# Analyzing the Relationship Between NAFLD, Vit. D, Alcohol consumption, and Cognitive Impairment in a West Texas Elderly Cohort: a Project FRONTIER Study


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## Introduction

- As the elderly population continues to grow, our understanding of cognitive impairments becomes increasingly important.
- Currently there is little literature on the relationship between cognitive impairment and hepatic diseases such as nonalcoholic fatty liver disease (NAFLD), despite the prevalence of both in later stages of life.
- Furthermore, the impact of vitamins on cognitive health is understudied especially in elderly populations.
- It is the goal of this study to further investigate these relationships within a west Texas population by observing relationships between
  - Self-reported alcohol use (aau_1)
  - Serum biomarkers of liver damage - gamma-glutamyl transferase, alanine transaminase, Aspartate transaminase, alkaline phosphatase, total protein, bilirubin, triglycerides (*ggt*, *alt*, ast, *alkp*, *bw_tprot*, *bw_tbili*, *trigy*)
  - Diagnostic liver indexes - fatty liver index (*FLI*), NAFLD fibrosis score (*NFS*), hepatic steatosis index (*HSI*), and the fibrosis-4 (*FIB-4*)
  - Serum Vit. D levels (bw_vitd)
  - Cognitive assessment - Repeatable Battery for Assessment of Neuropsychological Status (RBANS)

## Methods/Demographics

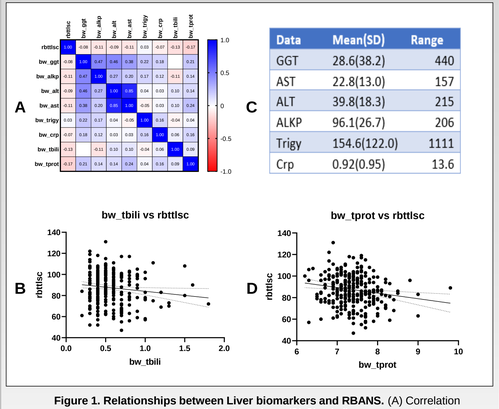
- Patient data was collected from the Project FRONTIER database.
- Data from 299 patients within Project FRONTIER were analyzed
- There were 212 females and 87 males
- All patients were greater than 40 years of age (mean=62.6±11.8) and from a west Texas county

## Hypotheses

- Serum biomarkers of liver damage are associated with cognitive dysfunction in elderly populations
- NAFLD-related indexes are associated with cognitive impairment in elderly populations
- Alcohol use is associated with cognitive impairment in elderly populations
- Vit. D is associated with NAFLD and cognitive impairment

## Results

### Biomarkers

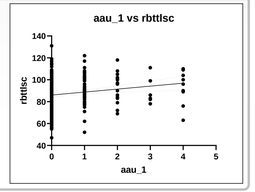



| Data | Mean(SD) | Range |
|---|---|---|
| GGT | 28.6(38.2) | 440 |
| AST | 22.8(13.0) | 157 |
| ALT | 39.8(18.3) | 215 |
| ALKP | 96.1(26.7) | 206 |
| Trigy | 154.6(122.0) | 1111 |
| Crp | 0.92(0.95) | 13.6 |

**Figure 1. Relationships between Liver biomarkers and RBANS.** (A) Correlation matrix between all measured liver biomarkers. (B) Simple linear regression of the relationship between total serum bilirubin and RBANS, Equation: Y = -7.807*X + 91.84, Line of Regression P value: 0.0294, F Value: 4.792. (C) Mean and range for all liver biomarkers examined. (D) Simple linear regression of the relationship between the total serum protein and RBANS. . Equation: Y = -5.205*X + 125.9, Line of Regression P value: 0.0028, F Value: 9.095.

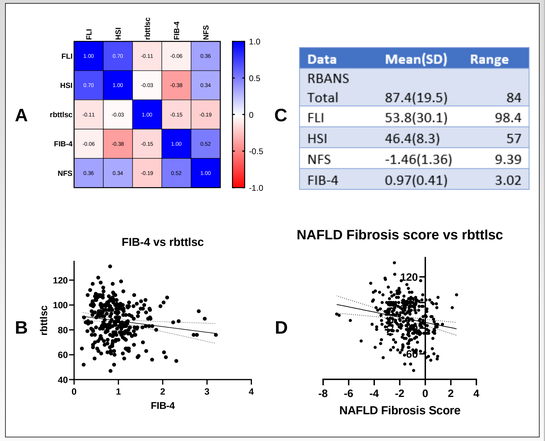
### Alcohol Use

**Figure 2.** Linear regression line of the frequency of alcohol consumption compared to RBANS. Equation: Y = 2.710*X + 86.06




### Diagnostic Tests

- Of the 299 patients analyzed, 138 patients had an FLI above 60 suggesting high risk for NAFLD. 19 patients had a Fibrosis score above 0.676 which is the cut off for a high probability for fibrosis. There were 144 patients with a NFS between -1.455 and 0.676 which suggests an intermediate probability of fibrosis.




| Data | Mean(SD) | Range |
|---|---|---|
| RBANS Total | 87.4(19.5) | 84 |
| FLI | 53.8(30.1) | 98.4 |
| HSI | 46.4(8.3) | 57 |
| NFS | -1.46(1.36) | 9.39 |
| FIB-4 | 0.97(0.41) | 3.02 |

**Figure 3. Relationship between diagnostic liver indexes and RBANS.** (A) This graph depicts the correlation matrix between FLI, RBANS, FIB-4, and NFS. (B) Simple linear regression of the relationship between FIB-4 and RBANS, Equation: Y = -4.581*X + 91.76, Line of Regression P value: 0.0108, F Value: 6.58. (C) Table of the mean, standard deviation, and range for the age, RBANS score, FLI, and NFS of all patients. (D) Simple linear regression of the relationship between NFS and RBANS, Equation: Y = -2.025*X + 84.45, Line of Regression P value: 0.001, F Value: 10.93.

### Vitamin D

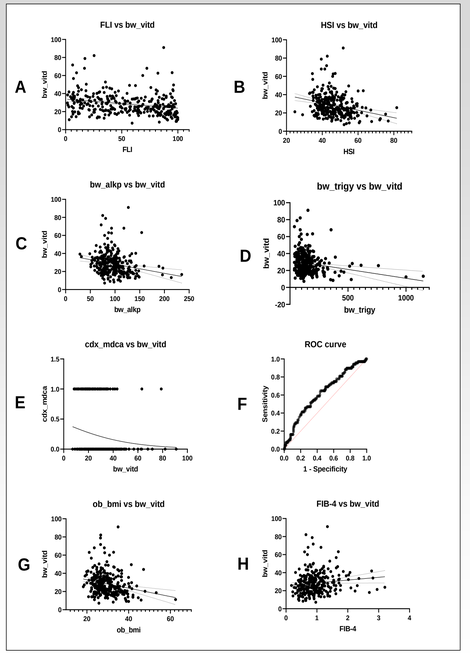



**Figure 4. Relationship between diagnostic liver indexes, liver biomarkers, bmi, diabetes and Vit. D.** Simple linear regression of the relationship between Vit. D and (A) FLI (r= -0.24, p<0.0001) , (B) HSI (r= -0.27, p<0.0001), (C) ALKP (r= -0.22, p<0.0001), (D) triglycerides (r= -0.21, p=0.0003), (E) Type 2 diabetes (r= -0.15, p=0.01), (G) BMI (r= -0.22, p=0.0001), and (H) FIB-4 (r= 0.12, p=0.045). (F) shows the ROC curve for Vit. D vs type 2 diabetes.

## Conclusion

Correlation analysis and linear regression suggest that there is…

- A significant negative correlation between serum bilirubin (r= -0.13, p= 0.029), total protein (r= -0.17 p=0.0028) and RBANS score
- A significant positive correlation (r= 0.17, p=0.0025) between reported frequency of alcohol consumption and RBANS score. These findings align with current literature that suggest alcohol has a protective effect against cognitive decline.
- A significant negative correlation between RBANS score and the NAFLD Fibrosis Score (Pearson r= -0.19, p= 0.0011) and FIB-4 (Pearson r= -0.149, p=0.011). These findings agree with existing studies that observed a relationship between liver fibrosis and cognitive decline.
- A significant correlation between Vit. D and FLI (r= -0.24, p<0.0001), HSI (r= -0.27, p<0.0001), ALKP (r= -0.22, p<0.0001), triglycerides (r= -0.21, p=0.0003), Type 2 diabetes (r= -0.15, p=0.01), BMI (r= -0.22, p=0.0001), and FIB-4 (r= 0.12, p=0.045)

## Future Direction and Acknowledgments

Future studies may be able to further analyze these relationships via

- the use of other cognitive tests that were not used in this study, such as the Mini Mental State Examination
- Looking at the individual variables used in the RBANS test
- Using a larger cohort ( e.g. Full project FRONTIER database)


We thank the TTUHSC Garrison Institute on Aging for compiling variables associated with the Project FRONTIER database.