

# Neuropsychological Assessment in Obesity: Cognitive Vulnerability in Patients with Type 2 Diabetes Mellitus

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## Background

Obesity is a pathological condition that is associated with an elevated risk of developing neurodegenerative diseases (Jack et al., 2024). However, the characterization of potential cognitive deficits and their association with comorbidities frequently present in the obese population remains inadequately understood.

## Objectives

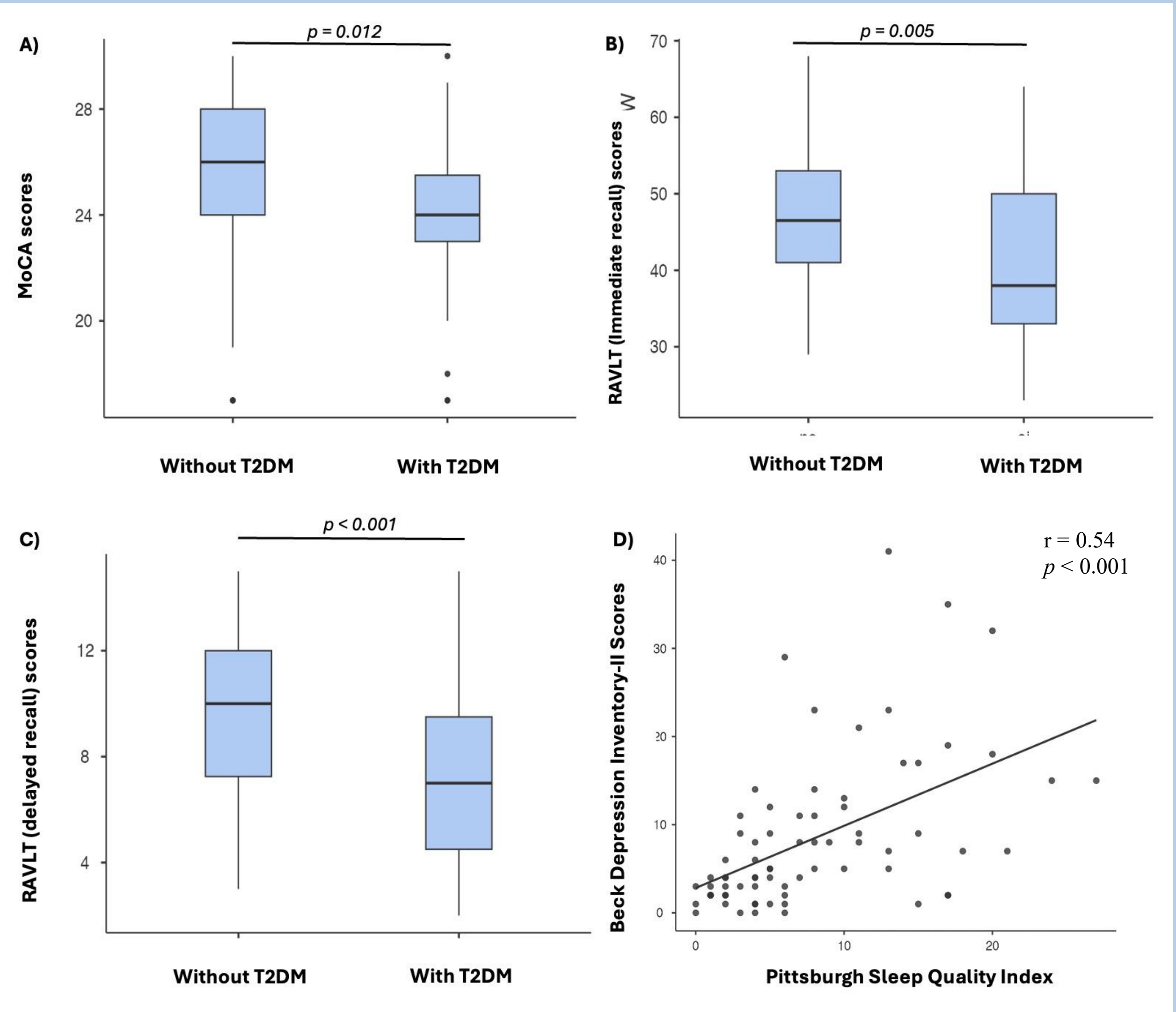
This study aims to conduct a cross-sectional comprehensive multidomain assessment of cognitive functions, mood, and sleep quality in a cohort of obese patients. Additionally, it seeks to evaluate the association of these factors with comorbidities.

## Methods:

One hundred and one obese patients (80 females) were recruited from the Endocrinology Unit of the University of Siena between September 2024 and May 2025. Participants underwent a neuropsychological assessment including the Montreal Cognitive Assessment (MoCA), the Rey Auditory Verbal Learning Test (RAVLT), the Beck Depression Inventory (BDI-II), and the Pittsburgh Sleep Quality Index (PSQI). Comorbidities were carefully recorded. A non-parametric statistical approach was adopted: group comparisons were performed using an analysis of covariance (ANCOVA) with age and BMI as covariates, while associations between variables were assessed with Spearman's rank correlation analysis, also controlling for age and BMI.

	Without T2DM	With T2DM	Whole Cohort
Number of patients (F/M)	74 (60/14)	27(20/7)	101 (80/21)
Median Age (25th–75th percentile)	45 (33.25-53)	54 (45-58.5)	48 (34–55)
Median Body Weight (25th–75th percentile)	119 (106.2-130)	110 (100.5-125.5)	116 (105–129)
Median BMI (25th–75th percentile)	43.7 (40.7-46.4)	40.3 (37.4-44)	43.1 (40–45.7)
Median MoCA(25th–75th percentile)	26 (24-28)	24 (23-25.5)	26 (23-27)
Median RAVLT immediate recall (25th–75th percentile)	46.5 (41-53)	38 (33-50)	45 (38-53)
Median RAVLT delayed recall (25th–75th percentile)	10 (7.25-12)	7 (4.5-9.5)	9 (7-11)
Median PSQI* (25th–75th percentile)	6 (3-10.5)	4.5 (2.25-14.5)	6 (3-11)
Median BDI-II* (25th–75th percentile)	6.5 (3-12)	3 (2-8)	5 (2-11)

**Table 1. Demographic and clinical data in the whole cohort and in groups with and without T2DM.** \*BDI-II and PSQI scores were available for a subset of 67 patients.



**Figure 1.** Cognitive and psychological measures in participants with and without type 2 diabetes mellitus (T2DM). (A–C) Boxplots comparing performance on the MoCA (A), RAVLT immediate recall (B), and RAVLT delayed recall (C). Participants with T2DM scored significantly lower across all tests compared to those without T2DM. (D) Scatter plot showing a positive correlation between Pittsburgh Sleep Quality Index (PSQI) scores and Beck Depression Inventory-II (BDI-II) scores, indicating that poorer sleep quality was associated with higher levels of depressive symptoms.

## Results:

Descriptive analysis are reported in **Table 1**. The median education level was 12 years, with no difference between diabetic and non-diabetic obese individuals.

- Comparing the subcohort of diabetic obese patients with those without diabetes, we found significantly lower scores for MoCA ( $p = 0.012$ ) (**Figure A**), immediate RAVLT ( $p = 0.005$ ) (**Figure B**) and delayed recall ( $p < 0.001$ ) (**Figure C**).
- BDI-II scores correlated with PSQI scores ( $r = 0.54$ ;  $p < 0.001$ ) (**Figure D**).

## Discussion:

Our ongoing study highlights that the comorbidity of type 2 diabetes mellitus and obesity may be associated with reduced cognitive performance. Furthermore, our findings indicate that the overall observed MoCA scores fall within a range indicative of borderline/impaired performance, according to the original normative cut-offs (Nasreddine et al., 2012). Longitudinal studies are essential to further stratify the increased risk of cognitive disability development in these patients.

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