# Polish Simmentals: early predictors of longevity

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## Objective

Estimate **genetic correlations between length of productive life and conformation** to identify **early predictors of longevity** in dual-purpose cattle

## Material and methods

- 166 Simmental sires
- Genetic correlations based on the correlation between EBVs of 20 conformation traits and functional longevity

## Results

- Positive correlations for udder and legs: *udder width (0.25), udder depth (0.11), rear leg set side view (0.27), rear leg set rear view (0.16)*
- Unfavourable correlations for body capacity traits:
  moderate values: *body depth (-0.36), chest girth (-0.24)*
  smaller values: *stature (-0.15), rump width (-0.16), muscularity of front end (-0.14), rear end muscularity (-0.13), chest width (-0.12)*

## Conclusions

- Estimates of genetic correlations low to moderate
- Traits with the largest correlations: **body depth, chest girth, udder width** and **rear leg set side view** as predictors of longevity
- Cows with smaller body capacity have a lower relative risk of culling

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We thank the FBF (Förderverein für Bioökonomieforschung e.V.) for the financial support

# Genetic relationships between age at first calving, its underlying traits and survival of Holsteins

67th Annual Meeting of the European Federation of Animal Science

Belfast UK, 29 Aug – 2 Sept 2016

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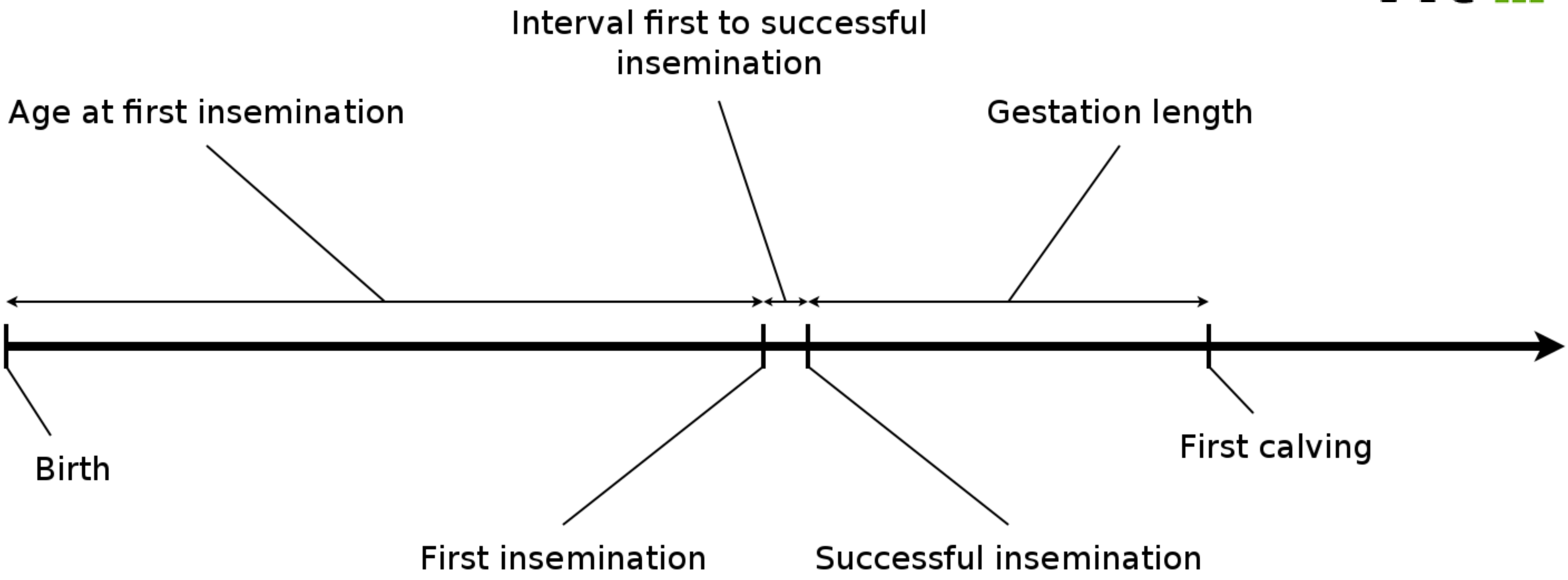
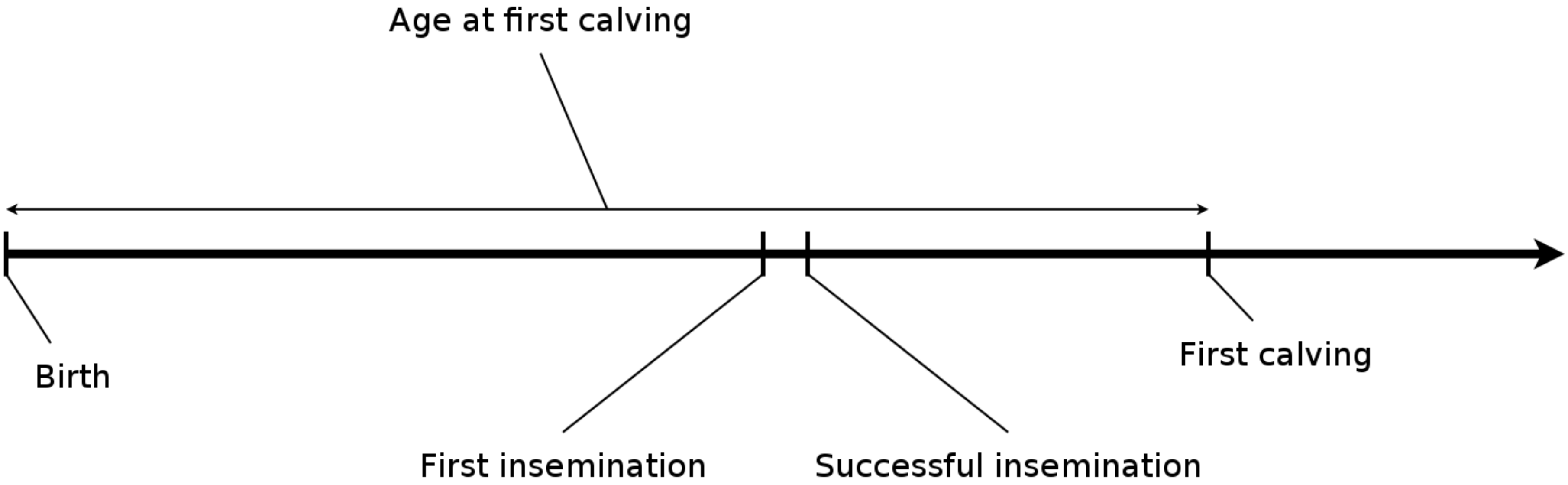
# Motivation


Interval first to successful insemination
Age at first insemination
Gestation length
Birth
First calving
First insemination
Successful insemination

# Motivation




Is it appropriate to correct for age at first calving in genetic evaluations of (functional) longevity?

## Results & Conclusion

| | S1 | S2 | S3 | AFI | FLI | AFC |
|---|---|---|---|---|---|---|
| **S1** | 0.021 | 0.77** | 0.42*** | -0.08 | -0.15 | -0.07 |
| **S2** | 0.03 | 0.014 | 0.68*** | -0.16* | -0.38** | -0.22* |
| **S3** | 0.03 | 0.03 | 0.027 | -0.22* | -0.40* | -0.30* |
| **AFI** | -0.02 | -0.02 | -0.02 | 0.230 | 0.18 | N. est. |
| **FLI** | -0.02 | -0.02 | -0.03 | -0.02 | 0.006 | N. est. |
| **AFC** | -0.03 | -0.03 | -0.04 | N. est. | N. est. | 0.101 |

**S1**: survival 0-49d from 1st calving; **S2**: 50-249d; **S3**: 250d to 2nd calving

Asterisks denote levels of significance, resulting from t-tests on the genetic correlations of the 4 samples ($H_0$: genetic correlation is 0): *: $p < 0.05$; **: $p < 0.01$; *** $p < 0.001$

Results suggest that age at first calving should not be correct for in genetic evaluations of (functional) longevity.

AARHUS UNIVERSITY

C. Gaillard, H.N. Phuong, P. Blavy, J. Sehested - **Abstract # 23017**

EAAP 2016
67th Annual Meeting of the European Federation of Animal Science
Belfast UK, 29 Aug – 2 Sept 2016

# Simulations to define the optimum lifetime management for Holstein cows

## Objectives

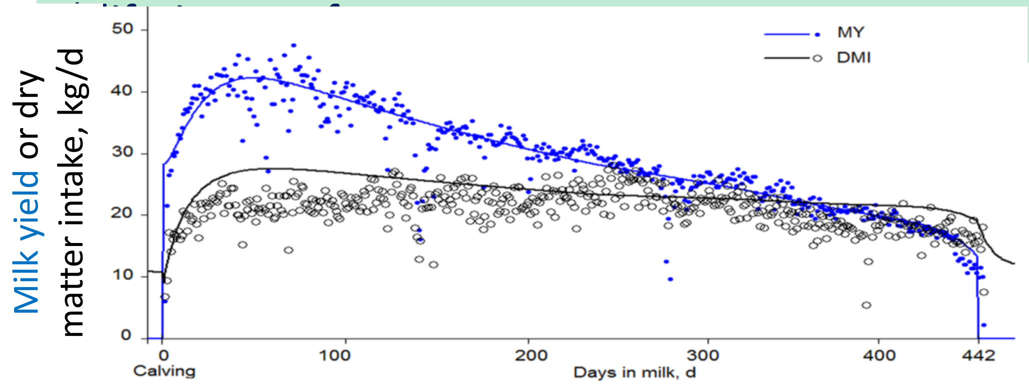
Using a lifetime prediction model to determine:

1) the optimum duration of a lactation to ↑ lifetime efficiency and pregnancy rate

2) if lactation duration should vary with parity to

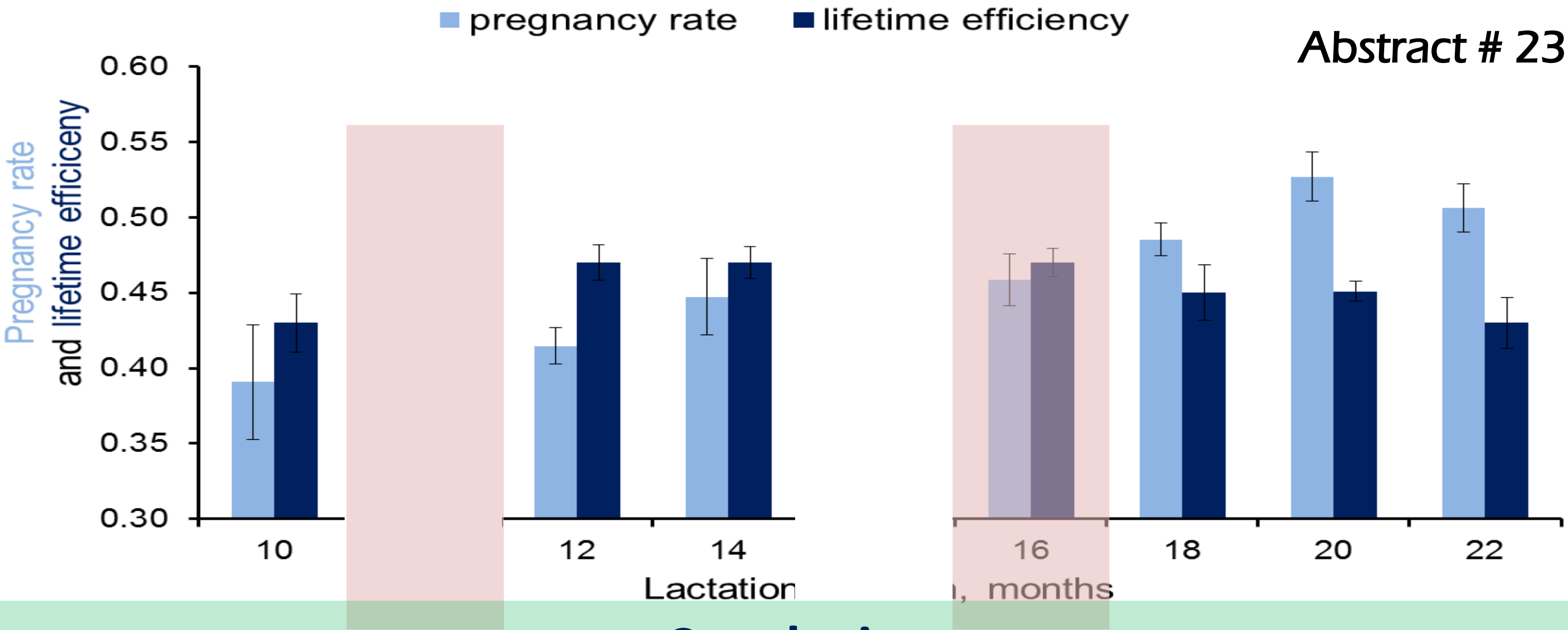
Lifetime efficiency (MJ/MJ)
= energy in milk / energy intake

GARUNS - a lifetime performance model taking into account the changing physiological priorities of an animal during its life




⇒ GARUNS can fit milk yield, dry matter intake, milk components, body weight, and BCS curves of 16 months extended lactation cows

Abstract # 23017




## Conclusions

1) a 16 mo lactation is the optimum extended lactation length in terms of productive-reproductive performance,

2) managing the primiparous cows with a 16 mo extended lactation, followed by 10 mo lactations, ↑ lifetime efficiency to being similar to cows managed for a 16 mo lactation in their entire life.

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# 39.15
# Genetic correlations between energy balance and lactation persistency of Holsteins in Japan

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# Background and Goal

NARO

In the early lactation stage…

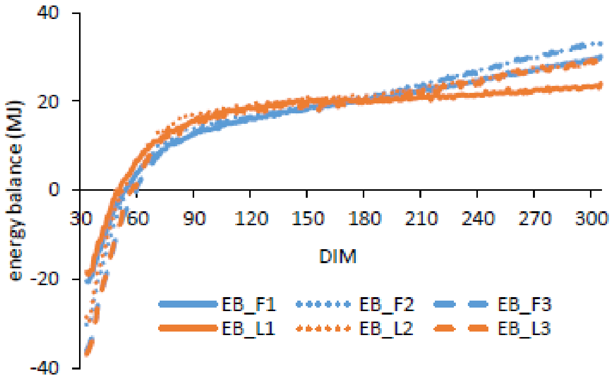
Energy Input by feed intake < Energy Output for milk production → Negative Energy Balance

**Improving lactation persistency (LP) may be better for energy balance (EB).**

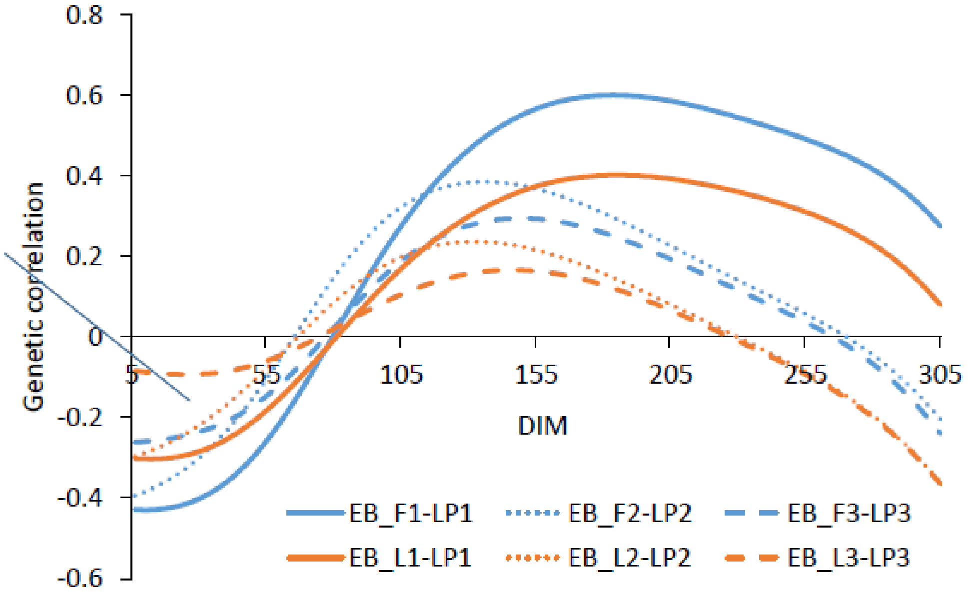
↓

*The objective of this study was to estimate genetic correlations between EB and LP.*

- EB was calculated using the multiple regression equation of Friggens et al. (2007) or Løvendahl et al. (2010).
- LP was defined as the difference in estimated milk yield between 240 and 60 DIM.
- Genetic parameters of EB and LP were estimated using a random regression test-day model.



# Results and Conclusion




**Negative** genetic correlation
in the early lactation stage

Negative genetic correlations were estimated between EB and LP in the early lactation stage, so we need to pay attention for improving EB and LP.

AARHUS UNIVERSITY

C. Gaillard, M. Vestergaard, J. Sehested - **Abstract # 23018**

EAAP 2016
67th Annual Meeting of the European Federation of Animal Science
Belfast UK, 29 Aug – 2 Sept 2016

# Voluntarily delayed rebreeding and double insemination effects on pregnancy rates of Holstein cows


high milk yield & NEB
“ estrus expression and detection

↓ Reproductive performance
“ Pregnancy rate
‘ Number of inseminations

Extended lactation (EL) — (previous studies) → ↑ Reproductive performance

Double insemination — (previous studies) → Different results on reproductive performance

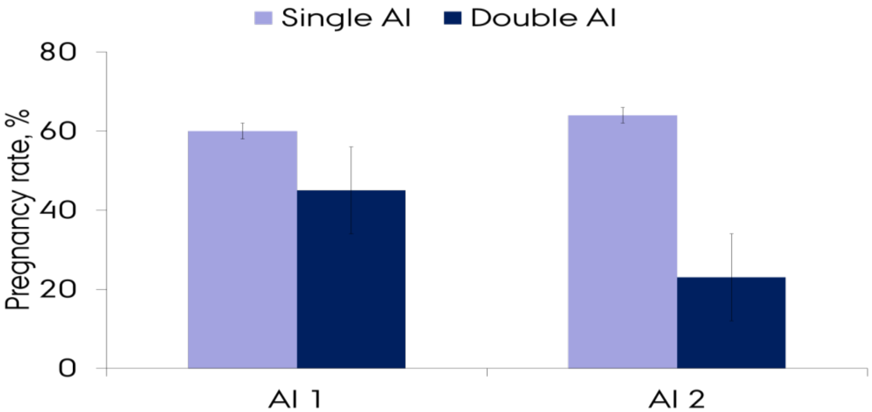
## Hypotheses

1) Delaying rebreeding to 8 months will ‘ mounting behavior and estrus detection, and ‘ pregnancy rate (PR)

2) The use of a double AI technique around estrus will ‘ PR

Abstract # **23018**

| Compare early rebreeding (2 months) with … | … late rebreeding (8 months) |
| --- | --- |
| Mounting behavior | **+** |
| Pregnancy rate **(PR)** | **=** |
| Number of inseminations | **=** |




## Conclusions

1) *Delaying rebreeding increased mounting behavior but did not increase PR*

2) *The double artificial insemination (AI) had a negative effect on PR*

# HERD DYNAMICS AND ECONOMICS OF DIFFERENT STRATEGIES FOR MANAGING A HERD FOR EXTENDED LACTATION

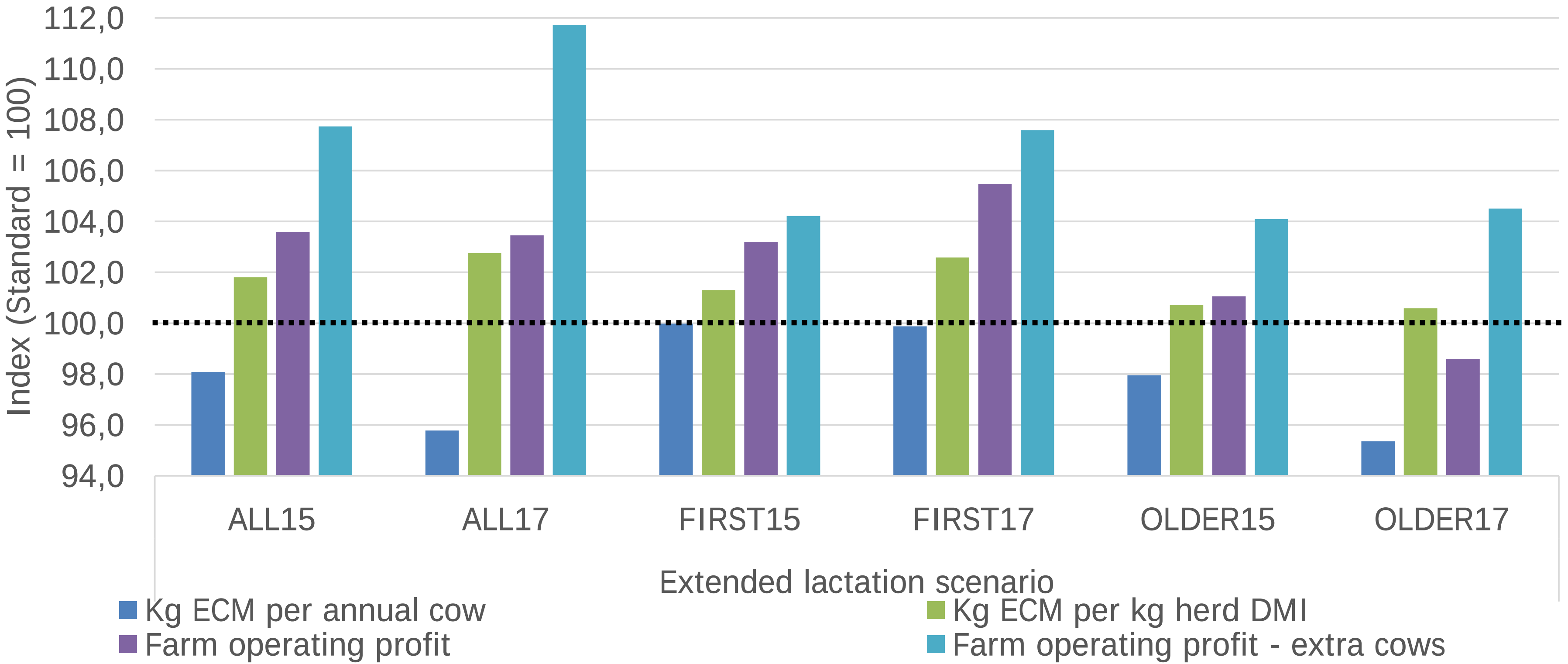
J. O. Lehmann, L. Mogensen, S. Østergaard,
J. F. Ettema & T. Kristensen

## Objective

To investigate the effect of different lactation management strategies on herd dynamics and economics.

| Scenario | Which cows? | Calving interval | |
|---|---|---|---|
| | | Prim | Mult |
| STANDARD | All | 13 | 13 |
| ALL15 | All | 15 | 15 |
| ALL17 | All | 17 | 17 |
| FIRST15 | Primiparous | 15 | 13 |
| FIRST17 | Primiparous | 17 | 13 |
| OLDER15 | Multiparous | 13 | 15 |
| OLDER17 | Multiparous | 13 | 17 |

# EXTENDED LACTATION COMPARED WITH STANDARD



# Effect of curve traits and Age of first calving on productive life of Holstein primiparous Walloon cows

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Longevity, productive life, or lifespan of dairy cattle defined as the time from first calving to culling, death or sale, is an important and ambiguous trait resulting from many factors.

## Aim

Linking cow's longevity to lactation curve caracteristics and age of first calving.

## Data

- Lactation curve traits for milk provided by the Walloon Breeding Association
- 20.766 primiparous Holstein cows calvings from 2003 to 2014
- 395 herds (> 50cows)

## Model

**Linear model :**

$$LPL_{ijkmpnoq} = \mu + H_i + CY_j + CS_k + AFC_m + M305_p + \beta 1\, PS_n + \beta 2\, Pk_o + \beta 3\, DIM_q + e_{ijkmpnoq}$$

$LPL_{ijkmpnoq}$: length of productive life, μ overall mean

$H_i$, $Cy_j$, $CS_k$ and $AFC_m$ fixed effects of $i^{th}$ herd, $j^{th}$ year of calving, $k^{th}$ calving season and age at first calving (AFC=C1 to C10)

$M305_p$, $PS_n$, $Pk_o$, $DIM_q$ fixed effects of Milk Yield adjusted to 305 days (M305d= L1 to L4), persistency, peak and days in milk.

β1, β2, β3 Regression coefficients, e residual effect with $e_{ijkmpnoq} \sim N(0, \sigma_e^2)$.

Authors are thankful to the Walloon Livestock Association (AWE), Belgium for providing the data
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# Effect of curve traits and Age of first calving on productive life of Holstein primiparous Walloon cows

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## Results and discussion

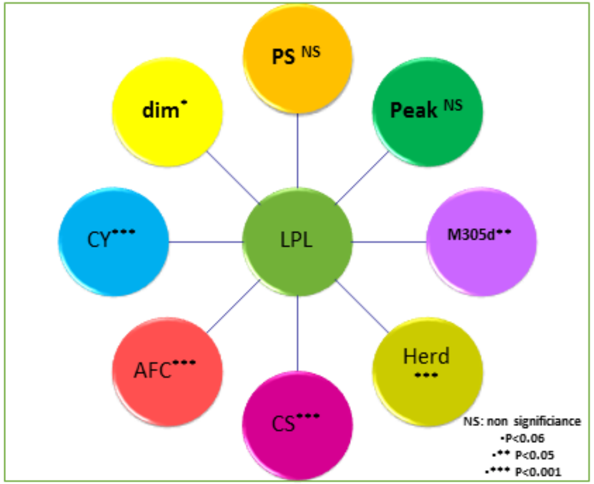


Figure 1: Effect of traits of interest on LPL.

the least favorable season

- Higher longevity
➔ voluntary culling of low producing cows and of involuntary culling for reasons such as diseases for very high producing cows.

- later calvings (> 28 month) linked to lower LPL.

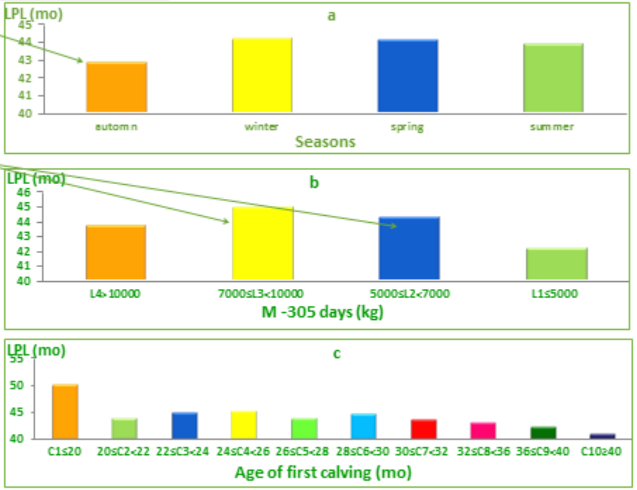


Figure 2: Lsmeans of LPL by season (a), M-305d (b) and by age of first calving (c).

## Conclusion

- LPL was affected by herd ➔ management and culling decisions
- The lack of significance for the regressions of PK and PS on LPL should be considered a preliminary result for two reasons:
-

1) the simultaneous presence of other correlated effects as milk yield in the model and
2) the use of a linear regression when non-linear relationship are more likely (intermediate optimum).

Authors are thankful to the Walloon Livestock Association (AWE), Belgium for providing the data
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CiBreed
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# Lost in transition – a reaction norm model to breed cows that can better cope with metabolic stress

## The Problem

In the transition phase in early lactation, dairy cows have higher energy requirements than can be satisfied by feed intake (**Fig. 1**).

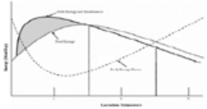


**Figure 1:** Discrepancy of energy requirements for maintenance and milk production and energy intake in the early lactation[1]

We hypothesize, that some cows are genetically less well suited to cope with this metabolic stress than others, leading to adverse follow-up effects on longevity. Robust cows thus will remain unaffected by a metabolic load, while non-robust cows will react with a reduced fitness (**Fig. 2**). We use a reaction norm sire model to test whether this robustness has a genetic component.

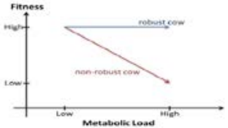



**Figure 2:** Robust cows stay unaffected by an increased metabolic challenge, while non-robust cows react with reduced fitness

## Animals, Data and Methods

- ~38 million test day records of ~1.4 million Brown Swiss dairy cows were available
- only bulls with ≥ 10 daughters that were born before 2011 and had an exit record were used

⇨ 4,983 bulls and 579,994 daughters, 30,842 animals in pedigree

**Challenge variables:** accumulated **milk yield** or accumulated **fat/protein ratio** for the first 3 test days, precorrected

**Response variable:** **functional longevity** from Survival Kit 5.0 (log pseudo records)

**Reaction norm sire model:**

$$y_{ij} = \mu + \beta x_{ij} + s_i + b_i x_{ij} + \epsilon_{ij} \qquad \binom{s}{b} \sim \left(0, A \otimes \begin{pmatrix} \sigma_s^2 & \sigma_{sb} \\ \sigma_{sb} & \sigma_b^2 \end{pmatrix}\right)$$

| | |
|---|---|
| $y_{ij}$ | *response variable of daughter j of sire i* |
| $x_{ij}$ | *challenge variable of daughter j of sire i* |
| $\mu$ | *fixed regression constant* |
| $\beta$ | *fixed regression coefficient* |
| $s_i$ | *random effect of sire i* |
| $b_i$ | *random regression coefficient of sire i* |
| $\epsilon_{ij} \sim (0, \frac{\sigma_e^2}{w_{ij}})$ | *random residual error* |
| $w_{ij}$ | *weights reflecting reliability of survival pseudo records* |
| $A$ | *additive-genetic numerator relationship matrix* |

Models were fitted using **ASReml 3.0**[2], random components were tested using a **likelihood ratio test** for hierarchical sub-models, standard errors and confidence bands for estimated parameters were obtained by adapted **bootstrap** procedures.[3]

## Conclusions

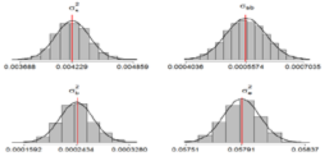
The results of this study show that the ability to cope with metabolic stress in the transition phase clearly has a genetic component.

The suggested reaction norm sire model can be used to identify bulls that inherit an improved ability to handle metabolic stress without adverse effects on longevity and thus resulting breeding values can be the basis to select for metabolically more robust dairy cows.

## Results

- All estimated (co-)variance components were significantly different from 0 (**Fig. 3**), and the models accounting for $\sigma_{sb}$ provided a significantly better fit compared to reduced models.
- Daughter groups of different bulls differed substantially in their ability to cope with metabolic stress (**Fig. 4**).
- Heritabilities of the response variable under high challenge are substantially increased (**Fig. 5**)
- Robustness to metabolic stress thus has a genetic component

**Figure 3**: Empirical bootstrap distribution of estimated (co-) variance components with the fat/protein ratio as challenge variable. The red vertical lines depict the estimates obtained from the original data.



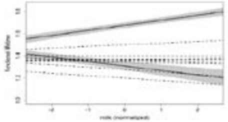


**Figure 4**: Estimated regression curves of ten randomly chosen bulls and the bulls with the highest and lowest slope for the regression (with bootstrap-based 95% confidence bands)

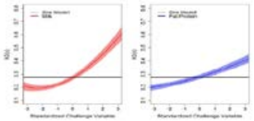


**Figure 5**: Estimated heritabilitiy functions (with bootstrap-based 95% confidence bands) from the reaction norm sire model as a function of the challenge variable milk yield (left) and fat/protein ratio (right) compared to sire model $h^2$ (black line)

## References and Acknowledgements

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[3] Thai, H.-T., F. Mentré, N.H.G. Holford, C. Veyrat-Follet, and E. Comets. 2013. A comparison of bootstrap approaches for estimating uncertainty of parameters in linear mixed-effects models. *Pharm. Stat.* 12:129–140.

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# GOOD LEG MEANS GOOD STAYABILITY OF THE SOWS

## AND GENOME-WIDE ASSOCIATION STUDY (GWAS) FOR LEG CONFORMATION

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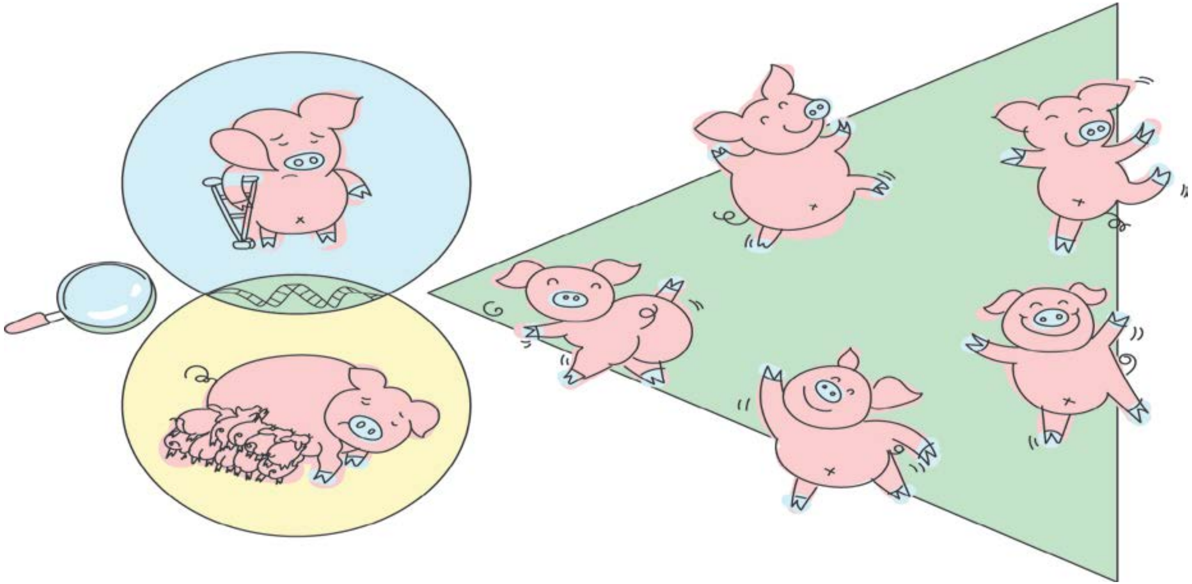

## 1. Introduction

**LONGEVITY** ← *early predictor* — **CONFORMATION**

*Late record*

*Improved longevity*

*Low heritability*

*Improved selection accuracy*

*MAS*

**Genomic variants**

1. Estimate **heritability and genetic correlations** of conformation and longevity in Swedish and Danish pigs
2. Identify **genomic variants** affecting conformation in Danish pigs

## 2. Material and methods


*Linear / linear threshold model*

*DMU*

**LONGEVITY**

Stayability to 2nd or 3rd parity, lifetime piglet production

**CONFORMATION** (B+@ 5 months, 100 kg)

Movement, Toes, Standing-under, Front leg, Back, Rear leg, Overall

**GWAS AND META-ANALYSES**

- *Mixed linear model, software GCTA*
- *Multiple traits within breed, approximate test statistic*
- *Across breeds, software METAL*

## 3. Results

### ❖ Genetic parameters

- Low to moderate heritablities for conformation traits
- Favorable correlation between conformation and longevity

### ❖ GWAS and meta-analyses

- Genes affecting conformation: related to bone and skeleton development , muscle and fat metabolism (*LRPPRC, WRAP73, VRTN, PPARD)* and growth (*GF2BP2, GH1, CCND2, MSH2)*
- Meta-analyses
  - ✓ Multi-trait within breed suggested QTLs with possible pleiotropic effect
  - ✓ Across breeds detected novel candidate genes *SOS2*, *TRIM24* and *ELMO1*

## 4. Conclusion

**BETTER LEG CONFORMATION – LONGER STAY**
→ possible to **improve longevity through conformation**

Conformation is complex, partly controlled by genes involved in **development and growth**

Meta-analyses **increased power** to detect QTLs