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# Genetic correlations among body condition score, yield and fertility in multiparous cows using random regression models

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## Context

Body Condition Score (BCS)

- assesses the stored energy reserves of dairy cows
- indicator of the extent and the duration of the postpartum energy balance status

→ Included in selection programs as indicator trait to improve fertility and health

The Walloon Region of Belgium has been taking part to the international genetic evaluation for BCS since September 2008.

## Context

Body Condition Score (BCS)

- assesses the stored energy reserves of dairy cows
- indicator of the extent and the duration of the postpartum energy balance status

→ Included in selection programs as indicator trait to improve fertility and health

↓ But it requires the estimation of consequences of BCS selection on fertility and on other economically important traits (i.e. production)

## Objective

**Estimate genetic correlations between BCS and economically important traits**

- Economically important traits:
  - Days open (number of days from calving to conception)
  - 305-days milk, fat, and protein yields (kg)
- Using random regression models
  - BCS as a longitudinal trait
  - production and fertility as traits measured as single lactation record

## Objective

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- Economically important traits:
  - Days open (number of days from calving to conception)
  - 305-days milk, fat, and protein yields (kg)
- Using random regression models
- For cows in lactation 1 to 3

Correlations estimated within and across lactations

## Data & Model

- Holstein cows in parity 1 to 3
- BCS data
  - monthly collected by milk recording agent since April 2006
  - scale from 1 (=emaciated cow) to 9 (=obese cow)
- Days open and production data
  - extracted for cows born after 1996 in herds with at least one BCS record
  - milk, fat, and protein yields at 305 days estimated for cows with lactation greater than 250 days using Modified Best Prediction (Gillon et al., 2010)

## Data & Model

- Variances components estimated using EM-REML
- Four 4-traits models

$$y = X\beta + Hh + Wc + Zp + Za + e$$

- y = observations
  - BCS in lactation 1, BCS in lactation 2, BCS in lactation 3
  - + one of the traits of interest
    - days open, 305-d milk yield, 305-d fat yield, or 305-d protein yield
    - including records of the 3 parities

## Data & Model

- Four 4-traits models

$$y = X\beta + Hh + Wc + Zp + Za + e$$

- β = fixed effects
  - for days open and 305-d milk, fat, and protein yields
    - year of calving x month of calving x parity
    - season of calving x age at calving x parity
    - herd x parity
  - for BCS
    - age at calving x stage of lactation
    - herd x BCS scoring date

## Data & Model

- Four 4-traits models

$$y = X\beta + Hh + Wc + Zp + Za + e$$

- h, p, a = random effects for days open and yields
  - h = herd x year of calving
  - p = permanent environment
  - a = additive genetic
- c, p, a = random regression effects for BCS
  - c = BCS recorder
  - p = permanent environment
  - a = additive genetic

Regression curves modelled with 2nd order Legendre polynomials

## Data & Model

BCS – days open

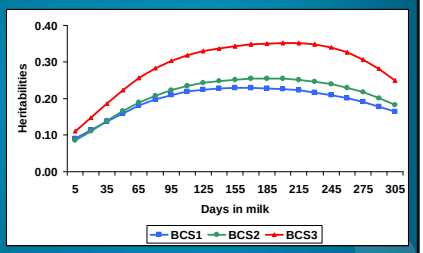
BCS – 305-d milk, fat or protein yields

| | Model 1 | Models 2,3,4 |
|---|---|---|
| No. of records of the trait of interest | 21,463 | 23,615 |
| No. of BCS in lactation 1 | 30,081 | 27,928 |
| No. of BCS in lactation 2 | 22,545 | 20,962 |
| No. of BCS in lactation 3 | 15,102 | 14,000 |
| No. of cows | 12,481 | 12,802 |
| No. of cows with both records | 5,893 | 5,921 |
| No. of herds | 97 | 88 |

## BCS heritabilities

Daily heritabilities averaged among the 4 analyses

| Average | |
|---|---|
| BCS1 | 0.19 |
| BCS2 | 0.21 |
| BCS3 | 0.29 |

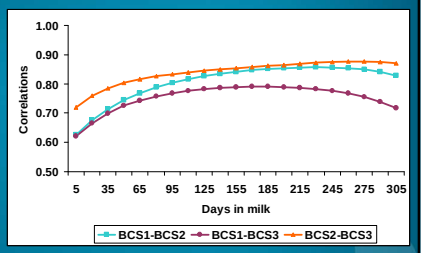



Heritabilities greater in mid lactation (200 DIM) and in lactation 3

## Correlations among BCS

Daily genetic correlations among BCS averaged for the 4 analyses

| Average | |
|---|---|
| BCS1-BCS2 | 0.81 |
| BCS1-BCS3 | 0.75 |
| BCS2-BCS3 | 0.84 |

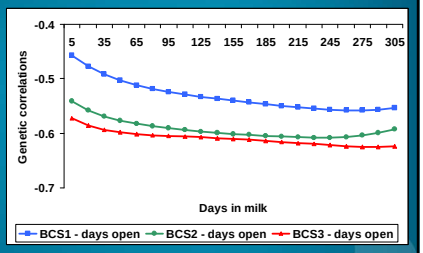



BCS is not exactly the same trait over the parities (especially between parity 1 and 3)

## BCS – days open

Daily genetic correlations between BCS and days open

| Average | |
|---|---|
| BCS1 | -0.53 |
| BCS2 | -0.59 |
| BCS3 | -0.61 |

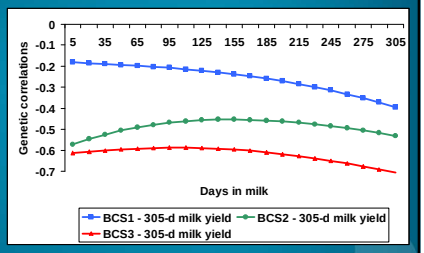



- Favorable genetic relationship between BCS and fertility
- Genetically low BCS related to higher number of days when the cow is not pregnant

## BCS – 305-d milk yield

Daily genetic correlations between BCS and 305-d milk yield

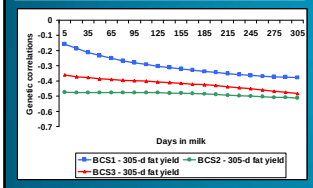
| Average | |
|---|---|
| BCS1 | -0.25 |
| BCS2 | -0.49 |
| BCS3 | -0.62 |



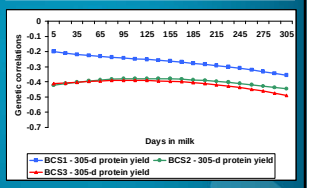

- Unfavorable genetic relationship between BCS and yield
- Selection on high lactation milk yield would slightly affect BCS in parity 1 (especially in early lactation)

## BCS – 305-d fat and protein yields

BCS and 305-d fat yield




BCS and 305-d protein yield




| | BCS1 | BCS2 | BCS3 |
|---|---|---|---|
| 305-d fat yield | -0.12 | -0.49 | -0.42 |
| 305-d protein yield | -0.27 | -0.40 | -0.42 |

Unfavorable genetic relationship between BCS and fat and protein yields (especially in parity 2 and 3)

## Conclusions

- BCS heritabilities low to moderate (0.08 to 0.35) and higher in mid to late lactation
  - Selection on the ability of the cow to recover body reserves after the peak
- BCS is not exactly the same trait over parities
  - especially in lactation 1
  - Interest of recording BCS for multiparous cows

## Conclusions

- Favorable and moderate genetic correlations between BCS and fertility
  - Lower BCS associated with increased number of days when the cow is not pregnant
- Unfavorable genetic correlations between BCS and production
  - Selection for higher BCS would affect production

BCS could be used as an indicator to improve fertility but negative impacts on other traits should be considered.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## Thank you for your attention!


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