



THE ROLE OF BODY IMAGE IN THE CONTEXT OF OBESITY TREATMENT AND ASSOCIATED BEHAVIORS IN WOMEN

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Humana, Especialidade de Saúde e Condição Física

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Para o meu pai, mãe, mano e avós

Para todos os que me aquecem o coração e enriquecem a vida

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ABSTRACT

This dissertation sought to investigate the role of body image in the context of obesity treatment. Specifically, it was designed to i) identify correlates of pre-treatment body image (evaluation and investment dimensions) in overweight/obese women, ii) investigate body image changes during and after a lifestyle weight loss intervention, iii) examine how, and by what mechanisms, body image changed over time, and iv) investigate the implications of this change to the process of weight management and associated behaviors. The four studies included in this dissertation were developed in the context of a longitudinal randomized controlled trial, consisting of a 1-year behavior change intervention and a 2-year follow-up, including 239 premenopausal women with overweight or obesity (age: 37.6 ± 7.1 yr; BMI: 31.5 ± 4.1 kg/m²). The main intervention aimed at increasing physical activity, adopting a moderately restricted diet, and ultimately establishing exercise and eating patterns that would support weight maintenance. A module covering body image contents was also included. The comparison group received a general health education curriculum.

Study 1 highlighted the damaging effect of dysfunctional investment in appearance, rather than body dissatisfaction, for psychological well-being, and showed that controlled motivations might be one of the mechanisms behind this detrimental effect. In turn, studies 2 and 3 suggested that body image could be effectively enhanced during obesity treatment, leading to a healthier eating self-regulation, and emphasized that physical activity could play an important role in improving body image in overweight/obese women, and also in preventing its deterioration overtime, mainly by tapping its excessive salience to one's life

and self. Finally, study 4 showed that body image investment and depressive mood (to a lesser extent) mediated the relation between physical activity and critical markers of eating self-regulation, and suggested that these associations are relatively consistent in this population.

These findings highlighted the importance of enhancing body image during obesity treatment, especially its investment component, to improve well-being, eating regulation, and ultimately weight-related outcomes. Future weight loss interventions would benefit from performing a more thorough assessment of body image investment features and from proactively addressing them as part of their protocols. Furthermore, regular physical activity participation should be emphasized in these interventions, given its important contribution to long-term weight management, which goes beyond increased energy expenditure. In fact, physical activity can also ameliorate key psychological variables such as body image and even prevent their deterioration overtime, which in the end, might reduce susceptibility to relapse and favor lasting weight maintenance.

Keywords: Body Image; Body dissatisfaction; Dysfunctional Investment in Appearance; Obesity; Weight Management; Women; Eating Self-Regulation; Physical Activity; Controlled Motivation for Treatment; Psychological Well-Being

RESUMO

Esta dissertação investigou o papel da imagem corporal no contexto do tratamento da obesidade. Teve como objetivos específicos: i) identificar correlatos da imagem corporal (dimensões de insatisfação e investimento disfuncional na imagem) à entrada de uma intervenção de controlo do peso, ii) investigar as alterações da imagem corporal durante e após uma intervenção comportamental de controlo do peso, iii) explorar potenciais mecanismos subjacentes às alterações da imagem corporal; e iv) investigar as implicações destas alterações no processo de gestão do peso e comportamentos associados. Os quatro estudos desta tese foram desenvolvidos no âmbito de um estudo experimental, controlado e com distribuição aleatória (RCT), compreendendo uma intervenção de 1 ano e um *follow-up* de 2 anos. A amostra incluiu 239 mulheres pré-menopáusicas com excesso de peso ou obesidade (idade: 37.6 ± 7.1 anos; IMC: $31.5 \pm 4.1 \text{ kg/m}^2$). A intervenção visou estabelecer padrões saudáveis de atividade física e comportamento alimentar, compatíveis com a manutenção do peso no longo-prazo. Incluiu também um módulo direcionado para as questões da imagem corporal. O grupo de controlo teve acesso a um currículo geral de educação para a saúde.

O estudo 1 sublinhou que a dimensão de investimento disfuncional na imagem tem um efeito mais prejudicial no bem-estar psicológico do que a dimensão de insatisfação corporal e mostrou que as motivações controladas para procurar tratamento poderão ser um dos mecanismos subjacentes a esta associação negativa. Por sua vez, os estudos 2 e 3 mostraram que a imagem corporal pode ser eficazmente melhorada durante o tratamento, conduzindo a uma regulação mais saudável do comportamento alimentar, e destacaram que a atividade física poderá desempenhar um papel importante, não só na melhoria da imagem

corporal mas também na atenuação da sua deterioração ao longo do tempo, sobretudo através do seu efeito na redução do investimento disfuncional na imagem. Finalmente, o estudo 4 verificou que a redução no investimento disfuncional na imagem, e em menor grau nos sintomas depressivos, poderá ajudar a explicar a relação entre a atividade física e uma regulação mais saudável do comportamento alimentar, nesta população.

Em conjunto, estes resultados sublinharam a importância de promover a melhoria da imagem corporal durante o tratamento da obesidade, especialmente da dimensão investimento, a fim de melhorar o bem-estar psicológico, a regulação do comportamento alimentar e, conseqüentemente, a gestão do peso em mulheres com excesso de peso. Futuras intervenções de controlo do peso irão beneficiar da inclusão de uma avaliação mais minuciosa da imagem corporal, nas suas múltiplas facetas, bem como de uma abordagem mais direcionada para cada uma delas. A prática de atividade física regular deverá ser enfatizada devido ao seu contributo para o controlo do peso no longo-prazo, que vai além do dispêndio energético, passando também pela melhoria de variáveis psicológicas como a imagem corporal e, inclusive, pela prevenção da sua deterioração ao longo do tempo.

Palavras-Chave: Imagem Corporal; Insatisfação Corporal; Investimento Disfuncional na Imagem; Obesidade; Gestão do Peso; Mulheres; Auto-Regulação Alimentar; Atividade Física; Motivação Controlada para o Tratamento; Bem-Estar Psicológico.

CHAPTER 1

Introduction

"We don't need Afghan-style burquas to disappear as women.

*We disappear in reverse – by revamping and revealing our
bodies to meet externally imposed visions of female beauty"*

*Robin Gerber
(Author and motivational speaker)*

As Joyce Brothers stated, “*the problem of body image dissatisfaction is sadly epidemic in today’s world*” [1; p.i]. Western societies send a powerful signal to women, suggesting that only the beautiful and the thin are valued and loved, catalyzing a cultural ideal of female body image where thinness is a sign of success, health, and happiness [2]. In contrast, overweight and obesity are generally viewed as physically unattractive, and indicative of a lack of self-discipline and willpower [3]. Unsurprisingly, these ideals and stereotypes affect overweight people’s beliefs about weight and shape, leading many of them to dislike their appearance and develop a negative body image [4].

Body image (BI) refers to how someone personally experiences his or her own embodiment. More than a mental representation of the body, it reflects one’s personal relationship with it encompassing perceptions, beliefs, thoughts, feelings, and behaviors [1]. The severity of body image problems frequently lies within the hidden meanings people attribute to appearance, which ultimately lead them to confuse their body with their selves. Predictably, poor body image is often associated with diminished quality of life and psychological well-being in obese individuals [5] and improving appearance and body image are commonly reported reasons for seeking obesity treatment among overweight individuals [4]. However, excessive appearance concerns may constitute an obstacle to successful weight management, hampering the acceptance of realistic weight loss goals, predicting poorer outcomes, and possibly resulting in program abandonment, increased relapse, and poorer psychological states [4, 6].

Treatment of body image disturbances within weight loss interventions is still in the developmental stages. There is some evidence suggesting that body image is typically improved during treatment, even without weight change [e.g., 7], and that it should be

actively addressed during obesity treatment [4]. However, several questions regarding body image role remain unanswered. For instance, what might pre-treatment body image be hiding, or what other psychological aspects are compromised? Are multiple body image dimensions (e.g., evaluation / dissatisfaction, investment / over-preoccupation) equally detrimental? Does obesity treatment produce long-lasting changes in multiple body image dimensions, and if so by what mechanisms? Does body image improvement facilitate weight management, and how? It is clear that the study of body image in the context of weight management is limited but of great relevance, especially in Portugal where obesity studies are in the beginning stages. The studies included in the present thesis sought to fill some of these research gaps.

This preliminary section aims at briefly contextualizing the main research questions and goals addressed in the current thesis, as well as clarifying this document's internal structure, logic, and organization.

Overview of research goals

The current thesis sought to investigate the role of body image in the context of obesity treatment, by responding, at least in part, to two central questions: 1) Does body image enhance or limit weight management, and by which mechanisms?; 2) Should body image be considered in obesity treatment and how/to what extent? As a result, this dissertation was primarily designed to i) identify correlates of pre-treatment body image (evaluation and investment dimensions) in overweight/obese women, ii) investigate body image changes during a lifestyle weight loss intervention, iii) examine how, and by what mechanisms,

body image changed over time, and iv) investigate implications of this change to the process of weight management and associated behaviors.

The four studies included in this thesis were developed in the context of a longitudinal randomized controlled trial, the P.E.S.O. Study, consisting of a 1-year behavior change intervention and a 2-year follow-up. A detailed explanation of the research goals that guided the development of the present dissertation is described below (organized by research articles):

Study I: Exploring baseline correlates: What might poor body image be hiding?

Body image is frequently impaired and often associated with psychological suffering and distress in treatment-seeking overweight/obese people. This might account, at least in part, for poorer treatment outcomes. Therefore, a better understanding of the association between body image and the psychological functioning of overweight people is central. How, or by what mechanisms, are these variables related? Evidence specifically focused on determining the mechanisms underlying this association is very limited. Responding to this research gap, study 1 was intentionally designed to explore one of the potential mediating factors of this relation, namely controlled motivations for enrolling in obesity treatment. In addition, considering that the main purpose of this thesis is to better understand body image functioning and its implications in the context of obesity treatment, and that a complete understanding can only be achieved if body image is conceived and evaluated as a multidimensional construct, study 1 distinguished between body image evaluative and investment dimensions, seeking to investigate whether these dimensions had different motivational and psychological consequences.

Study II: Changing body image: Does it help managing weight and related behaviors?

In a prior study conducted with participants from the P.E.S.O. Trial, body image change was found to mediate changes in weight [8]. Thus, to extend these findings, study 2 was designed to examine the role of body image change in other behaviors or processes considered critical for successful weight management, that might help elucidate why, or how, body image affects body weight regulation. Eating behavior regulation is one of the most critical processes involved in body weight regulation and, in addition, poor body image is consistently associated with maladaptive eating behaviors. Therefore, studying body image change during treatment as a potential mechanism involved in the successful regulation of eating behavior, and subsequent weight management, is clearly pertinent. Thus, the primary purpose of study 2 was to examine this hypothesis. Further, this study analyzed the distinct contributions of evaluative and investment body image dimensions to eating self-regulation. These findings could help improve intervention design and effectiveness, providing information on which dimensions should be emphasized to produce more successful outcomes.

Study III: Indeed, body image changes... But, by what mechanisms? For how long?

Continuing to explore the role of body image in the context of obesity treatment, and after realizing its positive change during the intervention and its benefits to eating self-regulation, we felt the need to further understand how body image changed over time, specifically looking into the trajectories and mechanisms of change of each dimension. Given that investigation of body image in weight management is limited, several questions remain unanswered. Study 3 was conducted to respond to some of these research questions:

Does treatment produce long-lasting positive changes in multiple body image dimensions? Are the patterns of change through time similar across different dimensions? Which mechanisms underpin body image changes (e.g., weight changes, exercise/physical activity)? Are different body image dimensions explained by the same mechanisms? Regarding mediating processes, we were particularly interested in the potential role of physical activity, since it was the main outcome of the present weight control intervention, and is viewed as a critical component in weight management, in part due to its psychological effects. Hence, this study aimed at extending study 2's findings, by examining not only medium but also longer-term effects of obesity treatment on different dimensions of body image (evaluative and investment). In addition, study 3 aimed at exploring the role of structured and lifestyle physical activity as putative mediators of body image changes across time.

Study IV: On the link between physical activity and eating behavior

Integrating and extending earlier findings (from studies 1 to 3), and fueled by existing theoretical and empirical propositions suggesting that the connection between the two cornerstones of behavioral obesity treatment, physical activity and eating behavior, is partially explained by psychological mechanisms, study 4 sought to examine whether body image dysfunctional investment and depressive mood mediated the relation between physical activity and eating regulation. Secondly, this study explored whether these effects were consistent through time.

Collectively, the four studies included in this thesis were developed to provide a comprehensive understanding of body image functioning in overweight and obese women

engaged in treatment, looking at multiple dimensions, different mechanisms of change, and implications for the regulation of weight and associated behaviors. Naturally, different populations face different problems, have specific needs, and thus are likely to require distinct strategies to improve body image or a different emphasis on each body image dimension (depending on the treatment outcome) in order to get more effective results. Collectively, these findings are expected to allow professionals to provide better care and develop more effective interventions.

Dissertation Structure

The present thesis incorporates a collection of four research articles already published, in press, or submitted for publication in peer-review journals with an established ISI Impact Factor. Although the option for a thesis based on independent articles has clear advantages, principally the possibility of communicating and sharing produced knowledge, it may increase the risk of repetition. As such, and to avoid redundancy, the present document is organized as follows:

- Chapter 2 includes a large and thorough literature review of the topic, seeking to introduce the conceptual, theoretical, and empirical grounds informing the main research questions and objectives of the four studies included in the current thesis. In addition, this chapter intends to clarify the “whys” underlying i) the chosen population (overweight and obese women); ii) the chosen setting (behavioral treatment of obesity); iii) the study of body image in the context of obesity treatment and associated behaviors; and iv) the relevance of distinguishing between multiple body image dimensions.

- A general methodology section is presented in chapter 3. This section provides a comprehensive description of the P.E.S.O. Study protocol (e.g., study design, recruitment, sample, etc.), giving special emphasis to the intervention principles and strategies that were most relevant to the present thesis. Details on the employed measures were also provided. Regarding statistical procedures, only methodological aspects that were common to all studies were described. A special emphasis was given to mediation analysis, given that this procedure was central to all manuscripts.
- Additional details on background, methodological and statistical procedures, or other aspects pertaining to specific research goals are detailed in the following chapters – 4, 5, 6, and 7 – which refer to the four empirical studies included in this thesis. Thus, these chapters are presented as individual empirical manuscripts with their own abstract, introduction, methods, results, discussion and references sections.
- Chapter 8 offers a summary and integrated discussion of the main empirical findings obtained within the four studies of this thesis. Theoretical and practical implications are drawn and discussed. Future directions are also presented.
- Bibliographic references (at the end of each article) followed the format requested by the journal of submission/publication. The same also applied to other specific differences in format (e.g. legends, figures, and tables). In the remaining chapters (introduction, literature review, methodology, and overall discussion sections) the numbered format was adopted for references.

- Finally, the Appendices section includes: i) the self-reported instruments used; and ii) the abstracts of oral/poster presentations related to the studies presented in the thesis.

List of articles, books, and conference communications/abstracts

The investigation carried out as part of the present doctoral research program resulted in the following publications/submissions, and communications (oral/poster) as first author:

Book chapters

Williams, G., Teixeira, P.J., Carraça, E.V., Resnicow, K. Physical wellness, health care, and personal autonomy. In Chirkov, V.I., Ryan, R.M., & and Sheldon, K.M. (Eds.). *Personal Autonomy in Cultural Contexts: Global Perspectives on The Psychology of Agency, Freedom, and People's Well-Being*. Springer, US (2011).

Peer-reviewed articles published or in press

Carraça, E.V., Markland, D., Silva, M.N., Coutinho, S.R., Vieira, P.N., Minderico, C.M., Sardinha, L.B., Teixeira, P.J. (in press). Physical Activity Predicts Changes in Body Image during Obesity Treatment in Women. *Medicine and Science in Sports and Exercise*.

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CHAPTER 2

Literature Review

Overweight and Obesity

Obesity can be simply defined as an excess of body fat, either referring to the body as a whole or to a particular depot of body fat (e.g., abdominal obesity). Alternatively, the fat surplus may pertain to the morphology and function of body fat such that, for example, adipocytes, independent of total fat mass or fat mass distribution, are excessively enlarged. Imbued in the present definition of obesity is the notion that the accumulation of body fat is sufficiently large to adversely affect health [1, p.70].

In clinical practice, body fat is most commonly estimated based on body mass index (BMI), calculated as weight in kilograms divided by the square of height in meters. The underlying assumption is that most variation in weight for persons of the same height is due to fat mass. Using this classification, a healthy or desirable BMI is between 18.5 and 24.9. A person is considered overweight if the BMI is between 25.0 to 29.9 and obese if the BMI is greater than or equal to 30.0. Persons who are obese can be further classified into stage I (BMI 30.0-34.9), stage II (BMI 35.0–39.9), or stage III (BMI > 40.0) [2]. This useful and operational index allows meaningful comparisons of weight status within and between populations and the identification of individuals and groups at risk of morbidity and mortality [3]. It also permits identification of priorities for intervention at an individual or community level and for evaluating the effectiveness of such interventions [3]. However, using BMI as the standard measure of body fat is not without controversy. While it is inexpensive and easily calculated, it is an indirect measure that assumes independence of such factors as age, gender, body composition, level of physical activity, and race or ethnicity, which can also influence the percentage of body fat [3]. Effectively, BMI does not provide information about body composition (i.e., it does not distinguish fat mass from

lean mass) and fat distribution. Thus, owing to differences in body proportions and fat distribution, the same BMI score may not correspond to the same degree of fatness across different individuals, and may not represent the same health risk. Nevertheless, BMI is highly correlated with densitometry measurements of fat mass, being particularly well-suited for epidemiological studies [3]. Other, more direct measures of body fat are available, including hydro-densitometry, dual energy x-ray absorptiometry, bioimpedance analysis, deuterium oxide dilution, and skinfold thickness. These direct measures of body fat can be expensive and not easily accessible to the primary care clinician. However, they should be used in combination with the BMI to assess risk and monitor the progress of therapeutic interventions [4]. These will not be further detailed here.

Obesity is a serious and increasingly prevalent condition all-around the world [5-6]. In Europe, the prevalence of obesity is in the range of 10–25% in men and 10–30% in women [7], and it has increased by 10–40% in the majority of European countries in the past 10 years [8]. In most countries more than 50% of people are overweight or obese [8]. Portugal accompanies this trend. The most recent Portuguese representative study on the epidemiology of obesity (2003–2005), using objective anthropometric measurements to evaluate participants aged 18-64 yr, showed that 39.4% of the sample were overweight (BMI between 25.0 and 29.9), and 14.2% were obese (BMI > 30) [9]. An examination of the data by obesity categories revealed that the more severe degrees of obesity (grade II: 35.0-39.9, and grade III: > 40) were present in a small minority (2.0 % and 0.6 % respectively) [10]. Regarding gender differences, the prevalence of overweight/obesity among men is higher (60.2%) than among women (47.8%) [9], which is in line with other countries' reality [8]. These data also showed that the overall prevalence of overweight and

obesity increased from 49.6% to 53.6% over the last decade, mainly because of a shift from the normal to the overweight category [9]. This means that the average Portuguese adult is now overweight.

Obesity: An “evolutionary trap”?

The obesity epidemic has arisen so quickly that it cannot be due to biology alone [11]. This matter has intrigued researchers for a few decades now and has been the target of considerable investigation and analysis [e.g., 12]. From an evolutionary standpoint, it has been suggested that the global obesity epidemic results from a mismatch between modern environment and human metabolism [13]. We could call it an “evolutionary trap”! Human physiology developed to function within an environment where high levels of physical activity were needed in daily life and food was inconsistently available. In previous times, physical activity was the main driving force ‘pulling’ appetite, as the primary challenge to the physiological system for body weight control was to obtain sufficient energy intake to prevent negative energy balance [13]. Thus, biological processes evolved to encourage adaptive behaviors to ensure survival in times of adverse conditions and famine. Physiologically, people were determined to eat as much as they could when food was available and to conserve energy when physical activity was not required [13]. At that time, little conscious effort was required to manage body weight [13]. However, the agricultural and technological revolutions of the late 20th century produced a profound shift in man’s ecological niche, affecting both components of the energy balance equation, physical activity and energy intake [14]. The current environment is characterized by a situation whereby minimal amounts of physical activity are required to function in daily life and

food is abundant, inexpensive, energy-dense (i.e., highly refined fats and carbohydrates), and widely available [14]. Judging by the increasing obesity rates, these changes were profound up to a point that, nowadays, fewer and fewer people are able to maintain a healthy body weight by relying on their own biology and ‘instinctual’ mechanisms, this is, without exerting a permanent conscious effort to limit energy intake [13]. Within this environment, food intake ‘pushes’ the system, and the challenge becomes to increase physical activity sufficiently to prevent positive energy balance [13]. The physiological systems that worked so well in the past (and still do!) are now contributing to the problem of obesity [13]. We still have multiple, redundant physiological systems that encourage us to eat despite having an abundant, energy-rich food supply and a sedentary lifestyle with reduced energy requirements [13]. Furthermore, in a moment that demands higher levels of energy expenditure, human’s physiological drive to increase physical activity in response to excess energy intake does not appear to be strong enough, and there appears to be only a weak adaptive increase in resting energy expenditure in response to excess energy intake [13]. In the modern world, the prevailing environment constitutes a constant background pressure that promotes weight gain [13]. Obesity is the predictable biologic response to these external changes.

The physical nature of the obesogenic environment, typified by the promotion of food (over) consumption and the discouragement of physical activity, is also accompanied by a set of cultural values, many of which support and promote consumption in excess of any nutritional need [15]. At the outset it should be considered that over-consumption of food is one example of a more widespread acquisition of a material “good life” well beyond any limits defined by personal need [16]. People in industrial societies are encouraged to

purchase more clothes, shoes, TVs, cars, furniture and palatable foods; only the last of these is strongly blamed for obesity [15]. However, the acquisition of possessions beyond need extends well beyond food. The prevailing socio-economic system encourages a philosophy of materialistic self-interest and unnecessary consumption (and purchasing) which is required in order to drive economic growth [16-17]. Therefore, over-consumption takes place in a climate of abundance, aggressive advertising and easy accessibility in which food consumption is promoted strongly by the socio-economic market [18]. In addition, it is undeniable that the food industry strives to produce foods of ever increasing palatability in order to make them more attractive to the consumer. Over-consumption is legitimized, and not prohibited, by the prevailing cultural values [18]. Given this situation (abundance, palatability and promotion), together with the operation of a powerful and well-functioning reward system in the brain, it is surprising that the level of obesity is not even higher [18].

Considering the overwhelming effect of the modern environment and its subliminal interests, we believe obesity should be viewed and understood more as a sociocultural disorder than as a failure of biological mechanisms. The high rates of obesity are a consequence and a reflection of the lifestyle and values that we have adopted as a society. “The causes of obesity are manifold and are woven into the fabric of our everyday lives” [13; p.70].

Obesity: Social Reality and Implications

Overweight and obesity cause or exacerbate a large number of health problems, both independently and in association with other diseases, and are among the most significant contributors to ill health [19]. The literature has presented well-documented links between

obesity and increased mortality and morbidity, hypertension, dyslipidemia, diabetes mellitus, coronary heart disease, congestive heart failure, stroke, gallstones, osteoarthritis, sleep apnea, certain types of cancer (colon, breast, endometrial, gall bladder), menstrual abnormalities, impaired fertility, and increased pregnancy risks [3-4, 20]. The risk of these comorbid conditions appears to be positively correlated with the BMI [4]. The amount of abdominal or visceral fat is of particular concern. The intra-abdominal visceral deposition of adipose tissue, which characterizes central obesity, is a major contributor to the development of hypertension, elevated plasma insulin concentrations and insulin resistance, hyperglycemia and hyperlipidemia (a phenomenon of risk factor clustering known as metabolic syndrome) [4].

However, the adverse effects of obesity are not only medical. As the focus on the obesity epidemic has intensified, there has been increasing recognition of the social and psychological consequences of being obese, which are serious and pervasive [21]. A comprehensive understanding of weight stigma and its impact may be important to document the global effects of excess weight on health and psychosocial functioning and well-being. For instance, those most exposed to stigma may be more vulnerable to psychological effects such as depression and social effects such as economic adversity and isolation, which could increase the likelihood of over-eating and sedentary activity, and in turn potentiate weight gain and the negative medical consequences of obesity. While such links with health outcomes require further empirical validation, it is clear that bias, prejudice, and discrimination permeate the everyday life of overweight individuals [21].

Obese individuals are highly stigmatized and face multiple forms of prejudice and discrimination because of their weight [22], since early childhood [23]. Negative

stereotypes include perceptions that overweight and obese people are stupid, ugly, unhappy, morally and emotionally impaired, less competent, sloppy, lazy, socially isolated, and lacking in self-discipline, motivation, and personal control [22]. Evidence indicates that negative attitudes in the form of stigma and bias are translated into discriminatory behaviors against obese persons [24], and that overweight women are judged more negatively than overweight men [21]. Weight bias and discrimination have been documented in multiple areas, including employment settings in which obese persons have been treated poorly by coworkers and employees and denied jobs and promotions, health-care environments where obese patients confront bias from health care professionals including doctors, nurses, dieticians, and mental health professionals, and educational institutions in which obese students have been ridiculed by peers, viewed negatively by educators, and less likely to be admitted to college or to have their education funded because of their weight [see 21 for a review]. Unfortunately, these prevalent stereotypes are rarely challenged in Western society, leaving overweight and obese persons vulnerable to social injustice, unfair treatment, and impaired quality of life. Yet, ironically, prejudiced attitudes are not exclusive of non-obese people; they appear to extend to obese individuals themselves. Effectively, several studies have documented the expression of anti-fat attitudes among overweight and obese populations, confirming that they also endorse these negative stereotypes [25].

Furthermore, unlike racial prejudice, society freely expresses prejudicial attitudes towards obese people, justifying these attitudes on the grounds that weight is controllable [26]. Research shows that the media often frames obesity in terms of personal responsibility, focusing on individual causes of obesity (e.g., eating an unhealthy diet) and individual-level

solutions (e.g., changing one's diet) [27]. The message that weight is easily modifiable and that successful weight loss is a simple matter of personal effort is also emphasized in advertisements [26, 28]. This focus on personal responsibility eclipses other important dimensions of the obesity epidemic and often unfairly blames obese individuals, potentially reinforcing weight bias [21]. Thus, obese people may be more likely than other minority groups to encounter overt hostility and discrimination.

Even so, somewhat provocatively, some researchers proposed that some degree of stigma and associated body image dissatisfaction may motivate weight control behaviors [29]. However, evidence supporting that weight bias serves this motivational function is scarce. In a recent qualitative study analyzing the experience of being obese and the consequences of stigma, Odgen and Clementi observed that for some individuals stigma, whilst uncomfortable to experience, actually fostered their motivation to change and/or lose weight [30]. Yet, for most individuals, stigma was perceived to have exacerbated their negative sense of self, making them more likely to overeat and gain weight [30]. Similar results were reported in an earlier study, which showed that obese individuals who internalized negative weight-based stereotypes were particularly vulnerable to the negative impact of stigma on eating behaviors (i.e., increased binge eating) and less likely to diet [31]. Thus, these findings appear to challenge Heinberg's hypothesis that stigma may motivate obese individuals to engage in efforts to lose weight [29]. In fact, if this were truly the case, one would expect the increase in weight bias over the past 40 years [21] to be associated with a decrease in the prevalence of obesity, rather than with its continuous increase [8].

Evidence clearly supports the relationship between weight-based stigmatization and psychological well-being. Greater frequency of stigma and discrimination has been associated with increased vulnerability to depression, low self-esteem, poor body image, and poor coping strategies [21]. This relatively new area of research may also shed some light into the literature addressing the relation between obesity and psychological functioning, which continues to produce controversial findings and to be the subject of debate among researchers [32]. Over the years, empirical articles have attempted to determine whether there is a negative association between the two and, if so, what might be the direction of causality. Community studies have consistently shown that obese individuals do not differ from their non-obese counterparts in psychological symptoms, psychopathology, or personality overall [32]. Friedman and Brownell argued it was premature to assert unequivocally that there were no unique or consistent psychological correlates of obesity, given the methodological limitations found in previous studies, but above all, considering the heterogeneous nature of obesity [33]. Indeed, research with clinical samples suggests that obese patients seeking treatment evidence more psychopathology than overweight individuals in the general population [32]. Not surprising, bearing in mind that this psychological discomfort is what likely motivates those persons to seek treatment. One explanation could be that patients seeking treatment for obesity are heavier and therefore the increased psychopathology is related to the increase in weight; however studies do not confirm this hypothesis [e.g., 34]. Alternatively, it just might happen that specific characteristics that increase vulnerability to psychological dysfunction, such as binge eating or body image disturbances, are more salient in treatment-seeking populations. In effect, body image disturbances consistently discriminate

obese from their non-obese counterparts [31], and along with the numerous medical problems associated with excess weight, they have been identified as “the most consistent psychosocial consequence of obesity” [35; p.437]. As such, several authors have been emphasizing that the identification of determinants and consequences of body image distress in obese persons should be a priority for research, as it may help clarify the larger picture of why some obese persons suffer psychosocial consequences of obesity and others do not, as well as improve care [33, 36-37].

Obesity treatment: Past, Present, and Future Directions

The increasingly compelling data on the growing prevalence of obesity, the adverse effects of obesity on health and quality of life, and the substantial economic drain of this condition on the health care system, resulted in a broad consensus that addressing obesity and reducing its rates and deleterious effects is imperative [38].

The behavioral treatment of obesity comprises three major components: diet, physical activity, and behavior therapy. This comprehensive approach relies on a set of principles and techniques used to help patients adopt healthier eating and exercise habits that can be sustained in the long-term, but recognizes that body weight is affected by other factors besides behavior (e.g., genetic, metabolic, and hormonal influences) that likely increase or decrease one’s predisposition to weight gain [39]. Studies show that behavioral interventions (also known as lifestyle interventions) result in average weight losses of approximately 7-10% in initial weight, which judging by the criteria for success proposed by the World Health Organization (i.e., a 5%-10% reduction in initial weight), can be considered optimistic [40]. For instance, the Look AHEAD trial (i.e., Action for Health in

Diabetes) examined 5145 overweight or obese individuals with type II diabetes and found that a 4-year lifestyle intervention designed to induce a 7% reduction in initial weight and increase physical activity to 175 min/wk, resulted in an 8.6% average weight loss, improved diabetes control and cardiovascular risk factors, and reduced medicine use [41]. However, while behavioral approaches to the management of obesity are often successful in achieving clinically significant weight loss, the weight lost is generally regained. Evidence shows that the great majority of patients regain about 30%-35% of their lost weight in the year following treatment, and that 50% or more of patients are likely to return to their pretreatment weight within 5 years [42]. Conversely, the mean percentage of weight maintenance is 54%, according to a recent systematic review [43]. Not surprisingly, in a very recent review, Kirk et al. concluded that obesity remains deficiently managed within current health systems and that the most effective or most promising strategies within lifestyle interventions remain to be identified [44].

Obesity is a complex, multifactorial condition and therefore should be treated as such. Addressing all forms of obesity simply with caloric restriction and exercise (“eat less and move more”) is rather simplistic and most likely ineffective [45]. Sharma and Padwal believe that an incomplete understanding of the precise aetiologie(s) of obesity and, consequently, a failure to address the root causes of positive energy balance might explain the lack of efficiency in classical therapeutic approaches [45]. Hence, these authors argue that the effective long-term management of obesity requires a systematic assessment of the aetiological causes of weight gain, including sociocultural, physiological, biomedical, psychological and iatrogenic factors that can affect metabolism. Rather than just identifying and describing critical behaviors (e.g., “this patient eats too much”), professionals should

seek to identify the determinants of those behaviors (e.g., “why does this patient eat too much?”) [45]. A thorough understanding of these factors, many of which may be predictive of successful long-term weight management (e.g., self-motivation, autonomy, self-efficacy, flexible eating restraint [46-47]), may contribute to the development of more effective weight maintenance strategies [48].

The identification of predictors of successful weight loss maintenance that can help people navigate to a healthier body weight and remain at that point, for instance, by adapting behavior change solutions to their lifestyle and monitoring (re)lapse markers when they start to drift back towards weight regain [49], has been a major concern of researchers in the last decade [e.g., 46, 50]. However, relatively few pretreatment predictors of weight loss and its maintenance have been consistently identified. Evidence suggests that there is a large inter-individual variability and that predictive models explain no more than 25-30% of the variance in weight that is lost [46]. The same is true for the maintenance of weight loss, where numerous factors that might seem intuitive pretreatment predictors of weight loss (self-esteem, body image, motivation, dietary behavior and exercise) do not turn out to be so. Many of these factors improve during treatment (fact that generally overrides the capacity of baseline levels to influence results) and are important process or treatment-based correlates of success, but the amount of variance they explain remains either small or highly variable between different groups [49]. Regrettably, little attention has been paid to why this is the case and how some formerly obese individuals are able to persist with successful weight-related behaviors. It is likely that combinations and/or interactions between some of these process correlates take place and are important to consider as well [49]. For example, autonomous motivation for exercise has been shown to mediate the

effects of physical activity participation on eating self-regulation in overweight women enrolled in obesity treatment, suggesting that there might be a motivational spill-over effect between these two process correlates – physical activity and eating [51]. At the present time, most of the variance in successful long-term weight management remains unexplained, keeping prediction extremely difficult [49]. Thus, identifying intervention-related predictors and mediators of long-term weight maintenance in behavioral intervention studies with adequate control groups, which will enhance the understanding of the most critical mechanisms involved, remains a research priority [43].

Perhaps the problem inherent to the disappointing results concerning the long-term effectiveness of behavioral treatment rests in the currently accepted definition of successful weight loss. Maybe we need to reconsider this definition. At present, weight-related outcomes (e.g., percent weight change, number of subjects who achieve the current guidelines of 5% or 10% weight loss [43]) are commonly regarded by researchers and laypeople as the perceived measure of success/efficacy in weight loss trials and interventions. Yet, it has been previously suggested that a major obstacle to long-term successful weight management is having unrealistic weight goals and weight loss expectations, fact that is believed to undermine people's ability to acquire and use effective weight maintenance behaviors [52]. As Blair and Lamonte pointed out, “a focus on weight loss is often counterproductive and unsuccessful, and sometimes may even be unnecessary” [53]. Furthermore, body weight per se might not be the most important risk factor for obesity comorbidities [54]. Thus, the selection of outcomes in obesity treatment may also merit renewed attention. Besides helping patients adopt and accept an appropriate weight goal, interventions should also seek to encourage the definition and focus on the

achievement of goals that are not contingent on weight loss [52]. In line with this, and based on a self-determination theory perspective, some researchers have recently suggested that selected psychological and behavioral outcomes could also be routinely considered successful in weight management, given that changes promoted by autonomous motivation and thus expected to last longer, go beyond weight and are associated with different psychological consequences [55-56]. Nevertheless, having alternative indices of success (besides weight), such as increased self-efficacy and perceived autonomy around weight management, finding personal meaning in being physically active, or displaying a more flexible and positive relation to food and diet, as long as these are accepted as markers of success by participants, could help avoid these treatment misfortunes [57].

Physical Activity and Weight Management

Since obesity is a product of energy imbalance, the prevalent view of public health organizations is that both diet and exercise are important for weight loss [e.g., 58]. Accordingly, weight management interventions almost always involve changes in the regulation of both these behaviors. Of the two interventions, energy restriction through dieting is seen as the most important factor for a change in weight; however, just as certainly, diet does not provide a long-term solution [59]. Results of weight loss treatments emphasizing caloric restriction exclusively have been universally poor. Mann and colleagues presented a strong case for the association of such treatments with weight gain, rather than reduction, over time [60]. Dietary restraint is difficult across time; it represents a state of deprivation, and runs against the current environment that provides enormous

amounts of palatable, high energy, low cost foods, and beverages available at almost any location [59].

The role of physical activity in weight management, namely its contribution to the preservation of fat-free mass and, especially, to the long-term maintenance of weight loss, is widely recognized [58, 61]. Physical activity is therefore recommended by virtually all public health agencies and scientific organizations, including the World Health Organization [8], the National Institutes of Health [62-63], and the American College of Sports Medicine [61]. However, despite the importance attributed to exercise, physical activity has not been regarded as the most effective strategy for obtaining weight loss. Several systematic reviews show that exercise interventions alone bring about modest, and typically disappointing, weight losses, and that slight increases in weight loss are observed when exercise is combined with dietary restriction [64-65]. This is reflected in the most recent report from the American College of Sports Medicine (ACSM) on exercise prescription guidelines for weight management [61]. Their summary statement indicated that moderate intensity physical activity between 150 and 250 minutes per week will provide only modest weight loss ($\approx 2\text{-}3$ kg), and suggested that greater amounts of physical activity (> 250 minutes per week) will be needed for clinically significant weight loss [61].

Nevertheless, quite a few prospective studies show that when higher levels of exercise are prescribed and supervised, and other factors that affect energy balance are controlled, enrolled individuals achieve substantially greater weight losses, in amounts comparable to those obtained after similar energy deficits were produced by caloric restriction [61, 64]. For example, Ross et al. have shown that a $700 \text{ kcal}\cdot\text{d}^{-1}$ energy deficit produced solely through exercise with energy intake remaining constant resulted in a weight loss of 7.6 kg

over a 3-month period [66]. The weight loss resulting from a similar energy deficit achieved through changes in energy intake was 7.4 kg [66]. Thus, under ideal or controlled conditions, there is reason to believe that exercise alone is efficacious in producing clinically significant weight losses. Still, in the real world, such high levels of exercise might be difficult for community-dwelling overweight and obese adults to achieve and sustain [61]. In effect, few studies with sedentary overweight or obese individuals using exercise as the only intervention result in decreases above 3% of baseline weight [61]. Hence, we could conclude that losing weight exclusively through exercise is not a matter of efficacy but a matter of reduced effectiveness, this is, reduced feasibility in the real world [61]. As a result, overweight and obese individuals trying to lose weight are currently advised to combine dietary changes with increases in physical activity levels [61]. And, effectively, two recent reviews provided further support to the notion that including physical activity in a weight management program offers additional benefit versus using dietary changes alone [67-68].

As opposed to its modest role in weight loss, physical activity seems to play a more crucial part in the maintenance of weight loss, being often cited as the best predictor of weight maintenance after weight loss [69]. Results from a systematic review of physical activity to prevent weight regain after weight loss indicated that individuals who engaged in exercise experienced less regain than those individuals who did not, and those individuals who engaged in greater amounts of exercise experienced less regain than those with more moderate levels of physical activity [65]. Yet, while prior research generally shows that exercise is beneficial, evidence is stronger for non-randomized designs than for randomized controlled trials (RCTs), as underlined in two comprehensive reviews on the topic [64-65].

The beneficial role of physical activity has been especially highlighted in studies from the US National Weight Control Registry, which has been providing continuous insight into the process of weight maintenance [70]. This Registry reports that those who are successful at maintaining weight loss (individuals maintaining a 13.6 kg weight loss for more than 1 year) are an extremely physically active group, despite a large variance in individual levels of physical activity. In fact, in over 3500 successful weight loss maintainers, from the several strategies that have been identified, the expenditure of large amounts of energy in voluntary physical activity has emerged as the most consistent one [67]. These findings have been confirmed by Jakicic and colleagues who found that obese women sustaining a loss of 10% or more of initial body weight at 24 months reported performing more physical activity (1835 kcal/week or 275min/week) compared to those sustaining a weight loss of less than 10% of initial body weight [71].

Beyond energy expenditure

In the field of obesity research, physical exercise has been traditionally considered as a strategy to burn calories [72], probably because researchers systematically, but erroneously, assumed a static model of energy balance viewing it as a simple matter of adding up the ‘ins’ and ‘outs’ [15]. Regrettably, this is not so simple since there is a dynamic interplay between the components of energy balance [15, 59]. In addition, there are several behavioral, inherited and/or physiological factors, which have often been neglected, and that may interfere within the energy balance equation, and thus affect the exercise-induced weight loss and maintenance [73]. Unfortunately, the typical view of weight loss as the marker of success in weight management, leads health professionals and lay people to

undervalue the arguably more important benefits of exercise to the individual's overall health [74], and on top of that, as mentioned above, data show that body weight changes are very poor indicators of the effects of physical activity.

But, physical activity is so much more than a calorie-burning agent! And in order to make effective and sustainable exercise prescriptions and improve adherence, fully understanding the mechanisms that link exercise to weight control is imperative [75]. Moreover, considering that healthy weight management comprises changes in physical activity and eating behavior, knowing whether changing physical activity interferes with, interacts with, or thwarts the regulation of eating behavior, could also provide further insight into successful weight management.

The physiological effects of exercise on weight management are well-documented in the literature [72, 74, 76]. Creating a negative energy balance is the primary goal of obesity treatment, and thus, greater emphasis is put on caloric expenditure. Exercise may alter energy balance by increasing the energy expended during the exercise activity, the energy expended shortly after the activity (EPOC), and by modifying resting metabolism [59]. However, this is considered a small component of the overall link between exercise and weight management, in particular at the beginning of a program when the individuals' level of fitness and excess weight limit both duration and intensity of activity [61, 74]. There are other important physiological effects of exercise besides caloric expenditure though. For instance, routine physical activity has been shown to result in clinically significant improvements in body composition, through reduced fat mass, abdominal adiposity, and increased lean body mass [74]. Physical exercise also plays an important part in maintaining cardiovascular health and preventing diseases [e.g., 77]. It has been shown that

physically active individuals have shown less likelihood of developing stroke, some forms of cancer, type 2 diabetes, osteoporosis, sarcopenia, and loss of function and autonomy [76]. In addition, a tight coupling between energy intake and energy expenditure has been documented at high levels of physical exercise, and habitual exercisers or those who engage in an exercise regime have demonstrated a better meal to meal appetite control (see [78] for a review). In other words, doing exercise seems to improve the sensitivity of the appetite regulatory system [15].

Regular physical activity is also associated with improvements in several markers of psychological well-being, including stress, anxiety and depression [79], several of which have been identified as predictors of sustained weight loss maintenance [e.g., 50]. This might account, at least partially, for the widely recognized role of physical activity in long-term weight management [61]. In line with this, Baker and Brownell proposed that psychological factors like self-efficacy, body image, or mood could be improved through regular physical activity, leading to increased psychological resources to successfully self-regulate, and in turn, foster persistence in weight control-related behaviors, including dietary and exercise habits [75]. There has been empirical confirmation of some of the expected relationships within this model. In brief, these studies found that exercise-induced improvements in body image, mood, and exercise self-efficacy contributed to increased compliance with exercise and resultant weight loss [80], and that self-efficacy to manage the physical and self-regulatory demands of exercise [81], understanding social and psychological benefits from exercise [82], and increasing autonomous motivation and self-determination for exercise [51] were associated with one's ability to sustain improved eating behaviors through spill-over effects. Moreover, prior research suggests that, for

persons beginning exercise regimens for weight loss, increases in positive mood such as energy, revitalization, and vigor are key predictors of continuance with their overall weight management programs that typically include restrictions in caloric intake [81]. Formerly sedentary individuals seeking weight loss frequently articulate, quite emphatically, how motivating vitality changes associated with exercise are for them. This apparent reinforcement effect may further explain why exercise is so strongly associated with maintenance of weight loss, well beyond the calories actually expended [72]. Health professionals would do well considering the overall benefits of exercise to long-term weight management [72].

Body Image

What is Body Image?

Body image is a complex, multidimensional construct consisting of an individual's mental representation of body-related perceptions¹ and attitudes (i.e., thoughts, feelings, and behaviors), especially focused on but not limited to physical appearance [83]. Much contemporary body image research derives from a perspective that conceptualizes body image as a function of cognitive social learning processes, including cognitive mediation of emotions and behaviors. The cognitive-behavioral model of Cash posits that both historical and proximal events shape and sustain body image attitudes and experiences [84].

¹ Body image perceptual dimension, i.e., the accuracy of an individual's body size estimation, will not be addressed in the current thesis.

Historical influences include cultural socialization concerning the values and standards of physical appearance, experiences in interactions and communication with others, one's actual physical characteristics, and personality dimensions that affect body image development. Such developmental factors shape body image attitudes, which according to Cash et al. [85], consist of two sub-dimensions. Evaluative body image pertains to cognitive appraisals and associated emotions about one's appearance, including self-ideal discrepancies and body satisfaction-dissatisfaction evaluations. Body image investment refers to the degree of cognitive and behavioral importance that people assign to their body and the extent to which the body's appearance defines their sense of self (i.e., self-schemas, self-objectification, etc.). It reflects a dysfunctional investment in appearance in order to regulate body image evaluations and emotions, as opposed to more adaptive valuing and managing of one's appearance [85]. Further, the core facet of this dimension comprises appearance-related self-schemas, that is, cognitive structures derived from past experience that summarize one's thoughts and beliefs about appearance and its centrality to one's self [86-87]. These are believed to be actively triggered and maintained by appearance-related internal or environmental events and cues [84]. The structure of attitudinal body image, especially the distinction between evaluative and cognitive-behavioral investment components, has been empirically supported [e.g., 88]. Findings indicated that, although the optimal prediction of poor/negative body image requires both evaluative and investment aspects of body image, the former is not sufficient per se to produce poor body image [88]. Similarly, both attitudinal components were found to predict eating disturbance, although body image investment presented greater predictive power, in some cases overriding the effects of evaluative body image [85, 89].

The evaluative dimension of body image, often referred to as body dissatisfaction, is typically measured by assessing people's feelings about their body or body parts, ranging from dissatisfaction to disparagement or dysphoria (e.g., Eating Disorder Inventory – Body Dissatisfaction Subscale [90]; Multidimensional Body Self-Relations Questionnaire – Body Areas Satisfaction [91]); or, alternatively, by evaluating self-ideal body size discrepancies (e.g., Figure Rating Scale [92]). The investment dimension of body image encompasses several facets including an over-preoccupation with body image and appearance, cognitive distorted thoughts about the importance of appearance, behavioral and coping reactions, and above all, appearance self-schemas [84]. Assessment of this dimension include measures of body-related overconcern and anxiety (e.g., Body Shape Questionnaire [93], Physical Appearance State and Trait Anxiety Scale [94]), coping strategies and adjustive reactions (e.g., Body Image Coping Strategies Inventory [95]), or body schematicity (e.g., Appearance Schemas Inventory-Revised [85]).

Although body image is currently conceived as a complex, multifaceted construct, much of the literature has focused on the evaluative component, neglecting body image investment [96]. Furthermore, too many researchers define body image using a singular measure (e.g., body dissatisfaction), fact that is partially a product of limited conceptualization of body image as an unidimensional construct, which, in turn, limits measurement. Limited measurement results, at best, in an incomplete understanding of body image and its implications; at worst, it distorts our understanding of body image functioning. According to Cash and Pruzinsky, greater precision in understanding and evaluating the multidimensional nature of the body image construct, and in particular its investment dimension, might help to clarify a fundamental axiom about body image functioning –

objective appearance is not necessarily indicative of the subjective experience of appearance –, and might contribute to overcome the common but simplistic view of body image distress as a synonym of body dissatisfaction [97]. Any progress in understanding body image development, dysfunction, or change must be based on a deep understanding of the nature of body image investment [97]. In line with this, Thompson also recommended the inclusion of multiple but pertinent facets of body image [98].

Developing Body Image Attitudes: A Sociocultural Trouble?

“Am I thin enough yet?”

Several theoretical models have been proposed to clarify the development of body image attitudes [96, 99]. Some theories have been more concerned with the explanation of body image perceptual dimension, addressing the accuracy of estimations regarding one’s body size, while other theoretical models have been more interested in elucidating the development of subjective (i.e., attitudinal) body image, directing their attention to the role of developmental and sociocultural factors. Yet, most researchers appear to agree that the strongest influences on body image development and disturbances in Western societies pertain to sociocultural factors, in particular the role of the media [e.g., 100].

Sociocultural influences

Sociocultural theories emphasize that the current standard for thinness, as well as other unrealistic standards of beauty for women, are all-pervading and, without resorting to extreme and unhealthy behaviors, impossible to achieve for the average women [101]. In

effect, as Tiggemann and Pickering noted, “Only the very thinnest 5-10% of all American women can actually acquire and easily maintain the supermodel’s salient and most desired feature: her fat-free body.”; we can easily imagine that this will be true for non-American women as well [102; p.199-200]. Hence, it does not surprise that concerns about weight and appearance have become so prevalent that they were considered “normative” [103]. According to sociocultural explanations, body image concerns appear to derive from three major factors: the culturally-sanctioned thin ideals and their symbolic meaning, the stigma associated with obesity, and the role of physical appearance as a core aspect of femininity [104-105].

The *ideals of feminine beauty* have changed over time, moving away from a preference for a hourglass figure to a less curvaceous and angular shape. Indeed, research indicates that media models have become progressively thinner, often exceeding the 15% underweight criteria used to diagnose anorexia [106-107]. These unrealistic and unhealthy ideals, achievable by only a few, are so ubiquitous in the media (e.g., TV, radio, internet, magazines, and shops) that women cannot avoid a sheer exposure to them [108]. But what makes women strive for these ideals?

There is a symbolic meaning inherent to the “body perfect” ideal [16]. Western culture sends a powerful message to women, that only the beautiful and the thin are valued and loved, promoting an ideal of female body image where thinness is a symbol of success, happiness, health, and being in control of one’s life [17]. According to Dittmar, there is a halo effect around the “body perfect” ideal, where the idealized media models not only convey that beauty and prosperity should be central life goals for everyone, but also establish what it means to be beautiful, successful and happy [16]. As a result, appearance

becomes central to women's identity, and the pursuit of thinness becomes imbued with the "myth of transformation": improving appearance holds the promise of changing more than just one's body size and shape; it promises to change one's social status, both economically and interpersonally [16, 104]. Acceptance and internalization of this cultural schema – that appearance and thinness are absolutely vital for happiness and success – implies that self-worth becomes associated to a woman's perceived attractiveness and, thus, contingent on meeting the societal ideals [109]. However, the "body perfect" ideal is no longer a primarily female concern [16]. Evidence shows that emphasis on, and objectification of, the ideal male body is growing, resulting that the well-toned upper torso has become so muscular that it is unattainable for most men [e.g., 110]. Even so, men are still not as acutely affected by sociocultural pressures as women.

Complementing the positive stereotype regarding physical attractiveness is the negative stereotype towards obesity. Nowadays, the decline in female body size ideals contrasts with the increase of ordinary women's average weight, with recent health statistics showing that overweight rates are well above 50% in several industrialized countries [5, 8-9]. The rising in obesity rates would not represent a problem if socially prevailing pro-thin bias were not accompanied by anti-fat bias, as it seems to be the case [e.g., 111]. Unfortunately, the *stigma and discrimination associated with obesity* is highly prevalent, and often due to widespread negative stereotypes viewing obesity as a "voluntary", controllable condition, and overweight and obese persons as lazy, unmotivated, lacking in self-discipline and competence to control their urges [21]. Hence, obesity is seen not only as an aesthetic flaw but as a character defect as well, further increasing the emphasis on the pursuit of thinness, and naturally, the prevalence of body image disturbances [104].

The role of physical appearance as a core aspect of femininity also constitutes a major influence on the pervasiveness of body image concerns in women. Objectification theory contends that the cultural milieu, mostly through mass-mediated images, sexually objectifies women's bodies, showing them as thin, beautiful, and often fragmented body parts [112]. Sexual objectification functions to socialize girls and women to treat themselves as objects to be evaluated based on appearance [113]. Women learn that their appearance matters, and that other people's evaluations of their body shape can determine how they are treated, and ultimately, affect their social and economic life outcomes [114]. Moreover, women are socialized to place higher priority on interpersonal relationships and taught to believe that their physical attractiveness is responsible for the success of their relationships [115]. As a consequence of this female-gender role stereotype, women tend to overidentify with their bodies, and their identity and sense of self-worth often become contingent on conforming to the prevailing norms for thinness and attractiveness [104, 113].

These three sociocultural factors – ultra-thin ideals, obesity stigma, and the centrality of appearance to women's femininity – contribute to the widening gap between the ultra-thin ideals portrayed in the media and women's actual body sizes, having several negative consequences on body image [108-109]. There may be perceptual distortion, where women overestimate their body size. Body-focused self-discrepancies and the failure to meet significant but unrealistic "body perfect" ideals might result in body dissatisfaction and negative mood. In the cognitive domain, investment in appearance as the central criterion for self-definition results in selective attention to appearance-related messages, and in terms

of behavior, women typically engage in dieting and other unhealthy body-shaping behaviors [96].

On top of this, mass media not only espouse these stereotypes, but also explicitly instruct how to comply with them by advertising several supposed solutions which will get women closer to the culturally-sanctioned ideals. Women are told that they can have the perfect body if only they consume more products: cellulite control creams, “miraculous” diet pills, individualized meal plans, work-out sessions with personal trainers, and cosmetic surgery are just a few examples [16-17]. Hence, advertising not only encourages the cult of ultra-slender ideals, it also offers the solutions making women believe they *should* and *can* be thin.

However, we live in a complex society dominated by capitalist interests and, in truth, supportive of a cultural paradox, which cultivates thinness at the same time it creates a toxic environment prone to weight gain [17]. As Wolf argued, “Ideal beauty is ideal because it does not exist: the [media] action lies in the gap between desire and gratification. That space, in a consumer culture, is a lucrative one” [116; p.176].

Mass media permeate the everyday lives of people living in Western societies; thus, without undervaluing the influence of other important agents (e.g., family, peers), mass media have been considered the most powerful and pervasive communicators of sociocultural standards [17, 109]. Women’s magazines, above all other forms of media, have been criticized as being strong conveyors of unrealistic thin ideals. In effect, media surveys indicate that up to 83% of girls and women report spending an average of 4.3 hours a week reading fashion magazines [117-118], and research confirms that the ultra-thin ideal

is promoted in printed magazines aimed at teenage girls and adult women [e.g., 119]. Television may also be a powerful influence: virtually every home has a television set, switched on for more than 7 hours per day, and the vast majority of female television characters are thinner than the average woman, with less than 10% of women appearing on television being overweight [99]. Formal content analyses of both women's magazines and television reveal a preponderance of young, tall and extremely thin women [120], as well as high levels of gender stereotyping and reinforcement of gender norms [121]. The Internet, especially social networking sites, also represents a powerful sociocultural influence on young women's lives [122]. One content analysis of websites of teen magazines concluded that these disseminate similar ideals of female beauty as their print counterparts [121].

However, today's visual media are not as innocuous as the visual arts of the past. In olden times, figures of art (e.g., Boticelli's Venus) were romanticized as otherworldly and unattainable, but today's print and electronic media images cloud the boundaries between fictionalized ideals and reality, and frequently advocate that one needs only to comply with provided guidelines to achieve those ideals. Photographic and editing techniques may blur the realistic nature of media pictures even further, making people believe these images are realistic representations of actual people instead of carefully manipulated, artificially developed images [123].

In support of the general sociocultural model, extensive correlational research has demonstrated links between fashion magazine, television and Internet consumption, and thin-ideal internalization [122], body/weight dissatisfaction [122, 124], and eating disorder symptomatology [122, 125]. Two recent meta-analytic reviews of studies across a number of Western countries concluded that media exposure is associated with increased levels of

internalization, body image disturbances, and disordered eating symptomatology, with a small to moderate effect size [126-127].

Developmental factors

Socialization about the meaning of one's body involves more than cultural and media-based messages. Apart from these, many other influences have been noted as formative in the development and maintenance of shape- and weight-related disturbances [96, 101]. These influences include, but are not limited to, interpersonal experiences and associated teasing or critical comments about one's appearance, physical characteristics and body changes, and personality characteristics [84].

Our self-concept, including how we feel about our body image, originates from our evaluations of how other people interact with us. *Social and interpersonal interactions* are the "looking glass" by which we come to form attitudes and beliefs about ourselves. Thus, the internalization of appearance-related social feedback and appraisals that we receive from family, peers and others also contributes to body image formation [128]. Family and peer interactions are two important sources of socialization about the meaning of one's appearance. Parents' expectations and opinions, including the degree to which physical appearance is valued within the family, are communicated in daily interactions through parental role modeling, verbal and non-verbal comments, and criticism. These messages are internalized by children, potentially determining the standard against which they compare themselves [129]. Furthermore, evidence suggests that an intrusive and conditionally approving parenting is associated with body image and eating disturbances through several mechanisms such as the development of maladaptive perfectionist and evaluative processes [130]. Siblings can also have a significant influence on body image formation, whether by

providing a referential for social comparison of a child's appearance, or by working as teasing agents [e.g., 84]. Likewise, peers play a paramount role in the promotion of body image disturbances, principally throughout adolescence [131]. Empirical evidence shows that teasing experiences from peers are associated with greater appearance-related concerns, more dieting behaviors, and worse well-being [132]. In addition, evidence suggests that peers' modeling behaviors and individuals' belief about whether they approve or disapprove their body shape may also affect body image and eating behaviors [124, 133].

Regarding *physical variables*, body image formation is certainly predicted by one's "objective" physical appearance: the attractiveness and social acceptability of a person's physical appearance will elicit different feedback and treatment from others, and subsequently affect one's self-image or adjustment [134]. Empirical evidence seems to corroborate this proposition [e.g., 135]. Two other physical characteristics that have received much attention from researchers are body weight and age-related body changes [100, 129]. Elevated adiposity/weight is believed to result in increased body dissatisfaction due to the natural deviations from the culturally sanctioned ultra-slender ideal and to the increased social pressures to conform to that ideal [100]. Research findings suggest that body mass can be considered a risk factor for body image disturbances [100].

Maturational status, in particular the timing of pubertal maturation, has also been proposed as a potential influence in body image formation [136]. However, evidence supporting the more detrimental effect of an early menarche over a later one is mixed [100]. Nevertheless, Thompson et al. [101] stressed that more important than its direct effect, early maturation and the resulting physical changes may place an adolescent at higher risk for being teased, a factor whose influence has been consistently supported in the literature [132].

Personality traits also have a say in body image development [84]. Self-esteem is probably the most influential of these traits, as attested by prior research showing that lower self-esteem is associated with higher body image vulnerability to threatening events and ensuing maladaptive eating behaviors [84, 137]. Perfectionism has also been proposed as a risk factor for body image disturbance, as it may promote a relentless pursuit of the thin ideal and a rigid style of functioning [84, 138]. Public self-consciousness (i.e., selective attention to one's appearance and behaviors) and the frequent body surveillance that follows also appear to contribute to body image development [84]. Similarly, a need for social acceptance and approval is likely to increase one's investment and struggle to achieve the socially sanctioned body ideals [84, 128]. Dispositional mindfulness, this is, being conscientious and intentional in what you do, being open to possibilities, and/or paying attention to what is occurring without grasping onto judgments [139], may facilitate the development of a positive appraisal of one's body. To date, only one study specifically examined this link suggesting that those individuals who were more mindful experienced higher body satisfaction [140]. The general disposition to act in a self-determined way has also been shown to protect against the adverse effects of sociocultural pressure to be thin, is negatively predictive of their tendency to endorse the thin ideal, and is associated with lower body dissatisfaction [141-143]. Furthermore, women with elevated levels of autonomy/self-determination appear to interpret media messages as societal ideals of female attractiveness instead of viewing them as standards of how their bodies should look [144]. Naturally, there are several other personality traits likely to affect body image formation (e.g., traditional gender-role attitudes); these are just some of the most relevant examples.

Internalization of Cultural Ideals and Body Image Attitudes

Sociocultural messages have indirect, but powerful, effects on individual's thoughts, feelings, and behaviors, and ultimately, end up molding what individuals see as reality [17, 118]. Furthermore, people tend to be unaware of its pervasive influence, fact that strengthens its power. In effect, Western culture "*can become a "cage within", its bars invisible and its power pernicious*" [16; p.23], where people are misled to believe they are expressing their selves and conquering happiness, when they are, actually, shaping and monitoring their identities according to unrealistic ideals promoted by these sociocultural messages [16].

The mass media, gender-role socialization, and verbal commentary (from family, peers, etc.) communicate at an almost constant rate sociocultural messages regarding one's ideal weight and appearance. Hence, individuals are repeatedly exposed to these messages [17]. Even though some individuals are more susceptible to these messages than others, they cannot escape internalizing "body perfect" ideals and associated stereotypes; and more and more, up to a point they believe those ideals are desirable and realistic, expressive of their inner desires or aspirations [16-17].

Through various types of social learning processes, sociocultural and developmental factors lead to the internalization of cultural ideals, instilling basic body image schemas and attitudes, including dispositional body image evaluations and degrees of body image investment [84]. Self-schemas are "cognitive generalizations about the self, derived from past experience that organize and guide the processing of self-related information" [86; p.64]. In this particular context, they reflect one's nuclear, affect-laden assumptions or beliefs about the centrality of appearance to one's identity, as well as about the importance

and influence of one's appearance – and thinness – in life [84]. Individuals for whom appearance is very important (i.e., appearance schematics) are professed to develop more complex, interconnected networks of knowledge and affect regarding appearance, and to demonstrate a variety of information- processing biases related to their self-schemas [145]. Researchers have in fact demonstrated biases in attention, memory, and interpretation of body image-related information, which has been accepted as evidence for the existence of appearance schemas [146].

There is compelling correlational and experimental evidence that exposure to unrealistic thin ideals leads to thin-ideal internalization and worsens women's body image experiences [126, 147-148]. However, thin-ideal internalization and the use of appearance for self-evaluation (i.e., body schemas) are processes that must necessarily develop over time in response to repeated and ongoing exposure to idealized images. Hence, they cannot provide an answer as to what people do or experience when exposed to sociocultural influences. So, what processes mediate people's reactions to acute exposure?

Body Image Experiences in Everyday Life

Cognitive-Behavioral Processes and Implications

“As we think, so we become.”

What occupies the space of the mind and what is most practiced will be what ultimately results in the perceptual reality of who we are. Thus, the core beliefs, attitudes, and concerns that individuals develop shape their experiences of themselves and the world, by affecting the way individuals process social stimuli. But how does that happen? What

cognitive processes are involved? In concrete, how do body image attitudes and beliefs operate in everyday life? What psychological processes mediate the effects of acute exposure to social pressures on body image daily experiences?

The most commonly proposed mechanism derives from Festinger's theory of social comparison [149]. In short, this theory proposes that in the absence of an objective basis for determining their own level of physical attractiveness, people seek to compare themselves to available social standards, including those presented in the media [150]. Moreover, *social comparisons* made regarding physical appearance are usually upward meaning that individuals compare themselves to those deemed as more attractive in some regard [105]. Given that these ideals are almost impossible to achieve, individuals are likely to feel that they fall short of that standard, which usually causes decreased or negative self-perceptions of attractiveness, and creates more pressure to conform to idealized standards [105]. Evidence seems to corroborate these propositions, showing that the processing of thin female images leads the majority of women to engage in direct, upward social comparisons, which then lead to the perception of a discrepancy between ideal and actual attractiveness, causing increased body dissatisfaction and negative body-focused affect [108, 151]. Researchers are now investigating the cognitive processes that occur upon exposure to an idealized comparison target, as well as the moderators or mediators of this process [152-153]. For example, it was suggested that the negative effects of social comparison might depend on the type of motive endorsed by the individual, with different, more detrimental, findings being observed for self-evaluation rather than for self-improvement motives [153]. A closely related process, which has been identified as central to women's body dissatisfaction [154], refers to the *activation of appearance-related self-discrepancies*

[108]. Drawing on self-discrepancy theory [155], which assumes that an individual's specific affective responses are heightened by discrepancies in their self-beliefs, Dittmar and his colleagues [108] recently proposed and tested a new model of media exposure effects on women's body image experiences. Instead of examining self-discrepancies as pre-existing, stable individual traits as it was done in prior research [151, 154], they conceptualized and analyzed self-discrepancies as temporarily activated constructs [108]. According to this model, temporarily salient, exposure-activated beliefs about appearance and associated negative body-focused emotions are proposed to mediate the acute detrimental impact of thin models on women's body image [108]. Exposure to thin models is believed to activate weight-related self-discrepancies, because women's bodies are generally larger than the media ideals against which they usually compare themselves. To the extent that such negative self-thoughts become temporarily salient, it is suggested that they generate body-related negative affect. Furthermore, the authors proposed that the degree of thin-ideal internalization would moderate these effects [108]. Model testing results confirmed their propositions, suggesting that the activation of weight-related self-discrepancies occurs, depending on whether or not individuals have internalized the thin ideal as a personal goal: only women who had internalized the thin ideal were affected by exposure to thin models [108].

The cognitive-behavioral model on body image experiences is different in emphasis, drawing on self-schema theory [86] to suggest the presence of appearance schemata in our cognition [156]. According to this perspective, specific environmental cues and contextual events related to appearance result in the *activation of body image schemas*. Triggering events may entail, for example, body exposure, social feedback or comparisons, verbal

commentary, weight or appearance changes [84]. This priming is thought to heighten awareness and salience of additional body and food-related information and to result in cognitive-affective processing consequences. These involve often dysphoric, emotion-laden automatic thoughts, inferences, interpretations, and conclusions about one's looks, and are generally in favor of fatness interpretations [157]. For example, feelings of fullness may be interpreted as "feeling fat". Similarly, inoffensive comments from other might be interpreted as negative evaluations of one's appearance. The activation of these cognitive biases elicits negative emotional states and body image dissatisfaction [84, 156].

In the context of a potential threat or challenge to body image, individuals develop and employ cognitive and behavioral strategies to adjust to or cope with these distressing thoughts, feelings, and situations [84]. Adjustive reactions include avoidant and body concealment behaviors, appearance correcting rituals, seeking social reassurance, and compensatory strategies [84]. However, these maneuvers are ultimately counterproductive because they serve to strengthen and maintain negative body image attitudes via negative reinforcement, as they provide temporary relief from body image discomfort through escape and avoidance [84, 145]. Cash and colleagues identified three different body image coping strategies [95]. Appearance fixing entails efforts to change one's appearance by concealing, camouflaging, or correcting a physical feature perceived as disturbing. Avoidance concerns attempts to evade threats to one's body image thoughts and feelings. The third strategy, positive rational acceptance, involves mental and behavioral activities that emphasize the use of positive self-care or rational self-talk and the acceptance of one's experiences [95]. The type of coping strategies typically selected by the individual might have different psychosocial implications. For example, Cash et al. showed that those who

engaged in higher levels of avoidant and appearance-fixing coping experienced greater body image dissatisfaction, were more likely to believe that their physical appearance influenced their personal worth, had less positive body image experiences, and, as a result, reported a poorer psychosocial functioning, including lower levels of self-esteem, less social support from friends and family, and more aberrant eating concerns [95]. In contrast, positive rational coping was associated with less psychosocial dysfunction, greater perceived social support, higher self-esteem, and slightly less eating disturbance (especially among women) [95].

Regarding the long-term psychosocial implications of body image disturbances, numerous studies have shown that negative feelings about one's body are associated with adverse psychosocial consequences, including poor psychological adjustment, negative affect, low self-esteem, increased depression and anxiety, impaired sexual functioning, and maladaptive eating behaviors [37, 96, 123, 158-159]. Cash and Fleming further observed that individuals reporting more body dissatisfaction, but also more dysfunctional investment in one's appearance, also experienced a poorer quality of life [128]. However, body image distressful attitudes may vary in their impact on an individual's psychological well-being. Effectively, it has been suggested that body image dysfunctional investment might have more detrimental effects on psychological well-being than evaluative body dissatisfaction, which per se is not considered a valid indicator of emotional distress and psychosocial impairment [89]. Prior studies appear to corroborate this hypothesis, showing that dysfunctional investment in appearance considerably exceeds the contribution of body dissatisfaction to the prediction of psychosocial functioning [e.g., 85, 89, 160]. For example, Cash et al. found that the appearance-schemas (i.e., a core facet of body image

investment) predicted social anxiety, depressive symptoms, and eating disturbance, above and beyond a simple index of body dissatisfaction [85], and in another study, Jakatdar et al. also found that cognitive errors or distortions related to body image thoughts predicted quality of life and disturbed eating attitudes above and beyond evaluative body image [160].

In the current sociocultural milieu, dominated by ultra-thin beauty ideals achievable by only a few, behavioral efforts to lose weight or prevent weight gain, and associated *maladaptive eating behaviors*, are probably the most natural and common consequences of body image disturbances. It does not even surprise that sociocultural models of bulimia nervosa assign body image concerns a causal role in the development of disordered eating [161]. According to the Dual Pathway Model, sociocultural pressures to be thin lead women to internalize the slender body as their standard for feminine beauty, and in turn, to experience discrepancies between that ideal and their actual figure in a regular basis [161]. This, in turn, prompts body dissatisfaction and over-preoccupation with appearance, often motivating the adoption of maladaptive eating behaviors in an effort to lose weight and reduce body image discomfort and associated negative affect. Ultimately, these behaviors might evolve to more severe disturbances, including binge eating and bulimia [100, 161]. Evidence clearly corroborates these theoretical propositions. Prior research not only confirms that body image experiences predict the severity of problematic eating patterns, but longitudinal and structural modeling studies also support poor body image role as a precursor of the adoption of dysfunctional eating behaviors among other unhealthy weight control strategies [e.g., 100, 141, 162, 163]. These findings have led researchers to

conclude that body image distress is one of the most potent risk factors for eating disturbances [104].

In sum, sociocultural influences play a significant role in how individuals construct their own versions of bodily norms (i.e., appearance schemas), and this, in turn, impacts people's body image, identity, and psychosocial functioning through cognitive mechanisms, such as upward social comparison, discrepancy creation, and schema activation. But, are all individuals equally vulnerable?

Individual Variability

Although the pervasiveness of the media ensures that virtually all women and girls are exposed to a substantial dose of idealized thin beauty images, not all develop extreme preoccupation with weight, and only a minority develops more severe clinical disorders [152]. Effectively, findings of a meta-analysis exclusively on experimental studies identified prior body image concerns as a powerful moderator of the detrimental effects of thin media images: the effect size was substantial for women with significant body issues, $d = .50$, whereas for other women it was only marginal, $d = .10$ [148]. Turning to single studies, diverse individual difference variables have been shown to moderate exposure effects, including trait body dissatisfaction [164], body surveillance [165], disordered eating [166], restrained eating [167], social comparison tendency [168], or dispositional levels of self-determination [141-144].

Women with a higher body mass index (BMI) consistently report more body dissatisfaction and weight/shape concerns [e.g., 169], and it would seem reasonable to expect so due to the

pervasiveness of the thin body ideals. Yet, curiously, objective indicators of weight, such as BMI, do not always correlate well with, or moderate, weight/shape concerns [170]; even women with an average, healthy weight or below can still feel fat [171]. Accordingly, some body image researchers suggest that there may be little relationship between what one thinks about the body and the objective reality of one's appearance [170-171]. They propose that the psychological importance individual women attach to weight may be more important. Therefore, next we focus on such constructs, which might underlie several of the vulnerability factors previously identified, namely thin-ideal internalization and appearance-schematicity.

Theoretically, it seems reasonable to think that the negative impact of ultra-slender models would depend on the degree to which women have internalized the thin ideal as their own personal beauty standard, given that the unrealistic, unattainable ideals portrayed in the media only make it more salient for them how distant they are from their ideal. Those who most aspire to being thin should be worst affected, more dissatisfied with their appearance and more dysfunctionally invested in its improvement. This has been demonstrated in several studies [e.g., 168, 172]. For instance, Dittmar and Howard [168] examined how individual differences in women's thin-ideal internalization affected their body-focused anxiety after to exposure to media images. They found that negative reactions took place only when high thin-ideal internalization was present [168].

Closely linked to the concept of thin-ideal internalization is the concept of appearance-schematicity, which also stresses the centrality of appearance to one's identity and the importance of appearance and thinness-related social comparisons and evaluations [172]. It has also been suggested that some individuals who are known as appearance-schematic

place a greater importance on appearance with respect to the self and have more complex, developed body image-related schemas [173]. These individuals are selectively attentive to the appearance-related aspects of any situation or event; thus, they are believed to exhibit more distressful body-esteem effects after exposure to appearance-related stimuli. Hargreaves and Tiggemann confirmed that only individuals who held certain beliefs and assumptions about their appearance (i.e., schematics) experienced more dissatisfaction after viewing commercials portraying the thin ideal [156]. Although these author failed to replicate this finding in a later study, they did report that highly invested individuals engaged in more appearance-related social comparisons with the thin ideals than did moderately or lowly invested individuals [174]. In effect, it has been previously suggested that self-schemas might be central to understand social comparison processes, by directing attention toward schema-relevant aspects of others and of oneself [175]. At last, Ip & Jarry recently suggested that the motivation behind investment might also moderate individuals' response to thin media images [176]. They found that although highly invested women are generally more responsive to thin media images than modestly invested women, those invested for self-definition are affected on more psychological dimensions than are those invested for appearance management.

Obesity and Body Image Distress: Specific Risk Factors

Despite the inconsistent associations between BMI and subjective measures of body image, the overweight and obese population seems to be particularly vulnerable to the development of body image disturbances [170]. And indeed, body image factors consistently discriminate obese from their non-obese counterparts. Obese individuals

overestimate or distort the size of their body more, are more dissatisfied and preoccupied with their appearance, and tend to avoid more social interactions because of their appearance [33]. Body image and obesity are linked in ways that defy simple analysis, given the complex relationships that appear to exist (e.g., obesity and body image distress might be more strongly linked if binge eating is present). Schwartz and Brownell summarized the factors that most consistently emerged from existing research, and which put this population particularly at risk of developing a negative body image (thus, demonstrating its clinical significance) [36]: (1) Sociocultural messages conveying that fat reflects deficiency and personal failing are so powerful and prevalent that feeling bad about one's body becomes the modal response. Some level of body image distress should be expected as the default. (For a more thorough description of this topic, see section 'Obesity: Social Reality and Implications'). (2) Population studies show that body image beliefs and concerns rise as people become more overweight. This is not consistent in treatment-seeking populations, perhaps because people in such samples are already so distressed with their body image that they are beyond the point where additional weight inflicts further damage on their body image. And effectively, several studies have found a relationship between increased body image distress, increased depressive symptoms, and decreased self-esteem among obese women seeking weight loss treatment [177-178]. (3) Findings of negative body image in obese women are clear. Relatively little is known about men, but research effectively suggests a more pronounced impact on women. (4) Binge eating accompanying obesity is consistently associated with body image disturbances. For example, Nauta et al. observed that most obese binge eaters mentioned negative self-schemas that could be characterized as negative generalizations about the self combined

with weight, shape, or eating concerns, whereas the majority of obese non-binge eaters mentioned weight, shape, and eating concerns that were not combined with negative generalizations about the self [179]. Other potential risk factors still produce mixed findings or remain poorly studied, including the age of obesity onset, the history of weight cycling, race, and sexual orientation [36].

Changing Body Image

There are several types of interventions to improve body image. These can be broadly divided into physical and psychosocial interventions. Physical interventions rely on an outside-to-inside approach to improve body image, seeking to change it through physical body changes, and include weight loss interventions, fitness and exercise regimens, cosmetic surgery for “elective” appearance changes, reconstructive surgeries for congenital or acquired deformities, and psychopharmacological treatments. In contrast, psychosocial interventions involve an inside-to-outside approach, seeking to improve body image by rationally challenging individuals’ learned views, thoughts, and beliefs about the importance and influence of their looks to their daily life experiences and to their sense of self-worth. These interventions include an array of psychotherapeutic and psychoeducational approaches, of which cognitive-behavioral approaches are the most well documented and empirically validated [180].

Naturally, different populations face different problems, have specific needs and, thus, are likely to call for different approaches to improve their body image. As previously described, overweight and obese populations are particularly affected by body image disturbances. Although the treatment of body image concerns of obese people is still in the

developmental stages, some considerations can already be made. The main findings are summarized in the following sections.

Body Image Change and Weight Loss

Among the overweight and obese, it is generally believed that the best way to improve body image is to lose weight. But, this belief is not exclusive of those who present excess weight! Most clinicians probably also regard dieting and weight loss as the proper route to a better body image among obese people. Indeed, weight reduction is one of the most widely practiced body image remedies [91, 181]. This raises an important question of whether weight reduction is truly effective for body image change. This appears to be true, as studies assessing body image distress before and after a weight loss program generally find improved body image as people lose weight, along with deterioration if the person regains [170]. For example, Foster et al. measured body image in obese women before, during, and after a 48 week low-calorie weight loss treatment and found significant improvement from pre to post-treatment [177]. At the midpoint of treatment, women had lost an average of 19 kg and reported significant improvements in body image. A weight regain of approximately 3 kg from weeks 24 to 48 was associated with a slight but significant worsening in body image. Changes in body image did not correlate with the amount of weight loss. Furthermore, weight losses ranging from 9 kg to 25 kg resulted in similar improvements, suggesting the possibility of a threshold effect in which smaller weight losses confer improvement in body image, with further reductions in weight offering no additional benefit [182]. Cash found similar body image improvements after an

average weight loss of 22 kg [183]. In both these samples, the body image ratings following weight loss were similar to non-overweight controls.

However, professionals accustomed to work in weight reduction programs probably have heard about the experience, “I lost weight but still didn’t like myself.” This exposes a basic fact about body image and the weight reduction enterprise. Body image is a psychological construct that refers to people’s evaluations of their physical attractiveness as opposed to their objective physical appearance, hence losing weight *does not* guarantee a positive or normal body image. This phenomenon has been termed “phantom fat” or “vestigial body image” [184]. Annis et al. found that relative to never overweight women, currently overweight women reported more body dissatisfaction/distress, overweight preoccupation, and dysfunctional appearance investment, in addition to greater binge eating pathology, poorer social self-esteem, and less satisfaction with life [185]. Consistent with a phantom fat interpretation, formerly overweight women were comparable to currently overweight women but worse than never overweight women on overweight preoccupation and dysfunctional appearance investment. In another study, Adami et al. found that severely obese patients following bariatric surgery report improved, yet worse, body image than that of non-obese counterparts [186]. These results appear to suggest that this phenomenon is present across various degrees of overweight. Yet, these findings are not confirmed in other studies [177, 183]; perhaps due to methodological differences. In effect, most studies that have supported the phantom fat phenomenon have been cross-sectional, whereas those not supporting it have been prospective [182]. Additionally, not all appearance concerns in overweight persons are focused on weight, which means that weight reduction is not always an appropriate remedy. Rosen et al. found that 35% of overweight women enrolled in body

image therapy presented non-weight-related concerns about their appearances in addition to their obesity [135]. These included preoccupation with height, facial features, scars and other skin blemishes, and breast size and shape. In sum, dietary interventions, even when accompanied by significant weight loss, may be ineffective in reducing total body dissatisfaction, which in part is focused on shape and other appearance features rather than fatness [135].

Any improvement in body image that accompanies weight reduction, unfortunately, is likely to be temporary for most overweight persons because of the high rate of weight regain. Indeed, even small weight gains (2-3 kg) have been reported to diminish improvements in body image. Foster et al. found that regaining 3.5 kg of a 19.4 kg weight loss from 24 to 48 weeks was associated with small but significant increases in negative body image [177]. Cash also noted that, with weight regain, improvements in appearance evaluation diminished [183]. Moreover, a long time ago, Wadden and colleagues had already noted that body image was among the factors cited as most negatively affected by weight regain [187]. Still, the effects of full weight regain on body image have not been well studied and represent an important gap in our current knowledge about how regaining weight affects body image.

Body Image Change without Weight Loss

Given the short-lived nature of weight loss, efforts to enhance body image that are not contingent upon weight loss may be more helpful in the long term. Most but not all non-dieting (i.e., psychotherapeutic) approaches produce favorable improvements in body image without weight loss. These approaches focus on issues of overall health, self-esteem,

and body image that are independent of weight and its change. Main strategies include mindfulness and acceptance of negative body image emotions and daily experiences, for example, by engaging in mirror-exposure activities and keeping a private body image diary; body and mind relaxation techniques for managing emotions in response to distressful events; identifying and critically challenging held beliefs, interpretations, and distorted thought patterns about the importance and influence of appearance, through the employment of cognitive restructuring techniques; learning specific behavioral strategies to modify avoidant and ritualistic behaviors related to body image, such as avoiding exercising or going to the beach, or engaging in repeated mirror checking; and, engaging in body-related activities through positive reinforcement by creating experiences of mastery and pleasure (e.g., reinforcing activities that pertain to physical exercise and health, enjoyment, and grooming for pleasure) [157].

Body image treatment can either be conducted independently as an obesity treatment alternative/complement, or integrated into weight loss programs. Rosen et al. developed an extensive cognitive-behavioral treatment for negative body image specifically tailored for overweight and obese individuals [135]. Treatment included modifying distressing body image thoughts, challenging stereotypes about obesity and beliefs about the importance of physical appearance, exposure to avoided body image situations, and eliminating body checking behaviors that promote appearance preoccupation. No recommendations to change eating habits, exercise, or weight were made. Obese women treated by this approach reported marked improvements in body image and self-esteem compared with the non-treatment condition. They did not, on average, experience weight loss though. At the end of treatment, 70% of women in body image intervention demonstrated significant

improvements on body image measures, moving from the clinically severe range (at pretreatment) to within the normal range. This study demonstrated that body image enhancement in overweight women can be achieved independently of weight change [135]. Strachan et al. also examined the outcomes of a self-directed cognitive-behavioral body image improvement program [188]. Obese and non-obese participants reported equivalently favorable body image changes, in spite of not losing weight [188].

On the other hand, some researchers have incorporated body image treatment into weight loss programs. An example is a study by Ramirez and Rosen comparing a weight loss treatment alone with combined body image/weight loss treatment in a sample of obese men and women [189]. They hypothesized that body image therapy would improve body image above the effects of weight control treatment, and would protect participants from the body image deterioration typically associated with weight regain. The combined treatment did not lead to greater improvements in body image (9-10% weight losses in both treatment conditions), nor better sustained improvements over time. Thus, the authors concluded that a weight control program alone is as effective in treating body image as body image treatment or a combined treatment [189].

Treatment for body image disturbances in obese people has drawn heavily from cognitive-behavioral models of psychotherapy. Most studies support their effectiveness; however, there has been little study of the components of treatment that are most critical to success. It is unclear if the behaviorally based strategies, such as exposure to avoided situations and behavioral changes to promote body acceptance, or if the cognitive elements of treatment, such as cognitive restructuring or coping skills training, play a more central role in

treatment outcome [190]. Ultimately, studies of the differential effectiveness of these strategies may provide important information on the treatment of body image disturbances.

What about Exercise: Is it helpful?

Besides seeking weight loss, other recurrent strategy used by individuals in order to conform to the unrealistic physique standards catalyzed by social pressures, is physical activity participation [191]. But, does it work? Effectively, there is a plethora of research examining the relationship between exercise and body image, which clearly supports the positive association between exercise and body image. Recent meta-analyses indicated that exercisers had a better body image than non-exercisers; participants in an exercise intervention reported greater improvements in body image and physical self-perceptions compared to non-active controls; and participants in an exercise program reported improved body image from the beginning to the end of the program [e.g., 192]. Thus, exercise may be a viable method to improve people's body image. In the obesity field, although related empirical research is sparse, previously inactive obese women experienced positive changes in body image, via improvements in self-appraisal, at the end of either a traditional or cognitive-behavioral exercise intervention, and even with minimal physical changes [193]. Similarly, Annesi and Unruh found that exercise participation was associated with significant improvements in body image, mood, and exercise self-efficacy, which in turn contributed to exercise persistence and resultant weight loss [80]. Based on these findings, the authors suggested that early incorporation of moderate physical activity into weight management treatments could have considerable value beyond energy

expenditure [80]. Thus, exercise also appears to be a viable option to improve body image in overweight and obese populations, and during weight loss interventions.

Which exercise is more effective? For how long? For mode of exercise, results indicated that participation in both aerobic and anaerobic exercise was associated with a more positive body image [191], but weight training seems to be the type of exercise most conducive to facilitating changes in body image [194]. For intensity of exercise, moderate and strenuous intensity level exercise interventions resulted in significantly larger effects compared to mild intensity exercise [191]. However, in a later meta-analysis, Campbell and Hausenblas did not find a moderating effect for exercise mode and intensity, as well as for exercise duration [192]. They did find that exercise frequency moderated the size of the effect though, with greater frequency per week resulting in larger effect sizes [192]. Nevertheless, researchers appear to agree on the recommendation of moderate to high exercise intensities and durations [194]. Additionally, there is some evidence suggesting that people who enjoy their workouts more show bigger improvements in body image, perhaps due to the parallel and cumulative effects of exercise on mood, which might lead to more positive feelings about oneself in general [194]. Finally, because only a few studies have conducted follow-ups, it is uncertain whether exercise interventions produce lasting body image change [192].

How does it work? There seems to be an inherent assumption within the exercise and body image literature suggesting that exercise produces changes in body image, by improving fitness. However, evidence from several studies indicates that fitness change is not necessary for enhanced body image [194-195], paralleling the obesity treatment literature pointing that the amount of weight lost is not consistently reflected in the psychological

benefits. Exercise effects might be mediated by changes in subjective perceptions of one's physical fitness and competence rather than by actual changes in fitness or body weight. These perceptions may simply arise because there is a feeling that the body is improving through exercise (e.g., muscle tone, agility, clothing fits better) [195]. Thus, even when interventions fail to generate statistically significant changes in weight and fitness, exercisers may perceive real or imagined yet personally meaningful improvements in their physical functioning, which in turn might enhance self-efficacy, producing more positive feelings about the body [194]. In addition, exercise may improve body image by making people more aware of their physical capabilities, while reducing focus on their physical appearance. Research on exercise motives indicates that although among initiate exercisers extrinsic motives such as exercising for appearance-related reasons are more prominent, intrinsic motives such as improving physical functioning, psychological well-being, or simple enjoyment, are more prominent than extrinsic motives among regular exercisers [e.g., 194]. Improved physical acceptance derived from exercise participation might also contribute to diverting attention from appearance-related concerns [196-197].

Addressing Body Image in Obesity Treatment: Is it important?

Negative body image is one of the main motivators of weight management efforts [181]. However, losing weight is imbued with the “myth of transformation”: Losing weight holds the promise of changing more than just one's body size and appearance; it promises to change one's socio-economic and interpersonal status, and to achieve happiness [52, 104]. As a consequence, many overweight individuals set very low, stringent, unrealistic weight goals for themselves, and become dissatisfied and frustrated with moderate weight losses if,

despite this, they remain overweight. Thus, body image concerns are likely to be a major obstacle to the acceptance of the level of weight loss that individuals can realistically achieve in treatment [52]. It has been suggested that undervaluing the weight loss achieved may contribute to participant's failure to acquire and practice weight maintenance skills [198], which is likely to increase the chances of relapse and weight regain. In effect, body dissatisfaction at the end of obesity treatment appears to predict weight regain [181].

Ramirez and Rosen [189] concluded that a weight control program alone is as effective in treating body image as body image treatment or a combined treatment, but they recognized that there may be subgroups of weight reduction seekers for whom the extra body image treatment might be useful. For instance, treatment-seeking obese participants with binge eating disorder might be such a case. Binge eating affects approximately 30% of participants enrolled in obesity treatment [199], and seem to interfere with weight loss and its maintenance after treatment due to the positive energy balance it induces [200]. It has been suggested that binge eating behavior could possibly be an emotion regulation strategy for coping with negative feelings such as frustration and even the depressive symptoms associated with dysfunctional attitudes referring to weight and shape [e.g., 201]. Thus, the integration of therapy modules focusing on body image disturbance in the treatment of obesity has been further recommended as a strategy to improve weight loss and maintenance, also by reducing binge eating behavior. This has been empirically demonstrated since [e.g., 202].

In this context, Foster and Matz also recommended that body image should be a primary outcome in all weight loss studies [182]. This includes affective, cognitive, and behavioral features of body image throughout treatment and follow-up. These authors highlighted that

it is particularly important to document whether cognitive and affective improvements translate into behavioral changes (e.g., engaging in previously avoided activities such as going to the gym; making healthier dietary options) [182]. In addition, documenting the improvement in psychological functioning associated with body image enhancement during obesity treatment would also be important to be able to intervene on, and buffer the effects of, the psychological contributors to relapse and weight regain [36]. Ultimately, such knowledge will enable clinicians to provide better care by offering their clients more realistic expectations regarding weight loss, body image changes, and associated well-being changes.

The present literature review made clear that overweight and obese women, especially those seeking treatment, are particularly at risk of developing a negative body image, and more likely to show increased levels of body dissatisfaction and dysfunctional investment in appearance. This is related to the already mentioned elevated levels of social pressure and stigma against overweight women, which put them at higher risk of developing poorer psychological profiles in general, which many times contribute to further weight gain. (This aspect also clarifies the option for a sample of pre-menopausal overweight women for the P.E.S.O. Trial, within which this thesis was conducted). In addition, body image problems might affect the success of treatment, by increasing chances of relapse or by making participants undervalue their small achievements. A more thorough understanding of pre-treatment correlates of body image distress is therefore of great relevance (study 1). On the other hand, body image improvement during treatment might have positive effects on weight control-related behaviors, and ultimately, on weight loss. Understanding whether

body image improvement occurs and is sustained in the long-term (study 3), and whether there are other positive consequences resulting from (or associated with) that improvement, for instance changes in eating self-regulation, is of great relevance in the context of weight management (study 2). Furthermore, exercise has a strong relationship with weight loss and maintenance, only scarcely accounted for by caloric expenditure. Exercise-induced changes in psychological variables (e.g., body image) also appear to play an important part in weight management. In addition, evidence suggests that there might be spill-over effects between physical activity and eating behaviors, even though there is a dearth of research examining whether self-regulation for exercise affects self-regulation for eating in those trying to lose weight. Therefore, further inquiry into whether exercise participation affects psychological variables (e.g., body image) associated with improved eating behaviors is warranted (studies 3 and 4). Finally, universal to all four papers included in the present thesis is the distinction between body image evaluative and investment dimensions, which has been recommended by several body image researchers, as a way of getting a deep understanding of body image functioning, and its implications; in this particular case, in overweight and obese women seeking obesity treatment.

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CHAPTER 3

Methodology

Study Design

All studies included in the present thesis were conducted within the “Promotion of Exercise and Health in Obesity” (P.E.S.O.) Study, a longitudinal randomized controlled trial, consisting of a 1-year behavior change intervention and a 2-year follow-up period with no intervention. Participants (n=258) entered the study in 3 annual cohorts and, within each cohort, were randomly assigned to intervention and control groups using the random number generator function for Microsoft Excel 2007 for Windows. Experimental groups received an equivalent amount of face-to-face contact with treatment providers. The intervention group attended 30 group sessions for approximately one year. The comparison group attended 29 group sessions and received a general health education curriculum based on several 3 to 6-week long educational courses on various topics (e.g., preventive nutrition, stress management, self-care, and effective communication skills). The interpersonal climate promoted in this condition was similar to that commonly observed in standard health care settings: choices, rationale, and explanations were limited; specific behavioral goals were not set; minimal feedback was provided (Sheldon et al., 2003). The Ethics Committee of the Faculty of Human Kinetics – Technical University of Lisbon reviewed and approved the study.

Participants

Overweight and obese women were recruited from the community through web and media (newspapers, TV and radio) advertisements and announcement flyers distributed in health care centers, local services, schools, etc., inviting candidates to participate in a university-based behavioral (i.e., no medication involved) weight management program. All

respondents were invited to one of several recruitment sessions in which the study was described in more detail, including inclusion/exclusion criteria. To be included, respondents had to fulfill the following criteria: to be between 25-50 years old, pre-menopausal, with a BMI between 25-40 kg/m²; be willing to attend weekly meetings (during 1 year) and be tested regularly (during 3 years); be free from major illnesses, not taking medication known to interfere with weight regulation (e.g., anxyolitics), and unwilling to participate in any other formal or informal weight loss program during the first year of the study (intervention group only). Of the 943 women who attended recruitment sessions, 462 were excluded because they failed to comply with the inclusion criteria, primarily related to BMI/age limits; 481 met inclusion criteria but only 290 ultimately committed to the study and were contacted to schedule their baseline measurements; 258 completed initial assessments and entered the study (see Table 1 for baseline characteristics). Participants' flow in the study is represented in Figure 1². Prior to participation, all participants gave written informed consent.

² This is the CONSORT diagram for the full study (36 months), which comprehended an effective sample size of 221 women at baseline. This sample size was determined according to the cumulative sum of the excluded participants until the 36-month assessment moment. This means that the effective valid sample will vary depending on the assessment moments examined in the papers. Therefore, the valid sample size for baseline and 12-month analysis was 239 women, and for 24-month analysis, it was 225 women. In addition, sample sizes for each of the four studies were affected by the number of participants lost to follow-up in each assessment period, as well as by the methodological constraints inherent to the statistical procedures employed.

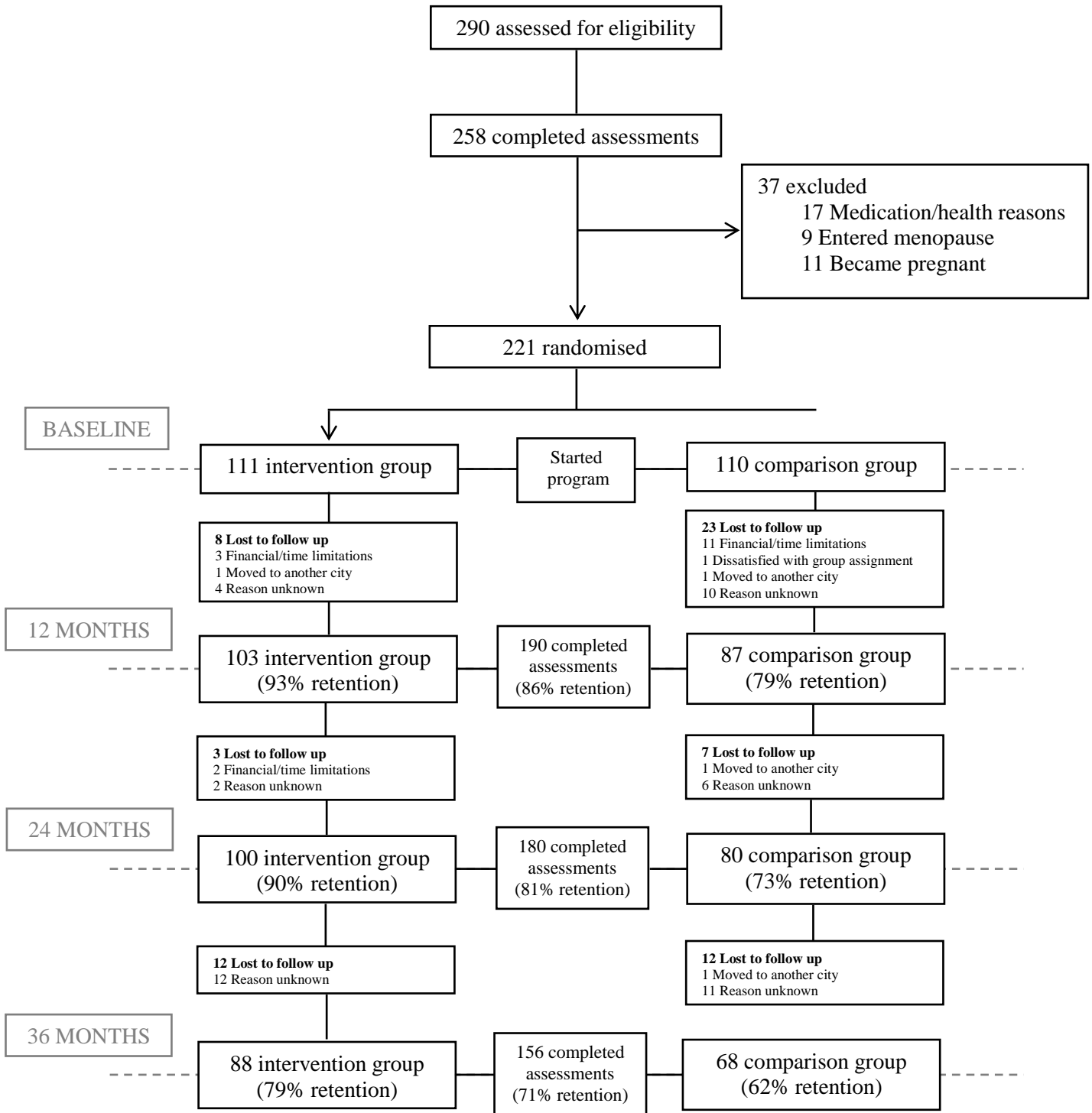


Figure 1. CONSORT diagram.

Table 1. Baseline Characteristics for the intervention and control groups.

	Intervention	Control
Demographics		
Age (years)	38.1 ± 7.04	37.1 ± 6.99
Higher education	64%	69%
Single	30%	37%
Married	56%	54%
Divorced, widow	14%	9%
Body Habitus		
Height (m)	1.61 ± 0.06	1.61 ± 0.06
Weight (kg)	82.1 ± 11.9	81.5 ± 12.1
Body Mass Index (kg/m ²)	31.7 ± 4.24	31.3 ± 4.00
Body fat (%)	43.7 ± 4.9	44.1 ± 4.94
Fat mass (kg)	36.0 ± 8.42	36.0 ± 8.04
Lean mass (kg)	45.5 ± 5.12	45.0 ± 6.13
Physical Activity		
Mod.+ Vig. PA (min/week)	110.2 ± 150.1	88.6 ± 122.3
Lifestyle Activity Index	2.79 ± 0.88	2.89 ± 0.83

Data are given as mean ± SD or %. There were no significant differences (independent t-test) between intervention and control groups.

Intervention

This 1-year behavioral change intervention was primarily aimed at increasing physical activity and energy expenditure, adopting a moderately restricted diet, and ultimately establishing exercise and eating patterns consistent with sustainable weight loss/maintenance. The 30 intervention sessions were designed to cover physical activity, nutrition and eating behavior, body image, and other cognitive and behavioral contents, and took place weekly or bi-monthly, lasting about 120 min each. The intervention's principles and style were based on self-determination theory basic tenets [2-3] with a special focus on

increasing competence and internal regulation toward exercise and weight control, while supporting participants' autonomous decisions as to which changes they wanted to implement and how. To create an autonomy-supportive environment, the intervention team attempted to promote in each participant a sense of ownership over their behavior such that it would stem from within. This involved building sustainable knowledge that supported informed choices, communicating through the use of neutral language (e.g., “may” and “could” instead of “should” or “must”); encouraging self-choice and self-initiation, while avoiding prescriptions, pressure, demands, and extrinsic rewards; providing participants with a menu of options and strategies for behavior change, supported by a clear rationale; encouraging participants to look for consonance between their inner values and goals, and their lifestyles; and giving informational, task-related positive feedback that enable feelings of competence. Further details on these strategies and their theoretical background are available elsewhere (Silva et al. 2008).

Regarding structure, the intervention implementation was generally developed in “modules” which were introduced sequentially but with substantial overlap (see Figure 2). The initial emphasis of the program focused on triggering weight loss, which was achieved primarily by reducing energy intake. Accordingly, Modules I (increasing knowledge) and II (triggering weight loss, improving diet) were focused on understanding energy balance and principles of gaining/losing weight, nutrition education, and establishing eating patterns more likely to help weight loss. Module III (adopting and increasing physical activity) was introduced around week 10 and aimed at establishing a more active lifestyle. First we addressed issues related to safety and skills, setting and managing physical activity goals, monitoring physical activity, and dealing with barriers to practice, in order to promote

feelings of competence. Module IV (addressing barriers, promoting self-regulation, developing autonomy) focused on identifying and addressing problem areas and difficulties related to the psychological (attitudinal, motivational) and behavioral changes expected to occur during the program. Critical areas addressed were emotional eating, exercise intrinsic motivation, and adequate goals for weight loss. In Module VI (improving body image), participants' concerns about their body shape were addressed. Finally, aiming at long-lasting behavior change, the main emphasis of Module VI (preparing weight maintenance) was on helping patients acquire the strategies and skills needed for long-term weight control, such as regular monitoring of weight, adoption of flexible guidelines regarding eating instead of rigid dietary rules, and especially establishing a more physically active lifestyle both through formal and informal exercise.

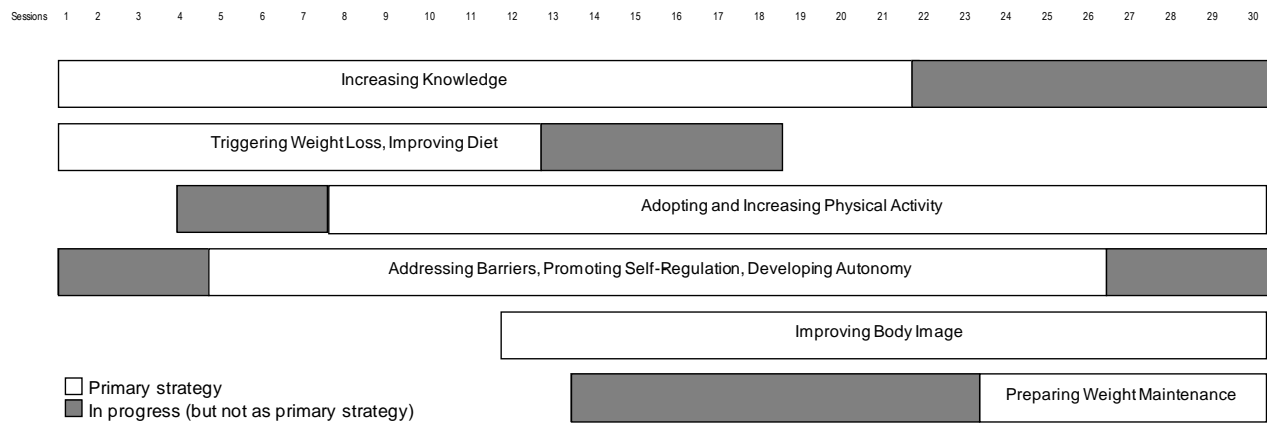


Figure 2. Intervention modules' implementation [1].

Nutrition and Eating Behavior

The initial emphasis of this program focused on inducing some initial weight loss, which is achieved with a sustained energy deficit, primarily by reducing energy intake. There was also a focus on increasing nutrition knowledge and establishing eating patterns more likely to help subsequent weight maintenance. Specific strategies/goals included: decrease daily caloric intake by 300–400 kcal; improve the overall nutritional quality in the diet; include breakfast and increase the number of meals throughout the day; avoid hunger and uncontrolled intake periods; reduce emotional and "distracted" eating; reduce the amount of food in accordance with energetic demands; prefer low energy-dense, satiating foods; reduce fat in the diet; increase the intake of fruits and vegetables, non-processed cereals and other rich-fiber foods; reduce the amount of highly processed food and added sugars; consistently read and understand food labels.

Physical Activity and Exercise

Participants were encouraged to find situations in their lives that could be changed in order to increase their caloric expenditure. This could be done in formal (e.g. health clubs) or informal (e.g. daily transportation) settings. Although most activity was home or community-based and unsupervised, some sessions included brief periods of physical activity and participants tried a variety of individual and group-activity classes. All participants were offered a pedometer to monitor their daily steps. Topics on physical activity included: planning and implementing a structured exercise plan to reach caloric expenditure goals; increasing daily walking and lifestyle physical activity (e.g., using the stairs more often); dealing with safety, weather, and equipment issues; overcoming typical

barriers to exercise (time, boredom, lack of facilities); how to monitor exercise intensity, among others. By providing options and letting people make their own decisions, one main goal in this area was to encourage participants to find the activities they enjoyed the most and were, thus, most likely to retain in the future. Dance classes and an activity challenge program were also developed to prompt fun, enjoyment, reaching new goals, and experimenting new activities.

Improving Body Image

Regarding body image enhancement, the intervention aimed at increasing participants' body acceptance and satisfaction and at decreasing their over-preoccupation and dysfunctional investment in appearance. For that purpose, several strategies were implemented within this intervention module. Some were predominantly used to improve evaluative body image while other strategies were essentially intended to reduce dysfunctional body image investment. Asking participants to view and gradually explore their body and its parts, in front of a mirror, in the privacy of their home; establishing more realistic goals and expectations for themselves and their weight/body, by confronting their ideal physique with the real limits in their biological capacities to meet their goals (e.g., observe their own and their parents weight history); and providing dance and relaxation classes were the main strategies employed to improve the evaluative component. To reduce dysfunctional investment in appearance, the following key strategies were implemented: helping participants understand the concept of body image (i.e., a subjective construct, independent of physical appearance) and recognize the social and personal roots of their own body image development; asking participants to keep a self-monitoring diary to record

critical body image experiences in which they feel self-conscious, their beliefs in the situation (e.g., thoughts, self-statements, negative “body talk”), and the associated emotional and behavioral consequences; helping participants cope with stereotypes and prejudice, facilitating the abandonment of the idea that they must look different to be happier; and working on cognitive restructuring to help participants challenge their maladaptive assumptions about appearance and its salience to their life and self-worth, by promoting the evaluation of evidence for and against their beliefs and the construction of alternative thoughts.

Measurements

Body Habitus

Measurements took place in the laboratory and were performed in the morning, after fasting for a minimum of 3h. Body weight was measured twice, using an electronic scale calibrated onsite and accurate to 0.1 kg (SECA, model 770, Hamburg, Germany). Vertex height was measured with a balance-mounted stadiometer to the nearest 0.1 cm. Body mass index (BMI) in kilograms per square meter was calculated from weight (kg) and height (m).

Body image Measures

The evaluative component of body image was measured by a self-ideal body discrepancy index, using the *Figure Rating Scale (FRS)* was used [4]. This scale comprises a set of 9 silhouettes of increasing body size, numbered from 1 (very thin) to 9 (very heavy), from which respondents are asked to indicate the figure they believed represented their current (i.e., perceived body size) and ideal body size. Self-ideal discrepancy was calculated by

subtracting the score for ideal body size from the perceived body size score. Higher values indicate higher discrepancies.

The dysfunctional investment component was represented by body shape concerns and social physique anxiety. Body concerns were evaluated with the *Body Shape Questionnaire (BSQ)* [5-6], a 34-item instrument scored on a 6-point Likert-type scale (from ‘never’ to ‘always’), developed to measure concern about body weight and shape, in particular the experience of “feeling fat” (e.g., “Has being naked, such as when taking a bath, made you feel fat?”), but also to measure several cognitive-behavioral consequences of those feelings (e.g., “Has thinking about your shape interfered with your ability to concentrate?”, “Have you avoided wearing clothes that make you aware of your body?”). This instrument addresses the salience of body image in one’s personal life, rather than merely asking about body image satisfaction [7], where higher values represent greater body shape concerns and greater salience. The *Social Physique Anxiety Scale (SPAS)* [8] was used to measure the degree to which people become anxious and concerned when others observe or evaluate their physiques, thereby assessing body image affective and cognitive features in a social environment. This scale comprises 12 items (e.g. “Unattractive features of my physique make me nervous in certain social settings”) rated on a 5-point Likert-type scale (from ‘not at all’ to ‘extremely’). Higher scores represent greater social physique anxiety.

Other Psychosocial Measures

Self-esteem, expressing the value or worth individuals attach to themselves, was assessed with the *Rosenberg Self-Esteem Scale (RSES)* [9], a 10-item instrument answered on a 4-point Likert-type scale. The *Beck Depression Inventory (BDI)* [10] is a widely used

inventory of the cognitive, affective, and somatic symptoms of depression (e.g., “sadness”, “suicidal ideation”, “self-criticism”). BDI is a 21-item inventory, scored on a 4-point scale, that results in a total score, where higher scores reflect greater depressive symptoms (i.e., depressive mood). Mental health was evaluated with the *SF-36* [11]. This instrument consists of a multi-item scale that assesses eight health concepts, of which four refer to psychological health: general mental health (psychological distress and well-being), role limitations due to emotional problems (role-emotional functioning), limitations in social activities because of physical or emotional problems (social functioning), and vitality (energy and fatigue). To reflect the overall mental health component (herein named psychological functioning), a global mental health score integrating these four measures is computed. Controlled regulation for entering obesity treatment was measured with the *Treatment Self-Regulations Questionnaire (TSRQ)* [12], an 18-item scale designed to assess reasons for entering a weight loss program, and thus to assess the degree to which a person's motivation is autonomous or controlled. The instrument has two subscales, autonomous and controlled, and it presents participants with items such as: “I want others to see that I am really trying to lose weight” for more controlled reasons, and “It's important to me that my efforts succeed” for more autonomous reasons. Each reason is rated on a 7-point Likert-type scale.

Physical Activity and Exercise Measures

To assess structured physical activity, minutes per week of leisure-time moderate and vigorous physical activities were estimated with the 7-Day Physical Activity Recall [13]. Habitual activities with a MET value above 3.0 and performed during the last 7 days were

quantified to produce this variable. Daily lifestyle activity was evaluated with a Lifestyle Physical Activity Index [14], specifically developed for this study. To calculate the Lifestyle activity Index we used a score based on 7 questions (“Using stairs or escalators”; “Walking instead of using transportation”; “Parking away from destination”; “Using work breaks to be physically active”; “Choosing to stand up instead of sitting”; “Choosing hand work instead of mechanical/automatic”; “Choosing to be physical active whenever possible”), rated on a 5-point Likert-type scale.

Eating Behavior Measures

Eating self-regulation (ESR) can be defined as the attempt to manage dietary intake in a mindful, voluntary and self-directed way (e.g., to achieve and maintain energy balance or weight loss), within the context of other physiological and environmental constraints [15]. In the current thesis, eating self-regulation referred to aspects known to positively influence weight management, namely high eating self-efficacy, high flexible cognitive restraint, reduced disinhibition, and reduced perceived hunger.

Eating self-efficacy was assessed with the *Weight Efficacy Lifestyle Questionnaire (WEL)* [16], by asking individuals to rate their confidence for successfully resisting opportunities to overeat and for self-regulating their dietary intake on a 10-point scale, ranging from “not confident at all” to “very confident”. Higher scores represent greater eating self-efficacy. Cognitive restraint, disinhibition, and perceived hunger were measured with the 51-item *Three-Factor Eating Questionnaire (TFEQ)* [17]. Cognitive restraint reflects the conscious intent to monitor and regulate food intake (21 items), and can be divided into flexible and rigid types of restraint [18]. Rigid restraint (7 items) is defined as a dichotomous, all-or-

nothing approach to eating and weight control, whereas flexible restraint (7 items) represents a more gradual approach to eating and weight control, for example, with “fattening” foods being eaten in limited quantities without feelings of guilt. Since flexible restraint is associated with low emotional and disinhibited eating, as opposed to rigid restraint, only the former subscale was considered in the present thesis (studies 2 and 4) as representing a better self-regulation of eating behavior. Higher scores indicate greater levels of flexible restraint. Disinhibition refers to an uncontrolled overconsumption of food in response to a variety of stimuli, such as situational and cognitive/emotional states (16 items). Perceived hunger refers to the extent to which respondents experience feelings and perceptions of hunger in their daily lives. Disinhibition and perceived hunger items were reverse scored, so that higher scores represented lower levels of these variables (and more positive eating self-regulation).

Assessments occurred at baseline, 12, 24, and 36 months, but not all of these measures/variables were available at each time point (e.g., eating self-efficacy was not measured at 36 months). The moments and variables assessed in each of the four papers included in the present thesis are specified in the respective methods’ section. Whenever change measures were reported, baseline-residualized scores were calculated, where the endpoint variable is regressed onto the baseline variable [19]. Subjects completed the Portuguese versions of all questionnaires cited above. Forward and backward translations between English and Portuguese were performed for all the questionnaires. Next, two bilingual Portuguese researchers subsequently reviewed the translated Portuguese versions, and minor adjustments were made to improve grammar and readability. Cronbach’s alphas

for all measurements were acceptable (above 0.70) except for flexible restraint which was slightly lower [20-22].

Statistical Procedures

The statistical procedures employed in each study varied according to their specific purposes, and are described in detail in the methods' section of each manuscript. Some statistical procedures were common to all studies but were not described in the manuscripts. They will be explained herein. In addition, considering that mediation analyses were a central statistical procedure to all manuscripts, a few, more detailed, comments will be made to clarify the utility of this procedure in the context of this thesis, and elucidate our options regarding the selected data-analytic methods.

Although not specifically related to the studies included in this thesis, it should be noted that sample size calculations were estimated for primary outcomes within the P.E.S.O. Trial to guarantee a statistical power of 0.80, for a significance level of $p < 0.05$ (two-tailed). By the end of the intervention (12 months), we assumed an increase in physical activity levels of 300 ± 500 METs.min/wk (intervention, mean \pm SD) and 50 ± 400 METs.min/wk for controls. An effect size (ES) of 0.56 for the difference between groups was obtained. To achieve this effect size, a total of 52 participants per group were estimated to be required. For percent changes in body weight (from initial values) estimated effect sizes were large (> 0.83), thus demanding considerably less participants per group. Regarding psychosocial variables, effect sizes for between-group differences were calculated according to estimates (means and SD) originating from our previous work [23], and ranged from 0.67 to 0.83. A maximum of 36 participants per group were estimated to be needed to detect significant

differences in these variables between intervention and controls. An assumed dropout rate of 20%, equivalent to the retention of approximately 120 participants per group at 12 months (our primary endpoint), indicates that this sample size would be enough to detect even small differences in physical activity. The lowest effect sizes observed (for PA, ~ 0.5) would require ~ 60 participants per group. In the behavioral sciences, "moderate" and "strong" effect sizes for associations between variables ($R^2 \times 100$ or percent variance accounted) have been set at 5% and 10% respectively, which is equivalent to correlations of 0.22 and 0.31 [66]. As shown in the CONSORT diagram (Figure 1), this trial's real dropout rates were below 20% at 12 and 24 months, and below 30% at 36 months; thus, the sample sizes will likely be adequate even for the lowest (i.e., "moderate") association levels.

Analyses were conducted for completers-only due to methodological constraints inherent to some of the statistical procedures employed (e.g., Partial Least Squares Analysis), but especially owing to the main purpose of the current thesis, which is the study of mechanisms underlying intervention effects and/or associations between variables and/or behaviors. Intention-to-treat (ITT) analysis is a pragmatic approach that intends to estimate treatment effectiveness rather than efficacy, which is the objective of an "as treated" analysis. The effectiveness concept is arguably of particular relevance in clinical and public health contexts, since a treatment may not be tolerated even if it is efficacious due to aversive side effects or because of the time and effort involved. These effects are reflected in an ITT analysis but not in an "as treated" analysis, where the focus is on efficacy in people who comply fully with treatment [24]. However, as mentioned above, the studies included in the present thesis were primarily interested in investigating mechanisms. And even in study 3, where the effects of treatment on body image were examined, the main

goal of these analyses relied on determining the efficacy of the intervention in changing each body image dimension, and not on determining its effectiveness/applicability in the real world. Determining the efficacy of a particular intervention and the mechanisms underlying its effects can only be done with participants that have completed the intervention. As a result, the potential for bias was expected to be smaller. Furthermore, a previous study comparing the performance of theoretically sound techniques such as maximum-likelihood based methods and multiple imputation with complete-case analysis, reported that the latter produces unbiased estimates only when the pretreatment scores do not influence the probability of withdrawals [24]. Thus, acknowledging the potential selective dropout biases known to limit completers-only analyses, to provide further insight into attrition-related bias, statistical comparisons between the complete and the missing dataset groups were performed in all four studies. In general, no significant differences were found between these two groups for any demographics or baseline psychosocial variable, which suggests data were missing completely at random (MCAR) and analyses would likely yield unbiased parameter estimates [25-26]. On these grounds, the option for completers-only analysis was considered appropriate.

Measures of central tendency and distribution were used to characterize the sample, measured variables, and/or their change. Correlational analyses were performed to examine the associations among each study's variables, controlling for putative confounders whenever pertinent (e.g., participation group). Mediation analyses were conducted to test how, or by what mechanisms (mediators *M*), independent variables (*IVs*) affected dependent variables (*DVs*).

Mediation Analyses

General Considerations

A mediation analysis consists of a causal model that explains the process of “why” and “how” a cause-and-effect happens [27-28], hence, presuming that an independent variable X precedes and causes a mediator M, which in turn, precedes and causes a dependent variable Y. Thus, mediating mechanisms should be proposed and tested only if causal relationships between variables can be justified on theoretical, empirical and/or procedural grounds [29]. Mediation analyses are important to improve the design of future interventions by identifying the possible mechanisms through which an existing intervention achieved its effects [30]. In addition, they provide information regarding the effectiveness of various intervention components and such information can be used to tailor interventions for specific groups, or to develop more parsimonious interventions by eliminating less important components and emphasizing others. This type of analyses has been recommended to improve the design of obesity prevention trials [31] and obesity treatment interventions [32]. But, improving overweight and obesity interventions remains a critical challenge [33] and mediation analysis could also be very valuable to understand the mechanisms underlying the associations between psychosocial variables (e.g., body image) and behaviors (e.g., eating and physical activity) that are critical to successful weight management.

There are two types of mediation analyses. Those involving only one mediating variable are named simple mediation, whereas those involving several mediators are called multiple mediation analyses. In face of several putative intervening variables, the literature suggests that the latter present various advantages against the former analyses and should be

preferred [29, 34]. First, testing the total indirect effect of X on Y is analogous to conducting a regression analysis with several predictors, with the aim of determining whether an overall effect exists. If a mediation effect is found, one can conclude that the set of k variables mediates the effect of X on Y. Second, it is possible to determine to what extent specific M variables mediate the X effect on Y, conditional on the presence of other mediators in the model. Third, if multiple mediation hypotheses are tested with a set of simple mediator models, omitted variables may lead to biased parameter estimates [35]. The likelihood of parameter bias is reduced when multiple putative mediators are modeled together. Fourth, including several mediators in one model allows the researcher to determine which mediators are more successful than others. Considering all these advantages, in the present thesis, multiple mediation analyses were preferred over simple mediation analyses; yet, whenever relevant simple mediation analyses were used.

Baron and Kenny's causal-steps approach [27, 35] is by far the most commonly employed method to test mediation, and is still regarded as the default paradigm for establishing a mediating effect. According to this approach, a variable M is a mediator if it fulfills the following four criteria: (1) an independent variable X significantly accounts for variability in a dependent variable Y, and thus there is an effect to be mediated (2) X significantly accounts for variability in M, (3) M significantly accounts for variability in Y when controlling for X, and (4) the effect of X on Y decreases substantially when M is entered simultaneously with X as a predictor of Y; a complete mediation is present when c' equals zero (i.e., statistically non-significant). Despite its wide use in substantive research, there are several limitations to the causal-steps approach. First, recent statistical-simulation studies show that the ability/power to detect mediated effects using the causal-step method

can be very low [36]. Second, the causal-steps approach does not explicitly test the question of interest. It does not provide an estimate of the indirect effect, nor tests its statistical significance. Instead, the conclusion that mediation exists must be drawn by jointly considering the results from disparate regression analyses, none of which directly addresses the central hypothesis. Finally, the test requires that there be a significant overall relation between X and Y for mediation to exist. However, many data analysts have argued against its necessity for the following reasons: an overall effect is implied if steps 2 and 3 are met; it is possible that an overall effect would not be observed, if c' were opposite in sign to ab , a scenario that MacKinnon et al. [34] referred to as *inconsistent mediation* and where the mediator acted as a suppressor; and the overall effect would not be observed if multiple mediation effects were present and cancelled each other out. Therefore, the causal steps approach is considered of little utility in a multiple mediator context [29]. An alternative approach that addresses the mediation hypothesis more directly is the product of coefficients strategy, which involves computing the product of a and b and testing its significance [36]. The most commonly applied significance test within this approach is the Sobel test, but this has been shown to have low statistical power because the distribution of the indirect effect often departs from normality [36]. Other techniques such as bootstrapping procedures, which are able to overcome this limitation, can also be employed to test the significance of the indirect effects [37], and are currently recommended as the primary option over other methods [29]. The bootstrap sampling distributions of the total and specific indirect effects are empirically generated by taking a sample (with replacement) of size n from the full data set and calculating the total and specific indirect effects in the resample. The bootstrap sampling distributions are built by repeating this

process k times, where k is some large number (e.g., 5000 resamples). Point estimates, standard errors, and confidence intervals for the total and each of the indirect effects are then derived [29]. Following recommendations [29], bootstrapping procedures were given precedence in the present thesis.

Structural equation modeling (SEM) approaches have several advantages over the most common regression-based approaches to test mediation, and are therefore recommended [29, 38]. Compared to the latter, which analyze only one layer of linkages between independent and dependent variables at the same time, SEM allows the simultaneous modeling of relationships among multiple causes, mediators, and outcome variables in one single model [36]. Although a simple mediation is often a valuable step in understanding a bivariate causal relationship, many psychological phenomena necessitate networking accounts that are beyond a third variable span. As the number of causes and third variables increase, regression-based approaches quickly become unwieldy, because they invoke numerous complex equations [39]. Additionally, unlike regression-based approaches, which assume there is no measurement error in the scores of measured variables when in fact there is [28], SEM enables the researcher to construct latent variables with multiple measured indicators as well as to explicitly model measurement error for the observed variables [40], improving the power and validity of mediation models [28].

Analytic Approaches to Test Mediation

Three different data analytic approaches to test mediation were used in the current thesis: a variance-based SEM approach (Partial Least Squares), a covariance-based SEM approach

(AMOS), and a multiple mediation approach that uses both regression analysis and resampling procedures (Preacher & Hayes SPSS macro).

Partial Least Squares (PLS) analysis is a variance-based structural equation modeling approach, thus similar to regression, but that estimates structural paths, i.e., theoretical relationships among latent variables (LVs), indirectly measured by a block of observable indicators. In addition, rather than assuming equal weights for all indicators of a scale, the PLS algorithm allows each indicator to vary in how much it contributes to the composite score of the latent variable. Thus, indicators with weaker relationships to related indicators and the latent construct are given lower weightings. In this sense, PLS is preferable to techniques such as regression which assume error free measurement [41]. This approach has other interesting features that further motivated its use in the current thesis. PLS is especially suitable for prediction purposes [42], since it explicitly estimates the latent variables as exact linear aggregates of their respective observed indicators; it uses non-parametric procedures making no restrictive assumptions about the distributions of the data [43]; and, unlike covariance-based SEM approaches, it is appropriate for use with small sample sizes [40], due to the partial nature of the estimation procedure, with only one part of the model being estimated at each time. However, it should be noted that partial least squares analysis has also some shortcomings, most importantly the use of listwise deletion of missing data, which has the potential to create bias [25], and the absence of a goodness-of-fit measure of the model being tested.

In contrast to variance-based SEM (e.g., PLS), which focuses on maximizing the variance of the dependent variables explained by the independent ones, the goal of covariance-based SEM (e.g., AMOS) is to determine the matrix of model parameters in such a way that the

resulting covariance matrix predicted by the theoretical model is as close as possible to the sample covariance matrix. Therefore, typically using a normal-theory maximum likelihood function, the parameter estimation process attempts to minimize the difference between both covariance matrixes, or in other words, to reproduce the covariance matrix of the observed measures [41]. These approaches usually involve constraints in the form of parametric assumptions, sample size, model complexity, identification, and factor indeterminacy. In order to use this approach, it is assumed that the observed variables follow a determined multivariate distribution, but possibly more critical is the large sample size required, with inadmissible solutions and increased chances of type II error being observed with sample sizes of 250 or less [44]. Yet, many covariance-based SEM softwares are now able to overcome some of these limitations, as well as some of the abovementioned PLS shortcomings (i.e., missing data, fit index). For instance, AMOS has the capability to incorporate cases with missing data and estimate missing values using maximum likelihood techniques, it has the capability of including non-normally distributed variables into SEM models, and conducting bootstrapped estimates of standard errors in tests of mediation [45], and it provides several measures to assess the global fit of the model, such as the χ^2 goodness-of-fit test, Bollen's incremental fit index, and the standardized root mean residual. Finally, AMOS allows the specification of hybrid models containing a mix of measured and latent variables, while still accounting for the measurement error. This option can be used to ensure sufficient power to conduct the analysis, while staying within the limits of sample size requirements for model testing [46]. However, most SEM software applications, including AMOS, are limited to tests of total indirect effects, not providing specific indirect effects for models with multiple mediators. Therefore, to test the

significance of specific indirect effects of multiple mediators, additional tools need to be employed [47].

Although SEM approaches are large-sample techniques, they are often recommended over ordinary least squares approaches due to their numerous advantages (already disclosed). In spite of that, regression-based approaches are generally considered adequate for conducting a mediation analysis [48]. Furthermore, several solutions are now available to improve on the limitations of classical regression-based approaches such as Baron and Kenny's, which do not formally require or test the significance of the indirect/mediated effect. For instance, Preacher and Hayes provided specialized SAS and SPSS macros that facilitate the estimation of the indirect effect with a normal theory approach and a bootstrap approach to obtaining confidence intervals [29]. These macros also provide all the output that one needs in order to assess mediation using Baron and Kenny's criteria [27]. Furthermore, these macros enable researchers to bootstrap confidence intervals not only for total but also for specific indirect effects in multiple mediator models, with and without statistical controls, overcoming a strong shortcoming of most available techniques to test mediation (including SEM approaches). Finally, this procedure also allows for statistical control of one or more covariates that are not proposed to be mediators of the total effect.

Mediation Analysis in the Current Thesis

The complexity of the models included in studies 1 and 2, involving one or more higher-order variables and the estimation of a relatively large number of indicators (e.g., about 100 parameters in study 1), precluded us from using covariance-based approaches given the large sample sizes that would be required. Hence our decision to use the PLS approach,

which has much more liberal sample size requirements. In study 3, we opted for a covariance-based SEM approach using AMOS, given the lower complexity of the models to be tested: they comprised several measured (non-latent) variables and no higher-order latent constructs, and thus required fewer parameters to be estimated. Furthermore, AMOS allows to overcome several shortcomings of PLS (e.g., missing data deletion and fit index) and has the capability to model hybrid models combining latent and observed variables to ensure sufficient power and sample size requirements for the analysis. Finally, study 4 encompassed two independent variables, two putative mediators, three dependent variables, one covariate, and two different time points. This would likely result in highly complex, unfeasible and poorly fitted models, thus difficult to test with SEM approaches. For parsimony, we decided to specify less complex models and use Preacher and Hayes SPSS macro to test mediation. Moreover, we were particularly interested in examining the specific indirect effects linking each independent and dependent variable, information explicitly provided within Preacher and Hayes procedures, but that we cannot directly obtain from SEM approaches like the ones used in the remaining studies.

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CHAPTER 4

Dysfunctional Body Investment versus Body Dissatisfaction: Relations with Well-Being and Controlled Motivations for Obesity Treatment (Study 1) ³

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Abstract

In this study, we investigated the associations between body image and psychological well-being, exploring the mediating role of controlled regulation for entering obesity treatment. In addition, we analyzed whether investment body image was more strongly associated with controlled regulation (and subsequent well-being) compared to evaluative body image. These analyses were performed controlling for baseline BMI effects. Participants were 139 overweight women (age: 38.0 ± 6.7 yr; BMI: 32.0 ± 4.1 kg/m²) entering treatment. Evaluative and investment body image, controlled regulation, and psychological well-being were assessed. Body image investment was positively associated with controlled regulation; evaluative body image was not. Controlled regulation was negatively associated with self-esteem and psychological functioning. Controlled regulation partially mediated the effects of body image investment on self-esteem, but did not mediate its effects on psychological functioning. Results suggest that dysfunctional body image investment might undermine well-being within overweight women, partly by increasing controlled regulation for entering obesity treatment. Discussion focuses on the importance of enhancing body image and autonomy during treatment to improve well-being and weight outcomes.

Key Words: Body image, Self-determination, Treatment Motivation, Well-being, Obesity

Dysfunctional Body Investment versus Body Dissatisfaction: Relations with Well-Being
and Controlled Motivations for Obesity Treatment

Body-related concerns and dissatisfaction with the physique are becoming increasingly prevalent in Western societies (Cash, 2002b). Due to the high emphasis modern culture places on the pursuit of a slim body-ideal, and to the existing stigmatization and discrimination towards obesity (Puhl & Heuer, 2009), it is not surprising that many overweight people dislike their appearance and develop a negative body image (Z. Cooper, Fairburn, & Hawker, 2003). Prior research has shown not only that obese individuals consistently differ from their non-obese counterparts regarding body image (Cash, Jakatdar, & Williams, 2004; Stunkard & Wadden, 1992), but also that those seeking weight loss treatment are the most affected, experiencing higher levels of appearance-related concerns and dissatisfaction (Cash, 1993; Foster, Wadden, & Vogt, 1997; Sarwer, Wadden, & Foster, 1998). This is particularly important given that body image problems seem to constitute an additional obstacle to successful weight management, predicting poorer outcomes and increasing chances of relapse (Z. Cooper, et al., 2003; Schwartz & Brownell, 2002; Teixeira, et al., 2002; Teixeira, et al., 2004). Part of the explanation for these effects might come from the psychological suffering and distress frequently associated with negative body image (see Cash & Pruzinsky, 2002). Thus, it is important to better understand the role of poor body image on the psychological functioning of obese individuals seeking treatment, and also to identify possible factors that might mediate this association. This will allow professionals to provide better care and develop more effective interventions.

One of these mediating factors might be motivational in nature. Ultra-slender body ideals are not only widely portrayed as highly important, but are difficult or nearly impossible to achieve (Dittmar, 2007). This dissatisfaction, in turn, could be experienced as imposed pressure to lose weight, fostering controlled regulations for enrolling in weight loss treatment. A detrimental effect on psychological well-being is likely to follow. Self-determination theory (SDT; Deci & Ryan, 1985, 2000) offers a motivational framework that may explain the relation between body image and well-being by proposing how controlled forms of regulation could be detrimental to psychological well-being. Therefore, the first main purpose of the present study is to investigate how SDT may contribute to the explanation of the associations between body image and psychological well-being, by exploring the mediating role of controlled regulation for enrolling in obesity treatment. The next section provides a definition of body image and evidence for its relation with well-being, followed by a brief description of SDT and some studies relating controlled regulations with body image or well-being. Finally, hypotheses are presented.

Body Image and Well-Being

Body image is a multidimensional construct that refers to an individual's mental representation of body-related perceptions and attitudes (i.e., thoughts, feelings, and behaviors), especially focused on but not limited to physical appearance (Cash, 2004). According to Cash, Melnyk, et al. (2004), body image attitudes consist of two sub-dimensions. Evaluative body image pertains to cognitive appraisals and associated emotions about one's appearance, including self-ideal discrepancies and body satisfaction-dissatisfaction evaluations. In contrast, investment body image refers to the cognitive-behavioral importance of appearance in one's personal life and sense of self, reflecting a

dysfunctional investment in appearance, as opposed to more adaptive valuing and managing of one's appearance (Cash, Melnyk, et al., 2004). Further, this dimension comprises appearance-related self-schemas, that is, cognitive structures derived from past experience that summarize one's thoughts and beliefs about appearance and its centrality to one's self (Markus, 1977; Stein, 1996). These are thought to be actively triggered by appearance-related internal or environmental events and cues (Cash, 2002a). The structure of attitudinal body image, especially the distinction between evaluative and cognitive-behavioral investment components, has been empirically supported (e.g., Cash, 1994). Findings indicated that, although the optimal prediction of poor/negative body image requires both evaluative and investment aspects of body image, the former is not sufficient per se to produce poor body image (Cash, 1994).

Extensive previous research has established significant and substantial relations between body image attitudes and psychosocial functioning and well-being. A negative body image (i.e., body dissatisfaction and dysfunctional body image investment) can have adverse psychosocial consequences, including poor psychological adjustment, poor self-esteem, increased depression and anxiety, emotional instability, impaired sexual functioning, and inadequate eating and exercise behaviors (Cash & Pruzinsky, 2002; Donaghue, 2009; Grilo & Masheb, 2005; Matz, Foster, Faith, & Wadden, 2002).

Research findings highlight the growing prevalence of a negative body image; however such discontent may vary in its impact on an individual's psychological well-being. For some individuals being dissatisfied with their body weight, or shape, or some facial feature, can have minimal or even benign implications; for others, the negative implications can be severe. Dysfunctional investment body image seems to have more

adverse consequences to psychological well-being than evaluative body dissatisfaction, which per se is not considered a valid indicator of emotional distress and psychosocial impairment (Cash, Phillips, Santos, & Hrabosky, 2004). Indeed, prior studies have confirmed that dysfunctional investment in appearance considerably exceeds the contribution of body dissatisfaction to the prediction of psychosocial functioning (e.g., Cash, Melnyk, et al., 2004; Cash, Phillips, et al., 2004; Jakatdar, Cash, & Engle, 2006). For example, Cash, Phillips, et al. (2004) found that the Body Image Disturbance Questionnaire (an investment measure) predicted social anxiety, depressive symptoms, and eating disturbance, above and beyond a simple index of body dissatisfaction. In another study, Cash, Melnyk, et al. (2004) obtained similar results using a different measure of body image investment (the Appearance Schemas Inventory - revised). Jakatdar et al. (2006) also found that body image investment, measured as cognitive errors or distortions related to body image thoughts, predicted quality of life and disturbed eating attitudes above and beyond evaluative body image. This notwithstanding, much of the literature on body image has focused on the evaluative component, neglecting body image investment (Cash & Pruzinsky, 2002). To fill this gap, in the present study we differentiated evaluative and dysfunctional investment components of body image in an attempt to further understand these constructs and their consequences for the psychological well-being of overweight and obese women.

Self-Determination: Body Image and Well-Being

Self-determination theory (SDT; Deci & Ryan, 1985, 2000) proposes that individuals go through a natural process of internalization in which they assimilate and attempt to transform social norms and demands into personally endorsed values and self-

regulations. According to SDT, the regulation of behavior can take many forms corresponding to qualitatively different styles of behavioral regulation, that can be differentiated along a continuum of self-determination ranging from non self-determined or controlled forms of behavioral regulation (i.e., amotivation, external and introjected regulations) to self-determined or autonomous forms of behavioral regulation (i.e., identification, integration, and intrinsic motivation). Behaviors are autonomously regulated to the extent to which they are experienced as chosen and are personally relevant (e.g., entering weight loss treatment to improve health or because it is consistent with one's valued lifestyle). Conversely, behaviors are considered controlled when performed due to pressure or coercion, either by external or internal forces (e.g., entering weight loss treatment following a doctor's orders or to avoid feelings of guilt or shame).

SDT postulates that greater self-determination is associated with enhanced psychological functioning (Deci & Ryan, 2000). Accordingly, when autonomous forms of regulation guide behavior, more adaptive behavioral, cognitive, and well-being outcomes are expected to ensue. In contrast, controlled forms of regulation are expected to result in maladaptive outcomes. Considerable evidence, conducted in several life domains, attests to the qualitative advantages of autonomous, relative to controlled, behavioral regulations, supporting this proposition (see Deci & Ryan, 2000; 2008, for reviews). In summary, autonomous regulations are associated with higher self-esteem, increased life satisfaction, greater happiness and self-realization, and enhanced mental health, whereas controlled regulations undermine these outcomes.

From a SDT perspective, the sociocultural demands to conform to the ideal physique that result in high body dissatisfaction and investment could be experienced as

controlling and overchallenging, fostering controlled regulations to engage in health-related behaviors. Prior studies, although in exercise contexts, have found consistent associations positively linking poor body image with non self-determined regulations (e.g., Markland, 2009; Thøgersen-Ntoumani & Ntoumanis, 2006, 2007), and lower levels of relative autonomy (Markland & Ingledew, 2007). For example, Markland (2009) found that body self-ideal discrepancy (an evaluative measure) was positively correlated with amotivation and external regulation for exercise (r_s .30 and .20, $p < .05$, respectively), while Markland & Ingledew (2007) found positive correlations between body size discrepancies and both external and introjected regulations (r_s .47 and .55, $p < .01$, respectively). In a similar context, Thøgersen-Ntoumani and Ntoumanis (2006) found that social physique anxiety (a measure of body image investment) was positively associated with external and introjected regulations (r .26, $p < .01$, for both). Finally, after testing a motivational model of regulation toward eating behaviors, Pelletier and Dion (2007) found that body dissatisfaction derived from the internalization of sociocultural pressures and messages related to thinness was strongly associated with controlled regulations for eating. Furthermore, these authors showed that controlled regulations for eating led to worse psychological adjustment by promoting dysfunctional eating behaviors (Pelletier & Dion, 2007). In the overweight and obese population, especially in women seeking obesity treatment, poor body image is highly prevalent due to the current sociocultural *milieu* (Z. Cooper, et al., 2003); thus, seeking weight loss for controlling body-related reasons is likely to be particularly salient and could provide a significant barrier to successful outcomes and ultimately to psychological well-being.

The distinct roles of evaluative and investment body image on controlled regulations has not been studied before. Considering the results from previous studies (e.g., Cash, Melnyk, et al., 2004) which showed more adverse consequences of body image investment on psychosocial functioning, this dimension might also present a greater influence on controlled motivation than evaluative body image. Moreover, prior research has shown that body dissatisfaction is not sufficient per se to produce poor body image (Cash, 1994) or emotional distress and psychosocial impairment (Cash, Phillips, et al., 2004). Thus it can be hypothesized that evaluative body image would be less strongly associated with controlled regulation for enrolling in obesity treatment and subsequent well-being.

Present Study

The purpose of this study was to investigate the mediating role of controlled regulation for entering obesity treatment between body image and psychological well-being, by testing a three-level model in which body image (i.e., evaluative and dysfunctional investment components) would be associated with controlled regulation for engaging in obesity treatment, which in turn would be related to psychological well-being (see the top of Figure 1). In addition, a second purpose of this study was to test the distinct role of investment and evaluative body image on controlled regulation and subsequent well-being.

The model tested included the following specific hypotheses. First, it was hypothesized that both components of body image would be positively associated with controlled regulation for enrolling in weight loss treatment; yet, dysfunctional body investment was expected to present stronger associations. Second, controlled regulation

was expected to have a detrimental effect on psychological well-being (i.e., self-esteem and psychological functioning). Finally, it was hypothesized that controlled regulation for engaging in obesity treatment would mediate both the associations between each body image component and psychological well-being. All analyses were performed controlling for baseline BMI.

Method

Design and Participants

This was a cross-sectional study. Overweight and obese women were recruited from the community through web and media advertisements and announcement flyers to participate in a university-based behavioral weight management program. To be included, respondents had to fulfill the following criteria: to be between 25-50 years old, pre-menopausal, with a BMI between 25-40 kg/m²; be willing to attend weekly meetings (during 1 year) and be tested regularly (during 3 years); be free from major illnesses and not taking medication known to interfere with weight regulation. Of the 481 women who met the inclusion criteria, 258 women completed initial assessments. Nineteen women were subsequently excluded from all analyses because they started taking medicine susceptible to affect weight (n=10), or because they were diagnosed with serious chronic disease or severe illness/injury (n=4). Others were excluded due to pregnancy (n=2) or because they entered menopause (n=3). These 19 women were of similar age ($p=.575$) and BMI ($p=.418$) to the 239 who were considered as the initial valid sample. These participants were between 23 and 50 years old (37.6 ± 7.1 years), overweight or mildly obese (BMI: 31.5 ± 4.1 kg/m²); 67% had at least some college education, 23% had 10-12 years of school, and 10% had less

than 10 years of school; 32% of the women were unmarried, 56% married, and 12% divorced or widowed.

Participants entered the program in three annual cohorts; however, the first cohort (n=96) did not complete all measurements analyzed herein and was not included. After listwise deletion of missing data, the effective sample size considered for the present study was 139. The mean age was 38.0 (*SD* 6.7 years) and the mean BMI was 32.0 (*SD* 4.1 kg/m²). T-tests comparing the valid dataset group vs. the missing dataset group were performed. Concerning the main demographic characteristics (e.g. age, BMI) and all body image measures included in this study, no significant differences were found between the two groups ($p > .05$), which suggests analyses should likely yield unbiased parameter estimates (Schafer & Graham, 2002).

The broader purpose of this study was to understand the associations between body image and psychological well-being at the start of a weight management intervention. Hence, the present analyses were performed using data from baseline assessments.

Measures

Body image. Several psychometric instruments recommended in the literature (Thompson, 1996) were used to assess the evaluation and investment dimensions of body image attitudes. Regarding the evaluative component, the Figure Rating Scale (FRS: Stunkard, Sorensen, & Schulsinger, 1983) was used to measure self-ideal discrepancy. The scale comprises a set of 9 silhouettes of increasing body size, numbered from 1 (very thin) to 9 (very heavy), from which respondents are asked to indicate the figure they believed represented their current (i.e., perceived body size) and ideal body size. Self-ideal

discrepancy was calculated by subtracting the score for ideal body size from the perceived body size score. Higher values indicate higher discrepancies.

Dysfunctional investment in appearance was represented by a higher-order variable, reflecting an over-preoccupation with weight and shape, their antecedents and consequences, and also an overconcern for how others judge our appearance and the subsequent social impairment. The Body Shape Questionnaire (BSQ: P. J. Cooper, Taylor, Cooper, & Fairburn, 1987; Rosen, Jones, Ramirez, & Waxman, 1996), a 34-item instrument scored on a 6-point Likert-type scale (from 'never' to 'always'), was developed to measure concern about body weight and shape, in particular the experience of "feeling fat" (e.g., "Has being naked, such as when taking a bath, made you feel fat?"), together with the assessment of their antecedents (e.g., "eating sweets, cakes, or other high calorie food made you feel fat") and behavioral consequences (e.g., "Has thinking about your shape interfered with your ability to concentrate?", "Have you avoided wearing clothes that make you aware of your body?"). Higher values represent greater body shape concerns and, thus, greater salience of body image in one's personal life. The Social Physique Anxiety Scale (SPAS: Hart, Leary, & Rejeski, 1989) was used to measure the degree to which people become anxious and concerned when others observe or evaluate their physiques, thereby reflecting the attentional focus on one's appearance. This scale assesses body image affective, cognitive, and behavioral avoidant features in a social environment, comprising 12 items (e.g. "Unattractive features of my physique make me nervous in certain social settings") rated on a 5-point Likert-type scale (from 'not at all' to 'extremely'). Items 1, 5, 8, and 11 are reversed scored. These measures do not evaluate appearance self-schemas, a core facet of investment body image, but do tap into the other

facets of this dimension – disturbed thoughts, emotions, and behaviors – which also reflect the attentional, cognitive, and behavioral salience of appearance in one’s personal life and sense of self.

Controlled regulation. Controlled regulation for entering obesity treatment was measured with the Treatment Self-Regulations Questionnaire (TSRQ; Williams, Grow, Freedman, Ryan, & Deci, 1996), an 18-item scale designed to assess reasons for entering a weight loss program, and thus to assess the degree to which a person's motivation is autonomous or controlled. The instrument has two subscales, autonomous and controlled, and it presents participants with items such as: “I want others to see that I am really trying to lose weight” for more controlled reasons, and "It's important to me that my efforts succeed" for more autonomous reasons. Each reason is rated on a 7-point Likert-type scale. Considering the goals of the present study, only the controlled subscale was used. The internal consistency found in the present study for this subscale was acceptable (see Results).

Psychological well-being. To evaluate psychological well-being, five measures were used: self-esteem, mental health, role-emotional functioning, social functioning, and vitality. Self-esteem, expressing the value or worth individuals attach to themselves, was assessed with the Rosenberg Self-Esteem Scale (RSES; Rosenberg, 1965), a 10-item instrument answered on a 4-point Likert-type scale. Some items refer to negatively worded feelings of self-worth or self-acceptance and are consequently reverse scored. The other four measures of psychological well-being were assessed with the SF-36 (Ware & Sherbourne, 1992). This instrument consists of a multi-item scale that assesses eight health concepts, of which four refer to psychological health: general mental health (psychological

distress and well-being), role limitations due to emotional problems (role-emotional functioning), limitations in social activities because of physical or emotional problems (social functioning), and vitality (energy and fatigue). These four measures were modeled as first-order components of a higher-order latent variable named psychological functioning and reflecting general mental health.

Anthropometry. Measurements took place in the laboratory and were performed in the morning, after fasting for a minimum of 3h. Body weight was measured twice, using an electronic scale calibrated onsite and accurate to 0.1 kg (SECA, Hamburg, Germany). Vertex height was measured with a balance-mounted stadiometer to the nearest 0.1 cm. Body mass index (BMI) was calculated from weight (kg) and height (m).

Analytical Procedure

Model testing was performed using partial least squares (PLS) analysis with the SmartPLS Version 2.0 (M3) software (Ringle, Wende, & Will, 2005). PLS is a prediction-oriented structural equation modeling approach that estimates path models involving latent (i.e., unobservable) variables indirectly measured by a block of observable indicators. PLS uses a partial least squares estimation method to produce factor loadings for each latent variable's block of indicators, as well as standardized regression coefficients for the structural paths linking latent variables. Three reasons justify the use of PLS in this study. First, PLS is especially suitable for prediction purposes (Fornell & Bookstein, 1982), since it explicitly estimates the latent variables as exact linear aggregates of their respective observed indicators. Second, PLS uses non-parametric procedures making no restrictive assumptions about the distributions of the data while estimating parameters (Frank & Miller, 1992). Third, in comparison to the covariance-based approach to latent variable

modeling, PLS is appropriate for use with small sample sizes (Chin, 1998), due to the partial nature of the estimation procedure, with only one part of the model being estimated at each time. According to Chin and Newsted (1999), sample size for PLS analysis should be estimated by conducting a power analysis based on the largest portion of the model (i.e., the portion with the dependent latent variable with the largest number of predictors). For the model tested here this was three predictors. With a medium effect size (Cohen's $f^2 = .15$), a sample size of 76 would be required to detect significant effects at the .05 level with power = .80 (Cohen, 1988).

The PLS model was analyzed in two stages, following Hulland's (1999) recommendations. In the first stage, the measurement model was tested (i.e., the relationships between latent variables and their indicators), and secondly, the structural paths were evaluated (i.e., the theoretical relationships among latent variables). PLS path modeling lacks indices comparable to those available in covariance-based SEM that allow for a global assessment of model fit. Instead, in PLS model evaluation relies on an examination of the reliability, convergent and discriminant validity of the measurement model and the predictive capacity of the structural model. To test the measurement model: (1) item reliability was assessed by checking the loadings of the items on their respective latent variables. (2) The internal consistency of each scale was assessed by examining their composite reliability (CR), a coefficient that is considered superior to Cronbach's alpha because it does not assume equal weightings of items (Fornell & Larcker, 1981). A CR of .70 or higher represents acceptable internal consistency, according to Fornell and Larcker (1981). (3) Convergent and discriminant validity were assessed by examining the average variance extracted (AVE), that is, the average variance explained in a block of indicators by

its latent variable. Convergent validity exists when the latent variable explains on average 50% or more of the variance in its indicators, that is, when the AVE is at least .50 (Fornell & Larcker, 1981). Discriminant validity between latent variables is satisfied when a construct shares more variance with its indicators than it shares with other latent variables in a given model, that is to say, when a latent variable's AVE is greater than its squared bivariate correlation with any other latent variable (Fornell & Larcker, 1981).

To test the structural model, the standardized path coefficients (β) and the variance explained in the endogenous variables (R^2) were examined. SmartPLS does not provide significance tests for the R^2 values for dependent latent variables. Therefore, the effect sizes of the R^2 values [Cohen's $f^2 = R^2 / (1 - R^2)$] were calculated to determine whether the amount of variance explained was negligible ($f^2 < .02$), small ($f^2 \geq .02$), medium ($f^2 \geq .15$), or large ($f^2 \geq .35$) (Cohen, 1988). Given that SmartPLS does not make data distribution assumptions, a bootstrapping procedure is used to assess the significance of the parameter estimates. In the present analyses 5000 bootstrap samples with replacement were requested. To test the difference in the path coefficients for evaluative and investment body image, the method described by Maruyama (1998) by which a t -score is calculated for the difference in coefficients [$t = (b_1 - b_2) / ((SE_1^2 + SE_2^2)^{0.5})$] was adopted.

Tests of mediation were conducted where there were significant intervening paths between distal variables. Full mediation is present when a significant direct effect in the absence of the intervening variable (C path) becomes non-significant in its presence (C' path), and there is a significant indirect effect. Partial mediation is present when the C' path is reduced but remains significant and there is a significant indirect effect (Baron & Kenny, 1986). According to Shrout and Bolger (2002), it is useful to consider also the strength of

the mediating effects. Hence, the ratio of the indirect effect to the direct effect (i.e., the proportion of the total effect explained by the indirect effect) was also calculated.

Results

Measurement Model

PLS path analysis showed that some observed indicators had low factor loadings (< .40). In general, items with loadings of less than .40 (a threshold commonly used in factor analysis) should be dropped (Hulland, 1999). However, to keep the integrity of the constructs/scales used in this study, and to facilitate comparisons with the prior literature, all items were retained. Factor loadings for all the indicators included in the model are available from the first author on request. Table 1 shows the CRs, AVEs, and correlations among the latent variables. Composite reliabilities (CRs) for all scales were greater than .70, suggesting an acceptable internal consistency. The average variance extracted (AVE) was below acceptable levels for body-shape concerns, self-esteem and controlled regulation (.34 to .44). The other variables showed acceptable AVEs (.50 or larger). Regarding the assessment of discriminant validity, an examination of first-order latent variables' relationships showed that AVEs for each latent variable were greater than the squared bivariate correlations with all the other latent variables, with the exception of the associations between controlled regulation, body concerns and social physique anxiety. However, an inspection of the cross-loadings between these variables showed they were not substantial in magnitude compared to each variable's respective loadings, providing some support for discriminant validity (Hulland, 1999). As expected, because the lower-order variables were modelled as indicators of their higher-order LV's, AVEs for each lower-order LV were below the squared bivariate correlations between lower and higher-order

variables. Thus this was not problematic. Taken together, these findings suggest that the measurement model had acceptable internal consistency, although the convergent validity and discriminant validity were limited. Nevertheless, it should be noted that although elimination of poor items improved the measurement model properties, it led to no substantive differences in the structural relations between the latent variables (results not presented).

Structural Model

Figure 1 shows the structural model, including the PLS bootstrap estimates for the structural paths, the variance accounted for in the dependent variables (R^2), and the loadings of first order latent variables on their second-order variables for investment and psychological functioning. The model explained between 10% and 42% of the variance in the dependent variables. Effect size was small for psychological functioning ($f^2 = .11$) and medium for self-esteem ($f^2 = .29$). Large amounts of variance were explained in controlled regulation ($f^2 = .90$).

Regarding the structural paths linking body image components to controlled regulation for entering obesity treatment, results show that only the path between body image investment and controlled regulation was significant. Evaluative body image was not associated with controlled regulation. These results were observed controlling for the effects of baseline BMI. Regarding the paths between controlled regulation and psychological well-being, controlled regulation presented significant negative associations with both self-esteem and psychological functioning.

Table 1

Composite reliability (CR), average variance extracted (AVE) and correlations among factors in the measurement mode

Factor	CR	AVE	Correlations												
			1	2	3	4	5	6	7	8	9	10	11		
1. BMI	1	1	-												
2. Evaluative Body Image	1	1	.46***	-											
3. Investment BI	.96	.92	.12	.27**	-										
4. Body Concerns	.95	.37	.12	.25**	.98***	-									
5. Social Physique Anxiety	.90	.46	.11	.24**	.86***	.73***	-								
6. Controlled regulations	.85	.34	.04	.12	.65***	.61***	.59***	-							
7. Self-Esteem	.88	.44	.06	-.13	-.51***	-.50***	-.45***	-.46***	-						
8. Psychological Functioning	.92	.80	-.02	-.14	-.45***	-.43***	-.40***	-.32***	.56***	-					
9. Mental Health	.92	.69	.00	-.11	-.44***	-.42***	-.40***	-.28***	.56***	.94***	-				
10. Role-emotional Functioning	.86	.67	.03	-.07	-.23**	-.23**	-.17*	-.28***	.42***	.67***	.49***	-			
11. Social Functioning	.83	.71	.04	-.06	-.41***	-.40***	-.37***	-.32***	.43***	.74***	.62***	.52***	-		
12. Vitality	.88	.64	-.09	-.17*	-.36***	-.34***	-.33***	-.20*	.36***	.84***	.73***	.37***	.47***	-	

Note. $N = 139$.

* $p < .05$, ** $p < .01$, *** $p < .001$.

of investment on self-esteem (C path) decreased but remained significant when in the presence of the mediator (C' path; $p < .001$). Thus, controlled regulation partially mediated this relationship (effect ratio .27). In contrast, no mediation was found for the association between body image investment and psychological functioning. Specifically, when the direct path from dysfunctional investment to psychological functioning was added to the model, the indirect path via the mediator (i.e., controlled regulation) was no longer significant.

Finally, we had intended to determine whether the effects of dysfunctional investment in appearance on controlled regulation for enrolling in obesity treatment were stronger than the effects of evaluative body image. Since the path between evaluative body image and controlled regulation was not significant, a test of the difference in the path coefficients for evaluative and investment body image would be redundant. In face of these results, it is clear that the effect of investment body image was ipso facto stronger.

Table 2

Tests of mediation for the significant indirect effects identified in the structural model, adjusting for BMI

Relationship		Indirect effect (ab path)		Total effect (C path)		Direct effect ^a (C' path)		
From	To	PLS estimate	Bootstrap estimate	PLS estimate	Bootstrap estimate	PLS estimate	Bootstrap estimate	Effect ratio
Investment Body image	Self-Esteem	-.12	-.14*	-.53	.54***	-.40	-.40***	.27
Investment Body image	Psychological Functioning	.03	.04	-.46	.46***	-.43	-.42***	.09

Note. $N = 139$.

^a Direct effect controlling for the mediator.

* $p < .05$, ** $p < .01$, *** $p < .001$.

Discussion

Many overweight people dislike their appearance and develop a negative body image (Z. Cooper, et al., 2003). Concomitantly, there is a growing body of research reporting on body image problems amongst the obese and on associated consequences for psychological functioning and weight management (e.g., Cash & Pruzinsky, 2002). However, very few studies have specifically focused on determining mediators of the relationships between poor body image and psychological suffering and distress. The sociocultural pressures to achieve a slim-body ideal, which can lead to poor body image (e.g., Stice, 2002), could be experienced as imposed pressure to lose weight, fostering controlled regulations for enrolling in weight loss treatment, and in turn, undermining psychological well-being. In the current study, we tested a three-level model to explore the mediating role of controlled regulation for enrolling in weight loss treatment between body image and well-being. Further, we distinguished body image dimensions, seeking to investigate whether dysfunctional investment was more strongly related than evaluative body image to controlled regulation and subsequent psychological well-being. Body weight effects were controlled for by including baseline BMI in the model.

The conceptualized paths within the structural model were generally supported by the study's findings, accounting for a substantial portion of the variance in controlled regulation and self-esteem. However, the study predictions were only partially supported. Specifically, results revealed that body image investment was positively associated with controlled regulation for enrolling in obesity treatment, but failed to show significant associations for evaluative body image. As expected, controlled regulation for entering treatment was negatively associated with psychological outcomes. Results showed

significant indirect effects of dysfunctional body image investment on both psychological outcomes and controlled regulation partially mediated the association between investment and self-esteem. In contrast, results did not show significant associations between evaluative body image and controlled regulation and psychological outcomes. These results suggest that the investment dimension of body image is more detrimental to the psychological well-being of overweight and obese women, partly by encouraging the adoption of controlled regulation for enrolling in obesity treatment. Results also suggest the existence of a direct and independent association between dysfunctional investment in appearance and psychological functioning, given that no mediating effects were found. These findings were independent of participants' baseline body weight.

The absence of significant associations between evaluative body image (measured as self-ideal discrepancy) and controlled regulation partially contradicts previous findings (Markland, 2009; Markland & Ingledew, 2007). For example, in Markland's study (2009), body image discrepancies were positively related to external regulation but not related to introjections, suggesting different associations for different types of controlled regulations. Methodological differences (e.g., sample, measurements) could help explain, at least in part, the discrepancies in these results. In Markland (2009), the sample was composed of healthy weight women recruited from a worksite and church community and specific forms of regulation for exercise participation were (separately) measured. In the current study, the sample was composed of overweight women seeking weight loss, and controlled regulations for entering treatment were evaluated, with an undifferentiated, composite score.

The present findings provide empirical support for the contention that a high level of dysfunctional investment in appearance rather than body dissatisfaction is more likely to encourage the adoption of controlled regulations to lose weight, and subsequently contribute to worsened psychological well-being. We observed a strong association between body image investment and controlled regulation (large f^2). Further, it was hypothesized that dysfunctional body image investment would be more strongly related to controlled regulation for entering treatment than evaluative body image. Given the absence of associations between evaluative body image and controlled regulation, this was ipso facto the case. Appearance-related self-schemas, a nuclear facet of body image investment that was not assessed in the present study, might help understand these findings. These cognitive structures “reflect one’s core, affect-laden assumptions or beliefs about the importance and influence of one’s appearance in life, including the centrality of appearance to one’s sense of self” (Cash, 2002a; pp. 42). Appearance self-schemas derive from one’s personal and social experiences (Stein, 1996), and are activated by and used to process self-relevant events and cues (Cash, 2002a). According to Cash’s cognitive-behavioral perspective (2002a), the resultant body image thoughts and emotions, in turn, prompt adjustive, self-regulatory activities (Cash, Melnyk, et al., 2004). Results from this study seem to suggest that seeking weight loss treatment for controlled reasons might be one of these self-regulatory activities.

As predicted, controlled motivation for entering a weight management program was associated with decreased psychological well-being. This finding is not only consistent with SDT theoretical premises and prior SDT research in several domains (see Deci & Ryan, 2000; 2008, for reviews) but, more importantly, it suggests that when overweight women

enter into treatment for controlled reasons, it may be related to poor psychological adjustment – including low self-esteem, reduced life satisfaction, symptoms of depression and helplessness (e.g., Georgiadis, Biddle, & Stavrou, 2006; Pelletier, Dion, D'Angelo, & Reid, 2004) – that predisposes them to less successful outcomes (e.g., Teixeira, et al., 2010). Thus, this is a risk factor clinicians should consider in their practice when evaluating patients' readiness to lose weight.

Results revealed that the pathway connecting body image investment to self esteem was in part mediated by controlled reasons for entering treatment. On the other hand, investment had only a direct relationship with psychological functioning. These findings suggest that the associations between dysfunctional investment in appearance and different psychological outcomes may be explained by distinct processes. According to SDT when one's self esteem is contingent on positive regard from others, one is prone to more controlled regulation of behavior (Ryan & Brown, 2003). This in turn leaves one susceptible to external social pressures. In the context of entering a weight loss program, participants' self esteem may be associated with controlled motivation because it is dependent upon reaching socially imposed standards about the ideal appearance. In contrast, the individual's general psychological functioning in everyday life and work-related activities (as measured by the SF-36; Ware & Sherbourne, 1992) may be less dependent upon such context-specific motivation. Future research should explore this hypothesis further.

Previous studies (Cuntz, Leibbrand, Ehrig, Shaw, & Fichter, 2001; Linde, et al., 2004; Williams, et al., 1996) suggest that being regulated by controlled reasons to lose weight and presenting poorer psychological profiles predict poorer weight outcomes and

lower treatment adherence. In this context, some practical implications can be drawn from our findings. First, when implementing interventions, health professionals would do well to consider the reasons regulating people's engagement in obesity treatment. Self-determination theory suggests that by maximizing patients' experience of autonomy, competence, and relatedness in health-care settings, the regulation of health-related behaviors is more likely to be internalized, behavior change will be better maintained (Silva, et al., in press; Williams, Rodin, Ryan, Grolnick, & Deci, 1998), and greater psychological well-being will be experienced (Deci & Ryan, 2008). Hence, health professionals should also consider the inclusion of strategies to promote autonomy and reduce controlled regulations when implementing weight management interventions (Silva, et al., 2008; Silva, et al., 2010). Specifically, interventions should be designed in order to provide structure and create an autonomy-supportive environment. Additionally, we believe interventions would benefit from including strategies to work on the investment component of body image, by encouraging individuals to question and gradually deconstruct their beliefs, interpretations, and thoughts about the importance of appearance in their lives and sense of self. Improving body image, body satisfaction and acceptance might progressively reduce controlled body-related motives to lose weight, favoring the adoption of more autonomous regulations, and consequently facilitate well-being and long-term health behavior adherence and weight maintenance.

The study has a number of limitations. First, it was cross-sectional in nature and we cannot exclude the possibility of an alternative causal ordering of the observed relationships, where regulations are not mediators, but might lead people to internalize social pressures to a lesser extent, or have independent effects on well-being. This would

imply a causal effect of controlled regulation on body image and psychological well-being rather than a mediating effect. Future longitudinal studies could help elucidate the causal directionality of these relationships. Second, we investigated a particular population in this study, overweight women seeking obesity treatment. Thus, these results cannot be generalized to the overall overweight and obese population, or to the general population. Third, the psychometric instruments used herein to measure investment body image were only able to capture some facets of this construct, the over-preoccupation with body image and appearance and its behavioral consequences, failing to capture a core facet of body image investment, the appearance-related self-schemas. Future studies should confirm the study's findings by measuring body image investment with comprehensive, empirically validated instruments, able to capture the meaning and significance of one's physical appearance for one's sense of self and self-worth (i.e., appearance-related self-schemas). Finally, to keep the integrity of all the constructs included in the model, we retained low-reliability items within the measures of body-shape concerns, controlled regulation, and self-esteem. As recommended by Hulland (1999), these findings should be interpreted with caution, given that low-reliability items can attenuate the estimated relationships between constructs. Nevertheless, an additional evaluation of the model after eliminating these poor items led to no substantive differences in the structural relations, offering greater confidence to the present findings.

In conclusion, this study builds on previous research findings (e.g., Markland & Ingledew, 2007; Pelletier & Dion, 2007; Ratelle, Vallerand, Chantal, & Provencher, 2004), integrating them in a model of psychological well-being and for the first time extending them into the context of obesity treatment. A strength of the current study is the

discrimination between evaluative and investment dimensions of body image, which allowed the opportunity to shed some light into the different motivational and psychological consequences of each component in overweight participants. These results are largely in line with prior research, highlighting the importance of dysfunctional investment in appearance, rather than body dissatisfaction, for psychological well-being. Body dissatisfaction is important, but the salience or meaning of appearance to one's personal self may be pivotal. Additionally, these findings extend the existing data by showing that controlled regulations might be one of the mechanisms behind the detrimental effect of poor body image on psychological well-being (specifically on self-esteem). Future work should explore these findings using longitudinal designs and using psychometric instruments more able to capture the whole body image investment dimension.

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CHAPTER 5

Body image change and improved eating self-regulation in a weight management intervention in women (Study 2)⁴

⁴Carraça, E. V., Silva, M. N., Markland, D., Vieira, P. N., Minderico, C. S., Sardinha, L. B., Teixeira, P.J. (2011). Body image change and improved eating self-regulation in a weight management intervention in women. *International Journal of Behavioral Nutrition and Physical Activity*, 8, 75-85.

Abstract

Background

Successful weight management involves the regulation of eating behavior. However, the specific mechanisms underlying its successful regulation remain unclear. This study examined one potential mechanism by testing a model in which improved body image mediated the effects of obesity treatment on eating self-regulation. Further, this study explored the role of different body image components.

Methods

Participants were 239 overweight women (age: 37.6 ± 7.1 yr; BMI: 31.5 ± 4.1 kg/m²) engaged in a 12-month behavioral weight management program, which included a body image module. Self-reported measures were used to assess evaluative and investment body image, and eating behavior. Measurements occurred at baseline and at 12 months. Baseline-residualized scores were calculated to report change in the dependent variables. The model was tested using partial least squares analysis.

Results

The model explained 18-44% of the variance in the dependent variables. Treatment significantly improved both body image components, particularly by decreasing its investment component ($f^2 = .32$ vs. $f^2 = .22$). Eating behavior was positively predicted by investment body image change ($p < .001$) and to a lesser extent by evaluative body image ($p < .05$). Treatment had significant effects on 12-month eating behavior change, which were fully mediated by investment and partially mediated by evaluative body image (effect ratios: .68 and .22, respectively).

Conclusions

Results suggest that improving body image, particularly by reducing its salience in one's personal life, might play a role in enhancing eating self-regulation during weight control. Accordingly, future weight loss interventions could benefit from proactively addressing body image-related issues as part of their protocols.

Key Words

Body image, Eating Self-regulation, Eating behavior, Weight Management, Obesity

Background

Overweight and obesity remain highly prevalent in Western cultures and constitute a major cause of preventable co-morbidities and death [1-3]. Further, they are associated with substantial health care costs [3]. The treatment of obesity is problematic and weight loss interventions generally result in modest effects [4]. Improving intervention efficacy remains a critical challenge and identifying mechanisms or factors (i.e., mediators) which facilitate adherence to health-related behaviors critical to successful weight management, such as healthy eating and exercise behaviors, will contribute to more successful interventions in the future.

Since obesity is a product of energy imbalance and thus highly reliant on dietary energy intake and energy expenditure, it is not surprising that healthy weight management almost always involves the successful regulation of eating behavior. Several studies indicate that eating-related behaviors such as high flexible restraint, high eating self-efficacy, reduced

disinhibition and emotional eating, and low hunger predict positive outcomes in obesity treatment [5-7]. At the same time, body image problems are highly prevalent in overweight and obese people [8] especially among those seeking treatment [e.g., 9] and can undermine successful weight management, predicting poorer weight outcomes and increasing chances of relapse [6, 8, 10-11]. A relatively large body of evidence indicates that there are associations between a range of body image disturbances and problematic eating behaviors and attitudes [c.f., 12, 13-14]. Therefore, improving body image might be a potential mechanism involved in the successful regulation of eating behaviors and obesity treatment is a critical setting to test this hypothesis.

Not only is there evidence that body image experiences predict the severity of problematic eating patterns, but longitudinal and structural modeling investigations also point to poor body image as a precursor of the adoption of dysfunctional eating behaviors among other unhealthy weight control strategies [e.g., 15, 16-18]. For instance, Neumark-Sztainer and colleagues (2006) showed that lower levels of body satisfaction were associated with more health-compromising behaviors, such as unhealthy weight control behaviors and binge eating, five years later [18]. Further, sociocultural models of bulimia nervosa assign body image concerns a causal role in the development of disordered eating [17]. Stice proposed that sociocultural pressures to be thin, widespread in Western cultures, lead women to internalize a slender body as the standard for feminine beauty [19]. Consequently, this internalization can result in the experience of a discrepancy between the ideal and one's actual figure and prompts body dissatisfaction and over-concern, since the ideal body weight is often very low and thus achievable by only a few. Weight/body dissatisfaction, in

turn, could motivate extreme and unhealthy behaviors in an effort to lose weight, which in turn might increase the risk of developing binge eating and other disturbed eating behaviors [17, 19]. These findings have led researchers to conclude that body image distress is one of the most potent risk factors for eating disturbances [20].

Body image comprises two attitudinal dimensions. Evaluative body image refers to cognitive appraisals and associated emotions about one's appearance, and it includes self-ideal discrepancies and body satisfaction-dissatisfaction valuations [21]. In contrast, body image investment refers to the cognitive-behavioral importance of appearance in one's personal life and its salience to one's sense of self. This dimension reflects a dysfunctional investment in appearance characterized by an excessive preoccupation and effort devoted to the management of appearance, as opposed to a more adaptive valuing and managing of one's appearance [21]. This structure of attitudinal body image has been empirically supported indicating that although the optimal prediction of poor/negative body image requires both evaluative and investment aspects of body image, the former is not sufficient per se to produce body image distress [22]. Similarly, both body image components were found to predict eating disturbance, although body image investment presented greater predictive power, in some cases surpassing the effects of evaluative body image [21, 23]. For example, Cash, Phillips, et al. [23] found that body image investment had not only a greater but also a unique, independent contribution to the prediction of disturbed eating attitudes, above and beyond a simple index of body dissatisfaction.

As Bruch originally argued, amelioration of dysfunctional body image is often necessary for effectively treating and improving disturbed eating behaviors [24]. Obesity treatment seems to be effective in improving body image even with modest weight losses [e.g., 25, 26]. Thus, the purpose of the present study was to examine whether body image (positive) change during a weight loss intervention comprising a body image module would mediate the successful regulation of eating behavior by testing a three-level model in which treatment would enhance body image (evaluative and investment components), which in turn would improve the regulation of eating behavior. Further, this study analyzed whether the change in body image investment presented stronger effects on the regulation of eating behavior than evaluative body image.

Methods

Study Design and Intervention

This study was part of a randomized controlled trial including a 1-year behavior change intervention, primarily aiming at increasing physical activity and energy expenditure, adopting a moderately restricted diet, and ultimately establishing exercise and eating patterns consistent with sustainable weight loss/maintenance. Participants were randomly assigned to intervention and control groups. The comparison group received a general health education curriculum based on several educational courses on various topics (e.g., preventive nutrition, stress management, self-care, and effective communication skills). The intervention included 30 group sessions covering topics such as physical activity, emotional and external eating, improving body acceptance and body image, among other cognitive-behavioral aspects (e.g., identifying personal barriers, overcoming lapses,

defining adequate goals, and implementing self-monitoring). The program's principles and style of intervention were based on self-determination theory [27-28] with a special focus on increasing competence and internal regulation toward exercise and weight control, while supporting participants' autonomous decisions as to which changes they wanted to implement and how.

Regarding body image enhancement, the intervention aimed at increasing participants' body acceptance and satisfaction and at decreasing their over-preoccupation and dysfunctional investment in appearance. For that purpose, several strategies were implemented within this intervention module. Some were predominantly used to improve evaluative body image while other strategies were essentially intended to reduce dysfunctional body image investment. Asking participants to view and gradually explore their body and its parts, in front of a mirror, in the privacy of their home; establishing more realistic goals and expectations for themselves and their weight/body, by confronting their ideal physique with the real limits in their biological capacities to meet their goals (e.g., observe their own and their parents weight history); and providing dance and relaxation classes were the main strategies employed to improve the evaluative component. To reduce dysfunctional investment in appearance, the following key strategies were implemented: helping participants understand the concept of body image (i.e., a subjective construct, independent of physical appearance) and recognize the social and personal roots of their own body image development; asking participants to keep a self-monitoring diary to record critical body image experiences in which they feel self-conscious, their beliefs in the situation (e.g., thoughts, self-statements, negative "body talk"), and the associated

emotional and behavioral consequences; helping participants cope with stereotypes and prejudice, facilitating the abandonment of the idea that they must look different to be happier; and working on cognitive restructuring to help participants challenge their maladaptive assumptions about appearance and its salience to their life and self-worth, by promoting the evaluation of evidence for and against their beliefs and the construction of alternative thoughts. It should be noted that effectively isolating and specifically targeting one body image component (e.g. evaluative) without affecting another related component (e.g. investment) is a difficult task; they are dimensions of a higher-order construct and as such they will naturally covary.

A detailed description of the study's theoretical rationale, protocol, and intervention strategies can be found elsewhere [29-30]. The Ethics Committee of the Faculty of Human Kinetics – Technical University of Lisbon reviewed and approved the study.

Participants

Participants were overweight or obese Portuguese women recruited from the community through web and media advertisements and announcement flyers to participate in a university-based behavioral weight management program. To be included, participants had to be women, between 25-50 years old, pre-menopausal, with a BMI between 25-40 kg/m², be willing to attend weekly meetings (during 1 year), be free from major illnesses, and not taking medication known to interfere with weight regulation. Of all women who entered the study (N=258), 19 women were subsequently excluded from all analyses because they started taking medication capable of affecting weight (n=10), were diagnosed with serious

chronic disease or severe illness/injury (n=4), became pregnant (n=2), or entered menopause (n=3). These women were of similar age (p=.575) and BMI (p=.418) to the 239 considered as the effective initial sample. Of these, 201 completed assessments at the end of the intervention (12 months). T-tests comparing the complete dataset group (n=170) vs. the missing dataset group (n=31) were performed. No significant differences were found between the two groups for BMI, weight and height, which suggests data were missing completely at random (MCAR) and analyses would likely yield unbiased parameter estimates [31-32]. The mean age for the complete data group was 38.0 (SD 6.8 years) and the mean BMI was 31.3 (SD 4.0 kg/m²). All participants signed a written informed consent prior to participation in the study.

Measures

Body Image

A comprehensive battery of psychometric instruments recommended in the literature was used to assess the two attitudinal components of body image, evaluative and investment [33]. To assess the evaluative component of body image, herein represented by self-ideal body discrepancy, the Figure Rating Scale (FRS) was used [34]. This scale comprises a set of 9 silhouettes of increasing body size, numbered from 1 (very thin) to 9 (very heavy), from which respondents are asked to indicate the figure they believed represented their current (i.e., perceived body size) and ideal body size. Self-ideal discrepancy was calculated by subtracting the score for ideal body size from the perceived body size score. Higher values indicate higher discrepancies.

The dysfunctional investment component was represented by body shape concerns and social physique anxiety. Body concerns were evaluated with the Body Shape Questionnaire (BSQ) [35-36], a 34-item instrument scored on a 6-point Likert-type scale (from ‘never’ to ‘always’), developed to measure concern about body weight and shape, in particular the experience of “feeling fat” (e.g., “Has being naked, such as when taking a bath, made you feel fat?”), but also to measure several cognitive-behavioral consequences of those feelings (e.g., “Has thinking about your shape interfered with your ability to concentrate?”, “Have you avoided wearing clothes that make you aware of your body?”). This instrument addresses the salience of body image in one’s personal life, rather than merely asking about body image satisfaction [37], where higher values represent greater body shape concerns and greater salience. The Social Physique Anxiety Scale (SPAS) [38] was used to measure the degree to which people become anxious and concerned when others observe or evaluate their physiques, thereby assessing body image affective and cognitive features in a social environment. This scale comprises 12 items (e.g. “Unattractive features of my physique make me nervous in certain social settings”) rated on a 5-point Likert-type scale (from ‘not at all’ to ‘extremely’). Items 1, 5, 8, and 11 are reversed scored. Higher scores represent greater social physique anxiety. In evaluating the measurement model (see below) cross-loadings of items between these two scales (BSQ and SPAS) were analyzed, and items with cross-loadings above .60 were removed.

Eating Self-Regulation

Eating self-regulation (ESR) can be defined as the attempt to manage dietary intake in a mindful, voluntary and self-directed way (e.g., to achieve and maintain energy balance or

weight loss), within the context of other physiological and environmental constraints [39].

In the current study, eating self-regulation referred to aspects known to positively influence weight management, namely high eating self-efficacy, high flexible cognitive restraint, reduced disinhibition (emotional, situational, and habitual), and reduced perceived hunger.

Eating self-efficacy was assessed with the Weight Efficacy Lifestyle Questionnaire (WEL) [40], by asking individuals to rate their confidence for successfully resisting opportunities to overeat and for self-regulating their dietary intake on a 10-point scale, ranging from “not confident at all” to “very confident”. Higher scores represent greater eating self-efficacy. Cognitive restraint, disinhibition, and perceived hunger were measured with the 51-item Three-Factor Eating Questionnaire (TFEQ) [41]. Cognitive restraint reflects the conscious intent to monitor and regulate food intake (21 items). However, this global concept might include several behavioral strategies varying in their effectiveness in establishing a well self-regulated eating behavior. Hence, Westenhoefer noted the need to refine this concept and proposed its division into flexible and rigid types of restraint [42]. Rigid restraint (7 items) is defined as a dichotomous, all-or-nothing approach to eating and weight control, whereas flexible restraint (7 items) represents a more gradual approach to eating and weight control, for example, with “fattening” foods being eaten in limited quantities without feelings of guilt. Since flexible restraint is associated with low emotional and disinhibited eating, as opposed to rigid restraint, only the former subscale was considered in the present study as representing a better self-regulation of eating behavior. Higher scores indicate greater levels of flexible restraint. Disinhibition refers to an uncontrolled overconsumption of food in response to a variety of stimuli, such as situational and cognitive/emotional states

(16 items). Taking into account the complexity of eating behavior, Bond and colleagues suggested the need for measuring and analyzing these factors at a more precise and domain-specific level [43]. Thus, disinhibition was also divided into three subscales: habitual, emotional, and situational susceptibility to disinhibition [43]. Habitual susceptibility (to disinhibition) describes circumstances that may predispose to recurrent disinhibition (e.g., “Do you go on eating binges though you are not hungry?”); emotional susceptibility is associated with negative affective states (e.g., “When I feel lonely, I console myself by eating”); and situational susceptibility which is fostered by specific environmental cues, such as social occasions (e.g., “I usually eat too much on social occasions”). This distinction allowed for higher item loadings and greater internal consistency of this construct. Perceived hunger refers to the extent to which respondents experience feelings and perceptions of hunger in their daily lives. Disinhibition and perceived hunger items were reverse scored, so that higher scores represented lower levels of these variables (and more positive eating self-regulation).

Assessments occurred at baseline and at 12 months. To report the change in body image and eating measures, baseline-residualized scores were calculated, where the 12-month variable is regressed onto the baseline variable [44]. Subjects completed the Portuguese versions of all questionnaires cited above. Forward and backward translations between English and Portuguese were performed for all the questionnaires. Next, two bilingual Portuguese researchers subsequently reviewed the translated Portuguese versions, and minor adjustments were made to improve grammar and readability. Cronbach’s alphas for

baseline and 12-month measurements were acceptable (above 0.70), except for flexible restraint which was slightly lower [5].

Analytical Procedure

The theoretical model was tested using partial least squares (PLS) analysis with the SmartPLS Version 2.0 (M3) software [45]. PLS is a prediction-oriented structural equation modeling approach that estimates path models involving latent variables (LVs) indirectly measured by a block of observable indicators. Three reasons justify the use of PLS in this study. First, PLS is especially suitable for prediction purposes [46], since it explicitly estimates the latent variables as exact linear aggregates of their respective observed indicators. Second, PLS uses non-parametric procedures making no restrictive assumptions about the distributions of the data [47]. Third, unlike the covariance-based structural equation modeling approach (e.g., LISREL), PLS is appropriate for use with small sample sizes [48], due to the partial nature of the estimation procedure.

The PLS model was analyzed in two stages. In the first stage, the measurement model was tested. Item reliability was assessed by checking the loadings of the items on their respective latent variables. Items that were statistically significant and had loadings greater than .40 were retained [49]. The internal consistency of each scale was assessed by examining their composite reliability (CR). A CR of .70 or higher represents acceptable internal consistency [50]. Convergent and discriminant validity were assessed by examining the average variance extracted (AVE). Convergent validity exists when the latent variable explains on average 50% or more of the variance in its indicators, that is,

when the AVE is at least .50 [50]. Discriminant validity is satisfied when the AVE for a latent variable is greater than its squared bivariate correlation with any other latent variable [50].

In the second stage, the structural model was tested. Three higher-order latent variables were defined. Investment BI was specified as a second-order variable with body shape concerns and social physique anxiety as its lower-order latent indicators; disinhibition was specified as a second-order variable with habitual, emotional, and situational susceptibility to disinhibition as its lower-order latent indicators; and eating self-regulation was specified as a third-order variable with flexible restraint, disinhibition, perceived hunger, and eating self-efficacy as its lower-order latent indicators. All latent variables were specified as reflective. The standardized path coefficients between latent variables (β) and the variance explained in the endogenous variables (R^2) were examined. Structural paths were retained if they were statistically significant. Where there were significant intervening paths connecting distal variables, tests of mediation were conducted using the bootstrapping procedures incorporated in SmartPLS. When examining mediating effects, past work has shown the bootstrapping approach to be superior to the alternative methods of testing mediation, such as the Sobel test, with respect to power and Type I and II error rates [51]. Baron and Kenny's [52] formal steps for testing mediation were also followed. Full mediation is present when the indirect effect is significant, and there is a direct effect in the absence of the intervening variable (C path) that becomes non-significant in its presence (C' path). Partial mediation is present when the C' path is reduced but remains significant [53].

In addition, the ratio of the indirect effects to the direct effects was calculated to express the strength of the mediation effects [54].

As mentioned earlier, PLS does not make data distribution assumptions, thus parametric tests for the significance of the estimates are not available. Instead, SmartPLS employs a bootstrapping procedure to assess the significance of the parameter estimates. In the present analyses 5000 bootstrap samples with replacement were requested. SmartPLS does not provide significance tests for the R^2 values for dependent latent variables. Therefore, the effect sizes of the R^2 values (Cohen's f^2) were calculated. Effect sizes of .02, .15, and .35 are considered small, medium, and large, respectively [44].

Results

The central focus of this study was to test a three-level model by which a behavioral weight control intervention, encompassing a body image component, produced effects on eating self-regulation. The main effects of the intervention on weight and key psychosocial variables are described elsewhere [55]. In brief, at the end of the intervention (12 months), average weight loss was higher in the intervention group ($-7.3\pm 5.9\%$) than in the control group ($-1.7\pm 5.0\%$), and so was the percentage of participants losing more than the accepted success criteria of 5 and 10% of initial weight ($ps < .001$, for all comparisons). In addition, the body image and eating self-regulation variables included in the present model changed in the expected direction within the intervention group ($ps < .001$). Evaluative body image was enhanced, body image investment decreased, and eating self-regulation variables

improved showing large effect sizes; significant between-group differences favoring the intervention were observed [55].

Measurement Model

Initial PLS analysis showed that some observed indicators had low factor loadings ($< .40$) and some first-order latent variables presented AVEs below acceptable levels (.27 to .40). Therefore, the indicators with the lowest loadings were eliminated and the model re-estimated until acceptable AVEs were obtained. Figure 1 displays the lower- and higher-order LV's and the bootstrap estimates for the respective factor loadings. Table 1 shows the CRs, AVEs, and correlations among the latent variables. CRs for all scales were greater than .70 and AVEs .50 or larger. Moreover, AVEs for each latent variable were greater than the squared bivariate correlations with all the other latent variables, with the exception of the associations between lower-order variables and their respective higher-order LV, as expected. All correlations were significant ($p < .05$) and in the expected direction. Taken together, these findings suggest that the measurement model had acceptable internal consistency, convergent validity, and discriminant validity.

Table 1 – Composite reliability (CR), average variance extracted (AVE) and correlations among factors in the measurement model

Factor	CR	AVE	Correlations														
			1	2	3	4	5	6	7	8	9	10	11	12	13		
1. Treatment (I vs C)	1	1	1														
2. <i>Investment BI</i>	.95	.91	-.48	.95													
3. Social Physique Anxiety	.87	.52	-.46	.83	.72												
4. Body Concerns	.95	.51	-.45	.98	.71	.71											
5. Evaluative BI	1	1	-.41	.36	.37	.32	1										
6. <i>Eating Self-Regulation</i>	.94	.75	.41	-.65	-.58	-.62	-.37	.86									
7. Flexible Restraint	.76	.51	.29	-.46	-.36	-.46	-.31	.57	.71								
8. Eating Self-Efficacy	.94	.53	.39	-.61	-.56	-.57	-.37	.97	.46	.73							
9. Perceived Hunger	.77	.53	.29	-.44	-.32	-.45 ^b	-.18 ^a	.68	.45	.54	.73						
10. <i>Disinhibition</i>	.83	.79	.33	-.57	-.51	-.55	-.26	.78	.39	.65	.57	.89					
11. Habitual Disin.	.80	.67	.23 ^b	-.48	-.43	-.45	-.21 ^b	.49	.36	.42	.35	.72	.82				
12. Emotional Disin.	.82	.60	.22 ^b	-.40	-.36	-.38	-.20 ^a	.59	.22	.49	.33	.82	.43	.77			
13. Situational Disin.	.79	.56	.33	-.51	-.45	-.49	-.22 ^b	.75	.38	.62	.66	.83	.45	.49	.75		

Note. N = 170. CR is composite reliability; AVE is average variance extracted; diagonal entries in bold are the square root of AVE; other values are correlation coefficients. Variables in italic are higher-order variables.

^a Correlations significant at $p < .05$; ^b Correlations significant at $p < .01$; All remaining correlations were significant at $p < .001$.

Structural Model

The model explained between 18% and 44% of the variance in the dependent variables.

Effect sizes were medium for the change in evaluative and investment body image ($f^2 = .22$ and $.32$, respectively), while large amounts of variance were explained for eating self-regulation ($f^2 = .79$). Figure 1 shows the PLS bootstrap estimates for the structural paths, and the variance accounted for in the dependent variables (R^2).

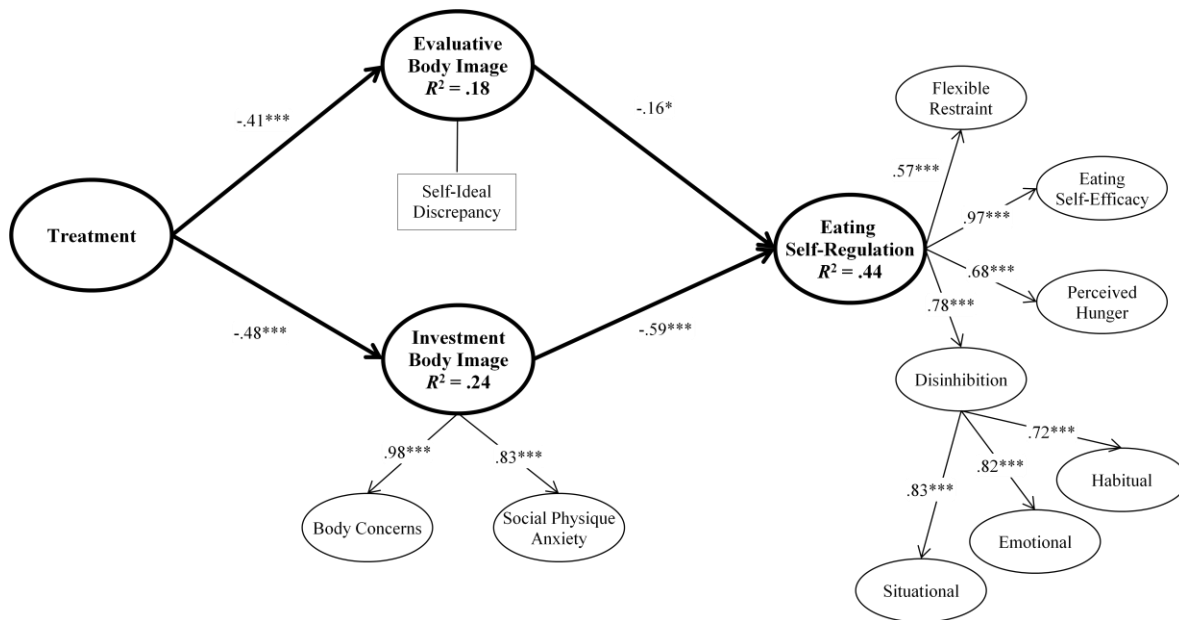


Figure 1 – Partial least squares model. Values in the paths represent the bootstrapped PLS estimates; * $p < .05$, ** $p < .01$, *** $p < .001$.

Treatment positively predicted the change in body image investment and evaluative body dissatisfaction. Although both components improved significantly, treatment effects on the investment component were stronger (effect size .32 vs. .22). In turn, the positive changes in body image components resulted in an increase in eating self-regulation. Given the observed path coefficients, the effects of body image investment on eating self-regulation appear to be greater than the effects of evaluative body image (paths: $-.59$, $p < .001$ vs. $-.16$, $p < .05$). In the face of these results and to further support the greater relative strength of investment over evaluative body image effects on eating behavior, the model was re-examined before and after the inclusion of investment body image change. SmartPLS uses a blockwise estimation procedure, with only one part of the model being estimated at each time, which permitted the use of this additional analysis [48]. Results showed a substantial

increase in variance explained in eating self-regulation (from an R^2 of .14 to .44) and a large effect size for change ($f^2 = 0.54$), further supporting a greater relative strength of investment over evaluative body image.

Table 2 shows the significant indirect effects between distal independent and dependent variables, and the resultant tests of mediation. Treatment had a significant indirect effect on eating self-regulation, which was fully mediated by the change in body image investment (effect ratio .68) and partially mediated by the change in evaluative body image (effect ratio .22). Results suggest that treatment effects on eating self-regulation occur especially through change in body image investment, given that the indirect effect via this dimension was greater than the one via evaluative body image (path coefficients: .28 vs .09).

To further explore the (mediating) role of body image change, secondary and more specific tests of mediation were conducted, considering each eating behavior as a separate outcome (see Table 2). Treatment had significant indirect effects on all measures of eating behavior (flexible restraint, eating self-efficacy, disinhibition, and perceived hunger). The change in investment body image fully mediated the effects of treatment on each one of these variables; the effect ratios were all large (.63 – .79). In addition, the positive change in body dissatisfaction partially mediated the path between treatment and eating self-efficacy (medium f^2 .25).

Table 2 – Significant indirect effects and tests of mediation in the structural model

Relationship			Indirect effect (ab path) ^a	Total effect (C path)	Direct effect (C' path) ^b	Effect ratio
From	To	Intervening variable				
Treatment	Eating self-regulation	Investment BI	.28***	.41***	.13	.68
Treatment	Eating self-regulation	Evaluative BI	.09**	.41***	.32***	.22
Treatment	Flexible Restraint	Investment BI	.21***	.30***	.08	.70
Treatment	Eating self-efficacy	Investment BI	.27***	.39***	.13	.69
Treatment	Eating self-efficacy	Evaluative BI	.10**	.40***	.30***	.25
Treatment	Disinhibition	Investment BI	.26***	.33***	.06	.79
Treatment	Perceived hunger	Investment BI	.19***	.30***	.10	.63

Note. $N = 170$. BI: Body Image. All values represent the bootstrapped PLS estimates. ^a Whenever there is more than one intervening variable for each IV->DV path, the total indirect effect results from the sum of the indirect effect through each intervening variable. ^b Direct effect controlling for the mediator. * $p < .05$, ** $p < .01$, *** $p < .001$.

Discussion

Body image problems are highly prevalent in overweight and obese people seeking treatment [56] and are consistently associated with poorer weight outcomes and increased chances of relapse [e.g., 6, 8, 11]. In addition, poor body image has been consistently related to the adoption of maladaptive eating behaviors [e.g., 16, 17], likely to undermine successful weight management. Thus, the advantage of tackling body image concerns in obesity treatment remains unquestioned. This study showed that body image improved during the intervention, confirming that behavioral weight loss programs, particularly those which include a body image module, can be an effective way of improving body image [25, 57]. The present results extend previous findings by distinguishing evaluative and investment body image dimensions, showing that both can be enhanced, and that they differentially mediate the effects of a weight loss intervention on the (successful) regulation of eating behavior.

The conceptualized paths within the structural model were generally supported by the study's findings, accounting for a substantial portion of the variance in investment body image and eating-self-regulation. The study predictions were also generally supported. Specifically, results showed that the intervention led to positive changes in body image which in turn resulted in the improvement of eating self-regulation. In addition, results revealed that relative to evaluative body image, the change in body image investment was more strongly related to the changes in eating behavior. Finally, results showed that both body image dimensions mediated the significant effects of treatment on eating self-regulation. Overall, body image change appears to be a valid mechanism through which the regulation of eating behavior can be improved in behavioral weight management interventions, at least in women.

Results showed that this study's intervention led to improvements in both dimensions of body image, increasing body satisfaction, and decreasing dysfunctional investment in appearance. These findings lend support to previous suggestions by Rosen and colleagues [57-58] recommending the inclusion of body image-related contents in weight management interventions. Although we must acknowledge that some improvement in body image might have been experienced due to weight reduction per se, the rationale for adding a body image component to the intervention is that it will enable participants "to exercise their new self-image more effectively and to unlearn body image habits that do not give way to weight loss" [59; pp.436]. In addition, prior research suggested that body image

enhancement could also facilitate the use of psychological resources, resulting in better adherence to the weight management tasks [60-61].

Change in both body image dimensions resulted in positive changes in eating self-regulation. Nevertheless, the present findings provide empirical support to the contention that reducing the levels of concern with body image (i.e., the investment in appearance) rather than body dissatisfaction is more strongly related to the successful adaptation of eating behavior. Besides the larger effect of investment change on eating regulation compared to the effect of evaluative body image, we observed a substantial increase in the variance explained in eating self-regulation (and a large f^2 for the change) after the inclusion of investment body image in the model. Previous research has shown that investment body image has more adverse consequences than evaluative body image to one's psychosocial functioning, and that dysfunctional investment in appearance is more associated with disturbed eating attitudes and behaviors than body dissatisfaction [21, 23]. Explanation for these findings has been proposed to partially derive from a nuclear facet of body image investment, appearance-related self-schemas. These cognitive structures "reflect one's core, affect-laden assumptions or beliefs about the importance and influence of one's appearance in life, including the centrality of appearance to one's sense of self" [62; pp.42]. Appearance self-schemas derive from one's personal and social experiences and are activated by and used to process self-relevant events and cues [62-63]. According to Cash's cognitive-behavioral perspective [62], the resultant body image thoughts and emotions, in turn, prompt adjustive, self-regulatory actions (i.e., coping efforts), such as the adoption of dysfunctional eating behaviors [21, 64]. In addition, Schwartz and Brownell

[61] argued that body image distress could form a barrier to emotion regulation that, for both biological and psychological reasons, could result in increased (and unhealthy) eating. The present intervention significantly reduced participants' investment in appearance and its salience to their lives. Thus, it is possible that an increase in the acceptance of body image experiences and the deconstruction of held beliefs and interpretations about the importance of appearance to the self resulted in reduced appearance schemas' activation. In turn, this might have led to improvements in the regulation of associated thoughts and emotions, leading to the adoption of healthier and more adaptive self-regulatory activities [21].

In the present study, the effects of treatment on eating self-regulation were mediated by changes in both body image dimensions. To further explore these findings, more specific analyses of mediation were conducted considering each lower-order component of eating self-regulation as a separate outcome. Results suggested that the change in investment body image influenced all eating self-regulation variables, whereas the change in evaluative body image only mediated the improvement in eating self-efficacy. This finding could help explain why evaluative body image showed smaller effects in general; it mainly affected one of the four components of eating self-regulation used in this study. This finding is not surprising. Body dissatisfaction was assessed with a self-ideal discrepancy index which reflects change in current body size (through weight reduction) and/or change in ideal body size, for instance, by increasing acceptance of larger ideal body sizes [60, 65]. In the face of more realistic and achievable ideal body sizes, individuals should feel more confident in making a compensatory aesthetic difference by losing some weight, namely via changes in

eating behavior. In fact, prior research has suggested an association between seeing one's body as closer to the societal norm and self-efficacy for making healthy changes [c.f., 61]. In addition, Valutis et al. [66] found that large body size discrepancies were related to disengaged coping efforts (i.e., reduced mental and behavioral energy put into change) due to low weight and eating-related self-efficacy. On the other hand, body image investment is related to the salience of appearance to one's life and sense of self [21] and is associated with negative affect [c.f., 17, 62] which makes it more likely to result in increased emotional eating, disinhibition and perceived hunger, and in the adoption of a rigid approach to eating.

The use of mediation analysis is a methodological strength of the present study. Mediation analysis is particularly well-suited to identify the possible mechanisms through which interventions achieve their effects, allowing the development of more parsimonious and effective interventions by emphasizing more important components and eliminating others [67]. Improving overweight and obesity interventions remains a critical challenge [68] and the present study represents one more step in this direction. This study was the first to explore body image as a mediator of eating self-regulation during weight control and to analyze the distinct effects of evaluative and investment body image components. The present findings are informative for professionals when designing future interventions, reinforcing the advantage of including a body image component within weight management treatments. Our results further suggest that within this intervention module, the strategies used to target body image investment should be emphasized to more effectively improve the regulation of eating behavior, and in turn more successfully manage body weight. This

could be achieved by actively deconstructing and defying held beliefs and predefined concepts about the centrality of appearance to one's life and sense of self, mindfully accepting and neutralizing negative body image emotions, identifying problematic thoughts and self-defeating behavior patterns, and replacing them with healthier thoughts and behaviors [69]. This study was also the first to investigate eating self-regulation as a global, higher-order construct, represented by several variables previously identified as predictors of a successful eating/weight regulation (i.e., flexible cognitive restraint, eating self-efficacy, low disinhibition, and low perceived hunger) within overweight individuals [5, 7]. Investigating specific mechanisms responsible for the successful regulation of eating behavior (e.g., increases in flexible cognitive restraint) is relevant as it will allow other weight loss interventions to focus on variables and components that are capable of effectively targeting behaviors already identified as predictors of successful weight management [5]. Future studies might find it important to continue to investigate this higher-order construct as a relevant outcome in weight loss interventions. This notwithstanding, the identification of other variables which may mediate the effects of treatment on eating self-regulation, for instance, related to physical activity [70], should be pursued.

Four limitations of the present study are noteworthy. First, although this was a longitudinal study and we did measure change in the variables of interest, changes in body image and eating measures occurred during the same period. Thus, we cannot exclude the possibility of alternative causal relations between these variables. It is possible that the change in eating self-regulation led to positive changes in body image, or that these variables

reciprocally influence each other. However, based on the existing literature suggesting that poor body image is a precursor of dysfunctional eating behaviors [15-16, 19], we hypothesized that it was the change in body image that resulted in positive changes in eating self-regulation. Second, the psychometric instruments used herein to measure investment body image were only able to capture some facets of this construct – over-preoccupation with body image and appearance and its behavioral consequences – thus failing to capture another core facet of body image investment, the appearance-related self-schemas. Future studies should include more comprehensive measures that are able to capture these additional facets of body image investment. Third, the format of the instrument used to assess evaluative body image has some inherent limitations. The Figure Rating Scale is a unidimensional and undifferentiated measure of body dissatisfaction that differs considerably from all other body image measures in format. By contrast, body image investment was assessed with more sophisticated and multidimensional instruments. This could account for the lesser role of the evaluative component in our model. Future studies should use multi-item questionnaire-type measures to assess evaluative body image. Finally, the generalizability of the findings in this study may be limited to overweight and obese women seeking treatment, a population that is particularly prone to body image disturbances, weight preoccupation, and dysfunctional eating patterns [7, 56, 71]. The effect of body image enhancement on eating self-regulation in other populations remains unknown.

Conclusion

Results showed that both evaluative and investment body image are relevant for improving eating self-regulation during obesity treatment in women, and suggested that the investment component might be more critical. Professionals would do well to consider these findings when designing and implementing new interventions.

Competing Interests

The author's declare that they have no competing interests.

Authors' Contributions

EVC, PJT, and DM conceived the study. EVC performed the statistical analysis, participated in the intervention and data collection, and drafted the manuscript. MNS led the implementation team and actively participated in the intervention's implementation and data collection. PNV and CSM actively participated in the intervention's implementation and in data collection. DM provided additional statistical advisement. PJT is a principal investigator of the trial and participated in drafting the final version of the manuscript. LBS is a principal investigator in the research trial. All authors read and approved the final manuscript.

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CHAPTER 6

Physical Activity Predicts Changes in Body Image During Obesity

Treatment In Women (Study 3)⁵

⁵ Carraça, E. V., Markland, D., Silva, M. N., Coutinho, S. R., Vieira, P. N., Minderico, C. S., Sardinha, L.B., Teixeira, P.J. (in press). Physical Activity Predicts Changes in Body Image During Obesity Treatment In Women *Medicine and Science in Sports and Exercise*.

ABSTRACT

Purpose: This study examined effects of a behavioral weight management intervention on body image (evaluative and investment dimensions), and explored the potential mediating role of structured and lifestyle physical activity (PA). **Methods:** Longitudinal randomized controlled trial, including a 1-year behavior change intervention and a 2-year follow-up (225 women; 37.6 ± 7 yr; 31.5 ± 4.1 kg/m² BMI). Statistical analyses comprised mixed-design ANOVAs with repeated measures, bivariate/partial correlations, and mediation analyses.

Results: Body image improved considerably in both groups, favoring the intervention group (small to moderate effect sizes: .03 - .05), but began to deteriorate from 12 to 24 months, especially in the intervention group. Consequently, at 24 months, between-group differences were small and did not reach significance. Yet, levels of body dissatisfaction and dysfunctional investment remained below initial values (for both groups). Results were similar for both body image dimensions. Structured PA (at 12 and 24 months) and lifestyle PA (at 24 months) were positively associated with ($r > -.25$, $p < .05$) and partially mediated body image improvements, especially in the investment component (95% CI of -1.88 to -.27 for structured PA at 12 months; 95% CI of -1.94 to -.21 for lifestyle PA at 24 months). In general, change in evaluative body image was not mediated by exercise participation, appearing more dependent on weight change. **Conclusions:** These findings highlight the importance of PA as a contributing factor in the improvement of body image in overweight/obese women, mainly by reducing excessive salience of appearance to one's life and self. Lifestyle PA may also be a valid option, particularly in the long-term. Exercise might provide a buffer against body image deterioration overtime, favoring lasting weight loss maintenance.

Key Words: Randomized controlled trial; mediation; obesity treatment; structured physical activity; lifestyle physical activity; body image improvement.

This trial is registered at [ClinicalTrials.gov \(NCT00513084\)](https://clinicaltrials.gov/ct2/show/study/NCT00513084).

INTRODUCTION

Paragraph 1. Appearance-related concerns and dissatisfaction are highly pervasive in overweight and obese individuals (32), especially among women and those seeking weight loss treatment (19). Extensive previous research supports the negative clinical impact of body image problems on the psychosocial functioning, well-being, and quality of life of obese individuals. Several adverse psychosocial consequences have been reported in the literature, including poor psychological adjustment, poor self-esteem, increased depression and anxiety, and inadequate eating and exercise behaviors (7, 27).

Paragraph 2. Improving appearance and body image are common motives for weight loss in obese individuals (32). However, body image problems may be an obstacle to successful weight management, predicting poorer outcomes and increasing chances of relapse (16, 33, 40). Treatment of body image concerns within weight loss interventions is still in the developmental stages. While some studies have shown that weight loss interventions result in significant improvements in body image (32), several questions remain unanswered. For instance, does treatment produce long-lasting positive changes in multiple body image dimensions? Which mechanisms underpin body image changes (e.g., weight changes, exercise-related factors)? Are different body image dimensions affected by the same mechanisms? This study addresses some of these questions.

Paragraph 3. Body image is a multidimensional construct that refers to subjective perceptual and attitudinal experiences about one's body (13). Prior research has confirmed

that body image attitudes encompass an evaluative component (self-ideal discrepancies, (dis)satisfaction with appearance) and a dysfunctional investment component (excessive cognitive-behavioral importance of appearance to one's life and sense of self) (9-10).

Currently, much of the literature on body image focuses on the former component, partially neglecting the dimension of body image investment (13). Even so, studies have confirmed that dysfunctional body image investment contributes substantially beyond evaluative body image to the prediction of various aspects of psychosocial and behavioral functioning (e.g., eating behavior) (8, 12). Given these results, one important step in extending current knowledge on body image change during obesity treatment is to determine whether both dimensions are targeted and improved during treatment.

Paragraph 4. An area that also requires additional research is the identification of causal factors (i.e., mediating mechanisms) in effectively improving body image that should thus be addressed within weight loss interventions. PA is considered a critical component in weight management (18), in part due to its effects on psychological predictors of sustained weight loss maintenance (e.g., 41). Following this line of research, Baker & Brownell (3) proposed that psychological factors such as body image and physical self-concept (among others) could be improved through regular PA, in turn increasing persistence in weight control-related behaviors, including dietary habits. Recently, Annesi and Unruh (2) tested part of Baker and Brownell's proposition, finding that exercise participation was associated with significant improvements in body image, mood, and exercise self-efficacy, which in turn contributed to exercise persistence and resultant weight loss. Based on these findings, the authors suggested that early incorporation of moderate PA into weight management treatments could have considerable value beyond energy expenditure (2). Thus, exercise is

a potential mechanism of interest through which body image might be enhanced during weight loss interventions.

Paragraph 5. Prior research also supports the positive association between exercise and body image. Recent meta-analyses indicated that participants in exercise interventions reported greater improvements in body image and physical self-perceptions compared to controls (e.g., 6). Although related empirical research in the obesity field is sparse, improvements in body satisfaction were found in formerly sedentary obese women, even with minimal physical changes (1). Similarly, previously inactive obese women experienced positive changes in body image, via improvements in self-appraisal, at the end of either a traditional or cognitive-behavioral exercise intervention (1). Other findings suggest that different types of PA (structured versus unstructured) might influence physical self-perceptions and global self-esteem in distinct ways (e.g., 4, 24). For example, Baldwin and Courneya reported significant positive associations between strenuous PA and physical self-perceptions, but not for mild to moderate PA (4). Based on these findings, Levy and Ebbeck stressed the need to investigate whether the effects of PA on physical self-perceptions (including body image) were applicable to unstructured and lifestyle PA (24). Given the need to promote different forms of PA (e.g., formal and informal or unplanned) amongst the overweight population, further understanding of this issue is particularly relevant.

Paragraph 6. Finally, evidence on the durability of changes in body image after weight loss or exercise interventions is clearly lacking (13). For instance, the question as to whether the effects of exercise are transitory or long-term remains virtually unexplored (6). Thus, the purpose of the present study was to analyze body image change during obesity treatment.

Specifically, we examined the medium (12 months) and longer-term (24 months) effects of a 1-year behavioral weight management intervention on different dimensions of body image attitudes (evaluative and investment); and explored the role of PA (structured and lifestyle) as a potential mediating mechanism of body image changes across time (see Figure 1).

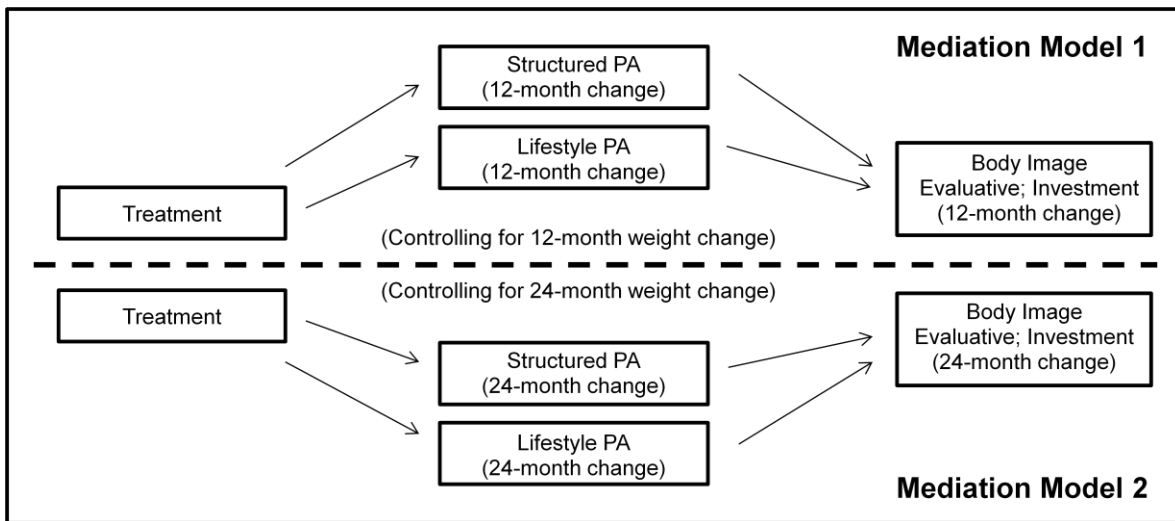


Figure 1. Proposed mediation models.

METHODS

Study Design and Intervention

Paragraph 8. This study was part of a longitudinal randomized controlled trial, consisting of a 1-year behavior change intervention and a 2-year follow-up period with no intervention. Participants (n=258) were randomly assigned to intervention and control groups. The comparison group received a 29-session general health education curriculum based on several educational courses on various topics (e.g., preventive nutrition, stress management, self-care, and effective communication skills). The intervention included 30

group sessions aimed at increasing physical activity and energy expenditure, adopting a moderately restricted diet, and ultimately establishing exercise and eating patterns consistent with sustainable weight loss maintenance. The program's principles and style of intervention were based on self-determination theory (17), with a special focus on increasing competence and internal regulation towards exercise and weight control, while supporting participants' autonomous decisions as to which changes they wanted to implement and how. A detailed description of the study's theoretical rationale, protocol, and intervention strategies can be found elsewhere (35). The Ethics Committee of the Faculty of Human Kinetics – Technical University of Lisbon reviewed and approved the study.

Paragraph 9. Regarding body image enhancement, the intervention aimed at increasing participants' body acceptance and satisfaction, and at decreasing their dysfunctional investment in appearance. Based on previous work from Cooper and colleagues (16), several strategies were implemented. Asking participants to view and gradually explore their body and its parts, in front of a mirror, in the privacy of their home; establishing more realistic goals and expectations for themselves and their weight/body by confronting their ideal physique with the real limits to meet their goals (e.g., observe their own and their parents' weight history); and providing dance and relaxation classes were the main strategies employed to improve body acceptance and satisfaction, and so, the evaluative component (predominantly). To reduce dysfunctional investment in appearance, i.e., the over-concern with and the salience of body image to oneself, the following key strategies were implemented: helping participants understand the concept of body image (i.e., a subjective construct, independent of physical appearance) and recognize the social and

personal roots of their own body image development; asking participants to keep a self-monitoring diary to record critical body image experiences in which they feel self-conscious, their beliefs in the situation (e.g., thoughts, self-statements, negative “body talk”), and the associated emotional and behavioral consequences; helping participants cope with stereotypes and prejudice, facilitating the abandonment of the idea that they must look different to be happier; and working on cognitive restructuring to help participants challenge their maladaptive assumptions about appearance and its salience to their life and self-worth, by promoting the evaluation of evidence for and against their beliefs and the construction of alternative thoughts.

Participants

Paragraph 10. Participants were recruited from the community at large through web and media advertisements. To join the trial, participants had to be female, between 25-50 years old, pre-menopausal, with a BMI between 25-40 kg/m², be willing to attend weekly meetings (during 1 year), be free from major illnesses, and not taking medication known to interfere with weight regulation. Of all women who entered the study (n=258), thirty-three were subsequently excluded from all analyses, because they started taking medication susceptible of affecting weight (n=13) or because of serious chronic disease diagnosis or severe illness/injury (n=4). Others were excluded because of pregnancy (n=9) or because they entered menopause (n=7). These 33 women were of similar age (p=0.905) and BMI (p=0.494) as the 225 participants who were considered the valid initial sample for this study. The sample was between 23 and 50 years old (37.5±7 years) and overweight or mildly obese, with an initial BMI of 31.5±4.1 kg/m². Women in the intervention group

(n=114) did not differ from those in the control group (n=111) in terms of demographic and main psychosocial variables at baseline ($p>0.05$). Of the 225 participants who started the program, 184 were available for 24-month assessments: 82% overall retention, 90% in the intervention group and 72% in the control group. This was considered the effective sample in the current statistical analyses. There were no differences between these 184 women and those who quit the program (n=41) for any demographic or baseline psychosocial variables, with the exception of age; women who stayed in the trial until the 24-month assessments were on average 3 years older ($p<0.05$) at program's start. All participants signed a written informed consent prior to participation in the study.

Measurements

Body Image

Paragraph 11. The evaluative component of body image, herein represented by self-ideal body discrepancy, was measured with the Figure Rating Scale (FRS) (39). This scale comprises a set of 9 silhouettes of increasing body size, numbered from 1 (very thin) to 9 (very heavy), from which respondents are asked to indicate the figure they believed represented their current (i.e., perceived body size) and ideal body size. Self-ideal discrepancy was calculated by subtracting the score for ideal body size from the perceived body size score. Higher values indicate higher discrepancies. Thompson and Altabe (1991) found that the FRS had good test-retest reliability and scores correlated with other measures of body image dissatisfaction, eating disturbance and self-esteem (43).

Paragraph 12. The dysfunctional investment component of body image was represented by measures of body shape concerns and social physique anxiety. Together these measures

tapped into several facets of the investment dimension of body image including disturbed thoughts, emotions, and behaviors which reflect the attentional, cognitive, and behavioral salience of appearance in one's personal life and sense of self. Body shape concerns were assessed with the Body Shape Questionnaire (BSQ) (15) and social physique anxiety was assessed with the Social Physique Anxiety Scale (SPAS) (21). The BSQ is a 34-item instrument scored on a 6-point Likert-type scale that evaluates concern about body weight and shape, in particular the experience of "feeling fat" (e.g., "Has being naked, such as when taking a bath, made you feel fat?") and several cognitive-behavioral consequences of those feelings (e.g., "Have you avoided wearing clothes that make you aware of your body?"). Higher values represent greater body shape concerns and greater body image salience in one's life. Rosen et al. (1996) reported good test-retest reliability and good concurrent validity with other measures of body image (31). The SPAS measures the degree to which people become anxious and concerned when others observe or evaluate their physiques, thereby assessing affective, cognitive, and behavioral avoidant features of body image in a social environment. This scale comprises 12 items (e.g. "Unattractive features of my physique make me nervous in certain social settings'") rated on a 5-point Likert-type scale. Higher scores represent greater social physique anxiety. Hart, Leary and Rejeski (1989) found good internal consistency and test-retest reliability for the Social Physique Anxiety Scale (21).

Physical Activity

Paragraph 13. Structured PA was assessed with the Seven-Day Physical Activity Recall (7 Day-PAR) (5), a semi-interview based instrument that estimates the time spent in PA for the past 7 days (or a typical week of last month, if the previous week was atypical). Trained

interviewers guided the participants through the recall process, day by day. Previous studies have supported the reliability and validity of the 7-Day PAR as a measure of physical activity (44). For the current study, activity reports were collapsed into total minutes of moderate and vigorous intensity PA in a week (all activities above 3 METs were considered). Daily lifestyle PA was evaluated with a Lifestyle Physical Activity Index (36), which was integrated in a questionnaire specifically developed for this study in order to measure habitual lifestyle physical activities typical of the last month. To calculate the Lifestyle PA Index we used a score based on 7 questions (“Using stairs or escalators”; “Walking instead of using transportation”; “Parking away from destination”; “Using work breaks to be physically active”; “Choosing to stand up instead of sitting”; “Choosing hand work instead of mechanical/automatic”; “Choosing to be physical active whenever possible”). Responses ranged from never (1) to always (5) on a Likert scale ($\alpha = .84$).

Paragraph 14. Participants completed Portuguese versions of all questionnaires cited above. Forward and backward translations between English and Portuguese were performed for all the questionnaires. Next, two bilingual Portuguese researchers subsequently reviewed the translated Portuguese versions, and minor adjustments were made to improve grammar and readability. Previous studies using the Portuguese versions of these scales reported acceptable internal consistencies (above 0.70) for all these instruments (7, 41).

Body Habitus

Paragraph 15. Weight-related measurements were performed in the morning, after fasting for 3h. Body weight was measured twice, with an electronic scale calibrated onsite and accurate to 0.1 kg (SECA, Hamburg, Germany). Vertex height was measured with a

balance-mounted stadiometer to the nearest 0.1 cm. Body mass index (BMI) was calculated from weight (kg)/height (m)².

Analytical Procedure

Paragraph 16. A mixed design ANOVA with repeated measures (time x group) was conducted to test the impact of the intervention on body image change across time (pre-intervention, intervention's end (12 months), and 1-year follow-up (24 months)). To perform this analysis, body image absolute scores at each time point were considered. A standardized composite score based on body shape concerns and social physique anxiety scores was created to represent dysfunctional investment body image. Participant's scores on each scale were recoded into a scale ranging from 0 to 100; a composite score reflecting the mean value of the two recoded scales was then calculated for each participant. Correlations between the original scores for each scale and the composite score were examined. The coefficients were very high (above .90), suggesting that both measures are represented in the computed score. The 24-month body weight change was included in the ANOVA as a covariate. Eta-squares (η^2) and confidence intervals for the effect sizes were estimated to express the magnitude of effects. Values of .01, .06, and .14 are considered small (but not trivial), medium, and large effect sizes, respectively (14). Additionally, confidence intervals for the eta-squares were estimated. Pearson and partial correlations were used to examine the associations between changes in physical activity and body image dimensions within each time point (12 and 24 months). The effects of participation group and body weight change, two putative confounders, were controlled for.

Paragraph 17. Two models were assessed using AMOS 18.0, one with change in 12-month PA (Model 1) and one with change in 24-month PA (Model 2) mediating the relation between treatment and body image change. Considering the sample size of this study, a hybrid model, combining one latent (i.e., body image investment) and observed variables, was specified to ensure sufficient power to conduct the analysis and to stay within the limits of sample size requirements for model testing (23). Model fit was assessed using the χ^2 goodness-of-fit test, Bollen's incremental fit index (IFI > .95), and the standardized root mean residual (SRMR < .08) values as the criteria (22). Tests of multivariate normality indicated significant departures from normality for both models. Therefore the Bollen-Stine bootstrap was used to assess the significance of the χ^2 statistic. Tests of mediation were conducted using a resampling method advocated by several authors for testing mediation (e.g., 29). AMOS does not give specific indirect effects for models with multiple mediators. Therefore, to test the significance of specific indirect effects of multiple mediators, a tool developed by Selig & Preacher (34), which calculates a sampling distribution and 95% confidence intervals for indirect effects using a Monte Carlo resampling method, was employed. In the present study 5000 replications were performed. An indirect effect is significant (at alpha .05) if its 95% confidence interval does not include zero.

Paragraph 18. For correlation and mediation analyses, change in body weight, body image, and exercise measures was expressed by baseline-residualized scores, where the 12 or 24-month value was regressed onto the baseline value (14). Using residualized change scores is considered preferable to the use of subtraction scores, since it provides a value that is orthogonal to the pretreatment value(s) (14).

RESULTS

Paragraph 19. The effects of the intervention on weight and PA are described elsewhere (36, 41). In brief, at the end of the intervention (12 months), average weight loss was higher in the intervention group ($-7.3\% \pm 5.9\%$) than in the control group ($-1.7\% \pm 5.0\%$, $p < .001$), and so were the levels of structured PA (300 ± 179 min/wk vs. 162 ± 171 min/wk, $p < .001$) and lifestyle PA ($3.84 \pm .69$ vs. $2.98 \pm .81$, $p < .001$) (36). At the 24-month follow-up assessment, average weight reduction remained higher in the intervention group ($-5.5\% \pm 7.79\%$) compared to the control group ($-2.2\% \pm 7.5\%$, $p < .001$). Similar results were observed for structured PA (244 ± 212 min/wk vs. 185 ± 182 min/wk, $p < .05$); however, no significant between-group differences were found for lifestyle PA ($3.40 \pm .87$ vs. $3.15 \pm .90$, $p = .144$).

Time course changes in Body Image

Paragraph 20. A mixed design ANOVA with repeated measures was used to assess group-specific time course changes in each dimension of body image, evaluative and dysfunctional investment, throughout the 24 months (see Figure 2). Results were adjusted for body weight change. Regarding evaluative body image, there was a significant group x time interaction ($F=5.51$; $p < .01$; $\eta^2=.034$; 95% CI [.004, .077]), indicating that time course changes in evaluative body image were different between participation groups. To break down this interaction, simple effects analyses were performed comparing groups at each time point (ANCOVA) and running separate ANOVAs with repeated measures for each group. Results revealed that during the intervention phase (0-12 months), body dissatisfaction decreased significantly in both groups, favoring the intervention group (at 12 months, $F=5.52$; $p < .05$; $\eta^2=.032$; 95% CI [.001, .099]); on the other hand, during the 1-year

follow-up (12-24 months), body dissatisfaction showed a significant, large increase in the intervention group ($F=12.9$; $p<.01$; $\eta^2=.125$; 95% CI [.026, .255]) but no substantial changes in the control group ($F=.403$; $p>.05$; $\eta^2=.006$; 95% CI [1.18E-03, .087]). At 24 months, no significant between-group differences were observed, although evaluative body image remained slightly more improved in the intervention group ($F=2.07$; $p>.05$; $\eta^2=.012$; 95% CI [4.81E-03, .063]). Regarding the dysfunctional investment component, a significant group x time interaction was found ($F=22.7$; $p<.001$; $\eta^2=.128$; 95% CI [.064, .195]). Simple effects analyses showed that groups differed considerably at 12 months, with the intervention group presenting greater improvement in dysfunctional investment ($F=8.63$; $p<.01$; $\eta^2=.05$; 95% CI [.005, .127]). In contrast, at 24 months the between-groups effect was small and did not reach significance ($F=2.09$; $p>.05$; $\eta^2<.012$; 95% CI [4.87E-03, .064]). During the follow-up phase, the improvement in the intervention group was reduced, whereas dysfunctional investment in appearance continued to decrease in the control group. Even so, dysfunctional investment in the intervention group at 24 months remained lower than among the controls, and also largely below the initial levels ($F=101.29$; $p<.001$; $\eta^2=.532$; 95% CI [.388, .632]).

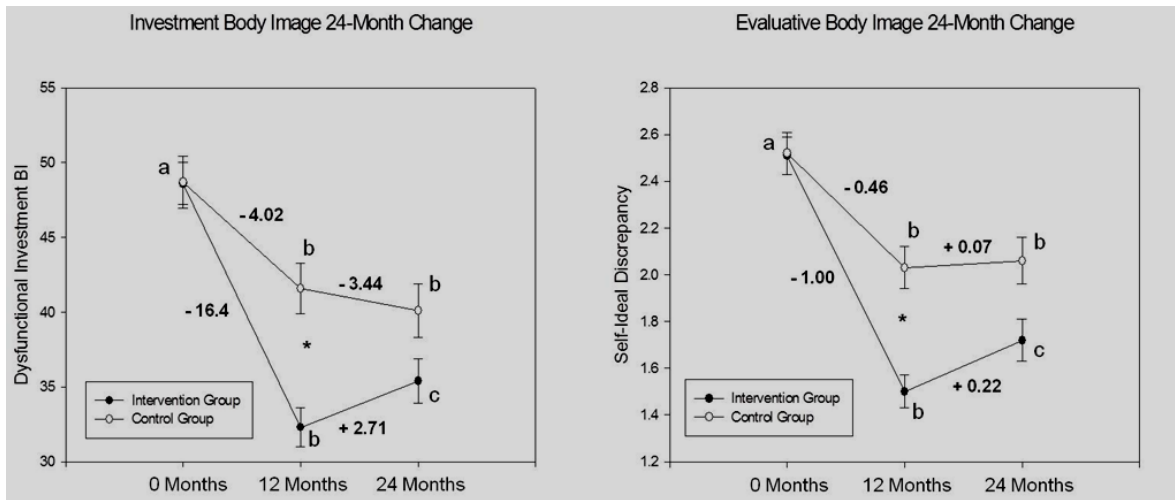


Figure 2. Change in body image dimensions during the 24 months for intervention and control groups. Errors bars show standard errors of the mean. Mixed design ANOVAs were conducted. Same superscript letter indicates no differences ($p > .05$), within intervention and control groups. * Indicates differences ($p < .05$) between groups at each time point.

Associations between Physical Activity and Body Image

Paragraph 21. Pearson correlations considering the whole sample showed significant associations between all exercise and body image measures at each time point, 12 and 24 months (table 1). Generally, correlations including investment body image and structured PA were of slightly higher magnitude. After adjusting for the effects of putative confounding variables, namely participation group and body weight change, the pattern of associations changed. At 12 months, only the association between structured PA and investment body image remained significant after the first (i.e., participation group) and second adjustments (i.e., participation group and weight change). At 24 months, after adjusting for the group effect, both structured and lifestyle PA remained significantly associated with dysfunctional investment in appearance, and lifestyle PA continued to show

a significant correlation with evaluative body image. After adjusting also for weight change, the latter association did not reach significance.

Table 1

Associations between Change in Exercise Behavior and Body Image at program's end (12 months) and after 1-year follow-up (24 months)

Exercise Behavior	Body Image					
	12 months					
	<i>r</i>	Evaluative BI		<i>r</i>	Investment BI	
	<i>partial r</i> (group adj) ¹	<i>partial r</i> (weight adj) ²		<i>partial r</i> (group adj) ¹	<i>partial r</i> (weight adj) ²	
Structured PA	-.24**	-.13	-.03	-.44***	-.33***	-.26**
Lifestyle PA	-.22**	.001	-.01	-.36***	-.07	-.08
Exercise Behavior	24 months					
	<i>r</i>	Evaluative BI		<i>r</i>	Investment BI	
		<i>partial r</i> (group adj) ¹	<i>partial r</i> (weight adj) ²		<i>partial r</i> (group adj) ¹	<i>partial r</i> (weight adj) ²
Structured PA	-.26**	-.20#	.03	-.29**	-.36**	-.27*
Lifestyle PA	-.28**	-.26*	-.17	-.31**	-.30**	-.25*

Note: *r*, Pearson Correlations. ⁽¹⁾ *Partial correlation (r)* controlling for the effect of the participation group; ⁽²⁾ *Partial correlation (r)* controlling also for the effect of weight change. # $p < .100$, * $p < .05$, ** $p < .01$, *** $p < .001$.

Mediation Analysis

Paragraph 22. To further understand the role of PA in the improvement of body image due to treatment, mediation tests were performed. First, we tested whether changes in structured and lifestyle PA mediated the effects of treatment on each body image dimension, during the 12-month intervention period (model 1). Second, we tested whether 24-month changes in both types of exercise mediated the changes in body image (model 2). Analyses were performed controlling for body weight changes during each respective time period. In

model 1, results showed an acceptable fit ($\chi^2 = 6.09$ ($df = 6$), $p > .05$; SRMR = .02; IFI = 1.00; Bollen-Stine $\chi^2 = 6.31$, $p = .445$). Mediation tests showed that the indirect effects of treatment on investment body image, through structured PA, were significant (95% CI of -1.88 to -.27). Changes in lifestyle PA did not mediate investment body image improvement during the 12-month intervention period (95% CI of -2.07 to 2.08). Results also revealed the absence of mediating effects through either PA type on treatment-related changes in evaluative body image (95% CI of -.03 to .03 for structured PA; 95% CI of -.12 to .10 for lifestyle PA). The second model (24-month changes in body image) presented a reasonable fit, showing adequate values for most of the indices ($\chi^2 = 21.65$ ($df = 6$), $p < .05$; SRMR = .06; IFI = .96; Bollen-Stine $\chi^2 = 6.79$, $p = .005$). The 95% CIs showed significant indirect effects through lifestyle PA on evaluative (95% CI of -.10 to -.01) and investment body image (95% CI of -1.94 to -.21) change at 24 months. Mediation analyses also showed significant (marginal) indirect effects through structured exercise, but only on the investment component (95% CI of -1.16 to -.004).

DISCUSSION

Paragraph 23. Prior research suggests that an improved body image can facilitate weight loss and maintenance by increasing psychological resources as well as persistence with requisite behaviors, such as those related with caloric restriction (28, 33). Corroborating this idea, a recent study by Carraça and colleagues (8) showed that body image enhancement during obesity treatment, especially the reduction in its dysfunctional investment component, contributed to a more flexible and self-confident regulation of eating behavior and to the adoption of less extreme and unhealthy eating patterns. All these

aspects are likely to lead to a more effective weight control process, which is more sustainable in the long-term. Thus, further investigation of body image improvement and its underlying mechanisms is of relevance in obesity studies. This was the general purpose of the current study.

Paragraph 24. As predicted, the intervention produced considerable improvements in both body image dimensions. However, at present, determining whether a given improvement in body image among the obese population is clinically meaningful remains a difficult task. There is no established minimum amount of change in body image that can be deemed clinically significant available in the literature, at least for this population, and research reporting meaningful improvements in body image with dieting or behavioral obesity treatment (that is, body image in the sense of satisfaction or social comfort with appearance) is scarce (30). Nevertheless, our findings seem to suggest that body image changes were substantial, based on the large magnitude of effects. In addition, Maciejewski and colleagues (2005) proposed that 5–10% improvements in psychosocial measures (including body image) could be adopted as a marker of success (25). Post-hoc analysis of our data in light of these criteria of success showed that the amount of change (%) far exceeded the 10% boundary for both body image dimensions. The treatment resulted in an average reduction of 33% vs. 8% in dysfunctional investment, and of 37% vs. 16% in body dissatisfaction, for the intervention and control groups, respectively. We further observed that the intervention was successful (with regards to at least a 10% improvement) for 90% and 77% of all participants for investment and evaluative BI respectively. Hence, these results seem to suggest that the impact of the intervention on body image improvement was of practical (and clinical) significance.

Paragraph 25. On the other hand, our study showed that in the long-term (24 months), these favorable outcomes may tend to fade, with body dissatisfaction and dysfunctional investment in appearance gradually increasing (medium-large effect sizes). Nevertheless, body image remained considerably improved compared to initial levels, indicating that positive changes are not completely reversed one year after the intervention. Prior research has shown that most changes in body image are maintained at least two or three months post-intervention (10); however, longer follow-ups have not previously been conducted. Our study appears to suggest that positive body image changes do persist over longer periods of time, even though they do diminish to some extent. Weight regain, which is the expected long-term outcome for many, might be one important factor in body image worsening after the intervention (9, 19). In this context, some authors (e.g., 16, 32) have suggested that the treatment of body image concerns may be most useful during the maintenance phase of treatment, when weight loss may be beginning to slow down or even reverse. More research on this topic, comprising longer follow-ups, is clearly warranted not only to confirm our findings but also to explore the causes underlying body image worsening (i.e., residual body image problems that are not being effectively tackled by the intervention).

Paragraph 26. As expected, body image improvements during the intervention phase favored the treatment group over the controls; yet, against expectations, at 24 months there were only small, non-significant, differences between groups for either dimension of body image. This was especially evident in the investment component, which continued to improve from baseline to follow-up in the control group. As previously mentioned, in the intervention group, during the follow-up phase, dysfunctional investment in appearance and

body dissatisfaction began to increase (i.e., deteriorate). To better understand these results, we explored each group's specific time-course changes in body weight and physical activity (data not shown). Results revealed slight, but significant, increases in body weight from 12 to 24 months in the intervention group, but no substantial changes were observed in the controls. Regarding PA variables, no 12 to 24-month changes were observed for either group in structured exercise; yet, while lifestyle PA slightly decreased in the intervention group, it showed a tendency to keep increasing in the controls. These aspects might account, at least partially, for these unexpected findings. For instance, as previously mentioned, it is well documented in the literature that even a small weight gain negatively affects body image (9, 19), and especially among individuals presenting an overweight history, and thus, a vestigial body image disparagement (11). In addition, as our study and previous others show (e.g., 1), PA is associated with positive changes in body image, which could help explain the continued body image improvement in the control group.

Paragraph 27. Correlation and mediation results revealed that structured rather than lifestyle PA was more relevant for the improvement of body image during the 12-month intervention, namely for reducing the dysfunctional investment in appearance. Our results are in line with previous findings that reported significant associations between structured exercise such as aerobic classes and swimming (e.g., 37), and physical self-perceptions, but which failed to find associations (24), or reported only minimal effects (42), when general PA (structured and unstructured; moderate intensity on average) was considered. In addition, Baldwin and Courneya reported significant positive associations between strenuous exercise and physical self-perceptions, but not for mild to moderate PA (4). This is an interesting point considering that these are the most typical intensities in unstructured

recreational activities. On the other hand, the present results suggest that lifestyle PA might be especially important in the long-term, if not to improve, at least to attenuate body image deterioration post-intervention. Given the current focus on lifestyle and unstructured PA as a means of meeting the guidelines for attaining the health-related benefits of PA, especially amongst the overweight/obese population (18), these findings are encouraging.

Paragraph 28. Results also showed that the investment component was more closely related to PA, especially after controlling for body weight change. In effect, partial correlations showed that the evaluative component was no longer associated with PA after the adjustment, suggesting that the change in this component might be more dependent on weight change than the investment component. Evaluative body image, as it was measured in this study (a self-ideal body size discrepancy index), is affected by actual change in weight and also by change in ideal body size (28). Our intervention worked on self-acceptance and on the establishment of more realistic, less stringent ideal figures, which likely affected one component of the equation (i.e., ideal body size); the other component was naturally influenced by weight change. On the other hand, the investment component is a more complex dimension (comprising cognitive, affective, and behavioral facets), which is reflected in excessive appearance management efforts (13). Hence, investment might be more susceptible to the effects of exercise participation. In the light of the present results, it can be concluded that although body image dissatisfaction and dysfunctional investment started to increase after the end of the intervention, PA might still provide a buffer against the effects of minor weight gain and other potential threats to body image (e.g., media messages; social pressure, etc.).

Paragraph 29. Several mechanisms (physiological and psychological) by which exercise might exert its influence on body image have been proposed, but the literature appears to suggest that these are more likely to be psychosocial in origin (20). One of the most plausible explanations is well illustrated by the exercise and self-esteem model (38), according to which exercise-induced changes in physical self-efficacy fuel exercise-related changes in body image. Exercise effects might be mediated by changes in subjective perceptions of one's physical fitness and competence rather than by actual changes in fitness or body weight. These perceptions may simply arise because there is a feeling that the body is improving through exercise (e.g., muscle tone, agility, clothing fits better) (20). Thus, even when interventions fail to generate statistically significant changes in weight and fitness, exercisers may perceive real or imagined yet personally meaningful improvements in their physical functioning, which in turn might enhance self-efficacy, producing more positive feelings about the body (26). In addition, exercise may improve body image by making people more aware of their physical capabilities, while reducing focus on their physical appearance. Research on exercise motives indicates that although among initiate exercisers extrinsic motives such as exercising for appearance-related reasons are more prominent, intrinsic motives such as improving physical functioning, psychological well-being, or simple enjoyment, are more prominent than extrinsic motives among regular exercisers (e.g., 26). Improved physical acceptance derived from exercise participation might also contribute to diverting attention from appearance-related concerns (24, 42).

Paragraph 30. This study is not without limitations. Although this was a longitudinal study and we did measure change in the variables of interest, changes in body image and PA

measures occurred during the same period. Thus, we cannot exclude the possibility of alternative causal relations between these variables. It is possible that the change in body image led to positive changes in exercise participation, or that these variables reciprocally influence each other. The psychometric instruments used to measure investment body image were only able to capture some facets of this construct, namely over-preoccupation with body image and appearance and its behavioral consequence, thus failing to capture another core facet of body image investment, appearance-related self-schemas. Future studies should include more comprehensive measures that are able to capture these additional facets of body image investment. Structured PA was measured using a self-report questionnaire that has been shown to provide a valid and reliable assessment of PA. However, future studies may consider incorporating objective measures of PA such as accelerometry and heart-rate monitors. Finally, this study only included overweight and obese women, and therefore it is unclear whether similar results will be observed in other groups.

Summary and Practical Implications

Paragraph 31. Improving overweight and obesity interventions remains a critical challenge and the present study represents one more step in this direction. Poor body image is associated with poor psychological well-being in obese individuals (e.g., 7), and its improvement during treatment, especially dysfunctional investment reduction, has been shown to result in improved eating self-regulation (e.g., 8). Hence, body image appears to play an important role in the weight control process and examining whether weight loss interventions effectively target and improve body image (in particular, but not exclusively, the investment component), and identifying the mechanisms by which it improves, are

relevant goals. Given that PA plays a critical role in long-term weight maintenance (18), appears to be positively associated with better body image (e.g., 1), and that it was the main outcome of this intervention (35), its mediating role was examined. Our findings highlight the relevance of encouraging PA participation as a way of improving body image in overweight women, especially by reducing the excessive salience of appearance to one's life and sense of self. Our results suggest that in order to see significant gains in body image in the short/medium-term moderately intense PA should be prescribed; as assessed in this study, this can include brisk walking, light sports, dancing and other activities of similar (or higher) intensity. Moreover, if enhanced perceptions of physical competence mediate changes in body image (38), then successful, challenging, moderate to vigorous PA will result in a greater improvement in self-efficacy and body image than lighter workouts (26).

Paragraph 32. A strength of our study is the inclusion of a measure of lifestyle, unstructured PA such as taking the stairs whenever possible or choosing to walk more in daily life. Since this type of exercise might be more easily integrated into people's lives, it has been the target of increased attention as a means of achieving the recommended doses of PA for weight management purposes (18), including amongst the overweight and obese population. Our results revealed that especially in the longer-term, lifestyle PA might also be important to attenuate body image deterioration. For the sake of weight maintenance, these findings are encouraging and informative for professionals, providing further support for the inclusion and recommendation of this type of PA (as a complement to structured activities) within future weight loss interventions.

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CONFLICT OF INTEREST

None to declare. The results of the present study do not constitute endorsement by the American College of Sports Medicine.

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CHAPTER 7

**Physical activity and eating self-regulation in overweight women:
The mediating role of body image investment and depressive mood
(Study 4)⁶**

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Abstract

Objective: Successful weight management relies heavily on eating and exercise behaviors. However, little is known about their association on a psychosocial level. This study examined the relation between exercise and eating regulation, by exploring the mediating effects of body image dysfunctional investment and depressive mood, and their consistency through time.

Methods: Cross-sectional analyses conducted at two different moments (12 and 36 months), involving a sample of 221 overweight/obese women (37.6 ± 7 yr; 31.6 ± 4.1 kg/m² BMI) that participated in a behavioral weight control intervention. Bivariate correlations and mediation analyses, using Preacher & Hayes resampling procedures, were conducted.

Results: At 12 months, body image dysfunctional investment was the only significant mediator of the exercise-eating relationship. This variable explained larger portions of the indirect effects of structured rather than lifestyle exercise on eating. At 36 months, dysfunctional investment and to a lesser extent depressive mood partially explained the exercise-eating association.

Conclusions: Findings suggest that, besides physiological effects of exercise, psychological mechanisms related to body image and mood also explain the role of physical activity as a “gateway behavior” for improved eating regulation in overweight women. These effects appear consistent through time and may help understand the key role of exercise in long-term weight management.

Key Words: Obesity; randomized controlled trial; physical activity; body image investment; depressive mood; eating behavior.

Introduction

Even though Western societies are gradually more alert and sensitive to issues involving overweight and obesity, they remain highly prevalent and constitute a strong risk factor for several co-morbidities and premature death (1-2). Behavioral weight loss interventions consistently result in 7-10% reductions in body weight, but these effects are commonly reversed over time (3), which can be attributable, in part, to an insufficient understanding of the connection between two cornerstones of obesity treatment, physical activity and eating behavior. Indeed, successful weight management relies heavily on modifying both these behaviors to induce an energy deficit. However, little emphasis has been placed on understanding how a change in one of these behaviors may interact with, support, or thwart, the efforts to regulate the other. Once a clearer understanding of the mechanisms inherent to the relation between physical activity and eating behaviors is achieved, interventions can be optimized to facilitate adherence to these (and possibly other) energy balance-related behaviors, potentiate their combined effect, and hopefully improve weight loss maintenance success.

In the last few decades, different lines of research have emerged aiming at unraveling the mechanisms involved in the exercise-eating behavior relationship. Some were dedicated to the study of physiological processes, suggesting that regular physical activity might have a positive effect on appetite regulation, for instance by increasing sensitivity to satiety signals (see 4 for a review). Others have proposed that psychological mechanisms are also involved and that key self-regulatory resources are likely to be shared and even transferable between health-related behaviors (e.g., 5). The suggestion that exercise could impact long-term weight management not only by influencing physiological

processes, but also by improving psychological variables such as self-efficacy, body image, or mood is well-known (e.g., 6). Positive changes in these variables would lead to increased psychological resources (e.g., increased motivation and confidence) to successful self-regulation, which would in turn lead to improved eating and exercise behaviors, and weight loss. Some of the relations hypothesized within this model have been empirically tested and supported since. For example, Annesi and Unruh (7) found that exercise participation was associated with significant improvements in body image and mood, which in turn contributed to increased exercise attendance and weight loss. In addition, increases in general and exercise-specific autonomous motivation (5), and in exercise self-efficacy (8) have been shown to predict positive changes in eating self-regulation, supporting the existence of a motivational “spill-over” between health behaviors important for weight management (5). Nevertheless, empirical evidence accounting for psychological processes relating exercise to improved eating self-regulation remains scarce. Within the obese population, two psychological variables that could potentially be involved in this association are body image and depressive mood (9-10).

Poor body image, in particular the excessive preoccupation and investment in the management of appearance, has been confirmed as a strong correlate, and even as a precursor of maladaptive eating behaviors, amid other unhealthy weight control strategies (11-13). Body image disturbances have also been associated with increased binge eating and other bulimic symptomatology (e.g., 14, 15). On the other hand, recent evidence indicates that improving body image (especially by reducing dysfunctional investment in appearance) could contribute to a better eating self-regulation in overweight women (16).

Regular exercise participation can improve body image. Prior research clearly supports the positive effects of exercise on body image, showing that physically active individuals present enhanced body image and related physical self-perceptions compared to sedentary controls (17). Empirical research in the obesity field has also reported improvements in body-related satisfaction and overvaluation in previously sedentary obese women (18-19). Thus, one could easily imagine that the positive effect of regular exercise participation on eating self-regulation could arise from the relief of body image distress. To date, no study has investigated the intervening role of body image dysfunctional investment on the exercise-eating relationship.

Negative emotional states can also negatively impact eating self-regulation (20), for example, depressive symptoms have been associated with emotional eating, increased consumption of high-calorie foods, and lower intake of vegetables/fruits (21). Negative affect has also been shown to predict increased risk for binge eating (22) and greater eating disorder severity (23). Conversely, there is consistent evidence that exercise is associated with positive changes in overall well-being and in specific variables such as mood and depression (24). For example, Teychenne et al. (25) reported that more active women had lower odds of presenting depressive symptoms than less active women, and Annesi and Unruh (7) found that exercise participation was associated with significant improvements in mood states in previously sedentary obese women. Hence, it seems plausible that physical activity may lead to a more positive psychological climate in which individuals have more cognitive and emotional resources available to regulate eating behavior.

In the context of obesity, both structured (e.g., fitness classes, running) and lifestyle physical activity (e.g., walking for transportation, taking the stairs) have been positively

associated with successful long-term weight control (26). Prior research has suggested that psychological and physiological correlates of different forms of physical activity might be specific, at least to some extent. For instance, Silva et al. (27) found that motivational mechanisms underlying the adoption of structured exercise differed from those associated with lifestyle physical activity in overweight women. Baldwin and Courneya (28) reported significant positive associations between strenuous exercise and physical self-perceptions, but not for mild to moderate physical activity, and a recent study (19) suggested that structured exercise could be more important to improve body image during weight management, while lifestyle physical activity could be especially important to prevent its deterioration in the longer-term. However, still very few studies have looked at these differences.

This cross-sectional study examined whether body image dysfunctional investment and depressive mood mediated the relation between physical activity and critical markers of eating self-regulation at the end of a weight management intervention (12 months), and whether these effects were consistent through time (36 months) (see Figure 1). Based on our previous research (19, 29), we predicted that the mediating effects through body image investment would be more marked for structured rather than lifestyle physical activity. Regarding depressive mood, current evidence does not allow to draw clear conclusions about the effect of different forms of exercise (24). Thus, apart from a partial mediation through depressive mood for both forms of exercise, no other specific predictions were made. Finally, mediations were expected at both time points and to get clearer as the intervention effect became more distant.

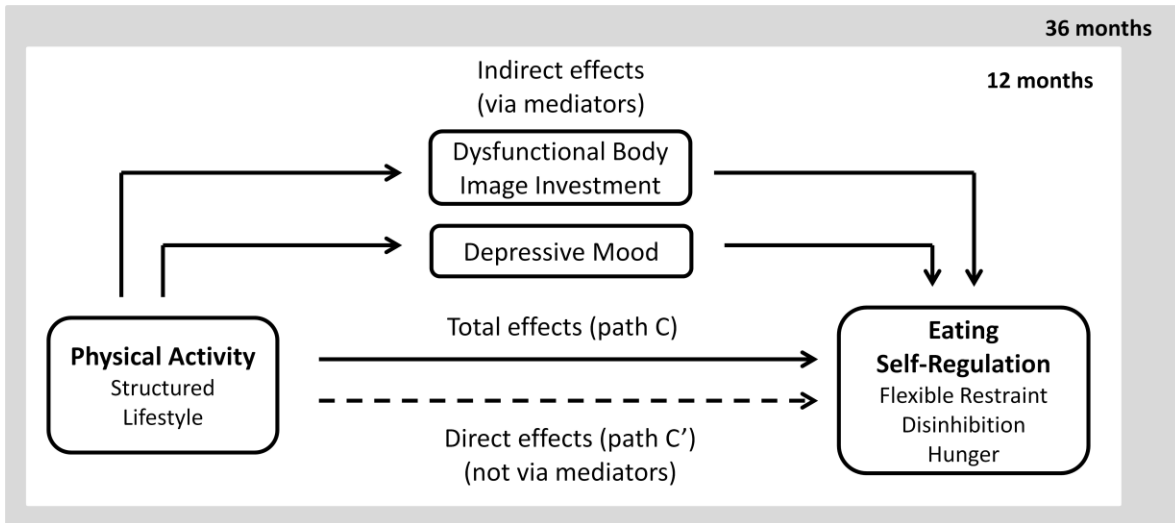


Figure 1. Mediation models. The model includes two predictors – structured and lifestyle physical activity –, two putative mediators – body image dysfunctional investment and depressive mood –, and three outcome variables – flexible restraint, eating disinhibition and perceived hunger. This mediation model was analyzed at 12 and 36 months.

Methods

Study Design and Intervention

This cross-sectional study was part of a larger longitudinal randomized controlled trial, consisting of a 12-month behavior change intervention and a 24-month follow-up period with no intervention. Participants were randomly assigned to intervention and control groups. The intervention group participated in 30 sessions for approximately 12 months, aimed at increasing physical activity and energy expenditure, adopting a moderately restricted diet, and ultimately establishing exercise and eating patterns that would support weight maintenance. The comparison group received a general health education curriculum. A detailed description of the study's theoretical rationale, protocol, and intervention strategies can be found elsewhere (30). The Ethics Committee of the Faculty of Human Kinetics – Technical University of Lisbon reviewed and approved the study.

Participants

Participants were recruited from the community at large through web and media advertisements. Inclusion criteria required participants to be pre-menopausal women, between 25-50 years old, with a BMI between 25-40 kg/m², free from major illnesses, and not taking medication known to interfere with weight regulation. Of all women who entered the study (n=258), thirty-seven were subsequently excluded from all analyses because they started taking medication (e.g., antidepressants, antiepileptics) susceptible of affecting weight (n=13), were diagnosed with serious chronic diseases or severe illness/injury (n=4), became pregnant (n=11) or entered menopause (n=9). These 37 women were of similar age (p=.737) and BMI (p=.852) as the 221 participants considered as the valid initial sample. The effective sample was between 23 and 50 years old (37.6±7 yr), and overweight or mildly obese (initial BMI of 31.6±4.1 kg/m²). They were relatively well educated, with 67% having at least some college education, and regarding marital status, 56% of the women were married. Women in the intervention group did not differ from those in the control group in terms of BMI, age, education, or marital status. There were also no differences between the women who completed the 12- and 36-month assessments and those who quit the program, for any demographics or baseline psychosocial variable, with the exception of age; women who stayed in the program until the 36-month assessments were, on average, 3 years older at the start of the program (p=0.05). All participants signed a written informed consent prior to participation in the study.

Measurements

Physical Activity. To assess structured physical activity, minutes per week of leisure-time moderate and vigorous physical activities were estimated with the 7-Day Physical Activity Recall (31). Habitual activities with a MET value above 3.0 and performed during the last 7 days were quantified to produce this variable. Daily lifestyle activity was evaluated with a Lifestyle Physical Activity Index (32), specifically developed for this study. To calculate this index we used a score based on 7 questions (“Using stairs or escalators”; “Walking instead of using transportation”; “Parking away from destination”; “Using work breaks to be physically active”; “Choosing to stand up instead of sitting”; “Choosing hand work instead of mechanical/automatic”; “Choosing to be physical active whenever possible”), rated on a 5-point Likert-type scale ($\alpha = .84$).

Eating Self-Regulation. In the current study, eating self-regulation referred to aspects known to positively influence weight management, namely high flexible cognitive restraint, reduced susceptibility to disinhibition, and reduced perceived hunger. The Three-Factor Eating Questionnaire (TFEQ) (33) was used to measure flexible cognitive restraint, disinhibition, and perceived hunger. Flexible restraint (e.g., “While on a diet, if I eat food that is not allowed, I consciously eat less for a period of time to make up for it.”) represents a more gradual approach to eating and weight control, as opposed to a rigid, all-or-nothing approach to eating and weight control, and is associated with low emotional and disinhibited eating (34). Higher scores on this subscale indicate greater levels of flexible restraint. Disinhibition refers to an uncontrolled overconsumption of food in response to a variety of stimuli, such as situational and emotional states (e.g., “Sometimes when I start eating, I just can’t seem to stop.”). Perceived hunger refers to the extent to which

respondents experience feelings and perceptions of hunger in their daily lives (e.g., “I get so hungry that my stomach often seems like a bottomless pit.”). Lower scores on both these subscales represented lower disinhibition and perceived hunger (and a healthier eating regulation).

Psychological Measures. Body image investment refers to the cognitive-behavioral importance of appearance to one’s personal life and sense of self, and is characterized by a dysfunctional, excessive preoccupation and effort devoted to the management of appearance, as opposed to a more adaptive valuing and managing of one’s appearance (13). Body image investment was assessed with the Body Shape Questionnaire (BSQ) and the Social Physique Anxiety Scale (SPAS). The BSQ (35) is a 34-item instrument scored on a 6-point Likert-type scale, used to evaluate concerns about weight and shape (e.g., “Has being naked, such as when taking a bath, made you feel fat?”), and associated cognitive-behavioral consequences (e.g., “Have you avoided wearing clothes that make you aware of your body?”). Higher values represent greater body shape concerns. The SPAS (36) was used to measure the degree to which people become anxious and concerned when others observe or evaluate their physiques. This scale comprises 12 items (e.g. “Unattractive features of my physique make me nervous in certain social settings”) rated on a 5-point Likert-type scale. Higher scores represent greater social physique anxiety. Participant’s scores on each scale were recoded into a scale ranging from 0 to 100; a composite score reflecting the mean value of the two recoded scales was then calculated for each participant. The Beck Depression Inventory (BDI) (37) is a widely used inventory of the cognitive, affective, and somatic symptoms of depression (e.g., “sadness”, “suicidal ideation”, “self-criticism”). BDI is a 21-item inventory, scored on a 4-point scale, that

results in a total score, where higher scores reflect greater depressive symptoms (i.e., depressive mood).

Assessments occurred at the end of the intervention (12 months) and at the end of follow-up (36 months). Participants completed Portuguese versions of all questionnaires cited above. Forward and backward translations between English and Portuguese were performed for all the questionnaires. Next, two bilingual Portuguese researchers subsequently reviewed the translated Portuguese versions, and minor adjustments were made to improve grammar and readability. Cronbach's alphas for all measurements were acceptable (above 0.70), except for flexible restraint which was 0.64 (38-39).

Analytical Procedure

To identify the pattern of associations between these variables and their stability through time, absolute scores were used for all analyses at each time point (12 and 36 months). In addition, analyses were conducted for all participants (intervention and controls) together. This was done to preserve statistical power and increase the range of possible scores in all measures under analysis, and also because the associations under scrutiny were hypothesized to hold constant regardless of group membership. Still, it is possible that the bivariate relationships between these variables were confounded by the intervention effect, which could have influenced both. Thus, all analyses were further adjusted by group membership (Note: We also meant to adjust for weight change, but since this variable was largely dependent on group membership, or at least highly associated with it, the risk for over-adjustment was increased. In spite of that, data analyses adjusting for weight change were also conducted, and led to similar results; thus, they were not reported).

Pearson and partial correlations were used to examine the associations between physical activity, body image investment, depressive mood, and eating measures within each time point (12 and 36 months). To examine whether body image dysfunctional investment and depressive mood mediated the relationship between physical activity and eating self-regulation, multiple mediation analyses were conducted following MacKinnon's et al. approach (40), which suggests that mediation can exist even in the absence of a significant relation between an independent (X) and a dependent variable (Y). According to these authors, previous approaches such as the causal steps approach have treated the test of the overall relation between X and Y as a perfect test of the relation, failing to recognize that it is a fallible statistical test that is subject to error (40). MacKinnon et al. support that the statistical test of the overall relation between X and Y can have less power than the test of the links in the mediation model in several situations, for instance when the sign of the mediated effect, ab , differs from the sign of the direct effect (c'), causing the overall relation of X to Y (c) to be zero (such cases are known as inconsistent-mediation models) (40). Preacher and Hayes procedures were employed to test mediation (41). These authors provided an SPSS macro to test the significance of indirect effects (total and specific for each mediator), using both normal theory and bootstrap procedures; yet, the latter are considered preferable because they do not assume normality of the distribution of the indirect effects and hence provide stronger protection against type 2 error, compared to normal procedures such as the Sobel test (41). We report results for both normal theory and bootstrap tests, with a resampling procedure of 5,000 bootstrap samples (bias corrected and accelerated estimates and 95% CI). Finally, effect ratios were calculated to express the amount of the total effect that is explained by the (total) indirect effects via the mediators.

Effect ratios are a preferable (quantitative) way to describe mediated effects, compared to the more common dichotomy of “full” vs. “partial” definitions (42).

Results

Retention rates were 93% and 79% at 12 months, and 79% and 62% at 36 months for intervention and control groups, respectively. Reasons for dropping out included financial/time limitations ($n = 15$), moving to another city ($n = 4$), and dissatisfaction with group assignment ($n = 1$); all other women lost to follow-up did not provide a reason ($n = 45$). At the end of the intervention (12 months year), average levels of structured exercise were higher in the intervention group (300 ± 179 min/wk) than in the control group (162 ± 171 min/wk, $p < .001$), and so were the levels of lifestyle activity ($3.84 \pm .69$ vs. $2.98 \pm .81$, $p < .001$) (32). Between-group differences in eating-related and body image variables were medium to large favoring the intervention group (all $ps > 0.001$). At 36 months, mean levels of exercise remained higher in the intervention group compared to the control group (243 ± 228 min/wk vs. 142 ± 158 min/wk, $p = .001$). A similar pattern was observed for lifestyle physical activity ($3.43 \pm .82$ vs. $3.02 \pm .92$, $p = .009$). With the exception of body image concerns (lower in the intervention group), no other body image- or eating-related differences were found between the two groups.

Table 1 shows bivariate correlations among physical activity, body image dysfunctional investment, depressive mood, and eating variables at 12 and 36 months. At the end of the intervention, both lifestyle and moderate/vigorous physical activity were significantly correlated with all eating-related variables. After adjusting for group membership, structured exercise was no longer significantly correlated with eating disinhibition and became only weakly related to flexible cognitive restraint ($p = .050$).

Regarding the associations between physical activity and psychosocial variables, results showed that higher levels of structured exercise were associated with less body image dysfunctional investment and depressive mood, before and after adjusting for group membership. On the other hand, lifestyle activity showed associations only with body image investment, which disappeared after the adjustment. Depressive mood was not significantly predicted by this type of physical activity. Finally, body image investment and depressive mood were consistently negatively associated with eating self-regulation, independent of treatment effect. At the end of follow-up (36 months), the pattern of associations among these variables was similar, more pronounced and clearer in many cases. The correlation coefficient between structured exercise and eating disinhibition was higher compared to the 12-month coefficient, and remained significant after the adjustment. Additionally, the associations between lifestyle activity and body image investment and depressive mood became significant, even after adjusting for group membership.

Next, mediation models were tested. For each time point, two models were created for each eating-related outcome, one for structured physical activity and one for lifestyle physical activity (both independent variables). Body image dysfunctional investment and depressive mood were tested as mediators. A total of 12 models were analyzed. However, prior to testing mediation, correlation coefficients between independent variables and mediators (path *a*), and between mediators and dependent variables (path *b*), were examined. Indirect/mediating effects through each mediator were analyzed only when both these paths were significant. Given that lifestyle physical activity was not correlated with depressive mood at the end of the intervention (12 months), the later variable was not included as a mediator of the lifestyle activity – eating behavior relationships. In these

cases, simple mediation models (via body image investment) were tested. The remaining models required multiple mediation tests.

Table 1. Bivariate correlations among the study's variables at 12 and 36 months

	Structured PA	Lifestyle PA	Eating Disinhibition	Flexible Restraint	Hunger	Body Image Investment	Depressive Mood
Structured PA	-	0.39*** (0.25**)	-0.18* (-0.10)	0.25** (0.17#)	-0.21** (-0.18*)	-0.36*** (-0.25**)	-0.16* (-0.20*)
Lifestyle PA	0.34*** (0.29**)	-	-0.29*** (-0.21*)	0.41*** (0.35***)	-0.37*** (-0.32***)	-0.20* (-0.001)	0.003 (-0.009)
Eating Disinhibition	-0.30*** (-0.30**)	-0.36*** (-0.33***)	-	-0.28*** (-0.28**)	0.64*** (0.60***)	0.55*** (0.48***)	0.26*** (0.24**)
Flexible Restraint	0.22** (0.16#)	0.38*** (0.36***)	-0.36*** (-0.38***)	-	-0.44*** (-0.46***)	-0.30*** (-0.26**)	-0.21** (-0.22*)
Hunger	-0.24** (-0.19*)	-0.34*** (-0.31**)	0.66*** (0.65***)	-0.47*** (-0.49***)	-	0.47*** (0.44***)	0.17* (0.23**)
Body Image Investment^(a)	-0.38*** (-0.37***)	-0.25** (-0.21*)	0.53*** (0.51***)	-0.24** (-0.20*)	0.45*** (0.42***)	-	0.35*** (0.37***)
Depressive Mood	-0.27** (-0.30**)	-0.24** (-0.22*)	0.38*** (0.41***)	-0.21** (-0.20*)	0.24** (0.21*)	0.42*** (0.36***)	-

Note: Pearson correlations. Coefficients above the diagonal represent 12-month correlations, while values below the diagonal represent 36-month correlations. Coefficients adjusted for group membership are presented inside parenthesis. ^(a) Body image investment is represented by a composite-score that reflects the level of concern and anxiety related to appearance. # $p < .100$; * $p < .05$; ** $p < .01$; *** $p < .001$.

Twelve-month Mediation Models

Table 2 summarizes results for the 12-month mediation analyses. For structured physical activity, results showed that lower body image dysfunctional investment was the only significant mediator, explaining between 36% and 100% ⁷ (see footnote on next page) of the total effect of structured physical activity on eating-related variables. Regarding the models for lifestyle physical activity, effect ratios were smaller, indicating that 10 to 33% of the effects of lifestyle activity on eating behavior were explained by reduced body image investment. An examination of the variance explained (R^2) by these models appears to

indicate that flexible eating restraint is the marker of eating behavior least affected by structured exercise ($R^2=0.14$). On the other hand, this appears to be the eating variable more strongly related to lifestyle physical activity.

Additional tests of mediation were conducted controlling for group membership. For structured exercise models, indirect/mediated effects through lower body image dysfunctional investment remained significant. The following 95% confidence intervals were obtained for flexible restraint (0.007; 0.128), eating disinhibition (-0.221; -0.050), and perceived hunger (-0.203; -0.040). It should be noted that total and direct effects became non-significant after the adjustment for group membership. In spite of this result, several authors have questioned the necessity of testing the overall association between the independent and dependent variables, advocating that, even when this overall effect is absent, significant indirect/mediated effects through one or more intervening variables should still be considered relevant (42). Depressive mood was again a non-significant intervening variable among all the tested associations. For the lifestyle physical activity models, no indirect/mediated effects were found for either marker of eating self-regulation. An increase in the direct effects of lifestyle activity on each eating-related variable was observed instead.

⁷ An effect ratio of 1.00 was observed for the significant indirect effects between structured physical activity and eating disinhibition suggesting a total mediation. This phenomenon is called an “empirical suppression” which is observed when the total effect of the IV on the DV is somewhat smaller than the indirect effect (through the mediators), and the direct effect holding M constant is of the opposite sign, but near zero and far from statistical significance. In cases of true suppression effects, results should be interpreted with caution. However, in case of a spurious, “empirical suppression” as the one observed in this study, data can be considered consistent with total mediation (41).

Table 2. Twelve-month mediation analysis

	Coeff.	SE	Normal Theory <i>p</i>	Bootstrap 95% CI	Effect ratio	Model R ² (<i>p</i>)
Flexible Restraint						
<i>Structured PA</i>						0.14
Total effect	0.226	0.076	0.004	-	-	(<0.001)
Direct effect	0.117	0.078	0.136	-	-	
Indirect effects (via mediators)	0.109	0.036	0.002	(0.050; 0.212)	0.48	
Body image investment	0.081	0.033	0.014	(0.028; 0.165)	0.36	
Depressive mood	0.028	0.019	0.147	(-0.003; 0.109)	0.12	
<i>Lifestyle PA</i>						0.21
Total effect	0.408	0.074	<0.001	-	-	(<0.001)
Direct effect	0.367	0.074	<0.001	-	-	
Indirect effects (via mediators)	0.041	0.022	0.064	(0.009; 0.115)	0.10	
Body image investment	0.041	0.022	0.064	(0.009; 0.115)	0.10	
Depressive mood	Not tested					
Eating Disinhibition						
<i>Structured PA</i>						0.30
Total effect	-0.189	0.083	0.025	-	-	(<0.001)
Direct effect	0.017	0.076	0.822	-	-	
Indirect effects (via mediators)	-0.206	0.051	<0.001	(-0.304; -0.123)	1.00	
Body image investment	-0.191	0.050	<0.001	(-0.294; -0.111)	1.00	
Depressive mood	-0.015	0.017	0.378	(-0.065; 0.019)	0.08	
<i>Lifestyle PA</i>						0.31
Total effect	-0.284	0.077	<0.001	-	-	(<0.001)
Direct effect	-0.190	0.069	0.006	-	-	
Indirect effects (via mediators)	-0.093	0.040	0.021	(-0.173; -0.025)	0.33	
Body image investment	-0.093	0.040	0.021	(-0.173; -0.025)	0.33	
Depressive mood	Not tested					
Perceived hunger						
<i>Structured PA</i>						0.25
Total effect	-0.210	0.079	0.009	-	-	(<0.001)
Direct effect	-0.036	0.075	0.613	-	-	
Indirect effects (via mediators)	-0.174	0.045	0.001	(-0.277; -0.097)	0.83	
Body image investment	-0.163	0.045	0.002	(-0.264; -0.087)	0.78	
Depressive mood	-0.011	0.016	0.487	(-0.056; 0.021)	0.05	
<i>Lifestyle PA</i>						0.28
Total effect	-0.358	0.073	<0.001	-	-	(<0.001)
Direct effect	-0.285	0.068	<0.001	-	-	
Indirect effects (via mediators)	-0.073	0.033	0.025	(-0.154; -0.020)	0.20	
Body image investment	-0.073	0.033	0.025	(-0.154; -0.020)	0.20	
Depressive mood	Not tested					

Note: For consistency with coefficients (and *p* values) for total and direct effects, coefficients and standard errors shown for indirect effects are relative to normal theory calculations. However, bootstrap 95% confidence intervals are preferably interpreted in the text (see Methods for more details).

Thirty-six-month Mediation Models

Thirty-six-month mediation analyses allowed a clearer view of the specific associations between physical activity and each eating-related variable (Table 3). Regarding both flexible eating restraint models, none of the mediators was significant by itself. Even so, structured exercise effects on flexible restraint were no longer significant after the inclusion of both mediators in the model, suggesting that the cumulative effect of exercise-induced reductions in body image investment and depressive mood partially mediated this relationship, explaining 40% of the total effects of structured physical activity on flexible restraint. For eating disinhibition, results were similar for the structured and lifestyle activity models, with both putative mediators being identified as significant. Respectively, effect ratios of 0.69 and 0.43 were found for the significant (total) indirect effects in each model, indicating that 69% and 43% of the total effects of each respective type of exercise on eating disinhibition was explained by the two mediators. Body image specific indirect effects amounted to 52% and 28% of the total effects of structured and lifestyle physical activity on eating disinhibition. Regarding perceived hunger models, results showed that body image dysfunctional investment was the only significant mediator, explaining 64% and 27% of the total effect of structured and lifestyle physical activity on hunger. Additional tests of mediation controlling for group membership were conducted and produced similar results.

Discussion

Successful weight management relies heavily on eating and exercise behaviors. However, little is known about their association at a psychosocial level. This study sought to fill this gap, by cross-sectionally examining whether body image dysfunctional investment and

depressive mood were potential mediators of the relation between physical activity (structured and lifestyle activity) and improved eating regulation (increased flexible restraint, reduced disinhibition and perceived hunger). As hypothesized, the relationship between self-reported physical activity and eating regulation was mediated by body image dysfunctional investment, and to a smaller degree, by depressive mood (for most eating variables). This suggests that, besides physiological effects of exercise, possibly related to increased energy expenditure and homeostatic appetite regulation, psychological mechanisms may also support the role of physical activity as a “gateway behavior” for improved eating self-regulation. In addition, these effects remained evident (or became significant, in the case of depressive mood) 24 months after the end of the intervention, indicating that exercise-induced changes in psychological markers of eating behavior may also explain why physical activity plays such a key role in long-term weight management, as consistently witnessed in the literature (e.g., 26). This study’s results give further empirical support to Baker and Brownell’s model (outlined in the introduction) and extend prior research (e.g., 5, 7) by suggesting that exercise-induced improvements in body image dysfunctional investment and to a lesser extent depressive mood may also generalize to other weight loss behaviors, allowing for an improved capacity to regulate eating.

Our findings appear to indicate that body image investment might be a more critical mediating mechanism in the exercise-eating relationship compared to depressive mood, at least for this population. At the end of the intervention (12 months), reduced body image dysfunctional investment was the only significant mediator of this relation, in some cases explaining over 75% of the positive effects of physical activity on eating variables; at 36 months, although (lower) depressive mood emerged as a significant mediator of the

Table 3. Thirty-six-month mediation analysis

	Coeff.	SE	Normal Theory <i>p</i>	Bootstrap 95% CI	Effect ratio	Model R ² (<i>p</i>)
Flexible Restraint						
<i>Structured PA</i>						0.09 (0.003)
Total effect	0.216	0.078	0.006	-	-	
Direct effect	0.130	0.084	0.123	-	-	
Indirect effects (via mediators)	0.086	0.035	0.019	(0.018; 0.175)	0.40	
Body image investment	0.056	0.025	0.110	(-0.012; 0.149)	0.26	
Depressive mood	0.030	0.048	0.217	(-0.033; 0.109)	0.14	
<i>Lifestyle PA</i>						0.17 (<0.001)
Total effect	0.365	0.081	<0.001	-	-	
Direct effect	0.314	0.084	<0.001	-	-	
Indirect effects (via mediators)	0.052	0.029	0.075	(-0.004; 0.128)	0.14	
Body image investment	0.022	0.023	0.352	(-0.014; 0.086)	0.06	
Depressive mood	0.030	0.023	0.200	(-0.029; 0.119)	0.08	
Eating Disinhibition						
<i>Structured PA</i>						0.32 (<0.001)
Total effect	-0.299	0.076	<0.001	-	-	
Direct effect	-0.094	0.073	0.198	-	-	
Indirect effects (via mediators)	-0.205	0.048	<0.001	(-0.308; -0.125)	0.69	
Body image investment	-0.154	0.042	<0.001	(-0.249; -0.088)	0.52	
Depressive mood	-0.051	0.025	0.038	(-0.106; -0.012)	0.17	
<i>Lifestyle PA</i>						0.37 (<0.001)
Total effect	-0.358	0.084	<0.001	-	-	
Direct effect	-0.204	0.076	0.008	-	-	
Indirect effects (via mediators)	-0.153	0.050	0.002	(-0.257; -0.069)	0.43	
Body image investment	-0.099	0.040	0.012	(-0.199; -0.038)	0.28	
Depressive mood	-0.053	0.027	0.047	(-0.123; -0.014)	0.15	
Perceived hunger						
<i>Structured PA</i>						0.21 (<0.001)
Total effect	-0.239	0.078	0.003	-	-	
Direct effect	-0.071	0.078	0.365	-	-	
Indirect effects (via mediators)	-0.164	0.044	<0.001	(-0.267; -0.092)	0.69	
Body image investment	-0.153	0.043	<0.001	(-0.254; -0.087)	0.64	
Depressive mood	-0.014	0.022	0.511	(-0.081; 0.042)	0.06	
<i>Lifestyle PA</i>						0.25 (<0.001)
Total effect	-0.336	0.084	<0.001	-	-	
Direct effect	-0.236	0.082	0.005	-	-	
Indirect effects (via mediators)	-0.101	0.041	0.013	(-0.192; -0.027)	0.30	
Body image investment	-0.092	0.038	0.016	(-0.186; -0.033)	0.27	
Depressive mood	-0.009	0.021	0.650	(-0.075; 0.052)	0.03	

Note: For consistency with coefficients (and *p* values) for total and direct effects, coefficients and standard errors shown for indirect effects are relative to normal theory calculations. However, bootstrap 95% confidence intervals are preferably interpreted in the text (see Methods for more details).

exercise-eating relationship, body image investment continued to explain a greater portion of the indirect effects of exercise on eating behavior.

The preponderant role of body image investment is not surprising considering the current social environment. Many overweight people present a negative body image (10), probably due to the high emphasis modern culture places on the pursuit of a slim body-ideal, and to the high stigmatization and discrimination levels towards obesity (43). Those seeking treatment, such as women represented in the current sample, are particularly vulnerable to excessive appearance-related concerns (44). Furthermore, improving appearance and body image are often primary motives to lose weight reported by obese individuals (45). Thus, it is only natural that this study's participants are more sensitive to changes in this particular psychosocial variable, even though the intervention curriculum included strategies to attenuate the attentional salience attributed to appearance-related issues. In addition, while exercise positive effects on body image appear to be consistent (17), a recent Cochrane review suggested that the improvement in depressive symptoms following physical activity participation remains inconsistent (46). Furthermore, the causal role of poor body image as antecedent/precursor of maladaptive eating behaviors has been consistently reported in the literature (11-13). On the other hand, the causal nature of the association between depressive mood and eating behavior is not clearly established in the literature, as depressive mood may be faced as a cause (e.g., 21) or an effect of maladaptive eating (e.g., 47).

Two forms of physical activity were analyzed in this study. As expected, the relationship between structured exercise and eating behavior was more strongly mediated by body image dysfunctional investment and depressive mood than what occurred for

lifestyle activity. As also hypothesized, lifestyle activity showed higher direct (not mediated) associations with all eating variables, especially flexible restraint. These findings are in line with our previous work (19, 29) and appear to support prior research suggesting that mild to moderate exercise intensities might not be enough to induce changes in psychosocial variables such as body image (e.g., 28, 48); instead, moderate to vigorous activities appear to be required. Additionally, our results suggest that other mechanisms might explain the association between lifestyle activity and eating behavior (especially with flexible cognitive restraint). Motivational factors, such as self-efficacy or internally regulated motivation, might also underlie the effects of exercise on eating behavior as prior research has shown (5, 8). Annesi and Marti (8) confirmed that increases in exercise self-efficacy would influence eating self-efficacy and dietary compliance, and Mata et al., (5) observed that autonomous motivation mediated the effects of physical activity on eating self-regulation. Small changes in daily life activities such as parking further away from the destination or regularly taking the stairs are unlikely to carry the physiological significance needed to affect mood-stabilizing neurotransmitters, but because they can be integrated more easily, and with less effort, into one's daily routine, they might generate an increased sense of mastery and competence, which might generalize to other weight loss behaviors such as eating. Furthermore, women who effectively internalize the motivation to be more physically active in such a way that they automatically (and consistently) prefer the more active option over the more sedentary behavior (e.g., standing instead of sitting when waiting), may also display a more internal and stable motivation (i.e., personally meaningful in the sense that it is strongly aligned with core values) to adopt other behaviors related to weight management, such as eating behavior.

Our results indicate that the indirect effects of exercise on eating behavior through reductions in body image dysfunctional investment and depressive mood are relatively consistent through time. Also, the intervening role of these psychological variables on the lifestyle activity-eating relationship, as well as the mediating role of depressive mood (in general) became clearer at 36 months, possibly due to the dissipation of the intervention effect. The 12-month group-adjusted analyses appear to offer some support for the presence of suppression effects by the intervention, in particular when lifestyle physical activity is involved. This intervention covered the topics of eating regulation and body image to a considerable extent (30), thus it does not surprise that the effects of lifestyle physical activity on eating and body image variables are masked (i.e. reduced or concealed) by the intervention.

This study is not without limitations. It was based on a post-hoc analysis of an RCT not specifically designed to study the association between exercise and eating behaviors. Although originating from an RCT, these data were analyzed cross-sectionally at two different points in time preventing us from drawing firm conclusions about the causal direction of the associations. Statistical analyses were adjusted for group membership, but we might not have been able to completely remove the effects of treatment. Nevertheless, even at 36 months, when these effects appeared less plausible, data analyses were also performed with the adjustment; results were similar before and after the adjustment, offering greater confidence to the present findings. The generalizability of the results in this study may be limited to overweight and obese women seeking treatment, a population that is particularly prone to body image disturbances, weight preoccupation, and dysfunctional eating patterns. Future studies specifically planned to study these associations, and able to

overcome at least some of the current limitations, are needed to confirm or refute these findings. Nevertheless, this study suggests that the relationship between physical activity and eating regulation might be, at least in part, explained by psychological mechanisms such as reduced body image dysfunctional investment and (to a lesser extent) depressive mood. If confirmed, our results clearly contribute to explain why physical activity appears to be such a critical element for successful long-term weight management.

Conflict of Interest Statement

The authors have no conflict of interest to disclose.

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CHAPTER 8

General Discussion

“The future of science and practice related to body image greatly depends on our willingness to question the adequacy of our assumptions and knowledge”

Cash & Pruzinsky (2002)

Overview

Overweight and obese women, especially those seeking treatment, are particularly at risk of developing a negative body image, and more likely to show increased levels of body dissatisfaction and dysfunctional investment in appearance. The elevated levels of social pressure and stigma against overweight women likely make them more susceptible of developing poorer psychological profiles in general, and many times contribute to further weight gain. Body image problems may also affect the success of treatment, by predicting poorer outcomes and increasing chances of relapse or by making participants undervalue small achievements that they manage to reach. Yet, body image research in the field of obesity is still limited, and its treatment often neglected.

The current thesis aimed to investigate the role of body image in the context of obesity treatment. Specifically, this thesis was designed to i) identify correlates of pre-treatment body image (evaluation and investment dimensions) in overweight/obese women, ii) investigate body image changes during a behavioral weight control intervention, iii) examine how, and by what mechanisms, body image changed over time, and iv) investigate the implications of this change to the process of weight control and associated behaviors.

The present thesis incorporated four empirical studies, which are depicted in an integrative model in Figure 1. A detailed discussion of theoretical and practical implications of each study's main findings was integrated in the respective chapters. The purpose of this section is to gather and integrate the contributions of the four studies, by summarizing the main results and globally reflecting on the key messages and implications for future research and interventions. Limitations of these studies and future avenues of research are also disclosed.

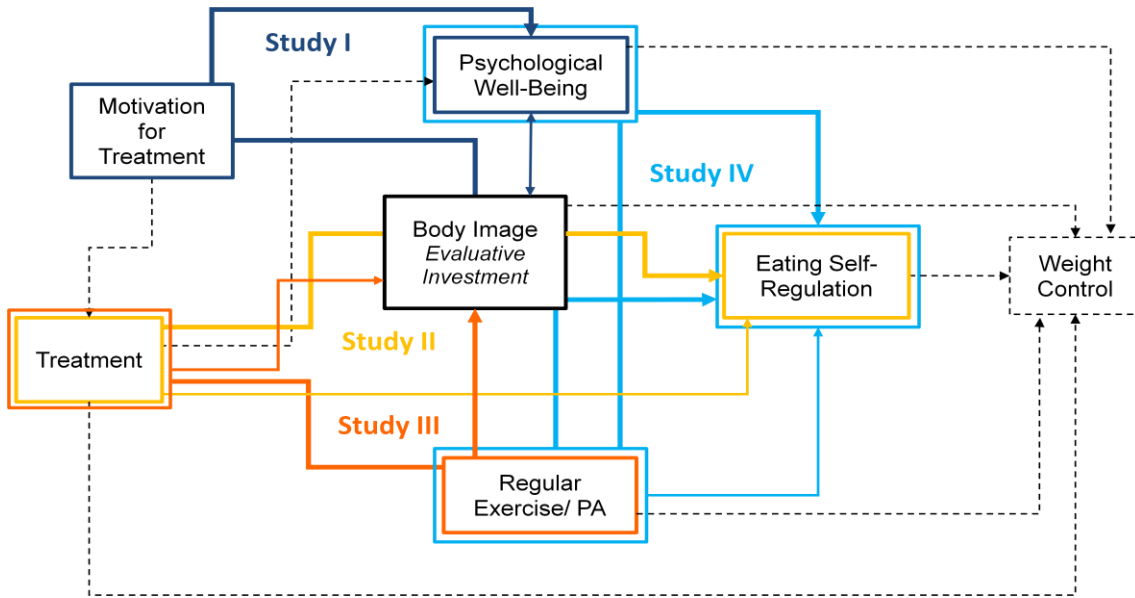


Figure 1. Integrative model of the four studies incorporated in the present thesis. Each study is represented by a specific color. For each study, thicker lines represent indirect/mediated effects, while the thinner lines represent direct effects. Dashed lines represent paths that help to contextualize the four studies included in the current thesis, but that were not analyzed.

Main research findings

Study 1 was designed to explore pre-treatment correlates of body image distress, in order to partly respond to the question “What might a poor body image be hiding?”. By testing a three-level model, this study investigated the association between body image and psychological well-being, examining the putative mediating role of controlled regulation for enrolling in obesity treatment (Figure 2). In addition, this study distinguished between body image evaluative and investment dimensions, seeking to investigate whether these dimensions had different motivational and psychological consequences. Results revealed that dysfunctional investment in appearance was positively associated with controlled regulation for entering treatment, and negatively associated with both psychological

outcomes (self-esteem and psychological functioning). On the contrary, results failed to show significant associations for evaluative body image. These findings are in line with prior research [e.g., 1, 2], and suggest that dysfunctional investment in appearance, rather than body dissatisfaction per se, is more detrimental to the psychological well-being of overweight and obese women. In addition, results showed that controlled reasons for entering treatment mediated the association between dysfunctional investment and self-esteem but not psychological functioning, which suggests that distinct processes may be involved in the associations between body image investment and different psychological outcomes. This study extended prior research by showing that controlled regulations might be one of the mechanisms behind the damaging effect of poor body image on psychological well-being. These findings are particularly relevant in the context of weight management, because they highlight that overweight women distressed with their appearance are more susceptible to enroll in treatment for controlled reasons, which are often associated with poorer psychological profiles – including low self-esteem, reduced life satisfaction, symptoms of depression and helplessness [e.g., 3, 4] –, which in turn might predict higher abandonment rates or less successful outcomes [e.g., 5].

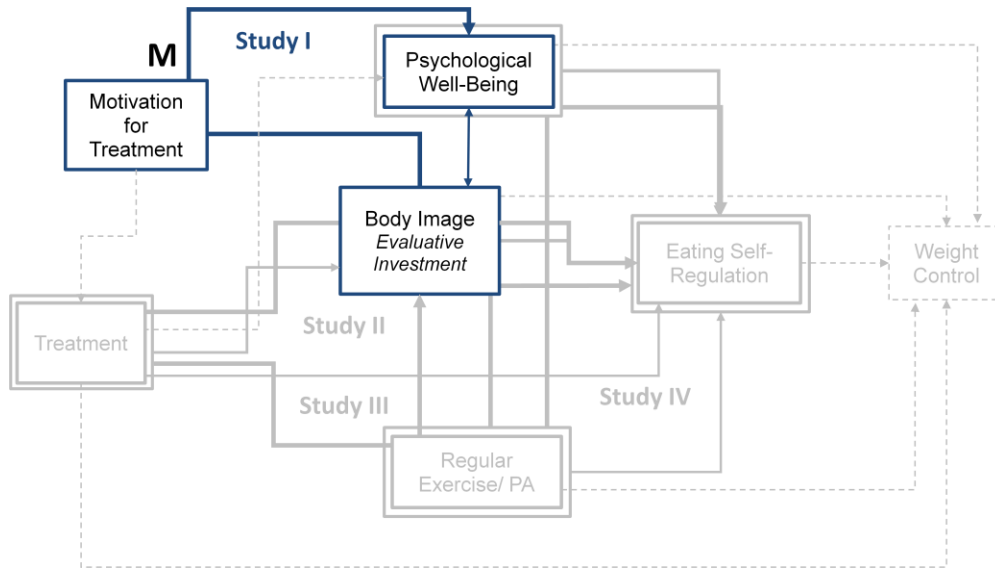


Figure 2. Study 1's model. This study tested if controlled motivation for treatment mediated the association between body image and psychological well-being.

Study 2 examined body image change during treatment as a potential mechanism involved in the successful regulation of eating behavior, and subsequent weight management (Figure 3). Additionally, it explored the distinct contributions of evaluative and investment body image dimensions to eating self-regulation. This study showed that body image effectively improved during the intervention, lending support to previous findings suggesting that weight management interventions, particularly those including a body image module, can be helpful [6-8]. Further, this study extended previous findings, by showing that both body image dimensions can be efficiently enhanced, but differentially affect and mediate the impact on eating self-regulation. Specifically, results revealed that relative to evaluative body image, the improvement in body image investment more strongly explained change in eating regulation. In addition, the change in evaluative body image was shown to affect essentially one of four markers of eating self-regulation (i.e. eating self-efficacy), whereas the change in investment affected all four markers. Overall, body image change appears to

be one mechanism through which the regulation of eating behavior can be improved in behavioral weight management interventions, at least in women. This study further suggests that the strategies used to target body image investment should be emphasized within weight loss interventions, to more effectively improve the regulation of eating behavior, and consequently manage body weight.

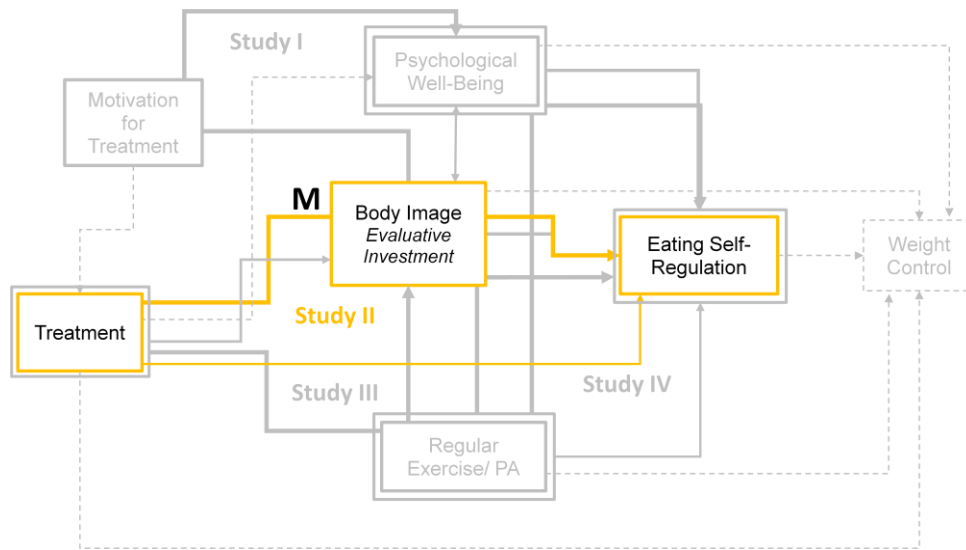


Figure 3. Study 2's model. This study examined whether change in body image mediated treatment effects on eating self-regulation.

Studies 1 and 2 are in line with previous findings [e.g., 2, 9, 10], suggesting that investment rather than evaluative body image might be more relevant to understand the whole psychological experience of embodiment. A plausible explanation for these findings has been proposed to partially derive from a nuclear facet of body image investment, appearance-related self-schemas, that is, cognitive generalizations about the influence of one's appearance in life, including the centrality of appearance to one's sense of self, which are activated by self-relevant events and cues [11-12]. Their activation then triggers body image-related thoughts and emotions, which in turn prompt adjustive, self-regulatory

activities such as the adoption of dysfunctional eating behaviors [10, 13], or developing controlled reasons for seeking weight loss treatment (as study 1 suggests). Perhaps surprisingly at first glance, the present weight control intervention significantly reduced participants' investment in appearance and its salience to their lives, working on the acceptance of body image experiences and deconstruction of beliefs and interpretations concerning the centrality of appearance to the self. This probably resulted in less appearance schemas' activation and better emotional regulation, leading to the adoption of healthier and more adaptive self-regulatory activities, including better eating self-regulation (as study 2 showed).

After completing study 2, the next logical step was to better understand body image changes, for instance, by looking into trajectories of change over a longer period of time and exploring potential mechanisms involved in body image improvement and maintenance. Specifically, **study 3** examined medium and longer-term effects of one obesity treatment program on different dimensions of body image (evaluative and investment), and explored the role of different forms of physical activity (structured and lifestyle) as putative mediators of body image changes across time (Figure 4). In line with our previous findings, study 3 showed considerable improvements in both body image dimensions during the 12-month treatment phase, favoring the intervention group. Yet, it should be noted that the control group also showed decreases in body dissatisfaction and dysfunctional investment. This could be interpreted as a "placebo" effect derived from enrolling in the study. Perhaps that reduction is the normal response, and if so, maybe the true magnitude of the improvement in the intervention group should be assessed as the difference between the two groups. In this case, this would amount to an intervention-

induced average reduction of 21% in body dissatisfaction and of 25% in dysfunctional investment. A few other explanations might help understand this finding. Physical activity levels increased substantially in the control group as well, which might have also mediated positive changes in body image in this group. In addition, several participants who volunteered to the study reported that they were seriously trying to lose weight, in part because they showed signs of psychological suffering; and for many, this was felt as their last resource (unpublished data collected in initial interviews). Thus, they might have overestimated their levels of body dissatisfaction and concerns at program's entrance; values that might then have normalized. Also, many participants from the control group referred that after knowing that they would not be receiving the intervention, they would search for other options. Finally, the control group received a mini-course on aesthetics and contouring, which might have contributed to their body image improvement, at least to some participants.

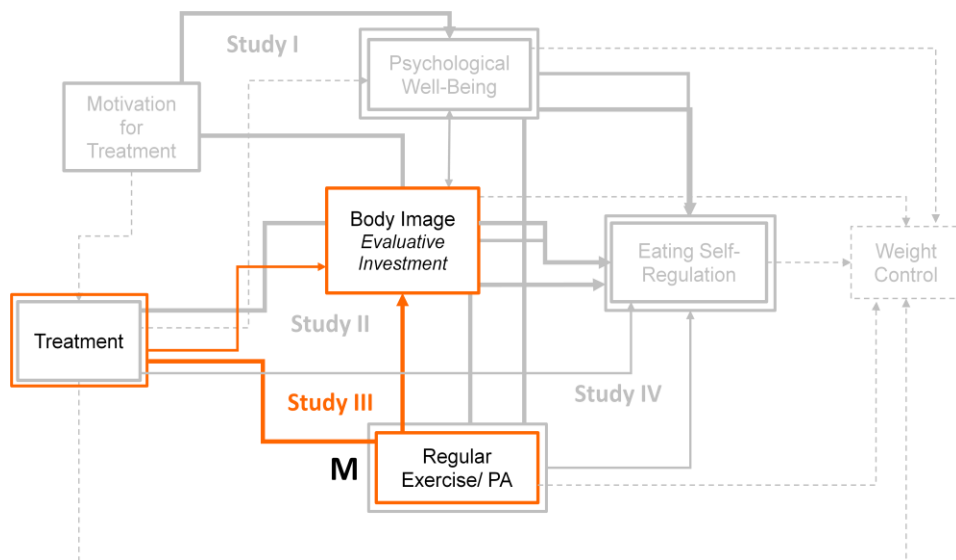


Figure 4. Study 3's model. This study analyzed body image changes during the intervention and examined whether exercise participation mediated those changes.

At present, determining whether a given improvement in body image among the obese population is clinically meaningful remains an intricate task. Currently, there is no literature defining a minimum amount of change in body image that can be deemed clinically significant, at least for this population, and research reporting meaningful improvements in body image with dieting or behavioral obesity treatment is scarce [14]. Nevertheless, these findings seem to suggest that body image changes were substantial, based on the large magnitude of effects. In addition, the present data showed that the percent of change in both body image dimensions (reported above) far exceeded the proposed 5-10% criteria of success for improvements in psychosocial measures [15]. Future research should focus on the development of a consensual definition of negative body image that recognizes the impact of body image on individuals' quality of life and daily functioning; in other words, that allows determining the clinical significance of body image problems as well as of their change. Also, researchers should consider the development of "standardized" body image assessment methods that permit comparing the efficacy of different interventions in producing clinically meaningful changes.

Regarding body image trajectories of change over longer periods of time (24 months), results showed that the favorable outcomes observed at the end of the intervention (12 months) tended to fade, with body dissatisfaction and dysfunctional investment in appearance gradually increasing. Even slight weight regain negatively affects body image [16-17] which could partially account for these results. Nonetheless, body image remained improved compared to initial levels. Extending prior research involving shorter follow-up periods [11], study 3 appears to suggest that positive body image changes do persist over longer periods of time, even though they do diminish to some extent. More research on this

topic, comprising longer follow-ups, is clearly warranted not only to confirm our findings but also to explore the causes underlying body image worsening (i.e., residual body image problems that are not being effectively tackled by the intervention; social pressures that continue to exist).

Mediation results revealed that structured rather than lifestyle physical activity was more relevant for the improvement of body image during the 12-month intervention, especially for reducing the dysfunctional investment in appearance; changes in evaluative body image appeared to be more dependent on weight changes. Consonant with previous findings, these results suggest that in order to see significant gains in body image in the short/medium-term moderately intense physical activity should be encouraged. On the other hand, the present results suggest that lifestyle physical activity might be especially important in the long-term, if not to improve, at least to decelerate body image worsening after the intervention. These findings are encouraging, given that lifestyle exercise might be more easily integrated into overweight and obese people's lives, as a means of meeting the recommended doses of physical activity for weight management purposes [18]. Overall, the present findings suggest that physical activity might provide a buffer against the effects of minor weight gain and other potential threats to body image deterioration over time (e.g., media messages; social pressure, etc.).

Informed by prior propositions suggesting that physical activity could impact long-term weight management by improving psychological variables that could facilitate the regulation of weight-related behaviors, **study 4** sought to integrate and extend earlier findings (from studies 1 to 3) by examining whether body image dysfunctional investment and depressive mood mediated the relation between physical activity and improved eating

regulation (increased flexible restraint, reduced disinhibition and perceived hunger) (Figure 5). Results confirmed the mediating role of body image dysfunctional investment, and to a smaller degree, depressive mood (for most eating variables). These findings further confirm that, besides physiological effects of exercise, psychological mechanisms also support the role of physical activity as a “gateway behavior” for improved eating self-regulation.

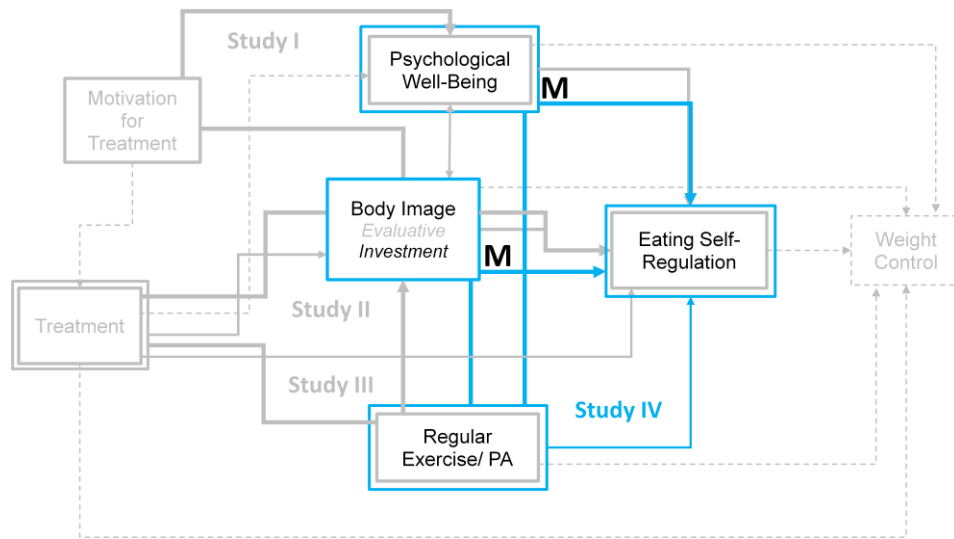


Figure 5. Study 4’s model. This study explored whether body image investment and depressive symptoms mediated the exercise-eating association.

Study 4 also discretely analyzed two distinct forms of physical activity. As predicted, the association between structured exercise and eating behavior was more strongly mediated by body image dysfunctional investment and depressive mood, whereas lifestyle physical activity showed higher direct (i.e., not mediated by the tested mechanisms) associations with all eating variables, especially flexible restraint. This suggests that other mechanisms – for instance, motivational factors, such as self-efficacy or autonomously regulated motivation [19-20] – might be more relevant to explain the association between lifestyle activity and eating behavior. Since this type of activities can be integrated with less effort

into one's daily routine, they might foster one's perception of mastery and competence, which might then transfer to other weight loss behaviors. In addition, women who effectively internalize the motivation to be more physically active in such a way that they consistently prefer the more active over the more sedentary option, may also display a more internal motivation to adopt other weight management behaviors, such as healthy eating [21].

Study 4 also aimed to explore whether these effects held through time. Results indicated that the effects of exercise on eating behavior, via reductions in dysfunctional investment in appearance and depressive mood, persisted two years after the end of the intervention. In fact, some effects, like the intervening role of these variables on the lifestyle activity-eating relationship and the mediating role of depressive mood (in general), became clearer at 36 months. These results, together with the 12-month group-adjusted analyses, appear to offer some support for the presence of suppression effects by the intervention, in particular when lifestyle physical activity is involved. This intervention covered the topics of eating regulation and body image to a considerable extent [22], thus it does not surprise that the effects of lifestyle physical activity on eating and body image variables were masked by the intervention.

In sum, these findings highlighted the importance of enhancing body image during obesity treatment, especially its investment component, to improve well-being, eating self-regulation, and ultimately weight-related outcomes. Furthermore, regular physical activity participation should be emphasized in these interventions, given that it can also ameliorate key psychological variables such as body image and even prevent their deterioration

overtime. In the end, this could reduce susceptibility to relapse and favor lasting weight maintenance.

Theoretical and practical implications and future directions

Moving beyond body dissatisfaction

Body image is widely recognized as a multidimensional phenomenon that encompasses self-perceptions and attitudes (i.e., evaluation/affect and cognitive-behavioral investment) [23]. Yet, a limited conceptualization and measurement of the body image construct has dominated research in the last few decades [24]. Simple measures of body image evaluation, or dissatisfaction, have often questionably been used to quantify, and equated with, body image disturbance [25]. However, this view is reductionist, given that it ignores the psychological significance that people place in their negative body image evaluations, and the consequences of those evaluations concerning personal distress and adaptive functioning [25]. In other words, it neglects body image investment.

However, recent studies suggest that body dissatisfaction per se is not a sufficiently valid index of disturbance, showing that dysfunctional investment in appearance has more adverse consequences and predicts psychosocial functioning, quality of life, and disturbed eating, beyond body dissatisfaction [e.g., 2, 9, 10]. The studies included in the present thesis corroborate these findings and extend them by confirming that the predominant role of investment over dissatisfaction also applies to overweight/obese women and to weight management contexts. Overall, these findings strongly support the necessity of moving beyond simplistic conceptions of body image, suggesting that greater attention should be

given to the dimension of body image investment, that is, to the degree of cognitive, affective, and behavioral importance that people assign to their body [10]. Body image investment features like people's misguided thoughts and assumptions about appearance (e.g., "One's outward physical appearance is a sign of the character of the inner person", "By controlling my appearance, I can control many of the social and emotional events in my life"), body-related negative emotions (e.g., "I felt ashamed of my body", "I felt so bad about my shape that I have cried"), and associated behavioral consequences (e.g., "I react by overeating", "I make a special effort to hide what's troublesome about my looks", "I withdraw and interact less with others"), should be well understood and evaluated if any progress in comprehending body image development, dysfunction, or change is to be achieved [24]. Researchers and practitioners are thus advised to replace simplistic measures of body image satisfaction by multiple and/or more sophisticated measures, that permit the assessment of several facets of body image, while ensuring that misleading interpretations regarding body image functioning or related outcomes are minimized [26]. Future weight management interventions should include a comprehensive body image assessment, if the goal is to get a deeper understanding of participant's body image functioning and possibly use that knowledge when implementing the intervention.

Besides this recommendation, a few other considerations relevant to obesity treatment arose from the present findings. First, compared to evaluative body image, reducing dysfunctional investment in appearance also appears to have a greater impact in body weight regulation, by inducing more effective improvements in the regulation of eating behavior. These findings reinforce the advantage of including a body image component within weight management interventions that targets both dimensions but that is

especially focused on body image investment. This could be achieved by actively deconstructing and defying held beliefs and predefined concepts about the centrality of appearance to one's life and sense of self, mindfully accepting and neutralizing negative body image emotions, identifying problematic thoughts and self-defeating behavior patterns, and replacing them with healthier thoughts and behaviors [27].

In addition, the current results seem to suggest that the change in the investment component might be less dependent on weight change than that of evaluative body image (as it was measured in this thesis). This is reasonable considering that the investment component is more complex in nature, and reflects the degree of cognitive and behavioral importance that people assign to their body and the extent to which appearance defines their sense of self [23]. In fact, these findings expose a basic reality about body image and the weight reduction enterprise. Body image is a psychological construct that refers to people's *subjective* evaluations of their physical attractiveness as opposed to their objective physical appearance; hence losing weight does not guarantee a positive body image. Moreover, these results might help understand why even slight weight regains result in body image worsening [28], and why former obese individuals often report a vestigial body image disparagement [29]. Again, practitioners should not expect that relying merely on weight loss (without addressing body image problems) will magically substitute people's negative body image by a positive or normal one. Thus, these findings suggest that weight loss interventions that do not contemplate body image treatment might not suffice to achieve long-lasting improvements in body image, in particular in the investment component. Professionals should consider the inclusion of body image components within obesity

treatment, as well as the need to emphasize the strategies used to target body image investment.

Towards positive body image

Most research to date tends to focus solely on body image negative features, such as body dissatisfaction or overvaluation [24]. These efforts have been fruitful, since many precipitating factors (e.g., internalization of the thin-ideal) and consequences (e.g., maladaptive eating behaviors) of negative body image have been articulated. However, they do not say much about how promoting a positive body image can be accomplished.

Unfortunately, positive body image is often conceptualized as solely the absence of negative features and, inherent to this conceptualization, is the assumption that interventions geared to reduce negative body image will result in parallel increases in positive body image. Yet, portraying positive body image in this manner is incomplete, because the absence of pathology does not always signal flourishing [30]. According to Striegel-Moore and Cachelin, variables contributing to or resultant from positive body image could be the opposite of those associated with negative body image (e.g., high self-esteem in lieu of low self-esteem), but it is also very likely that positive body image could be related to variables not documented for negative body image [31]. In effect, prior research seems to support this view, suggesting the presence of qualitative differences between positive and negative body image. For instance, Williams et al. delineated body image groups from cluster analysis – women with positive body image (51%), normative body image discontent (23%), and negative body image (24%) – and showed that the positive body image group reported less thin-ideal internalization and disturbed eating, and

increased social support and physical activity than women in the other groups [32]. In terms of personality characteristics and coping strategies, these authors found that women with a positive body image had higher levels of optimism, self-esteem, and coping via positive rational acceptance and lower levels of self-presentational perfectionism and coping by avoidance and appearance-fixing than women with negative body image and normative body discontent [32]. Additionally, other researchers identified several qualities suggestive of positive body image and integrated them into a definition [33-34]; positive body image was defined as an overarching love and respect for the body that allows individuals to (a) appreciate the unique beauty of their body and the functions that it performs for them; (b) accept and even admire their body, including those aspects that are inconsistent with idealized images; (c) feel beautiful, comfortable, confident, and happy with their body; (d) emphasize their body's assets rather than dwell on their imperfections; (e) have a mindful connection with their body's needs, for instance, by making healthy food choices in response to hunger and satiety cues; and (f) interpret incoming information in a body-protective manner whereby most positive information is internalized and most negative information is rejected or reframed [33]. These findings clearly suggest that positive body image encapsulates its own unique properties and is not merely the absence of negative body image.

Interventions and prevention programs, in general and specifically in the obesity field, could benefit greatly from this information, as they could be designed to target specific positive body image characteristics and not simply reduce their negative features. In turn, this could potentially contribute to increase interventions' effectiveness and long-lasting behavior change, by freeing and facilitating the use of important psychological and self-

regulatory resources. Thus, researchers and practitioners are strongly advised to move beyond the typical pathology-driven paradigm (i.e., focused on negative features) to embrace a new paradigm that recognizes and studies the development and experience of a ‘positive body image’. Within these lines, Wood-Barcalow et al. emphasized the need for additional questions and instruments that can explore and measure the uncovered characteristics of positive body image in more detail. They further suggested that, once this is done, researchers will be able to articulate predictors and consequences of positive body image using more sophisticated analyses, such as structural modeling [33]. Besides that, following women in longitudinal studies as they transition from a negative to a positive body image and conducting experimental studies to test the efficacy of different intervention strategies, and their specific targets, would also be beneficial to better understand this process and to improve program design and effectiveness.

Negative body image: symbolic meanings, motivational consequences

Currently, many women (and arguably many men as well) feel dissatisfied with their body image and pressured to lose weight due to the high emphasis modern culture places on the pursuit of body perfect ideals. This might be even more pronounced for overweight and obese women, provided that the social valuation of thinness is accompanied by the devaluation and stigmatization of overweight and obesity. Therefore, it is not startling that many women engage in (often unhealthy) weight control behaviors to improve appearance and achieve the socially-approved ideals. However, comments such as “I lost weight but still didn’t like myself” are not unusual, and suggest that weight loss likely represents more than merely losing a few pounds.

Such comments may be primarily a reflection of the current environment. Society constantly exposes people (particularly women) to images of thin and attractive models through advertisements and mass media, encouraging and rewarding those who strive for the thin-ideal. Yet this ideal is not only associated with female attractiveness; it falsely carries an array of symbolic meanings, which connote it with success, happiness, health, and being in control of one's life [35]. The problem is that people tend to be unaware of the implicit social messages conveyed in the media, and of its pervasive influence [35]. They are misled to believe they are expressing their selves and conquering happiness when they are actually shaping and monitoring their identities according to the unrealistic ideals transmitted by these messages [36]. As a result, appearance becomes central to women's identity and self-worth, and the pursuit of thinness (or weight loss) becomes imbued with the "myth of transformation": improving appearance (or losing weight) holds the promise of changing more than just one's body; it promises to change one's social acceptance, status, and sense of worth [36-37]. Yet, this may largely be an illusion. The pursuit of such goals and behaviors can be rewarding in the short-term but it is counterproductive because it serves to camouflage and perpetuate the true problem, as it only provides temporary satisfaction and relief from body image discomfort [38]. Furthermore, it fails to yield long-term well-being benefits, because it creates an unstable, and short-lived form of well-being, which is conditional on escalating standards and goals [39].

Self-determination theory [40-41] offers a different but complementary contribution to the understanding of sociocultural influences and consequences. This theory proposes that individuals potentially go through a natural process of internalization in which they assimilate and attempt to transform social norms and demands into personally endorsed

values and self-regulations. It further suggests that individuals have an innate tendency to be active and autonomously motivated, and to regulate their behaviors through choice as an expression of themselves. Self-determination theory also suggests that individuals' optimal functioning requires the satisfaction of three basic psychological needs (i.e., autonomy, competence, and relatedness), whose fulfillment is closely associated with the characteristics of the social milieu [40]. Accordingly, when the social environment is excessively controlling and evaluative, pressurizing individuals to act in certain ways, psychological needs are not satisfied and, subsequently, the process of internalization gets thwarted and becomes associated with less autonomous functioning. In this case, individuals are generally moved to act as a result of feeling pressured or coerced by internal and environmental forces (e.g., entering weight loss treatment to avoid feelings of guilt or shame, or following a doctor's orders). The continuous thwarting of basic needs results in increased susceptibility to sociocultural messages advocating that the pursuit and attainment of extrinsic goals (e.g., physical attractiveness, fame, economic prosperity) brings happiness and success [39]. However, these goals represent need substitutes that individuals develop to compensate the absence of need satisfaction and, in reality, they only provide a fleeting relief, interfering with genuine need satisfaction and undermining individuals' autonomous functioning even further [40].

In the context of obesity treatment, and from a self-determination theory's standpoint, the sociocultural demands to conform to the ideal physique that result in high body dissatisfaction and dysfunctional investment could be experienced as controlling and overchallenging, thwarting the satisfaction of basic psychological needs and, consequently, encouraging the pursuit of extrinsic goals such as having an attractive appearance to get

social acceptance and status. A strong focus on such an extrinsic goal, rather than on being healthy and fit (i.e., an intrinsic goal), might induce a more contingent approach towards weight management in which one's self-worth becomes largely dependent upon reaching socially imposed standards about the ideal appearance [39]. As a result, one might become more susceptible to social pressures, either internal (e.g., guilt, shame) or external (e.g., media, family), and thus be drawn to a more controlled regulation of weight-related behaviors [40, 42]. The present findings seem to support this, suggesting that controlled regulations for enrolling in obesity treatment might be one of the mechanisms behind the detrimental effect of poor body image on psychological well-being. Furthermore, the tendency to evaluate self-worth in terms of weight and shape, or to be regulated by controlled reasons to lose weight, predicts poorer weight outcomes and lower treatment adherence [43-44], and even weight regain [45]. This might derive from the fact that the majority of women who feel distressed with their bodies and pressured to achieve the thin ideals, regulate their weight loss behaviors in a rigid or controlling manner, using an all-or-nothing approach [46]. Given that flexibility is not tolerated within this approach, even small deviations or setbacks give rise to feelings of frustration, compromising long-lasting engagement and, ultimately, success [47-48]. On the other hand, internal motivation to lose weight and autonomy, which typically reflect a more flexible regulation of weight-related behaviors, have been positively associated with successful weight management [47-48].

Therefore, when implementing interventions, health professionals would do well to consider the reasons regulating people's engagement in obesity treatment. Self-determination theory suggests that by maximizing patients' experience of autonomy, competence, and relatedness in health-care settings, the regulation of health-related

behaviors is more likely to be internalized, behavior change will be better maintained [49-50], and greater psychological well-being will be experienced [51]. Hence, health professionals should also consider the inclusion of strategies to promote autonomy and reduce controlled regulations when implementing weight management interventions [22, 52]. Specifically, interventions should be designed in order to provide structure and enable feelings of competence (e.g., practicing skills necessary for completion of specific tasks, or giving informational, task-related positive feedback), and create an autonomy-supportive environment, for instance by encouraging self-choice and self-initiation, while avoiding prescriptions, pressure, demands, and extrinsic rewards, acknowledging participants' feelings and perspectives, and providing choices, supported by a clear rationale, that guide and facilitate the decision-making process [e.g., 22, 53]. Additionally, interventions could benefit from including strategies to improve body image (especially its investment component), given that increasing healthy investment in appearance, body satisfaction and acceptance, might progressively reduce controlled body-related motives to lose weight, favoring the adoption of more autonomous regulations, and consequently facilitate well-being and long-term health behavior adherence and weight maintenance. Thus, professionals should be aware of and consider these aspects when evaluating patients' readiness to lose weight, and when providing care.

From “changing the body” to “changing body image”

As Mark Twain once said, “The worst loneliness is not to be comfortable with yourself”. Naturally, when people dislike their looks, they will understandably try to figure out how to change their appearance. Instead of thinking about adjusting their attitude towards their

body, they contemplate how they can adjust their looks – slimmer/toned body, larger muscles, a more youthful complexion, larger (or smaller) breasts, etc. This reality is reflected in the high numbers of people, women in particular, that are (re)currently trying to lose weight [54]. These solutions have one basic psychological purpose – to make the person feel better, at least temporarily, about the body she or he lives in. However, as discussed above, these compensatory activities and behaviors do not really contribute to deep-rooted and stable well-being, and in fact, they may aggravate people's feelings of dissatisfaction, frustration, and hopelessness, and can lead to health problems and disturbed eating behaviors that increase the likelihood of additional weight gain.

On the other hand, and contrary to some popular perception, the present findings suggest that the more positive people are about their bodies, even when they are overweight or obese, the easier it is to lose weight, particularly by eating in a more healthful and balanced way. When people actively challenge held beliefs and predefined concepts about the centrality of appearance to one's life and sense of self, feel less pressured to achieve certain body ideals, feel more positive and accepting about the body that they have, and define more realistic weight loss goals. Not only do their psychological resources and emotional well-being increase (and that should support behavior change) but they also appear to regulate their diets in a more flexible and confident way, relying less on extreme and unhealthy eating practices. So it is important that weight loss professionals learn how to best help patients and clients explore the causes of poor body image and work with them towards improvements in this area. This will likely help people lose weight, if not faster, in a lasting and more sustainable way. Also, professionals should not be concerned that if overweight people accept and like their bodies they will "lose their motivation" and

abandon their efforts to lose weight. In fact, the opposite seems to be true. It appears that persons who appreciate their bodies simply start listening to their body's needs and making healthy rather than appearance-based decisions, as well as indulging their bodies (e.g., getting massages, grooming rituals). They naturally, effortlessly, decide to be proactive about their health and start taking charge. "It wasn't about how I looked; it was about how I felt. I want to remain healthy for the rest of my life" [33; p.110].

The multiple roles of physical activity: More than a burning-calorie agent

Bearing in mind that weight loss has typically been viewed as the marker of success in weight management, physical activity has been mostly considered as a strategy to "burn calories" and its effectiveness often based on body weight and the capacity to create and maintain a negative energy balance [55]. This limited conceptualization fails to consider behavioral and physiological responses that may interfere within the energy balance equation, and thus affect the exercise-induced weight loss and maintenance [56]. Furthermore, it leads health professionals and ordinary people to frequently overlook other important benefits of exercise, such as improvements in psychological aspects that may also contribute to a more adaptive self-regulation.

Over the last decade, a growing number of empirical studies has been providing support to the proposition that the widely recognized role of exercise in long-term weight management might not only rely on physiological processes, but also be mediated by psychological and self-regulatory mechanisms [e.g., 20, 57], several of which have been implicated in sustained weight loss maintenance [e.g., 5]. In addition, some of these studies suggest that key self-regulatory resources are likely to be shared and even transferable between weight-

related behaviors [e.g., 19, 20]. The present studies corroborate these findings in the sense that they highlight the relevance of regular exercise for improving body image in overweight women, especially the investment dimension, and reinforce physical activity's role (indirectly through reduced body image investment and depressive mood) as a "gateway behavior" for improved eating self-regulation. Taken as a whole, these findings clearly suggest that physical activity has considerable value beyond just energy expenditure. Exercise-induced "positive changes in overall well-being, and in specific variables such as depression and anxiety [and body image], could lead to a healthier psychological climate in which individuals have more cognitive and emotional resources, as well as motivation and energy, to sustain the long-term commitment" to weight management efforts [58; p.320]; these self-regulatory resources might even "spill-over" to other health behaviors important for weight management.

Professionals are therefore strongly encouraged to abandon the reductionist view of physical activity merely as a calorie-burning agent to embrace a far-reaching formulation that considers exercise's arguably more important psychological benefits to successfully manage weight. Also, these findings bring additional attention to a currently debated topic among researchers and professionals in the obesity field – the need for reconsidering the definition of success in weight management (which is typically conditional on weight changes). According to previous propositions [59], selected psychological and behavioral outcomes (e.g., displaying a more flexible and balanced eating behavior, adopting more autonomous behavior regulations) could, and perhaps should, also be routinely appointed as indicators of successful body weight regulation, as they might signal long-lasting weight management efforts. Still, a long road has yet to be travelled in order to convey the message

that success is, and should be seen as weight-independent, at least to some degree. Naturally, it does not suffice that researchers and professionals agree on and adopt more comprehensive conceptualizations of success; these must also, and above all, be accepted by the person undergoing an intervention. This calls for more global and concerted actions, involving not only experts in the obesity field, but also the main socializing agents (especially the media) that work collectively to convey the message that a person's value extends far beyond his or her weight or looks and that it can be fulfilled and affirmed at any size.

The effects of physical activity on body image remain poorly understood. Yet, the current findings provided additional information that can be considered by health professionals when developing body image interventions, in isolation or integrated in larger interventions (e.g., weight management). First, these results distinguish the role of physical activity between two phases of body image treatment – an enhancement phase (short/medium-term) and a maintenance phase (longer-term) – suggesting that structured exercise of moderately vigorous intensity might be important in the first phase, whereas in the maintenance/relapse-prevention phase, lifestyle/unstructured physical activities, such as taking the stairs whenever possible or choosing to walk more in daily life, might also be helpful, and perhaps even more than structured activity, to attenuate the natural tendency for body image deterioration. The increasing contribution of lifestyle physical activity might be related to the fact that this type of physical activity might be more easily integrated into overweight and obese people's lives, and thus sustained over longer periods of time. These findings are encouraging and informative for professionals, further supporting the inclusion and recommendation of this type of physical activity (as a

complement to structured activities) within future weight loss interventions. Second, they suggest that physical activity participation, especially the structured type, can be a valuable tool to reduce the excessive salience of appearance to one's life and sense of self, which appears to be more detrimental to one's overall health and psychological well-being. These findings are important for future weight loss interventions, but also for obesity prevention and physical activity promotion campaigns targeting younger generations. For instance, by enhancing people's perceptions of their physical fitness, competence and self-efficacy, by making them more aware of their physical capabilities, while reducing their focus on physical appearance and body image-related concerns and information (e.g., media's conveyed messages and ideals of thinness and beauty), physical activity might play a decisive part in the development of a positive body image among adolescents, possibly habituating them to better self-regulate in critical life domains (not exclusively health-related). Nevertheless, future research should continue to explore the role of physical activity in body image enhancement and maintenance, given that this area is ripe for investigation. Researchers should also continue to explore the mechanisms underlying body image changes, which are still poorly understood. Finally, it would also be interesting to examine the effects of different activities. For instance, do dance activities produce similar (amounts) and equally lasting changes in body image as weight training or common aerobic activities? Some evidence suggests that activities that provide greater enjoyment show larger improvements in body image [60]. Future research should explore these and other directions that remain undetermined.

Insights into the obesity problem

So far, successful interventions for obesity have been elusive. Despite the prolific evidence supporting external and/or environmental causes, obesity interventions (and society in general) continue to place the majority of responsibility upon the individual [61], and to be implemented under a “should/must/have to” paradigm. When weight loss does not occur, the obese are often judged as unmotivated, lazy, lacking ‘willpower’, or non-compliant by medical caregivers [62]. Yet successfully managing weight is not simply a matter of eating less and exercising more. This focus on personal rather than collective responsibility eclipses other important dimensions of the obesity epidemic and often unfairly blames obese individuals, potentially reinforcing weight bias [62].

The present findings contribute to a better understanding of the obesity condition, in particular of its social reality, in the sense that they highlight that the factors in society that contribute to the normative discontent about the body expressed by overweight/obese people may make their efforts to lose weight more difficult. The high focus on appearance in society conveys the message that it is virtually impossible to be happy and successful if one is overweight or obese. In turn, this pressure leads many overweight people to attempt to lose weight in ways which are not satisfying, sustainable, and ultimately also not successful. The present findings therefore do not support prior propositions claiming that some degree of stigma and body dissatisfaction may motivate weight control behaviors [63], and further alert for the necessity of reflecting on the implications of common social messages portrayed in the media on those affected by obesity, which might be damaging to their health and well-being by invoking feelings of shame, guilt, and inadequacy [62]. Unfortunately, these implications are still rarely discussed by the media and other

socializing agents.

Perhaps somewhat paradoxically, the present findings may also be helpful to tackle the obesity problem, in the sense that they may increase social awareness to these issues. It may be that if or when society becomes more accepting of larger bodies as "normal" and equally attractive, this will actually help people, especially women, lose weight more successfully. Obesity is a complex condition with many causal factors. However, social pressures to be thin are believed to be one important factor that at least tends to perpetuate the high levels of obesity, by making the task of losing weight all the more difficult. Perhaps part of the resources spent on weight loss products, medications, and programs should instead be spent on ways to have overweight/obese people viewed more positively by society and accepted with less bias and discrimination. Strategies such as increasing media literacy by providing citizens with skills for reading and processing media messages (critically, rather than passively), and implementing social activism initiatives, protesting or boycotting media messages, advertisements or products that are identified as conveying unhealthy messages, could be helpful in this quest. Or perhaps some resources could be reallocated to training programs for weight loss specialists in areas such as body image, stress management, and positive emotional self-regulation. Further, professionals working in the obesity field should keep on working (collectively if possible) to make the pervasive influences of modern culture – the “cage within” – more transparent, as well as their psychological and physical consequences on overweight individuals. This will likely contribute to a greater social awareness to these matters, and also to the development of targeted interventions, both at the level of social policy and individual education, which can help protect future generations.

Limitations and future research directions

Each study's specific limitations were separately addressed within each respective chapter. Resulting from an integrative view of this dissertation body of work, this section intends to describe the general limitations and propose future avenues of research.

One limitation concerns the targeted population. This study only included pre-menopausal overweight and obese women seeking obesity treatment. Therefore it is unclear whether similar results will be observed in other groups of obese people, such as non-clinical, male-gender, or minority ethnic samples. One of the most frequent motivations for weight loss reported by treatment-seeking overweight women is the desire to improve appearance and body image [64-65]. Moreover, several participants enrolled in the P.E.S.O. trial reported being determined to lose weight, because they presented signs of psychological suffering; for many it was felt as their last resource (unpublished data collected in initial interviews). Thus, it is very possible that this study's participants were more sensitive to body image-related issues and cognitive-behavioral consequences. Hence, the extent to which the present findings are generalizable remains to be determined.

Although originating from an RCT, the way the data were analyzed precludes from drawing firm conclusions about the causal direction of the associations. Even studies 2 and 3, which were longitudinal in design and measured change in the variables of interest, referred to changes occurring during the same period, thus making it impossible to infer causality. The possibility of an alternative causal ordering of the observed relations cannot be excluded. For example, it is possible that the change in eating self-regulation led to positive changes in body image and not the other way, or that the change in body image led to positive changes in exercise participation instead of being altered by it. Future longitudinal studies

are in order to confirm our findings and elucidate the causal directionality of the reported associations.

The psychometric instruments used to measure investment body image were only able to capture some facets of this construct, namely over-preoccupation with body image and appearance and its behavioral consequence, thus failing to capture another core facet of body image investment, appearance-related self-schemas. Future studies should continue to give greater attention to the dimension of body image investment, including more comprehensive measures that are able to capture its additional facets (e.g., self-schemas, self-objectification). An accurate and complete understanding of body image functioning can be achieved only if a deep understanding of the nature of body image investment is also present [24]. In addition, it would be important to use instruments that are comparable in format (i.e., multi-item questionnaire-type measures) to assess different body image dimensions. The fact that body dissatisfaction was measured with a unidimensional and undifferentiated measure (i.e., self-ideal discrepancy index), that differed considerably from all other body image measures employed, could account for the lesser role of the evaluative component in our studies.

Body image is often conceived and assessed exclusively as a stable and dispositional or trait-like construct, reflecting how people usually think, feel, or act. The role of situational and emotional contexts in the fluid and dynamic experience of body image in daily life is seldom taken into consideration. A woman who is generally discontent with her weight is not constantly thinking or feeling upset about it. Certain situations and events activate her thoughts and emotions, while at other times these distressful experiences are either absent or much more benign. State measures, such as the Body Image Diary [27], are ideal for use

in clinical settings, since they provide permanent information about body image “ups” and “downs” and how such fluctuations relate to individual attributes and contextual triggers. These are excellent tools for ongoing clinical work, but they might also be quite useful for immediate pre-post testing of the effects of a particular clinical intervention, such as mirror desensitization or a cognitive restructuring treatment session [26]. Future research in the obesity field would do well to include this type of measures, in order to acquire a more precise knowledge of those components/strategies of body image interventions that contribute to the effectiveness of weight management programs.

The P.E.S.O. trial included objective measures of physical activity levels; yet, the available data at the time of studies 3 and 4 was limited and would further reduce their valid sample sizes. Hence, structured physical activity was measured using a self-report questionnaire that has been shown to provide a valid and reliable assessment of physical activity. Furthermore, other preliminary studies conducted in the same lab, using the data already collected (limited), showed consistent correlation patterns between objective (accelerometry and pedometry) and self-reported measures (7-day PAR). Nevertheless, future studies should consider incorporating objective measures of physical activity such as accelerometry and heart-rate monitors.

The studies included in the present thesis did not address moderators (i.e., pre-treatment variables that identify subgroups of patients within the population that show different treatment responses [66]). The level of body dissatisfaction and dysfunctional investment varies considerably. Not all women develop extreme preoccupation with weight and appearance, suffer psychologically with appearance-related issues, or internalize sociocultural messages to be thin to the same extent, and only a minority develops severe

clinical disorders [67]. For the sake of obesity treatment effectiveness, the variables that influence (i.e., moderate) people's body image functioning and how they respond to treatment should be better understood. Personality-like traits as self-esteem, perfectionism, global self-determination, social comparison tendency, and appearance-schematicity, might be within such moderating characteristics [23]. Future studies should investigate the effect of these and other potential moderators of body image functioning within treatment-seeking overweight populations. The ignorance of moderating variables might generate biased effect sizes, attenuate power, and overlook clinically important information [66]. On the other hand, their identification will contribute to a better assessment of patients' readiness and adequateness to the offered approach, a better match between treatments or treatment-specific strategies and patients, and the reallocation of resources that might not be relevant in a certain situation. Hence, one of the next logical steps in the study of body image in the context of obesity treatment should be the investigation of this type of variables.

Final Remark

I hope that the present findings will serve as a catalyst for new ideas, more productive research, more effective interventions, and far-reaching applications. After all, "the experience of embodiment is central to the quality of human life" [24; p.516].

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APPENDICES

Abstracts of oral/poster communications related to the thesis

Published abstracts

Carraça, E.V., Silva, M.N., Vieira, P.N., Minderico, C.S., Sardinha, L.B., Teixeira, P.J. Body image enhancement mediates 12- and 36-month positive changes in body weight and psychological well-being in women undergoing obesity treatment. *Obesity Facts* 5 (supp.1):217.

Introduction: Body image (BI) is often compromised in overweight women, and frequently associated with poorer psychological well-being and weight outcomes. This study tested whether BI improvement during treatment mediated changes in weight and psychological well-being at intervention's end and after a 2-yr follow-up. The effects of changes in different BI dimensions were also examined.

Methods: At baseline, 221 overweight women (age: 37.6 ± 7.0 yr; BMI: 31.6 ± 4.1 kg/m²) were assigned to a control or 1-year group intervention designed to improve diet and increase physical activity. Controls received a health education curriculum. Participants were followed for 2 years post-intervention. Assessments were performed at baseline and at 12 and 36 months. Preacher and Hayes (2007) resampling procedures to test indirect/mediated effects were used.

Results: Changes in evaluative BI were correlated with 12- ($r = .60$) and 36-month ($r = .34$) weight change, and significantly mediated treatment effects (*effect ratios*: .47 and .61, respectively; all $ps < .01$). This dimension had no effects on well-being. Reductions in investment BI were associated with better weight and psychological outcomes at both time points, and significantly mediated treatment effects (all $ps < .05$). The indirect effects of treatment on well-being through BI investment remained significant after adjusting for weight change.

Conclusions: Improving BI during obesity treatment might contribute to more favorable weight outcomes and psychological well-being immediately post-intervention, but also in the longer-term. Its effects on well-being appear to be independent of weight change. These findings are particularly relevant in the context of relapse prevention, further supporting the need for addressing BI issues during obesity treatment.

Carraça, E.V., Tomás, R., Silva, M.N., Vieira, P.N., Sardinha, L.B., Teixeira, P.J. (2011). Baseline behavioral and psychosocial predictors of attrition and long-term weight loss in a weight management program for overweight and obese women. *Obesity Reviews* 12 (supp.1):240.

Introduction: Weight loss is difficult to achieve but maintaining weight loss is an even greater challenge. This study analyzed baseline behavioral and psychosocial predictors of attrition and long-term weight loss maintenance in overweight and obese women.

Methods: At baseline, 221 overweight women (age: 37.6 ± 7.0 yr; BMI: 31.6 ± 4.1 kg/m²) were assigned to a control or 1-year group intervention designed to improve diet and increase physical activity. Controls received a general health education curriculum. Participants were followed for 2 years post-intervention. Psychometric assessments were performed at baseline and scores evaluated against follow-up (36-month) weight change. Associations were analyzed with correlation/regression analyses and comparing completers and non-completers.

Results: In the intervention group, self-esteem, weight-related quality of life, and lower weight loss expectations and eating disinhibition predicted 36-month weight change ($p < 0.05$). In the control group, higher exercise self-efficacy and self-determination, fewer exercise perceived barriers, and lower internal locus of control for weight were significant predictors ($p < 0.05$). Regarding attrition, non-completers (vs. completers) showed greater weight loss expectations ($p < 0.01$) and, marginally, greater body shape concerns and lower weight-related quality of life in intervention women ($p < 0.10$). Within controls, non-completers presented higher bulimic tendencies ($p < 0.01$), emotional eating ($p < 0.05$), and weight loss expectations ($p < 0.01$) than completers; eating disinhibition and body shape concerns were marginally higher.

Conclusions: Several pretreatment predictors of attrition and/or long-term weight loss were identified, such as lower outcome expectations, self-esteem, quality of life, and lower eating disinhibition. These factors enhance the understanding of the prerequisites that are crucial to sustaining a lowered body weight.

Carraça E.V., Silva M.N., Coutinho S.R., Vieira P.N., Sardinha L.B., Teixeira P.J. (2010). The Role of Improved body image mediates the effects of a behavioral weight loss intervention on the eating self-regulation of overweight and obese women. Obesity Reviews, 11 (supp.1):300.

Introduction: Successful weight management involves the regulation of different health behaviors, especially eating. However, the specific mechanisms underlying the enhancement of eating self-regulation remain unclear. This study aimed at studying one of those paths by testing a three-level model in which improved body image (BI) mediates the effects of obesity treatment on eating self-regulation.

Methods: Participants were 239 overweight women (age: 37.6 ± 7.1 yr; BMI: 31.5 ± 4.1 kg/m²) engaged in a 12-month behavioral weight management program. Body

image was measured with the Body Shape Questionnaire and the Social Physique Anxiety (investment BI), the Figure Rating Scale (evaluative BI), and the Physical Self Perception Profile (physical self-worth). The Three-Factor Eating Questionnaire and the Eating Self-Efficacy Scale were used to measure eating behavior. The causal models were tested using Partial Least Squares (PLS) latent variable modeling.

Results: The model explained 9-45% of the variance in the dependent variables. Treatment significantly improved all body image measures, particularly its investment component (-.46; $p < .001$). Eating behavior was positively predicted by investment body image change ($p < .001$) and to lesser extent by evaluative body image ($p < .05$); physical self-worth did not influence eating self-regulation. Treatment had significant effects on 12-month eating behavior change, which were fully mediated by the investment and evaluative body image paths (effect ratios: 0.25 - 0.77).

Conclusions: Results suggest that improving body image, particularly its salience in one's personal life, might play a role in enhancing eating self-regulation during weight control. Accordingly, future weight loss interventions could benefit from addressing body image-related issues as part of their protocols.

Carraça, E.V., Silva, M.N., Coutinho, S.R., Vieira, P.N., Sardinha L.B., Teixeira, P.J. (2010). Alterações da imagem corporal e comportamento alimentar durante uma intervenção de controlo ponderal. *Endocrinologia, Diabetes & Obesidade*, 4(4):248.

Introdução: A regulação eficaz do comportamento alimentar é fundamental para o sucesso do processo de controlo do peso mas os mecanismos responsáveis por essa regulação ainda não estão claramente identificados. Os problemas com a imagem corporal apresentam elevada prevalência na população obesa e estão associados à adoção de padrões alimentares disfuncionais. Este estudo analisou o papel mediador das alterações na imagem corporal na melhoria da regulação do comportamento alimentar ao longo de um programa de controlo do peso.

Métodos: Amostra de 239 mulheres com excesso de peso (idade: $37,6 \pm 7,1$ anos; IMC: $31,5 \pm 4,1 \text{ kg/m}^2$) distribuídas aleatoriamente por dois grupos – intervenção (GI) e controlo (GC). O GI participou numa intervenção comportamental de controlo ponderal. O GC teve acesso a um programa educacional generalista. As participantes preencheram uma bateria de questionários para avaliar as componentes avaliativa e de investimento da imagem corporal, e o comportamento alimentar, aos 0 e 12 meses. Utilizou-se a técnica de modelação por equações estruturais via *Partial Least Squares*.

Resultados: O modelo explicou 14-44% da variância das variáveis dependentes. A intervenção resultou em melhorias significativas de ambas as componentes da imagem corporal ($p < 0,001$), sobretudo da dimensão investimento ($f^2 = .28$ vs. $f^2 = .16$). As alterações

na dimensão investimento (-0,60; $p < 0,001$) e, em menor grau, na dimensão avaliativa (-0,15; $p < 0,05$) foram preditores das alterações positivas no comportamento alimentar. A intervenção produziu efeitos significativos na melhoria do comportamento alimentar, tendo estes sido totalmente mediados pela dimensão investimento e parcialmente pela dimensão avaliativa (ratio do efeito indireto/total: 0,77 e 0,26; respetivamente).

Conclusões: Os resultados sugerem que a melhoria da imagem corporal, sobretudo a sua dimensão investimento (i.e., saliência da imagem corporal no dia-a-dia do indivíduo), poderá desempenhar um papel importante na regulação mais eficaz do comportamento alimentar durante o processo de controlo do peso, pelo menos em mulheres.

Carraça E.V., Silva M.N., Coutinho s.R., Vieira P.N., Palmeira A.L., Sardinha L.B., Teixeira P.J. The (2009). Role of Personality Causality Orientations in Overweight Women Seeking Behavioral Weight Loss Treatment. Obesity 17 (Supp 2): S273.

Purpose: No previous study explored the role of personality causality orientations in weight management. This study was specifically aimed at understanding autonomous and impersonal orientations in this context. Specifically, we analysed baseline psychosocial correlates of causality orientations, whether these constructs changed throughout a 1-year intervention, and if orientations predicted change in weight and physical activity (PA).

Methods: At baseline, 237 women (37.6 ± 7.0 yr; 31.5 ± 4.1 kg/m²) were randomly assigned to intervention (IG) or comparison groups (CG). The IG participated in a 12-month weight management program seeking to improve diet/nutrition and increase PA, by promoting autonomy and self-determined behaviors. The CG received a general health education curriculum. Assessments included the General Causality Orientations Scale (autonomous (AO) and impersonal (IO) subscales), and several measures believed to be conceptually related to the orientations (e.g., self-determination, depression, anxiety, neuroticism, body image). PA at program's end was assessed with the 7-day PAR.

Results: At baseline, the autonomous and impersonal orientations were negatively correlated ($r = -.24$, $p < .001$). In addition, self-determination, self-motivation, internal locus of control for weight, and self-esteem were positively associated with the AO, whereas depression, anxiety, neuroticism, and social physique anxiety were negatively correlated. The same variables were associated with the IO, but in the opposite directions. During the program, there was a small increase in the autonomous orientation in the intervention group ($+1.62 \pm 8.0$; $p = .037$; $ES = .23$) while IO did not change (-1.33 ± 7.2 ; $p = .060$; $ES = .15$). Baseline orientations did not predict weight loss and PA adherence, before and after adjusting for participation group. Change in impersonal orientation was marginally associated with moderate/vigorous PA at 12 months, after adjusting for treatment group ($r = -.15$, $p = .047$).

Conclusions: Results confirmed that an autonomous causality orientation, reflecting an internal frame of reference for behavioral regulation, is associated with positive psychological outcomes. Contrarily, impersonal orientations, a marker for amotivation and inefficacy, predicted a more negative profile, in overweight and obese women. However, orientations were generally not associated with intervention outcomes, suggesting that these dispositional traits should not hamper success in weight management.

Carraça, E.V., Markland, D., Silva, M.N., Coutinho, S.R., Vieira, P.N., Sardinha, L.B., Teixeira, P.J. (2009). Relationships between body image, exercise behavioural regulations, and moderate and vigorous physical activity, in a weight management intervention in women. The 8th Annual Conference of the International Society for Behavioral Nutrition and Physical Activity *ISBNPA*. FMH Edições Lisbon, Portugal.

Introduction: This study aimed at i) testing a three-level model in which treatment moderates the relationship between pre-treatment body image (BI) and exercise self-regulations, and subsequent exercise behaviour; ii) analysing the mediating effects of body image change in the relationship between treatment and exercise regulations and behaviour, using a four-level model.

Methods: Participants were 160 overweight women (age: 38.3±6.8yr; BMI: 31.3±4.0kg/m²) engaged in a 12-month behavioural weight management program. Body Shape Questionnaire, Social Physique Anxiety Scale, and Physical Self Perception Profile measured Attitudinal BI; Body Image Assessment assessed Perceptual BI. The Exercise Self-Regulation Questionnaire and the 7-Day Physical Activity Recall measured exercise regulations and behaviour, respectively. The causal models were tested using Partial Least Squares (PLS) latent variable modelling.

Results: Exercise behaviour was positively influenced by integrated regulation ($p < 0.001$) in both models. In model 1, exercise self-regulations were not influenced by pre-treatment attitudinal nor perceptual BI and treatment did not moderate pre-treatment BI effects on exercise regulations. However, all regulations, except for external regulation, were positively influenced by treatment ($p < 0.001$), and integration mediated the effects of treatment on exercise behaviour ($p < 0.001$). In model 2, all regulations, except for introjection, were influenced by attitudinal BI at 12 months ($p < 0.05$). Treatment positively influenced attitudinal and perceptual BI, after controlling for pre-treatment BI levels ($p < 0.001$). Attitudinal BI and integrated regulation mediated the effects of treatment on exercise behaviour ($p < 0.01$).

Conclusions: Results suggest BI change might make a difference in enhancing exercise motivation and adoption, regardless of pre-treatment BI levels, during weight management in women.

Carraça, E.V., Markland, D., Silva, M.N., Vieira, P.N., Coutinho, S.R., Teixeira, P.J. (2009). Autonomous vs. Controlled regulation mediates the relationship between body image and psychological well-being in overweight and obese women. *The European Journal of Obesity* 2 (Supp 2): 242.

Introduction: The aim of this study was to test a three-level model in which body image, represented by several of its dimensions, predicted perceived choice and behavioural regulations for obesity treatment, which in turn influenced psychological well-being.

Methods: Participants were 142 overweight women (age: 38.0±6.7 yr; BMI: 31.9±4.1 kg/m²), entering a behavioural weight management program. They completed a comprehensive battery of body image questionnaires – Body Shape Questionnaire, Social Physique Anxiety Scale, Body Image Assessment, Body Dissatisfaction Scale (EDI-2), and Physical Self Perception Profile –, the Treatment Self-Regulation Questionnaire, and the Self-Determination Scale. The Rosenberg Self-Esteem and SF-36 questionnaires assessed psychological well-being. The causal model was tested using partial least squares latent variable modelling.

Results: Well-being was positively influenced by perceived choice ($p < 0.05$), negatively by controlled regulation ($p < 0.01$), but not influenced by autonomous regulation. Behavioural regulations were influenced by body image: perceived choice by physical self-worth (PSW, $p < 0.05$); autonomous regulation by body image discrepancy ($p < 0.05$); controlled regulation by body shape concerns (BSC, $p < 0.001$) and social physique anxiety (SPA, $p < 0.001$); all positively. Mediation effects were found: controlled regulation mediated BSC–well-being relations, except for vitality and mental health, and SPA–well-being relations, except for vitality; perceived choice mediated PSW–well-being relations, except for emotional health.

Conclusions: Poor body image may be detrimental to well-being in treatment-seeking overweight/obese women, to the extent it increases controlled regulation and decreases perceived choice (a marker of self-determination). Body image should be addressed during obesity treatment, particularly its importance/salience in one's personal life, as a way of increasing autonomy and well-being.

Carraça EV, Silva MN, Vieira PN, Coutinho SR, Castro MM, Minderico CS & Teixeira PJ. (2008). Associations of Body Image with Obesity Level and With 12-Month Weight Change During a 12-Month Behavioral Weight Management Program in Women. *Obesity* 16 (Supp 1): S159.

Purpose: Previous studies show that poor initial body image (BI) is a negative predictor of weight loss during treatment. Additionally, BI is usually decreased in obese groups, in comparison with normal-weight samples. We sought to describe the association between

several BI measures and overweight/obesity category before behavioral treatment, and to evaluate the moderating effect of pre-treatment BI on weight change during the program.

Methods: Initially, 258 overweight /obese (BMI: 25-40 kg/m²) women (37.6±7.1yr; 31.6±4.1 kg/m²) were randomly assigned to intervention/comparison groups. The 12-month intervention was designed to improve diet, increase physical activity, and promote autonomy and a healthier body image, at any weight. The comparison group received a general health education curriculum. At baseline, participants completed a comprehensive BI psychosocial battery. Multiple linear regression using interaction terms (initial BI vs. intervention group) was used to test for moderator effects of pre-treatment BI on 12-month weight outcomes.

Results: At baseline, body figure dissatisfaction (BIA, $r=0.46$; $p<0.001$) and body dissatisfaction with particular body regions (EDI-2, $r=0.27$; $p<0.001$) were positively associated with BMI. Comparing obesity categories, significant differences were found for these two variables; class II obesity participants reported greater dissatisfaction than class I obese and overweight women. No differences existed for physical self-worth, body shape concerns, fear of negative appearance evaluation, and social physique anxiety. Weight change was $-7.33\pm 6.0\%$ and $-1.77\pm 5.0\%$ for the intervention and comparison groups, respectively ($p<0.001$). No associations were found between pre-treatment BI measures and 12-month weight loss. In addition, there were no significant interactions between baseline BI variables and participation group, in predicting treatment-end weight loss.

Conclusions: In a relatively large sample of overweight and moderately obese women, some pre-treatment body dissatisfaction measures, though not all BI variables, were decreased at higher obesity levels. However, initial body image did not predict weight loss success nor did it moderate the intervention group significant effects on body weight change.

Other publications

Carraça E.V., Silva M.N., Coutinho s.R., Vieira P.N., Palmeira A.L., Sardinha L.B., Teixeira P.J. (2010). The Role of Personality Causality Orientations in Overweight Women Seeking Behavioral Weight Loss Treatment. The 4th International Conference on Self-Determination Theory. Editado pela Universiteit Gent.

Purpose: This study aimed at understanding causality orientations in a weight management context, by analysing their baseline psychosocial correlates, whether orientations changed

throughout a 1-year intervention, and if orientations predicted change in weight and physical activity (PA).

Methods: At baseline, 239 women (37.6 ± 7.1 yr; 31.5 ± 4.1 kg/m²) were randomly assigned to intervention (IG) or control groups. The IG participated in a 12-month SDT-based weight management program. Controls received a general health education curriculum.

Results: Controlled orientation was not analysed, due to the inconsistency/instability of the correspondent subscale. At baseline, the autonomous (AO) and impersonal (IO) orientations were negatively correlated ($r = -.24$, $p < .001$). In addition, self-determination, self-motivation, internal locus of control for weight, and self-esteem were positively associated with the AO, whereas depression, anxiety, neuroticism, and social physique anxiety were negatively correlated. The same variables were associated with the IO, but in the opposite directions. During the program, there was a small increase in the autonomous orientation in the intervention group ($+1.62 \pm 8.0$; $p = .037$; $ES = .23$) while IO did not change (-1.33 ± 7.2 ; $p = .060$; $ES = .15$). Baseline orientations did not predict weight loss and PA adherence, before and after adjusting for participation group. Change in impersonal orientation was marginally associated with moderate/vigorous PA at 12 months, after adjusting for treatment group ($r = -.15$, $p = .047$).

Conclusions: Results confirmed that an autonomous orientation predicts a more positive psychological profile compared to an impersonal orientation, in overweight and obese women. However, orientations were generally not associated with intervention outcomes, suggesting that these dispositional traits should not hamper success in weight management.

Carraça EV, Silva MN, Vieira PN, Coutinho SR, Castro MM, Minderico CS, Markland D, Teixeira PJ. (2008) Previous Weight Loss Attempts: Associations with Self-Determination and Body Image in Overweight and Obese Women. 7th Annual Meeting of International Society for Behavioral Nutrition and Physical Activity: Banff, Canada.

Purpose: In weight control programs, the number of previous weight loss attempts is a consistent negative moderator of success. We sought to analyze if, and by what mechanisms self-determination and body image predict previous dieting attempts, in overweight and obese women.

Methods: Before starting obesity treatment, 255 women (37.5 ± 7.1 yr; 31.6 ± 4.1 kg/m²) completed a comprehensive body image psychosocial battery, the Self-Determination Scale (sub-scales: self-awareness, perceived choice) and a weight/dieting history questionnaire. Regression analysis, using Preacher and Hayes (2007) procedures to test indirect/mediated effects, were used for statistical analyses.

Results: Previous weight loss attempts (WLA) were predicted by body shape concerns (BSC, $r=0.34$; $p<0.001$), physical self-worth (PSW, $r=-0.15$; $p=0.035$), social physique anxiety (SPA, $r=0.16$; $p=0.021$), and fear of negative appearance evaluation (FNAE, $r=0.25$; $p<0.001$); 13% of the variance in WLA was explained in multiple regression ($p<0.001$). Self-awareness was significantly related to all body image measures, with the strongest effect observed for BSC ($r=-0.45$; $p<0.001$). There were no significant total or direct effects of self-determination on WLA. However, indirect effects of self-awareness through BSC, SPA, and FNAE were significant ($p<0.05$). For perceived choice, significant indirect effects were observed only for BSC.

Conclusions: Recent dieting attempts are strongly related to poor body image. Mediation analysis suggests that awareness of self may hold an indirect effect on dieting attempts through body image. Results are consistent with the hypothesis that reduced self-awareness contributes to body dissatisfaction, which in turn increases the desire to diet and/or lose weight. This trial will continue to explore mechanisms that might explain repeated dieting attempts.

Other communications

Carraça, E.V., Silva, M.N., Markland, D., Teixeira, P.J. Self-determination and long-term exercise adherence. In Simpósio/Symposium: “Getting the Chronically Inactive off the Couch: Does Theory Work?”. In ACSM's 59th Annual Meeting and 3rd World Congress on Exercise is Medicine. San Francisco, US, 2012.

Purpose: Motivation is a critical factor in supporting sustained exercise participation, which in turn is associated with important health outcomes. Self-determination theory (SDT) is a well-known theoretical framework that explores motivational mechanisms linked to physical activity (PA) adoption and maintenance. SDT-based research has grown considerably in recent years. This study presents a broad review of published empirical data, examining relations between key SDT-based constructs and exercise behavioral outcomes.

Methods: This systematic review includes 66 empirical studies published up to June 2011, including experimental, cross-sectional, and prospective studies that have measured exercise causality orientations, need support and need satisfaction, exercise motives/goals, and exercise self-regulations and motivation. We also studied SDT-based interventions aimed at increasing exercise behavior. In all studies, actual or self-reported exercise,

including attendance, was analyzed as dependent variable. Findings are summarized based on quantitative analysis of the evidence.

Results: Results show consistent positive relations between more autonomous forms of motivation and exercise, with a trend towards identified regulation predicting initial/short-term adoption more strongly than intrinsic motivation, and the latter being more predictive of long-term exercise adherence. Perceived competence satisfaction in exercise and more intrinsic motives/goals to be physically active (affiliation, skill development) consistently predicted exercise participation across diverse samples and settings. Mixed evidence was found regarding the role of other types of motives/goals (health/fitness and body-related goals), and the specific nature and consequences of introjected regulation. Most of these studies used descriptive designs but similar results are found across cross-sectional, prospective, and experimental designs.

Conclusion: Overall, the literature provides supportive evidence for the value of SDT in explaining exercise behavior, demonstrating the relevance of developing autonomous regulations and addressing the nature of exercise goals in fostering adherence. Results are discussed in the context of refining SDT application to PA research and promotion.

Carraça, E.V., Teixeira, P.J. Alterações na atividade física, no comportamento alimentar e na imagem corporal em mulheres com excesso de peso: Uma inter-regulação? In Simpósio/Symposium: Quem consegue perder peso e porquê? Preditores de sucesso em mulheres portuguesas com excesso de peso. In 9º Congresso Nacional de Psicologia da Saúde. Aveiro, Portugal, 2012.

A alimentação e a atividade física (AF) são os dois elementos-chave do balanço energético e sobre os quais recai a maioria das intervenções de controlo do peso. Por seu lado, a imagem corporal assume-se como uma variável psicossocial consistentemente comprometida na população com excesso de peso. A evidência sugere que existem inter-relações causais e recíprocas entre estas variáveis e mecanismos associados, com importantes implicações para o sucesso da auto-regulação do peso. Esta comunicação tem como objetivos descrever os principais efeitos da intervenção P.E.S.O. na atividade física, comportamento alimentar e imagem corporal; e analisar interações entre estas variáveis e a sua associação com outros aspetos de natureza auto-regulatória e psicológica. A intervenção influenciou a AF moderada/vigorosa e AF do estilo de vida e conduziu a melhorias em vários marcadores do comportamento alimentar, particularmente na restrição alimentar rígida e flexível, e da imagem corporal, resultando em alterações similares nas suas dimensões (insatisfação e preocupação excessiva). Tendo como referência central o papel da imagem corporal, serão exploradas algumas relações entre estas e outras variáveis de natureza auto-regulatória e psicológica. Os resultados sugerem que a preocupação excessiva com a imagem está associada a maior sofrimento psicológico através da sua

associação com uma regulação externamente controlada, mas indicam que esta pode ser eficazmente reduzida com o tratamento e com a prática de AF moderada/vigorosa e dessa forma contribuir para uma melhor regulação alimentar e bem-estar psicológico. Estes resultados sugerem a presença de fenómenos inter-regulatórios entre os diversos preditores da gestão do peso.

Carraça, E.V. O papel da regulação externa na imagem corporal e regulação do comportamento alimentar. In Simpósio/Symposium: “Diga-me...!: A regulação externa e a motivação para a alimentação e exercício físico”. In 13º Congresso Português de Obesidade. Vilamoura, Portugal, 2009.

Resumo: Começar-se-á por fazer um enquadramento desta questão, tendo como referência conceptual a Abordagem Sociocultural da Atratividade Física e a Teoria da Auto-Determinação. De forma empiricamente suportada serão discutidas as influências socioculturais enquanto promotoras de orientações/regulações mais externas e controladas e, por sua vez, será analisado o contributo deste tipo de regulações para a insatisfação corporal e imagem corporal empobrecida. De seguida serão debatidas as consequências deste processo na regulação do comportamento alimentar, tendo como base o modelo dual da Bulimia Nervosa de Stice. Por último serão consideradas algumas implicações do exposto para o tratamento da obesidade (tendo como alvo a sua sustentação no longo prazo). Serão discutidas possíveis soluções e estratégias, empiricamente suportadas, sendo enfatizada 1) a importância de criar um ambiente promotor de autonomia e auto-determinação e 2) a importância de promover a melhoria da imagem corporal. Para terminar esta secção, introduzir-se-á uma nova variável – exercício – que apresenta grande relevo na gestão do peso no longo prazo, explorando-se o papel que este poderá desempenhar neste processo.

APPENDICES

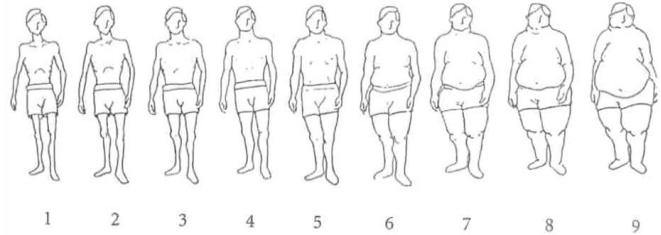
Self-report instruments used in the thesis

Figure Rating Scale

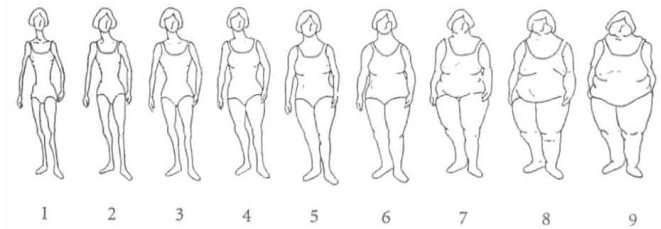
Questionário de Imagem Corporal

1. Utilize as silhuetas para responder às seguintes questões:

a) Qual a figura que mais se assemelha ao peso adulto médio da sua mãe? _____



b) Qual a figura que mais se assemelha ao peso adulto médio do seu pai? _____



c) Qual a figura que melhor representa a sua silhueta ACTUAL? _____

d) Qual a figura que melhor representa a sua silhueta IDEAL? _____

Body Shape Questionnaire

Questionário da Forma Corporal

Estamos interessados em saber como se tem **sentido acerca da sua aparência DURANTE AS ÚLTIMAS QUATRO SEMANAS**. Por favor leia cada afirmação e assinale com um círculo o número mais adequado.

NAS ÚLTIMAS QUATRO SEMANAS...

	NUNCA	RARAMENTE	ALGUMAS VEZES	BASTANTE S VEZES	MUITAS VEZES	SEMPRE
1. Em alturas em que estava sem nada para fazer, deu por si a pensar na sua figura?	1	2	3	4	5	6
2. Sentiu-se tão preocupada acerca da sua figura que achou que devia fazer dieta?	1	2	3	4	5	6
3. Pensou que as suas coxas, anca e nádegas são demasiado grandes para o resto do seu corpo?	1	2	3	4	5	6
4. Sentiu receio de ficar “gorda” (ou mais “gorda” do que é)?	1	2	3	4	5	6
5. Preocupou-se com a pouca firmeza do seu corpo?	1	2	3	4	5	6
6. Sentiu-se cheia (depois de uma grande refeição) o que a levou a achar-se “gorda”?	1	2	3	4	5	6
7. Sentiu-se tão mal acerca da sua figura que chorou?	1	2	3	4	5	6
8. Evitou correr porque a sua pele e gordura poderiam abanar demasiado?	1	2	3	4	5	6
9. Esteve com mulheres magras o que a faz sentir alguma vergonha pela sua figura?	1	2	3	4	5	6
10. Preocupou-se acerca das suas coxas ocuparem muito espaço (“espalharem-se”) quando sentada?	1	2	3	4	5	6
11. Sentiu-se “gorda” depois de comer mesmo uma pequena porção de comida?	1	2	3	4	5	6
12. Reparou na figura de outras mulheres e sentiu que a sua figura era pior do que a delas?	1	2	3	4	5	6
13. Notou que ao pensar na sua figura, isto interferiu com a sua capacidade de concentração (ao ver TV, ler ou ao conversar)?	1	2	3	4	5	6
14. Sentiu-se “gorda” quando estava nua, por exemplo, ao tomar banho?	1	2	3	4	5	6

Appendices

	NUNCA	RARAMENTE	ALGUMAS VEZES	BASTANTE S VEZES	MUITAS VEZES	SEMPRE
15. Evitou vestir roupas que a fazem especialmente consciente da figura do seu corpo?	1	2	3	4	5	6
16. Imaginou-se a cortar partes mais gordas (maiores) do seu corpo?	1	2	3	4	5	6
17. Sentiu-se “gorda” após comer doces, bolos ou outras comidas com muitas calorias?	1	2	3	4	5	6
18. Deixou de ir a eventos sociais (ex. festas) porque se sentiu mal acerca da sua figura?	1	2	3	4	5	6
19. Sentiu-se excessivamente grande e roliça/rechonchuda?	1	2	3	4	5	6
20. Sentiu vergonha do seu corpo?	1	2	3	4	5	6
21. Fez dieta (restringiu comida) pois estava preocupada com a sua figura?	1	2	3	4	5	6
22. Sentiu-se mais feliz acerca da sua figura quando o seu estômago estava vazio?	1	2	3	4	5	6
23. Pensou que tem a figura que tem porque lhe falta capacidade de auto-controlo?	1	2	3	4	5	6
24. Preocupou-se em não deixar outras pessoas verem “pneus” na zona da sua barriga?	1	2	3	4	5	6
25. Sentiu que não é justo que outras mulheres sejam mais magras que você?	1	2	3	4	5	6
26. Vomitou de modo a ser ou sentir-se mais magra?	1	2	3	4	5	6
27. Quando estava acompanhada preocupou-se em ocupar demasiado espaço (ex.: num sofá ou lugar de autocarro)?	1	2	3	4	5	6
28. Preocupou-se com o facto da sua pele/gordura ser demasiado mole e abanar?	1	2	3	4	5	6
29. Sentiu-se mal acerca da sua figura ao ver a sua imagem reflectida (ex.: espelho ou vidro numa loja)?	1	2	3	4	5	6
30. Beliscou partes do seu corpo para ver quanta gordura lá tem?	1	2	3	4	5	6
31. Evitou situações onde as pessoas podem ver o seu corpo (balneários comuns ou piscinas públicas)?	1	2	3	4	5	6
32. Tomou laxativos (produtos para ir à WC mais vezes) para se sentir ou ser mais magra?	1	2	3	4	5	6

Appendices

	NUNCA	RARAMENTE	ALGUMAS VEZES	BASTANTE S VEZES	MUITAS VEZES	SEMPRE
33. Sentiu-se especialmente preocupada/envergonhada na sua figura na companhia de outras pessoas?	1	2	3	4	5	6
34. Pensou que devia fazer exercício ao sentir-se preocupada com a sua figura?	1	2	3	4	5	6

Social Physique Anxiety Scale

Escala de Ansiedade Física Social

As afirmações seguintes dizem respeito a características que as pessoas podem apresentar. Leia cada uma delas, assinalando até que ponto essa afirmação é característica ou verdadeira para si, de acordo com a escala.

	Nada	Ligeiramente	Moderadamente	Muito	Extremamente
1. Sinto-me confortável com a minha aparência física	0	1	2	3	4
2. Nunca me preocuparia com o uso de roupas que possam fazer-me parecer demasiado magra ou obesa	0	1	2	3	4
3. Gostava de não estar tão preocupada com a minha estrutura física	0	1	2	3	4
4. Há alturas em que sou importunada por pensamentos acerca de avaliações negativas que os outros estão a fazer do meu peso ou do meu desenvolvimento muscular	0	1	2	3	4
5. Quando olho ao espelho sinto-me bem com a minha estrutura física	0	1	2	3	4
6. As partes pouco atractivas da minha estrutura física fazem-me ficar nervosa em certos contextos sociais	0	1	2	3	4
7. Fico apreensiva acerca da minha figura na presença dos outros	0	1	2	3	4
8. Sinto-me confortável com a forma como o meu corpo parece aos outros	0	1	2	3	4
9. Sentir-me-ia desconfortável se soubesse que os outros estavam a avaliar a minha figura	0	1	2	3	4
10. Quando se trata de mostrar a minha figura aos outros, sou uma pessoa tímida	0	1	2	3	4
11. Habitualmente, sinto-me relaxada quando é óbvio que os outros estão a olhar para a minha figura	0	1	2	3	4
12. Quando estou em fato de banho, sinto-me frequentemente nervosa acerca da forma do meu corpo	0	1	2	3	4

Treatment Self-Regulation Questionnaire - Initial

Questionário de Auto-Regulação para o Tratamento - Inicial

As seguintes afirmações referem-se a possíveis motivos para participar num programa de controlo de peso. Diferentes pessoas poderão apresentar diferentes razões. Neste sentido, ao ler as afirmações constantes neste questionário, deve considerar até que ponto elas são verdadeiras para si, ou seja até que ponto elas reflectem a sua visão.

Nota: Para cada grupo apresentado, deve responder a todas as afirmações

A. Decidi entrar neste Programa de Controlo de Peso porque:

1. Não conseguirei gostar de mim até perder peso

Nada verdadeiro			Moderadamente Verdadeiro			Totalmente verdadeiro
1	2	3	4	5	6	7

2. As pessoas gostarão mais de mim quando for magra

Nada verdadeiro			Moderadamente Verdadeiro			Totalmente verdadeiro
1	2	3	4	5	6	7

3. É pessoalmente importante para mim ser mais magra

Nada verdadeiro			Moderadamente Verdadeiro			Totalmente verdadeiro
1	2	3	4	5	6	7

4. Eu quero realmente promover algumas mudanças na minha vida

Nada verdadeiro			Moderadamente Verdadeiro			Totalmente verdadeiro
1	2	3	4	5	6	7

B. Se permanecer no Programa será provavelmente porque:

5. Sentir-me-ei como estando a falhar se não o fizer

Nada verdadeiro			Moderadamente Verdadeiro			Totalmente verdadeiro
1	2	3	4	5	6	7

6. Os outros pensarão que sou uma pessoa fraca se não o fizer

Nada verdadeiro			Moderadamente Verdadeiro			Totalmente verdadeiro
-----------------	--	--	--------------------------	--	--	-----------------------

			Verdadeiro			
1	2	3	4	5	6	7
7. Sentir-me-ei muito mal comigo mesma se não o fizer						
Nada			Moderadament			Totalmente
verdadeiro			e			verdadeiro
			Verdadeiro			
1	2	3	4	5	6	7
8. Os outros ficarão zangados comigo se não o fizer						
Nada			Moderadament			Totalmente
verdadeiro			e			verdadeiro
			Verdadeiro			
1	2	3	4	5	6	7
9. Sinto que é a melhor forma de me ajudar a mim própria						
Nada			Moderadament			Totalmente
verdadeiro			e			verdadeiro
			Verdadeiro			
1	2	3	4	5	6	7
C. Eu tenciono perder peso porque:						
10. Terei vergonha de mim própria se não o fizer						
Nada			Moderadament			Totalmente
verdadeiro			e			verdadeiro
			Verdadeiro			
1	2	3	4	5	6	7
11. Detestar-me-ei se não conseguir manter o meu peso sob controlo						
Nada			Moderadament			Totalmente
verdadeiro			e			verdadeiro
			Verdadeiro			
1	2	3	4	5	6	7
12. Os meus amigos/família não gostam da minha aparência						
Nada			Moderadament			Totalmente
verdadeiro			e			verdadeiro
			Verdadeiro			
1	2	3	4	5	6	7
13. Ter excesso de peso torna complicado fazer certas coisas						
Nada			Moderadament			Totalmente
verdadeiro			e			verdadeiro
			Verdadeiro			
1	2	3	4	5	6	7

D. Eu aceitei seguir as linhas orientadoras do Programa porque:

14. Preocupa-me entrar em conflito com a equipa de intervenção se não o fizer

Nada verdadeiro			Moderadamente Verdadeiro			Totalmente verdadeiro
1	2	3	4	5	6	7

15. Sentir-me-ei culpada se não cumprir com todas as orientações

Nada verdadeiro			Moderadamente Verdadeiro			Totalmente verdadeiro
1	2	3	4	5	6	7

16. Quero que os outros vejam que estou realmente a tentar perder peso

Nada verdadeiro			Moderadamente Verdadeiro			Totalmente verdadeiro
1	2	3	4	5	6	7

17. Acredito que me ajudarão a resolver o meu problema

Nada verdadeiro			Moderadamente Verdadeiro			Totalmente verdadeiro
1	2	3	4	5	6	7

18. É importante para mim atingir os meus objectivos

Nada verdadeiro			Moderadamente Verdadeiro			Totalmente verdadeiro
1	2	3	4	5	6	7

Rosenberg Self-Esteem Scale

Questionário de Auto-Estima

Segue-se uma lista de afirmações acerca da forma como você considera que é.

Se CONCORDAR FORTEMENTE, faça um círculo em CF.

Se CONCORDA com a afirmação, faça um círculo em C.

Se DISCORDA, faça um círculo em D.

Se DISCORDA FORTEMENTE, faça um círculo em DF

	DISCORDO FORTEMENTE	DISCORDO	CONCORDO	CONCORDO FORTEMENTE
1. Sinto que sou uma boa pessoa – pelo menos tão boa como outras.	DF	D	C	CF
2. Tenho um grande número de boas qualidades.	DF	D	C	CF
3. Levando tudo em conta, sinto-me uma pessoa falhada.	DF	D	C	CF
4. Sou capaz de fazer as coisas tão bem como a maior parte das pessoas.	DF	D	C	CF
5. Sinto que não tenho muito por que me orgulhar.	DF	D	C	CF
6. Tenho uma atitude positiva em relação a mim próprio/a.	DF	D	C	CF
7. Globalmente estou satisfeito comigo próprio/a.	DF	D	C	CF
8. Desejava ter mais respeito por mim mesmo.	DF	D	C	CF
9. Às vezes sinto-me mesmo inútil.	DF	D	C	CF
10. Às vezes penso que não presto para nada.	DF	D	C	CF

Beck Depression Inventory

Inventário de Depressão de Beck

Este questionário é composto por 21 grupos de afirmações. Por favor leia cada grupo de afirmações cuidadosamente e depois escolha **uma afirmação**, em cada grupo, que melhor descreva a forma como se tem sentido nas **duas últimas semanas, incluindo o dia de hoje**. Faça um círculo à volta do número correspondente à afirmação que seleccionou. Se lhe parecer que diversas frases do mesmo grupo se aplicam igualmente bem, coloque o círculo à volta do número mais elevado para esse grupo. Assegure-se de que não escolhe mais do que uma frase em cada grupo, inclusive no Item 16 (Mudanças no Padrão de Sono) ou no Item 18 (Mudanças no Apetite).

1. Tristeza

Não me sinto triste.....	0
Sinto-me triste a maior parte do tempo	1
Estou sempre triste	2
Estou tão triste ou infeliz que não aguento mais	3

2. Pessimismo

Não estou pessimista em relação ao meu futuro	0
Sinto-me mais pessimista acerca do meu futuro do que era normal	1
Não espero que as coisas se vão resolver em meu benefício	2
Não tenho esperança no meu futuro e penso que ainda irá piorar.....	3

3. Fracassos do passado

Não me sinto um falhado/a.....	0
Fracassei mais do que deveria.....	1
Quando olho para o meu passado, vejo imensos fracassos	2
Como pessoa, sinto-me completamente falhado/a	3

4. Perda de prazer

Sinto a mesma satisfação de sempre, com as coisas de que gosto	0
Não gosto tanto das coisas como gostava antes	1
Obtenho muito pouco prazer das coisas de que costumava gostar.....	2
Não consigo ter qualquer prazer com as coisas de que costumava gostar	3

5. Sentimentos de culpa

Não me sinto particularmente culpado/a	0
Sinto-me culpado/a com muitas coisas que fiz ou que devia ter feito.....	1
Sinto-me culpado/a a maior parte do tempo.....	2
Sinto-me constantemente culpado/a.....	3

6. Sentimentos de punição

Não sinto que esteja a ser punido/a	0
Sinto que talvez venha a ser punido/a	1
Espero vir a ser punido/a.....	2
Sinto que estou a ser punido/a.....	3

7. Auto-desvalorização

O que sinto acerca de mim próprio/a não se tem alterado.....0
 Perdi a confiança em mim1
 Estou desiludido comigo próprio/a2
 Não gosto de mim3

8. Auto-crítica

Não me critico ou culpo mais do que o habitual0
 Sou mais crítico/a de mim próprio/a do que era habitual1
 Critico-me por todos os meus erros.....2
 Culpo-me por todo o mal que acontece.....3

9. Pensamentos ou desejos suicidas

Não tenho pensamentos suicidas.....0
 Tenho pensamentos suicidas, mas nunca os levaria à prática1
 Gostaria de me suicidar2
 Se tivesse oportunidade matava-me3

10. Chorar

Não choro mais do que chorava0
 Choro mais do que costumava chorar1
 Choro por tudo e por nada.....2
 Tenho vontade de chorar mas não consigo3

11. Agitação

Não estou mais inquieto/a ou agitado/a do que o normal.....0
 Sinto-me mais inquieto/a ou agitado/a do que o normal1
 Estou tão inquieto/a ou agitado/a que é difícil ficar parado/a2
 Estou tão inquieto/a ou agitado/a que tenho de estar sempre a mexer-me ou a fazer alguma coisa3

12. Perda de interesse

Não perdi o interesse nas outras pessoas ou actividades0
 Estou menos interessado nas outras pessoas ou coisas do que era habitual1
 Perdi a maior parte do interesse nas outras pessoas ou coisas2
 É muito difícil interessar-me por alguma coisa.....3

13. Indecisão

Tomo decisões tão bem como sempre.....0
 Sinto mais dificuldade em tomar decisões do que é normal1
 Tenho muito mais dificuldade em tomar decisões do que antes2
 Tenho problemas em tomar qualquer decisão3

14. Sentimento de inutilidade

Não sinto que seja um/uma inútil ou uma pessoa sem valor.....0
 Não considero que tenha tanto valor e utilidade como dantes1
 Sinto que tenho menos valor quando me comparo com outras pessoas.....2
 Sinto-me completamente inútil e sem valor3

15. Perda de energia

Tenho tanta energia como sempre.....0

Tenho menos energia do que era habitual	1
Não tenho energia para fazer muita coisa	2
Não tenho energia para o que quer que seja.....	3

16. Alterações no ritmo de sono

Não tenho notado qualquer mudança no meu padrão de sono	0
Durmo um pouco mais/menos do que o costume.....	1
<i>OU</i>	
Durmo muito mais/menos do que o costume	2
Durmo a maior parte do dia.....	3
Acordo 1-2 horas mais cedo e não consigo voltar a adormecer	3

17. Irritabilidade

Não estou mais irritável do que o normal.....	0
Estou mais irritável do que o normal.....	1
Estou muito mais irritável do que o normal	2
Estou sempre irritável.....	3

18. Mudanças no apetite

Não noto qualquer mudança no meu apetite	0
O meu apetite é um pouco menor do que o normal.....	1
<i>OU</i>	
O meu apetite é um pouco maior do que o normal	1
O meu apetite é muito menor do que antes	2
<i>OU</i>	
O meu apetite é muito maior do que antes	2
Não tenho nenhum apetite.....	3
Estou constantemente com vontade de comer.....	3

19. Dificuldade de concentração

Consigo-me concentrar tão bem como sempre	0
Não me consigo concentrar tão bem como o habitual.....	1
É difícil concentrar-me nalguma coisa durante muito tempo.....	2
Acho que não me consigo concentrar em nada	3

20. Cansaço ou falta de energia

Não me sinto mais cansado ou sem energia do que o normal	0
Fico cansado ou sem energia mais facilmente do que o normal	1
Sinto-me demasiado cansado ou sem energia para fazer muitas das coisas que costumava fazer	2
Sinto-me demasiado cansado ou sem energia para fazer a maior parte das coisas que costumava fazer	3

21. Perda de interesse em sexo

Não notei qualquer mudança recente no meu interesse por sexo	0
Tenho menos interesse por sexo do que era habitual	1
Actualmente estou muito menos interessado em sexo	2
Perdi completamente o interesse por sexo	3

SF-36

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Acerca destas perguntas:

As questões que se seguem pedem-lhe opinião sobre a sua saúde, a forma como se sente e sobre a capacidade de desempenhar as actividades habituais. Pedimos que leia com atenção cada pergunta e responda o mais honestamente possível. Se não tiver a certeza sobre a resposta a dar, dê-nos a que achar mais apropriada e, se quiser, escreva um comentário a seguir à pergunta. A informação que nos der nunca será usada de modo a poder ser identificado/a.

Para as perguntas 1 e 2, por favor coloque um círculo no número que melhor descreve a sua saúde.

1 – Em geral, diria que a sua saúde é:

Ótima	Muito boa	Boa	Razoável	Fraca
1	2	3	4	5

2 – Comparando com o que acontecia há um ano, como descreve o seu estado geral actual:

Muito melhor	Com algumas melhoras	Aproximadamente igual	Um pouco pior	Muito pior
1	2	3	4	5

3 – As perguntas que se seguem são sobre actividades que executa no seu dia-a-dia. Será que a sua saúde o/a limita nestas actividades? Se sim, quanto? (por favor assinale com um círculo um número em cada linha)

	Sim muito limitado/a	Sim, um pouco limitado/a	Não, nada limitado/a
3.1. Actividades violentas, tais como correr, levantar pesos, participar em desportos violentos	1	2	3
3.2. Actividades moderadas, tais como deslocar uma mesa ou aspirar a casa	1	2	3
3.3. Levantar ou carregar as compras da mercearia	1	2	3
3.4. Subir vários lanços de escada	1	2	3
3.5. Subir um lanço de escadas	1	2	3
3.6. Inclinar-se, ajoelhar-se ou baixar-se	1	2	3
3.7. Andar mais de 1 Km	1	2	3
3.8. Andar vários quarteirões	1	2	3
3.9. Andar um quarteirão	1	2	3
3.10. Tomar banho ou vestir-se sozinho/a	1	2	3

4 – Durante as últimas semanas teve, no seu trabalho ou actividades diárias, alguns problemas apresentados a seguir como consequência do seu estado de saúde físico? (por favor, em cada linha ponha um círculo à volta do número 1, se for sim, e à volta do número 2, se a resposta for não)

	Sim	Não
4.1. Diminuiu o tempo gasto a trabalhar, ou noutras actividades	1	2
4.2. Fez menos do que queria	1	2
4.3. Sentiu-se limitado/a no tipo de trabalho ou outras actividades	1	2
4.4. Teve dificuldade em executar o seu trabalho ou outras actividades (por exemplo, foi preciso mais esforço)	1	2

5 . Durante as últimas 4 semanas, teve com o seu trabalho ou com as suas actividades diárias, algum dos problemas apresentados a seguir devido a quaisquer problemas emocionais (tal como sentir-se deprimido/a ou ansioso/a) (por favor, em cada linha ponha um círculo à volta do numero 1, se for sim, e à volta do número 2, se a resposta for não)

	Sim	Não
5.1. Diminuiu o tempo gasto a trabalhar, ou noutras actividades	1	2
5.2. Fez menos do que queria	1	2
5.3. Não executou o trabalho ou outras actividades tão cuidadosamente como era costume	1	2

6 – Durante as últimas 4 semanas, em que medida é que a sua saúde física ou problemas emocionais interferiram com o seu relacionamento social normal com a família, amigos, vizinhos ou outras pessoas? (Assinale com um círculo a sua resposta)

Absolutamente nada	Pouco	Moderadamente	Bastante	Imenso
1	2	3	4	5

7 – Durante as últimas quatro semanas teve dores? (Assinale com um círculo a sua resposta)

Nenhumas	Muito fracas	Ligeiras	Moderadas	Fortes	Muito fortes
1	2	3	4	5	6

8 – Durante as últimas 4 semanas, de que forma é que a dor interferiu com o seu trabalho normal (tanto o trabalho fora de casa como o trabalho doméstico)? (Assinale com um círculo a sua resposta)

Absolutamente nada	Pouco	Moderadamente	Bastante	Imenso
1	2	3	4	5

9 – As perguntas que se seguem pretendem avaliar a forma como se sentiu e como lhe correram as coisas nas últimas 4 semanas. Para cada pergunta, coloque por favor um círculo à volta do número que melhor descreva a forma como se sentiu. Certifique-se que coloca um círculo em cada linha.

Quanto tempo, nas últimas 4 semanas ...	Sempre	A maior parte do tempo	Bastante tempo	Algum tempo	Pouco tempo	Nunca
9.1. Se sentiu cheio/a de vitalidade?	1	2	3	4	5	6
9.2. Se sentiu muito nervoso/a?	1	2	3	4	5	6
9.3. Se sentiu tão deprimido/a que nada o/a animava?	1	2	3	4	5	6

Appendices

9.4. Se sentiu calmo/a e tranquilo/a?	1	2	3	4	5	6
9.5. Se sentiu com muita energia?	1	2	3	4	5	6
9.6. Se sentiu triste e em baixo?	1	2	3	4	5	6
9.7. Se sentiu estafado/a?	1	2	3	4	5	6
9.8. Se sentiu feliz?	1	2	3	4	5	6
9.9. Se sentiu cansado/a	1	2	3	4	5	6

10 – Durante as últimas 4 semanas, até que ponto é que a sua saúde física ou problemas emocionais limitaram a sua actividade social (tal como visitar amigos ou familiares próximos)?

Sempre	A maior parte do tempo	Algum tempo	Pouco tempo	Nunca
1	2	3	4	5

11 – Por favor, diga em que medida são verdadeiras ou falsas as seguintes afirmações. (Assinale com um círculo a sua resposta)

	Absolutamente verdade	Verdade	Não sei	Falso	Absolutamente falso
11.1. Parece que adoço mais facilmente do que os outros.	1	2	3	4	5
11.2. Sou tão saudável como qualquer outra pessoa	1	2	3	4	5
11.3. Estou convencido/a que a minha saúde vai piorar	1	2	3	4	5
11.4. A minha saúde é óptima	1	2	3	4	5

7-Day Physical Activity Recall

1. Dia da semana a que se refere o questionário: _____

2. Gostaria que se lembrasse de todas as actividades físicas que fez nos últimos 7 dias (o último dia recordado será ontem). Indique se em cada um dos 7 dias, realizou actividade física e que actividades fez. Só estamos interessados em actividades físicas de intensidade moderada ou superior (actividades intensas).

Actividades moderadas são as que fazem aquecer o seu corpo e até suar um pouco (num dia de temperatura normal) e que aceleram a sua frequência cardíaca e a sua respiração mais do que o normal. O melhor exemplo de uma actividade física de intensidade moderada é uma caminhada a um passo rápido. Alguns trabalhos de jardinagem mais activos e alguns trabalhos domésticos (p.ex., aspirar ou lavar janelas), se executados de forma contínua e acelerada, podem também fazer elevar a sua respiração e calor corporal e ser considerados actividades físicas moderadas. Nestas actividades, ainda consegue conversar de forma relativamente normal.

Actividades intensas são as que tornam a sua respiração claramente mais frequente e aumentam muito a sua frequência cardíaca, tais como uma corrida ou uma aula de ginástica aeróbica. Se já não consegue conversar normalmente durante uma certa actividade, está por certo a fazer uma actividade física intensa.

Indique apenas actividades que tenham durado 10 minutos ou mais. Está pronta? Vamos então pensar na última semana... *(passar para a página seguinte)*

3. Esta semana foi típica em termos do seu padrão habitual de actividade ou exercício? Sim Não Se não, explique de forma breve:

Se não, foi mais ou menos activa do que costuma ser? Mais Menos

- Se faz mais actividade que o normal, gostaria que me indicasse quais as actividades que acabou de me listar que foram a mais do que é o habitual... *(indicar estas actividades no quadro com a codificação NHE⁺, utilizando caneta vermelha)*
- Se fez menos actividade que o normal, gostaria que me descrevesse agora as actividades físicas que faz habitualmente (últimos 3 meses aproximadamente) mas que não efectuou a semana passada... *(indicar estas actividades no quadro com a codificação HNE, utilizando caneta vermelha)*

Até agora, temos falado apenas dos últimos sete dias. Agora gostaria que pensasse nas suas actividades habituais nos últimos três meses.

4. Quantos lances de escadas sobe por dia? (1 lance = 10 degraus aproximadamente) _____ número de lances

5. Costuma realizar regularmente exercícios de força e flexibilidade, tais como agachamentos, flexões de braços, “abdominais”, yoga ou alongamentos?

Não Sim Se sim, quantos dias por semana realiza estes exercícios? _____ número de dias (0-7)

6. Nos dias em que realiza exercícios de força e flexibilidade, durante quantos minutos os executa? _____ minutos/semana (total)

Uma semana atrás

Ontem

	dia da semana	dia da semana	dia da semana	dia da semana	dia da semana	dia da semana	dia da semana
Dormir	HRS MIN ----- :	HRS MIN ----- :	HRS MIN ----- :	HRS MIN ----- :	HRS MIN ----- :	HRS MIN ----- :	HRS MIN ----- :
	descrição	descrição	descrição	descrição	descrição	descrição	descrição
	----- duração :	----- duração :	----- duração :	----- duração :	----- duração :	----- duração :	----- duração :
	----- :	----- :	----- :	----- :	----- :	----- :	----- :
	----- :	----- :	----- :	----- :	----- :	----- :	----- :
	----- :	----- :	----- :	----- :	----- :	----- :	----- :
AF Habitual Não Efectuada (HNE)	----- :	----- :	----- :	----- :	----- :	----- :	----- :

(voltar à página anterior, questão 3)

Lifestyle Physical Activity Index

Index de Atividade Física do Estilo de Vida

As questões seguintes descrevem actividades do dia-a-dia. P.f. indique quantas vezes, no último mês, escolheu cada uma das actividades descritas.

1. Subir escadas em vez de utilizar elevadores ou escadas rolantes (p.ex. no seu prédio, em centros comerciais, no local de trabalho, etc.)

Nunca Poucas vezes Algumas vezes Muitas vezes Sempre que possível

2. Escolher estar em pé em situações em que podia estar sentado/a (p.ex. em casa, enquanto fala ao telefone, enquanto espera em locais públicos, espera pelo transporte, etc.)

Nunca Poucas vezes Algumas vezes Muitas vezes Sempre que possível

3. Escolher caminhar quando habitualmente costumava ir de carro ou transportes (p.ex. ir às compras, deslocar-se no bairro ou em percursos pequenos equivalentes a 5-10 min de carro, ir aos correios ou à farmácia, etc.)

Nunca Poucas vezes Algumas vezes Muitas vezes Sempre que possível

4. Estacionar o carro num local mais distante da entrada (p.ex. centros comerciais, lojas, cinema, trabalho, etc.) para poder caminhar mais até à entrada

Nunca Poucas vezes Algumas vezes Muitas vezes Sempre que possível

5. Escolher fazer manualmente o que antes fazia com auxílio de máquinas automáticas (p.ex. lavar o carro, lavar janelas, etc.)

Nunca Poucas vezes Algumas vezes Muitas vezes Sempre que possível

6. Fazer pausas durante o trabalho ou utilizar os intervalos do trabalho para caminhar ou movimentar-se mais (p.ex. caminhar até o restaurante, caminhar para entregar uma mensagem ao colega de trabalho em vez de enviar via e-mail ou telefonar, escolher um WC mais distante do lugar onde trabalha em vez do mais próximo, etc.)

Nunca Poucas vezes Algumas vezes Muitas vezes Sempre que possível

7. Escolher caminhar ou outra forma activa quando é forçado/a a esperar em circunstâncias diárias (esperar por alguém, esperar para ser atendido, durante os anúncios da TV)

Nunca Poucas vezes Algumas vezes Muitas vezes Sempre que possível

8. Existem outras situações em que escolhe ser fisicamente mais activo/a, quando podia facilmente gastar menos energia? Se sim indique em baixo, p.f.

Descreva a situação: _____

Nunca Poucas vezes Algumas vezes Muitas vezes Sempre que possível

Descreva a situação: _____

Nunca Poucas vezes Algumas vezes Muitas vezes Sempre que possível

Weight Efficacy Lifestyle Questionnaire

Questionário de Auto-Eficácia para a Alimentação

Leia as afirmações seguintes e coloque um círculo no número à direita que melhor descreve o seu **grau de confiança** em controlar o que come em cada situação.

		Nada								Muito	
		1	2	3	4	5	6	7	8	9	10
1. Consigo resistir à comida quando estou ansiosa (nervosa).....	1	2	3	4	5	6	7	8	9	10	
2. Consigo controlar o que como durante os fins-de-semana	1	2	3	4	5	6	7	8	9	10	
3. Consigo resistir à comida, mesmo quando tenho de dizer “não” a outras pessoas	1	2	3	4	5	6	7	8	9	10	
4. Consigo resistir à comida mesmo quando me estou a sentir fisicamente cansada.....	1	2	3	4	5	6	7	8	9	10	
5. Consigo resistir à comida quando estou a ver televisão	1	2	3	4	5	6	7	8	9	10	
6. Consigo resistir à comida quando estou deprimida (ou “em baixo”)	1	2	3	4	5	6	7	8	9	10	
7. Consigo resistir à comida quando estão disponíveis muitos tipos de comida diferentes.....	1	2	3	4	5	6	7	8	9	10	
8. Consigo resistir à comida mesmo quando sinto que é indelicado recusar repetir o prato.....	1	2	3	4	5	6	7	8	9	10	
9. Consigo resistir à comida mesmo quando tenho uma dor de cabeça.....	1	2	3	4	5	6	7	8	9	10	
10. Consigo resistir à comida quando estou a ler	1	2	3	4	5	6	7	8	9	10	
11. Consigo resistir à comida quando estou zangada (ou irritada)	1	2	3	4	5	6	7	8	9	10	
12. Consigo resistir à comida mesmo quando estou numa festa.....	1	2	3	4	5	6	7	8	9	10	
13. Consigo resistir à comida mesmo quando outros me estão a pressionar para comer	1	2	3	4	5	6	7	8	9	10	
14. Consigo resistir à comida quando estou com dores	1	2	3	4	5	6	7	8	9	10	
15. Consigo resistir à comida mesmo antes de ir me deitar.....	1	2	3	4	5	6	7	8	9	10	
16. Consigo resistir à comida quando sinto que falhei	1	2	3	4	5	6	7	8	9	10	
17. Consigo resistir à comida mesmo quando estão disponíveis alimentos com muitas calorias	1	2	3	4	5	6	7	8	9	10	
18. Consigo resistir à comida mesmo quando penso que as outras pessoas ficarão chateadas se não comer.....	1	2	3	4	5	6	7	8	9	10	
19. Consigo resistir à comida quando sinto desconforto	1	2	3	4	5	6	7	8	9	10	
20. Consigo resistir à comida quando estou alegre.....	1	2	3	4	5	6	7	8	9	10	

Three-Factor Eating Questionnaire

Inventário do Comportamento Alimentar

PARTE I: A seguir encontra várias afirmações seguidas de quatro letras. Assinale com um círculo a letra que melhor traduz a sua forma de pensar.

**Se: Concorda totalmente assinale A;
 Concorda na maior parte marque B;
 Discorda na maior parte marque C;
 Discorda totalmente marque D.**

	Concordo totalment e	Concordo na maior parte	Discordo na maior parte	Discordo totalment e
1. Quando sinto o aroma de um alimento saboroso, ou vejo um alimento com aspecto delicioso, tenho dificuldade em evitar comê-lo mesmo que tenha acabado de fazer uma refeição	A	B	C	D
2. Em ocasiões sociais, como por exemplo festas, geralmente como demais	A	B	C	D
3. Tenho normalmente tanta fome que como mais do que três refeições por dia	A	B	C	D
4. Quando já comi o que penso ser a minha “dose” certa de calorias, geralmente consigo parar de comer	A	B	C	D
5. É muito difícil para mim fazer dieta porque fico com muita fome	A	B	C	D
6. Como deliberadamente pequenas porções de comida como forma de controlar o peso	A	B	C	D
7. Às vezes os alimentos sabem tão bem que continuo a comê-los mesmo quando já não tenho fome	A	B	C	D
8. Uma vez que sinto fome, gostava que um nutricionista me dissesse, enquanto estou a comer, se já comi o suficiente ou se podia comer mais um pouco	A	B	C	D
9. Dou por mim a comer quando me sinto ansioso	A	B	C	D
10. A vida é demasiado curta para me preocupa com dietas	A	B	C	D
11. Uma vez que o meu peso sobe e desce, por vezes faço dieta	A	B	C	D
12. Às vezes sinto tanta fome que tenho logo que comer qualquer coisa	A	B	C	D
13. Quando estou com alguém que come demasiadamente geralmente também como excessivamente	A	B	C	D
14. Tenho uma boa noção das calorias existentes nos alimentos comuns	A	B	C	D

Appendices

	Concordo totalment e A	Concordo na maior parte B	Discordo na maior parte C	Discordo totalment e D
15. Às vezes quando começo a comer, parece que não consigo parar	A	B	C	D
16. Não me é difícil deixar comida no prato	A	B	C	D
17. A certas horas do dia sinto fome porque me habituei a comer	A	B	C	D
18. Quando faço dieta e como um alimento que não é permitido, durante um certo período de tempo como menos para compensar	A	B	C	D
19. Estar com alguém que está a comer deixa-me muitas vezes com fome suficiente para comer também	A	B	C	D
20. Quando me sinto deprimido geralmente como excessivamente	A	B	C	D
21. Gosto demasiado de comer, para estragar tudo a contar calorias ou a controlar o peso	A	B	C	D
22. Quando vejo um alimento muito apetitoso geralmente fico com tanta fome que tenho que comer	A	B	C	D
23. Geralmente paro de comer quando ainda não estou realmente "cheio", como forma consciente de limitar a quantidade do que como	A	B	C	D
24. Fico tão esfomeado que o meu estômago parece muitas vezes estar sempre vazio	A	B	C	D
25. O meu peso raramente variou nos últimos anos	A	B	C	D
26. Sinto-me sempre de tal maneira esfomeado, que me é muito difícil parar de comer antes de acabar tudo o que tenho prato	A	B	C	D
27. Quando me sinto só consolo-me a comer	A	B	C	D
28. Contenho-me no que como para não ganhar peso	A	B	C	D
29. Às vezes, ao fim da tarde ou durante a noite, fico com muita fome	A	B	C	D
30. Como tudo o que quero e sempre que me apetece	A	B	C	D
31. Mesmo sem pensar nisso, demoro muito tempo a comer	A	B	C	D
32. Calculo as calorias dos alimentos que ingiro de forma a controlar o meu peso	A	B	C	D
33. Não como certos alimentos porque me fazem engordar	A	B	C	D
34. Tenho sempre fome suficiente para comer a qualquer momento	A	B	C	D
35. Presto muita atenção a eventuais modificações do meu corpo	A	B	C	D
36. Quando estou a fazer dieta, se como um alimento que não é permitido, acabo depois por comer ainda mais e ingerir alimentos	A	B	C	D

muito calóricos

PARTE II: Cada questão nesta secção é seguida por um número de opções de resposta. Depois de ler cada questão cuidadosamente, escolha a opção que melhor se aplica a si e coloque um círculo no número apropriado.

37. Qual a frequência com que faz dieta, como forma de controlar o seu peso?

1	2	3	4
Raramente	Às vezes	Frequentemente	Sempre

38. Uma flutuação de peso de 2 a 2,5 quilos afectaria a sua alimentação?

1	2	3	4
Nada	Um pouco	Moderadamente	Muito

39. Com que frequência sente fome?

1	2	3	4
Só às refeições	Às refeições e, por vezes, entre as refeições	Às refeições e, frequentemente, entre as refeições	Quase sempre

40. Os sentimentos de culpa que sente quando come demais ajudam-no/a a limitar a ingestão de alimentos?

1	2	3	4
Nunca	Raramente	Geralmente	Sempre

41. Que dificuldade teria se parasse de comer a meio de um jantar e tivesse que se manter sem comer nas 4 horas seguintes?

1	2	3	4
Fácil	Ligeiramente difícil	Razoavelmente difícil	Muito difícil

42. Quanto consciente está daquilo que come?

1	2	3	4
Nada	Pouco	Moderadamente	Extremamente

43. Com que frequência evita abastecer-se de alimentos que acha tentadores mas demasiado calóricos?

1	2	3	4
Quase nunca	Às vezes	Geralmente	Quase sempre

44. Qual a probabilidade de comprar alimentos “light” ou de baixo valor calórico (iogurtes dietéticos tipo “Linha Zero”, “Cola Diet”, leite magro)?

1	2	3	4
Não é provável	Pouco provável	Moderadamente provável	Muito provável

45. Come de forma equilibrada na presença de outras pessoas e excessivamente quando está sozinho/a?

1	2	3	4
Nunca	Raramente	Geralmente	Sempre

46. Qual a probabilidade de intencionalmente comer devagar para diminuir a quantidade do que come?

1	2	3	4
Não é provável	Pouco provável	Moderadamente provável	Muito provável

47. Com que frequência não come sobremesa porque já não tem fome?

1	2	3	4
Menos do que 1 vez por mês	Pelo menos 1 vez por mês mas menos do que 1 vez por semana	Entre 1 e 3 vezes por semana	4 ou mais vezes por semana

48. Qual a probabilidade de conscientemente comer menos do que o que realmente gostaria de comer?

1	2	3	4
Não é provável	Pouco provável	Moderadamente provável	Muito provável

49. Tem episódios em que come excessivamente mesmo sem ter fome?

1	2	3	4
Nunca	Menos do que 1 vez por mês	Pelo menos 1 vez por mês mas menos do que 1 vez por semana	1 ou mais vezes por semana

50. Numa escala de 0 a 5, em que o 0 significa não fazer qualquer restrição alimentar (comer o que quiser e quando quiser) e 5 traduz o máximo de restrição (limitar constantemente a ingestão de alimentos sem nunca ceder), que número traduziria o seu comportamento?

0. Come sempre o que quer e quando quer
1. A maior parte das vezes come o que quer e quando quer
2. Geralmente come o que quer e quando quer
3. Geralmente limita a ingestão mas às vezes come tudo o que lhe apetece
4. A maior parte das vezes limita a ingestão e raramente come tudo o que lhe apetece
5. Limita sempre a ingestão de alimentos e nunca come tudo o que lhe apetece

51. Em que medida a seguinte frase corresponde ao seu comportamento alimentar: “Começo a fazer dieta de manhã, mas porque acontecem tantas coisas durante o dia, quando chego à noite já desisti e como aquilo que quero, prometendo a mim mesmo iniciar a dieta no dia seguinte”.

1	2	3	4
Não sou nada assim	Normalmente não sou assim	Uma descrição razoável do meu comportamento	Descreve-me na perfeição

52. Se comi um bocadinho mais num dia, compenso isso no dia seguinte. V F

53. Ingiro alimentos para emagrecer, mesmo que não tenham um sabor muito bom. V F

54. Fazer uma dieta para eu perder peso seria muito maçador. V F

Appendices

55. Apesar de prestar muita atenção à minha figura, posso ter prazer com a variedade dos alimentos. V F
56. Prefiro saltar uma refeição do que parar de comer depois de já ter ingerido metade da refeição. V F
57. Alterno entre momentos em que estou estritamente a fazer dieta e momentos em que não presto muita atenção ao que como e à quantidade que ingiro. V F
58. Às vezes salto refeições para evitar ganhar peso. V F
59. Estou a evitar certos alimentos, por norma, mesmo apesar de gostar deles. V F
60. Enquanto perco peso, tento aderir a um plano. V F
61. Geralmente prefiro alimentos “light” que não fazem engordar. V F
62. Se comi um bocadinho a mais numa refeição, compenso isso na refeição seguinte. V F
63. Sem um plano de dieta, nem saberia como controlar o meu peso. V F
64. O sucesso rápido durante uma dieta é muito importante para mim. V F
65. Costuma restringir deliberadamente o que come nas refeições apesar de lhe apetecer comer mais?

1
Sempre

2
Muitas Vezes

3
Raramente

4
Nunca