# Estimation of Liver Span Using MRI for Prediction of Type 2 Diabetes in Non-obese Asian Indians

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The pathogenesis of type 2 diabetes (T2DM) in non-obese Asian Indians is ill understood; the relative contributions of insulin secretion and insulin resistance continue to be debated.[1] As compared to Caucasian men, young, non-obese Asian Indians have more than a 2-fold increased hepatic triglycerides, with 3 to 4-fold increased insulin resistance.[2] Previously, we have shown close correlation of fatty liver with liver span in non-obese patients with T2DM,[3] thus suggesting that liver span could be a surrogate marker of fatty liver. We hypothesized that increased liver span predicts T2DM risk and derived a prediction model using liver span in young, nonobese (BMI < 25 kg/m$^2$) Asian Indians in North India.

This study was approved by the institutional ethics committee of Fortis Hospital, New Delhi, India, and was conducted in accordance to the ethical guidelines of the declaration of Helsinki 2013.[4] Non-obese (BMI < 25 kg/m$^2$) patients with T2DM, diagnosed within 1 year from onset (cases, n= 93) and BMI-matched, nondiabetic subjects (controls, n = 40), aged between 18 and 40 years, were recruited after obtaining informed and written consent. Pregnant or lactating women, subjects having ketonuria, on insulin therapy, or on drugs known to affect body composition (steroids or thiazolidinediones), significant alcohol intake, subjects with metallic implants, pacemaker leads, radioactive seeds, or surgical staples in the body were excluded for the study.

The detailed magnetic resonance imaging (MRI) methodology with protocol has been mentioned previously. Briefly, using 1.5 Tesla MRI scanner (Signa HDxt, GE Healthcare, Waukesha, WI, USA), liver span was measured using a T2-weighted coronal scan. Furthermore, Region of Interest (ROI) analysis was performed on the slice displaying the maximum span of the liver and the distance was measured. Fat deposition in the liver was measured using IN/OUT FSPGR sequence as mentioned previously.[3] Data were analyzed using Stata 11.0 (College Station, TX, USA) and presented as frequency (percentage values) or mean ± standard deviation/median (min-max) as appropriate. Analysis of covariance was used to adjust for age. Categorical variables such as family history were analyzed using a chi-square test. Receiver Operating Characteristic (ROC) curve analysis was performed to derive appropriate cutoff values for liver span and serum triglycerides. A *P* value of less than 0.05 (2-tailed) was considered statistically significant.

The area under ROC curve was 0.91 (95% CI: 0.84-0.96) with 82.6% sensitivity and 82% specificity, positive likelihood ratio of 4.1, and negative likelihood ratio of 0.2 (Table 1). A non-obese subject with a score ≥ 41 in the prediction model was considered as having higher risk for the onset of T2DM. Non-obese individuals > 30 years of age with serum triglycerides > 105 mg/dl and liver span > 15.6 cm have increased risk of T2DM. Specifically, a liver span above 15.6 cm increases the risk of T2DM by nearly 4 times, especially in males. Liver span can be accurately assessed by ultrasonography,[5] which is available in urban and suburban areas of India at an affordable cost of around US$5. In conclusion, Asian Indians with BMI in non-obese category but having increased liver span should be investigated for diabetes.

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**Table 1.** Liver-Span-Based Prediction Model for Diabetes Risk in Nonobese Asian Indians.

| Variable | Odds ratio (95% CI) | *P* value | Beta coefficient | Standard error | Sensitivity (%) | Specificity (%) | Area under curve |
|---|---|---|---|---|---|---|---|
| Age ≥ 30 years | 15.2 (4.2, 55.8) | <.001 | 2.4 | 0.6 | 82.6 | 82.0 | 0.91 |
| Gender (male) | 5.0 (1.1, 22.5) | <.05 | 1.6 | 0.7 | | | |
| Triglycerides (≥105 mg / dl) | 5.2 (1.2, 14.3) | <.05 | 1.3 | 0.7 | | | |
| Liver span (≥15.6 cm) | 4.2 (1.2, 14.3) | <.05 | 1.5 | 0.6 | | | |
| Family history of T2DM (parental/grandparental) | 5.3 (1.4, 19.3) | <.05 | 1.7 | 0.06 | | | |

Prediction score: 25 × age (1 if age ≥ 30 years, 0 if age < 30 years) + 16 × gender (1 if male, 0 if female) + 15 × liver span (0 if liver span < 15.6 cm, 1 if liver span ≥ 154.6 mm) + 18 × family history (1 if family history is positive, 0 if negative) + 13 × triglycerides (0 if triglycerides < 105, 1 if triglycerides ≥ 105 mg/dl). A total score ≥ 41 in the model indicates increased risk for T2DM in Asian Indians.

## Abbreviations

MRI, magnetic resonance imaging; T2DM, type 2 diabetes.

## Declaration of Conflicting Interests

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