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Ph.D. THESIS

Summary

RELEVANT PSYCHOLOGICAL FACTORS AND MECHANISMS OF CHANGE IN WEIGHT MANAGEMENT FOR ADULTS WITH OVERWEIGHT AND OBESITY

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CHAPTER 1. THEORETICAL BACKGROUND

1.1 Introduction and Research Problem

1.1.1 Defining overweight and obesity

World Health Organization (WHO) defines overweight and obesity as "an abnormal or excessive accumulation of fat that can be harmful to health."

1.1.2 The causes of overweight and obesity

Obesity is a multifactorial disease. The causes of obesity are diverse: genetic mutations, metabolic defects, behavioral and a confluence of multiple interrelated environmental factors: food environment, a decreased physical activity, changing modes of transportation, and increasing urbanization (Hall, 2018). Some of these causes produces an imbalance between calories consumed (an increased intake of high-calorie foods, high in fat and sugars) and calories expended, which is a plausible explanation for overweight and obesity (WHO, 2021b). Most of the guidelines made by health organizations rely on this fact (Blüher, 2019). The investigation in the genetic area has just begun, and preliminary results show that there are likely several genes associated or linked with human obesity (Bouchard, 2020).

1.2 Relevance of the Problem

1.2.1 Prevalence

Obesity is one of the most critical health problems that affect many people around the globe (Castelnuovo et al., 2017). In the last years, the prevalence of obesity has increased at pandemic levels throughout the world (Blüher, 2019). However, although obesity is one of the most visible public health problems today, negatively impacting health and quality of life, it is also one of the most neglected (WHO, 2021a).

1.2.2 Health consequences

The health consequences of being overweight or obese affect more than 2 billion people (WHO, 2021b). Excess weight is associated with an increased risk of type 2 diabetes, hypertension, stroke, some forms of cancer (Cooper & Fairburn, 2001), menstrual irregularity, endometrial pathology, and infertility (Broughton & Moley, 2017). In addition, obstructive sleep apnea, asthma, and breath problems are health problems more common among obese individuals (Finer, 2015).

1.2.3 Economical consequences

The accelerated increase in the prevalence of obesity has led to an increase in obesity-related treatments and medical expenses. For example, an individual with obesity has 14-25% more visits to a physician than those with a normal weight. Also, individuals with a BMI greater than 30 kg/m^2 had more pharmacy dispenses, especially for conditions comorbid with obesity

(Finkelstein et al., 2005).

1.3 Current status of the field

1.3.1 Weight loss and weight maintenance

Weight loss is an important concern for the population and thus to specialists in the field of obesity. Moreover, reducing the prevalence of obesity has clinical and economic implications (Swift et al., 2018). Due to the high prevalence of obesity and related health consequences, weight loss is recommended for its benefits on cardiovascular health. Although these benefits already appear at a weight loss of only 2-3% of initial weight, specialists recommend weight loss of 5-10% weight loss (Swift et al., 2018; Wing et al., 2011). Weight loss maintenance is determined mainly by behavioral and cognitive factors and less by environmental factors (Varkevisser et al., 2019). A recent review (Greaves et al., 2017) showed that making the necessary behavior changes for weight loss generates psychological "tensions" and requires constant effort. Therefore a change in habits and self-concept is often needed to lose weight.

1.3.2 Treatments for weight loss

Three main evidence-based approaches for treating obesity include: surgical treatment, pharmacotherapy, and psychological interventions.

Behavioral interventions are the most commonly used psychological treatments for weight loss and for maintaining lost weight (Teixeira, PJ et al., 2003). Behavioral treatments' efficacy is near 10% of weight loss, but unfortunately, this loss is almost always regained (Cooper & Fairburn, 2001). A loss of 5-10% from the individualțs initial weight is typically associated with clinically significant health improvement (Wing et al., 2011).

1.3.2.1 Cognitive-Behavioral Therapy for Weight Loss

In standard behavioral treatment, the focus is on changing eating behaviors, reducing calorie intake, and increasing exercise. The addition of cognitive techniques to behavioral treatments, generally improve weight loss and weight maintenance (Cooper & Fairburn, 2001). The use of cognitive-behavioral interventions (CBT) has increased based on greater and more sustainable weight loss (Shaw et al., 2005). Besides behavioral changes, CBT aims to produce cognitive changes to facilitate the long-term weight loss maintenance and to addresses the mechanisms known to negatively influence weight loss and maintenance of treatment gains (Dalle Grave et al., 2020).

Recent meta-analyses, have revealed that CBT interventions produce a statistically significant small effect on weight loss. CBT is considered the first-line psychological treatment and the most preferred intervention for obesity (Castelnuovo et al., 2017).

1.3.2.2 Hypnosis

Hypnotic interventions consist of induction and suggestions (Oakley & Halligan, 2013). In the induction process, the participant is guided through instructions to achieve a focused,

absorbed, attentional state, in which the hypnotist delivers suggestions. Hypnotic suggestions are delivered to induce cognitive, behavioral, or emotional changes. Hypnotic suggestions are usually used as a method for addressing a range of symptoms within a therapeutic context (Terhune & Brugger, 2011), and they describe new, modified states, experiences, or behaviors. Studies showed that posthypnotic suggestions could alter cognitive processes (Raz et al., 2005).

Furthermore, recent research revealed that hypnosis could be an effective technique for weight loss (Erşan & Erşan, 2020; Milling et al., 2018; Roslim et al., 2021).

1.3.2.3 Food inhibition training

Food inhibition training (FIT) is a novel computerized intervention that trains participants to inhibit a motor response to pictures of high-calorie foods. This training uses Go/no-go task in which high-calorie food images with cues indicating when the participants have to withhold a behavioral response are repeatedly presented (Stice et al., 2016). Researchers developed this intervention based on the dual-process models that holds that behavior is determined by the interaction between an impulse system driven by hedonic needs and a reflective system associated with conscious thoughts and deliberation. When someone overeats, it signifies a robust impulsive system to the detriment of a reflective one, so a lack of control arises in response to high-calorie food. FIT was designed to target these processes (Adams et al., 2017), and a single session of training has a moderate effect on reducing consumption of high-calorie foods and increased consumption of low-calorie foods in people who are obese or overweight (Adams et al., 2017; Houben, 2011; Houben & Jansen, 2011, 2015; Lawrence, Verbruggen, et al., 2015; Oomen et al., 2018; Turton et al., 2018; Veling et al., 2011).

1.3.3 Mechanisms of change

A new direction in studying weight loss is identifying psychological factors that are mechanisms of change in eating behaviors (Teixeira et al., 2015). Many studies identified cognitive factors, such as motivation and self-efficacy, that functions as mediators or predictors of weight control in psychological interventions for weight management and will be considered herein as alleged mechanisms of weight loss change. Reviews (Elfhag & Rossner, 2005; Foreyt & Goodrick, 1994; P. J. Teixeira et al., 2010, 2015) have also identified cognitive factors as mediators for medium or long-term weight control. However, most studies reviewed are rather than empirical and do not reveal the magnitude of effects associated with change mechanisms.

1.4 Concluding Remarks

Based on a review of data from on psychological aspects of weight loss management, the following limitations are important to address from both theoretical and methodological point of view:

a) Basic research has identified cognitive and behavioral potential moderators or mediators of weight loss, but not the magnitude of the effect (Elfhag &

Rossner, 2005; Foreyt & Goodrick, 1994). Recent meta-analyses address weight, eating behaviors, and emotional components (Jacob et al., 2018; Podina & Fodor, 2018), but have not examined cognitive or psychological outcomes of interventions or mechanisms associated with weight loss.

b) It is essential to know why some people gain weight or find it difficult to lose weight to improve the long-term results of psychological treatments. It is unclear why some individuals succeed in weight loss, and others do not. Only a few studies analyzed the relevant psychological factors that determine if the behaviors for losing weight to be maintained, especially the irrational beliefs involved.

c) More research regarding cognitive and behavioral factors determining weight loss maintenance is needed because the current literature is scarce and difficult to interpret given the limitations noted (Varkevisser et al., 2019).

d) Future research should thus address how psychological factors impact weight loss and maintenance (Jacob et al., 2018).

e) Regarding hypnosis interventions, further studies are needed that conduct compare hypnosis with other methods for modulating cognitive control, including placebo control conditions (Raz et al., 2005).

f) Also, there are significant limitations in terms of the design of the trials that study hypnosis (Lynn et al., 2020; Ramondo et al., 2021; Roslim et al., 2021).

g) A key contributor for increasing the number of people with overweight and obesity is the food-rich environment which leads to overeating. As a result, people need to improve their inhibitory capacity to manage impulsive reactions to high-calorie foods. Thus, weight management interventions need to include behavior change strategies to improve eating behavior and reduce energy intake (Lawrence, O'Sullivan, et al., 2015).

h) There is a need for new effective interventions, cost-effective and easy to use and implement.

CHAPTER 2. RESEARCH OBJECTIVES AND OVERALL METHODOLOGY

2.1 Theoretical / methodological and / or practical objectives

2.1.1 General aim

This thesis addressed some of the theoretical, methodological, and practical issues concerning weight loss and weight maintenance difficulty.

Therefore, this research had two primary objectives: (1) to investigate the cognitive mechanisms of change involved in weight loss management in adults who are overweight or obese and (2) to develop a more effective and efficient intervention for weight loss and its maintenance, addressing the limitations identified.

2.1.2 Specific objectives

To attain the first aim, we conducted a meta-analysis to evaluate the efficacy of CBT on weight loss and psychological components such as cognitive, behavioral, and emotional outcomes. Then, we analyzed the relationship between alleged cognitive mechanisms of change and weight loss.

Moreover, to improve the long-term results of psychological treatments, it is essential to know why some people gain weight or find it difficult to lose weight. We have information about the specific behaviors associated with maintaining or losing weight, but we know less about the psychological factors determining if these behaviors are to be maintained. Therefore, in the same registry of the first primary objective, we also conducted a second cross-sectional study to identify which of the cognitive factors (general and food-specific irrationality, self-efficacy) and behavioral ones (cognitive restraining, uncontrolled eating, and emotional eating) differ between those who have succeeded to maintain the weight loss or not. Also, we examined which of these psychological variables characterize better how people grouped according to different weights think about and behave concerning food.

We attained the second primary objective in studies three and four.

Study 3 started from the idea that to add value in weight management, we need new perspectives and proposed the Free Will concept as a starting point. We consider that this model can be used based on hypnotic suggestions to change eating intentions. Thus, study 3 aimed to evaluate the effectiveness of three types of hypnotic suggestions on changing eating intentions through the Free Will concept's prism.

Study 4 is a randomized clinical trial that followed study 3 and aimed to evaluate the effectiveness of changing eating behavior using cognitive training. For this purpose, we compared two interventions that have not yet been compared to each other: hypnosis and food inhibition training. These interventions have the role of creating new routines (unconsciously processed) in terms of healthy eating behaviors.

CHAPTER 3. ORIGINAL RESEARCH

3.1 Study 1. Outcomes and Mechanisms of Change in Cognitive-Behavioral Interventions for Weight Loss: A Meta-analysis of Randomized Clinical Trials[1]

3.1.1 Introduction

CBT is a well-established treatment (Hofmann et al., 2012). Its efficacy is very well studied on various interventions, but only one meta-analysis addresses obesity (Jacob et al., 2018). They considered that CBT has proven to be effective for many treatments because it targets all the psychological factors (behavioral, emotional, and cognitive); therefore, it is important to synthesize the evidence assessing these factors. With our meta-analysis, we come to complete their work and examine the efficacy of CBT, including the cognitive factors.

3.1.1.1 Objectives

This meta-analysis has two main objectives. The first is to evaluate the efficacy of CBT on weight loss and psychological components such as cognitive, behavioral, and emotional outcomes. The second is to analyze the relationship between alleged cognitive mechanisms of change and weight loss.

3.1.2 Method

3.1.2.1 Identification and selection of studies

We found the potentially relevant studies through a systematic search of literature by accessing the following electronic databases: Web of Science, PubMed, PsycInfo, and Scopus on January 17, 2020.

In our search, we followed the requirements recommended by Preferred Reporting Items for Systematic reviews and Meta-analyses: the PRISMA statement (Moher et al., 2009). Figure 1 shows the Flow diagram of the search process. The study was registered in PROSPERO and had the ID CRD42020167110.

[1] Comșa, L., David, O., & David, D. (2020). Outcomes and mechanisms of change in cognitive-behavioral interventions for weight loss: A meta-analysis of randomized clinical trials. *Behaviour Research and Therapy, 132*, 103654. https://doi.org/10.1016/j.brat.2020.103654

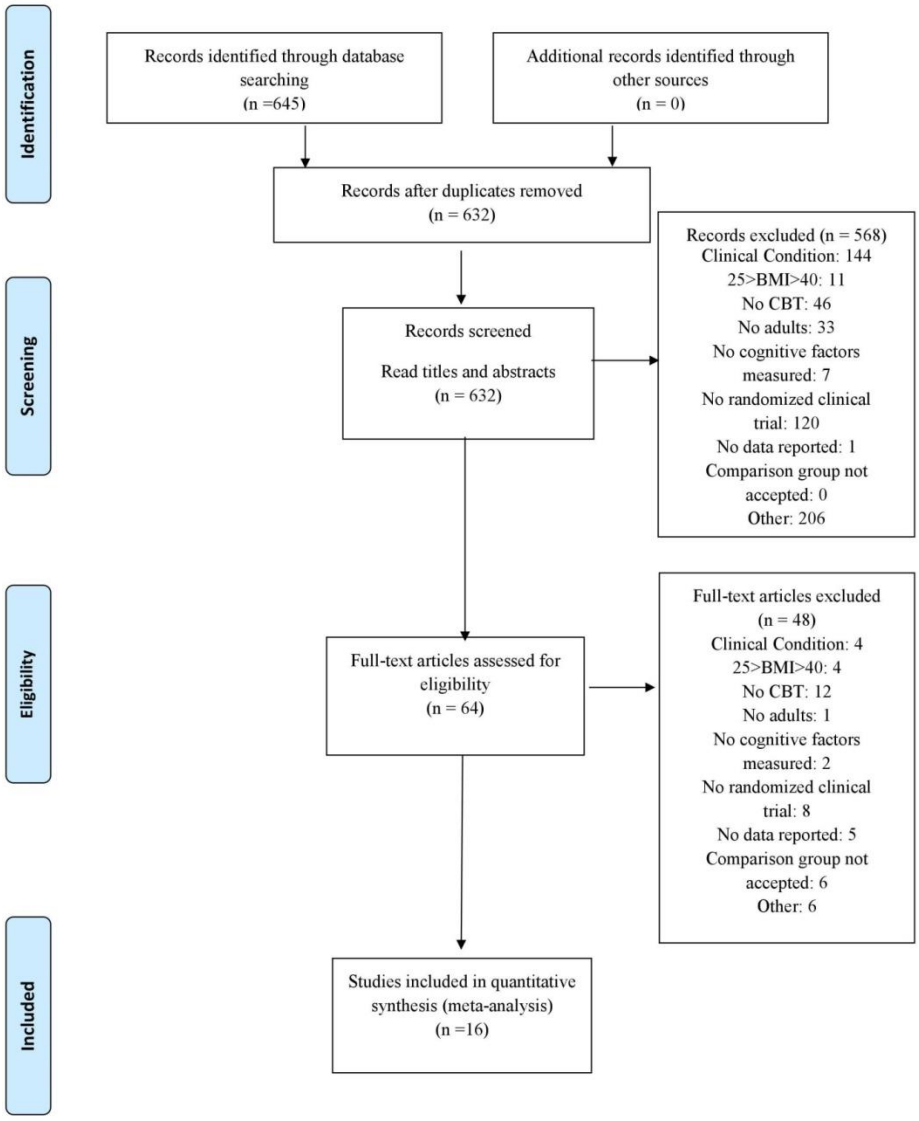

Figure 1. PRISMA Flow

3.1.2.2 Selection criteria

3.1.2.2.1 Characteristics of the studies

We included only studies that had an active CBT intervention and where we could identify a CBT component within the analyses. CBT interventions were required to have CBT strategies delivered to a group or an individual. CBT strategies were defined by Jacob et al. (2018) as interventions that focused on cognitive and behavioral conceptualizations of weight changes.

The comparison groups accepted were those who delivered standard behavioral techniques, education, dieting, or no intervention, and they do not include in curricula any cognitive strategies.

3.1.2.2.2 Types of outcome measures

We accepted only studies that reported quantitative assessments of change in weight and cognitive components (e.g., motivation, self-efficacy, self-regulation, body image acceptance) as a primary or secondary outcome. We also included in our analysis other psychological features if reported in the studies, such as behaviors and emotional states.

3.1.2.3 Data Extraction and Quality Assessment

Because of the variety of outcomes reported by the studies, we classified all the psychological outcomes into three general clusters, representing the psychological factors (behavioral, cognitive, and emotional) considered in psychological interventions (e.g., CBT).

The Cognitive cluster is representing variables that describe cognitions. In the Emotional cluster, we include variables that describe a person's subjective affect. The Behavioral cluster is composed of variables that refer to lifestyle and eating behaviors. Then, we grouped the proposed cognitive mechanisms into three theoretically coherent clusters for analysis: motivation, self-efficacy, and body image, based on the constructs measured and with the help of the scale used for their measurement.

3.1.2.4 Statistical analyses

We performed the statistical analyses using Comprehensive Meta-Analysis (CMA version 2.2.064 for Windows). For weight and psychological outcomes, we calculated the effect sizes (ESs) at post-treatment and follow-up. The value of the ES indicates standardized mean differences (SMD) between the mean of the CBT group and that of the control group at a specific time-point and then divided to the pooled standard deviations of the two groups. We choose Hedges`s *g* as the ESs indicator to correct for small sample bias (Borenstein et al., 2009) and it was computed based mainly on SMD. Hedges`s *g* is interpreted in the same way as Cohen-d, that is small (*d*=0.2), medium (*d*=0.5) and large (*d*=0.8) (Cohen, 2013). When a study reported more than one outcome from the same psychological component, we computed a mean effect size for that component for each study, creating a synthetic effect size for each component in each study.

In multiple comparisons, we computed separate ESs for each comparison between the CBT and the control groups. We pooled ESs using a random-effects model. We evaluated heterogeneity with the I^2 statistic. The values of 25%, 50%, and respectively 75% are showing low, moderate, and high heterogeneity.

We performed sensitivity analyses: (a) by excluding outliers, (b) limited to the psychological outcome: cognitive, behavioral, and emotional outcomes. Outliers were defined as studies in which the 95% confidence interval was not overlapping with the 95% CI of the pooled ESs.

We conducted subgroup analyses for categorical moderators using the mixed-effects model, which uses a random-effects model within subgroups and a fixed-effects one across subgroups (Borenstein et al., 2009). For continuous moderators, we used meta-regression analyses with the restricted maximum likelihood model with the Knapp-Hartung method (Borenstein et al., 2009).

Given that there have been few studies with a follow-up at 3, 6, 9, or 24 months, we only made the analysis based on the studies with one year (i.e., 12 and 13 months) follow-up.

To test if the psychological components are mechanisms of change, we examined the association between effect sizes in the psychological outcomes and weight loss.

3.1.3 Results

3.1.3.1 Participants

This meta-analysis includes 1.663 healthy adult participants with a mean BMI of 34.45 kg/m2 and a mean age of 42.9 years. Ten studies had only women as participants, and seven had combined. The sample size varied between 24 to 203 participants and follow-up periods between 3 and 24 months. The length of treatment ranged from 12 to 48 weeks and the number of sessions from 6 to 30.

3.1.3.2 Intervention

Most of the time, CBT techniques were delivered with nutrition and exercise counseling (Annesi, 2010; Annesi et al., 2016; L. Bacon et al., 2002; Linda Bacon et al., 2005; Clifford et al., 1991; Hales et al., 2016; Jamal et al., 2016; Kalarchian et al., 2011; Munsch et al., 2003; Ramirez & Rosen, 2001; Sbrocco et al., 1999; Silva et al., 2010; Teixeira et al., 2010). There was one study that delivered CBT alone (L. Palmeira et al., 2017), one that delivered CBT together with exercise only (Mensinger et al., 2016), and one that delivered CBT together with nutrition (Cooper et al., 2010).

Psychologists (Ph.D., M.S., or undergraduate in Psychology), counselors, or a multidisciplinary team, all with different levels of expertise, delivered the interventions.

Regarding the comparison, some studies used education (Silva et al., 2010; Teixeira et al., 2010), in which participants had courses with different themes like healthy nutrition, self-care, stress management, or effective communication skills. Two of them were no intervention (Clifford et al., 1991; Munsch et al., 2003) which means only assessments, ten of them were SBT (L. Bacon et al., 2002; Linda Bacon et al., 2005; Cooper et al., 2010; Hales et al., 2016; Jamal et al., 2016; Kalarchian et al., 2011; Mensinger et al., 2016; L. Palmeira et al., 2017; Ramirez & Rosen, 2001; Sbrocco et al., 1999). The other two were self-help (Annesi, 2010; Annesi et al., 2016), where participants were taught how to complete a specific exercise, identify their associated benefits, and the focus was on the physiological factors.

3.1.3.3 Main results

3.1.3.3.1 CBT-interventions compared to a control condition at Post-treatment

Weight outcomes

The pooled ESs of the 18 contrasts (1.663 participants) in which a CBT-intervention was compared to a control condition in terms of weight loss, was Hedges' g= 0.31 (95% CI 0.04 to 0.58), NNT = 5.75, favoring CBT-interventions. The heterogeneity was high, Q(17) = 119.81, $p < .001$; I^2 = 86%. The visual inspection of the forest plot revealed the presence of two outliers. Their exclusion does not decrease the ESs, g = 0.31 (95% CI 0.11 to 0.50), NNT = 5.75, $Q(15)$ = 45.34, $p < .001$; I^2 = 67%.

Cognitive outcomes

Analyses restricted to cognitive outcomes (18 contrasts with 1.663 participants), showed a significant ESs, g = 0.37 (95% CI 0.22 to 0.45), NNT = 4.85, with reduced evidence of heterogeneity, $Q(17)$ = 25.31, p =0.157; I^2 = 25%. The visual inspection of the forest plot revealed the absence of any outliers.

Emotional outcomes

Analyses restricted to emotional outcomes (7 contrasts with 441 participants), showed a significant ES, g = 0.36 (95% CI 0.08 to 0.65), NNT = 5, with reduced evidence of heterogeneity, $Q(6)$ = 10.30, p= 0.11; I^2 = 41.17%. After the visual inspection of the forest plot we found no outliers.

Behavioral outcomes

Analyses restricted to behavioral outcomes (11 contrasts with 757 participants), showed also a significant ES, g = 0.44 (95% CI 0.30 to 0.59), NNT=4.1. No evidence of heterogeneity, $Q(10)$ = 8.86, p = .55; I^2 =0 % and the visual inspection of the forest plot reveals no outliers.

3.1.3.3.2 CBT-interventions compared to a control condition at Follow up

Weight outcomes

Nine contrasts (593 participants) reported outcomes at one-year follow-up. The pooled ES was Hedges' g= 0.29 (95% CI 0.06 to 0.51), NNT =6.17, indicating that participants receiving the active treatment reported significantly better weight outcomes than control. Analyses shows no evidence heterogeneity $Q(8)$= 14.46, p= .07; I^2 = 45 %. The visual inspection of the forest plot found no outliers.

Cognitive outcomes

Nine contrasts (593 participants) reported cognitive outcomes at one year follow up; the pooled ES was small but significant g = 0.25, (95% CI 0.09 to 0.41), NNT =7.14, with no evidence of heterogeneity $Q(8)$=7.8, p=.145; I^2 = 0%. The visual inspection of the forest plot reveals no outliers.

Emotional outcomes

The pooled ESs of the fourth contrasts (186 participants) that reported emotional outcomes at one year follow up, were non-significant, g = 0.26 (95% CI −0.03 to 0.55), with reduced evidence of heterogeneity $Q(3)$ = 0.08, p =.99; I^2 = 0%. No outliers were found after the visual inspection of the forest plot.

Behavioral outcomes

Only six contrasts (308 participants) reported behavioral outcomes at one year follow up; the pooled ESs were small, g = 0.37 (95% CI 0.14 to 0.61), NNT= 4.85, with no evidence of heterogeneity $Q(5)$ = 3.43, p =0.63; I^2 = 0% (see Table 6). After the visual inspection of the forest plot, no outliers were found.

3.1.3.3.3 Subgroup and meta-regression analyses for CBT interventions compared with Controls at Post-treatment

Weight outcomes

We conducted subgroup analyses to examine if the characteristics of the included studies were associated with ESs. The comparison type was a statistically significant moderator; the largest pooled ESs were registered in the studies where the comparison condition was represented by Education (g=1.29, 95% CI 0.74 to 1.85) followed by No intervention (g=0.50, 95% CI 0.09 to 0.92), Self-help (g=0.38, 95% CI -0.14 to 0.90) and lastly by SBT (g=0.09, 95% CI -0.13 to 0.31), between groups Q(3)=16.9, $p < .001$. This subgroup analysis indicated that Education compared with Self-help (Q(1)=5.60, p= .018), No intervention (Q(1)=5.04, p=.025) and SBT (Q(1)=15.77, p< .001) was the only significant moderator.

In addition, the nature of the individual delivering intervention was a significant moderator, yielding larger pooled ESs in the studies where when the intervention was delivered by a multidisciplinary team (g=0.46, 95% CI 0.11 to 0.81) compared to those where a psychologist delivered the intervention (g=0.19, 95% CI -0.45 to 0.83) or by a counselor (g=-0.31, 95% CI -0.73 to 0.11), between groups Q(2)=7.71, p=.021. Compared with the counselor, the multidisciplinary team of interventions was the only significant moderator (Q(1)=7.70, p=.006). The intervention type, the type of delivery (to group or individual), the mean age of the participants, the level of expertise, and the cognitive component of the intervention, were not statistically significant moderators.

The meta-regression analyses indicated a significant positive association between ESs and length of treatment (slope = 0.027, 95% CI 0.01 to 0.04, $p < .001$); the results were maintained when outliers were excluded. Another significant negative association was found between ESs and mean BMI (slope = -0.136, 95% CI -0.23 to -0.04, $p = .02$); the results also were maintained when outliers were excluded. The number of participants in the study was also in a significant positive association with ESs (slope = 0.006, 95% CI 0.003 to 0.009, $p < .001$); the results were not maintained when outliers were excluded. The number of sessions and the intervention type were not associated with ESs.

Psychological outcomes

We did not conduct a subgroup and meta-regression analysis for any psychological outcomes**.** These analyses were not done due to the limited number of studies and reduced evidence of heterogeneity.

3.1.3.3.4 Subgroup and meta-regression analyses for CBT interventions compared with Controls at Follow-up

Due to the limited number of studies and the reduced evidence of heterogeneity, we only conducted subgroups and meta-regression analyses for weight outcomes**.** The type of intervention, the type of comparison, the delivery mode, the cognitive component of the intervention, the mean age, who delivered the intervention, and the level of expertise of who delivers the intervention were not statistically associated with the ESs.

Meta-regression analyses revealed no significant associations between ESs and length of treatment, number of sessions, or mean BMI.

3.1.3.4 Association between proposed mechanisms of change and outcomes ESs

To investigate if cognitive outcomes relate to weight outcomes, we computed several meta-regressions using ESs on the alleged mechanisms as predictors and the ESs of the outcomes as the dependent variable. Due to the small number of studies that reported outcomes at follow-up, we computed those analyses only at the end of the intervention.

The analysis found that the ESs on cognitive factors (slope = 0.913, 95% CI 0.012 to 1.81, $p = 0.047$) are significantly associated with weight outcomes.

From all the proposed cognitive mechanisms of change, results indicated a significant association between motivation outcomes ESs (slope= 0.992, 95% CI 0.13 to 1.85, $p =0.02$) and weight and between self-efficacy ESs (slope= 1.59, 95% CI 0.24 to 2.94, $p =0.02$) and weight outcomes at the end of the intervention. No other significant association between other cognitive (body image and self-regulation) factors were found.

3.1.3.5 Supplementary analyses

We performed supplementary analyses to investigate the association between emotional and behavioral outcomes and weight outcomes, but no significant association was found.

3.1.4 Discussion

This meta-analysis had two objectives. The first aim was to evaluate the efficacy of CBT on weight loss and psychological components such as cognitive, behavioral, and emotional outcomes, and the second was to analyze the relationship between alleged cognitive mechanisms of change and weight loss. This research is the first quantitative synthesis of the efficacy of CBT on weight loss and cognitive, behavioral, and emotional factors.

We conclude that CBT is an efficient psychological treatment for weight loss. Its efficacy lies in adding the cognitive factors, more specifically motivation and self-efficacy. Our results show that CBT intervention is more effective when delivered by a multidisciplinary team in longer sessions since these two factors are significant moderators.

3.2 Study 2. Relevant Psychological Factors in Weight Management. How to Think and Behave To Lose Weight and Maintain It for Good

3.2.1 Introduction

3.2.1.1 Background

It is essential to look for psychological factors that can ease and sustain weight-loss behaviors. The research in this field is precious because we know little about the psychological mechanisms responsible for those changes, which can improve the treatments for obesity (S. Byrne et al., 2003; S. M. Byrne, 2002; S. M. Byrne et al., 2004). It is also recommended for further research to identify psychological determinants of weight loss maintenance (Varkevisser et al., 2019).

Based on the current literature, the psychological factors that could make the difference for weight loss are behavioral variables, such as cognitive restraint and emotional eating, and cognitive variables, such as self-efficacy and irrational beliefs.

Many studies (Edell et al., 1987; Jeffery et al., 1984; Linde et al., 2006; A. L. Palmeira et al., 2007; Teixeira et al., 2010) found self-efficacy (SE) to be positively associated with weight loss and weight maintenance.

In cognitive-behavioral therapy, more specifically in the Rational Emotive Behaviour Therapy (REBT) of Albert Ellis (Ellis, 1962, 1991, 1995), vulnerability factors for psychopathology are considered to be irrational beliefs (IB) (David et al., 2018). These beliefs are dysfunctional evaluative cognitions that lack pragmatic, empiric, and logical support. Irrational beliefs were found to be positively associated with dietary restraint (Ruderman, 1985), obsession with eating, dieting (Tomotake et al., 2002), and emotional eating (Nolan & Jenkins, 2019). Irrational food beliefs (IFB) are defined as cognitive distortions and unhealthy attitudes towards food (Osberg et al., 2008). In their review, Greaves, Poltawski, Garside, & Briscoe (2017) found that catastrophic thinking in response to lapses and rigid, rule-bound thinking influences the challenge of weight loss maintenance.

Behavioral factors, such as cognitive restraint, uncontrolled, and emotional eating, have been documented to predict weight change or weight maintenance (Teixeira et al., 2010, 2015). Also, Varkevisser et al. (2019) found a moderate level of evidence that uncontrolled eating and emotional eating during weight loss were negatively predictive of weight loss maintenance. Cognitive restraint (CR) refers to the conscious eating restriction to control body weight or lose weight. Uncontrolled eating (UE) is the tendency to eat more than usual or healthy due to a loss of control over intake, and emotional eating (EE) is the tendency to overeat in the presence of emotional distress (Blandine de Lauzon et al., 2004).

However, the main limitation of current literature on this topic is that most studies only look at the difference between obese vs. non-obese individuals and do not consider those who have succeeded or not to lose and maintain the weight loss achieved. Only a few studies analyzed this comparison between maintainers and regainers of weight loss. Moreover, most of these studies were quasi-qualitative, relying exclusively on a semi-structured interview or open-

ended questions (S. M. Byrne, 2002; Lewis et al., 2010). The novel element of our study is that we analyzed irrational beliefs and examined them in terms of the differences between weight loss maintainers and regainers.

It is essential to know why some people gain weight or find it difficult to lose weight to improve the long-term results of psychological treatments. We have information about the specific behaviors associated with maintaining or losing weight, but we know less about the psychological factors determining if these behaviors are to be maintained. It is unclear why some individuals succeed in weight loss, and others do not.

3.2.1.2 Objectives

Our study aims to identify which cognitive factors (general and food-specific irrationality, self-efficacy) and behavioral factors (cognitive restraining, uncontrolled eating, and emotional eating) differ between those who have succeeded or not to maintain weight loss. Our second aim is to identify psychological variables that characterize better how people from different weight groups think and behave in relation to food.

3.2.2 Methods

3.2.2.1 Procedure

Our study was conducted following the Declaration of Helsinki, and the protocol has the ethical approval 22.655/22.11.2019 of the Ethics Committee from the university where the research was conducted.

Participants registered in the study and completed online the participation consent, information about the study, the data processing, and the questionnaires.

The participants were considered eligible if they were over 18 years old. In addition, they had to be in one of the three categories: one of the persons with a constant normal weight over min two years and the other two, persons who in the last two years have lost min 10% of their weight and they maintained or regained min 5% of their weight loss through one year. Other studies have defined these categories (S. Byrne et al., 2003; McGuire et al., 1999). Because this research has two aims, we divided it into two sub-studies: study 2A and 2B.

3.2.2.2 Measures

Eating self-efficacy was measured used the Weight Efficacy Lifestyle Questionnaire – short form (WEL-SF). Higher total scores are associated with higher eating self-efficacy and motivation to make positive lifestyle changes. The scale has been translated into Romanian.

We measured the irrational beliefs with the 26-item General Attitudes and Beliefs Scale – Short Version (GABS-SV) with one rational subscale and six irrationality subscales: Self-Downing, Need for Achievement, Need for Approval, Need for Comfort, Demands for Fairness, and Other Downing. High scores indicate high irrationality.

The irrational food beliefs were measured with the Irrational Food Beliefs Scale (IFB). It has 57 items from which 41 measures irrational beliefs about food and 16 rational ones. Higher scores are significantly associated with weight gain and poor weight loss maintenance.

The eating behaviors were measured using the Three-Factor Eating Questionnaire (TFEQ). The scale measures three aspects of eating behavior: cognitive restraint (CR),

uncontrolled eating (UE), and emotional eating (EE). Higher scores indicate greater CR, UE, or EE.

Weight was self-reported.

3.2.2.3 Statistical methods

We computed a MANOVA analysis to detect group differences in terms of psychological factors. In addition, to identify how the categories are different in terms of variables, we computed a post hoc analysis using the Games-Howell procedure.

3.2.3 Results

3.2.3.1 Study 2A

3.2.3.1.1 Participants

The participants' flow for study 2A is described in figure 1. The mean age was 31.05 (*SD*=11.37), all adults with a mean BMI of 24.98 kg/m² (*SD*=5.58), of which 82 were women and five men. We grouped them into three categories of interest: Maintainers, Regainers, and Normal Stable Weight (S. Byrne et al., 2003). (see Figure 1)

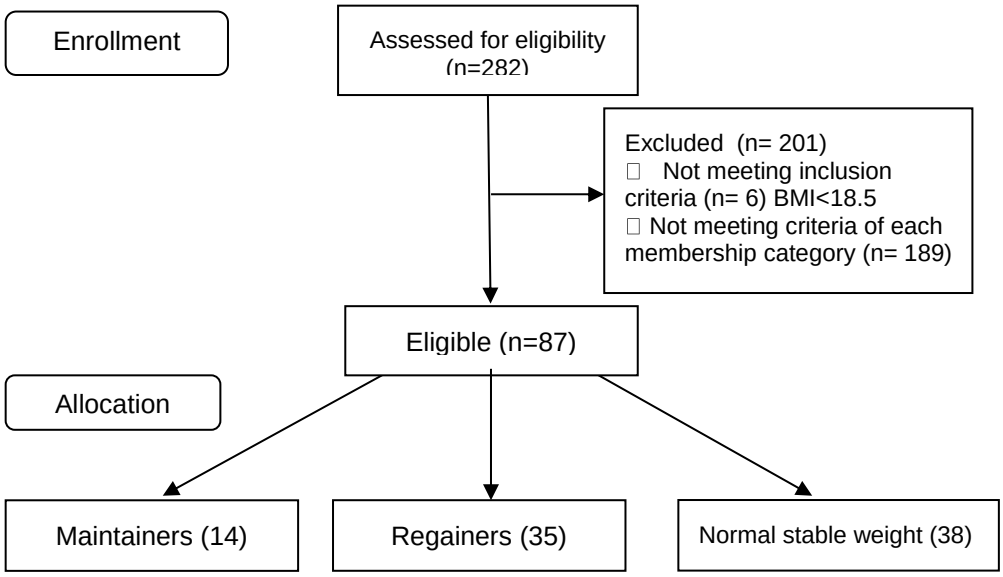

Figure 1. Participant flow for study 2A

3.2.3.1.2 Outcomes

Using Pillai's trace, results showed a significant effect of categories on the variables considered V=0.37, F(16,156)=2.21, p<.05, η^2=.18. Separate univariate ANOVAs were further conducted, and the results are presented in Table 1, showing significant differences between groups in terms of self-efficacy, irrational food beliefs, uncontrolled eating, cognitive restraint, and emotional eating (see Table 1).

Table 1.

Results of Univariate ANOVA in study 2A

Dependent Variable	**F**	**Sig.**	η^2
Self-efficacy	$F(2,84)=7.17^{**}$	.001	.15
Irrational Food Beliefs	$F(2, 84)=8.15^{**}$	.001	.16
Need for Approval	$F(2, 84)=4.14^{*}$	.019	.10
Uncontrolled eating	$F(2, 84)=7.95^{**}$	.001	.16
Cognitive Restraint	$F(2, 84)=4.17^{*}$	.020	.09
Emotional eating	$F(2, 84)=6.97^{**}$	.002	.14

Note. *p< .05 level; **p<.01.

The multiple comparison results showed significant differences between categories when we compared Regainers with Maintainers or Normal Stable regarding self-efficacy and irrational food beliefs. In comparing Regainers and Normal Stable, we found significant differences in uncontrolled and emotional eating. In terms of cognitive restraint, the results showed that Maintainers restraint significantly more than Regainers or Normal Stables (see Table 2).

Table 2.

Multiple Comparisons in study 2A

Dependent Variable	(I)Categories	(J)Categories	MD (I-J)	SE	Sig.	95% CI	
						Lower Bound	Upper Bound
Self-efficacy	Maintainers	Regainers	13.61*	5.22	.035	.83	26.40
		Normal stable	-2.47	4.85	.868	-14.48	9.53
	Regainers	Normal stable	-16.09**	4.58	.002	-27.05	-5.12
Irrational Food Beliefs	Maintainers	Regainers	-10.47*	3.53	.014	-19.10	-1.84
		Normal stable	2.01	3.49	.834	-6.54	10.57
	Regainers	Normal stable	12.48**	3.33	.001	4.51	20.45
Uncontrolled eating	Maintainers	Regainers	-6.14	6.83	.647	-23.22	10.95
		Normal stable	12.73	6.56	.153	-3.82	29.28
	Regainers	Normal stable	18.86**	4.75	.001	7.46	30.26
Cognitive Restraint	Maintainers	Regainers	15.40*	5.85	.035	.95	29.85
		Normal stable	20.88**	6.32	.006	5.43	36.33
	Regainers	Normal stable	5.49	5.58	.589	-7.87	18.85
Emotional eating	Maintainers	Regainers	-16.19	10.22	.274	-41.97	9.59
		Normal stable	9.19	10.12	.642	-16.41	34.80
	Regainers	Normal stable	25.38**	6.61	.001	9.55	41.21

Note. *p< .05 level; **p<.01; CI=confidence interval; MD= mean difference; SE= Standard Error

We also computed a MANOVA analysis to see if general irrational beliefs measured with GABS subscales significantly affect categories. We found that when we take all the irrational beliefs styles, using Pillai's trace, there was a significant effect of categories on the variables $V=0.53$, $F(26,146)=2.00$, $p<.05$, $\eta^2= .26$. Separate univariate ANOVAs showed no significant effect of categories on irrational thinking, except for the need for approval $F(2,84)=4.14$, $p<.05$, $\eta^2= .10$ (see Table 1).

The results of a post hoc analysis found significant differences when we compared Regainers with Normal Stable Weight on the need for approval. No significant difference was found between participants with Normal Stable Weight and Maintainers (see Table 3).

Table 3.
Multiple Comparisons for Irrationality Subscales in study 2A

Dependent Variable	(I)Categories	(J)Categories	MD (I-J)	SE	Sig.	95% CI Lower Bound	95% CI Upper Bound
Other Downing	Maintainers	Regainers	-1.24*	.469	.029	-2.38	-.11
		Normal stable	-1.23*	.450	.023	-2.32	-.14
	Regainers	Normal stable	.01	.535	1.000	-1.27	1.29
Need for Approval	Maintainers	Regainers	-1.59	.707	.080	-3.33	.16
		Normal stable	-.07	.674	.994	-1.74	1.60
	Regainers	Normal stable	1.52*	.589	.032	.11	2.93

Note. *p< .05; **p<.01 level; CI=confidence interval; MD= mean difference; SE= Standard Error

3.2.3.1.3 Discussion study 2A

Our study identified significant differences between the abovementioned categories regarding self-efficacy, irrational food beliefs, uncontrolled eating, and emotional eating. We also found that the irrational belief type regarding the need for approval also differed significantly between categories.

Multiple comparison analyses showed that self-efficacy is significantly lower among the Regainers than the Maintainers or the Normal Stables. When we examined irrational food beliefs, they were significantly higher among the Regainers than among the Maintainers or the Normal Stable. We found no significant differences in irrational food beliefs between people in the Maintainers or Normal Stable categories. Our findings can explain why Maintainers can keep the lost weight in that they imply that eating is easier to restrain when it is not associated with irrational attitudes such as eating is a source of comfort, relaxation, or a purpose for social events.

Moreover, the irrational belief related to the need for approval was significantly higher among the Regainers group than the Normal Stable group. It might be that this irrational belief activates their weight loss motivation and could cause failures in maintaining their weight. This finding is an exciting result that future research needs to investigate further.

Regarding eating behaviors, the Regainers cognitively restraint significantly less than Maintainers, and they eat significantly, uncontrolled, and emotionally than Normal Stable.

Maintainers and individuals in the Normal Stable category did not differ in their eating behaviors, although they did differ in terms of Cognitive Restraint which could explain the weight regain. Maintainers do not differ significantly from Regainers in terms of uncontrolled and emotional eating.

Our results align with previous research, which found that self-efficacy and eating behaviors are important psychological factors in weight loss and weight maintenance (Elfhag & Rossner, 2005; Teixeira et al., 2010, 2015; Varkevisser et al., 2019). (S. M. Byrne, 2002) also found that the Regainers have more dysfunctional thoughts in terms of dichotomous thinking than the Maintainers. We found that different types of irrationality: food-related and need for approval, are also factors that can be characteristic to a category or another and, therefore, can be essential to address in weight management.

3.2.3.2 Study 2B

3.2.3.2.1 Participants

The participants' flow for study 2B is described in figure 2. The mean age of the participants was 31.3 (*SD*=11.20), with a mean BMI of 26.93 kg/m² (*SD*=5.54). 258 were females and 18, males. We organized into three groups depending on their BMI: Obesity, Overweight, and Normal weight.

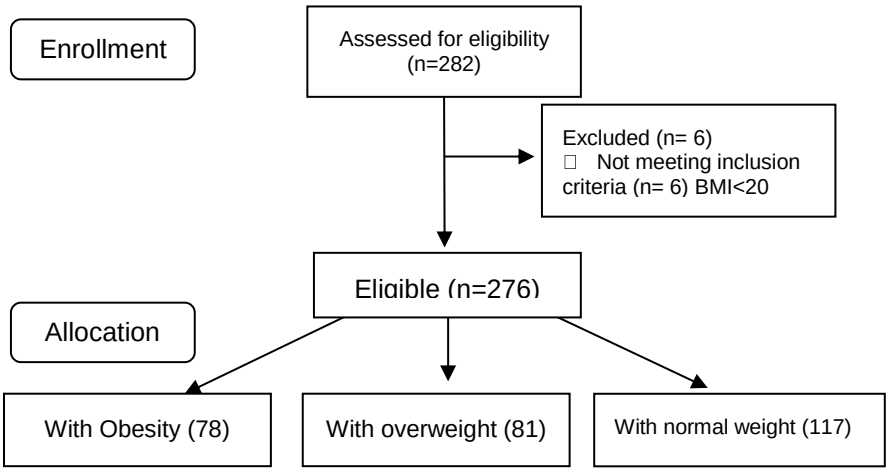

Figure 2. Participant flow for study 1B

3.2.3.2.2 Outcomes

Using Pillai's trace results showed a significant multivariate effect of categories on the variables considered V=0.19, F(16,534)=3.53, p<.001, η^2=.10. Also, after we conducted separate univariate ANOVAs, we found significant effects in self-efficacy, irrational food beliefs,

uncontrolled eating, cognitive restraint, and emotional eating (see Table 4).

Table 4.
Results of Univariate ANOVA in study 2B

Dependent Variable	**F**	**Sig.**	η^2
Self-efficacy	$F(2,273)=6.49^{**}$	.002	.05
Irrational Food Beliefs	$F(2, 273)=10.17^{***}$	.000	.07
Need for Comfort	$F(2, 273)=6.58^{**}$	.002	.05
Demand for Fairness	$F(2, 273)=4.30^{*}$	.015	.03
Uncontrolled eating	$F(2, 273)=7.08^{**}$	.001	.05
Cognitive Restraint	$F(2, 273)=3.58^{*}$	.029	.03
Emotional eating	$F(2, 273)=20.24^{***}$	.000	.13

Note. *p< .05; **p<.01; *** p<.001 level.

Based on post hoc analysis, the results showed statistically significant differences in self-efficacy, irrational food beliefs, uncontrolled eating, cognitive restraint, and emotional eating between the Obesity and the Normal Weight group that remained significant except for uncontrolled eating when we compared the Overweight with the Normal Weight group (see Table 5).

Table 5.
Multiple Comparisons in study 2B

Dependent Variable	(I)Categories	(J)Categories	MD (I-J)	SE	Sig.	95% CI Lower Bound	95% CI Upper Bound
Self-efficacy	Obesity	Overweight	.53	3.16	.984	-6.95	8.02
		Normal weight	-7.97*	2.86	.016	-14.75	-1.20
	Overweight	Normal weight	-8.51**	2.63	.004	-14.72	-2.29
Irrational Food Beliefs	Obesity	Overweight	2.65	2.37	.506	-2.97	8.26
		Normal weight	9.18***	2.07	.000	4.28	14.07
	Overweight	Normal weight	6.53**	2.21	.010	1.31	11.74
Uncontrolled eating	Obesity	Overweight	5.93	3.06	.131	-.1.31	13.16
		Normal weight	11.00**	2.91	.001	4.15	17.87
	Overweight	Normal weight	5.07	2.91	.192	-1.81	11.95
Cognitive Restraint	Obesity	Overweight	-1.81	3.05	.824	-9.02	5.40
		Normal weight	-7.83*	3.07	.031	-15.09	-.58
	Overweight	Normal weight	-6.03*	3.18	.014	-13.53	1.49
Emotional eating	Obesity	Overweight	6.01	4.07	.306	-3.63	15.65
		Normal weight	23.88***	3.94	.000	14.58	33.18

	Overweight	Normal weight	17.87***	4.03	.000	8.34	27.40

Note. *p< .05; **p<.01; ***p<.001 level; CI=confidence interval; MD= mean difference; SE= Standard Error

This study also examined different types of irrationality, and we computed another MANOVA analysis. We found that when consider all the irrational subscales, Using Pillai's trace, there was a significant effect of categories on the variables V=0.26, F(26,524)=2.94, p<.001, η^2=.13. Separate univariate ANOVAs were further conducted, showing significant differences between groups regarding the need for comfort and demand for fairness (see Table 4).

The multiple comparison analysis results showed significant differences when comparing the Obesity and Overweight groups with the Normal Weight group on the need for comfort. Regarding the demand for fairness, the difference was significant only between the Overweight and Normal Weight groups (see Table 6).

Table 6.

Multiple Comparisons for Irrationality Subscales in study 2B

Dependent Variable	(I)Categories	(J)Categories	MD (I-J)	SE	Sig.	95% CI Lower Bound	95% CI Upper Bound
Need for Comfort	Obesity	Overweight	-.27	.38	.756	-1.18	.64
		Normal weight	.87*	.32	.021	.11	1.63
	Overweight	Normal weight	1.14**	.36	.005	.30	1.98
Demending for Fairness	Obesity	Overweight	-1.02	.54	.144	-2.29	.25
		Normal weight	.44	.49	.645	-.72	1.60
	Overweight	Normal weight	1.46*	.51	.014	.25	2.67

Note. *p< .05; **p<.01 level; CI=confidence interval; MD= mean difference; SE= Standard Error

3.2.3.2.3 Discussion study 2B

Previous research explored the potential utility of irrational beliefs and eating behaviors in weight management (Nolan & Jenkins, 2019; Teixeira et al., 2010, 2015) and how some are associated with obesity (Fathabadi et al., 2017; Lewis et al., 2010; Tomotake et al., 2002). Our study 2B revealed the psychological differences between persons with obesity, overweight, and normal weight. We determined significant differences between the aforementioned groups regarding self-efficacy, irrational food beliefs, uncontrolled eating, cognitive restraint, and emotional eating. Our analysis also found that two irrational thinking styles called demanding fairness and need for comfort, are also significantly different between these groups.

Multiple comparison analyses showed that participants from Obesity or Overweight groups have a significantly lower level of self-efficacy than those from the Normal weight group. We found no significant differences in terms of self-efficacy between the Obesity and

Overweight group. This result was expected, considering that these two categories of people have gained weight continuously and do not have a desired or healthy weight.

Irrational food beliefs were significantly higher in participants with obesity or overweight compared with those with normal weight but not significantly different between the first two categories. This finding is an expected but exciting result because the attitude towards food can change eating behaviors.

Regarding specific types of irrationality not related to food, we found that the levels of need for comfort were significantly higher for those with overweight and obesity than those with normal weight. Also, we found higher levels of demand for fairness in those with overweight. The high level of need for comfort might explain the inability of people with overweight or obesity to adhere to a diet, and demandingness for fairness is a potential mechanism of emotional eating to regulate the negative emotions activated by these beliefs. These relations need to be further investigated.

Regarding eating behaviors, the participants with obesity and overweight reported a significantly higher rate of emotional eating, uncontrolled eating, and less cognitive restraint than those from the normal weight group. We found no significant differences in eating behaviors between obese and overweight groups, which suggests that similar cognitive mechanisms are involved in both overweight and obesity-related behaviors.

3.2.4 General conclusions

As noted, this is the first quantitative study that identified psychological variables that are characteristic of persons who lost weight voluntarily. We determined some of the psychological differences between the participants who maintain or regain the lost weight, those who had a normal stable weight, and those with obesity or overweight.

We found that psychological factors may explain why some people maintain weight loss whereas others do not. Also, the results of study 2B specify relevant cognitive factors (i.e., self-efficacy, irrational beliefs) and eating behaviors of individuals with obesity or overweight and how they differ from those with normal weight. Our findings help us understand the psychological factors that contribute to weight loss failure and have implications for creating more efficient weight-loss interventions.

3.3 Study 3. Eating Behavior - Choice or Reconstruction of Past Experience? A Randomized Clinical Trial of Changing Eating Intentions of Healthy Adults through Hypnotic Suggestions[2]

3.3.1 Introduction

This study proposes a different approach to changing eating intentions —an approach from voluntary movement research. The concept of Free Will was first described in an experiment by Libet et al. (1983). According to this concept, the decision to act is taken before being acknowledged and made following previous experiences' reconstruction. Therefore, it can be inhibited in a short time (max 100ms) after awareness. Thus, the moment the decision becomes conscious can be used to inhibit the action. Decision consciousness occurs about 150 ms before muscle activation, enough for the conscious function to modify the volitional process's final result (Brooks, 2016). People become aware of the intention to act with a little delay of 350-400 ms after readiness potential start, but 200 ms before the action is performed (Brooks, 2016).

This experiment was then replicated with more naturalistic tasks, like giving the participants strong reason to inhibit or execute actions (Kühn et al., 2009) or to decide between two buttons freely (Soon et al., 2008).

The action is considered caused by the reconstruction of experience ("subjective back referral") (Kühn & Brass, 2009), and it works under a forward model (Wolpert et al., 1995), which makes predictions about motor system behavior and its sensory consequences. This forward model is used in mental training to learn to select between possible action choices by predicting the sensory of action without actually performing it (Wolpert et al., 1995).

The potential role of the moment of consciousness is to stop or veto the volitional action's progress. In this way, the conscious will could affect the outcome (Kühn et al., 2009). About 100ms is enough for the conscious function to modify the volitional process's outcome (Brooks, 2016). Indeed, memory plays a crucial role in determining the decision - in uncertain or ambiguous situations, we act as we have done successfully in the past. Furthermore, the memory of previous stimuli or the reward value of associated actions can change actions and make them stimulus-driven ones (Haggard, 2008). For this reason, autobiographical memory plays an essential part in the psychological elements of human behavior (Haggard, 2008).

We consider that this model can be used based on hypnotic suggestions to change eating intentions. Hypnotic suggestions are widely used as an investigative tool in neuroscience and cognitive research areas regarding behavior and the ability to wield control over automatic processes (Oakley & Halligan, 2013; Raz et al., 2005). This study is interested in cognitive suggestions that affect high-level psychological processes involving memory and perception,

[2] Comșa, L., David, O., & David, D. (2021). Eating Behavior - Choice or Reconstruction of Past Experience? A Randomized Clinical Trial of Changing Eating Intentions of Healthy Adults through Hypnotic Suggestions. *Behavior Therapy*. https://doi.org/10.1016/j.beth.2021.09.005

such as selective amnesia or guided goal-directed imagery. Studies showed that posthypnotic suggestions could alter cognitive processes (Raz et al., 2005). Thus, our study starts from the evidence coming from recent neuroscience research suggesting that hypnosis is a physiologically based experience that, with the help of targeted suggestions, modifies automatic, unconscious processes over which participants have little or no volitional control (Oakley & Halligan, 2013).

Hypnosis is an effective treatment for rapid weight loss (Erşan & Erşan, 2020; Milling et al., 2018; Roslim et al., 2021) and can be applied alone or combined with other treatments, like Cognitive Behavioral Therapy (CBT) (Kirsch, 1996). However, to confirm its effects, further studies should be conducted to compare hypnotic suggestions with other methods that modulate cognitive control, including placebo (Raz et al., 2005). It is also important to use, designs that control for placebo and expectancy effects, to disambiguate the effects of hypnosis from the effects of suggestion alone, and also to establish the mechanisms by which suggestion produces significant effects (Lynn et al., 2020; Roslim et al., 2021), in studies that randomly allocate participants to conditions, and employ adequately trained clinicians to delivered interventions based on manualized treatments (Ramondo et al., 2021).

Our study addresses these limitations by using an active control group to compare interventions that contain different types of hypnotic suggestions. We believe that our study makes a valuable contribution to the literature by identifying precisely how hypnotic suggestions can change the intentions of eating and thus emphasize their role as a mechanism of change.

3.3.1.1 Objectives and hypothesis

This study aimed to evaluate the effectiveness of three types of hypnotic suggestions on changing eating intentions through the Free Will concept's prism.

We hypothesized that, with the help of hypnotic suggestions, we could inhibit eating intentions: first, by acting on the moment of decision's consciousness -Will, and second, by altering the past experience. Thus, we expected to see a significant change in eating intentions in the intervention groups, measured by the number of images of high-calorie food chosen by the participants.

3.3.2 Methods

The study is a randomized, parallel, experimental trial with three active interventions and one active placebo as a control group. The study was conducted following the CONSORT guidelines (Boutron et al., 2017).

3.3.2.1 Participants

We conducted this study following the Declaration of Helsinki, and the protocol has the ethical approval 20.834/12.11.2019 of the Ethics Committee of the university where it was conducted. The protocol was registered to ClinicalTrials.gov on 25.11.2019 and had the ID NCT04178486.

We considered eligible to participate in the study healthy adults (≥18 years old) with a minimum normal weight (BMI> 18.5) seeking out weight loss.

There was an important similarity across interventions: apart from suggestions, all groups received hypnotic relaxation induction. Each intervention takes a similar amount of time, nearly 50 minutes, and the Control near 40 minutes. The intervention groups differed only in the suggestions received.

3.3.2.2 Interventions

3.3.2.2.1 Amnesia

Hypnotic amnesia is a functional dissociation from awareness, during which some information is not available to consciousness and is well documented (Jamieson et al., 2017). Posthypnotic amnesia results from suggestions to forget specific information after hypnosis and can effectively interfere with the recognition and recall of semantic and episodic information. At the end of the hypnosis, the suggestion can be canceled so that the mnemonic function returns to normal (Terhune & Brugger, 2011). Much research has successfully used posthypnotic amnesia for forgetting pictures or real-life memoranda (Jamieson et al., 2017; Mendelsohn et al., 2008). In the Amnesia group, the suggestions were to experience amnesia for the food pictures they had just seen. These suggestions were given to alter the past experience of participants.

3.3.2.2.2 Cognitive rehearsal

According to the Free will concept, the decision to inhibit the action has to be taken in a very short time (200ms). Thus, if this decision is processed routinely, it will be easier and faster because this normally operates unconsciously (Jack, 2001; Oakley & Halligan, 2009). Intentional actions involve substantial deliberate preplanning and show more anticipatory awareness (Haggard et al., 1999). This shift in perception can be done by altering voluntary action awareness through hypnotic suggestions of involuntariness. Haggard et al. (2004) used hypnotic suggestions to create the experience of involuntariness in healthy participants. Their results offered strong support that involuntary actions represent dissociation between voluntary action and conscious experience. Cognitive Rehearsal is a cognitive hypnotherapy technique in which the participant receives targeted suggestions to imagine himself behaving in new ways in problematic situations (Dowd, 2000). In the Cognitive Rehearsal group, the suggestions were to imagine themselves in front of high-calorie food and see them not taking it because their brain decided not to. The role of these suggestions was to ease the act of inhibition on the moment of decision's consciousness - Will.

3.3.2.2.3 Memory Substitution

Much research shows that memories are not permanently encoded in the brain but are at least partially constructed over time (Loftus, 1997, 2005; Loftus & Pickrell, 1995). Memories can be shaped significantly, which may have therapeutic benefits (Dowd, 2000). Modification of memory is a successful technique for ameliorating the psychological distress of traumatic experiences. The memories of the original events can be restructured and replaced with other benign ones (Gravitz, 1994; Lamb, 1985; Meyerson, 2010). In the Memory Substitution group, hypnotic suggestions described past events in which they always controlled their eating behaviors. These suggestions were given to alter the past experience of participants.

3.3.2.2.4 Control Group

Participants in this group received only the hypnotic relaxation induction without any suggestions relevant for eating or food pictures they saw.

3.3.2.3 Procedure

After we screened the participants for eligibility, we scheduled them for the intervention by phone. The intervention occurred at the location of the department of the university where the study was conducted.

Participants were invited to sit in front of the computer. When they were ready to begin, the computer task started with a welcome message, and 60 pictures of food were presented in a randomized order, each for a 3s duration. There were 30 pictures of low-calorie and 30 of high-calorie food. To minimize habituation, no image was used more than twice. After each picture, a grey display appears with the question: "If this food were in front of you, would you eat it?" The participants could choose to answer Yes or No.

After completing the task, participants were kindly asked to sit in the chair in a comfortable position, and a certified psychologist trained in hypnosis (the first author) started to administer the intervention based on a standard script. The intervention consisted of a hypnotic relaxation induction in which participants closed their eyes and received hypnotic suggestions that were different in every active intervention and were missing in the control group. The hypnotic induction is an adaptation from the one used in the Harvard Group Scale of Hypnotic Susceptibility (Shor & Orne, 1963). After receiving the suggestions, participants were kindly asked to open their eyes and start a new computer task with the same procedure. After completing the task for the second time, they were asked to close their eyes and relax. Induction was then terminated, participants opened their eyes and came back into the "in vivo" state, and then, they had to start the same task on the computer again, for the third and last time. At the end of the task, participants have a short debriefing discussion with the investigator in which, as a manipulation check, they were asked what they felt during the intervention. Their answer was noted on the participant's sheet. Five of them declared that they felt nothing during hypnosis.

3.3.2.4 Measures

The outcome was eating intentions measured through the number of pictures of food chosen by the participants. They were asked to answer the question: "If this food were in front of you, would you eat it?" This outcome was measured three times: before the hypnosis, during hypnosis, and immediately after hypnosis. We considered three forms of eating intentions: high-calorie food, low-calorie, and a total of food chosen.

To see if some individual differences can affect the participants' eating intentions, we also measured the participants' hunger levels using a Visual Analogue Scale (VAS). Participants had to evaluate the degree to which they feel hungry on a scale ranging from 1 (I am not hungry at all) to 10 (I am very hungry), and the score was graphically measured to pursue any dimensional changes.

In addition, other information like height, weight, and age were taken from the participants in the enrolment phase.

3.3.2.5 Statistical analysis

To test the effects of the interventions on eating intentions, we computed a 4 (group) x 3 (time) x 2 (types of chosen food: High-calorie food and Low-calorie food) repeated measures ANOVA analysis. Power analysis was conducted by using the multivariate partial η^2 provided by SPSS, which, according to Cohen (1988), is interpreted as small (d=0.2), medium (d=0.5), and large (d=0.8). The significance criterion was p<.05. We then used a Bonferroni-adjusted pairwise comparison of the estimated marginal means for within- and between-subjects effects.
We ran a correlation analysis to see any significant relations between baseline characteristics and the results from post-test.

3.3.3 Results

3.3.3.1 Participants

The participants' chart flow is presented in Figure 2. After analyzing the eligibility from the 100 participants enrolled, all of them were retained, and scheduled for intervention. Finally, only 88 were present at the laboratory and entered into the intervention.

There were no statistically significant differences in demographic and clinical characterisitcs among participants in the four conditions (see Table 1). All participants were Caucasian.

Table 1.
Baseline Demographic and Clinical Characteristics for Each Group

	Amnesia *N*=20	Cognitive Rehearsal *N*=23	Memory Substitution *N*=21	Control *N*=24
Age	30.65	35.75	34.52	33.3
BMI	26.17	28.69	26.86	25.99
Male	1	2	4	1
Female	19	21	17	23

Note. *N*=number of participants in a group

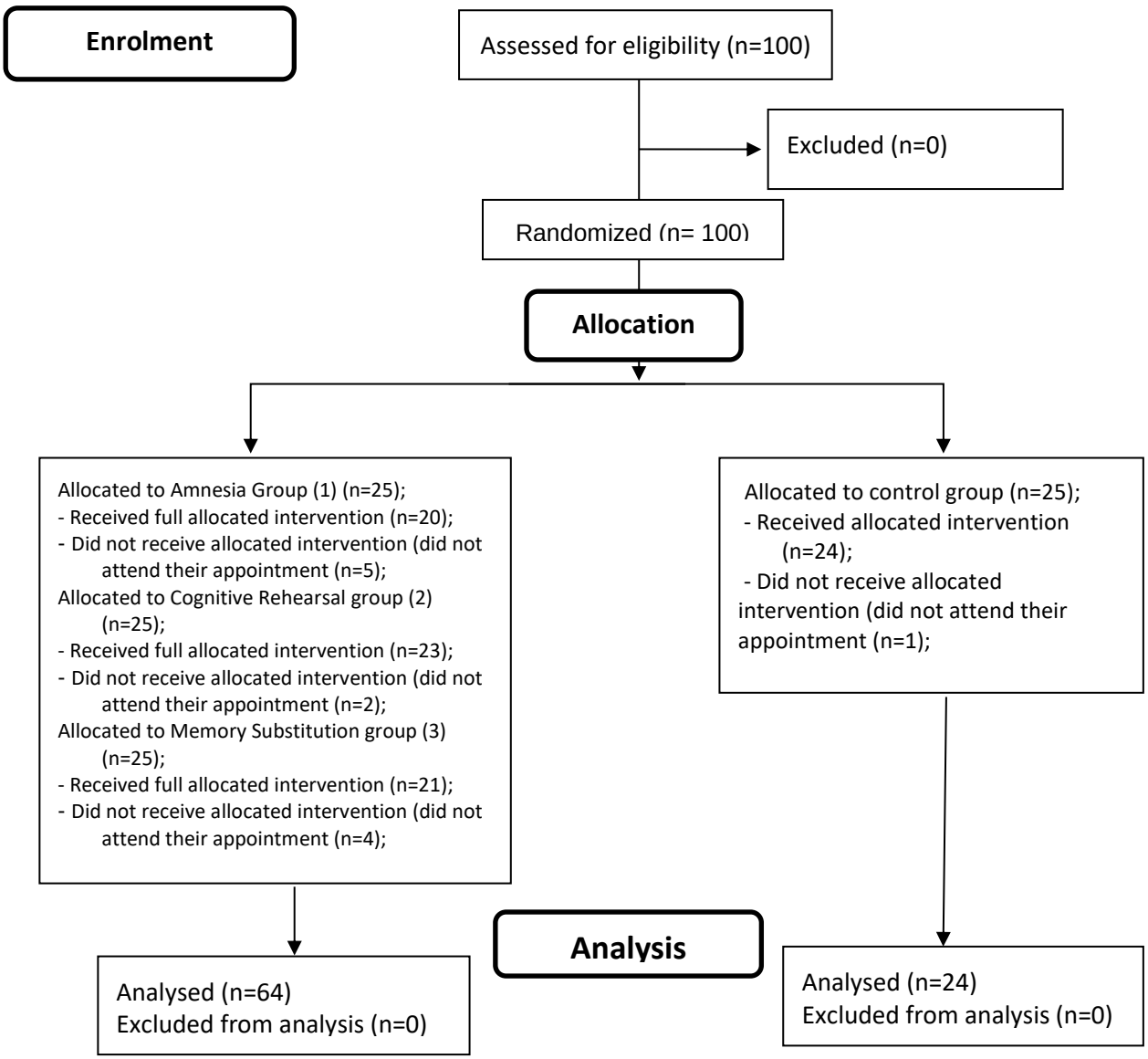

Figure 2. CONSORT 2010 Flow Diagram

3.3.3.2 Main analysis

We found a significant main effect of the interventions on eating intentions (pre-test vs. post-test) within-subjects: $F(2,83)=26,20$, $p<.001$, $\eta^2 =0.39$ and between-subjects: $F(3,84)=3.67$, $p<.05$, $\eta^2 =0.12$ (Amnesia vs.Cognitive Rehearsal vs. Memory Substitution vs. Control). We also identified a significant interaction time x intervention effect: $F(6,168)=3.12$, $p<.005$, $\eta^2 =0.10$.

To identify the interaction effects, we computed pairwise comparisons both for within- and between-subjects and we generated plots for visual inspection (Fig. 3). We found significant differences in eating intentions from pre- to post-test only in Cognitive Rehearsal (both in low-calorie (MD=4.78, SE=1.23, p<.005, CI= [1.78, 7.78], d=0.71) and high-calorie food images (MD=5.48, SE=1.19, p<.001, CI= [2.57, 8.40], d=0.81) and Memory Substitution Group (in low-

calorie (MD=6.43, SE=1.29, p<.001, CI= [3.29, 9.57], d=1.06) and high-calorie food images (MD=5.57, SE=1.25, p<.001, CI= [2.52, 8.62], d=0.82).

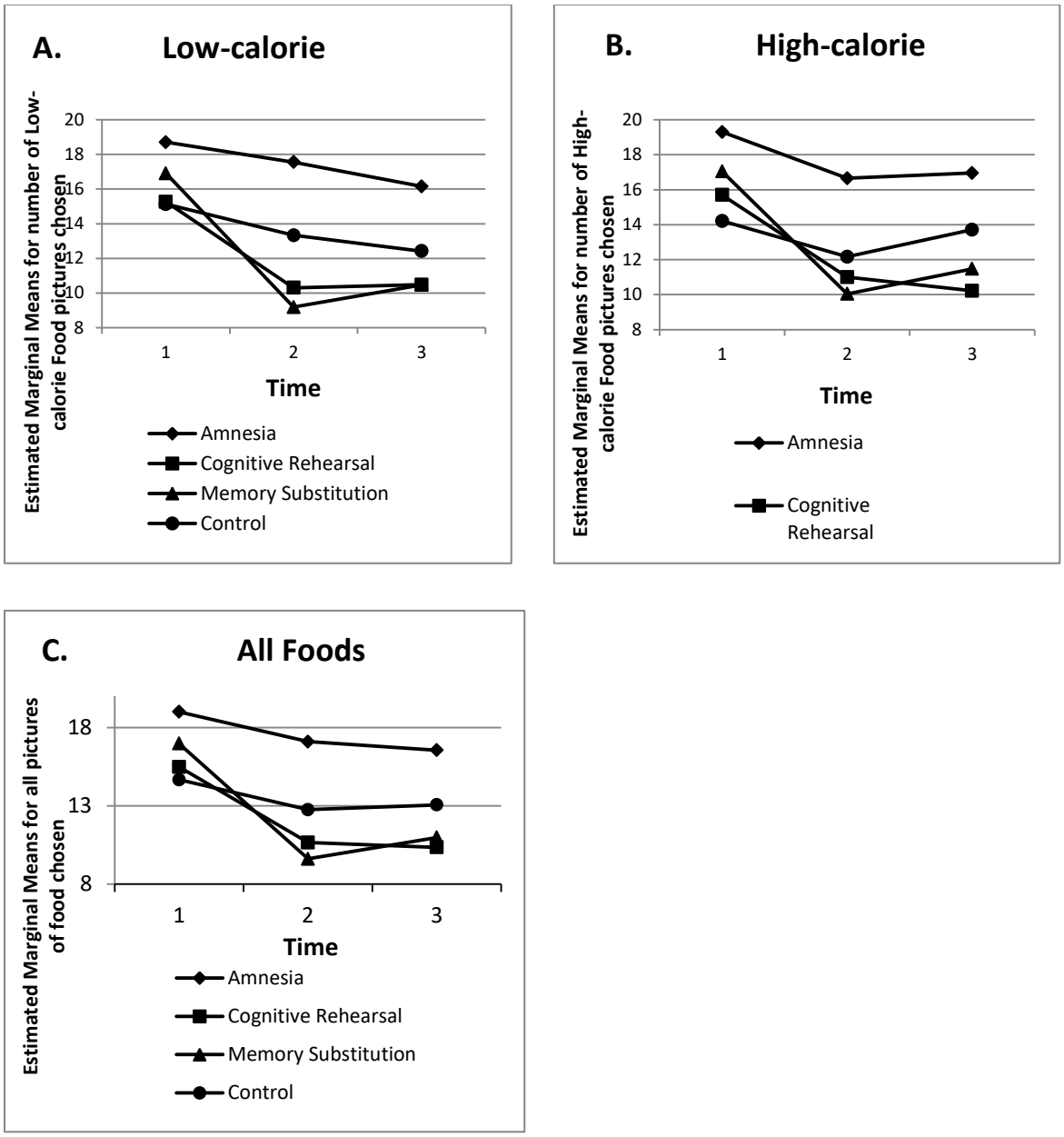

Figure 3. Graphical representation for significant interaction effects. Panel A represents the results for the number of pictures of the low-calorie food chosen; Panel B represents the results for the number of the pictures of high-calorie food chosen; Panel C represents the results for the number of the pictures of high-calorie food chosen.

Of the four groups, Cognitive Rehearsal and Memory Substitution hypnotic suggestions significantly changed eating intentions during hypnosis (Time point 2), which remained unchanged after the induction was canceled (Time point 3). From Time point 1(before hypnosis) to Time point 2 in the Cognitive Rehearsal group the intentions of eating changed significantly

for both low-calorie (MD=4.96, SE=1.39, p<.005, CI= [1.57, 8.35], d=0.70) and high-calorie food images (MD=4.70, SE=1.09, p<.001, CI= [2.05, 7.35], d=0.71). The same pattern was also found in the Memory Substitution group where the intentions of eating were changed significantly also on both low-calorie (MD=7.71, SE=1.45, p<.001, CI= [4.17, 11.26], d=1.09) and high-calorie food images (MD=7.00, SE=1.14, p<.001, CI= [4.23, 9.77], d=1.06). From Time point 2 to Time point 3, we found no significant differences in any food types in all four groups.

Regarding the difference between groups at post-test, we found significant differences only between Amnesia vs. Cognitive Rehearsal (MD=5.67, SE=2.05, p<.05, CI= [0.15, 11.20], d=0.85 for low-calorie and MD=6.73, SE=2.06, p<.05, CI= [1.16, 12.30], d=1 for high-calorie food images) and Amnesia vs. Memory Substitution MD=5.67, SE=2.09, p<.05, CI= [0.03, 11.32], d= 0.96 for low-calorie food images.

We found no significant differences between the control group and intervention groups at post-test.

After computed the correlation analysis, there was a significant relationship only between the level of hunger and all types of food chosen, r=.*378, p* (two-tailed) <.005; low-calorie food r=.339 *p* (two-tailed) <.005 and high-calorie food r=.382; *p* (two-tailed) <.01. Finally, we followed the correlation with a linear regression analysis with hunger as an independent variable and eating intentions as a dependent one. We found that the level of hunger is a significant predictor of eating intentions: for the total of food chosen R^2=.15; F(1,87)=14.35, p<.001; B=1.78, SE=.47; p<.001, for the low-calorie food R^2=.12; F(1,87)=11.16, p=.001; B=0.83, SE=.25; p=.001 and for high-calorie food: R^2=.15; F(1,87)=14.70, p<.001; B=.95, SE=.25; p<.001.

3.3.3.3 Ancillary analyses

The visual inspection of the fourth groups'(interventions and Control) evolution revealed a considerable yet no significant difference between the pre-test variables in the Amnesia group, and we decided to consider it. Thus, we implemented an ancillary analysis computing a separated univariate analysis of covariance (ANCOVA's). We compared post-test scores of eating intentions between groups using as covariates the pre-test scores of eating intentions. The analyses indicated significant differences between groups for all variables: for total of food chosen (F(1,83)=75.07, p<.001, η^2 = 0.48), low-calorie food (F(1,83)=62.35, p<.001, η^2 = 0.43) and high-calorie food (F(1,83)=58.55, p<.001, η^2 = 0.41). The comparative analysis yielded significant differences at post-test between the Control and Cognitive Rehearsal group: (MD=4.51, SE=1.51, p<.05, CI=[0.45,8.58] only for chosen pictures of high-calorie food.

3.3.4 Discussion

The results of this study can be preliminary support of our hypothesis that this concept is also applicable in modifying ecological actions relevant to eating intentions.

Our results align with others (Bolocofsky et al., 1985; Kirsch, 1996; Kirsch et al., 1995; Milling et al., 2018), showing that hypnosis is an effective technique in weight management.

Of all four groups, Cognitive Rehearsal and Memory Substitution hypnotic suggestions significantly changed eating intentions during hypnosis, which remained unchanged after the induction was canceled. The visual inspection of the Control group's main effect reveals that the eating intentions remain almost constant across all three measurement times, while the results differed in the other three groups. The result that the Cognitive Rehearsal group performed significantly better than Control on eating intentions regarding high-calorie food showed the efficacy of the hypnotic suggestions because they specifically targeted those types of food. In groups Control and Amnesia, eating intentions does not significantly change through time.

This study not only shows that hypnosis is useful for changing intentions of eating, but it also points to the responsible elements of this change: hypnotic suggestions that intervened both by changing past experience or by training for future experience to inhibit action.

Our research has several limitations: the intervention was offered in a single session, and the eating intentions were measured immediately after the intervention, using images and not real food. Future research will need to verify these results in more ecological real-life interventions.

This study makes a valuable contribution primarily because it enriches hypnosis research through a correct design, using the active placebo as the control group. Secondly, as far as we know, this study is the only study that analyses eating intentions based on the Free Will concept, and this can highlight the lack of control in the face of high-calorie food and explain why changing undesirable eating behaviors is so difficult. This intervention can be delivered as an independent one or together with other psychological interventions (e.g., CBT) targeting eating behaviors to increase their effectiveness, as eating intentions are strong predictors ((Louis et al., 2009; McClain et al., 2009; Psouni et al., 2016). It could also be transported in ecological contexts because it is easy to implement and can be offered both face-to-face and online.

3.4 Study 4. Strengthening the Freedom of VETO! A Randomized Clinical Trial to Test the Efficacy of Cognitive Training in Changing Eating Behaviors

3.4.1 Introduction

3.4.1.1 Background and objectives

Results of many studies showed that psychological interventions have a small to medium effect on weight loss (Jacob et al., 2018), and it is now known that changing eating behaviors such as weight loss activities, diet, exercise (Linde et al., 2006) or flexible eating restraint, self-monitoring, lower emotional eating (Teixeira et al., 2010, 2015) leads indeed to weight loss. Therefore, this study aims to improve eating behaviors by testing two effective techniques that are cost-effective and easy to use and implement: Hypnosis and Food Inhibition Training. Both interventions are designed to train implicit attitudes and result in healthier automatic behaviors (Adams et al., 2017; Kirsch & Lynn, 1999; Oakley & Halligan, 2013), in our study, the inhibition of approach and consumption of high-calorie food.

A new approach in developing the ability to override food-related impulses is the computerized go/no-go task in which pictures with high-calorie foods are always presented onscreen with no-go cues. This approach is called Food Inhibition Training and is designed to teach participants to associate high-calorie foods with behavior inhibition (Jones et al., 2016).

Hypnosis is an intervention that can be used to induce a deep state of relaxation, in which therapeutic suggestions re provided. Thus, hypnosis consists of two processes: induction and suggestions (Oakley & Halligan, 2013). In the induction process, the hypnotherapist is guiding the participant to enter into a focused, attentional state and the subject receives hypnotic suggestions, which are considered a valuable tool for investigating behavior and the ability to handle control over automatic processes (Oakley & Halligan, 2013; Raz et al., 2005).

This randomized clinical trial aims to evaluate the effectiveness of two implicit cognitive change techniques. Both active interventions are compared to an active control group that completed the same go/no-go training as the FIT group but using non-food images.

As far as we know, they have not yet been compared to each other.

We hypothesize that active interventions will effectively change eating behaviors and weight and perform better than an active placebo.

3.4.2 Methods

3.4.2.1 Participants

Participants were eligible to participate in the study if they were ≥18 years old and they reported they frequently eat high-calorie foods (at least 2-4 a week). We excluded people who were enrolled in a weight loss program, who reported health and clinical problems or who take medicines that can affect weight loss. They were recruited via Facebook ads and randomized into three groups. Two of these groups received active interventions, and the third received an active placebo.

3.4.2.2 Procedure

The study was carried out online. After completing the online participation consent, the participants filled online questionnaires and their demographic details: age, height, weight, and contact details.

In the first week, participants completed a daily food frequency questionnaire and two food journals (one for a weekday and the other for a weekend day). After this week, participants were randomized via random.org in one of the three groups. No participants (even those in the Hypnosis group) knew the Control Group's form of intervention. In the week of the intervention, participants continued to complete their daily frequency and the food journals, identical to the week before intervention. To receive the intervention, participants met online, via Zoom platform with one of the investigators, and accessed the Go-No Go Task on their computer or received the hypnosis intervention. The meetings were scheduled every time at 8 pm for Go-No Go Task Groups and 8.30 for the Hypnosis Group. The intervention included five online sessions of training. Four of them were in consecutive order in the first week (Monday, Tuesday, Wednesday, and Thursday) and a fifth in the next week (Monday). The timeline and the intervention procedure were adapted from the one developed and used in other trials (Lawrence et al., 2015), which we considered a standard intervention. At the end of all interventions, participants completed another online questionnaire and sent the picture of their weight shown on the screen of their weight scale. The weighing had to be made at the same time of the day before eating anything. The same questionnaire and pictures were sent at a one-month and six months follow-up.

3.4.2.3 Interventions

3.4.2.3.1 Intervention group 1 – Hypnosis.

Participants were asked to sit comfortably in front of their computer or on the couch and begin the hypnotic induction procedure with suggestions - in the future when they are in front of caloric foods: chocolate, biscuits, crisps, cakes, their brain will make the decision not to take those foods, and he/she will not take them. Instead, their brain will make healthy choices, fruits, vegetables, food with low calories. The foods used here were the same foods that were presented as a no-go in the FIT group. The hypnotic induction is an adaptation from the one used in the Harvard Group Hypnotic Susceptibility Scale (Shor & Orne, 1963) induction. After the suggestions, the induction was then terminated, and the participants had a debrief discussion with the investigator before the Zoom session was over. In this discussion, participants were asked how they felt during hypnosis as an assessment to determine if the hypnosis was successful and if the participants experienced the intended hypnotic effects. The duration of the hypnosis sessions was approximately 15 min.

3.4.2.3.2 Intervention group 2 – Food Inhibition Training (FIT)

This intervention consisted of a Go-No Go computer task. Participants were shown pictures of energy-dense food (chocolate, biscuits, crisps, cakes) or low-calorie food (fruits, vegetables) alongside a cue to press a button or not. Energy-dense foods were always presented with a no-go cue (a bold frame) and low-calorie foods with a go cue (thin frame). Half of the

trials included filler images (clothing) paired with go and no-go cues 50% of the time. Each training session consisted of 192 trials, divided into six blocks. The task was created at the Exeter University and described in detail elsewhere (Lawrence, O'Sullivan, et al., 2015).

3.4.2.3.3 Intervention group 3 – Active PLACEBO

This intervention consisted of a Go-No Go computer task. First, participants were shown neutral pictures (e.g., households, clothes) alongside a cue to press a button or not. The task used here was the same as the FIT. The difference consisted only in the content of the images (Lawrence, O'Sullivan, et al., 2015).

3.4.2.4 Outcomes

3.4.2.4.1 Primary outcomes measures

Weight was reported in kilograms. For a more standardized measurement, the participants weighed themselves in the morning and sent a picture with the scale's display.

Daily frequency was measured through a Food Frequency Questionnaire (Churchill & Jessop, 2011) in which participants provided daily ratings of how often they consumed eight typical snacks: chocolate, potato chips, cakes, crisps, candies, biscuits, ice-cream, and pastry. The rating was made through a six-point scale (ranging from 1=None to 6= More than four a day). Every evening, the participants received an e-mail containing the link to the questionnaire and completed it every day for two weeks. The arithmetic mean was calculated for each week (before and during the intervention), resulting in two-time point measures.

The monthly frequency had the same format as the daily frequency, with the exception that the frequency referred to the last month's consumption through an eight-point scale (ranging from 1=None to 8= Four or more a day).

Energy intake was measured through a self-reported diary of food. The participants wrote what they had eaten on two different days of the week (weekday and weekend days). These diaries were completed the week before and during the intervention.

To measure changes in Food preferences, participants rated how much they like eight typical snacks: chocolate, chips, cakes, crisps, candies, biscuits, ice-cream and pastry through a five-point Likert like scale (ranging from 1=Not at all to 5= I like it very much) created by the authors about the preferences of high-calorie food. Higher scores mean a high preference for high-calorie food.

Eating behaviors were measured with 21-item Three-Factor Eating Questionnaire (Stunkard & Messick, 1985). The scale measures three aspects of eating behavior: cognitive restraint (CR), uncontrolled eating (UE), and emotional eating (EE). Higher scores indicate greater CR, UE, or EE. We translated it into Romanian.

3.4.2.4.2 Secondary Outcomes Measures

To assess for changes in eating intentions, the authors created a self-report fourth-point Likert scale in which participants had to rate to what degree they wish to avoid eating snacks in the next two weeks. Higher scores indicate a stronger desire to avoid high-calorie food. The items ranged from 1= Definitely False to 4=Definitely True.

Eating self-efficacy was measured online with the Weight Efficacy Lifestyle Questionnaire – short form. This questionnaire is a valid measure of self-report self-efficacy for controlling eating. Higher total scores indicate higher eating self-efficacy. We translated the questionnaire into Romanian.

The motivation was measured with the Interest/Enjoyment subscale from the Intrinsic Motivation Inventory (McAuley et al., 1989; Ryan, 1982). This subscale is considered the self-report measure of intrinsic motivation, and it is the only one that assesses intrinsic motivation, per se. Higher total scores indicate a high intrinsic motivation**.**

Positive and negative affect was also measured as potential moderators of effects using Positive and Negative Schedule (PANAS) (Watson et al., 1988). A higher score on negative affect represents higher levels of negative affect, and a higher score on positive affect representing higher levels of positive affect.

3.4.2.4.3 Predictors of the outcome

At the beginning of the intervention, we measured the variables that are considered to influence eating behaviors and weight loss: irrational food beliefs and behavioral activation. In addition, intervention expectations were also measured to determine whether pre-treatment expectancies potentially predict the results. Finally, the positive and negative emotions from the pre-test were also analyzed as potential predictors.

The level of irrational food beliefs was measured at the beginning of the study with the Irrational Food Beliefs Scale (IFB) (Osberg et al., 2008). This study used only the irrational subscale. Higher scores indicated a higher level of irrational thinking about food.

Intervention expectations were measured at the beginning of the trial through a VAS scale in which participants were asked the extent to which they expect the intervention to be effective.

This study used the Fun Seeking Subscale from the Behavioral Inhibition/Behavioral Activation Scales (Carver & White, 1994). Higher scores are linked to impulsivity. A high Behavioral Activation System (BAS) reactivity is positively related to food craving and BMI (Franken & Muris, 2005).

The primary and secondary outcomes were measured at four time points: pre-intervention (1 week ahead), post-intervention (7 days after the start of the intervention week), one month, and six-month after the intervention. However, the daily food frequency was measured at two time points (for the first week and the intervention week), and the monthly food frequency was measured pre-intervention (1 week ahead) and one month and six-month after the intervention.

3.4.3 Results

The flow chart of the participants is described in figure 1.

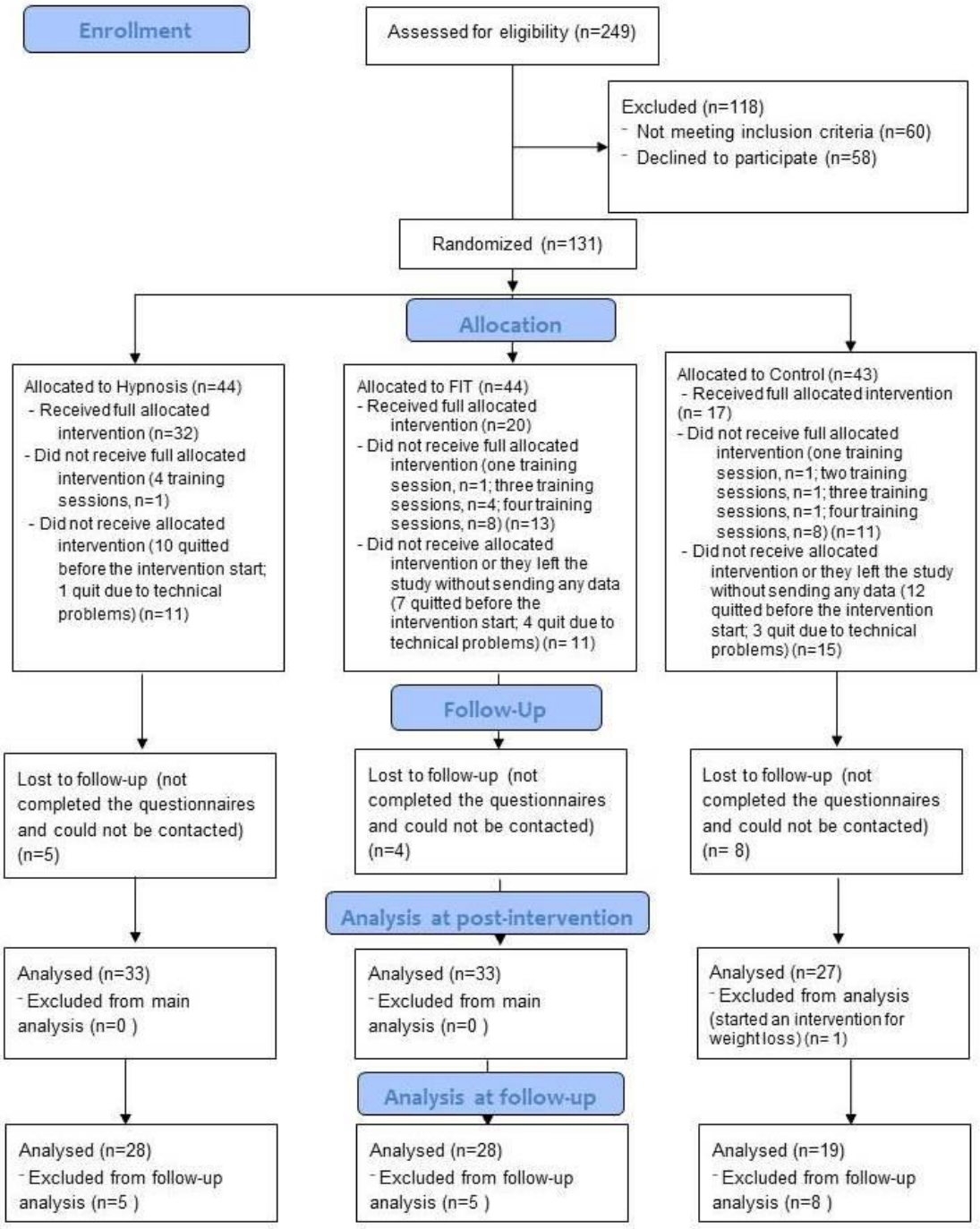

Figure 1. CONSORT Flow Diagram

The main effects of all outcomes are presented in Table 1.

Table 1

Main effects of all outcomes.

Outcome	Fixed effects			Random effects
	time	group	time x group	
Weight	*F*(2,159.64)=3.53, *p*=.032*	*F*(2,93)=.72, *p*=.488	*F*(4,159.33)=0.64, *p*=.64	NA
Daily FFQ	*F*(1,87.80)=31.72, *p*<.000***	*F*(2,92.31)=2.1, *p*=.129	*F*(2,87.79=3.52, *p*=.034*	NA
Monthly FFQ	*F*(1,73.93)=7.82, *p*<.000***	*F*(2,81.31)=0.89, *p*=.42	*F*(2,72.97)=1.56, *p*=.22	NA
Uncontrolled Eating	*F*(2,72.46)=34.32, *p*<.000***	*F*(2,89)=.18, *p*=.839	*F*(4,73)=1.38, *p*=.25	*B*=262.98, *SE*=57.94, *p*<.000***
Cognitive Restriction	*F*(2,122.52)=12.04, *p*<.000***	*F*(2,97=.378, *p*=.69	*F*(4,122.58)=4.52, *p*=.002**	*B*=110.85, *SE*=83.26, *p*=.18
Emotional Eating	*F*(2,80.84)=53.47, *p*<.000***	*F*(2,89.86)=1.20, *p*=.31	*F*(4,80.97)=2.46, *p*=.052	*B*=409.42, *SE*=103.63, *p*<.000***
Food Preferences	*F*(2,97.11)=19.53, *p*<.000***	*F*(2,93.83)=4.76, *p*=.011*	*F*(4,98)=1.23, *p*=.30	*B*=0.174, *SE*=0.04, *p*<.000***
Positive Emotions	*F*(2,90.65)=7.87, *p*=.001**	*F*(2,92.75)=0.03, *p*=.97	*F*(4,114.58)=0.30, *p*=.88	*B*=11.55, *SE*=3.43, *p*=.001**
Negative Emotions	*F*(2,98.67)=2.11, *p*=.13	*F*(2,92.83)=2.1, *p*=.13	*F*(4,99.48)=1.29, *p*=.28	*B*=8.31, *SE*=3.2, *p*=.009**
Self-efficacy	*F*(2,79.62)=11.16, *p*<.000***	*F*(2, 94.47)=.37, *p*=.69	*F*(4,79.94)=0.83, *p*=.51	*B*=170.69, *SE*=30, *p*<.000, ***
Motivation	*F*(2,78.14)=7.4, *p*=.001**	*F*(2, 92.74)=.1.25 *p*=.29	*F*(4,81.45)=0.852, *p*=.50	*B*=24.85, *SE*=5.97, *p*<.000, ***

Note. *p< .05; **p<.01; *** p<.001 level, FFQ= food frequency.

3.4.3.1.1 Primary outcomes

For weight, we found a significant main effect of time *F*(2,159.64)=3.53, *p*<.05, but no statistically significant main effect of the intervention or interaction between time and intervention. Pairwise comparisons of the weight change in every group showed the Hypnosis was the only group in which the weight changed significantly from pre-test to one-month follow-up (*MD*=0.78, *SE*=0.32, *p*<.000, 95% CI= [0.04, 1.56], *d*=0.05, *p*<.05.

The result of the univariates MLM conducted for each candidate predictor showed the initial BMI (*B*=2.38, *SE*=0.11, *p*<.000) and behavioral activation (*B*=.14, *SE*=.06, *p*=.02) were significantly associated with a greater reduction in weight. We followed these analyses with a multivariate MLM in which both variables were entered simultaneously. The variables remained statistically significant (BMI from pre-post to one-month follow-up, *B*=0.09, *SE*=0.03, *p*=.005 and from post-test to one-month follow-up, *B*=0.06, *SE*=0.02, *p*=.011) together with behavioral activation from pre-test to one-month follow-up (*B*=0.12, *SE*=0.06, *p*=.032).

Uncontrolled eating was impacted in all groups through time since we found a significant main effect of time (*F*(2,72.46)=34.32, *p*<.000) and not a significant main effect of intervention group or time x group interaction. Follow the multiple comparisons, we found that this outcome was modified in all the groups. The marginal means for uncontrolled eating score from pre-test

to post-test larger in the Hypnosis group (*MD*= 12.86, *SE*=2.66, *d*=0.65, *p*<.000), followed by the FIT group (*MD*= 11.53, *SE*=2.65, *d*=0.58, *p*<.000, and in the Control group (*MD*=10.43, *SE*=2.89, *d*=0.53, *p*=.002). From pre-test to one-month follow-up, the group hierarchy was different: the larger effect size was still in the Hypnosis group (*MD*= 17.06, *SE*=3.09, *d*=0.83, *p*<.000), but the Control group had a larger effect size than the FIT group (*MD*= 15.87, *SE*=3.62, *d*=0.76, *p*<.000 vs. *MD*= 9.61, *SE*=3.04, *d*= 0.47, *p*=.006).
The random effect was statistically significant (*B*=44.07, *SE*=4.07, *p*<.000, 95% CI= [36.02, 52.12]).

The random intercept was not significant B=110, SE=83.255, p>.05, 95% CI= [25.44, 483.1] on cognitive restriction, so we followed only the fixed effects. The result showed that this variable registered a significant increase in the FIT group with a significant time effect (*F*(2.90,76)=12.48, *p*<.000) and time x group interaction effect (*F*(4.90,55)=4.47, *p*<.01). Followed the pairwise comparison analyses, we found that in the FIT group, the cognitive restriction significantly increased from pre-test to post-test (*MD*=-16.82, *SE*=2.63, *d*= 0.95, *p*<.000) and from pre-test to one-month follow-up (*MD*=-13.58, *SE*=3.44, *d*=0.73, *p*<.01).
The univariate MLM analyzes for candidate predictors found no significant values.

Emotional eating had a statistically significant random effect of *B*=409.42, *SE*=103.63, *p*<.000 and was found significantly changed in all groups, over time (*F*(2,80.84)=53.47, *p*<.000). A marginally significant effect size was found regarding the interaction between time x group (*F*(4,81)=2.46, *p*=.052. After following the pairwise comparisons, significant differences between all time points were found in all groups. From pre-test to post-test, the Hypnosis intervention had the largest effect size (*MD*= 22.64, *SE*=3.26, *d*=0.90, *p*<.000), followed by the FIT intervention (*MD*= 17.80, SE=3.25, *d*= 0.71, *p*<.000) and then by Placebo from the Control group (*MD*= 13.37, *SE*=3.55, *d*= 0.53, *p*=.001). Regarding the difference between pre-test and one-month follow-up Hypnosis intervention still produced the largest effect size (*MD*= 30.64, *SE*=4.03, *d*=1.16, *p*<.000), followed by the Placebo from the Control group (*MD*= 21.83, *SE*=4.7, *d*=0.81, *p*<.000) and the FIT intervention (*MD*= 16.95, *SE*=3.96, *d*=0.65, *p*<.000).
Nor for this variable, the univariate MLM analyzes for candidate predictors found no significant values.

For daily food frequency, we analyzed the fixed effects. There was a statistically significant effect of time on daily food frequency (*F*(1,87.8)=31.72, *p*<.000) and a significant effect of the interaction between time and group (*F*(1,87.8)=31.72, *p*<.000). In terms of pairwise comparisons, we found that for the Control group, Daily Food Frequency was not statistically significantly different between the two time points up (*MD*=0.03, *SE*=0.03, *d*=0.19, *p*>.05) but was statistically reduced in the Hypnosis group (*MD*=0.12, *SE*=0.02, *d*=0.76, *p*<.000) and the FIT group (*MD*=0.08, *SE*=0.02, *d*=0.49, *p*<.01). The comparisons between groups in week post-intervention showed a statistical difference between Control and Hypnosis groups (*MD*=11, *SE*=0.04, *d*=0.66, *p*<.05). That is, Control participants consumed more daily snacks. None of the analyses regarding the variables considered candidate predictors were found to be statistically significant.

Regarding monthly food frequency, we also analyzed the fixed effects. The main fixed effect of time showed a statistically significant difference in mean, at different time points (F(1,73.39)=7.82, p<.001) and no main effect of group or their interaction. The pairwise comparison analysis revealed that the marginal means for monthly food frequency scores were statistically different in the Hypnosis Group (MD=0.41, SE=0.15, d=0.55, p<.05). No other statistically significant difference was found in other groups.

Energy intake was measured through a self-reported diary of food. Unfortunately, the reports were incompletely detailed or inconsistent, and, as a result, no credible analyses could be made,and they were therfore not considered in subsequent analyses.

3.4.3.1.2 Secondary outcomes

Self-efficacy changed over time; that is, the results of MLM analyses revealed significant fixed effect size (F(2,79.62)=11.16, p<.000) and a random effect (B=170.69, SE=30.02, p<.000, CI= [120.92, 240.93] and no statistically significant effect of the intervention group or for the interaction between time and intervention group. The pairwise comparisons analysis found that self-efficacy significantly changed over time only in the Hypnosis group from pre-test to post-test (MD=-10.90, SE=2.72, d=0.65, p<.000) and from pre-test to one-month follow-up (MD=-10.90, SE=2.72, d=0.59, p<.000). Univariates MLM analyzing candidate predictors found no significant results.

Regarding motivation, a significant fixed effect of time was found (F(2,78.14)=7.40, p<.000) and a random effect (B=24.85, SE=5.97, p<.000, CI= [15.52, 39.79] but no statistically significant effect of the intervention group or interaction between time and intervention group. The pairwise comparison analysis showed that motivation was significantly changed over time only in the FIT group at pre-post MD=-3.28, SE=1.03, d=0.49, p<.05). Univariates MLM analyzing candidate predictors found no significant results.

Positive emotions were increased through time, as showed by the fixed effects of time (F(2,90.65)=7.87, p<.05), and a random effect (B=11.55, SE=3.43, p<.05, CI= [6.44, 20.69]. The pairwise comparison analysis showed that the Control group participants benefited the most (pre-test to post-test: MD=3.15, SE=1.13, d=0.59, p<.05). The result of the univariates MLM conducted for each candidate predictor showed that behavioral activation (F(2,161.1) = 3.48, p<.05) was significantly associated with greater positive emotions.

The MLM analysis for negative emotions found no significant fixed effect of time, the interaction between time and group, but a random effect (B=8.31, SE=3.19, p<.05, CI= [3.92, 17.63].

The main effect of time showed a statistically significant difference in mean Food preferences (F(2,97.1)=19.53,p<.000) at different time points. We also found a significant main effect of group (F(2,93.8)=4.76, p<.05). The random effect was B=0.17, SE=0.4, p<.000, CI= [0.11, 0.27]. Univariates MLM analyzing candidate predictors found no significant results.

The MLM analysis of eating intentions showed a significant main fixed effect of the interaction between time and intervention groups (F(4,82.59)=3.82, p<.05, reflecting a statistically significant difference in eating intentions in time between the different groups. The

pairwise comparison analysis revealed a significant differences between pre-test to follow-up in Control Group (*MD*=-69, *SE*=18, *d*=0.91, *p*<.05) and also a significant difference between groups at one month follow-up between Control and Hypnosis (*MD*=0.50, *SE*=0.18, *d*=0.70, *p*<.05) and FIT (*MD*=0.61, *SE*=0.18, *d*=0.89, *p*<.05). A one month follow up, the participants from the control group had more wishes to avoid snacks than those from the other two groups. Univariates MLM analyzing candidate predictors found no significant results.

3.4.4 Discussion

This study aimed to identify wheter cognitive training could significantly change eating behaviors. To do so, we investigated two inexpensive and easy interventions together with an active placebo. One intervention, namely Hypnosis, is well known as an effective adjunct to Cognitive Behavioral Therapy for Weight loss, and its efficacy has long been investigated since Mesmer boasted of its success. In contrast, FIT is a modern, computerized technique, albeit both have the same purpose of changing habits through cognitive training. Our study showed that both techniques are efficient in terms of changing eating behaviors. Hypnosis significantly decreased the daily and monthly frequency of eating snacks, reduced weight, and enhanced self-efficacy. However, FIT increased cognitive restriction, motivation and decreased the daily frequency of eating snacks.

Regarding uncontrolled eating and emotional eating, participants in all groups experienced improvements, but the effect sizes in the intervention groups were larger than in the Control. These results may be due to participants monitoring the amount of food they consumed that, in turn, restricted food consumptions.

Our results are in line with the study of Houben and Jansen (2015), which showed that FIT has a moderate effect size in changing the desire to eat and reducing the consumption of high-calorie food and influence health behavior (Allom et al., 2016). Regarding weight loss, our findings differed from other researchers (Adams et al., 2017; Lawrence, O'Sullivan, et al., 2015), who showed that FIT is an effective intervention in weight loss. A possible explanation for this discrepancy and the modest findings regarding the weight lost that our trial was carried out, for the most part, during the Christmas holidays. This period is specific to excessive food consumption in the local culture.

Also, studies have indicated that hypnosis is very effective in producing weight loss even as a stand-alone treatment (Milling et al., 2018). However, we did not identify previous hypnosis studies that measured or reported specific elements of weight management such as eating behaviors, emotions, or cognitive factors.

CHAPTER 4. GENERAL CONCLUSIONS AND DISCUSSIONS

4.1 General conclusions

Although overweight and obesity are not communicable diseases, they can be viewed through an epidemiological model. Thus, much effort is needed to control these diseases because weight lost tends to be regained (Bray et al., 2017). A recent review (Varkevisser et al., 2019) showed that weight loss maintenance depends on the behavioral determinants involved in the caloric energy balance and the determinants that promote it.

Accordingly, the research presented investigated the cognitive mechanisms of change involved in weight loss management in overweight and obese adults. To do so, we conducted study 1, a meta-analysis that examined the efficacy of CBT interventions on weight loss and the alleged mechanisms of change. The results showed that CBT is an efficient psychological treatment for weight loss and has a significant small effect. Its efficacy lies in adding cognitive factors, more specifically motivation and self-efficacy, because relative to all cognitive factors proposed as mechanisms of change, these two variables are significantly associated with weight outcomes at the end of interventions studied.

Moreover, Study 2 investigated relevant psychological factors that differ between those who lost their weight and maintained it versus those who regain the lost weight. We also evaluated how these psychological factors differ among people with obesity, overweight, and normal weight to contribute to knowledge regarding psychological factors that help maintain these behaviors to be initiated and maintained. We found significant differences between the categories mentioned above in terms of self-efficacy, irrational food beliefs, uncontrolled eating, and emotional eating and found that the irrational beliefs type need for approval is also significantly different between them. Relevant to weight categories, we determined significant differences in self-efficacy, irrational food beliefs, uncontrolled eating, cognitive restraint, and emotional eating. Here, we found that two irrational thinking styles, demanding fairness and need for comfort, are also significantly different.

To attain the second primary objective of this research, namely to develop a more effective and efficient intervention for weight loss and its maintenance, we conducted studies 3 and 4.

In Study 3, we investigated a new approach in weight management based on the Free Will concept. Thus, study 3 aimed to evaluate the effectiveness of three types of hypnotic suggestions on changing food intentions. Of the four hypnotic suggestions investigated, only those suggestions that used the cognitive rehearsal and memory substitution techniques significantly changed eating intentions during hypnosis, which remained unchanged after the induction was canceled. The finding that the Cognitive Rehearsal group performed significantly better than Control on eating intentions regarding high-calorie food supported the efficacy of the hypnotic suggestions because they specifically targeted those types of food. This study not only shows that hypnosis is useful for changing intentions of eating, but it also points to the

responsible elements of this change: hypnotic suggestions that intervened both by changing past experience or by training for future experience to inhibit action. These results can preliminary support our hypothesis that the concept of Free Will is also applicable in modifying ecological, rela-life actions relevant to eating intentions.

Similarly, to attain the second aim of this research and develop a more effective and efficient intervention for weight loss, in Study 4, we extended our earlier research. More specifically based on the results of Study 3**,** we investigated hypnosis with hypnotic suggestions for cognitive rehearsal in a more ecological variant – grounded in the real world together with another new approach for weight loss – food inhibition training. This randomized clinical trial aimed to evaluate the effectiveness of changing eating behavior using cognitive training. We found that both techniques are efficient in terms of changing eating behaviors. Hypnosis significantly decreased the daily and monthly frequency of eating snacks, reduced weight, and enhanced self-efficacy, whereas, FIT increased cognitive restriction and motivation and decreased daily frequency of eating snacks.

4.2 Implications of the Thesis

4.2.1 Theoretical implications

The theoretical implications of the present research are base on the outcomes of the studies included. Our meta-analysis, Study 1, was the first quantitative synthesis of the efficacy of CBT on weight loss and cognitive, behavioral, and emotional factors. Our study was the first that evaluated the psychological mechanisms of change in weight loss, while the existing meta-analyses only or primarily considered outcome analyses of weight interventions or a number of psychological outcomes.

Study 2 reveals the quantitative differences in thinking and behaving between individuals who have succeeded in maintaining or not maintain weight loss. Only a few studies analyzed this comparison between maintainers and regainers. Moreover, most of these studies were quasi-qualitative, relying on a semi-structured interview or open-ended questions (S. M. Byrne, 2002; Lewis et al., 2010). A novel element is that we analyzed the level of irrational beliefs: general and specific.

Study 3 also has theoretical implications in considering a new approach for changing eating behaviors through hypnotic suggestions in the light of the Free Will concept. The results provide preliminary suppot for our hypothesis that this concept is also applicable in modifying real world actions relevant to eating intentions. This study not only shows that hypnosis is useful for changing intentions regarding eating, but it also points elements potentially responsible for this change: hypnotic suggestions that intervened both by changing past experience or by training for future experience to inhibit action.

Furthermore, in terms of theoretical implication, Study 4 brings together for the first time for analysis two effective techniques, that are cost-effective and easy to use and implement: Hypnosis and Food Inhibition Training. Another theoretical implication of study 4 is that, as far as we know, this is the only study that measured or reported the efficacy of hypnosis on specific

elements of weight management such as eating behaviors, emotions, or cognitive factors. Another theoretical implication is that study 4 showed that these two interventions analyzed increased the participants' self-efficacy (Hypnosis) and motivation (Food Inhibition Training), which study 1 reveal are important factors in weight loss. Also, Study 4 brings a valuable contribution to this area of research by identifying how eating behaviors (daily and monthly food frequency, uncontrolled eating, cognitive restriction, and emotional eating), cognitive factors (motivation and self-efficacy) and emotions, are impacted by these interventions besides the weight loss provided, in an ecological variant, the everyday life.

4.2.2 Methodological implications

As for methodological implication, several features were refined by the studies included in this research. Study 1 had important contributions regarding the inclusion criteria: for data analysis of alleged cognitive mechanisms of change, one of the main inclusion criteria in our meta-analysis was for studies to include and report a quantitative assessment of change in weight and in potential cognitive mechanisms of successful change in weight.

Study 3 has a significant methodological implication researchers have suggested that a need exists for studies that compare hypnotic suggestions with other methods for modulating cognitive control, including placebos (Raz et al., 2005). To disambiguate the effects of hypnosis from the effects of suggestion alone and also to establish the mechanisms by which suggestion produces significant effects, it is also important to use, designs that control for placebo and expectancy effects (Lynn et al., 2020; Roslim et al., 2021). In Study 3, we met this request by using an active control group to compare to interventions containing different hypnotic suggestions. Another request for a correct design was met by randomly allocating the participants in an automatized manner, sufficiently trained the clinicians who delivered the intervention, using manualized treatments (Ramondo et al., 2021), and registering the study in an online database (i.e., ClinicalTrials.gov).

Study 4 has methodological implications by using an active placebo as a control group, and even if the study was entirely conducted online, the measurements were objective and standardized by using the pictures of the scale to report the weight instead of the self-reported one.

4.2.3 Practical implications

The findings of this research have mainly practical implications. Study 1 showed that CBT is an efficient psychological treatment in weight loss and that its efficacy lies in adding cognitive factors, more specifically motivation and self-efficacy. In addition, that CBT intervention was more effective when delivered by a multidisciplinary team in longer sessions, which emerged as significant moderators of findings. Thus our research has clear therapeutic implications for therapists who treat individuals for weight loss.

Moreover, Study 2 determined psychological differences between persons who maintain or regain the lost weight or those who had a normal stable weight and those with obesity and overweight. Study 2 showed that psychological factors could potentially explain why some

people may or may not maintain the weight following successful weight loss. These results are significant because it is essential to know the psychological characteristics of people with obesity or overweight to tailor the interventions for weight loss and weight loss maintenance.

Study 3 findings provides empirical support for the use of hypnosis – a cost-effective and efficinet intervention as a vehicle for clinicians to address excessive weight loss issues by changing participants' perceptions of past experience or training for future food-related experience to inhibit action. Hypnosis can be delivered on an independent basis or together with other psychological interventions (e.g., CBT) targeting eating behaviors. It could also be transported in real-world contexts because it is easy to implement and possible to offer both face-to-face and online.

Finally, Study 4, aimed to improve eating behaviors by testing two effective techniques that are cost-effective and easy to use and implement: Hypnosis and Food Inhibition Training. Both interventions can be used to change habits through cognitive training. Furthermore, as, in this trial, the interventions and outcomes were measured in the real world, the approach may be useful in addressing weight related issues in everyday life.

4.3 Limitations and Future Directions

Although the present research has led to important practical and theoretical conclusions and implications, this thesis has limitations. Therefore, in the following, the thesis's general limits that should be considered when interpreting the main findings will be presented.

In Study 1, the number of studies meeting our selection criteria was small, so the subgroup analyses were underpowered. Another limitation comes from the fact that the outcomes categories used were very general. Many questionnaires were used to measure psychological factors, and because there were only sixteen studies, we cannot make them more specific. Furthermore, although our meta-analysis support the association between change in cognitive factors and change in weight outcomes, because changes in weight and cognitive factors were measured simultaneously and most studies did not perform tests of formal mediation, we can not argue that a causal relation exists.

Study 2 also had limitations: First, the study is cross-sectional. Therefore, a causal prediction or explanation is not appropriate. Accordingly future studies should employ longitudinal designs to overcome this limitation. Second, because the analyzed categories were based on retrospective self-reported data on weight, a remembering bias is possible.

An important limitation of this thesis is the small number of participants. Although acceptable in the literature, the use for each sample, in each analysis of the minimum sample size recommended, generates a low statistical power. In order to draw more robust conclusions, future studies should consider a larger sample.

4.4 Summary of General Conclusions

However, this thesis has significant theoretical, methodological, and practical implications despite the limitations stated above. Based on the studies conducted in this research and described previously, several general conclusions can be drawn:

1. There is a need for improved psychological interventions for weight loss since overweight and obesity are growing diseases. The health consequences of these diseases are multiple and affect more than 2 billion people.
2. CBT is the most effective psychological treatment for weight loss, but the effect size is small, and the lost weight maintenance is very difficult. Its effectiveness lies in adding cognitive factors, more precisely, self-efficacy and motivation whose change is associated with weight change.
3. Also, CBT for weight loss is more effective when delivered by a multidisciplinary team in longer sessions since these two factors are significant moderators.
4. For an improved and tailored psychological intervention for weight loss, clinicians can consider the cognitive and behavioral characteristics of those with overweight and obesity. It is stated above that persons who did not maintain weight loss have significantly lower self-efficacy and a higher level of irrational food beliefs than those who could maintain their weight loss. Furthermore, they had a higher level of irrational thinking – the need for approval.
5. Furthermore, people with obesity and overweight have significantly lower levels of self-efficacy than those with normal weight and a higher level of irrational food beliefs. Regarding specific types of irrationality not related to food, we found significantly higher levels of need for comfort at those with overweight and obesity than those with normal weight.
6. Hypnotic suggestions, which use cognitive rehearsal and memory substitution techniques, can significantly change eating intentions during hypnosis and after the induction is canceled. Moreover, cognitive rehearsal hypnotic suggestions are significantly more effective than relaxation induction on eating intentions regarding the targeted high-calorie food.
7. Hypnosis is useful for changing intentions of eating, and the responsible elements of this change are hypnotic suggestions that intervene both by changing past experience or training for future experience to inhibit action. These results can preliminary support our hypothesis that the concept of Free Will is also applicable in modifying ecological actions relevant to eating intentions.
8. Hypnosis is an effective technique for reducing weight and snack frequency (daily and monthly) and increasing self-efficacy.
9. FIT is an effective intervention in decreasing daily snack frequency and increasing cognitive restriction and motivation.

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