

# DEVELOPMENT OF A PREDICTIVE NORMOGRAM TO ASSESS THE RISK OF LIVER STEATOSIS IN CHILDHOOD OBESITY

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The authors have nothing to disclose

## INTRODUCTION

- Ectopic fat accumulation in the liver (non-alcoholic fatty liver disease or liver steatosis, **LS**) can be present in obesity already at early ages.
- The onset of **LS** does not seem to depend exclusively upon the severity of obesity and shows large inter-individual variability.
- Significant associations have been described between **LS** and insulin resistance (**IR**), ethnicity and specific nutritional habits.

## AIM

- Our objective was to develop a predictive normogram for **LS** in children and adolescents with obesity based on their demographic, anthropometric, body composition and metabolic features.

## PATIENTS AND METHODS

- An abdominal ultrasonography to study the presence of **LS** was performed in 50 prepubertal children and 100 adolescents with severe obesity (BMI Z-score:  $+4.10 \pm 1.37$ ). Patients were 50% Caucasians / 50% Latinos and 50% males / 50% females in each group.
- The variables that were significantly associated with **LS** in a preliminary univariate analysis including demographic (sex, ethnicity), body fat content and distribution (BMI, waist, waist to hip-ratio, whole-body DXA-scan, abdominal MRI) and biochemical and metabolic parameters (AST, ALT, uric acid, lipid profile, glucose and insulin, fasting and throughout the OGTT) served as independent variables for multivariate analysis (binary logistic regression using forward conditional method; dependent variable: **LS**). The discriminatory power of the model was evaluated using receiver-operator characteristics (ROC) curves.

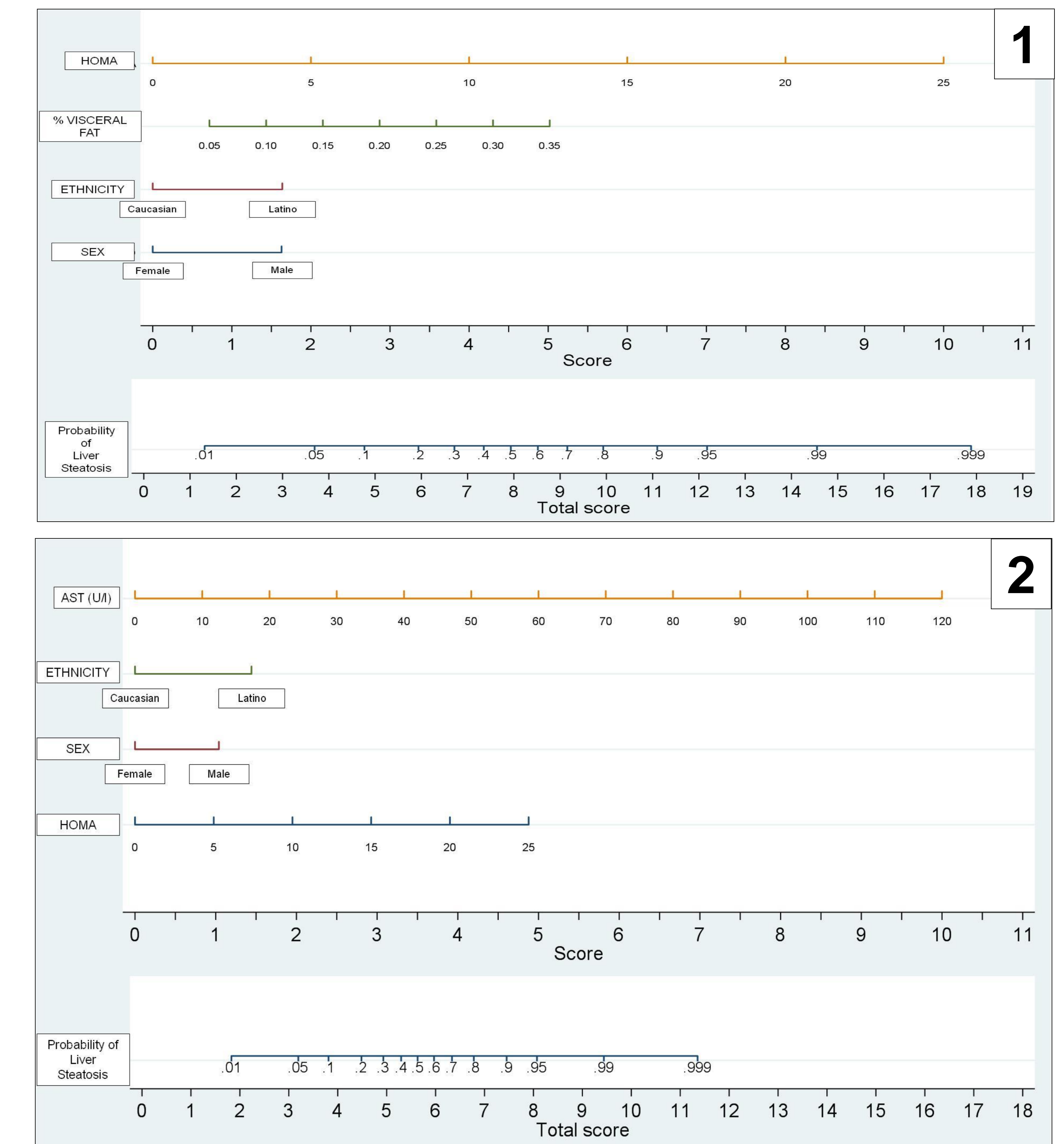
## RESULTS

- The overall **prevalence of LS** was 21.3% (n=32), **higher in Latinos** ( $\chi^2$ : 8.69;  $p < 0.01$ ) both in prepubertal children (33.3% vs. 16.0%) and adolescents (31.4% vs. 8.0%).
- Univariate analysis showed that the **excess of body fat** either indirectly estimated (BMI-SDS) or directly measured (total body-fat percentage Z-score or fat/lean mass ratio by DXA) **did not reach statistical significance**, whereas **abdominal fat distribution did** [trunk/lower-limb and abdominal visceral/subcutaneous fat ratios (both  $p < 0.05$ )].
- Significant influences of HOMA** index, **WBISI** and **insulin at 120'** in the OGTT (glucose metabolism) and **triglycerides** and **HDL** (fat metabolism) were also found.
- In the whole cohort** (n=150), the Hosmer-Lemeshow model showed a discriminatory power of 0.7931 for **LS prediction** considering **ethnicity, sex and HOMA** as independent variables. However, when children and adolescents were analyzed separately, **this model was not useful in prepubertal children, whilst its discriminatory power increased in adolescents (0.8349)**, establishing a **numerical risk score for LS in adolescents with obesity** based upon their **sex, ethnicity, HOMA and percentage of visceral abdominal fat** (measured by MRI) (**Figure 1**).
- However, in order to develop a predictive normogram that could be used in the clinical setting (where abdominal MRI is not usually available or performed), a second normogram was developed substituting MRI measurements of abdominal fat distribution for the waist Z-score and the waist to hip ratio Z-score, adding AST and ALT serum levels.
- Using this second model, **in the whole cohort** (n=150), the Hosmer-Lemeshow model showed a discriminatory power of 0.8126. for LS prediction considering **ethnicity, sex, HOMA, AST and waist to hip ratio Z-score** as independent variables. Again, when children and adolescents were analyzed separately, **this model was not useful in prepubertal children whilst its discriminatory power increased in adolescents (0.8244)**, establishing a **numerical risk score for LS in adolescents with obesity** based upon their **sex, ethnicity, HOMA and AST serum levels**, but not on waist to hip Z-score ratio (**Figure 2**).

**Figure legend:** Total score: Sum of individual score for every considered variable. The scale above the total score represents the probability to present liver steatosis (0 means 0% / .999 means 99.9% probability).  
**Abbreviations:** AST: aspartate aminotransferase, % Visceral fat: percentage of visceral regarding total abdominal in abdominal magnetic resonance imaging.

## CONCLUSIONS

- Ethnicity, sex, insulin resistance and visceral fat accumulation**, but not the severity of obesity, are the major determinants of the **probability to present LS** in childhood obesity. Such risk can be estimated through a numerical predictive normogram **in adolescents, but not in prepubertal children**.
- In the clinical setting, **AST serum levels along with ethnicity, sex and HOMA** index can allow to predict the **probability to present LS in adolescents** and thus guide the need for ultrasonographic abdominal evaluation.



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