The Neurological and Physiological Effects of Anorexia Nervosa

Alessandra Shires

Abstract

This research focuses on the neurological and physiological effects one may have when suffering or recovering from a long-term mental illness of Anorexia Nervosa (AN). The study first hypothesizes that someone in recovery for at least 6 months will experience improvement in neurological effects, such as cognitive function, as well as physiological effects, such as low energy and weight loss. However, he or she may still experience long-term neurological differences due to the disorder. Secondly, the study hypothesizes that someone with long-term anorexia may suffer from neurological effects of mood disorders such as depression, anxiety, substance abuse issues, and sleep apnea, as well as physiological effects of excessive weight loss, hair loss, hormonal changes, and heart conditions. This project will consist of a meta-analysis followed by a qualitative survey. The meta-analysis will consist of previous studies' research on the physiological effects, comorbidities, and neurological chemical imbalances derived from anorexia. The qualitative survey will be administered to high school students and ask about disordered eating habits they may come across. This project is going to be showcased in a digital poster. ‘

Introduction

Out of any psychiatric disorder, Anorexia Nervosa (AN) is known to contain the highest mortality rate (Hoeken & Hoek, 2020). Although this illness isn't passed through genetically, it is most common among families with perfectionist, competitive, or obsessive traits (Melrose, 2011). AN may be used as a coping mechanism against trauma and depression (Melrose, 2011). Many people with this illness strive to have the lowest body mass index possible. Almost 50% of people with eating disorders meet the criteria for depression (Eating Disorder Statistics, 2020). Someone with long-term anorexia may suffer from the neurological effects of mood disorders such as depression, anxiety, substance abuse issues, and sleep apnea, as well as the physiological effects of excessive weight loss, hair loss, hormonal changes, and heart conditions (Kaye, 2014).

There are many different treatment methods for individuals struggling with AN that can lead to recovery. It has been suggested that someone in recovery for at least 6 months may experience improvement in his or her neurological effects, such as cognitive function (working memory, learning, etc.) (Gould, 2010). The physiological effects have also been shown to improve, such as restored energy level and normal BMI ranges. However, he or she may still experience long term neurological differences due to the disorder. In this research, I will discuss the physiological and psychological effects AN has on the brain in someone who is recovered from AN or has been struggling with it long-term. I will be deriving qualitative data from the most common diagnosed age group, adolescents. To derive the data, I have put together a survey for adolescents ages 14-18 to fill out. This survey will particularly be targeted towards the effects social media has on teenagers that lead to eating disorders and body dysmorphia. I will also be conducting a meta-analysis by combing through different research studies done in the past

about physiological effects on AN. It is hypothesized that someone in recovery for at least 6 months will experience improvement in neurological effects such as cognitive function and physiological effects such as low energy and weight loss, however, he or she may still experience long-term neurological differences due to the disorder.

Methods

Meta-Analysis

In my research, I combined articles from past studies on the physiological and neurological effects of someone with an active eating disorder and someone who has recovered from an eating disorder. In order to discover the effects of AN, I combined research from other studies to draw my own analysis from the statistics and studies to make this research accessible to my target audience, adolescents. I strongly believe that adolescents are the target audience for eating disorders because their brains are still developing and following what they see around them. This leads them to struggle to attain something that isn't realistic, especially in what they see on social media, which inspired the second part of the study.

Qualitative Survey

I created a digital survey through Google Forms to collect first-hand data from people on eating disorders and social media. The survey contained questions such as their age, gender, symptoms they have experienced, and the effects social media can cause on body image issues and eating disorders. An example question from the survey included, "Do you think social media plays a big factor on unhealthy body image, restrictive eating, etc.?" The participants included people who have suffered from an eating disorder or were people that wanted to display their thoughts on this subject. My target audience for this research included adolescents. Due to the anticipation of many of the participants in this research being under the age of 18,

each participant in the survey was required to sign a consent form to have their data in this research. Additionally, an Institutional Review Board (IRB) was created by recruiting specifically authorized adults with the titles of a physician, a science teacher, and a school administrator. They signed for their approval of the project, ensuring the protection of each minor human participant in the research. Results were gathered by sending a digital survey answering questions about personal experiences with eating disorders and body image issues in today's society. Results were generated and presented in analytical graphs and open-ended responses through Google Forms.

Results

Meta-Analysis

I created a meta-analysis of results found in multiple studies that I didn't have the ability to measure myself. In an MRI study conducted, it was found that individuals with AN were shown to have a significant loss in brain gray matter volume. Having a loss in brain gray matter volume can cause an individual's cognitive function and working memory to decrease (Roberto CA, Mayer LE, Brickman AM, et al. 2011). The MRI showed that even when the individual diagnosed with AN recovered and had 90% of their ideal body weight restored, gray matter volume improved but was not able to restore fully (Roberto CA, Mayer LE, Brickman AM, et al. 2011). Compared to the prior study, which consisted of 51 weeks, another study was conducted testing the brain gray matter volume in AN patients after a long-term 29 to 40- month recovery (Wagner A, Greer P, Bailer UF, et al. 2005). This study showed that their brain gray matter volume was able to restore to its average volume, suggesting that long-term recovery could help reverse some effects (Wagner A, Greer P, Bailer UF, et al. 2005).

When restricting food intake, individuals diagnosed with AN are found to affect the neurotransmitters in the brain (Giordano, G., Renzzetti, P., Parodi, R., Foppiani, L., Zandrino, F., Giordano, G. & Sardanelli, F. (2001). These individuals have been found to significantly decrease in size of their hippocampus, amygdala formation, and pituitary gland (Giordano, G., Renzzetti, P., Parodi, R., Foppiani, L., Zandrino, F., Giordano, G. & Sardanelli, F. (2001). These structures in the brain being affected can cause deregulation in hormones, body temperature, menstrual cycle, bone mass, and glucose levels (Giordano, G., Renzzetti, P., Parodi, R., Foppiani, L., Zandrino, F., Giordano, G. & Sardanelli, F. (2001). As well, dopamine levels in a person with AN have been shown to have a change in the way the dopamine system works (Giordano, G., Renzzetti, P., Parodi, R., Foppiani, L., Zandrino, F., Giordano, G. & Sardanelli, F. (2001). As dopamine is the neurotransmitter of the brain that is responsible for pleasure and rewards, it is studied that a person with AN's dopamine levels increase when they achieve traits of an eating disorder (Giordano, G., Renzzetti, P., Parodi, R., Foppiani, L., Zandrino, F., Giordano, G. & Sardanelli, F. (2001). Dopamine levels have been shown to shift to feeling rewarded and motivated when one loses weight, exercises compulsively, restricts their food, and meets certain goals they have in mind (Giordano, G., Renzzetti, P., Parodi, R., Foppiani, L., Zandrino, F., Giordano, G. & Sardanelli, F. (2001).

Qualitative Survey

After sending out the Google Forms survey through multiple online platforms, I obtained responses from 97 participants from ages 14-18. Out of all 97 participants, 73.2% were female, 23.7% were male, and 3.1% preferred not to specify their gender. (Fig. 1). All 97 participants willingly agreed to participate in this study. When presented with the question, "Have you or your peers suffered from an eating disorder/unhealthy eating habits?" 88.7% of participants stated

“yes” (Fig. 2). When presented with the second question, “Do you think social media plays a big factor in unhealthy body image, restrictive eating, etc. ?” 93.8% of the participants answered “yes.” In comparison, 6.2% of participants said “no” (Fig.3). 89.7% of participants answered “yes” when asked the question, “Do you believe there would be fewer cases of eating disorders or body image issues if social media didn’t exist?” (Fig. 4). With an average of 76% of American teens that use social media in ages 14-17, this plays a big role in body image and unhealthy eating habits (Young 2017). One participant claimed, "There are so many pressures on social media to look a certain way and have a certain body. Even though social media is often fake and those insane bodies are sometimes photoshopped, people still feel the need to achieve those unrealistic bodies. People try diet after diet in hopes of losing weight but realize that the fastest way to lose weight is to starve. Social media blinds people to what actual people look like without all the makeup and photoshop. People also pose themselves on social media so that they will be skinnier. Social media makes people have unrealistic body images and pressures them to try to have that perfect body.” Another participant said, " Social media plays a big role in this issue, but at the same time, brand marketing and ad agencies do not help, so even if social media were not a thing, billboards and magazines would still contribute to this issue. Although it has changed recently, there is still some factor of a perfect image. Even when you think about the way photos are shot just to make things look better, certain angles or lights will always make photos look better than realistically. I think that pushing towards a more real social media or magazine/commercial use is ideal, I don’t know if it will ever be fixed.” If the participant answered yes to having an eating disorder, they were then asked to fill out an additional part of the survey to answer the side effects they experienced. 81.8% of participants experienced low energy, 78.2% experienced depression, 74.5% experienced anxiety, 56.4% experienced

excessive weight loss, 50.9% experienced hormonal changes, and 47.3% experienced hair loss (Fig. 5).

Discussion

From the results in the meta-analysis, the fact that there was a significant decrease in brain gray matter volume, shows how detrimental this physically affects cognitive function and working memory, especially in adolescents, supporting the study's hypothesis. Being that adolescents' brains are still developing and not at their "full potential," this can cause a significant barrier in not only their everyday lives, but their academics as well. As we progress in age, our brains are already vulnerable to memory loss and slower cognitive abilities to function. By depriving our brain from nutrients that it needs to work at its full potential, this decreases the function of the brain even more than it already naturally is as time progresses. The hypothesis stated that someone in long-term recovery of Anorexia Nervosa can experience improvement in neurological and physiological effects. This was supported by finding that density of brain gray matter volume can be restored to its initial volume overtime, improving in their cognitive function and working memory. The hypothesis was also supported in that there were significant neurological changes within AN patients. The fact that dopamine shifted to being released in response to maladaptive achievements of Anorexia Nervosa, such as restricting food, shows the significant difference between a healthy person who typically has a release of dopamine in response to fueling your body with food. This also exemplifies how addicting and strongly reinforced anorexic behavior is.

The hypothesis was also supported by the qualitative survey, as the results indicated how prevalent the disorder is, and the large factor social media has on this disorder. The comments from participants shown in the qualitative survey results are a primary source of what it feels like

to be trapped in an internet society of false reality. With social media being the main source of eating disorders and negative body image in teenagers, the rates will only increase as these unhealthy patterns continue. I conducted this research to combine studies that had been done in the past about the physiological and psychological effects of AN, to be able to conduct my own hypothesis and findings to present to my target audience. This allows it to make the research easier for adolescents to read and understand the importance of providing enough nutrients for our bodies to function properly. In future research, I would like to discuss the physiological and psychological effects other mental illnesses that one can struggle from (ie. anxiety, drug abuse, alcohol addiction, etc.). Creating and publishing an analysis of past research studies on these different mental illnesses and combining them with my own, can help it become more interpretable by any person on these prominent illnesses that are visible in today's society.

References

Anorexia and the brain: What do we know? Eating Disorder Hope. (2022, June 17). Retrieved October 18, 2022, from https://www.eatingdisorderhope.com/information/anorexia/anorexia-and-the-brain-what-do-we-know

How malnourishment affects the brain: Research on anorexia and neurobiology. Eating Disorder Hope. (2022, July 7). Retrieved October 18, 2022, from https://www.eatingdisorderhope.com/information/anorexia/how-malnourishment-affects-the-brain-research-on-anorexia-and-neurobiology

How to regain weight during Ed Recovery. Eating Disorder Hope. (2021, December 11). Retrieved October 18, 2022, from https://www.eatingdisorderhope.com/nutrition-counseling-eating-disorders/regain-weight-during-recovery

Instant (chemical) messenger: Anorexia and the chemical communication of the brain. Eating Disorder Hope. (2022, June 17). Retrieved October 18, 2022, from https://www.eatingdisorderhope.com/information/anorexia/instant-chemical-messenger-anorexia-and-the-chemical-communication-of-the-brain

Lauren Muhlheim, P. D. (2020, May 22). *The importance of weight restoration for people with anorexia*. Verywell Mind. Retrieved October 18, 2022, from https://www.verywellmind.com/brain-starvation-and-recovery-in-anorexia-nervosa-1138303

manager, J. K. I. M. (2020, October 17). *Eating disorder statistics*. Gen Psych. Retrieved October 18, 2022, from https://www.genpsych.com/post/eating-disorder-statistics

Mandelli, L., Draghetti, S., Albert, U., Ronchi, D. D., & Atti, A.-R. (2020, September 8). *Rates of comorbid obsessive-compulsive disorder in eating disorders: A meta-analysis of the literature*. Journal of Affective Disorders. Retrieved October 18, 2022, from https://www.sciencedirect.com/science/article/pii/S0165032720326975?casa_token=Qpqtx-HoX

yAAAAAA%3AN4e0t92oLCWr1BulqVCuFY4QwQmiG8r0azPFn1dFXMgHbaRje2Oc9xBzazyGHC-Txr_qL95A

U.S. National Library of Medicine. (n.d.). *Home - PMC - NCBI*. National Center for Biotechnology Information. Retrieved October 18, 2022, from https://www.ncbi.nlm.nih.gov/pmc/

Appendix

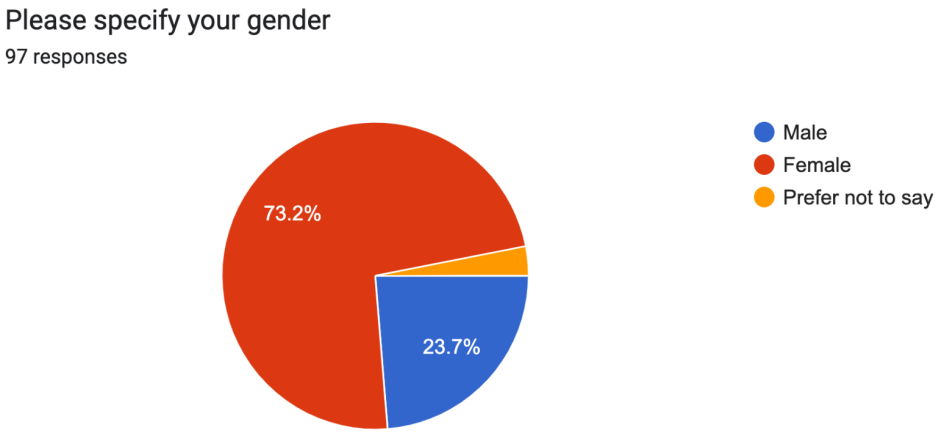

Figure 1. Gender identification reported by participants.

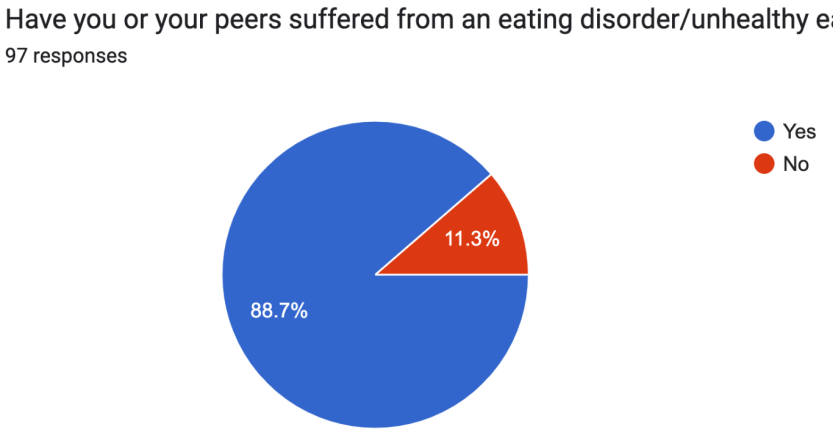

Figure 2. Percentage of peers that have suffered from eating disorder.

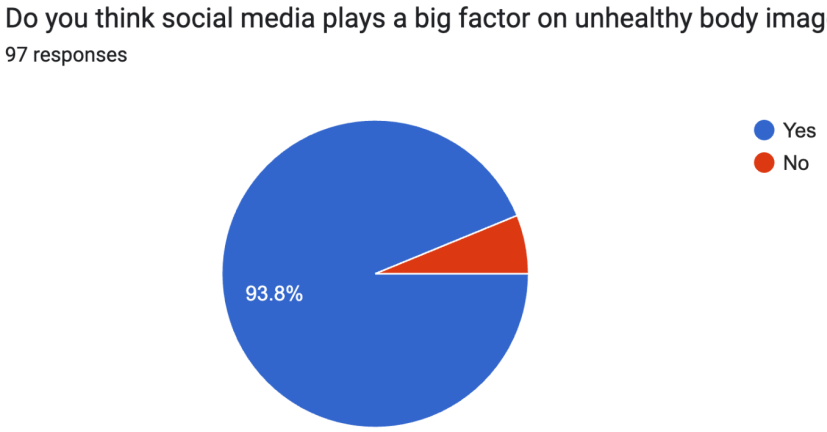

Figure 3. Question regarding social media's influence on unhealthy body image.

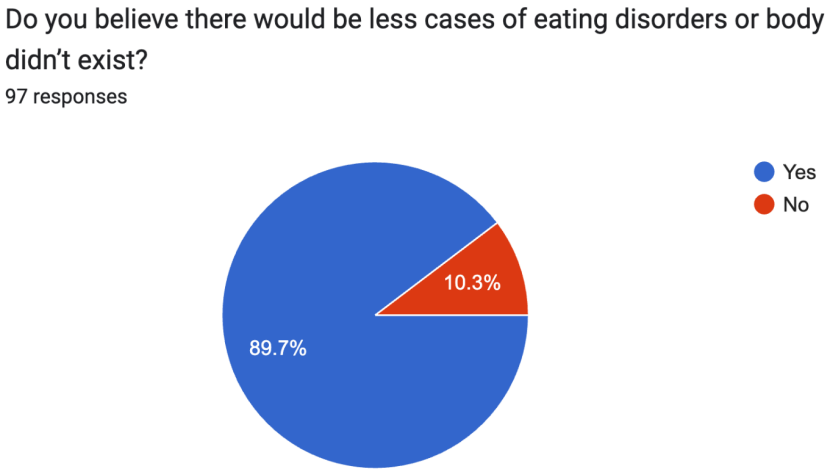

Figure 4. Question asking if social media didn't exist would there be less eating disorder cases.

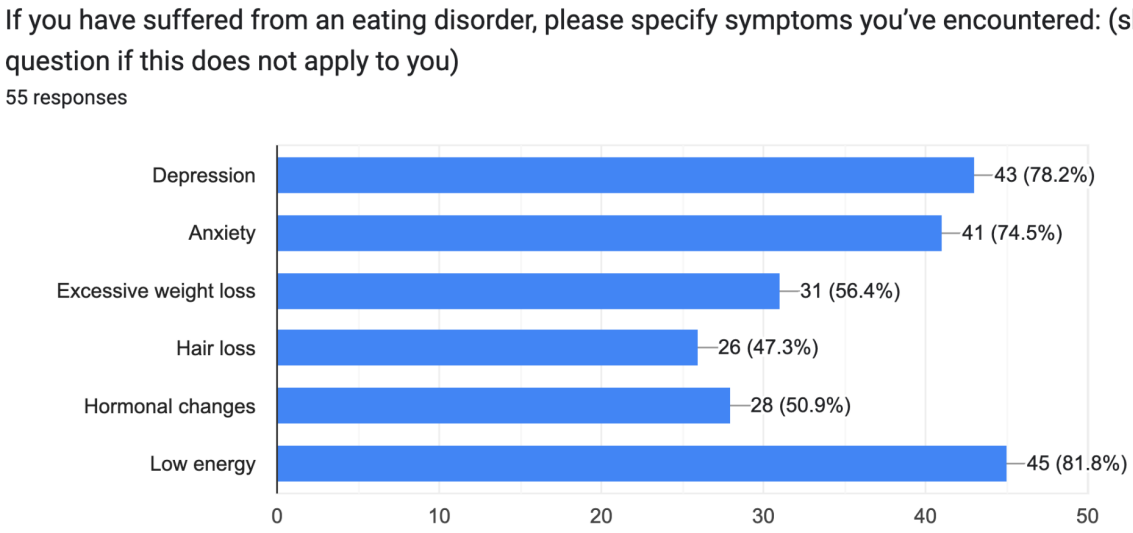

Figure 5. Bar graph displaying participants who experienced certain symptoms from AN.

Supplemental Materials: [Infographic of Research Paper]