**Aim of study**

Metabolic health was investigated in a randomized, controlled cross-over trial with two 8-week dietary intervention periods with a whole-grain-rich and gluten-poor and a refined grain diet. The global metabolic response reported in the wholegrain and gluten studies were not necessarily universal in all individuals [1]. In clinically controlled trials, people tend to lose weight independent of the intervention diet [2].

In this project we aimed to:

- Predict who will lose weight during the intervention periods.
- Identify factors predictive of weight loss and compare their predictiveness.

**Study design**

Study participants included healthy Danish men and women exhibiting a metabolic risk profile [3].

The criteria for participating in the studies included:

- Age 20-65 years
- Apparently healthy
- BMI 25-35 kg/m² or waist circumference ≥ 94 for men and ≥ 80 cm for women
- Weight stable

**8 weeks dietary intervention**

WHOLE GRAIN RICH → (N=60)
GLUTEN POOR → (N=60)
REFINED GRAIN → (N=120)

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**Machine learning framework and data integration strategy**

Data sets were generated based on the data available for each participant before an intervention took place. Feature subsets for machine learning models were selected using either prior knowledge filtering of data or data-driven forward feature selection through cross-validation.

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**Performance of integrative random forest models**

The most predictive models included urine metabolome identified by LC-MS and faecal microbiome features represented by 16S-based OTU clusters or prior knowledge selected MGraph mapper tax.

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**Conclusion**

- The best predictors for weight loss response (ROC-AUC: 0.88) were based on selected gut microbiome features and urine metabolites identified by LC-MS.
- Without microbiome and metabolites, genetotype, transit time and physiology (including post-prandial response) lead to an ROC-AUC: 0.72.
- AI frameworks can help understanding responders and their diet and place in comprehensive strategies for weight management.