

Quantifying the Effectiveness of Dr. Bredesen's ReCODE Protocol in Alzheimer's Disease

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Alzheimer's Disease currently has no cure, although there are various drugs to treat the symptoms of cognitive decline. However, Dr. Dale Bredesen claims to have discovered a way to prevent and reverse Alzheimer's Disease, with a protocol of interventions that he termed "ReCODE". To test the effectiveness of the ReCODE protocol, researchers collected patient reviews from the books off Amazon, rated the reviews on a 1-5 scale of patient cognitive change, and analyzed the results using a Chi-square test for goodness of fit. Statistical analysis rejected the null hypothesis and accepted the alternative hypothesis that the ReCODE protocol was effective in the treatment of Alzheimer's disease.

1 Introduction

For many decades, Alzheimer's Disease has been assumed to be a fatal disease with inevitable decline in memory and cognition until the patient's death. Alzheimer's is a currently incurable neurodegenerative disease that causes memory loss, and mental decline that impairs daily life. In the brain, Alzheimer's is characterized by amyloid beta plaques and tau neurofibril tangles [1]. To combat the severe illness, patients often choose to use lecanemab and aducanumab—two drugs that have the ability to temporarily delay the progression of Alzheimer's [1]. However, rather than use drugs to restrain the cognitive disease, Dr. Bredesen explains in detail about the interventions in ReCODE in two books: *The End of Alzheimer's* and *The End of Alzheimer's Program* [3, 4, 2]. In these books, Dr. Bredesen explains that there are three major causes of Alzheimer's: inflammation, loss of trophic support, and exposure to toxic compounds [3]. Instead of solely focusing on amyloid beta, the ReCODE protocol addresses and underlines essential information about the roles of nutrition, exercise, sleep, stress management, supplements, and hormones in the escalation of Alzheimer's [2, 3].

Dr. Bredesen outlines specific tests for risk factors, including: ApoE4 status, obesity and diabetes, cardiovascular diseases such as hypertension, heart attack or stroke, systemic inflammation as manifested in chronic pain, fatigue, GI problems and mood problems, diets that are rich

in animal proteins and starch, lack of antioxidant supplements, chronic stress, and low activity level [3]. Examples of certain courses of actions to take are stated in the ReCODE protocol. They include the intake of supplements, such as vitamin D, and daily fasting, which would induce ketosis, both of which have shown to be effective in improving the patient's cognitive functions [10]. Dr. Bredesen concludes that the ReCODE protocol is successful and more importantly, impactful, as it was able to reverse the worsening of cognitive functions in more than 200 patients [10].

Nevertheless, many people voiced concerns about the effectiveness of the method due to its technicality while others reinforced its credibility through positive reviews. In this research endeavor, we assessed the effectiveness of the ReCODE program by quantifying the experience of patients through their reviews of the books on Amazon. The reviews were carefully selected for its credibility in participation, processed through a subjective rating system and further analyzed using a Chi-square test. Our results demonstrate a successful rejection of the null hypothesis, confirming the effectiveness of the ReCODE program.

2 Methodology

In order to collect credible data and reach conclusions for our research we collected data from the two books and gathered different opinions on how well the ReCODE pro-

gram itself works [3, 4]. In order to find out the effectiveness of the program, we looked for patient reviews that contained specific information on how the reader's symptoms improved or did not improve, not those about how well the books were written or feedback on the program's hypothetical logic.

First, we collected reviews of the two books, book 1 referred to as *The End of Alzheimer's* and book 2 as *The End of Alzheimer's Program* on Amazon. The first book had ~5000 ratings, but only ~1000 reviews and the second book had ~2000 ratings and ~100 reviews [3, 4]. To efficiently collect data, each researcher divided the work to gather the viable reviews of each book onto a spreadsheet which all the researchers could access. Our collection criteria was that the patient had to have tried the protocol, or describe the person who tried the protocol. After collecting all patient ratings of both books, researchers rated each review on a scale of 1 to 5 uninfluenced by the original patient's star rating: 1 being significant deterioration of symptoms, 2 being mild deterioration of symptoms, 3 being no change, 4 being mild improvement of symptoms, and 5 being significant improvement of symptoms as indicated in the customer review. Multiple researchers rated each patient review so that the average of the ratings allowed for an unbiased scoring of the reviews.

Researchers then did statistical analysis to quantify the effectiveness of the ReCODE program through a Chi-Square goodness of fit test on the null hypothesis to reach a conclusion on the effectiveness of the program based on patients who followed the book's protocol and described a change in their symptoms of cognitive decline.

3 Results

Different researchers had different 1-5 ratings on the patients level of improvement, and as a result the average rating contained decimal values. Out of the ~1000 written reviews for book 1, there were 34 viable reviews that fulfilled our selection criteria [3]. Out of the ~100 written reviews for book 2, there were 24 viable reviews that fulfilled our selection criteria [4]. Across both books, there were 58 total viable reviews collected and 9 rating values for our rating scale from 1-5 on patient improvement. The histogram below displays our collected data.

On our rating scale of 1-5, a rating of 3 marks the middle ground of no symptom change. If the ReCODE protocol was ineffective, the ratings would be equally distributed across all star levels since there would be no association with cognitive improvement. On the other hand, participants whose cognitive decline improved from using the ReCODE protocol received a rating greater than 3. Out of the 58 reviews collected, 43 of our ratings were higher than 3, meaning approximately 74.13% of the participants' cognitive decline benefited from the ReCODE protocol.

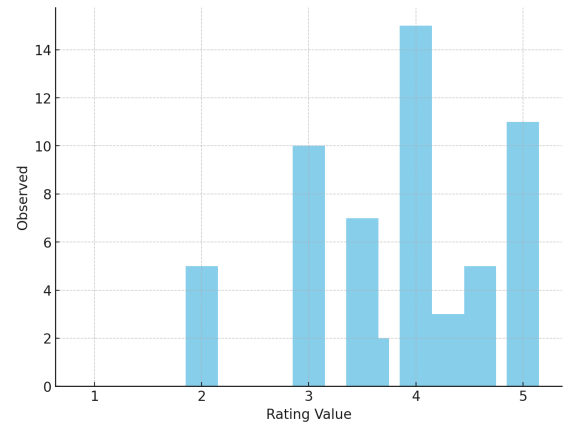


Figure 1: Histogram of Observed Rating Values

We performed a Chi-square goodness of fit test to evaluate whether the observed distribution significantly deviates from the expected equal distribution of ratings. The hypotheses were set as follows:

Null Hypothesis (H_0): People with cognitive decline who tried the ReCODE protocol showed no significant improvement in their symptoms, and the data will have equally distributed ratings.

Alternative Hypothesis (H_A): People with cognitive decline who tried the ReCODE protocol showed significant improvement in their symptoms and the ratings do not follow a uniform distribution.

The data included 9 groups, and with an expected equal distribution, the expected frequency for each group is the total number of reviews divided by 9:

$$\text{Expected} = \frac{11 + 5 + 3 + 15 + 2 + 7 + 10 + 5 + 0}{9} = 7.25 \quad (1)$$

The Chi-square number is calculated with the formula where O_i is the observed frequency in group i and E_i is the expected frequency in group i :

$$\chi^2 = \frac{\sum(O_i - E_i)^2}{E_i} \quad (2)$$

The degrees of freedom are calculated as:

$$\text{df} = \text{Number of Groups} - 1 = 8 \quad (3)$$

Using the above formulas, the Chi-square calculated statistic is about 26.22, and with its corresponding df of 8, the p-value is approximately 0.000965. Since the p-value is smaller than our alpha level of 0.05, we reject the null hypothesis and accept the alternative hypothesis that people with cognitive decline who tried the ReCODE protocol showed significant improvement in their symptoms, and the ratings do not follow a uniform distribution.

4 Discussion

Using our analysis, which resulted in a p-value less than the alpha level of 0.05, we were able to reject the null hypothesis and accept the alternative hypothesis that the ReCODE protocol was effective in the improvement of Alzheimer's symptoms such as cognitive decline.

The ReCODE program specifically, involves the use of a use of a plant-rich ketogenic diet that prioritizes low mercury, wild-caught seafood, and pastured eggs, a long daily fast; an exercise program comprised of both aerobic and anaerobic exercise combined with the suggestion to avoid prolonged periods of sitting; 7–8 h of quality, restorative sleep; a stress management program emphasizing regular deep breathing breaks with meditation; regular brain training, maintenance of social connectivity; an avoidance of toxins along with instructions to upregulate detoxification [3]. Daily supplements include probiotics, omega-3s, multivitamin, and antioxidants [3]. Many reviews commented on their decreased, and some reversed, cognitive decline after following Dr. Bredesen's program, including clearer thinking and better memory. Some described elevated moods or a decrease in depression after following the program. Others also mentioned improved physical functioning and sleep. For those who experienced significant improvements, many had followed Dr. Bredesen's ReCODE diet, cutting out processed foods, eating vegetables, fresh fruits and minimal carbs to stay in ketosis. Others also mentioned taking supplements and exercise.

Although we were able to support our alternative hypothesis, there are some limitations to this study. The method of sampling used has aspects of convenience sampling due to the accessibility of Amazon book reviews. Because the data was collected from Amazon reviews of Dr. Bredesen's book, this excluded those who may have been recommended the ReCODE program by a health professional or those who followed the ReCODE program but did not make a review or buy the book off of Amazon.

Dr. Bredesen's approach to preventing Alzheimer's, slowing cognitive decline, and reversing neurodegenerative diseases is a multifaceted approach that focuses on overall health instead of solely focusing on associated factors such as amyloid beta [3]. The treatment suggestion of following a plant rich ketogenic diet is similar to the Mediterranean diet, which research has shown to be associated with decreased cognitive decline [6, 9]. Both diets emphasize eating healthy fats and limiting processed food, although a ketogenic diet is more restrictive towards carbohydrates [5]. Other aspects of the ReCODE protocol, such as aerobic and anaerobic exercise as well as meditation are shown to be associated with Alzheimer's prevention [8, 7]. The ReCODE protocol utilizes lifestyle factor changes to prevent and combat Alzheimer's disease progression.

5 Conclusion

In *The End of Alzheimer's* and *The End of Alzheimer's Program*, Dr. Bredesen outlines his ReCODE protocol in the prevention and treatment of Alzheimer's disease. Based on the statistical analysis, we reject the null hypothesis and accept the alternative hypothesis that the reCODE protocol was effective in the improvement of Alzheimer's symptoms such as cognitive decline. In future studies examining the effectiveness of the ReCODE protocol on cognitive decline, research should further investigate the relationship between the specific aspects of the ReCODE protocol and Alzheimer's disease.

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