Machine Learning Quest for Predictive Markers of Lifestyle Modification Outcomes in Pediatric Obesity Treatment

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INTRODUCTION

The traditional approach to childhood obesity management is lifestyle modification/LSM. Nevertheless, the response rate is variable and difficult to predict.

AIM

A systematic search for markers to predict outcomes of simple LSM in pediatric obesity management.

PATIENTS & METHOD

Out of **240 children** with **obesity** (BMI>97%), recruited to a prospective 'multi-OMICS' study granted by ESPE Research Unit, **159 subjects** (age 8-17 yrs, median 12.8 yrs; 45% females) finished twelve-months of LSM obesity management at three clinical centers in three counties.

Their **baseline (V0) phenotype** was precisely described with **more than 180 clinical and laboratory features** grouped as markers of

- general description,
- family and patient's history,
- lifestyle/LS,
- socioeconomic status/SES,
- body composition/BC,
- insulin resistance/IR,
- liver diseases/LD,
- metabolic syndrome/MetS,
- steroid metabolome
- gut microbiome.

Additional **150 features were measured at V3/V6/V12** months.

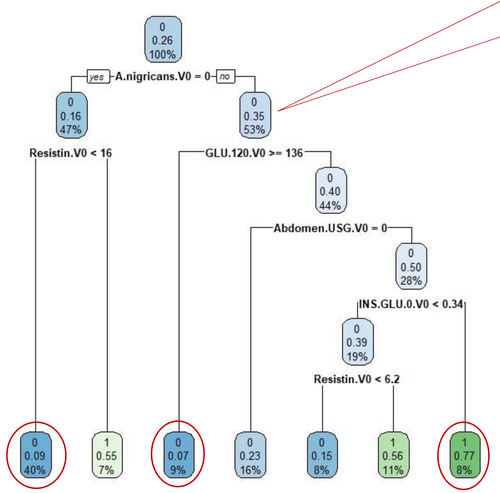
Machine learning technique/CART as implemented in 'rpart' & 'rpart.plot' R-packages was applied **to build & visualize decision trees** to automatically identify the markers and their cut-offs with the strongest correlation **to a "success" of LSM, defined as a decrease in z-score BMI V12-V0.**

Odds Ratio (OR) and P-values (p) were calculated by Fisher's Exact test

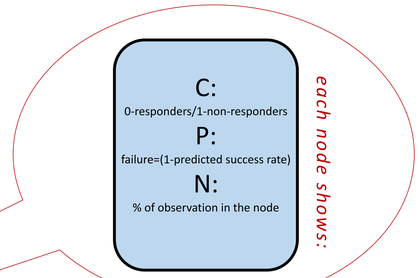
RESULTS

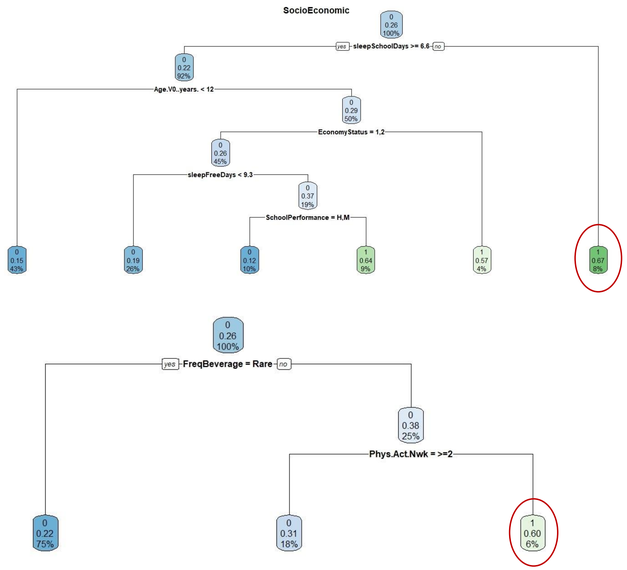
118 out of 159 (74.2%) participants were classified as responders to LMS.

- When built on the **IR & LD features**, a decision tree pointed to a strongest role of the following parameters:
  - acanthosis nigricans/AN,
  - resistin levels,
  - glucose 120',
  - NAFLD in USG
  - and insulin/glucose ratio.
- The **AN** feature was significantly associated with the response to LSM (OR 2.75; p=0.0106), where the lack/presence of AN predicted success in **84%/65%** cases, resp.
- When the **lack of AN** was observed simultaneously with **resistin value <16 ng/ml** the response rate grew to **91%** (OR 9.05; p=0.0026), while the **presence of AN** together with **glucose 120'≥136 mg/dl** predicted **93%** of the successful outcomes (OR 8.51; p= 0.0281).
- On the other extreme, high **insulin/glucose ratio ≥0.34** (with the **presence of AN** together **with NAFLD/USG**, and with **glucose 120'<136 mg/dl**), decreased the response rate to **23%** (OR 0.20; p=0.0452).

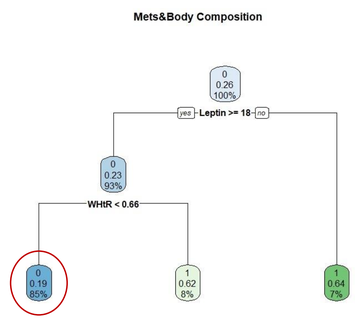


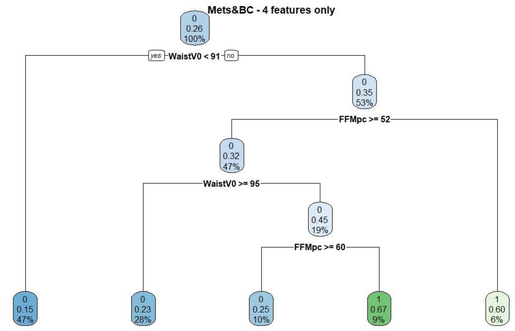
- Out of **SES & LS features** at V0, a small **(<6.6hrs) number of sleep hours** on schooldays /**high frequency of sweet beverages + lack of Physical Activity** were found to be associated with the lowest chance for success (success rate 33%/40%, OR 0.15/0.34, p=0.0023/0.013, respectively).





- **Leptin >= 18 ng/ml** and **WHtR < 0.66** (**MetS & BC features**) were putative positive predictive markers.





CONCLUSIONS

Insulin resistance features, and history of inappropriate sleep or beverages consumption before intervention are significantly associated with failure of LSM in childhood obesity. Pending the validation on an independent cohort, our findings suggest the predictive role of these markers.

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CONTACT INFORMATION

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