

# Examining the Relationship Between Ketosis and Sleep Quality in Older Adults



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## Introduction

- Sleep quality is essential for immune health, restoring energy, and memory consolidation, which is vital for overall health and cognitive function (Binks et al., 2020).
- Ketosis is a metabolic state where the body uses fat as an energy source instead of glucose. Existing research in older adults suggests that a high fat, low-carbohydrate ketogenic diet has beneficial effects. (Iacovides et al., 2019). As nutritional ketosis stabilizes insulin and blood glucose levels, there may be beneficial effects on sleep quality.
- The relationship between ketosis, sleep, and glucose levels is currently being researched to bridge gaps in the knowledge. However, the current findings across research studies are contradictory. Some sources indicate that there is no association between these factors (Castro et al., 2018; Iacovides et al., 2019), while others suggest that sleep quality has a positive correlation to ketosis (Hallböök et al., 2007; Siegmann et al., 2019).
- To address these research gaps, we investigated the relationship between ketosis and sleep quality in older adults and examined whether this relationship depends on changes in blood glucose associated with ketosis.

**Hypothesis:** We predict that as the participant level of ketosis increases, their sleep quality will also improve based on the Pittsburgh Sleep Quality Index.

## Methods

### Participants:

- Participants included community older adults (60-85) with subjective or objective evidence of mild cognitive impairment (N=59; M=72.78).

### Trial/Study Design:

- Two-arm pilot clinical trial, with participants randomly assigned to the Mediterranean Ketogenic Nutrition Program (education only) or a Mediterranean Ketogenic Adherence Program.
- Both groups were assessed at baseline, 6-weeks, & 3-months.

### Measures:

- **Ketosis** was calculated from the number of days above trace levels of ketones and a weekly keto adherence rating both summed across six weeks in order to get total ketones. Ketosis was evaluated daily using at-home Trueplus urinalysis© ketone test strips (negative = 0, trace = 5, small = 15, moderate = 40, large = 80-160, measured in mg/dL; 6-week M=1.64, SD=15.392)
- **Sleep quality** was assessed at 6-weeks using an item from the Pittsburgh Sleep Quality Index: "During the past month, how would you rate your sleep quality overall?" (PSQI; (1=Very Good, 4=Very Bad)
- **Blood glucose** levels were evaluated at baseline and 6-weeks using point of care HbA1c testing and serum glucose (normal levels are 99 mg/dL or lower) evaluated using a Piccolo Xpress chemistry analyzer.
- **Covariates** included age, summed self-reported health conditions (M=97.97), and sex (1=female, 2=male, 0=other)

### Analyses:

- We used linear regression and the PROCESS macro in SPSS, Model 1, to examine the effects of ketosis on sleep quality in relation to changes to blood glucose.
- Age, sex, and health conditions were included as covariates

## Results

### Direct Effects:

- There was no direct effect between change in glucose and sleep quality ( $b=0.34$   $p=0.26$ )
- There was no direct effect between ketone level and sleep quality ( $b=0.07$ ,  $p=0.65$ )

### Moderation Effect:

- The progression of ketosis has a slight relation to improving overall sleep quality depending on if an individual experiences normalization in blood glucose levels ( $b= -0.0008$ ,  $p=0.07$ )

Table 1

Baseline Demographic Variable Table

Measure	N	M	SD	Skewness	Range	Minimum	Maximum
Age	59	72.78	6.37	0.04	25	60	85
Sex	59	1.19	0.39	1.65	1	1	2
MSQ	59	97.97	19.76	0.77	80	70	150

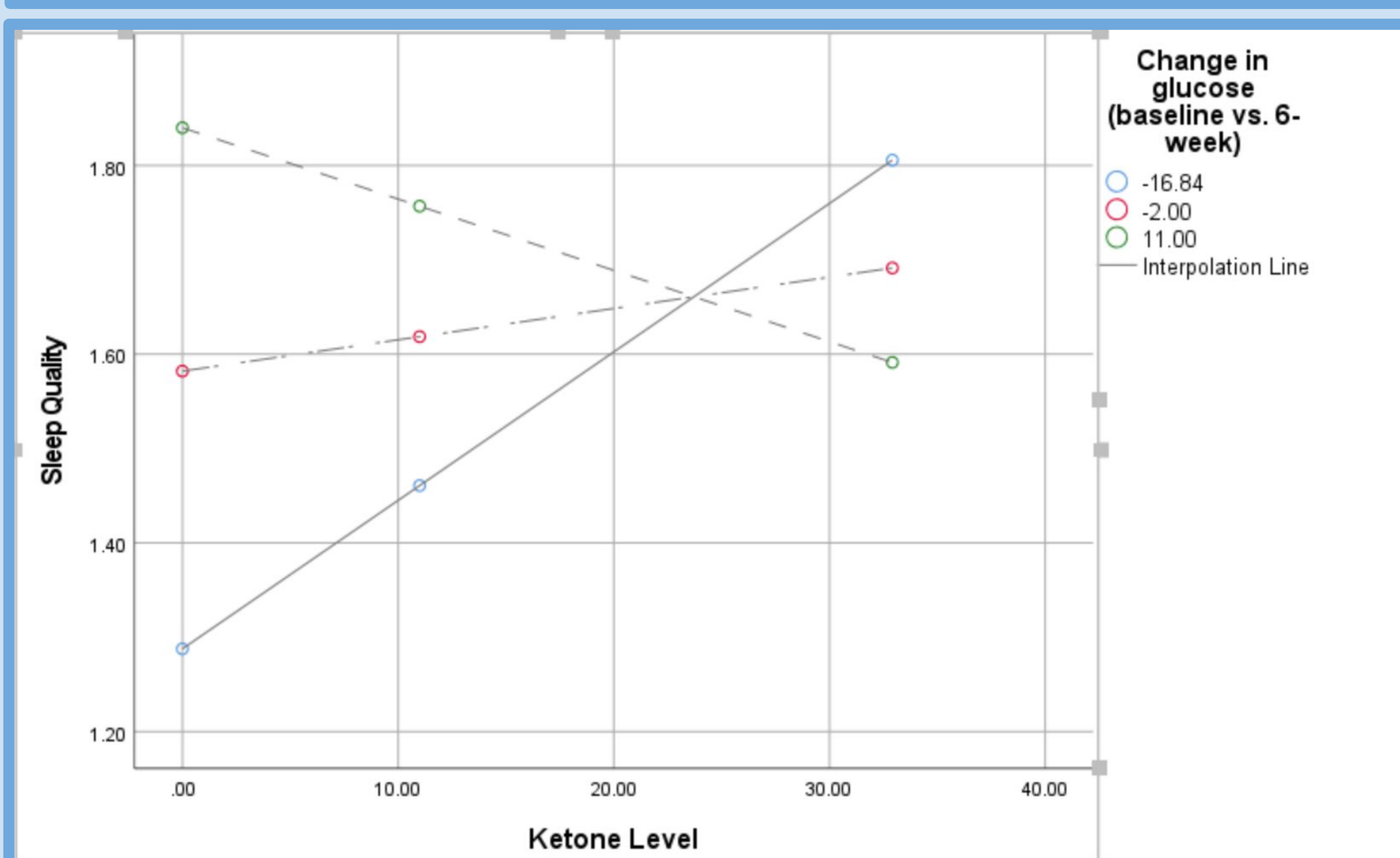
Note. Participant demographic variables were included as covariates regarding analyses.

Table 2

Baseline & 6-Week Measures Table

Measure	N	Baseline		6 Week	
		M	SD	M	SD
Glucose	43	107.10	15.76	104.47	11.68
HbA1c	45	5.33	0.48	5.26	0.38
Sleep Quality	50	1.79	0.66	1.64	0.63
Ketones	49	0	0.007	31.44	14.8

Note. Values for ketones were measured as days above trace level of ketones summed across six weeks and weekly keto adherence rating summed across six weeks.



## Conclusions

- Our findings demonstrate that there was no direct effect between change in ketosis and sleep quality. There was also no direct effect between change in glucose and sleep quality.
- Although no direct effect was found, there was a statistical trend for the moderating effect of glucose on the relationship between ketosis and sleep quality.
- Higher levels of ketosis appeared most beneficial for individuals with greater improvements in their blood glucose across the 6 weeks; whereas, ketosis was associated with worse sleep quality for individuals whose blood glucose increased.

### Limitations

- The sample size did not contain a significant amount of poor sleepers at baseline, which could have interfered with measuring change over time.
- Using only one item from the PSQI may have reduced the sensitivity of our analyses, as subtle changes in sleep quality may not be captured.

## References

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