

BACKGROUND

To quantify the average vitamin B12 consumption through animal-based protein sources and supplementation among college students and analyze its association with cognitive function.

What are vegetarian and vegan diets?

- Abstinance of:
 - meat consumption¹ (Vegetarian)
 - consumption of all animal products¹ (Vegan)
- Plant-based diets were popularized due to their health benefits: decreased saturated fat intake, increased fiber intake, and disease prevention²

Correlation of plant-based diet and cognitive function:

- Plant-based diets lack vitamin B12, a vital nutrient only naturally found in meat³
- Randomized Control Study in Kenya:
 - Study population: school grade children
 - Intervention groups with meat, milk, and oil additives to same soup base
 - Greater increases in cognitive development and performance in the meat-intervention group compared to other additives⁴
- Further studies also support lack of vitamin B12 consumption to be associated with lower levels of cognitive function^{3,5}

METHODS

Participants and procedures:

- Web-based survey: 'College Students' Dietary Habits & Memory'
- Assessed cognitive function, animal-based protein consumption, and vitamin B6 and/or 12 supplementation of participants (n=59)
- Inclusion criteria: respondents over 18 years old and currently enrolled in a college or equivalent institution

Demographics data:

- Self-report of non-identifying demographic variables: age, sex, race, and usual dietary habits (omnivore, vegan, vegetarian, etc.)

Exposure variables:

- Average animal-based protein intake per week was self-reported:
 - Predetermined ranges in the survey: "<300 g," "300-500 g," "500-700 g," ">700 g," "I don't consume animal-based protein," and "I don't know"
- Consumption of vitamin supplements was collected in a select-all-that-apply manner:
 - To eliminate any bias, the choices included common vitamin supplements other than vitamins B6 and B12

Outcome variable:

- Human Benchmark^{1,2}, a standardized, web-based cognitive ability testing platform
 - Links for the "Verbal Memory Test"¹ and the "Visual Memory Test"² were embedded in survey client
- Lower third of the cognitive test results were stratified and assigned to the score "0", middle third were given "1", and the highest scores were given "2"

Statistical analysis:

- ANOVA: compared the results of verbal and visual memory tests vs. average animal-based protein consumed per week (stratified by a predetermined range: 'none', '<300 g', '300-500 g', '500-700 g', '>700 g', and 'unsure')
- Independent samples T-test: compared the results of verbal and visual memory test results vs. diet (vegan/vegetarian inclusive vs vegan/vegetarian exclusive)

RESULTS

Data:

- Total of 89 Qualtrics survey responses, 59 viable responses for analysis
- Participant demographics:
 - Racial demographics: 43 Asian, 2 Middle Eastern or North African, 9 White, 5 Multiracial
 - 20 male, 38 female, 1 preferred not to list gender
- **Exclusion criteria:** incomplete surveys and non-student respondents

Figure 1

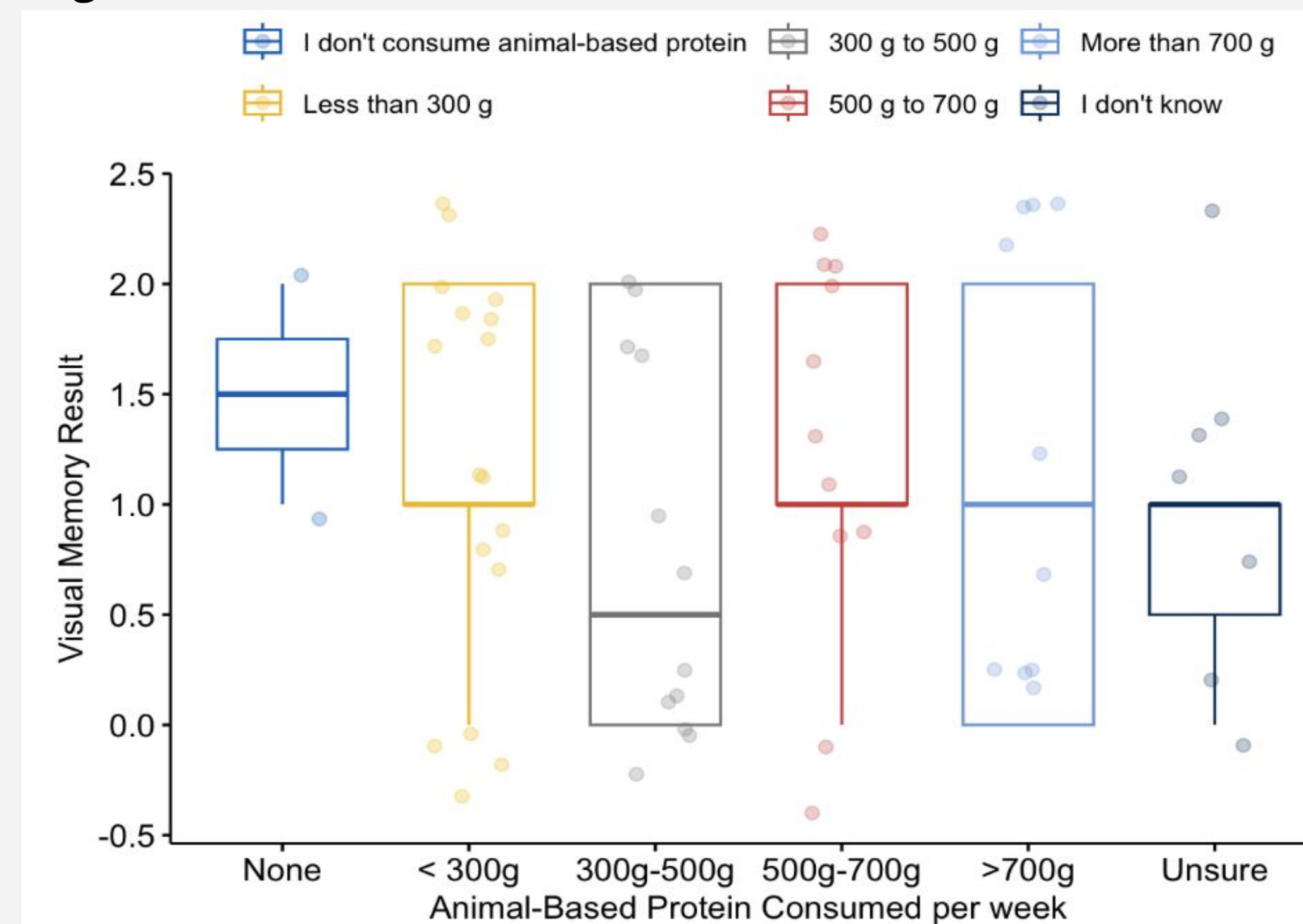


Figure 1. Visual memory test results did not vary significantly between participants who consumed varying amounts of animal-based protein and large variability among data points led to inconclusive results ($F(5, 52) = 0.64, p = 0.670$).

Figure 2

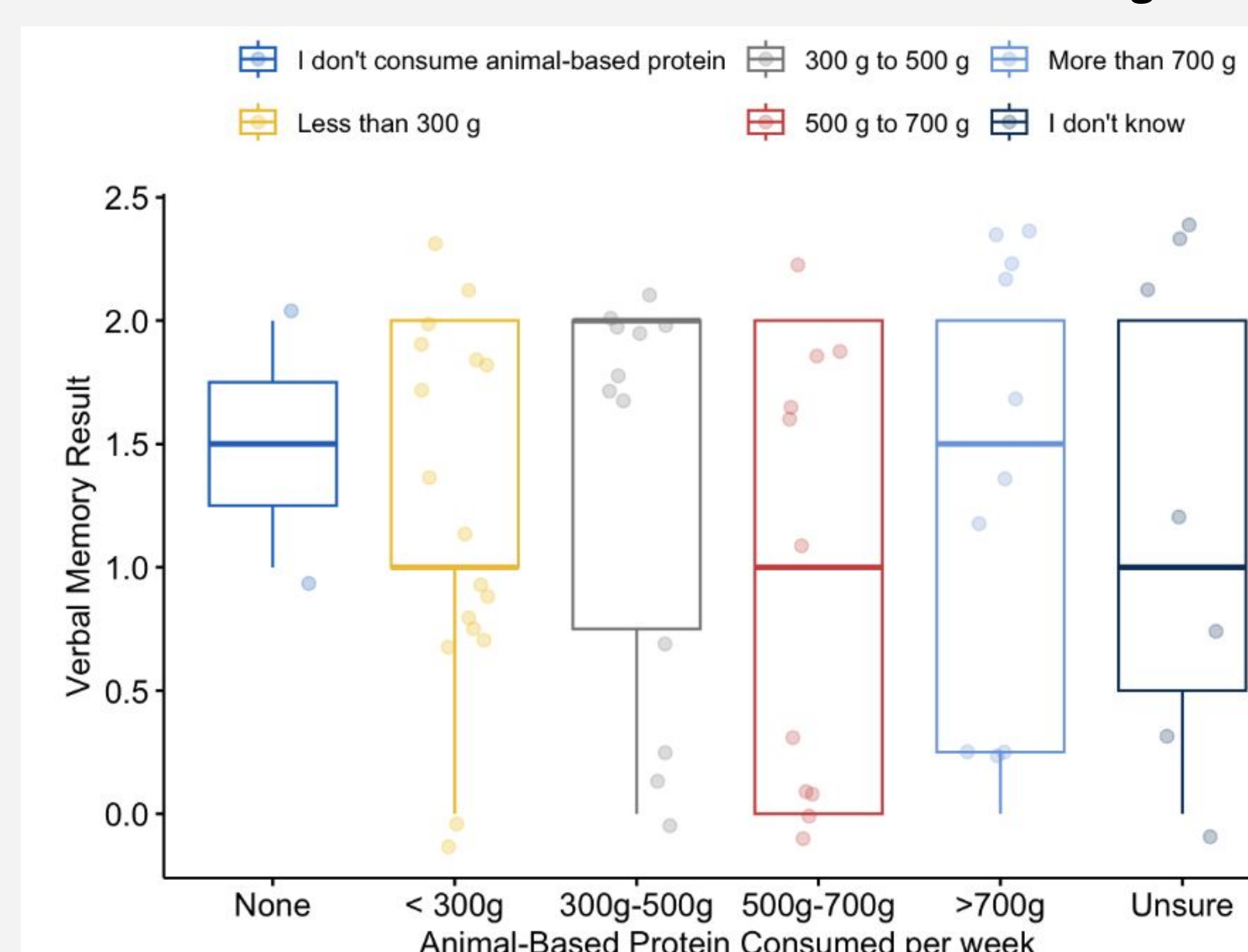


Figure 2. Verbal memory test results did not vary significantly between participants who consumed varying amounts of animal-based protein and large variability among data points led to inconclusive results. $F(5, 52) = 0.34, p = 0.885$.

Figure 3

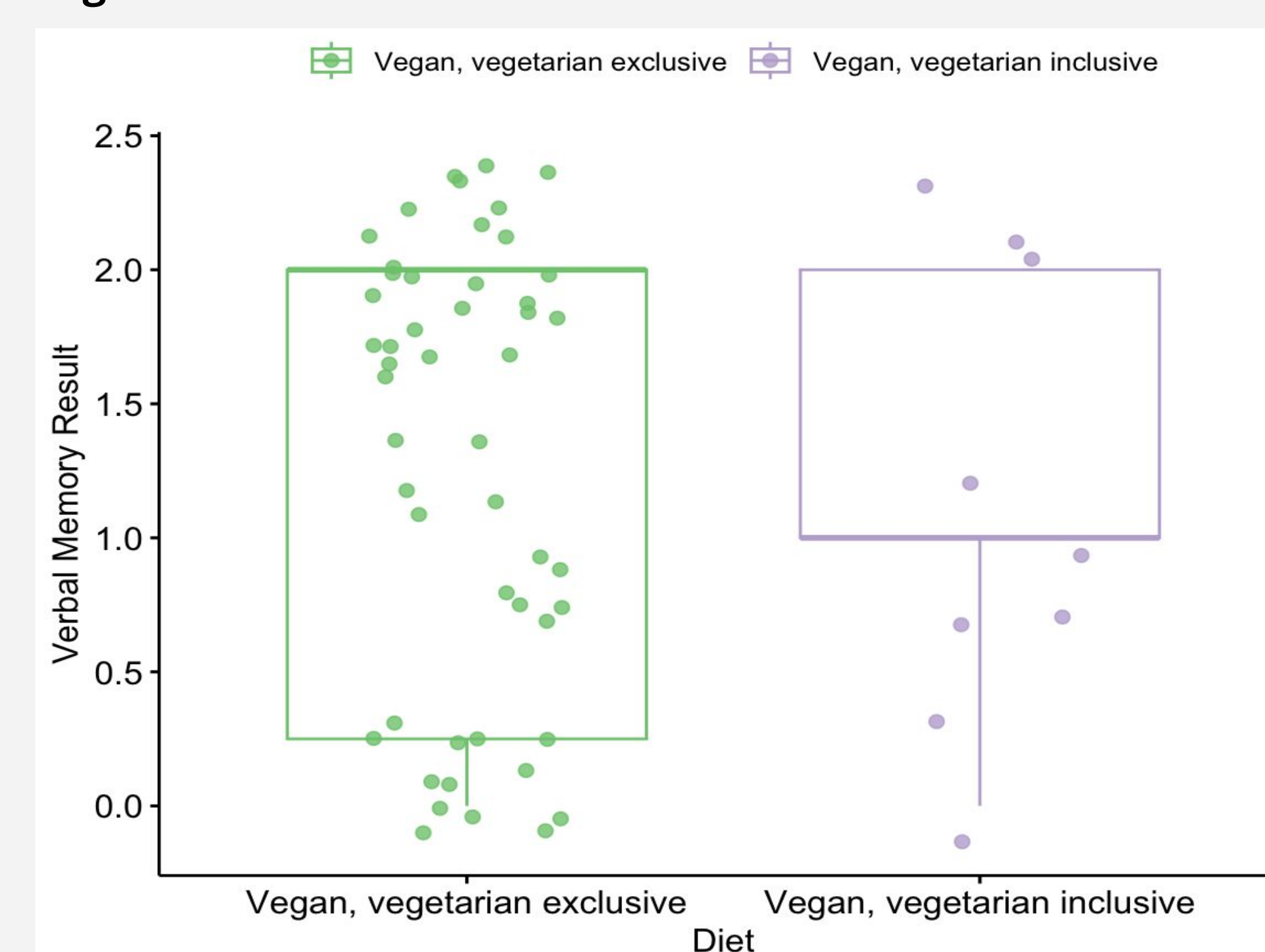


Figure 3. Verbal memory test results did not significantly differ ($t[57] = 0.52, p = 0.614$) with an average of 0.15 points (95% CI = -0.48, 0.78) among participants whose diets were vegan/vegetarian inclusive (Mean = 1.26) versus those whose diets were not vegan/vegetarian (Mean = 1.11).

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CONCLUSIONS

- No significant difference in cognitive function between plant-based vs. non-plant-based and vitamin B6/B12 supplementation vs no supplementation ($p \gg 0.05$)

Limitations and future direction:

- Lack of plant-based participants (n=9) compared to non-plant-based participants (n=50)
- Larger sample sizes, consideration of confounding exposures such as genetics and home environment, and more relevant cognitive tests may strengthen the data⁸
- Did not have a way to assure participants took cognitive tests in controlled environment

POLICY IMPLICATIONS

Because the results of our study were inconclusive, it is difficult to extrapolate policy implications with the current data. However, research institutions may fund follow-up studies with structural modifications.

For example, establishing a designated survey location may allow participants to take the survey and report their exposures in a controlled, quiet environment. Additionally, alternative cognitive testing methods that align with the specific cognitive function targeted by vitamin B6/B12 deficiencies may be used to determine the outcome more accurately.

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