

Relationships between metabolic status and behaviour

in dairy cows in week 4 of lactation after different dry period lengths

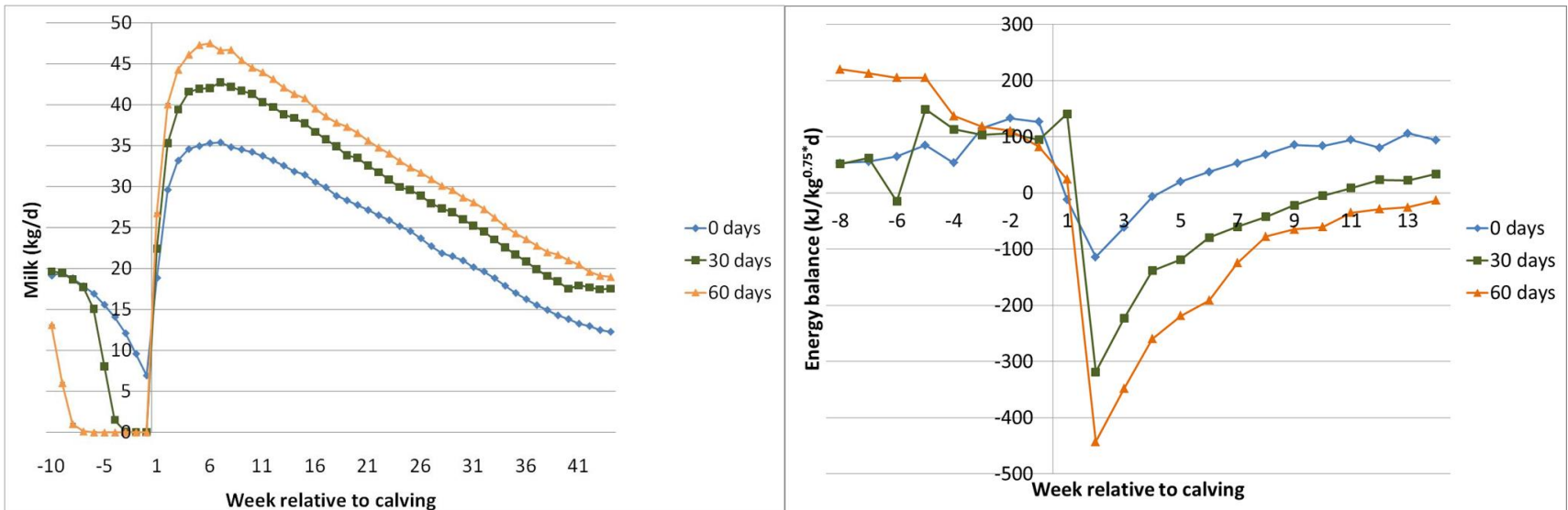
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Background: Dry period/ no dry period

- Dry period maximises milk yield next lactation
 - Negative energy balance, reduced health & fertility
- No dry period: lower milk yield, better energy balance

Milk yield and energy balance of cows with 0, 30 or 60 days dry period



(Van Knegsel et al. 2014, JDS)

Relation between energy balance and cow behaviour

- No (vs. short) dry period increased energy balance, lying time and feed intake in early lactation
- Correlations between behaviour and energy balance (EB) were weak

| Variable ² | Pearson Correlation ¹ | |
|----------------------------------|----------------------------------|------|
| | Milk | EB |
| Basal ration intake (kg per day) | 0.21 | 0.26 |
| Feeding rate (g per min) | n.s. | n.s. |
| Meals (No. per day) | n.s. | 0.25 |
| Visits (No. per day) | n.s. | 0.22 |
| Total meal time (min per day) | n.s. | 0.19 |
| Total feeding time (min per day) | n.s. | n.s. |
| Lying time (h per day) | -0.22 | 0.28 |
| Lying bouts (No. per day) | n.s. | n.s. |
| Steps (No. per day) | n.s. | 0.27 |

(Kok et al. 2017, AABS)

Relation between metabolic status and cow behaviour?

- Metabolic diseases are associated with changes in behaviour
- Metabolic status may be more relevant than energy balance for an animal
- ***Is metabolic status without clinical disease reflected in behavior of cows in early lactation?***

Approach

- Analyse associations between metabolic status and behaviour in dairy cows in week 4 postpartum

feeding

lying & steps

based on plasma metabolites and hormones



Materials and methods

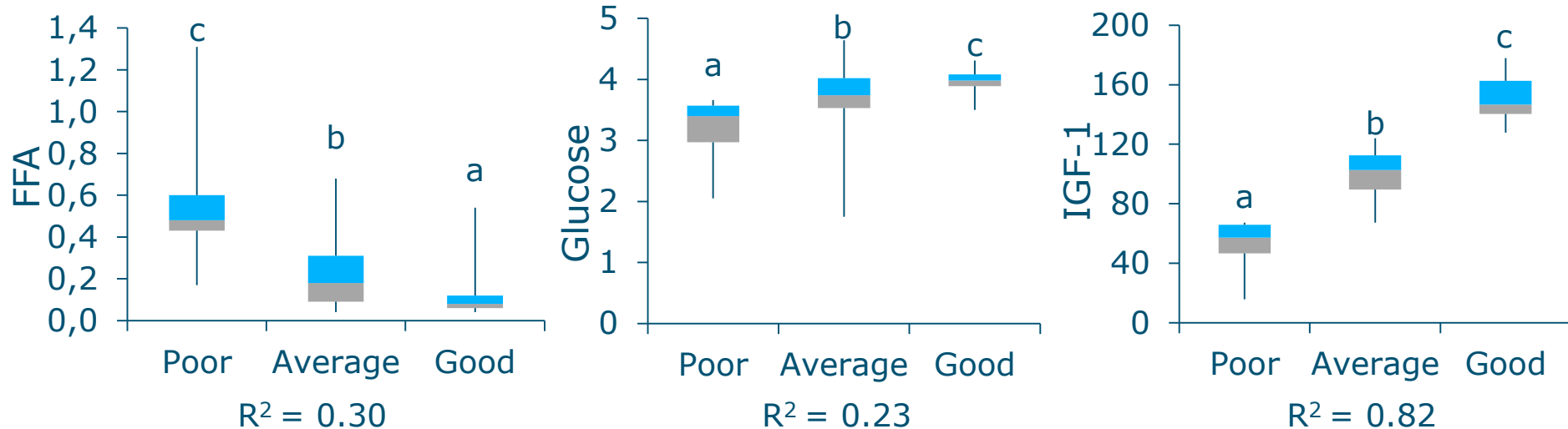
- 81 cows in wk 4 of lactation after a 0-d or 30-d DP
- Data: plasma variables and automatically recorded behaviour
- *Pearson correlations*
 - Plasma [FFA, BHB, glucose, insulin, IGF-1, GH]
 - Behaviours
 - Feed intake, meals, daily meal time
 - Daily lying time, lying bouts, steps
- *Cluster analysis* with plasma variables: “metabolic clusters”
- *General linear models* $Y_{\text{behaviour}} = \text{cluster}_i + \text{dry period} + \text{parity} + e$

Results - correlations

| | FFA (mmol/L) | BHB (mmol/L) | Glucose (mmol/L) | Insulin (μ U/mL) | IGF-1 (ng/mL) | GH (μ g/L) |
|----------------------------|-----------------|-----------------|---------------------|--------------------------|------------------|--------------------|
| DMI (kg DM/d) ¹ | -0.49** | Ns | 0.23* | Ns | 0.22* | -0.34** |
| Meals (n/d) | -0.34** | Ns | Ns | Ns | 0.34** | -0.24* |
| Meal time (min/day) | -0.38** | Ns | Ns | Ns | Ns | Ns |
| Lying time (hrs/d) | -0.43** | Ns | Ns | Ns | 0.32** | Ns |
| Lying bouts (n/d) | Ns | Ns | Ns | Ns | Ns | Ns |
| Steps (n/d) | -0.32** | -0.25* | Ns | Ns | Ns | Ns |

- FFA most and strongest correlations with behaviour

Results – metabolic status clusters



- 3 clusters: 'poor', 'average', and 'good' metabolic status
 - Poor → good cluster = lower FFA, higher glucose and IGF-1
 - No sign. difference in BHB, GH and insulin
 - Cluster mainly determined by IGF-1 (highest R²)

Results – metabolic cluster ~ behaviour

| | Adjusted R ² | Metabolic status | | | SE _p | P-value | | |
|----------------------------------|-------------------------|-------------------|-------------------|-------------------|-----------------|-----------------|-------|-------|
| | | Poor | Average | Good | | Cluster | DryP | Par |
| Cows | | 9 | 41 | 25 | | | | |
| FPCM (kg/d) | 0.07 | 38.8 | 39.0 | 35.6 | 2.5 | 0.06 | | |
| EB (kJ/ [kg ^{0.75} *d]) | 0.22 | -242 ^a | -124 ^b | 6 ^c | 66 | <0.01 | | |
| DMI (kg DM/d) | 0.25 | 19.5 ^b | 22.0 ^a | 22.4 ^a | 0.9 | <0.01 | <0.01 | 0.44 |
| Meals (n/d) | 0.15 | 7.17 ^b | 7.38 ^b | 8.24 ^a | 0.49 | 0.02 | 0.62 | 0.64 |
| Meal time (min/d) | 0.25 | 200 | 224 | 225 | 22 | 0.39 | 0.57 | <0.01 |
| Lying time (h/d) | 0.12 | 10.3 | 10.9 | 11.9 | 0.8 | 0.06 | 0.26 | 0.32 |
| Lying bouts (n/d) | 0.07 | 11.6 | 12.0 | 13.2 | 1.5 | 0.40 | 0.84 | 0.16 |
| Steps (n/d) | 0.18 | 1100 | 1231 | 1324 | 134 | 0.21 | 0.73 | 0.01 |

- Dry matter intake & meals/d were higher, and lying time tended to be higher for better metabolic status

Discussion

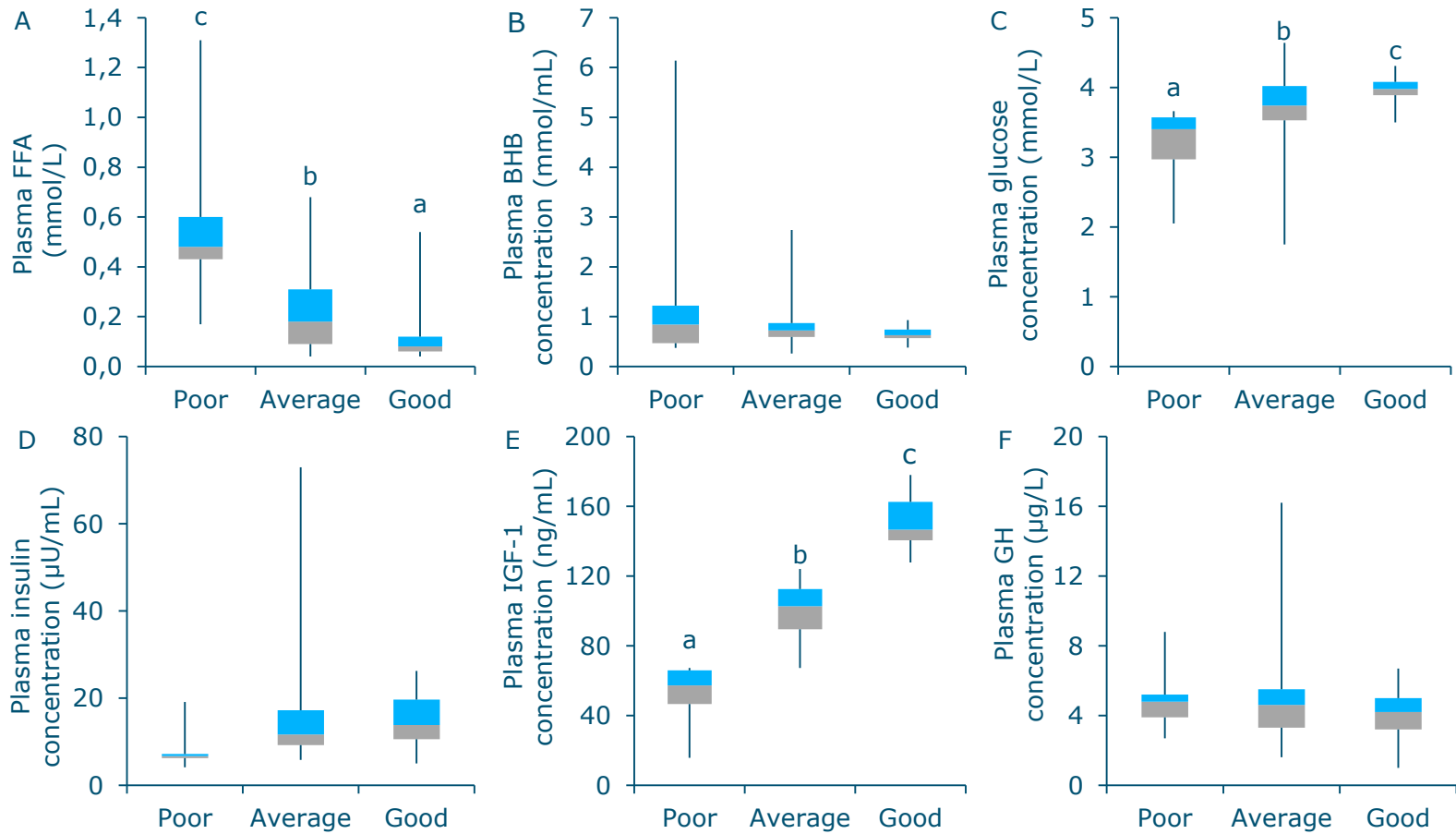
- Metabolic status is associated with behaviour, also without clinical metabolic disorders
- Associations with behaviour were stronger for plasma variables than for metabolic cluster
 - Cluster determined by IGF-1, whereas FFA had most & strongest correlations with behaviour
- Relations may be different in other weeks of (early) lactation

Conclusions

- A better metabolic status was associated with a greater DMI, increased feeding activity, and a tendency for more time spent lying
- A compromised metabolic status was reflected in altered cow behavior in week 4 of lactation



Results – metabolic status clusters



Pearson correlations

| | FFA (mmol/L) | BHB (mmol/L) | Glucose (mmol/L) | Insulin (μ U/mL) | IGF-1 (ng/mL) | GH (μ g/L) |
|--|-----------------|-----------------|---------------------|--------------------------|------------------|--------------------|
| FPCM (kg/d) ¹ | 0.49** | 0.31** | -0.37** | -0.47** | -0.41** | 0.26* |
| DMI (kg DM/d) ¹ | -0.49** | Ns | 0.23* | Ns | 0.22* | -0.34** |
| EB (kJ / kg ^{0.75} ·d) ¹ | -0.78** | -0.41** | 0.48** | 0.33* | 0.55** | -0.45** |
| Feeding rate (kg/min) | Ns | Ns | 0.30** | Ns | Ns | -0.25* |
| Meals (n/d) | -0.34** | Ns | Ns | Ns | 0.34** | -0.24* |
| Meal time (min/day) | -0.38** | Ns | Ns | Ns | Ns | Ns |
| Lying time (hrs/d) | -0.43** | Ns | Ns | Ns | 0.32** | Ns |
| Steps (n/d) | -0.32** | -0.25* | Ns | Ns | Ns | Ns |

Results – metabolic cluster ~ behaviour

| | Adjusted R ² | Metabolic status | | | SE _p | P-value | | |
|-------------------|-------------------------|-------------------|-------------------|-------------------|-----------------|-----------------|-------|-------|
| | | Poor | Average | Good | | Cluster | DryP | Par |
| Cows | | 9 | 41 | 25 | | | | |
| DMI (kg DM/d) | 0.25 | 19.5 ^b | 22.0 ^a | 22.4 ^a | 0.9 | <0.01 | <0.01 | 0.44 |
| Meals (n/d) | 0.15 | 7.17 ^b | 7.38 ^b | 8.24 ^a | 0.49 | 0.02 | 0.62 | 0.64 |
| Meal time (min/d) | 0.25 | 200 | 224 | 225 | 22 | 0.39 | 0.57 | <0.01 |
| Lying time (h/d) | 0.12 | 10.3 | 10.9 | 11.9 | 0.8 | 0.06 | 0.26 | 0.32 |
| Lying bouts (n/d) | 0.07 | 11.6 | 12.0 | 13.2 | 1.5 | 0.40 | 0.84 | 0.16 |
| Steps (n/d) | 0.18 | 1100 | 1231 | 1324 | 134 | 0.21 | 0.73 | 0.01 |

- Dry matter intake & meals/d were higher, and lying time tended to be higher for better metabolic status