



**UNIVERSITATEA DE MEDICINĂ ȘI FARMACIE  
"CAROL DAVILA" din BUCUREȘTI**



**2024**  
**UNIVERSITATEA DE MEDICINĂ ȘI FARMACIE**  
**„CAROL DAVILA”, BUCUREȘTI**  
**ȘCOALA DOCTORALĂ**  
**DOMENIUL MEDICINĂ**

***Effects of applying cognitive-behavioral therapy and  
hypnosis on psychological factors and BMI in adults  
with primary obesity: analysis, intervention and  
evaluation***

**SUMMARY OF DOCTORATE THESIS**

**Conducător de doctorat:**  
**PROF. UNIV. DR. ZĂGREAN LEON**

**Student-doctorand:**  
**NUȚU ANGELA**

**2024**

**Universitatea de Medicină și Farmacie „Carol Davila” din București**  
Strada Dionisie Lupu nr. 37 București, Sector 2, 020021 România, Cod fiscal: 4192910  
Cont: RO57TREZ70220F330500XXXX, Banca: TREZORERIE sect. 2  
+40.21 318.0719; +40.21 318.0721; +40.21 318.0722

[www.umfcd.ro](http://www.umfcd.ro)

## Index

INTRODUCTION .....	1
I. GENERAL PART .....	4
1. THEORETICAL FRAMEWORK REGARDING OBESITY, ETIOLOGY AND IMPLICATIONS .....	4
1.1. Definition and conceptualization of overweight and obesity .....	4
1.2. Obesity, a public health problem – prevalence and health effects .....	6
1.3. Pathogenesis of obesity and its determinants .....	8
1.4. The main directions of intervention and treatments of obesity scientifically validated .....	12
2. Psychological factors associated with obesity; CBT and hypnosis in weight management .....	16
2.1. Psychological factors associated with obesity, eating disorders and the psychopathology of obesity .....	16
2.2. The role of negative affectivity in relation to obesity .....	19
2.3. Personality traits and their influence on body weight .....	22
2.4. Eating behavior and its psychological dimensions .....	24
2.5. Cognitive Behavioral Therapy CBT – first-line intervention in weight management .....	25
2.6. Hypnosis, adjunct in CBT interventions .....	27
II. PERSONAL CONTRIBUTIONS .....	29
3. Working hypothesis and general objectives .....	29
4. Study 1 - Translation and adaptation for the Romanian population of the Three-Factor Eating Questionnaire (TFEQ) .....	33
4.1. Introduction (working hypothesis and specific objectives) .....	33
4.2. Material and method .....	35
4.3. Results .....	38
4.4. Discussions .....	43
5. Study 2 - The mediating effect of dietary behavior factors in the relationship between personality traits and Body Mass Index (BMI) .....	45
5.1. Introduction (working hypothesis and specific objectives) .....	45
5.2. Material and method .....	48
5.3. Results .....	50
5.4. Discussions .....	54
5.5. Conclusions.....	55
6. Effects of TCCH -MG on psychological factors and BMI in adults with primary overweight and obesity .....	56
6.1. Study 3 – Evaluation of the results of an intervention combining techniques of cognitive behavioral therapy and hypnosis (TCCH – MG) in addressing obesity .....	56

6.1.1. Introduction, working hypothesis and specific objectives .....	56
6.1.2. Material and method .....	61
6.1.3. Results .....	75
6.1.4. Talks .....	100
6.1.5. Conclusions .....	104
6.2. Measurements and evaluations at the neuroelectrophysiological level pre and post-intervention TCCH - MG. ....	105
6.2.1. Introduction, working hypothesis and specific objectives .....	105
6.2.2. Material and method .....	108
6.2.3. Results .....	110
6.2.4. Discussions .....	116
7. General conclusions and personal contributions .....	123
Bibliography .....	130
Appendices .....	149

## **Introduction**

Today obesity is a more widespread phenomenon than ever before, in recent decades having become a major public health problem and still increasing at an exponential rate. This increase can be attributed to genetic (Lee, Cardel & Donahoo, 2000), biological and environmental [2], as well as psychological factors and the inappropriate eating behaviors involved. Due to these multiple causes, obesity has become one of the greatest challenges of the 21st century [3,4].

It is precisely for this reason, understanding the complexity of the obesity phenomenon, that we deemed it necessary to join the sustained efforts, to accompany or complement the medical interventions on obesity with psychological interventions [5,6] that support the individual's psycho-emotional well-being [7], which ultimately acts as a fertile ground for better weight management.

The major objective of this work was to design, apply and evaluate the impact of an intervention using Cognitive Behavioral Therapy (CBT) and hypnosis techniques for weight management (CBTH - WM). The motivation of the topic is also anchored in the fact that, although they are being addressed in a broad manner and their usefulness is being recognized, psychological treatments that are addressing obesity [8] remain still open to the discovery of new approaches and solutions that may bring us closer to solving this health problem.

The practical and original aspects of the research converge towards the introduction of CBT techniques [9], along with hypnosis, as an adjuvant [10], as they have the potential to improve the effectiveness of the applied intervention [11]. We also mention some studies related to the main research aim (i.e. the validation of a psychometric instrument on the Romanian population and the investigation of some correlations and mediation effects on the main psychological variables studied), as well as some measurements of several brain parameters, using fNIRS technology Functional Near-Infrared Spectroscopy - with the MENDI device) [12] and EEG technology (with the MUSE device).

The favorable results obtained constitute a motivation to continue research in new directions, such as the development of standardized and replicable interventions that can also be used for preventive purposes.

## **I. General part**

### **Chapter 1 theoretical framework on obesity, etiology and implications**

Obesity can be broadly defined as excess body mass and body fat [13], i.e. abnormal or excessive accumulations of fat or adipose tissue which can affect health, and these are mainly identified by an increase in body mass index (BMI), which is a simple weight index calculated by dividing weight (in kilograms) by height squared (in meters). Thus, in the medical sense, according to these criteria, a person is classified as overweight at a BMI value in the range of 25 - 29.9 kg/m<sup>2</sup> and obese if they have a BMI that exceeds 30 kg/m<sup>2</sup> [14].

Obesity is also defined by some authors as an "increased level of body weight" beyond the limits of physical requirements, an "excessive accumulation of triacylglycerols in adipose tissue" as a result of excessive energy intake compared to energy expenditure [15] and a "condition of increased adipose tissue mass" that becomes excessive, damaging health [16,17]. On the other hand, obesity can also be viewed as a metabolic disease [18] and a "chronic, recurrent and progressive disease as well as a public health problem" that in the long term contributes to cardiovascular risk factors such as dyslipidemia, type 2 diabetes, sleep problems, hypertension, etc. [19].

The most common cause of weight gain and obesity is primarily the consumption of foods with high caloric density, rich in sugars and fats combined with sedentary lifestyles [20],

genetic [1], environmental [21], epigenetic [22–24], hormonal [25] behavioral, psycho-emotional [26], developmental factors and so on are also involved, therefore in the current understanding of the causes of obesity, the focus should be on a multifactorial framework of etiologies [27].

In order to prevent and properly treat overweight and obesity, a multidisciplinary approach is needed [28]. Some of the main interventions in obesity management are: lifestyle, nutritional selection, caloric restriction and exercise; pharmacological treatment, bariatric surgery and psychological treatment: cognitive behavioral therapies (CBT); hypnosis; food inhibition training (FIT), etc. [29].

## **2. Psychological factors associated with obesity; cbt and hypnosis in body weight management**

Given the fact that the extreme prevalence of obesity is largely attributed to an inappropriate eating pattern compared to maintaining a normal weight status, many studies have aimed to understand its psychological causes and develop interventions to address it.

Taking into account results of research and meta-analyses conducted in the field [30,31], we observe that there are a number of psychological factors that contribute to the development and maintenance of obesity and may influence eating behaviors, including depression, anxiety and psychosocial stress. These factors can often be recognized as predisposing factors of obesity but also as psychological consequences of obesity, being in a bidirectional relationship with the latter [5,32,33]. People with obesity and people who are overweight are more likely to report low self-esteem, body image disorder, decreased quality of life, food addiction, stress-related disorders, mood disorders[6,34] and disorders in emotional processing [35].

Another aspect worth considering are the personality traits of an individual, that are thought to influence body weight through various disordered eating behaviors that contribute to obesity [36]. The Big Five Model postulates that an individual's personality can be described by five broad domains (Neuroticism, Extraversion, Openness to Experience, Agreeableness and Conscientiousness). There is a growing interest for studies[24,37,38] trying to elucidate the relationships that may exist between emotional eating, cognitive restraint and uncontrolled eating as factors of eating behavior and how these might mediate the relationship between personality traits and BMI.

Cognitive behavioral therapy (CBT) is an intervention method that combines standard obesity procedures (monitoring, goal setting, stimulus control, etc.) with a set of cognitive strategies and procedures, leading to healthy weight loss and optimal weight maintenance by addressing the key mechanisms that influence obesity [39,40].

Hypnosis is a psychological approach, a method of intervention based on two stages: induction, in which the participant is guided to achieve a state of relaxed focus and attention, and suggestion – as a basis for a wide range of improved experiences and behaviors compelling from a subjective perspective [41]. We exemplify some of the studies on the role of hypnosis in obesity reduction: a study that involved monitoring leptin, adiponectin (ADP) and irisin levels showed that after 10 weeks of intervention, there was a decrease in BMI and serum leptin levels and an increase in ADP levels, concluding that hypnotherapy works, it is easy to apply, and does not have potential side effects; in another study, as a result of the suggestions received, hypnotherapy subjects started to have increased physical activity and eating behaviors appropriate to a healthy and balanced lifestyle [9]; in another recent study [42], conducted on 82 participants with the aim to observe the adjuvant effects of hypnosis and self-hypnosis, it was found that after eight hypnosis sessions, in addition to weight loss, by combining hypnosis and self-hypnosis with nutrition education, the study participants improved their self-esteem, acquiring better coping strategies.

## **II. Personal contributions**

### **3. Working hypothesis and general objectives**

In this research, we set out to investigate the potential of a psychological intervention method based on CBT and hypnosis for body weight management (CBTH-WM). The intervention aimed to reduce body weight (BMI) and improve the psychological factors involved in body weight management.

To accomplish this aim, the research included 4 studies presented below.

1) Study 1 - Translation and adaptation of the Three-Factor Eating Questionnaire (TFEQ) to the Romanian population.

It was based on the need to introduce in the present research a psychometric measuring instrument that would fit the investigation and the formulated hypotheses.

2) Study 2 - The mediating effect of behavioral factors in the relationship between personality traits and Body Mass Index (BMI).

The objectives of this study were to investigate the possible correlations between certain personality traits (neuroticism, conscientiousness as well as self-esteem) and BMI, and also to investigate the mediating role that eating behaviors (emotional eating, cognitive restriction and uncontrolled eating) might have between personality traits and BMI.

3) Study 3 – The main goal of the research was the evaluation of the results of a psychological intervention combining cognitive behavioral therapy techniques and hypnosis for weight management (CBTH-WM), and emphasized its practical and innovative aspects.

The study intended to investigate the efficacy of the CBTH-WM intervention in reducing BMI and improving the psychological factors that may be involved in body weight management. The specific objectives of the study were to develop the design of the CBTH-WM intervention, its application in the chosen format, and to evaluate the impact of the intervention through pre- and post-intervention measurements.

4) Study 4 - Evaluation of the effects of the CBTH-WM intervention at pre- and post-intervention neuroelectrophysiologic level. Discussion and correlation with results obtained by psychometric tests. The purpose of the study was to perform brain level measurements using fNIRS (Functional Near-Infrared Spectroscopy, with the MENDI device) and EEG (with the MUSE device) technology at T1 and T2, in order to evaluate the effects of the intervention, in terms of changes at brain level. Also, at T2 we wanted to observe and measure, at brain level, the effects of the administration of a stimulus - 5 minutes of relaxation suggestions (through EEG measurements - MUSE Headband), in order to highlight the potential of hypnosis techniques to produce changes in the psycho-emotional status of the individual.

#### **4. Study 1 - Translation and adaptation of the Three-Factor Eating Questionnaire (TFEQ)/TFCA for the Romanian population**

In this study, we adapted and validated the Romanian version of the Three-Factor Eating Questionnaire (TFEQ) [43].

##### **The specific objectives were:**

1. The analysis of the factor structure of the instrument

2. The analysis of the internal consistency of the instrument
3. The analysis of convergent validity
4. The analysis of criterion validity

#### **Assumptions**

1. The Romanian language version of the TFEQ items will replicate the 3-factor structure of the instrument.
2. The internal consistency of the 3 scales will be at least acceptable (Cronbach's alpha above 0.7).
3. In terms of convergent validity, we expect the emotional eating and uncontrolled eating scales to correlate with the bulimia scale of the EDI 3.
4. Regarding criterion validity, we expect the 3 scales to correlate with the BMI level.

**Participants:** 206 participants with a mean age of 49.15 (89% female; 11% male). In terms of BMI, participants were distributed as follows: 27.2% of participants had normal BMI; 28.2% were overweight; 26.2% had Class 1 obesity; 9.2% had Class 2 obesity; 9.2% had severe obesity.

#### **Instruments:**

- 3-factor eating questionnaire (TFEQ) [43]
- EDI 3, Bulimia Scale [44]
- BMI (body mass index)

#### **Procedure**

The data were collected online via a Google form. All participants were informed that participation in the study was voluntary and that they could withdraw at any time. Participants were also informed that all data collected would be kept confidential and would be used for research purposes only (i.e. a series of general statistical trends rather than individual results). After the information was presented, participants were asked to give their consent to participate in the study.

## **Results**



The results showed that the instrument has interitem reliability (measured by Cronbach's alpha internal consistency coefficient) above the threshold of 0.7 for all three dimensions. The results regarding fidelity are positive and similar to those obtained by previous studies [45,46].

Regarding the factor structure, the results showed that the 3-factor model (with 21 items) was the best fit for the data. Moreover, the high correlations between the dimensions of uncontrolled and emotional eating on the one hand and bulimia on the other hand provided evidence of the construct validity. Regarding criterion validity, the dimensions of uncontrolled eating and emotional eating correlated with the BMI level, whereas cognitive restriction did not.

The study showed that the 3-factor Eating Questionnaire had increased levels of fidelity and validity for the Romanian population, and so it can be considered a faithful, valid and relevant instrument for investigating eating behaviors in future studies.

## **5. Study 2 - The mediating effect of eating behavior factors in the relationship between personality traits and Body Mass Index (BMI)**

The main objectives were:

- To investigate the possible correlations between certain personality traits (as conceptualized in the Big Five model) and self-esteem on the one hand and BMI on the other hand;
- investigating the role played by eating behavior factors on BMI and the potential mediating role that these eating behaviors (emotional eating, uncontrolled eating and cognitive restraint) might play between personality traits and BMI.

The study started from the premises that there are relationships between personality traits (including the variable low self-esteem) and BMI. Previous research has supported that personality traits in the Five Factor Model, as well as self-esteem, can influence eating behavior and BMI, and that certain traits may be either protective against, or risk factors, for overweight and obesity [47].

### **We advanced the following hypotheses:**

- the relationship between neuroticism and BMI will be mediated by emotional eating, uncontrolled eating and cognitive restriction;
- the relationship between conscientiousness and BMI will be mediated by emotional eating, uncontrolled eating and cognitive restriction;

- the relationship between low self-esteem and BMI will be mediated by emotional eating, uncontrolled eating and cognitive restraint.

### **Material and method**

In conducting the study, all data were collected online via Google Forms in the period June-July 2023. Participants were informed that participation in the study was voluntary and they could withdraw from the study at any time. They were also informed about the confidentiality of their responses and the use of their responses strictly for research purposes, after which they were asked to give their consent to participate in the study. In exchange for taking part in the study, participants received a personality profile report (based on scores on the 5 traits).

### **Participants**

The study included 166 participants (12% male), aged 19 to 70 years ( $m = 49.81$ ; standard deviation = 9.08). Of the 166 participants, 83 (50%) were obese, 53 (31.9%) were overweight and 30 (18.1) had a normal BMI. The sample was a convenience sample, selected from the general population of people, without mental disorders.

### **Instruments used**

**EDI 3.** To measure self-esteem, we used the EDI 3 (Eating Disorder Inventory) instrument [44], i.e. the 6 items corresponding to the scale - Low Self-Esteem, which has good internal consistency, Cronbach's alpha = 0.850. EDI 3 has good psychometric properties in a wide variety of populations [44,48].

**Three-factor eating questionnaire (TFEQ)** We used the Three-Factor Eating Questionnaire instrument [43,45]. In the study, the Cronbach's alpha coefficient value for the uncontrolled eating scale was very good (0.892), emotional eating had an excellent Cronbach's alpha value (0.953), and the cognitive restriction scale had an acceptable value (0.729).

### **Personality**

To measure personality traits, we used 50 items that measure the 5 dimensions (agreeableness, conscientiousness, neuroticism, openness to experience and extraversion) from the International Item Set [49]. The items used are measured on a scale from 1 to 5. The Cronbach's alpha coefficient values are 0.873 for Extraversion, 0.867 for Agreeableness, 0.842 for Conscientiousness, 0.905 for Neuroticism and 0.832 for Openness to Experience. Thus, we can conclude that the instrument has very good fidelity.

**The BMI** was calculated from the self-reported weight and height of the study participants.

### **Statistical analysis**

In order to analyze the relationships between personality traits on the one hand and eating behavior variables on the other hand, we performed a simple correlation analysis and a hierarchical regression analysis, in which we included control variables in the first block (age, gender) and personality traits (extraversion, conscientiousness, openness to experience, neuroticism, agreeableness and self-esteem) in the second block, the dependent variable being BMI. Next, we were interested in testing the extent to which the 3 factors (emotional eating, uncontrolled eating and cognitive restraint) mediate the relationship between personality traits (the 5 factors and self-esteem) and BMI. For this we used the Hayes Process application [50].

### **Results**

We could observe that the 6 personality traits investigated correlated weakly and statistically insignificantly with BMI, the highest correlation being between conscientiousness and BMI ( $r=-0.14$ ,  $p>0.05$ ), and the lowest being between openness to experience and BMI ( $r=0.004$ ,  $p>0.05$ ). Emotional eating correlated strongly with BMI ( $r=0.449$ ,  $p<0.449$ ,  $p<0.01$ ), and uncontrolled eating correlated moderately to strongly with BMI ( $r=0.367$ ,  $p<0.01$ ), while cognitive restraint correlated weakly and insignificantly with BMI ( $r=0.136$ ,  $p>0.05$ ). Emotional eating and uncontrolled eating showed the same correlation trends with personality traits, both correlated statistically significantly with low self-esteem, conscientiousness and neuroticism.

In terms of the relationship between the three factors of the TFEQ, emotional and uncontrolled eating correlated very strongly ( $r=0.768$ ,  $p<0.01$ ). The correlation between cognitive restraint and emotional eating was moderate ( $r=0.296$ ,  $p<0.01$ ), as was the relationship between cognitive restraint and uncontrolled eating ( $r=0.270$ ,  $p<0.01$ ).

The regression analysis allowed us to estimate the total variance of BMI explained by personality traits as well as the unique association between each personality trait and BMI. The model explains a small variance in BMI, about 6%, and the standardized regression coefficients for all personality traits have statistically insignificant values, which shows that the 6 personality traits are not directly associated with BMI.

Emotional eating mediates the relationship between low self-esteem, conscientiousness, and neuroticism on the one hand and BMI on the other hand, and the hypotheses of mediation

by uncontrolled eating and cognitive restraint were not supported by the data. In mediating relationships in which each mediator was entered separately into the analysis (this allowed the investigation of each mediating effect, ignoring the other mediators), emotional eating mediated the relationship between the 3 personality traits and BMI but uncontrolled eating mediated all 3 relationships. A very likely explanation for this result is that the two constructs correlate very strong [50]. Cognitive restraint does not mediate these relationships. Concerning the relationships between the other personality traits (openness to experience, agreeableness and extraversion) and BMI, although we did not advance hypotheses in this regard, we performed the same analyses and did not obtain any statistically significant mediation.

In conclusion, our results showed that:

1. Both correlational and hierarchical regression analyses show that the 6 personality traits are not directly associated with BMI, partially confirming the results of previous studies.
2. Emotional eating is a mediator in the relationship between low self-esteem, conscientiousness and emotional stability on the one hand and BMI on the other hand.
3. Uncontrolled eating is a mediator in the relationship between low self-esteem, conscientiousness and emotional stability on the one hand and BMI on the other hand only when each mediator is tested separately.
4. Cognitive restriction does not mediate relationships between personality traits and BMI.
5. Emotional eating is an important mechanism in the relationship between personality traits and BMI, and psychological interventions should target these behaviors.

## **6. The effects of CBTH-WM on psychological factors and BMI in overweight and primary obese adults**

### **Study 3 - Evaluation of the results of an intervention combining CBT techniques and hypnosis (CBTH-WM) in the treatment of obesity**

In this study we aimed to investigate the effectiveness of a psychological intervention, developed by combining and applying Cognitive Behavioral Therapy (CBT) and Hypnosis

techniques - CBT-Hypnosis - on BMI reduction and improvement of the psychological factors that may be involved in body weight management.

In the study, we referred to primary obesity, associated with unbalanced, overeating eating behaviors (not secondary obesity, caused by the presence of specific medical conditions or the administration of drugs with effects on body weight).

**The specific hypotheses** of the study were:

- The CBTH-WM intervention will lead to a decrease in BMI
- The CBTH-WM intervention will lead to decreased scores on the following dimensions: Depression, Anxiety, Stress (DASS-21R)
- The CBTH-WM intervention will lead to decreased scores for the following dimensions: Emotional Eating, Uncontrolled Eating, Cognitive Restriction (TFEQ)
- CBTH-WM intervention will lead to decreased scores for the dimension Low Self-Esteem (EDI 3).
- The recorded results will be maintained over the 6-month period, at which time the psychometric measurements will be taken, at T3 or follow-up.

We considered it important for the development of an effective intervention to start by clarifying a theoretical model which, in our perspective, encompasses the theories and principles that explain the functioning of the two methods included in the research, CBT and hypnosis, in relation to the psychological mechanisms involved in obesity (i.e. the emotions and cognitions of a person, which play a role in maintaining, losing or regaining an optimal body weight).

The theoretical model that we propose is based on the synthesis of the following 3 models:

1. **The bio-psycho-behavioral model** of the complex mechanisms of homeostatic energy regulation of the organism. Under optimal conditions, the organism regulates its energy balance and achieves neural control of appetite by monitoring both the internal environment (by analyzing the hormonal and neural systems of nutrient sensing, through what can be called the "metabolic brain") and the external environment, through the senses and their interpretations, through what can be called the "cognitive brain and the emotional brain" [51]. When the effects of these pathways become unbalanced, and the body's homeostatic needs are over-suppressed by the cognitive and/or emotional brain, the cognitive and emotional signals are prioritized, leading to the ignoring of endocrine/autonomic processes (this is recognized as the hedonic neural pathway, which in turn will lead to "hedonic obesity") [52].

2. **The cognitive-experiential theory or dual process theory** (rational system and experiential system) of Epstein [53] and Daniel Kahneman [54], a Nobel Prize winner in economics, who proposes the model known as System 1 and System 2.

The rational, (or analytic/deliberative) system is characterized by logical and analytical processing, operates on deductive reasoning, is slow and deliberate in its operation (requiring significant time and cognitive effort), involves awareness and control, and minimal emotional involvement. The experiential system, also known as the intuitive or automatic system, involves associative and intuitive processing (based on learned associations and patterns/patterns), is fast and automatic in operation (processes information quickly without conscious effort), encodes experience into images and feelings (in non-verbal forms, images, metaphors and narratives), is emotionally oriented (closely related to emotional and affective experiences) and involves learning from experience (builds on past experiences) [53]. The two theories overlap to a large extent, Epstein's experiential system corresponds to Kahneman's system 1, while the rational system corresponds to Kahneman's system 2.

3. **CBT techniques** allow for understanding, awareness and implementation of changes in cognitions, thoughts and behaviors, respectively, including to a greater extent (than hypnosis) techniques suitable for system 2/rational. **Hypnosis** includes techniques with predominantly experiential processing, involving imagination, emotions, metaphors and effortless, automatic processing, specific to the experiential system/system 1. There are studies that explain the complex effects of hypnosis precisely by facilitating the shift from deliberate to experiential processing, as hypnotic suggestions can be experienced as real, internalized and implemented without excessive interference from the rational system, and produce an authentic response and significant changes in perception, memory and behavior [55].

Given that a significant part of the interactive neural processing between the two types of pathways (homeostatic and hedonic), takes place outside the zone of awareness, and that maintaining optimal eating behaviors by willful and cognitive restraint can be extremely difficult [56] as it can be observed in the case of primary obesity, as well as taking into account the characteristics of the two types of therapeutic methods and the two types of processing, respectively, corroborating all these elements, we obtain what we can call **a conceptual theoretical model**, on which we based the construction of the intervention.

We propose this model as a possible explanation for the increased efficiency obtained by combining the two methods, due to operating changes in both types of processing, producing thus synergistic effects.

The intervention that we applied aimed to support the regulation of the mechanisms involved in eating behavior, reducing the impact of the hedonic neural pathway, through techniques such as cognitive restructuring, re-learning or, in other words, "reconditioning" the reward systems conditioned in relation to food, obtaining a stable emotional background, and increasing positive emotions (calm, relaxation, self-confidence and self-esteem, etc.).

### **Material and method**

The research represents the construction, application and evaluation of the outcomes of the CBTH-WM intervention to reduce BMI and improve scores of behavioral and psycho-emotional variables in the intervention group.

#### **Participants**

Participants were recruited via online communication, and screened based on inclusion/exclusion criteria and signing the informed consent. The number of participants was 50 for the intervention group and 60 for the control group. The intervention group consisted of 46 (92%) females and 4 (8%) males, and the control group of 48 (80 %) females and 12 (20%) males. In terms of BMI, in the intervention group, 34 people had a BMI greater than 30 (68%) - i.e. varying degrees of obesity, and 16 (32%) had a BMI between 25 and 30 - i.e. overweight. In the control group we had the following distribution - 20 people with a BMI below 25 (33,3%), 20 with a BMI between 25 and 30 (33,3%), and also 20 people with a BMI above 30 (33,3%).

**Inclusion criteria:** obesity of a primary nature, BMI greater than or equal to 26; absence of specific etiologic conditions; age between 20-70 years; willingness and interest for sustained, weekly, minimum 12-week intervention; informed consent from subjects.

**Exclusion criteria:** the existence of tumor diseases or serious chronic diseases, the administration of drugs with side effects on body weight; serious psychological disorders or psychiatric disorders, psychoses; the presence of obesity from secondary causes, such as - genetic, endocrine, drug related.

The research was conducted, via an online platform designed for courses, meetings and events, while the actual stage of implementation of the CBTH - WM intervention protocol involved a period of 3 months (June 2023 - September 2023).

The design of this study was quasi-experimental. The protocol consisted of 12 online sessions, one per week, each lasting approximately 90 minutes, in mixed group (predominantly - 11 sessions) and individual (1 session) formats. Participants in the intervention group were divided into two equal groups of 25 participants each, based on their personal choice of the day of the week when they could participate during the program, over the 12 sessions. Participants in the control group were provided with psycho-education and free access to informational materials.

### **Instruments used**

**The BMI** was calculated from the self-reported weight and height of the study participants - the ratio of weight and height squared (kg/cm<sup>2</sup>).

### **Psychometric tests:**

**DASS-21R** - The DASS-21R questionnaire (purchased under license from S.C.Cognitrom), is, as stated in the user manual, an instrument for the assessment of negative emotional states of depression, anxiety and stress. DASS-21R contains 21 questions and represents the adapted and standardized version of the instrument for the Romanian population.

**The TFEQ** - Three-Factor Eating Questionnaire assesses three key aspects of eating behavior: emotional eating, uncontrolled eating and cognitive restraint [43,45].

### **EDI 3 (Eating Disorder Inventory)**

The EDI 3 (Eating Disorder Inventory) [44], purchased under license from Cognitrom S.C.Cognitrom, is a self-report instrument consisting of 12 scales measuring psychologically relevant constructs for eating disorders. **Low Self-Esteem (EDI 3)** - To measure low self-esteem we used the related subscale of EDI 3, with the corresponding 6 items. This measures the primary self-concept in negative terms. **Bulimia Scale (EDI 3)** - This scale (8 items) assesses a person's tendency to think about and engage in uncontrolled eating episodes compulsively and in response to upset. **Emotional Imbalance Scale** - The 8 items of the scale describe the tendency towards mood instability, impulsivity, recklessness and self-destructive behaviors and the **Interceptive Deficits Scale** - composed of 9 items that measure the difficulties in adequately recognizing the emotional states experienced, and the distress experienced when experiencing very intense, uncontrolled emotions.

**Personality** - To measure personality traits, we used 50 items that measure the 5 dimensions (agreeableness, conscientiousness, neuroticism, openness to experience and



extraversion) from the International Item Set [49,57]. The items used are measured on a scale from 1 to 5, and the instrument has been tested and has a very good fidelity.

### **Protocol - CBT and Hypnosis Intervention / CBTH – WM**

The intervention was conducted online, with a frequency of one meeting per week.

In addition to hetero hypnosis techniques (hypnosis applied by the hypnotherapist to another person), the protocol also included training participants in the use of simple self-hypnosis techniques (self-administered hypnosis) and the use of audio recordings, with the aim of deepening the strategies and changes introduced. Participants were instructed to practice self-hypnosis sessions individually, both during the intervention and after the completion of the assisted intervention. The homework consisted in the instruction to practice self-hypnosis at least twice a day (in the morning and evening) together with the scenario or suggestions given in the related steps, based on the audio recordings.

For informational purposes, we mention only a few aspects covered in the sessions:

- Psychoeducation elements, creating a setting for group work, introduction of techniques and principles. By introducing information about hypnosis positive expectations were aroused in the participants. There are studies that show, for example, that the use of the words - hypnosis, hypnotherapy, etc., in other words, the "label" hypnosis, can lead to an improvement in the subjects' responses to the techniques applied [58].

- The hypnosis sessions primarily involved the application of hypnotic induction techniques (several variations were used, emphasizing the escalating effect of the process with each repetition and with a new induction formula used). Hypnotic induction is the first step in the hypnosis process (focusing on an object/point, deep breathing, counting, relaxation and imagery of an ideal place, etc.), aiming to prepare the person for the subsequent process by increasing their ability or tendency to respond to suggestions [59], facilitating a state of deep relaxation and concentration. Process deepening techniques were also used to deepen the state of hypnosis, receptivity to the suggestions received and stimulate automatic, effortless processing (as per system 1 & experiential).

- Direct suggestions, which were repeated throughout the intervention. Example: 'I eat as much as I need, when I need it and what I need; I easily choose the right foods for me, in the right amounts...!'

- Identification of individual goals, the requirement for (daily) self-monitoring of food

consumed, emotional states associated with meals, frequency of eating instances in the absence of hunger or frequency of overeating episodes, intrinsic motivation techniques, increasing motivation.

- Hypnosis and self-hypnosis techniques to change self-perception and self-image (visualization of optimal image and weight), hypnotic script aimed at reestablishing positive and conscious connection to the act of eating, i.e. - "Eating as an art" and recognizing the importance of accurate hunger sensations (adapted from [60]), conscious eating, creating new habits (less food on the plate so you don't feel "compelled" to finish everything; putting cutlery down between bites; taking your time, noticing the feeling of satiety and fullness) changing the 'locus of control'.

- Eliciting and disputing distorted beliefs about 'diets', undoing food restriction trials and reframing eating behavior, observing and self-evaluating sensations, addressing and reinforcing self-esteem, reinforcing the 'self', cognitive reframing to increase impulse control (adapted from [61]), problem management training.

### **Results**

Within the intervention group, there were statistically significant differences between pre-intervention (T1) and post-intervention (T2) measurements as follows:

- **a statistically significant reduction in BMI;**
- **the uncontrolled eating was significantly reduced;**
- **emotional eating, which, although significantly decreased, did not reach statistical significance;**
- **an important and statistically significant decrease in depression;**
- **an important decrease in stress, very close to the significance threshold ( $p = .055$ );**
- **the low self-esteem showed an important and significant decrease between T1 and T2 (in fact an improvement in self-esteem).**

Cognitive restraint did not change to a relevant extent and we also have no significant changes in the anxiety dimension, which of the 3 DASS dimensions showed the smallest differences following the intervention. With regard to the other variables investigated, decreases were also recorded, but they did not reach the statistical significance threshold. For the control group there were no significant changes in BMI and in any of the other variables investigated.

**Table VI.1. Intervention Group T1, T2, T3 (follow-up)**

Dependent variable	Test t T1-T2 (n=50)	p	Test F (n=27)	p	Post-hoc					
					T1-T2		T1-T3		T2-T3	
					Median Differences	p	Median Differences	p	Median Differences	p
IMC	4.41	.00	8.98	.00	1.01	.00	1.69	.00	.66	.10
UE	3.83	.00	5.50	.00	2.74	.02	3.51	.00	.81	.47
EE	1.50	.13	1.13	.26	-	-	-	-	-	-
CR	1.07	.29	.64	.52	-	-	-	-	-	-
DASS-D	2.34	.02	2.16	.12	-	-	-	-	-	-
DASS-A	.78	.43	2.69	.07	-	-	-	-	-	-
DASS-S	1.96	.055	3.56	.03	2.18	.01	1.55	.06	-.63	.47
LSE	4.67	.00	12.86	.00	2.11	.00	3.66	.00	1.55	.06

Note: BMI – body mass index, UE – uncontrolled eating, EE – emotional eating, CR – cognitive restriction, DASS-D - depression, DASS-A - anxiety, DASS-S - stress, SSS – low self esteem.

Analyzing the results of the measurements carried out 6 months after the end of the intervention for the follow-up intervention group (N=27) we can observe:

- the BMI level decreased significantly from T1 to T2 and a decrease in BMI is also observed from T2 to T3, the results show the same decreasing trend, yet it is not statistically significant;

- for uncontrolled eating the post hoc tests show significant differences between T1 and T2 (p=.02), and between T1 and T3 (p=.00);

- for stress, the post-hoc tests show that the difference between T1 and T2 is statistically significant (p=.01), and the difference between T1 and T3 is close to being statistically significant (p=.06).

- The low self-esteem shows statistically significant differences between T1 and T2 and between T1 and T3 (p=.00), and a T2 and T3 difference close to being statistically significant (p=0.06);

- changes in stress and anxiety are also increasing in the decreasing direction;

- for depression, the differences remain similar to those for N=50.

We can conclude that the 27 participants who took part in all 3 measurements experienced significant decreases in BMI, uncontrolled eating, depression, stress and low self-esteem between T1 and T2 following the intervention, and these decreases were maintained at T3 or even increased in some cases (BMI and low self-esteem).

**Taken together, these results support the effectiveness of CBTH-WM in reducing BMI and improving psychological factors, as well as the trend of maintenance of these results 6 months after the end of the intervention.**

### **Discussion**

The results of the study show that the intervention had an effect in reducing BMI, with a statistically significant difference between pre-intervention and post-intervention measurements in the intervention group.

As expected, uncontrolled eating was significantly reduced, but emotional eating, although showing significant decreases, did not reach the threshold of statistical significance, while cognitive restraint did not change to a relevant extent. A possible explanation for the fact that in the present study uncontrolled eating was reduced more than the other TFEQ dimensions could be attributed to the techniques used in the intervention applied (in the intervention, emphasis was placed on awareness and analysis of eating urges in order to identify their causal background; participants were taught to distinguish between real hunger and the impulse to eat triggered by factors such as the presence of tempting foods, social contexts and unhealthy eating habits, and to eat only when they feel real, physiological hunger).

Encouragingly, we observed that even after the 6-month interval (follow-up measurement) the results for stress and anxiety were still improving (in the sense of decreasing), while for depression, the differences were similar to those of the whole intervention group. Taken as a whole, all three DASS dimensions show changes, with a decreasing trend in both depression and stress and anxiety in the 6 months following the intervention; a possible explanation for these interesting results could be related to the higher level of motivation and adherence to the program in these individuals, but we do not have explicit measures for these variables (motivation and adherence).

These results, together with the decreases in eating behaviors (uncontrolled eating and emotional eating) may be an explanation for the decrease in BMI following the intervention. As shown in previous studies [62,63], emotional and uncontrolled emotional eating may mediate between negative emotional states (such as depression) and BMI.

In terms of the 'uncontrolled eating' dimension, our food choices are often influenced by the hedonic aspects of eating, triggered by the senses, such as the pleasure of smell and taste, or simply by the feeling of well-being we experience at the moment of consumption [64], the

tendency to seek out tasty foods and consume them outside the metabolic needs curve amplifying over time.

In our intervention, we were able to achieve a significant reduction in the uncontrolled eating behavior, which in the long term may lead to a sustainable reduction in obesity. Moreover, the result was achieved not by restriction, often recognized as a predictor of overeating tendencies in response to the cognitive and volitional effort involved in the restrictive act, but by improving parameters such as depression, stress and anxiety. This improvement was in turn associated with increased self-esteem and mindfulness.

Thus, our results are consistent with the way the intervention design was conceived, aimed at producing changes in psychological factors that are known to be among the causes of obesity.

We can hypothesize that the techniques used in the intervention, aimed at changes in the psychoemotional background, such as reduction of uncontrolled and emotional eating, depression, stress and anxiety, and increased self-esteem, made it possible to reduce BMI in the explicit absence of any other intervention (diet, exercise, medication, etc.).

Another aim of our study, included in the paper, was to investigate the explanatory and predictive potential of personality traits for the effectiveness of the intervention, as well as of the other variables measured, by performing correlational and regression analyses that we have presented in detail in the discussion chapter, in order to provide as much insight as possible into the psychological mechanisms studied.

## **6.2. Neuroelectrophysiologic measurements and assessments pre and post - CBTH-WM intervention. Discussion and correlations with the results obtained by psychometric tests.**

This study aimed to perform brain level measurements by using fNIRS (Functional Near-Infrared Spectroscopy, with MENDI device) and EEG (electroencephalography - with MUSE device) technology, at T1 and T2, respectively at the beginning and the end of the CBTH - WM intervention.

### **Specific objectives:**

- to perform brain level measurements using fNIRS (Functional Near-Infrared Spectroscopy, with the MENDI device) and EEG (electroencephalography - with the MUSE

device) technology at T1 and T2 of the intervention and to investigate the differences between the scores at the two times, in terms of changes at brain level;

- to correlate the scores of the psychological variables obtained from the psychometric measurements with those obtained by using the above-mentioned technologies; to investigate how the psychological factors measured pre- and post-intervention can be associated with the changes at the brain level.

Also, at the time of T2 measurements we wanted to observe and measure the effects at brain level of the administration of a short hypnotic induction protocol - 5 minutes of relaxation suggestions and attention orientation to the inner forum (by EEG - MUSE Headband), in order to reflect the potential of hypnosis techniques, respectively relaxation suggestions specific to hypnotic induction, to produce changes in the psychoemotional status of the individual.

**Hypotheses:**

1. We expect the parameter "neuronal activity" measured with Mendi to show changes from T1 to T2

2. We expect the Muse measured parameters (respiratory harmony, mental calm and heart rate) to show changes from T1 to T2.

3. We expect the neural activity parameter (Mendi) to correlate with uncontrolled eating and DASS dimensions (depression, anxiety and stress).

4. We expect that the measured Muse parameters (respiratory harmony, mental calm and heart rate) will correlate with the DASS dimensions (depression, anxiety and stress).

5. We expect the Muse measured parameters (respiratory harmony, mental calmness and heart rate) to show changes before and after administration of hypnotic suggestions.

The use of brain imaging technologies such as EEG and fMRI has long been standard practice in the field of psychiatry to support, confirm and validate psychiatric diagnoses. These methods allow a detailed understanding of brain activity and its correlations with various mental disorders. Over the last decades, however, these tools have also begun to be explored in the context of psychological interventions, opening new directions for the investigation and validation of psychological traits and constructs.

In the present study, we relied on the use of two such, namely Mendi (fNIRS) and MUSE (EEG) to investigate the changes in brain activity that may be associated with the CBTH-WM intervention, which had the right goal and outcomes respectively, the reduction of BMI,

depression, stress, anxiety and the improvement of self-esteem, as well as the reduction of uncontrolled and emotional eating.

The combined use of fNIRS and EEG may offer particular advantages in studying brain activity, with fNIRS having a better spatial resolution and being less sensitive to motion artifacts compared to EEG, while EEG offers a superior temporal resolution [65].

### Material and method

This study, for objective reasons (the difficulty of organizing the measurement sessions involved) was carried out with a secondary, small sample, i.e. - 22 people from the 50 people in the CBTH-WM intervention group (study no. 3). The study was carried out on the basis of a research collaboration agreement between UMF Carol Davila and the University of Bucharest, Faculty of Psychology and Educational Sciences (UB, FPES), drawing on the support provided by UB, FPES, through the collaboration offered by a UB, FPES lecturer and psychologist specialist, regarding the realization of the two sessions of electroencephalographic data recording and also by providing the material means, namely the two devices used.

The procedure entailed the recording of electroencephalographic data at T1 and T2 (pre-CBTH-WM intervention) and T2 (post-CBTH-WM intervention), using the two devices successively, during the same sessions, at 5-minute intervals, based on a protocol explained in the paper.

### Results

**Table VI.21. - Descriptive statistics brain measurements with Mendi**

	<b>T1</b>	<b>T2</b>
<b>Neuronal Activity</b>	19.18 (9.83)	14.86 (5.50)
<b>Control</b>	17.00 (5.54)	18.68 (9.18)
<b>Resilience</b>	1429.95 (1004.20)	1205.54 (604.07)

Note: first values represent the arithmetic means, and the values in parentheses the standard deviations T1 – measurement before intervention TCCH - MG, T2 – measurement after intervention

**Table VI.22 Descriptive statistics brain measurements with Muse**

	<b>T1</b>	<b>T2</b>	<b>T2 (hipnoză)</b>
<b>Breathing harmony</b>	4.90 (9.26)	23.31 (16.80)	41.36 (19.85)
<b>Mental Calm</b>	47.95 (6.47)	48.81 (10.59)	60.09 (10.29)

<b>Heart Rate</b>	78.72 (13.37)	76.81 (10.10)	75.27 (10.34)
-------------------	---------------	---------------	---------------

Note: the first values represent the arithmetic means, and the values in parentheses the standard deviations T1 – measurement before intervention TCCH - MG, T2- measurement after intervention, T2 (hypnosis) – measurement after hypnosis

*Paired sample t tests - Mendi and Muse*

**Table VI.23. Paired sample t tests (T1 și T2) Mendi**

<b>Variable</b>	<b>Pearson Correlation</b>	<b>Diference between means</b>	<b>T test</b>	<b>p</b>
<b>Neuronal Activity</b>	<b>.611</b>	<b>4.31</b>	<b>2.59</b>	<b>.01</b>
<b>Control</b>	-.059	-1.68	-.71	.48
<b>Rezilience</b>	.640	224.40	1.36	.18

**Table VI.24. - Paired-samples t-tests T1-T2 Muse measurements**

<b>Variabile</b>	<b>Pearson Correlation</b>	<b>Diference between means</b>	<b>Test t</b>	<b>p</b>
<b>Breathing Harmony</b>	.470	-18.40	-5.79	.00
<b>Mental Calm</b>	<b>.357</b>	<b>-.86</b>	<b>-.39</b>	<b>.24</b>
<b>Hear Rate</b>	.861	1.90	1.29	.21

We also performed correlational analyses between the Mendi and Muse measures, on the one hand, and the psychological measures, the DASS 21 and the TFEQ questionnaire (to see whether the differences (improvements) observed in negative affectivity and eating behavior can be explained by the differences observed in the brain measures).

Next, we performed paired-samples t-tests for differences in Muse measures before and after hypnosis.

The first hypothesis, namely that neuronal activity (measured with the Mendi instrument) showed significant changes from T1 to T2. What we know from the presentation of the instrument is that it measures neuronal activation in the Brodmann area (BA10), without providing us with specific information and data about neuronal activity in the left versus right hemisphere, which may limit the accuracy of our interpretations and discussions of these results.

The results show a significant decrease ( $p=0.01$ ) in neuronal activity in the pre-intervention - post-intervention interval, in parallel with the decrease in the control and resilience parameters. As an explanation, we suggest that after the combined CBTH-WM intervention, there was a significant decrease in neuronal activity in the BA10 area compared to that recorded at T1 during the application of an identical cognitive task, through an increased



cognitive and emotional efficiency. We can take into account that when neuronal activity decreases in a specific region, this may indicate that the same amount of resources is no longer required to fulfill the task, suggesting a better performance of the respective processes.

The improvements in the EEG wave profile that we see illustrated in the Muse measurements (which appear to show indicators of increased parasympathetic activity and may be associated with a heightened alpha and theta wave profile typical of relaxed states), together with the relaxation and emotional balance illustrated by changes in psychological variables, strongly suggest that the post-intervention measurements reflect a reduction in stress and improved emotional regulation.

In terms of the differences in the Muse measures before and after hypnosis, it can be observed that all 3 investigated dimensions had statistically significant changes.

These results were recorded with some surprise, in the sense that they overcame the limitations regarding the variability of the indicators and the small sample size. They illustrate, within the limits of an experimental design limited in possibilities, the potential effects of hypnotic procedures and techniques, effects on which we have also relied in the construction of the intervention applied in study 3.

The results obtained suggest an increased cognitive efficiency and a better emotional regulation. Of course, responsibility for these results will be taken with a degree of caution, as the interpretation of results and correlations in small samples may be difficult to generalize or validate.

## **CHAPTER 7. General conclusions and personal contributions**

The first two studies conducted achieved their objectives and served as instrumental (validation of the TFEQ questionnaire) and informative support (correlations and averages of the measured psychological variables) for the research conducted in study 3.

In regards to the CBTH-WM intervention, within the intervention group, the most important results (statistically significant differences between pre-intervention (T1) and post-intervention (T2) measurements) were as follows:

- **a statistically significant reduction in BMI;**
- **uncontrolled eating was significantly reduced;**

- **emotional eating, which, although significantly decreased** (did not reach statistical significance)

- **an important and statistically significant decrease in depression;**

- **an important decrease in stress**, very close to the significance threshold ( $p = .055$ );

- **low self-esteem showed an important and statistically significant decrease between T1 and T2** (thus an improvement in self-esteem)

**Taken together, these results support the effectiveness of CBTH-WM in reducing BMI and improving psychological factors, as well as the trend of maintenance of these results 6 months after the end of the intervention.**

### **Personal contributions**

We briefly mention the following contributions:

- Validation of the TFEQ instrument, which can be used for future studies in the form translated and validated in this study. The adequate translation of the questionnaire was achieved by the translation and back-translation method, so that the items are easy to understand and retain the original meaning of the English version. The questionnaire is easy to administer and distinguishes well between different eating behaviors (Chap.4, subchap. 4.3, pg. 38).

- a contribution to our understanding of the mechanisms by which personality influences body weight, investigating the correlations between personality traits and eating behaviors, and suggesting a mediation model showing that the two types of eating behaviors influence BMI (Chap. 5, subchapter 5.3, pg. 50).

- One of the most important personal contributions of the research is (in Chapter 6) the design of the TCCH - MG intervention, based on the selection, adaptation and organization of CBT and hypnosis techniques, resulting in an intervention protocol that proved effective in reducing BMI, decreasing uncontrolled and emotional eating, depression and stress, and improving self-esteem (Protocol, pg. 65-75).

- a personal and original contribution is also the elaboration of a conceptual theoretical model linking, on the one hand, the causes (the "hedonic" and "homeostatic" neural pathways) involved in obesity and, on the other hand, the mechanisms of effective functioning of CBT and hypnosis based on important theories in the field (Chapter 6, pg. 57-60).

- The inclusion of hypnosis and self-hypnosis techniques alongside CBT (augmenting it), which also brings forward an element of originality, as there is little integrative research investigating the adjuvant potential of hypnosis at national level. (Chap. 6, Protocol, pg. 65-75).

- Another contribution is the adoption of the predominantly group format of the intervention, which entails a number of advantages, among which we mention - increased emulation and motivation for change, specific to a group work climate (we mention here as a positive effect the fact that at the end of the intervention, everyone in the intervention group participated in the T2 measurements, compared to a significant drop-out in the control group); the decrease, through this type of format, of the efforts and costs involved in the intervention; it facilitates the implementation of interventions on a larger scale and allows the observation of general trends and common mechanisms among participants; the possibility of adapting a similar protocol for the overweight and obesity prevention stages. (Cap.6, Protocol, pg. 65-75)

- maintenance of the intervention results, and even a tendency for some of them to become more pronounced 6 months after the end of the intervention (Subchapter 6.1.3, pp. 90, table VI.9.)

- we also mention the introduction of the study on investigations of brain functions and changes in neuronal and physiological levels following the intervention, using cost-effective imaging technologies, characterized by great ease and addressability in research. Here we also mention the contribution of the research on the potential of hypnotherapy techniques to produce measurable effects in terms of bio-psycho-emotional states (Subcap.6.2.3., pg.110-115).

Among the limitations encountered in the research approach, we mention that the two groups (intervention and control), for pragmatic reasons, independent of our research intention, were not formed by randomization, and there are some slight asymmetries between the two (this limitation was however addressed in the study by conducting additional analyses, designed to exclude the possibility that the results were justified by these differences). Also, the sample used is a convenience sample, part of a non-clinical population, and the sample size is not very large, which may affect the statistical power of the research.

Another limitation is the predominance of females in the research sample, however, this is a common occurrence in studies of this type (explained by the higher prevalence of obesity in women and the greater interest from women in participating in interventions compared to

men). As a result, there are psychometric instruments validated exclusively on female populations (such as EDI 3).

In terms of limitations, we also mention the small sample in the study on neural activity, which affects the statistical power of the research, and the use of the scores provided by the two software tools in their processed version and not in their primary form (raw), which did not allow for more complex and nuanced interpretations and required a degree of caution in interpreting these results.

As further steps, we take into consideration replicating some of the studies included in the paper, with the intention of improving the experimental design, in terms of sample size, sample homogeneity, duration of intervention, etc.

We also plan to adjust the CBTH - WM protocol in a standardized form, aiming at its replicability aspect to allow its application in a wider area. We also intend to create a form of this intervention dedicated to prevention, relying on the potential of these techniques to generate protective changes in the bio-psycho-emotional status of the individual, in the hope that, through these methods, we can contribute to reducing the number of people suffering from primary obesity due to negative emotions and maladaptive behaviors.

## **Selected Bibliography**

1. Tirthani E, Said MS, Rehman A. Genetics and Obesity. [Updated 2023 Jul 31]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2024 Jan-. Available from: <https://www.ncbi.nlm.nih.gov/books/NBK573068/>
2. Lee A, Cardel M, Donahoo WT. Social and Environmental Factors Influencing Obesity. In: Feingold KR, Anawalt B, Blackman MR, et al., eds. Endotext. South Dartmouth (MA): MDText.com, Inc.; October 12, 2019
3. Hruby A, Hu FB. The Epidemiology of Obesity: A Big Picture. *PharmacoEconomics*. iulie 2015;33(7):673-689 . 4. Blüher M. Obesity: global epidemiology and pathogenesis. *Nat Rev Endocrinol*. mai 2019;15(5):288–98.
5. Weiss F, Barbuti M, Carignani G, Calderone A, Santini F, Maremmani I, et al. Psychiatric Aspects of Obesity: A Narrative Review of Pathophysiology and Psychopathology. *JCM*. 23 iulie 2020;9(8):2344.
6. Chu DT, Minh Nguyet NT, Nga VT, Thai Lien NV, Vo DD, Lien N, et al. An update on obesity: Mental consequences and psychological interventions. *Diabetes & Metabolic Syndrome: Clinical Research & Reviews*. ianuarie 2019;13(1):155–60

7. Segal Y, Gunturu S. Psychological Issues Associated With Obesity. În: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2024
8. Dalle Grave R, Conti M, Calugi S. Effectiveness of intensive cognitive behavioral therapy in adolescents and adults with anorexia nervosa. *Intl J Eating Disorders*. septembrie 2020;53(9):1428–38
9. Roslim NA, Ahmad A, Mansor M, Aung MMT, Hamzah F, Hassan H, et al. Hypnotherapy for overweight and obese patients: A narrative review. *Journal of Integrative Medicine*. ianuarie 2021;19(1):1–5.
10. Ramondo N, Gignac GE, Pestell CF, Byrne SM. Clinical Hypnosis as an Adjunct to Cognitive Behavior Therapy: An Updated Meta-Analysis. *International Journal of Clinical and Experimental Hypnosis*. 3 aprilie 2021;69(2):169–202.
11. Rosendahl J, Alldredge CT, Haddenhorst A. Meta-analytic evidence on the efficacy of hypnosis for mental and somatic health issues: a 20-year perspective. *Front Psychol*. 2024;14:1330238. Published 2024 Jan 8. doi:10.3389/fpsyg.2023.1330238
12. Boere K, Hecker K, Krigolson OE. Validation of a mobile fNIRS device for measuring working memory load in the prefrontal cortex. *International Journal of Psychophysiology*. ianuarie 2024;195:112275.
13. Schwartz MW, Seeley RJ, Zeltser LM, Drewnowski A, Ravussin E, Redman LM, et al. Obesity Pathogenesis: An Endocrine Society Scientific Statement. *Endocrine Reviews*. 1 august 2017;38(4):267–96.
14. OMS. Obesity and overweight [Internet]. [citat 7 iulie 2024]. Disponibil la: <https://www.who.int/news-room/fact-sheets/detail/obesity-and-overweight>
15. Arroyo-Johnson C, Mincey KD. Obesity Epidemiology Worldwide. *Gastroenterology Clinics of North America*. decembrie 2016;45(4):571–9.
16. Sikaris KA. The clinical biochemistry of obesity. *Clin Biochem Rev*. august 2004;25(3):165–81.
17. Wells JCK. The evolution of human adiposity and obesity: where did it all go wrong? *Disease Models & Mechanisms*. 1 septembrie 2012;5(5):595–607.
18. Slawik M, Vidal-Puig AJ. Adipose tissue expandability and the metabolic syndrome. *Genes Nutr*. 10 octombrie 2007;2(1):41–5.
19. Koparkar G, Biswas DA. Adiposity and Cardiac Defects: Pathophysiology and Etiology. *Cureus*. 2023;15(1):e34026. Published 2023 Jan 21. doi:10.7759/cureus.34026
20. Coutinho W, Halpern B. Pharmacotherapy for obesity: moving towards efficacy improvement. *Diabetol Metab Syndr*. 3 ianuarie 2024;16(1):6.

21. Albataineh SR, Badran EF, Tayyem RF. Overweight and obesity in childhood: Dietary, biochemical, inflammatory and lifestyle risk factors. *Obesity Medicine*. septembrie 2019;15:100112.
22. Yadav HM, Jawahar A. Environmental Factors and Obesity. [Updated 2023 May 1]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2024 Jan-. Available from: <https://www.ncbi.nlm.nih.gov/books/NBK580543/>
23. Matei D, Cucuș N, Restian A, Condur L, Stănescu AAM, Iancu MA. Epigenetica și determinismul bolilor nutriționale. 2018
24. Mattei J, Qi Q, Hu FB, Sacks FM, Qi L. TCF7L2 genetic variants modulate the effect of dietary fat intake on changes in body composition during a weight-loss intervention. *The American Journal of Clinical Nutrition*. noiembrie 2012;96(5):1129–36.
25. Chen P, Wang Y, Chen F, Zhou B. Epigenetics in obesity: Mechanisms and advances in therapies based on natural products. *Pharmacology Res & Perspec*. februarie 2024;12(1):e1171.
26. Porada D, Gołacki J, Matyjaszek-Matuszek B. Obesity in perimenopause — current treatment options based on pathogenetic factors. *Endokrynol Pol*. 7 noiembrie 2023;VM/OJS/J/96679.
27. Robinson E, Roberts C, Vainik U, Jones A. The psychology of obesity: An umbrella review and evidence-based map of the psychological correlates of heavier body weight. *Neuroscience & Biobehavioral Reviews*. decembrie 2020;119:468–80.
28. Singh A, Hardin BI, Singh D, et al. Epidemiologic and Etiologic Considerations of Obesity. [Updated 2023 Aug 28]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2024 Jan-. Available from: <https://www.ncbi.nlm.nih.gov/books/NBK585067/>
29. **Nuțu A**, Paraschiv V, Paraschiv T. The main lines of intervention and treatment of obesity: the effectiveness of cognitive behavioral therapy (CBT) and hypnosis. *HSRM*. 14 iunie 2023;24(2):88–92.
30. Baker JS, Supriya R, Dutheil F, Gao Y. Obesity: Treatments, Conceptualizations, and Future Directions for a Growing Problem. *Biology*. 19 ianuarie 2022;11(2):160.
31. Eik-Nes TT, Tokatlian A, Raman J, Spirou D, Kvaløy K. Depression, anxiety, and psychosocial stressors across BMI classes: A Norwegian population study - The HUNT Study. *Front Endocrinol*. 10 august 2022;13:886148.
32. Pan A, Sun Q, Czernichow S, Kivimaki M, Okereke OI, Lucas M, et al. Bidirectional association between depression and obesity in middle-aged and older women. *Int J Obes*. aprilie 2012;36(4):595–602.
33. Khraisat BR, Al-Jeady AM, Alqatawneh DA, Toubasi AA, AlRyalat SA. The prevalence of mental health outcomes among eating disorder patients during the COVID-19

- pandemic: A meta-analysis. *Clinical Nutrition ESPEN*. aprilie 2022;48:141–7.
34. Asch RH, Holmes SE, Jastreboff AM, Potenza MN, Baldassarri SR, Carson RE, et al. Lower synaptic density is associated with psychiatric and cognitive alterations in obesity. *Neuropsychopharmacol*. ianuarie 2022;47(2):543–52.
  35. Vasiliu O. Current Status of Evidence for a New Diagnosis: Food Addiction-A Literature Review. *Front Psychiatry*. 10 ianuarie 2022;12:824936.
  36. Steward T, Picó-Pérez M, Mata F, Martínez-Zalacaín I, Cano M, Contreras-Rodríguez O, et al. Emotion Regulation and Excess Weight: Impaired Affective Processing Characterized by Dysfunctional Insula Activation and Connectivity. Yuan J, editor. *PLoS ONE*. 22 martie 2016;11(3):e0152150.
  37. Gilmartin T, Gurvich C, Sharp G. The relationship between disordered eating behaviour and the five factor model personality dimensions: A systematic review. *J Clin Psychol*. septembrie 2022;78(9):1657–70.
  38. Van Strien T. Causes of Emotional Eating and Matched Treatment of Obesity. *Curr Diab Rep*. iunie 2018;18(6):35.
  39. Ha OR, Lim SL. The role of emotion in eating behavior and decisions. *Front Psychol*. 7 decembrie 2023;14:1265074.
  40. **Nuțu A**, Zăgrean L. The mediation effect of eating behaviour factors in the relationship between personality traits and Body Mass Index (BMI). *HSRM*. 12 aprilie 2024;25(1):29–36.
  41. Moraes ADS, Padovani RDC, La Scala Teixeira CV, Cuesta MGS, Gil SDS, De Paula B, et al. Cognitive Behavioral Approach to Treat Obesity: A Randomized Clinical Trial. *Front Nutr*. 18 februarie 2021;8:611217.
  42. Oakley DA, Halligan PW. Hypnotic suggestion: opportunities for cognitive neuroscience. *Nat Rev Neurosci*. august 2013;14(8):565–76.
  43. Untas A, Lamore K, Delestre F, Lehericey G, Giral P, Cappe E. Psychosocial effects of hypnosis in patients with obesity: a pilot randomized controlled trial. *American Journal of Clinical Hypnosis*. 3 aprilie 2023;65(4):281–98.
  44. Karlsson J, Persson LO, Sjöström L, Sullivan M. Psychometric properties and factor structure of the Three-Factor Eating Questionnaire (TFEQ) in obese men and women. Results from the Swedish Obese Subjects (SOS) study. *Int J Obes*. decembrie 2000;24(12):1715–25.
  45. Cappelleri JC, Bushmakin AG, Gerber RA, Leidy NK, Sexton CC, Lowe MR, et al. Psychometric analysis of the Three-Factor Eating Questionnaire-R21: results from a large diverse sample of obese and non-obese participants. *Int J Obes*. iunie 2009;33(6):611–20.

46. Duarte PAS, Palmeira L, Pinto-Gouveia J. The Three-Factor Eating Questionnaire-R21: a confirmatory factor analysis in a Portuguese sample. *Eat Weight Disord.* februarie 2020;25(1):247–56.
47. Clausen L, Rosenvinge JH, Friborg O, Rokkedal K. Validating the Eating Disorder Inventory-3 (EDI-3): A Comparison Between 561 Female Eating Disorders Patients and 878 Females from the General Population. *J Psychopathol Behav Assess.* martie 2011;33(1):101–10.
48. Garner D. *Eating disorder inventory-3 (EDI-3) Professional Manual.* Lutz, FL: Psychological Assessment Resources. Vol. 35, *International Journal of Eating Disorders.* 2004. 478 p.
49. Iliescu D, Popa M, Dimache R. Adaptarea românească a Setului Internațional de Itemi de Personalitate: IPIP-Ro. *Psihologia Resurselor Umane.* 2015;13(1):83–112.
50. Hayes AF. *Introduction to mediation, moderation, and conditional process analysis: a regression-based approach.* New York: The Guilford Press; 2013. 507 p. (Methodology in the social sciences).
51. Hayes AF. *Introduction to mediation, moderation, and conditional process analysis: a regression-based approach.* Second edition. New York: Guilford Press; 2018. 692 p. (Methodology in the social sciences).
52. Berthoud HR. Metabolic and hedonic drives in the neural control of appetite: who is the boss? *Current Opinion in Neurobiology.* decembrie 2011;21(6):888–96.
53. Berthoud HR, Morrison CD, Münzberg H. The obesity epidemic in the face of homeostatic body weight regulation: What went wrong and how can it be fixed? *Physiology & Behavior.* august 2020;222:112959.
54. Epstein S. Integration of the cognitive and the psychodynamic unconscious. *American Psychologist.* 1994;49(8):709–24.
55. Kahneman D. *Thinking, fast and slow.* 1st pbk. ed. New York: Farrar, Straus and Giroux; 2013. 499 p.
56. Epstein S. *Cognitive-experiential theory: an integrative theory of personality.* Oxford ; New York: Oxford University Press; 2014. 333 p.
57. Alldredge CT, Elkins GR. Adaptive Experiential Theory of Hypnosis. *International Journal of Clinical and Experimental Hypnosis.* 3 iulie 2023;71(3):165–75.
58. Berthoud HR, Münzberg H, Morrison CD. Blaming the Brain for Obesity: Integration of Hedonic and Homeostatic Mechanisms. *Gastroenterology.* mai 2017;152(7):1728–38.
59. Garner DM, Miclea Ș, Joja OD, Albu M, Moldovan E, Apostol L. *EDI - 3: inventarul tulburărilor de comportament alimentar - 3 : manual de specialitate.* Cluj-Napoca: A.S.C.R



[Asociația de Științe Cognitive din România]; 2010.

60. Gandhi B, Oakley DA. Does ‘hypnosis’ by any other name smell as sweet? The efficacy of ‘hypnotic’ inductions depends on the label ‘hypnosis’. *Consciousness and Cognition*. iunie 2005;14(2):304–15.
61. Nash MR. The Truth and the Hype of Hypnosis. *Sci Am*. iulie 2001;285(1):46–55.
62. Hammond DC, editor. *Handbook of hypnotic suggestions and metaphors*. 1st ed. New York: Norton; 1990. 602 p.
63. Spiegel H, Spiegel D. *Trance and treatment: clinical uses of hypnosis*. 2nd ed. Washington, DC: American Psychiatric Pub.; 2004.
64. Dakanalis A, Mentzelou M, Papadopoulou SK, Papandreou D, Spanoudaki M, Vasios GK, et al. The Association of Emotional Eating with Overweight/Obesity, Depression, Anxiety/Stress, and Dietary Patterns: A Review of the Current Clinical Evidence. *Nutrients*. 26 februarie 2023;15(5):1173.
65. Avena, Nicole M., 'Introduction', *Hedonic Eating: How the Pleasurable Aspects of Food Can Affect Our Brains and Behavior* (2015; online edn, Oxford Academic, 1 July 2015), <https://doi.org/10.1093/med/9780199330454.003.0001>
66. Flanagan K, Saikia MJ. Consumer-Grade Electroencephalogram and Functional Near-Infrared Spectroscopy Neurofeedback Technologies for Mental Health and Wellbeing. *Sensors*. 15 octombrie 2023;23(20):8482.
67. **Nuțu A**, Zăgrean L. Assessment of the outcomes of an intervention combining cognitive behavioral therapy techniques and hypnosis for the therapy of obesity. *Health, Sports & Rehabilitation Medicine*. iunie 2024;25(2):80–9