

# Thesis Presentation

Presentation by **Jennifer Woodward**

Integrative Nutrition | 2022

# Topic

**The Role of the Minerals Copper and Iron in The  
Creation of Cellular Energy  
and in Modulating Immune Health**



# Overview

✦ Problem

✦ Abstract

✦ Literary Review

✦ Theoretical Framework

✦ Objectives

✦ Hypothesis

✦ Methodology

✦ Implementation

✦ Result

✦ Conclusion

✦ Thank You



# Problem

When patients visit their primary care physician and complain about fatigue, the clinical standard of care is to assess serum levels of iron and supplement with iron pills if anemia is determined to be a factor in the reported energy issues. Fatigue affects 38% of American workers. Iron deficiency affects two billion people worldwide and has been extensively researched and written about in the literature. However, the mineral copper is also needed to complete the electron transport chain and create cellular ATP. The body also uses copper to regulate inflammation, manage T cell growth and function, kill microbes, and scavenge free radicals. Too much iron in the body can create damaging reactive oxygen species and can also become food for pathogenic microbes.



# Abstract

The purpose of this research was to determine if an excess of iron and/or a deficiency of copper was associated with decreased cellular energy and a weakened immune system. The survey research revealed that the majority of respondents (25, 86%) reported feelings of increased energy after adding dietary copper. The research also showed that only (7, 24%) of respondents reported less frequent colds and flus after adding dietary copper. Future studies may provide increased knowledge about the effects of supplemental copper on the reduction of fatigue. Future studies may also show the effects of copper on specific microbial pathogens in vitro and in vivo.

# Introduction

Fatigue is a common reason for seeking medical care in western nations, and the prevalence of fatigue in the general population is reported to span from 7% to 45%, with one study showing that 38% of American workers complained of fatigue (Ranjith, 2005; Ricci et al, 2007; Dittner et al, 2004). There is no clinical diagnosis of fatigue, but the literature shows that it can be generalized subjectively as a decrease in ability to perform up a particular standard (MacIntaosh & Rassierm, 2002). The root cause of fatigue is debated in the literature, with a wide number of factors said to be responsible for the general feelings of exhaustion in the population.

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# Fatigue

It is theorized that low serum iron results in lowered hemoglobin production and decreased red blood cell hemoglobin. When hemoglobin concentration is below 120g/L in women and 130g/L in men, a diagnosis of anemia is given. Fatigue is the most common symptom of anemia (Sobrero et al, 2001). Therefore, physicians and other practitioners may recommend iron supplements in response to the complaint of fatigue and the clinical presentation of low iron.

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It is of note that the literature also suggests that low copper status is associated with microcytic, normocytic, and macrocytic anemia (Wazier & Ghobrial, 2017).



Both iron and copper are needed for a healthy body, but balance is key. Both iron and copper have the potential to form damaging reactive oxygen species and negatively affect the body. This can lead to inflammation, tissue damage, and disease. It is for this reason that iron and copper metabolism are theoretically tightly regulated by advanced homeostatic controls (Wang et al, 2018).

# Literature Review

01

Anemia is the term for a state of imbalance where the number of red blood cells (RBC) are low, or the blood cells do not have an adequate amount of hemoglobin

02

Anemia affects about two billion people around the world and it is estimated that about one-half of these cases are due to low iron (World Health Organization, 2001).

03

Copper is an essential metal in the body and is needed for energy production and iron metabolism, among other roles. While experts recommend between 1.5–3.0mg of dietary copper each day, the average Westerner only gets 1 mg of copper each day, and only 50% of that is absorbed (NRC, 2000).



# Literature Review

04

Oxygen is the last electron carrier in aerobic cellular respiration. Copper is a necessary cofactor for this delivery of electrons to oxygen (Ahmad et al, 2021).

05

Multiple researchers have asserted that the proper assembly and functioning of the ETC is dependent on copper (Kim et al, 2008; Turski and Thiele, 2009).

06

When copper is deficient in the body, increased production of ROS and cell death can occur (Bustos et al., 2013).



# Literature Review

07

Research from 1974 and 1977 showed that even a mild copper deficiency was associated with neutropenia (Dunlap & James, 1974; Zider et al, 1977).

08

Neutropenia refers to a lack of neutrophils and is associated with an increased risk of infection (Djoko et al, 2015).

09

In subjects with low copper, reduced phagocytic activity and also lowered bactericidal activity were both observed and also corrected with the administration of sufficient levels of dietary copper (Xin et al, 1991).



# Literature Review

10

There is no more paramount need for copper than in the mitochondria (Cobine et al, 2020).

12

When copper is insufficient or biounavailable, the creation of red blood cells slows down (Ames et al, 2005).

11

In each mitochondrial matrix, there are approximately 50,000 atoms of copper (Cobine et al, 2004).

13

With copper deficiency, the body will not be able to regulate iron metabolism and iron will build up inside the ferritin storage proteins inside the mitochondria and the cells and greater oxidative damage will occur (Robbins, 2021).



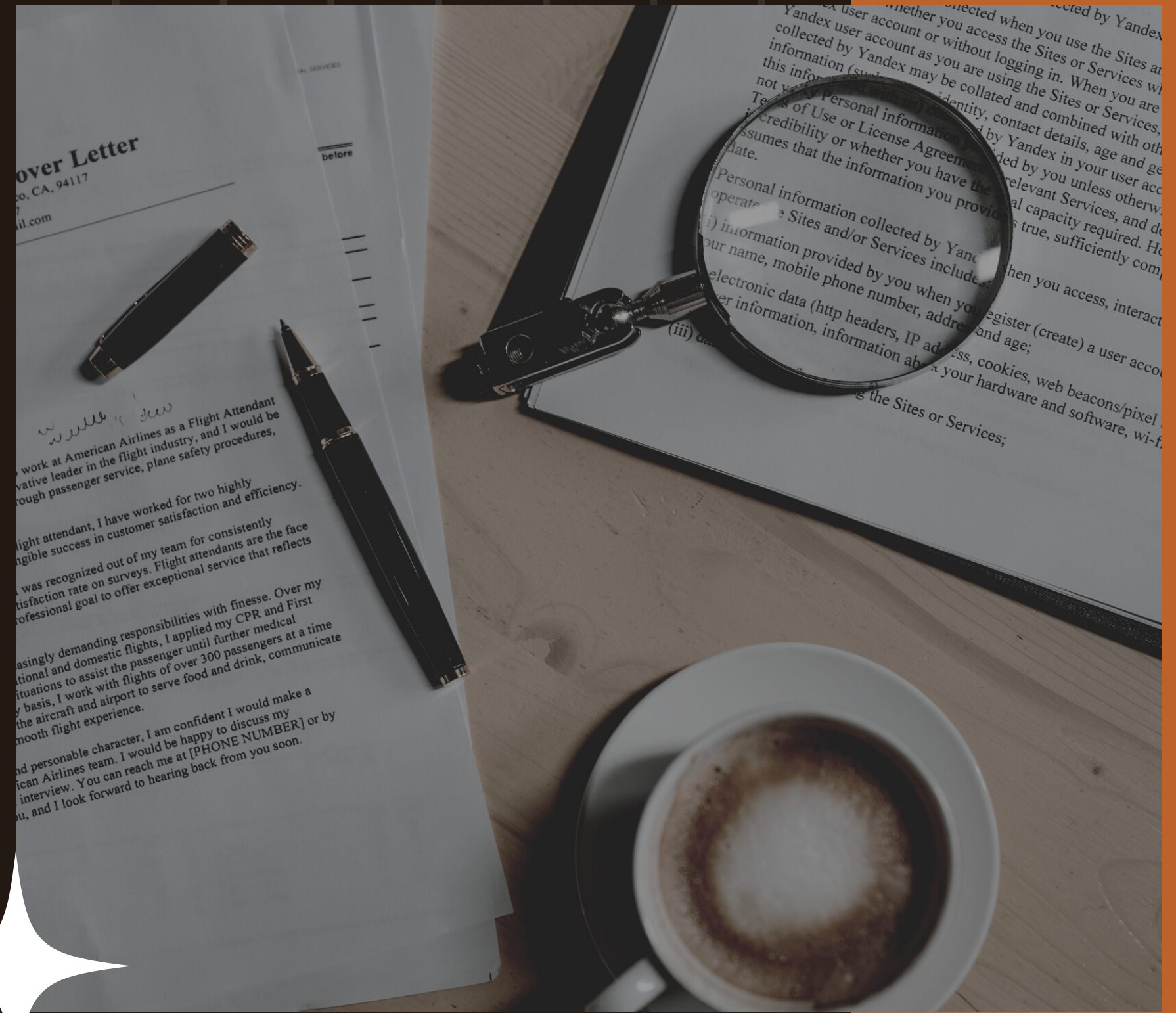
# Research Methods

## Question

What is causing the Western epidemic of fatigue and immune issues?

## Purpose

To determine whether an imbalance of copper and iron in the body may lead to decreased energy and immunity.



# Research Design

## Online Survey

The survey was a quantitative study with the end goal of acquiring an in-depth understanding of whether or not copper supplementation led to overall feelings of increased energy and increased health and wellbeing.

## Subjects

Subjects were taken from an online Facebook group of copper-curious individuals. The group is called The Copper Revolution: Healing with Minerals. The group consists of 13,100 members as of October 2022, and is led by Jason Hommel.



# Research Design

## Population

The target population was western adults who with energy and immune issues who had been using copper supplementation for 7 days or longer. 29 Respondents.

## Instrumentation

Online Google Forms Survey posted to *The Copper Revolution: Healing with Minerals* group.





# Research Design

## Procedures

The survey was created in Google forms, using a mix of yes/no, multiple choice, short answer, long answer, and Likert scale questions (See Appendix A).

## Data Analysis Procedures

statistical analysis will be applied to the Likert scale questions only. The mean, standard deviation, and the 95% confidence interval for each metric will be calculated.

Responses to open-ended questions will be listed, categorized, and graphed.



# Research Design

## Assumptions

- Truthful responses
- Health minded already; healthy diet and lifestyle

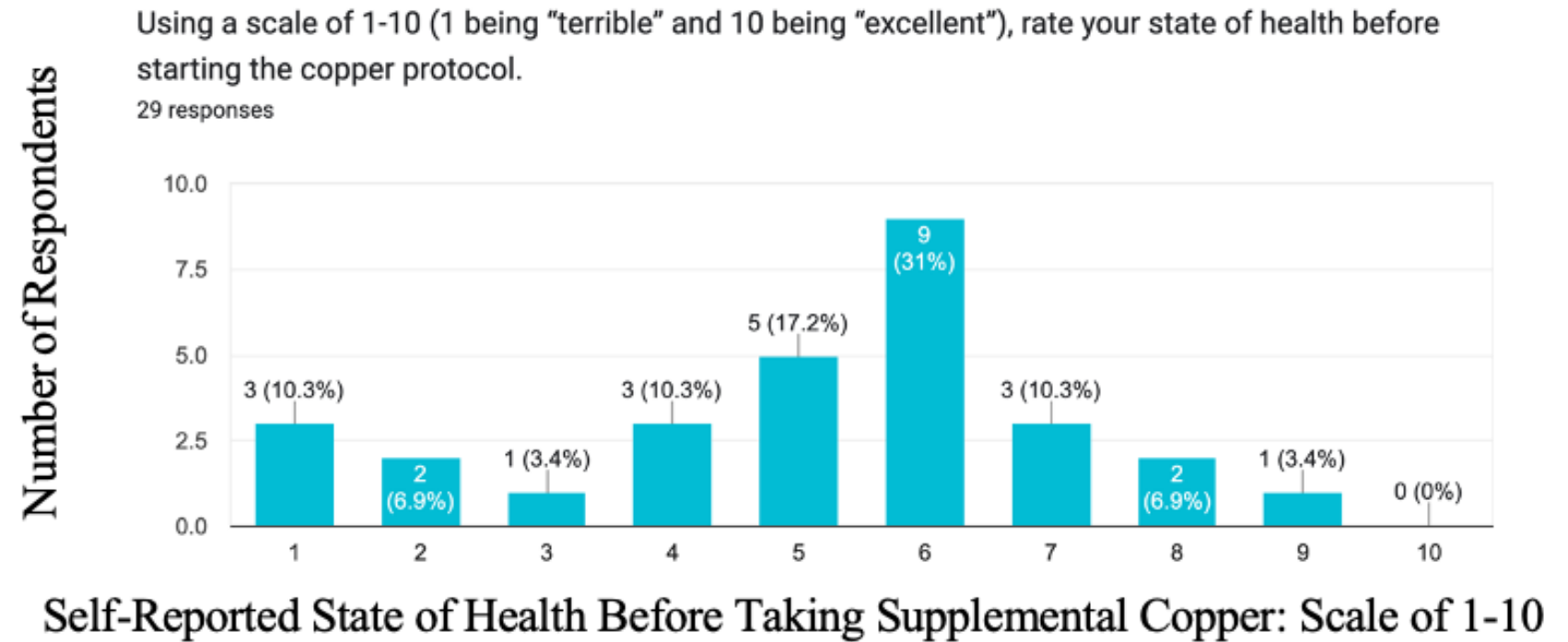
## Limitations

- not general public
- only those who had already seen benefit
- bias toward copper by nature of being in FB group



# Results

Using a scale of 1-10 (1 being “terrible” and 10 being “excellent”), it was found that the mean of 29 participants rated their health at a 5.06, with an upper limit of 5.87 and a lower limit of 4.29 (Table 1). The 95% confidence interval was 5.07 +/- 0.78, and the standard deviation was 2.14.



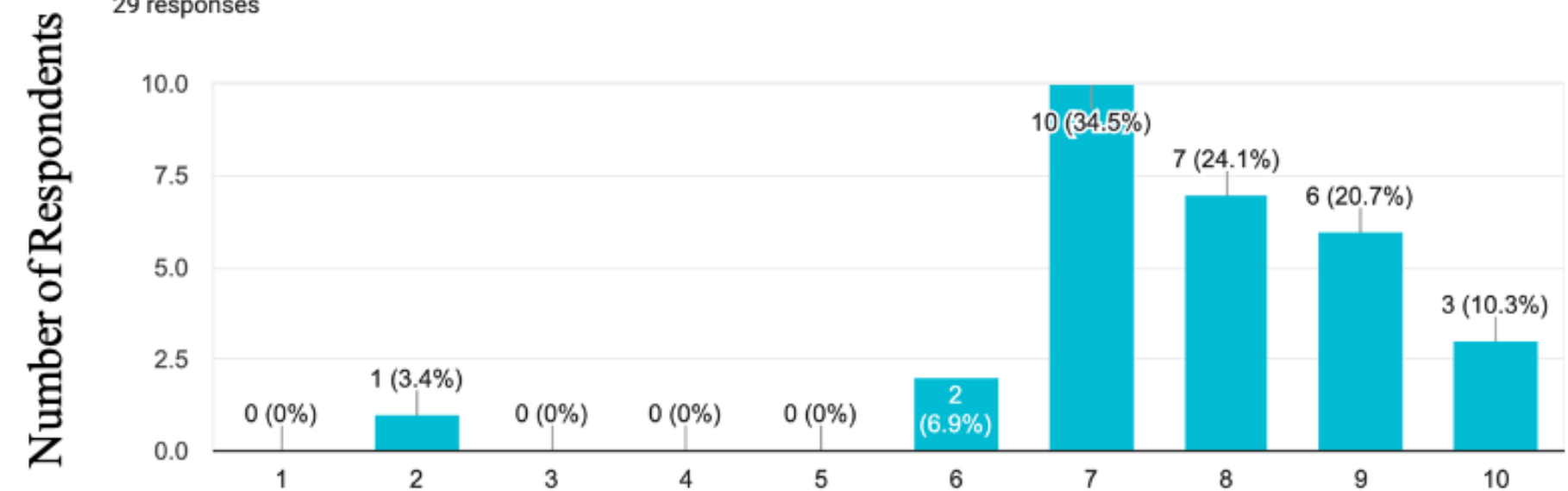
**Table 1.**

# Results

After taking supplemental copper for a period of time, 29 participants were found to report their health (1 being “terrible” and 10 being “excellent”) at a mean of 7.69 with a 95% confidence interval of 7.69 +/- 0.62, and a standard deviation of 1.71 (Table 2).

Using a scale of 1-10 (1 being “terrible” and 10 being “excellent”), rate your state of health currently being on the copper protocol.

29 responses



Self-Reported State of Health While Taking Copper: Scale of 1-10

**Table 2.**

# Results

An unpaired t test showed the two-tailed P value is less than 0.0001, and therefore this difference is considered to be extremely statistically significant (Figure 1). The mean of before copper supplementation compared to after copper supplementation equals -2.62, and the 95% confidence interval of this difference is from -3.634 to -1.60. The standard error of difference is 0.509.

## Unpaired t test results

### P value and statistical significance:

The two-tailed P value is less than 0.0001

By conventional criteria, this difference is considered to be extremely statistically significant.

### Confidence interval:

The mean of Before Copper minus After Copper equals -2.6200

95% confidence interval of this difference: From -3.6390 to -1.6010

### Intermediate values used in calculations:

t = 5.1507

df = 56

standard error of difference = 0.509

### Review your data:

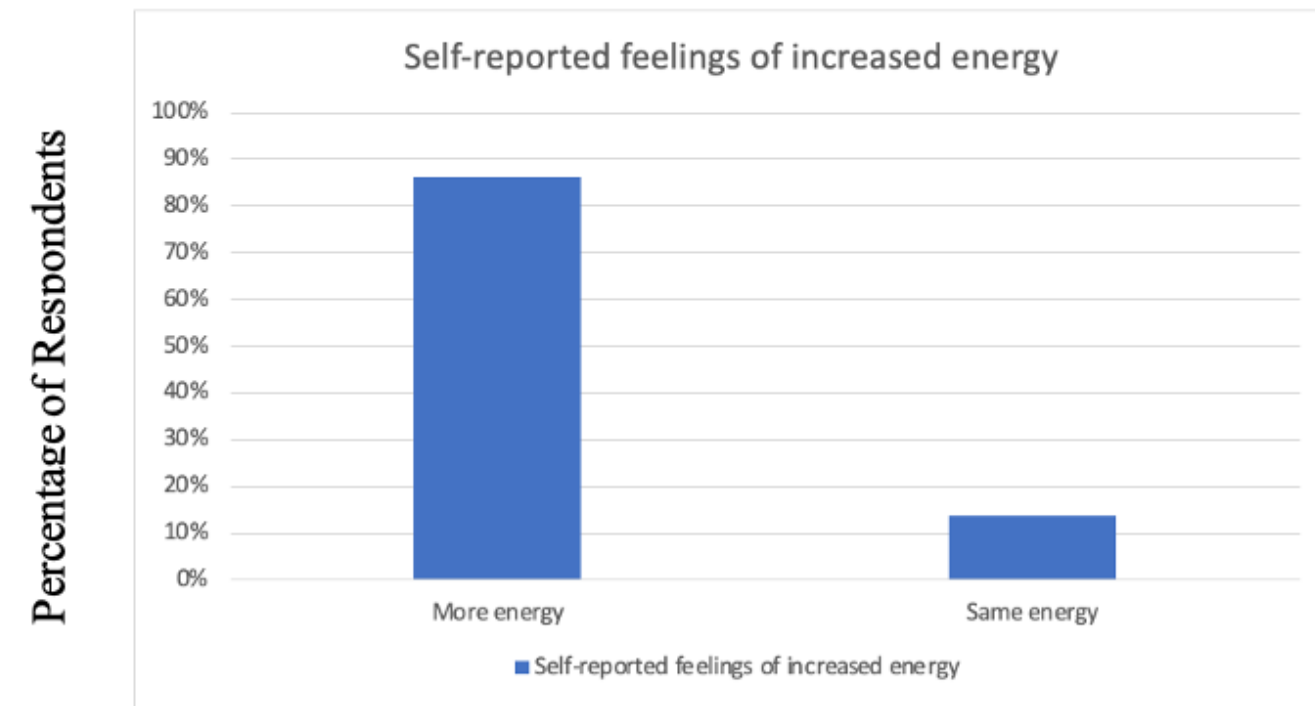
Group	Before Copper	After Copper
Mean	5.0700	7.6900
SD	2.1400	1.7100
SEM	0.3974	0.3175
N	29	29

**Figure 1.**

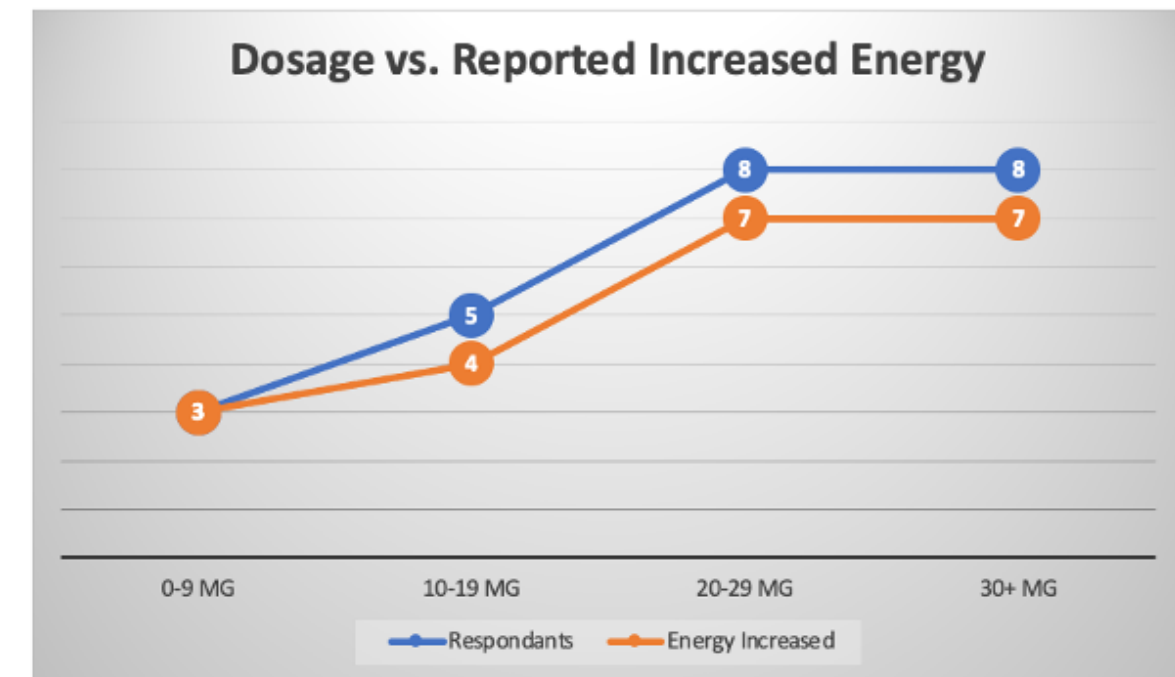
# Results

A total of 86% of the 29 participants reported feelings of increased energy after supplementing with copper (Table 4), vs 14 % of participants who did not notice feelings of increased energy (Table 5). Interestingly, increasing the amount of copper taken did not seem to correlate with greater reported feelings of increased energy. A total of 100% (3/3) of participants who added 0-9 mg of daily copper reported feelings of increased energy, and feelings of increased energy were reported by 4 out of 5 respondents taking 10-19 mg of copper daily, 7 out of 8 respondents taking 20-29 mg of copper daily, and 7 out of 8 respondents taking 30 mg or more of copper daily.

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**Table 4.**

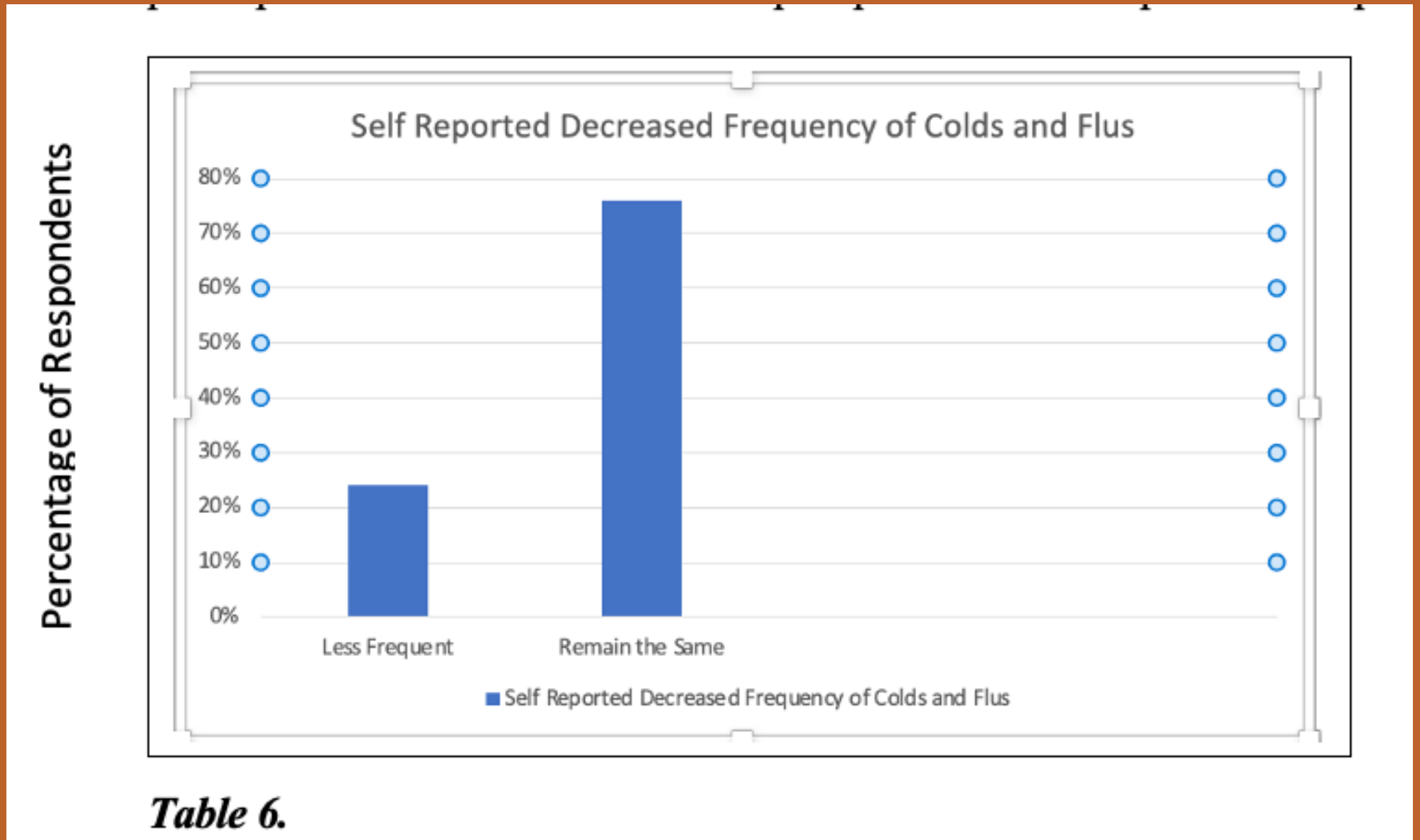


Blue line: Total number of respondents  
Orange line: Number of respondents whose energy increased.

**Table 5.**

# Results

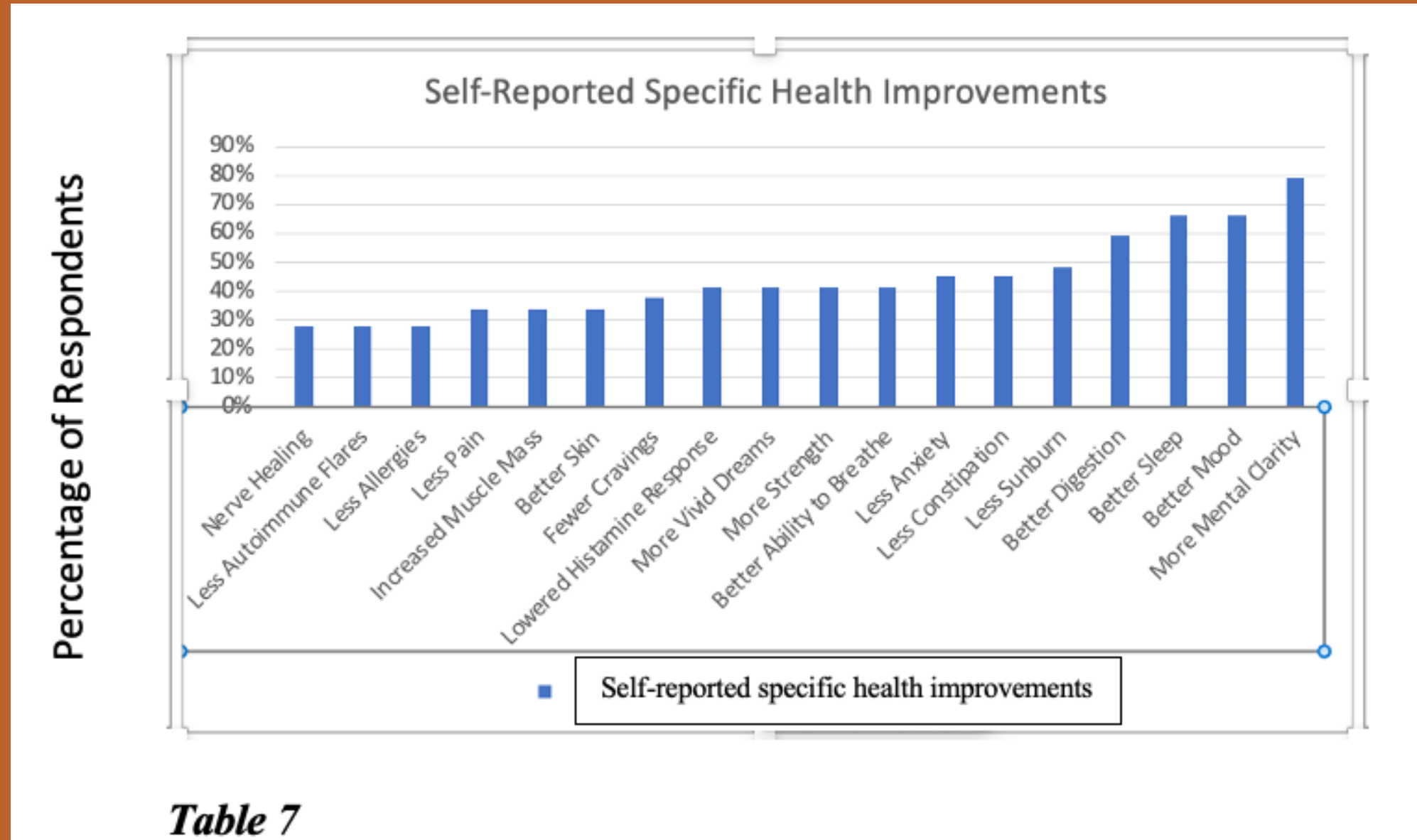
This paper also sought to determine if an increased amount of supplemental copper is associated with increased immunity. However, only 24% of participants reported getting sick less often on copper supplementation, compared to 76% of respondents who did not notice increased immunity.



**Table 6.**

# Results

Other specific health improvements were reported by the 29 respondents (Table 6). A total of 79% reported more mental clarity, 66% reported better mood, 66% reported better sleep, 59% reported better digestion, 48% reported less sunburn, 45% reported better digestion, 45% reported less anxiety, 41% reported better ability to breathe, 41% reported more bodily and muscle strength, 41% reported more vivid dreams, 41% reported lowered histamine response, 38% reported fewer dietary cravings, 34% reported better skin health, 34% reported increased muscle mass, 34% reported less pain, 28% reported less allergies, 28% reported fewer autoimmune flares, and 28% reported feelings of nerve healing. Participants ranged in age from 26-74, with the majority of respondents aged 45-64. (Table 7). It should be noted that participants were able to select multiple specific health improvement options on the survey form.



**Table 7**



# Discussion

## Introduction

A total of 29 participants aged 26–74 who had been taking supplemental copper for between 1 and 8 or more weeks were given a survey requesting information on how the addition of copper to their regime influenced their energy levels and also their incidence of colds, flus, and other illnesses



# Discussion

## Summary of Major Findings

A statistically significant 86% of the 29 participants reported feeling more energetic after adding supplemental copper. An increased dose of copper was not found to be associated with increasingly higher levels of energy. At up to 9 mg of copper, 100% (3/3) respondents reported feeling more energetic. Four out of 5 people taking 10–19 mg of copper felt more energetic, 7 out of 8 people taking 20–29 mg of copper felt more energetic, and 7 out of 8 people taking 30 mg or more of copper felt more energetic.



# Discussion

## Final Thoughts

The seemingly rampant lack of copper in western diets may be a factor in the regular reporting of fatigue by patients. This may be one of the reasons that after taking copper supplements in doses from 1-30+mg, 86% of survey respondents reported a noticeable increase in energy. This may also be a reason that participants noted other specific health improvements that can be correlated with an overall increase in energy. Specifically, a large percentage of participants reported more mental clarity, better mood, better sleep, and even better digestion; and specifically, less constipation. The addition of copper appears to be correlated with energy balance in the body.



# Discussion

## Final Thoughts

The sample size of 29 was a limiting factor in collecting clinically significant data.

The addition of supplemental copper did not seem to be correlated with decreased incidence of colds, flus, and illnesses. This was surprising as the literature seemed to suggest the opposite.



# Conclusion

The addition of supplemental copper is seemingly not correlated with increased immunity as observed by experiencing less colds and flus. The addition of supplemental copper is correlated with feelings of increased energy. Data analysis rejects the hypothesis that copper increases immunity, but the analysis accepts the hypothesis that copper increases feelings of energy. However, a greater sample size would be necessary to achieve statistical significance.

# Recommendations

It could be concluded that adding 1-10 mg supplemental copper daily for those struggling with chronic fatigue may be beneficial. If a patient is also complaining of low mood, poor digestion, poor sleep, and also brain fog, physicians would be wise to suggest a small dose of supplemental copper with breakfast or lunch.

Further study is warranted on this subject.

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# Thank You!

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