Capturing Subjective Mental Improvements Associated with a Ketogenic Diet: an Online Survey

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Background

- The ketogenic diet (KD) is a nutritional therapy with neurobiologic effects that has been used clinically in the treatment of refractory childhood epilepsy for the past century.
- The KD has gained popularity over the last few years due to increasing anecdotal endorsements from celebrities. Much of the attention focuses on weight loss and metabolic health, but many have also endorsed improvements in cognition, mood, and energy. Despite the positive attention, the KD has not been extensively studied, and the medical community has yet to fully embrace it.
- While studies related to clinical psychiatry are scarce, mouse models for depression have shown potential neurobiologic mechanisms such as reduction of oxidative stress/inflammation[1], increased GABA release[2], and increased BDNF production[3].
- Technological advances have allowed rapid spread of information, which have contributed to the recent rise in the popularity of the KD.

Objective

•The purpose of this study is to capture, in a quantifiable manner, self-reported subjective effects of the ketogenic diet on cognitive and emotional parameters in controls, as well as subjects with previously diagnosed psychiatric disorders. A secondary goal was to find factors associated with cognitive and/or emotional benefit.

Methods

A Survey was constructed using Qualtrics software and is available for viewing at https://login.qualtrics.com/jfe/preview/SV_3NOrDyfEvvi8b77?Q_SurveyVersionID=current&Q_CHL=preview

Demographic information (age, gender, race), anthropometrics (height, weight, weight change) and information regarding diet (current use of ketogenic diet, concurrent diets used, supplements used) were obtained. A section called "global changes" assessed subjective percent change in the categories of mood, anxiety, energy, sleep, attention, concentration, memory, and athletic performance, using a visual analog scale with a range of -100 to 100.

Previous psychiatric diagnoses and psychotropic medication usage were assessed. A list was provided for diagnoses to be checked off. Regarding psychotropics, participants were asked for a calculation, estimated as the sum of medications used multiplied by the number of years they have been on that medication

Patients who reported history of depression were directed to fill out a "change in symptom" adaptation of the PHQ-9, where they would select from -100 to 100% changes in symptoms attributable to the KD. Similarly, those who reported history of anxiety disorder were directed to a GAD-7 of the same format.

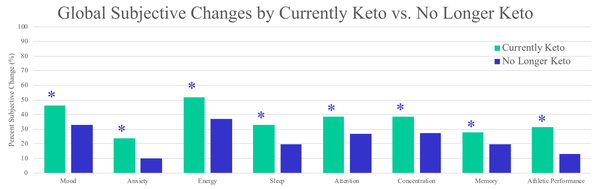
Incomplete submissions and attempts by minors were filtered out, leaving 626 total responses. Some instances of data were obviously erroneously entered, and were recoded as blanks. Means, Standard Deviations, T-tests, and chi square tests were calculated/performed using Qualtrics and Microsoft Excel.

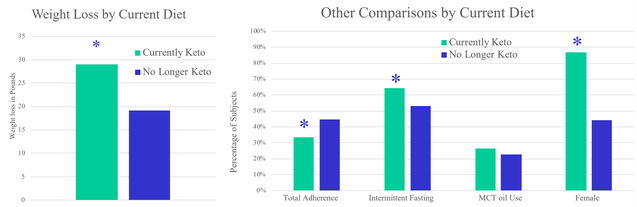
Results

Sample Characteristics and Global Changes

Adults that completed Survey	**N=626**
Age (years) Mean ± SD	33.3±10.8
Female Gender (%)	64.7%
White Ethnicity (%)	79.1%
US residents (%)	57%
Currently on KD (%)	83.2%
Always Adherent (%)	35.7%
Intermittent Fasting (%)	62.6%
Supplement – MCT oil (%)	26.5%
Length of Diet (months) Mean ± SD	9.3±13.0
Initial BMI (Mean ± SD)	33.5±10.6
Weight Change in Pounds (Mean ± SD)	-27.7±39.7 (-11.2%±14.0)
Global Changes: % Subjective Improvement Mean ± SD, No. of Responses	
Mood	43.8±33.6, N=589
Anxiety	21.6±37.3, N=545
Energy	49.2±35.3, N=604
Sleep	30.9±34.1, N=576
Attention	36.5±33.6, N=564
Concentration	36.6±33.7, N=562
Memory	26.5±31.5, N=524
Athletic Performance	28.1±37.2, N=552

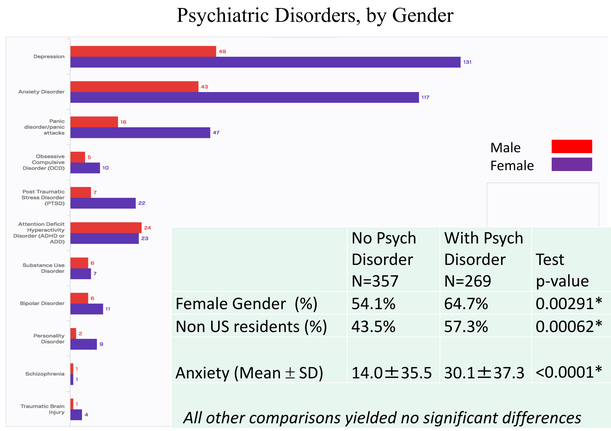
Differences between those currently on Ketogenic Diet vs. those no longer on it





Subjects no longer on KD also had significantly greater Medication*years (mean of 8.3 versus 3.8) in the subset with psychiatric disorder.

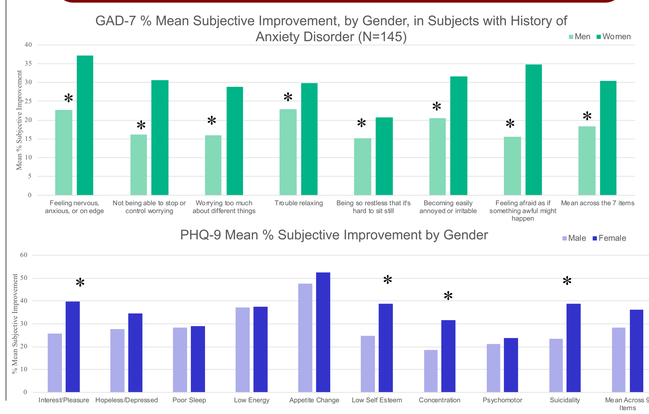
Differences in Subsample with History of Psychiatric Disorder



	No Psych Disorder N=357	With Psych Disorder N=269	Test p-value
Female Gender (%)	54.1%	64.7%	0.00291*
Non US residents (%)	43.5%	57.3%	0.00062*
Anxiety (Mean ± SD)	14.0±35.5	30.1±37.3	<0.0001*

All other comparisons yielded no significant differences

Subjective Changes in PHQ9/GAD7 in subjects with history of Depression/Anxiety, by Gender



Discussion

This study demonstrates the subjective emotional and cognitive changes in people on a ketogenic diet.
There are subjective improvements, most prominently in energy and mood, but also across the other parameters, that are statistically greater in those currently on the diet compared to those who are no longer on the diet. These persisters also have significantly greater weight loss (though lower adherence), are more likely to be female, and are more likely to concurrently use intermittent fasting.

In the subset of subjects with a psychiatric disorder, a greater percentage were female, non-US residents, and had larger improvement in anxiety compared to those without psychiatric disorders.

A further subset of subjects with a history of anxiety or depression was examined, as these categories had the largest numbers. Notably, all subjects with depression or anxiety history reported 20-30% improvements across the PHQ9 and GAD7, respectively. However, women had significantly greater mean improvement scores compared to men.

While the generalizability of this study is limited due to the number of depressed/anxious people that would be willing to try a KD, what is clear is that certain people have the potential to benefit greatly.
The data also raises questions regarding etiologies of depression/anxiety, and further study may elucidate the degree to which the KD (as opposed to weight-loss-related improvements in self esteem, or a covert gastrointestinal issue) may mediate these changes.

Limitations

- Personal Bias – first author is on a ketogenic diet
- Recall Bias in subjects
- Input errors by subjects
- Uncontrolled experimental design
- Associations were found; cannot be assigned causation
- Current diet may be a confounder for significant results regarding gender

References

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[3]Sleiman S, Henry J, Al-Haddad R et al. Exercise promotes the expression of brain derived neurotrophic factor (BDNF) through the action of the ketone body β-hydroxybutyrate. Elife. 2016;5. doi:10.7554/elife.15092.