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Re-occurrence of Obesity; Role of Neurobehavioral Characteristics and Genetics After Bariatric Surgery - A Systematic Review

Franchell Richard Hamilton*
Founder of NeuroSwitch Weight Loss

Abstract

Background: Obesity is a multifaceted, complicated neurobehavioral disease. Over 72% of U.S population is obese, and the prevalence of obesity in children is on the rise, causing consequences for the next generation. Although bariatric surgery for obesity has as its primary goal to cause significant weight loss, neurobehavioral characteristics and genetics may also be necessary to avoid weight gain. **Methodology:** Key phrases such as "obesity," "neurobehavioral," "eating disorder," "genetics and psychology," "treatment and re-occurrences," or "obesity management", "bariatric surgery", "precautions and management" were used to search the MEDLINE, PUBMED, and Google Scholar databases. The included methodological dataset was assessed using the EPPI (Evidence for Policy and Practice Information) Tool. The graphical depiction was produced using PRISMA flowchart generation. **Results:** Studies from the systematic review highlighted that obesity is a hereditary neurobehavioral condition. The findings identified that the heritable variance in body mass index had genetic associations with cortical thickness, cognitive tests, and regional brain volume. Surgery affects epigenetics by playing a crucial role in the hypo/hyper methylation of genes. The screened studies highlighted behavioral therapy, diet control, and temptation therapy to be needed in parallel to avoid the re-occurrence of obesity after surgery. **Conclusion:** Post-bariatric surgery weight stability depends on many factors. Bariatric surgery can modify brain structure and cause neurobehavioral factors such as decreased temptation, depression, and the desire to eat. CBT is recommended to control such factors. Since surgery regulates gene hypo- and hypermethylation, genetics also have an impact on weight gain. This systematic review will help us understand neurobehavioral characteristics and genes in bariatric surgery and create CBT-oriented gene targets for obesity treatment.

Keywords: Obesity; Neurobehavioral; Genetics; Obesity treatment; Bariatric surgery

Introduction

Obesity is a form of chronic disease that is experiencing a rise in incidence and is now being recognized on a worldwide scale as an epidemic. It has an effect on all systems to include the reproductive system, the heart, the liver, the kidneys, and the joints. It can result in a wide variety of non-communicable illnesses (NCDs), including diabetes type 2, coronary heart disease, hypertension, and stroke; several types of cancer; and mental health problems [1]. According to the World Health Organization (WHO), people who are obese have a risk that is three times higher of being hospitalized due to COVID-19. There are more than one billion obese persons in the globe, including 650 million adults, 340 million adolescents, and 39 million children. This number has not yet reached its maximum. The World Health Organization (WHO) predicts that by the year 2025, the health of about 167 million people, including adults and children, will deteriorate as a direct result of being overweight or obese. Over 72% of U.S population is obese, and the prevalence of obesity in children is on the rise, causing consequences for the next generation [2]. There is growing consensus that bariatric surgery is now the most effective and long-lasting therapy for clinically severe obesity. As a direct consequence of this growing consensus, the number of bariatric surgery procedures that have been conducted have skyrocketed over the past few years. . Patients undergoing bariatric surgery go through a significant number of significant changes to their lifestyles [3]. Comprehensive pre-surgical screening that is carried out by a multidisciplinary team is essential in order to adequately prepare patients for the multiple changes that are necessary for a successful outcome. In addition, thorough preoperative screening can assist the healthcare professional in determining which patients could benefit from additional treatments either before or after surgery. These patients can be prioritized for these additional services [4].

Recent research in molecular genetics has demonstrated that the majority of genes related to obesity are transcribed in the central nervous system. Bariatric surgery was shown to elicit a dramatic molecular remodeling of SAT (subcutaneous adipose tissue) at 12 months post-operative, mostly by the down-regulation of genes and the hypermethylation of other genes. This was discovered through whole transcriptome and methylome profiling [5]. Since bariatric surgery may be seen as an environmental element that modifies the epigenome, even though some epigenetic markers may be inherited, epigenetics may aid in our knowledge of how individuals will react to the procedure [5-7]. The most extensively studied epigenetic pathway is DNA methylation, and some investigations have predicted weight loss or re-gain after bariatric surgery based on preoperative gene methylation [6].

Additionally, bariatric surgery encourages changes in methylation patterns in obese people, making them more similar to lean people [8]. In SAT, some publications have similarly noted reduced overall methylation levels following RYGB [9]. On the other hand, more recent research has found that RYGB and SG procedures result in higher levels of global and CpG site methylation (CpG islands are areas of DNA that have been methylated and are found in promoters. These regions have been discovered to regulate gene expression by suppressing the transcription of the gene that they correspond to. Gene expression and the mechanisms that are unique to each tissue are dependent on the methylation of DNA at CpG islands) in peripheral blood [10] as well as higher levels of CpG methylation at CpG sites in skeletal muscle. Tissue-specific DNA methylation may help to explain some of these differences [11]. Due to a shorter intestinal segment that may be used for absorption than in RYGB and SG, BPD-DS causes larger nutrient malabsorption than other procedures. However, it has been shown to be particularly successful in treating people with extreme obesity. The effect of BPD-DS on the epigenetic makeup of SAT, on the other hand, is mostly unknown [12].

Obesity has also been linked to neurobehavioral traits, such as the architecture of the brain, cognitive performance, and personality. This link has been proven via extensive research. When dealing with a patient who has undergone bariatric surgery, it is of the utmost importance to address any psychological or behavioral concerns that the patient may have [13]. Patients have a duty to ensure that they have a complete comprehension of how many aspects of their lives, such as food habits, social and physical functionality, and body image, will be altered as a result of surgery. In addition, preoperative and post-operative therapies contain a plethora of behavioral modifications required for a satisfactory outcome, and patients need to be prepared to make many adaptations to their way of life [4,14]. Therefore, this systematic article is designed to analyze how neurobehavioral characteristics and genetics play a crucial role in the re-occurrence of obesity even after bariatric surgery.

Methodology

Data collection

In order to find relevant studies, researchers employ a variety of search techniques. Websites were utilized as data collection tool to gather studies and to find information. This approach involved the use of search engines like Medline, Google Scholar, Pubmed, and others. Key phrases that were used are: as "obesity," "neurobehavioral," "eating disorder," "genetics and psychology," "treatment and re-occurrences," or "obesity management" , “bariatric surgery”, “precautions and management”. About 22 articles were gathered using the following as the baseline statement: " Re-occurrence of obesity, the role of neurobehavioral therapy and genetics after bariatric surgery"

Data cleaning and processing

Since the data was acquired from numerous websites, duplicates from the articles were removed. The automation software EPPI (Evidence for Policy and Practice Information) was selected for additional processing [15]. The tool identified the incompatible or out-of-domain articles as invalid and rejected them in accordance with this determination. The records inclusion criteria that are considered acceptable for performing a systematic review are publications in English, journal articles of research documented in the last five years (2018-2022), authentic and adequate describing obesity, in particular, research papers addressing bariatric surgery, the neurobehavioral role, and genetics of obesity. These records must meet all of the following criteria in order for the systematic review to be considered appropriate. Studies that are difficult to locate, do not contain references that can be relied upon, or have an unreasonable price tag are not included.

Systematic analysis

The results of collected studies are evaluated by using a PRISMA tools (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) [16], and articles that do not fulfill the requirements for identification, filtration, validity, and finally accessing the relevant information are eliminated using a flowchart focused on the 2020 PRISMA checklist. This ensures that only the most relevant articles are accessed. A careful analysis was performed on the selected body of work, which had to be relevant as well as credible (Figure 1).

Results and Discussion

The researcher utilized schematics that were based on the PRISMA evaluation for the year 2020 and included and omitted publications that were written in English, published in the most recent five years, and could be read without paid services. Obesity is a multifaceted, complicated neurobehavioral disease. Obesity has become a top global public health concern as its prevalence has grown over the past few decades. There is a growing consensus that the best effective and long-lasting therapy for clinically severe obesity at the moment is bariatric surgery. However, neurobehavioral characteristics and genetics may also be necessary to avoid weight gain [4]. According to the results screen from one of the studies, [17] reinforces that the inexorable tendency to weight re-gain reported after weight loss is not reductively likely to have contributed to the loss of patients' motivation or adherence, but rather it is driven by powerful biological mechanisms that appear to stimulate intake of food (gut hormones) and decrease energy expenditure. This is the case because the article explains that patients' motivation and adherence are not the only factors that play a role in weight re-gain (metabolic adaptation). The synergistic effect of these peripheral processes exerts a force on overeating, so paving the way for the actions produced by the central nervous system. The other screened study describes this effect in detail [18]. This study gave 40 patients in the bariatric surgery group a battery of neuropsychological tests both before and six months after surgery as part of the study. He then compared the results of these patients to those of a control group that was on a waiting list. Subsamples of patients from both groups underwent structural MRIs, and the data were examined in order to compare and contrast the various surgical techniques [19].

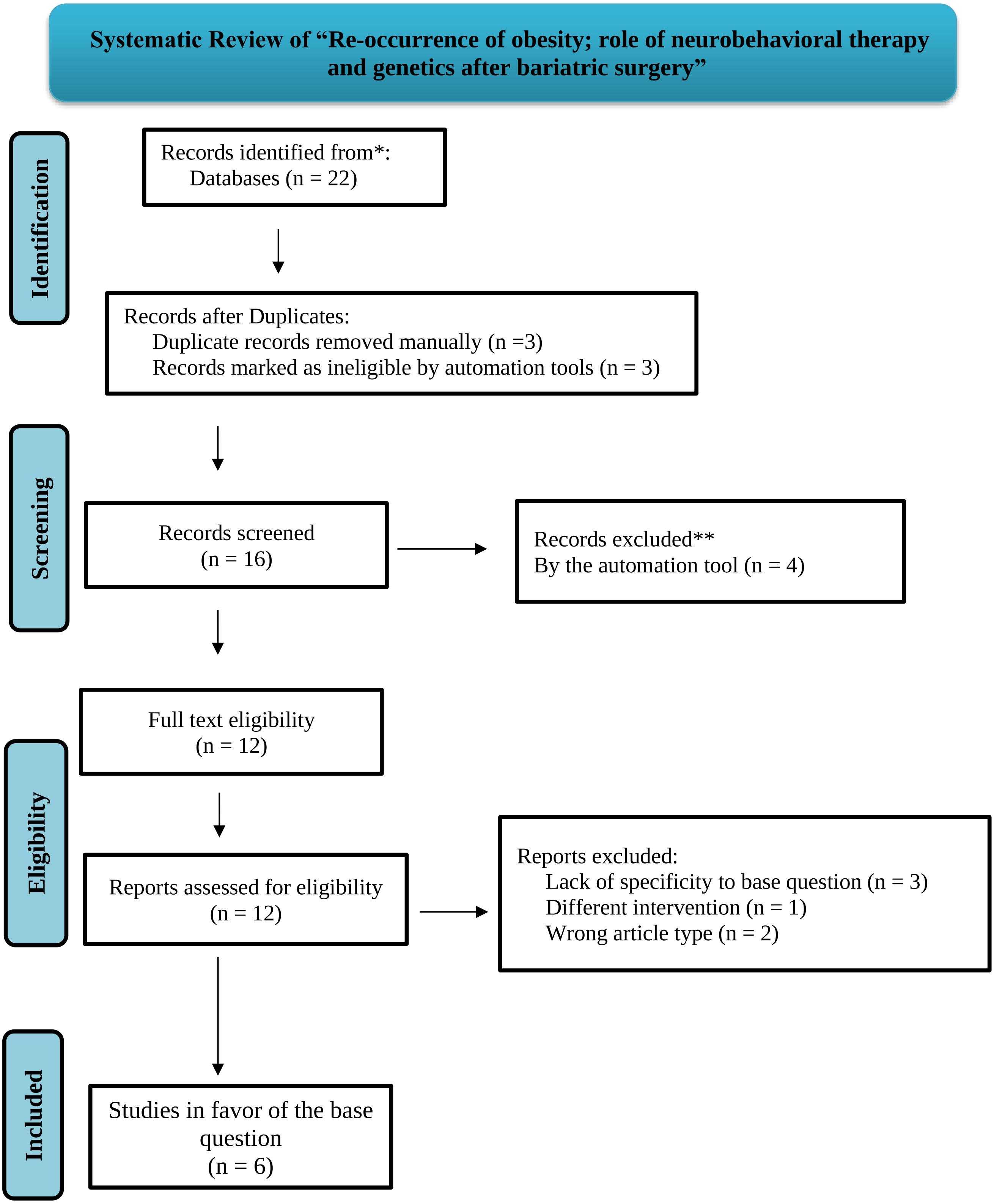

Figure 1: Graphical representation of systematic review process retrieved from PRISMA.

In terms of cognition, there did not appear to be any significant differences between the bariatric surgery group and the control group. However, in comparison to the controls, those in the bariatric surgery group had a bigger volume of grey matter in the fronto-temporal regions of the brain, whereas the volume of grey matter in the ventral striatum was reduced. Patients who had Roux-en-Y gastric bypass experienced greater weight loss than those who underwent restrictive treatment alone, however the latter group did not benefit more from improvements in cognitive outcomes. The findings of this research indicate that there is a possibility that bariatric surgery will result in the rearrangement of brain structure at long-term follow-up, whereas the kind of surgical operation does not differentially impact cognitive performance [18]. In addition to a reduction in body mass and recovery from disorders connected to obesity, a number of studies shown an improvement in cognitive function after bariatric surgery treatment [20-22].

Another screening publication revealed that after bariatric surgery, binge-eating disorder (BED) and major depressive disorder (MDD) are powerful determinants for decreased post-operative weight loss and re-gain. However, cognitive-behavioral treatment (CBT), which addresses both disorders following surgery, has not been researched up until this point [23]. This research investigated the efficacy of a short-term CBT program based on evidence-based guides for BED and MDD and adapted to patients who had undergone bariatric surgery. The CBT program was also examined for its feasibility in the context of patients who had recently undergone bariatric surgery [24-26]. The findings suggested that from the beginning of treatment to the end of treatment, researchers observed that patients not only lost a considerable amount of body weight but also saw medium to big impacts in the recovery of disordered eating psychopathology, depression, and self-esteem [23]. Similarly, a publication by [27], also selected from this systematic review, discussed diets that are too restrictive, such as those that are low in calories, are difficult to stick to over the long run. As a result of this, their level of popularity has declined in comparison to that of non-restrictive techniques, which instead encourage healthy eating choices. According to the findings, restrictive diets appeared to enhance eating patterns, and the evidence that was evaluated argues against the concept that they may make binge eating more severe. In addition to this, they may bring about short-term alterations in brain structure as well as improvements in cerebrovascular indicators, both of which, in turn, may have an effect on eating patterns. It's possible that measures that aren't restrictive can have a favorable impact on both weight maintenance and eating habits. However, there is a lack of evidence about their impacts on the neurological system [27,28].

The last two screened studies deal with the role of genetics after bariatric surgery in the re-gain of weight. According to the researchers [14], there is a link between brain-genes association and susceptibility to obesity. In a large brain imaging cohort with many related people, the author investigated whether the heritable variation in body mass index (BMI) is accounted for by neurobiological factors. According to the study, there were genetic associations between cortical thickness, cognitive assessments, regional brain volume and heritable BMI variability ranging from 0.25 to 0.45. BMI was specifically linked to variations in the temporal-parietal perception systems and frontal lobe asymmetry. Additionally, there was a genetic overlap between a few behavioral and brain components [14]. Similarly, [29] presented a study suggesting that higher metabolic remission rates may be associated with stronger SAT molecular reconfiguration. According to full transcriptome and methylome analysis, the results showed that at 12 months post-operatively, bariatric surgery produced a considerable molecular remodeling of SAT. Most of this remodeling occurred due to gene down-regulation and hypermethylation. Genes that are selectively hypermethylated or hypomethylated are often associated with a significant reduction in the immune and inflammatory responses of the body. All genes that showed contemporaneous differential expression and methylation after surgery were significantly associated to weight loss, with the GPD1L gene exhibiting the strongest association with weight loss [29].

Conclusion

There are different factors that can contribute towards the stability of weight after bariatric surgery. Though surgery is key to treat obesity, some neurobehavioral factors among other things can lead to re-occurrence of the disease. Bariatric surgery can cause a change in the brain structure and cause many neurobehavioral factors that result in decreased temptation, depression and an urge to eat. CBT is recommended to control such factors long term. Genetics also has a role in re-gaining weight as the surgery acting as an epigenetic factor regulates many gene hypo- and hypermethylation. This systematic review will help to a deeper understanding of the role of neurobehavioral characteristics and genes involvement in bariatric surgery and will ultimately lead to the creation of CBT-oriented-gene targets for the treatment of obesity.

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***Corresponding author:** Franchell Richard Hamilton M.D FACS, FASMBS, FOMA, Founder of NeuroSwitch Weight Loss, Medical Director, USA; e-mail: franchell.richardmd@gmail.com

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