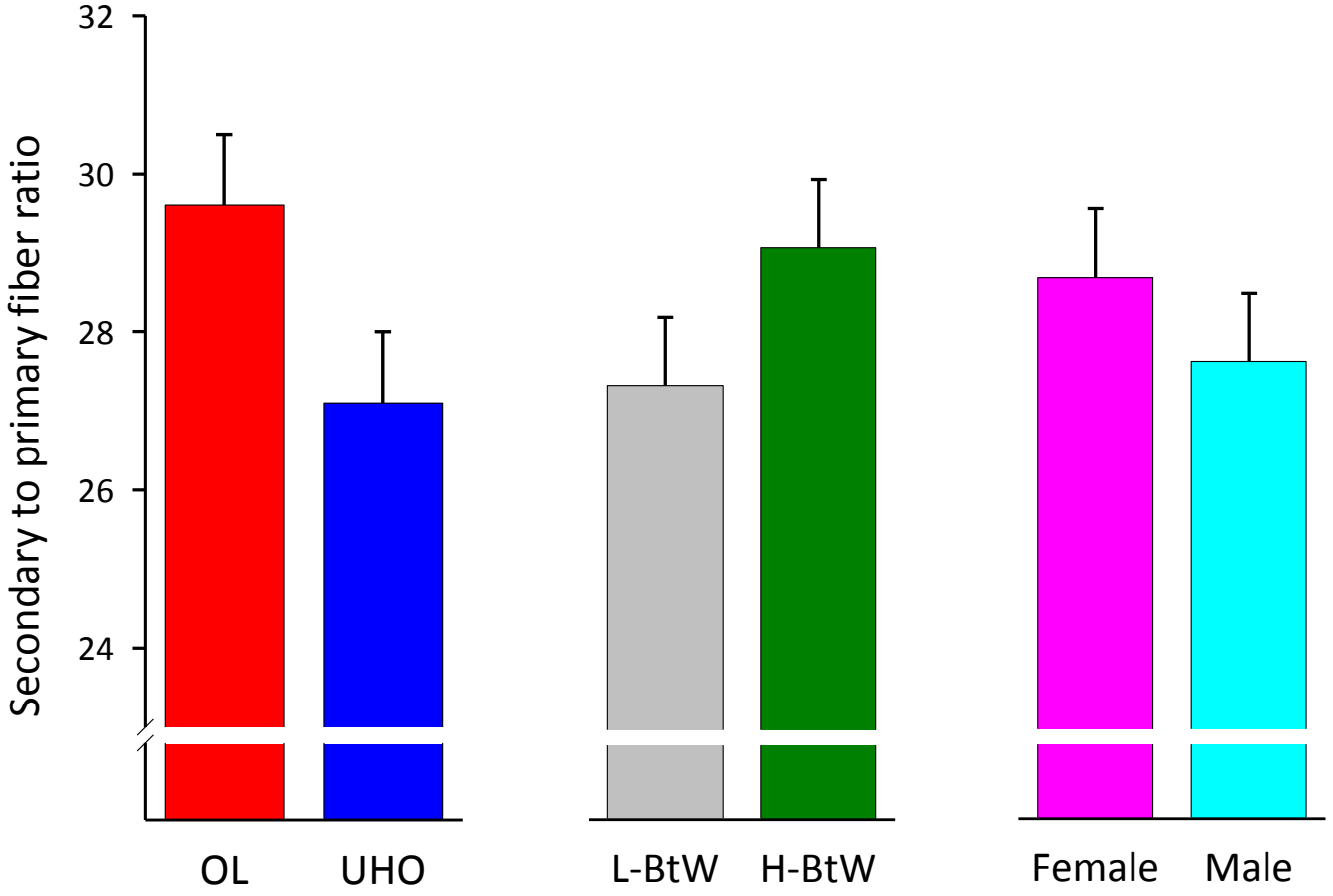
## Muscle fiber characteristics of the LM




Trt, $P = 0.92$
BtW, $P = 0.35$
Gender, $P = 0.80$

# Results

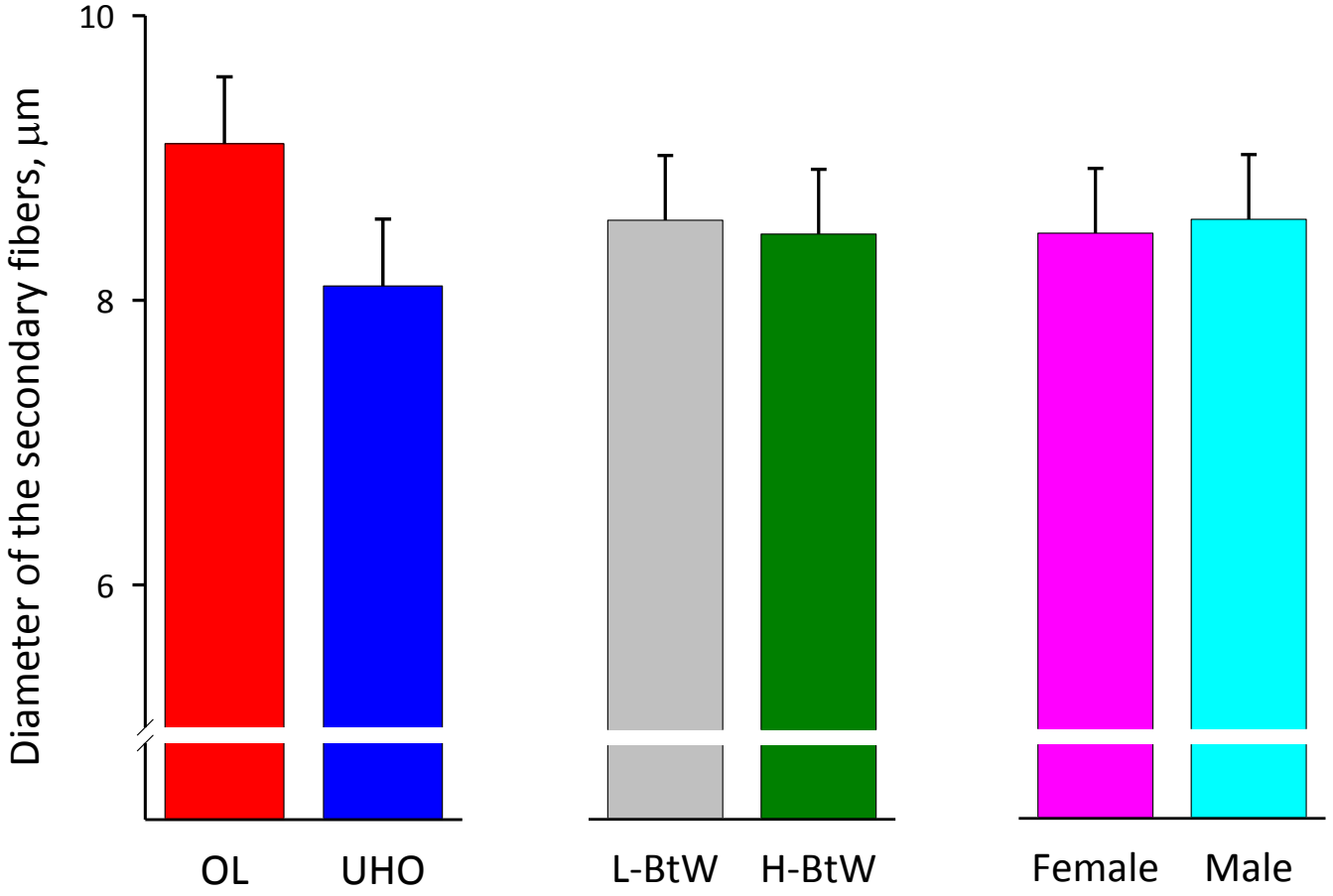
## Muscle fiber characteristics of the LM




Trt, ***P* = 0.05**
BtW, *P* = 0.14
Gender, *P* = 0.38

# Results

## Muscle fiber characteristics of the LM




Trt, ***P* < 0.01**
BtW, *P* = 0.71
Gender, *P* = 0.80

# Conclusions

**Reproductive performance**

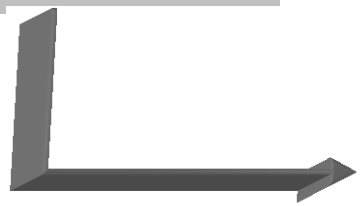
- UHO and OL proved to be an effective model to mimik differences in uterine space.
- Litter size of UHO sows was more than 50% greater in half of the uterine space.
- Regardless of gender average litter BtW decreased by ~28% *but was still relatively high*.

**Development of the newborns**

- Organ weights decreased with decreasing BtW.
- Compensatory growth of the brain in offspring of UHO sows and offspring with a low BtW.

# Conclusions

Myogenesis



- Lower secondary:primary myofiber ratio in UHO offspring.
- Smaller secondary myofibers in UHO offspring.

Expected lower muscle growth

Thank you for your attention

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