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Weight Loss

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Contributors

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Meet the editor

Ignacio Jáuregui-Lobera, MD, PhD, MSc, is the director at the Behavioural Sciences Institute and an associate professor at the Pablo de Olavide University, Seville (Spain). He is a psychiatrist, family practitioner, and psychologist, and since 1993, he is working in the field of eating disorders, overweight, and obesity. He has published several books about eating disorders as well as more than 100 articles in the same field of study. He is an editorial board coordinator of the *Nutrición Hospitalaria* journal and an editorial board member of the *Journal of Negative and No Positive Results* (*JONNPR*). He is a member of the Royal Academy of Medicine of Seville and Valladolid (Spain).

Contents

Preface

Since epidemiological studies have reported that weight loss has many benefits to general health, different attempts (dietetic, pharmacologic, and surgical) have been explored in order to lose and maintain weight. Health and esthetic reasons have been given to establish therapeutic programs. With regard to health benefits, weight reduction is usually associated with an improvement in different facets (control of glycemia, blood pressure, lipid profile, etc.).

Sometimes weight loss is the result of several pathologies, so both intentional and unintentional weight loss are very different from a clinical point of view, each being a relevant focus of study. With respect to intentional weight loss, willpower has been considered as an internal factor to regulate the individuals' responses actively. When this willpower is insufficient, different undesired behaviors tend to emerge. Nevertheless, failures in terms of willpower are not sufficient to explain the difficulties that many people show in their weight control. In this regard, Magdalena Marszał-Wiśniewska and Ewa Jarczewska-Gerc, from the SWPS University of Social Sciences and Humanities (Warsaw, Poland), unveil different topics referred to as the self-control of weight loss process. They try to explain several techniques (mental simulations) aimed to increase volitional strengths, and they emphasize the role of individual differences in effective weight loss.

Along with intentional weight loss, it must be remarked that unintentional weight loss is a common symptom, particularly among older patients. Naim Abu-Freha, from the Institute of Gastroenterology and Hepatology (Soroka University Medical Center and the Faculty of Health Sciences, Ben-Gurion University of the Negev, Beer-Sheva, Israel), recalls that significant unintentional weight loss consists of at least 5% of usual body weight over 6–12 months, this weight loss being unintentional and unexplained. In this case, patients should be carefully evaluated by means of a comprehensive medical history, physical examination, laboratory testing, imaging, and endoscopy. Finally, the treatment should be targeted to the primary disease causing the weight loss.

Gender and ethnic topics related to weight loss are also relevant facets of this field of study. Regarding males, two chapters deserve our attention. Amanda Baker (School of Psychology, University of Ottawa, Ottawa, Canada) provides a review of the consequences associated with men's unhealthy body image. In this regard, some psychological, behavioral, and cognitive health outcomes are discussed in the chapter. The author concludes that generally experts emphasize that failing to explain why some individuals are more resistant than others to the deleterious effects associated with cultural body ideals and weight concerns continues to remain a large gap in the literature. At the same time, she proposes that future investigations, prevention strategies, and intervention efforts should aim at reducing and deterring the negative body image outcomes among men. Jaffar Mir et al. (from Milann Fertility Center, India) focus their chapter on the fact that obesity is associated with significant disturbance in the hormonal milieu that can affect the reproductive system. In men, this effect has been poorly characterized. Since a decline in fertility has occurred in parallel with increasing rates of obesity, the possibility that obesity is a cause of male infertility and reduced fecundity should be addressed, and this is the objective of this chapter.

Daiki Kato et al., in a very interesting chapter, state that there are some psychological factors in Japanese culture that might be potential reasons for eating disorders. As a result, this chapter

concludes that the risk behavior of weight loss and inappropriate eating attitudes are not special symptoms but a familiar problem for adolescents and emerging adults. A relevant conclusion is that psychological support is necessary for weight loss problems of the younger generation. Bearing in mind, future studies, the viewpoint of cultures, several generations, and gender difference are required. Taking into account the importance of different cultures, Professor Rynal Devanathan and Mrs. Viveka Devanathan (from South Africa) have written a chapter focused on Zulu women's perceptions of their body image relative to weight status attending a noncommunicable disease clinic. As a result, the authors find that urban Zulu women tend to misperceive themselves to be thinner than their actual body mass index. They propose that the reasons for that distorted perception could be linked to the awareness that slenderness is related to having a disease. To avoid stigmatization, urban women often preferred a larger body size over a healthy body size.

From an ecological point of view, Roberta Di Pasquale refers to childhood obesity as a complex and dynamical clinical condition based on a dysfunctional pattern of ineffective regulation of eating behavior coupled with diminished physical activity and increased sedentary time, which develops within a specific physical and social environment often characterized by the presence of obesogenic elements. In her chapter, Di Pasquale writes about the usefulness of the "self-determination theory," specifically regarding some parenting dimensions that seem to be relevant to the process of children's internalization of socially desired behaviors and values. This framework seems to be useful to conceptually organize parenting practices in the feeding and physical activity domains. As a result, parenting styles are a proper theoretical framework to investigate the relationship between parenting and child overweight/obesity or child obesity-related behaviors.

Flor de María Cruz Estrada (from the Autonomous University of the State of Mexico, Toluca, Mexico) argues that some concepts are necessary to be distinguished: physical fitness, physical shape, and physical activity. The author also states that physical activity is essential to improve body composition in obesity and overweight conditions and also to keep an ideal weight, which will serve as a protection against metabolic disease. In addition, physical activity improves the emotional state and physical condition of any person who practices it.

Many health professionals usually have different opinions about the results of weight loss attempts. The most optimistic tend to think that a strong willpower along with a good diet will lead to weight loss. On the contrary, the most pessimistic opinions infer that weight loss attempts are rarely successful, so weight regain invariably will occur. Overweight and obesity are related to different chronic diseases, and weight loss is associated with improvements in many healthy parameters (blood pressure, glycemia, lipid profile, etc.). Considering that improvements appear with modest weight loss, practitioners should emphasize health benefits rather than cosmetic reasons for enrolling a person in a weight loss program.

Psychologists, nurses, doctors, and nutritionists, among others, will be the professionals interested in this book, mainly if they develop their work in interdisciplinary teams that focus their interest on overweight and obesity.

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Section 1

Intentional and Unintentional Weight Loss

Chapter 1

Unintentional Weight Loss

Naim Abu Freha

Additional information is available at the end of the chapter

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Abstract

Unintentional weight loss (UWL) is a common symptom, particularly among older patients. In one site, patients with UWL have increased morbidity and mortality; in the other site, the prognosis of the patients is related to primary cause of the UWL. The differential diagnosis of the underlying diseases leading to UWL is broad and includes both malignant and nonmalignant gastrointestinal (GI) diseases, as well as endocrine, infectious, cardiopulmonary, and psychiatric disorders and side effects of medications. Patients with UWL should be investigated. The diagnostic approach to patients with UWL includes comprehensive medical history, physical examination, laboratory testing, imaging, and endoscopy. The imaging and endoscopy should be targeted according to the symptom, physical examination findings, and laboratory results. The treatment of UWL should be targeted to the primary disease causing weight loss. Non-pharmacologic nutrition intervention is the important treatment, and some pharmacologic treatment could be helpful in part of the patients.

Keywords: unintentional, unexplained, weight loss, diagnosis, gastrointestinal disorders, gastrointestinal malignancy, endoscopic investigation, morbidity

1. Introduction

The most accepted and most frequently used definition of significant unintentional weight loss (UWL) is the loss of at least 5% of usual body weight over 6–12 months [1, 2]. The weight loss is unintentional and unexplained and should be further investigated.

UWL is a common phenomenon among older adults, with an annual incidence of approximately 13% [3]. Other epidemiologic studies have shown that about 15–20% of elderly patients experience weight loss and this prevalence increases in high-risk patients [4–6].

The body weight changes during the life cycle include increasing of the body weight during early adulthood until the fifth to sixth decade of life, the reason for this increase is the increasing of the body [7]. But regarding the lean body mass, there is a decline at a rate of 0.3 kg/year, beginning in the third decade. Total body mass remains stable from the fifth decade until about age 70; it then slowly decreases at a rate of only 0.1–0.2 kg/year [7].

Different Inflammatory cytokines and interleukins are involved in the pathogenesis of UWL. Tumor necrosis factor-α (TNF-α), interleukin-1β, and interleukin-6 have been implicated in cachexia and weight loss [3].

One of these important mediators is the TNF-α, which considered to be a primary mediator of the muscle wasting of cachexia [3]. Cytokines may act both centrally and peripherally; the most important effects include inhibiting feeding behavior, by decreasing gastric motility, gastric emptying, and intestinal motility and by modifying gastric secretion [3].

2. Risk factors of UWL

On the basis of several studies, different risk factors were found for UWL among adults older than 65 years, subgrouped as:

1. Physiologic factors: acute illness, hospitalization, exacerbation of chronic diseases, dementia, constipation, pressure ulcers, daily pain, medications, compromised motility, recurrent falls, eating and swallowing problems, reduced appetite, low food intake, thirst, serum albumin <35 g/l, and total cholesterol <4.2 mmol/l were found to be factors for UWL [8–13].
2. Psychological factors: depression and bereavement [11, 13].
3. Social factors: reduced social activity and low income [9, 10].

3. Unintentional weight loss morbidity, mortality, and prognosis

Increased fracture risk has been associated with weight loss in postmenopausal women; significant association was found between unintentional weight loss and fracture of the hip, spine, and clavicle within 1 year of weight loss; and these associations were still present at 5 years [14]. Another study showed that unexplained weight loss may be important predictors of suicide [15].

Functional decline, infections, decubitus ulcers, exacerbation of cognitive and mood disorders, and increased use of acute and long-term care facilities are important clinical consequences of the UWL [16].

In general, the result of different studies has shown that UWL is associated with mortality rates ranging between 9 and 38% in elderly adults [17–20].

UWL is a nonspecific condition that may be caused by a multitude of medical and psychiatric disorders. Consequently, its natural history varies considerably depending on the underlying cause.

On the basis of study of Marton et al., 25% of the patients died within 1 year, and another 15% continued to lose weight or deteriorate in function [17].

Most patients who did poorly had advanced cardiopulmonary disease or cancer. In another study 51 of the 104 cancer patients had disseminated disease at diagnosis; median survival of the cancer patients was just 2 months; and only 9 lived longer than 1 year [21].

Most patients without a physical cause of weight loss fared well, survivors do well. Most either maintain or gain weight, but only a minority return to their baseline weight [17, 20, 22].

4. Differential diagnosis of UWL

The differential diagnosis of the underlying diseases leading to UWL is broad and includes both malignant and benign gastrointestinal (GI) diseases, as well as endocrine, infectious, cardiopulmonary, and psychiatric disorders [20]. GI disorders are commonly associated with

Gastrointestinal diseases
Esophageal ulcer
Moderate/severe esophagitis
Esophageal stricture
Achalasia
Esophageal cancer
Moderate/severe gastritis
Peptic ulcer
Gastric cancer
Gastric lymphoma
Celiac disease
Malabsorption syndromes
Inflammatory bowel disease
Colon cancer
Chronic pancreatitis
Pancreatic cancer
Cholangiocarinoma
Hepatocellular carcinoma
Endocrine diseases
Diabetes mellitus
Hyperthyroidism
Pheochromocytoma
Infectious diseases
Tuberculosis
Endocarditis
Acquired immunodeficiency syndrome (AIDS)

Cardiopulmonary diseases
Congestive heart disease
Myocarditis
Chronic lung disease
Lung cancer
Psychiatric disease Depression
Schizophrenia
Anxiety
Hematologic disease Lymphoma
Renal chronic kidney disease
Inflammatory non-infection disease
Connective tissue disease
Vasculitis
Temporal arteritis
Other Medications
Dental and oral health problem
Laryngeal cancer
Pharyngeal cancer
Advanced metastatic cancers
Unknown/idiopathic

Table 1. The most common diseases causing unintentional weight loss.

UWL, with gastric and colon cancer, celiac disease, peptic ulcers, and inflammatory bowel diseases being the leading causes [19].

The list of medications causing weight loss includes a different kinds of medications, which used for treatment of cardiac, neurologic and psychiatric diseases, and tablets used for treatment of diabetes mellitus and pain management can also cause weight loss. Side effects of different medications could include anorexia, dry mouth, dysgeusia, dysphagia, nausea, and vomiting, and the result of these side effects will be lowering the daily oral intake and weight loss [8, 23]. Despite the long list of weight loss causes, in about 5-36% of the patient the cause of the UWL is unknown [2].

However, among elderly patients the 9 Ds could help us to focus of the most common reasons among this group, dementia, depression, disease (acute or chronic), dysphagia, dysgeusia, diarrhea, drug, dentition, and dysfunction (functional disability) [24].

The most common causes of unintentional weight loss are summarized in **Table 1**.

5. UWL and cancer

When evaluating patients with UWL, detection of an underlying malignancy is of the greatest concern. A large list of different cancers could cause unintentional weight loss, not only in gastrointestinal cancer but in other malignancies too.

Furthermore, any type of malignant neoplasm can be the cause of weight loss in the advanced metastatic stage. The most common neoplasms causing weight loss are included in **Table 1**.

The reported prevalence of gastrointestinal (GI) malignancies in patients with UWL varies significantly between studies, with rates of 6–38% in different publications [17, 18, 20, 21, 25]. GI malignancy is an important and a feared cause of UWL. Different reports have shown a low GI malignancy rates of 6.6–12% in patients with UWL depending on the diagnostic modality used [20, 26], and another study found 57 (3.7%) and 24 (4.3%) cases of malignancy in the upper and lower GI tract, respectively [27]. Additional study showed that UWL alone was not associated with colorectal cancer among patients who underwent colonoscopy [28].

The differences between malignancy detection rates found in the different studies in the literature are mainly a result of variations in study design, population diversity, and the lack of a standardized definition for what is considered meaningful endoscopic findings in the context of UWL across different studies.

6. Diagnostic approach to patients with UWL

Patients with UWL must be investigated, and it poses a diagnostic challenge for the clinician in a large part of the patients because of the broad range of etiologic possibilities. To date, no guidelines have been published for the evaluation and management of patients with UWL; when evaluating patients with UWL, practitioners need to exercise careful judgment in terms of the extent of the initial workup and, if additional investigations are required, in choosing the most appropriate diagnostic modalities. However, the workup should include simple and noninvasive tests in the early investigation stage, and additional invasive tests should be directed to specific organ later. Common practices include detailed medical history, physical examination, laboratory testing, fecal occult blood testing, and imaging as part of the baseline evaluation [2, 23, 24, 29], and endoscopy should be part of the investigation among patients with gastrointestinal symptoms or if the baseline evaluation was normal.

6.1. Medical history

Comprehensive detailed medical history is the first and important step. Information regarding other symptoms, particularly gastrointestinal, hematological, and psychiatric symptoms, and symptoms like abdominal pain, rectal bleeding, change of bowel habits, vomiting, anemia, night sweating, and depression should be part of the medical history taking.

Asking about smoking, alcohol abuse, medications, psychosocial factors, dietary history, travel, and sexual risk behavior should be part of taking medical history [2]. Further investigation could be directed by specific symptoms.

6.2. Physical examination

Comprehensive whole-body examination should be done and focused on abdominal mass, organomegaly, lymphadenopathy, breast mass, prostate enlargement, sign of wasting, and weight loss. The importance of mouth examination particularly among elderly adults is to exclude dental problem, dry mouth, or other lesions that may interfere chewing and swallowing.

6.3. Laboratory testing

Laboratory testing is an important part of the UWL investigation, abnormalities of results could be a direction to the cause of the weight loss and then further specific investigation should be the next step. The important laboratory tests should be included in the baseline investigation are: complete blood count, liver, kidney, thyroid function tests, serum glucose, lactace dehydrogenase, C-reactive protein, electrolytes, albumin, iron studies, urinalysis and fecal occult blood test.

6.4. Imaging

Chest radiography and abdominal ultrasonography are included in the baseline investigation on unintentional weight loss. However, there are no published dates regarding the diagnostic yield of computer tomography among patients with UWL. For patients, who underwent baseline investigation, and there is no direction to diagnosis, further investigation with chest, abdominal, and pelvic contrast computer tomography will be appropriate; the advantages of computer tomography are imaging of chest, mediastinum, lymphadenopathy, and better imaging of the abdomen and pelvis including organs like pancreas and the bowel.

6.5. Endoscopy

Gastrointestinal disorders may account for up to 25–30% of the cases of UWL [20, 25]. Unfortunately, data on the diagnostic yield of endoscopy in UWL are scant [26, 30]. The role of endoscopic evaluation in this framework remains controversial. Although some authors include esophagogastroduodenoscopy (EGD) as part of the initial workup of all patients with UWL, others argue that it should be reserved for those who initially present with GI symptoms or signs [1, 24]. However, little is known about the diagnostic yield of endoscopy in the context of UWL. A small study from the non-English literature has showed that gastroscopy can lead to a definite diagnosis in more than half of the cases [31]. However, this study was carried out in a small cohort of elderly (mean age, 80 years) in-patients; thus, its conclusions may not be generalizable to the broader population of patients with UWL. Another study found that the yield of endoscopy for the evaluation of UWL was not negligible. Of 2098 procedures performed in 1843 patients, endoscopic findings that could explain weight loss were found in 10% of EGD and 6% of colonoscopies [27]. However, the rate of detection of clinical significant endoscopic finding in both upper and lower endoscopies was significantly lower in patients who had no other indications for endoscopy besides weight loss [27].

Patients, who have gastrointestinal symptoms in addition to the UWL and patients with normal baseline evaluation, should undergo endoscopy.

7. Age and UWL

A slow decrease in body mass (0.1–0.2 kg/year) usually occurs in association with normal aging [32]. However, beyond this naturally occurring process, elderly patients are more prone to present with clinically significant weight loss [7, 16]. Accurate diagnosis of the underlying

cause for weight loss in this population is important as the natural history of this condition at an older age is less favorable [33].

Approximately 60% of the patients in both the gastroscopy and colonoscopy cohorts were 65 years of age and older [27]. Furthermore, age older than 65 years or more was strongly associated with detection of any pathologic endoscopic findings, whereas 60% of the clinical significant endoscopic finding by gastroscopy and 50% of those diagnosed by colonoscopy were found in patients in this age group. Different studies showed increased mortality among patients older than age 65 with UWL [16, 34, 35].

8. Treatment of UWL

The treatment of UWL should be targeted to the primary disease causing the weight loss. In cases, in which no organic or psychiatric disease was found, the treatment has to be individualized and target patient's nutrition status, risk factors, and social conditions.

Patient's medications must be reviewed and if any medication is suspected to be contributed to the weight loss should be discontinued and replaced by an alternative drug.

Nutritional interventions as a non-pharmacologic treatment were investigated in several studies. The hallmarks of nutritional intervention should include optimizing food intake, oral nutritional supplements, and adding multivitamins. The patients should have been encouraged to eat small and often meals, eating favorite food, avoiding gas-producing foods, and taking multiple vitamins daily. The compliance of patients to the different diets is an important issue.

Consultation, support, and follow-up by a dietician are important parts of the management of patients with UWL.

Physical training has a positive impact of the increasing weight among community-dwelling individual. Regular exercise (particularly resistance training) is also recommended for frail elderly patients because it stimulates appetite and prevents sarcopenia.

Different small trials examined pharmacologic treatment of patients with UWL.

The evidence supporting any pharmacologic agent for the treatment of weight loss is limited to mostly small and uncontrolled studies.

The effect of different appetite stimulants and anabolic medications of UWL was examined. Some of them showed a trend of weight gain; however, most of the medications have significant side effects, particularly in frail elderly people. Megestrol acetate, dronabinol, ornithine oxoglutarate, cyproheptadine, and human growth hormone were examined in few studies.

9. Conclusions

Unintentional weight loss is a common health problem with increase mortality with a broad spectrum of differential diagnosis. The diagnostic approach should be targeted according the medical history, physical examination, and laboratory results.

Conflict of interest

There are no conflicts in interest to be reported.

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Chapter 2

Self-Control in Weight Loss Process

Magdalena Marszał-Wiśniewska and
Ewa Jarczewska-Gerc

Additional information is available at the end of the chapter

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Abstract

Classical motivation theories assumed that the probability of success in goal striving process (including weight loss) depended on two factors: likelihood of success and attractiveness of the result. However, research referring to obesity showed that motivational factors are not sufficient in effective weight loss. In other words, obese people value anticipated weight loss but still do not succeed in this process. It is implied by the fact that effectiveness and persistence of this process depend also on volitional factor. This factor refers to self-control mechanisms, which mediate between intention to reach the goal and its enactment. The current empirical data suggest that implementation intentions and mental simulations are especially beneficial techniques of self-control enhancement. This chapter will unveil main theories and research concerning self-control mechanisms and influence of various mental simulations and implementation intentions in weight loss process and weight-related behaviors. Moreover, our empirical data concerning individual differences in self-control of weight loss process are presented.

Keywords: weight loss, self-control, mental simulations, implementation intentions

1. Introduction

According to the World Health Organization, overweight and obesity serve as a serious potential health risks [1]. Statistics shows that since 1970 the number of people suffering from overweight or obesity has tripled, and its prevalence is still growing. It is proved that weight problems are responsible for several chronic diseases such as diabetes, cardiovascular diseases or even cancer [2]. Both global institutions, as WHO, and local governments strive for actions directed to stop this pervasive and threatening trend. Majority of those actions are

informative in their form—they convey information concerning benefits of healthy lifestyle, including diet and physical activity, or negative consequences of excessive fat accumulation.

However, everyday observation and research data [2–4] suggest that mere knowledge referring to what is healthy and, on the contrary, what is insalubrious is not sufficient to change peoples' behavior. In other words, people know they should consume fruits and vegetables but they grab for chips and sweets. They also know they should go jogging, but instead of that they lie down on the sofa and watch TV. Interestingly, when asked, most people say they would like to change their unhealthy habits, but they do nothing or almost nothing to enact their intentions. At this point, one question may arise in our minds—where is our rationality? The problem is that we often identify consciousness with rationality or even confuse them [5]. In other words, people assume that since one is aware of some phenomena, e.g. knows that it is recommended to drink two liters of water per day, she or he should drink each day at least this amount of water. "Rational mind" takes into account all available data, processes the information and as an output makes the best decision which is subsequently implemented into ongoing behavior. Unfortunately, this is just a desired ideal construction, having not much in common with everyday observation. The proverb says, "the road to hell is paved with good intentions." What does it mean? It means that there must be another than just a desire factor (formulation of intention) responsible for effective goal pursuit. In the psychological literature, this phenomenon is being called volitional factor, volitional processes or volitional strategies [6–8].

This chapter presents theory and empirical data considering psychological processes mediating effectiveness and persistence in intention enactment, especially significant in area of weight loss and weight loss maintenance. It also unveils theory and research concerning influence of techniques of self-control enhancement (various mental simulations and implementation intentions) in weight loss process. Moreover, our empirical data concerning personality characteristics that may possibly differentiate the effectiveness of self-control in area of weight loss process will be overviewed.

2. Volitional factor in effective intention enactment

Imagine the situation of a person who decided to abandon junk food and shift toward healthy eating. Let us assume that the decision was made autonomously, which means that is based on personally relevant needs and values, and is perceived by the person as a free will choice [9]. The person is highly motivated, speaks loudly about his or her eagerness to improve diet and become healthier. It seems like all requirements are fulfilled to lead this person to effective goal attainment. This expectation is in accordance with classical model of motivation [10, 11], which assumed that probability of turning into action is based on the expectancy of success and perceived value of desired outcome. However, after two successful days of dieting, the person experiences stressful situation at work. Everything around her or him seems sad and helpless. The mood is going down and the natural human reaction is attempting to regulate own mood in order to resume previous emotional state. What were the most commonly used stress and mood strategy for this person in the past? For many people, it is eating or even binging on tasty and unhealthy foods. At this point, the person faces not one but two

intentions simultaneously: to eat healthy (distal and long-term intention) and to eat chocolate (proximal and "here and now" intention). Interestingly, and unfortunately, both intensions are internally contradictory. Even though in "cold" conditions the person was determined to stick previous intention, now, in "hot" conditions gets very close to the breakdown. Which intention will win? The question is not so easy to answer, but undoubtedly refers to ones "willpower" to overcome temporal temptation and persist in goal congruent actions.

2.1. What does volitional mean?

The term "willpower" and its role in the motivational process, though present in psychology from the very beginning [12, 13], are one of those which are not easy to define. Ach [13] wrote about the *efficiency of will* which meant cognitive activities dedicated to the reduction of discrepancy between present and anticipated states. James [12], however, distributed self-management skills into *regulatory motivation* and *regulatory competence*, which state for respectively motivation to reveal willpower and actual capacity to do it successfully. Contemporary authors, e.g. Kuhl [14, 15], prefer to use term volition, which refers to the central coordination of cognitive, motivational and emotional processes.

What is the difference between motivation and volition? The answer is absolutely crucial to understand, explain and prevent peoples' failures to attempt their goals, especially difficult like losing weight or maintaining appropriate weight. Indeed, setting the goal and strong motivation to achieve are not sufficient to succeed. Heckhausen [16–18] and Gollwitzer proposed a model of action phases, which addresses Levin's distinction for goal setting and goal-striving process [19]. According to this model [20, 21], action includes two distinct stages. The first is a motivational or deliberative phase during which the individual cognitively processes the expenses and profits of prospective behavior. The second is volitional phase during which the subject generates the strategies and plans subordinated to enact the intention. Therefore, proposed model denotes that intention enactment is most probable when the subject is not only motivated to act but also produced strategies and plans which foster intention attainment [7]. The main objective for those plans and strategies is to control own behavior in order to successfully achieve the goal. This mode of control dedicated to goal maintenance activities is called self-control [14].

3. Self-control mechanisms which mediate between intention to reach the goal and its enactment

In accordance with processual approach to willpower, researchers are trying to find an answer considering mechanisms and processes engaged in action control process. In other words, they try to demystify the notion of willpower, identifying psychological mechanisms which are responsible for intra and inter-individual differences in self-control. In the following sections, we will focus only on selected concepts and models, which, in our opinion, due to their empirical value, are significant in self-control mechanisms in weight loss process and in weight-related behaviors.

3.1. Willpower as self-regulatory strength

According to the *Self-Regulatory Strength Model* developed by Baumeister [22, 23], the willpower is served by internal energetic resources of organism. The main assumption of this model implies that the ability to regulate responses actively (thus to move the self closer to a desired state) depends on a restricted and depletable self-regulatory resource. When regulatory resources have been depleted, self-regulation failure is more probable.

As Baumeister and his colleagues assume [22], the main cause of undesired behaviors, also diet related leading to obese, is insufficiency of self-regulatory processes. The term "self-regulation" is understood as an effort undertaken by the subject, directed to change the reactions of self, what in fact means self-control. Effective functioning of the self is possible due to the energy, which is served by specific, limited resource sufficient for limited acts of will. Self-control can be then compared to the muscle which as a result of intensive exercise gets tired, hence its efficiency in subsequent task decrements. To renovate the resources time and rest is required, thus many acts of self-control losses happen at night when people are tired after all day long regulation of own behavior [24].

In the study conducted by Vohs and Heatherton [25], ego depletion in dieting behaviors was induced and measured. Dieters were exposed with temptations, either strongly depleting—sitting very close to the bowl of candies, or weakly depleting—sitting quite far away from the same temptation. The study showed that after strong depletion of ego resources subjects indeed exerted less self-regulatory strength. In more detail, subjects consumed more ice cream and persisted less in the cognitive task after sitting closer to the bowl full of candies than those participants who were sitting more far away.

The vast number of studies conducted in the typical schema for Baumeister's ego depletion model (see meta-analysis, [26]) as well as the study referring to everyday experiences measures by *experience sampling* method [27] acknowledge, in their authors' opinion, the existence of ego depletion phenomenon. Although Baumeister's model provides with a simple and opportune explanation of self-control loss, researches confirming its legitimacy also have some shortcomings. In our opinion, one of them is an excessive liberty in understanding what actually self-regulatory acts and tasks which document ego depletion are. Also reductionist form of Baumeister's model meets with attention of critics. Bandura [28] for instance notices that the loss or lack of control over behavior not necessary is tied to ego strength but can be rather imposed by the perception of personal standards or engagement level according to those standards. Moreover, studies which tested relation between the type of regulation and ego depletion conducted by Muraven et al. [29, 30] showed that non-autonomic regulation performed in the conditions of internal or external pressure depletes ego resources more than autonomic regulation. Similar conclusions can be posed by the research results of Moller et al. [31]. Summarizing the research results mentioned above, comprehension of self-regulatory failure or loss only in terms of ego depletion is not sufficient to explain the difficulties in the behavioral control area. As the studies show, the distribution of willpower (defined by Baumeister et al. [22] as an ability to put effort to control own behavior) to different behaviors depends on the character of regulation or autonomy level of standards which drive the behavior.

3.2. Willpower as the central coordination system: the role of affect regulation

According to *Personality Systems Interactions Theory* [15], willpower coordinates functioning of cognitive, motivational and emotional processes. The basic function of volitional processes is to enable performance in accordance with the goal and to maintain the self-system integration as well. In Kuhl's theory [15, 32], the self-system can be identified with extension memory, which is served by the implicit system representing own needs, values' preferences and autobiographical memory. This system contributes to the integrated knowledge about self and personal experience. The effective intention enactment requires an access to extension memory, and the significant factor which limits this access is stress [33]. Thus, it becomes clear that effective affect regulation is a must for volitional efficiency [33, 34].

Demands-related stress (e.g. stress implied by the conflicts of goals, difficulty of the task, monotony or lack of favorable circumstances) is tied to the lack of positive affect [32, 33]. This lack of positive affect activates intension memory (which includes cognitive representation of goals, and its main goal is to maintain intention in working memory), and at the same time, it impedes the access to extension memory (self-system). As a result, the subject is excessively focused on the goal and unable to move to the core phase of the action which is intention implementation [21]. The ability to arouse positive affect enables both intention implementation and starting the activity [35].

In turn, *threat-related stress* (which is caused by the threats, failures and serious life changes) is accompanied by negative affect [32, 33]. This negative affect concentrates the subject's attention on ongoing negative experiences and inhibits an access to extension memory (self-system). In such situations, the subject is unable to stop contemplating the unfavorable situation (rumination) and is unable to detach from it in order to make a decision about further action. The ability to neutralize negative affect allows the accessibility to extension memory (self-system) and enables integration of the experiences into consistent whole with account to self-system [36, 37].

The mechanisms described above, function differently under two, differentiated by Kuhl self-management modes: self-regulation and self-control [14, 15].

3.2.1. Paradoxes of self-management processes

Baumeister and his colleagues [24] identify terms "self-regulation" with "self-control" thus they use them interchangeably. However, this approach seems to be misleading, what was emphasized by Kuhl in the 1996 article titled *Who controls whom when I control myself* [14]. The author recalls, among others, paradoxes of the self-regulatory processes, which are worthy to be noted at this point. Let us consider the situation of a woman who decided to lose weight and as one of the strategies she planned to jog everyday after work. It is winter, she comes back home tired and cold. The day at work was nervous and exhausting. She would rather stay at home, eat some delicious chocolate and watch her favorite TV show. What activity (staying at home versus going out for a jog) will be an accurate self-regulatory strategy used by the women in this particular situation? If she decides to go for a jog will she demonstrate the willpower? Or maybe the genuine willpower will be to break the previous decision, sabotaging internal imperative and immerse into pleasure of the moment?

Let us consider another dilemma in the subject of self-management area. Based on the previous example, the women who want to lose weight issue an order to herself to grab for an apple when she feels like eating a snack. But at the kitchen table, besides fruits there is also a plate with donuts. Her internal voice (let us call it "angel") says: eat an apple, you decided to shift into a healthy lifestyle! But at the same time, another voice ("devil") demands: eat a donut! You like it better! The truth is that indeed she likes sweets more that fruits, but at the same time after eating too much junk food she feels bad, both physically and emotionally.

How can it be explained that one tells him of herself "eat an apple" but his or her own hand grabs for a donut? To understand this phenomenon, two modes of self-management should be distinguished [15].

3.2.2. Self-regulation and self-control: democratic and autocratic self-management modes

Kuhl distinguished two modes of self-management: self-regulation and self-control [14, 15] Self-regulation is a mode, which is dedicated to support self-maintenance and can be metaphorically portrayed as a democratic leadership aimed to sustain or increase one's well-being (positive emotionality). The self-control mode, on the other hand, supports goal-maintenance activities and can be paralleled to mild or even strict dictatorship. The role of this mode is to inhibit potentially uncooperative processes like feelings, values or preferences in order to protect and conserve the intention from any distracters. When the subject decides to reduce body weight following the serious health condition, the necessity to change the menu most probably arouses negative emotions and is not perceived as democratically assigned (even though patients rationally agrees that this is a proper decision). A good solution in this situation is to gradually incorporate this goal to the patient's personal goals network, so it could be seen as a great chance for development, getting respect from others or to avoid adverse health effects. However, prior to this positive introjection, the effective dietary change discounting self-control mode seems to be very unlikely. Thus, Kuhl and Fuhrmann [35] mark some advantages of using this mode, especially when realizing difficult and effortful tasks. Nevertheless, the long-term and rigid employment of self-control drains psychophysical resources and can lead to negative consequences [38].

3.2.3. State and action orientation

Based on the vast empirical data [15, 33], Kuhl assumes the existence of relatively stable individual dispositions in affect regulation: state or action orientation. The action-oriented subjects facing demand-related stress are able to elicit positive affect and to neutralize negative affect when confronted with threat-related stress [15]. They also manifest higher self-motivation when challenged by difficult task and imply self-relaxation while threatened to risks or failures. On the contrary, state-oriented persons expose low ability to generate positive affect when faced with challenge, and at the same time, they show inability to effectively initiate the goal-related behavior. That is why they expose tendency for procrastination, experience passive rumination over the goal, engage in counterintentional behaviors and are oppressed by the task-irrelevant intrusions.

3.3. The ability to delay of gratification: self-control in inhibiting impulses and temptations

An effective self-management strongly depends on the temporal perspective. What is good for me here and now (e.g. eating a donut) is no longer good for my distant goal (losing weight). On the other hand, what is good for my distant goal (e.g. reduce BMI), not necessarily is good for me at the moment (go outside to the frosty air to jog). This problem is widely known in the literature as a delay of gratification paradigm or marshmallow dilemma [39–42]. In the series of experiments, Mischel and his colleagues [40, 43, 44] showed that:

1. Under 4 years of age, children are generally unable to wait any time for the delayed gratification.
2. Above this age, children start to vary—some of the young subjects can wait until experimenter goes back to the room to receive bigger treat and some cannot do it even when gets older.
3. The number of seconds the child waits in the situation of being exposed with temptation (e.g. cookie or marshmallow) strongly predicts his or her results in the Scholastic Aptitude Test (SAT) and social-cognitive, personal and interpersonal skills many years later.

How to explain those effects? Mischel distinguished two types of control: stimulus-control and self-control [42]. The first type refers to the power (control) which is executed by tempting object present in one's perceptual field. The second type is a control operated by self over the stimuli. This type of control provides one with the ability to resist the temptation as so not to consume it. The effectiveness of delay of gratification or resisting the temptation relays, according to the Mischel's concept, on the interaction between *hot* and *cool* systems [45]. The hot system is a "go" system, which directs emotional, quick, simple and significant for survival information. It regulates fight or flight reactions. The system is ready to operate from the very early childhood and enables the child to communicate with outside world. The most probable neural substratum for hot system is amygdala [46, 47]. Amygdala is a small, almond-shaped structure in the brain, which reacts to the situations perceived by the subject as threatening [46]. The effect of amygdala's activation is physiological arousal, which fosters automatic, survival reactions. However, there is also a second system of behavior regulation—the "cool" system. This one is cognitive, slow, thoughtful and elaborative and outputs rational, deliberative and rational behaviors. The neural origins of the cool system are being attributed to hippocampal and frontal lobe processing [45]. Those neural structures are responsible for metacognitive processing, memory, problem-solving and knowledge organization. The effective self-control while being exposed with temptation depends on the maturity of the brain (especially hippocampus and frontal lobe, which ripen quite late in the ontogeny) and stress level (high emotional activation attenuate or even turn off the cool system). Mischel and his colleagues mark also the role of mental representation of the temptation (gratification) [42] in the successful delay. For example, in the study by Mischel and Baker [43], children who were hinted with a cool, informational representation of temptation were able to wait for a reward (snack) 13 minutes in average, while those who

were cued with a hot instruction could delay only for 5 minutes. Concluding the findings by Mischel [40], it can be pointed out that the significant role in delay of gratification (self-control) is played by attentional control, namely the way in which the temptation is mentally represented. Mentally portrayed as "white, puffy cloud" or "yummy and chewy" marshmallow is objectively still the same treat but subjectively its appealing strength is much different.

4. Mental simulations and implementation intentions as beneficial techniques of self-control enhancement

Since effective goal pursuit requires engagement not only in motivational but also, or even primarily, in volitional phase, significant question arises: Are there any techniques which can increase one's self-control? In this section, we review two basic techniques, which are proved to be especially beneficial in enhancing successful goal achievement, mental simulations and implementation intentions.

4.1. Mental simulation

Mental simulations can be defined as cognitive activities, which constitute an imitative representation of event or series of events [48]. There are three basic forms of mental simulations: outcome simulations (representing the result of performance), process simulations (portraying the following steps of action to be taken in order to achieve the goal), and ruminations (negative images of setback or adversity) [49]. Three primary psychological mechanisms are responsible for beneficial effects of process mental simulations on goal attainment: effective emotional regulation (e.g. reduction of stress), plan for action formulation and activation of problem-solving behaviors. On the other hand, positive outcome simulations are maladaptive because, though they imply positive affect (pleasure derived from the mental image of success), they veil effective planning and problem-solving activities. Ruminations, however, also hinder effective goal pursuit. Ruminative thoughts glue one's attention to negative aspects of the reality and distract from potential planning and problem-solving activities [49–52].

The effectiveness of process-focused simulations was displayed in areas such as problem-solving [53], examination performance [49], planning fallacy reduction [49], quitting smoking [54] running on time skills [55] and finally weight loss [52].

Mental contrasting developed by Oettingen [56] is a kind of cognitive procedure, similar to mental simulations but slightly different in the form. The subject is mentally contrasting when he/she is actively processing the discrepancy between the presence and the desired future [50]. Based on this cognitive process, the subject starts to perceive the reality as an obstacle to reach a desired goal [57]. If the subject exposes high expectations of realizing the future, then the actual behavior (performance) is highly probable. On the contrary, if the expectations are low, mental contrasting is supposed to inhibit the performance, since it depicts the necessity of effortful goal attainment requiring personal or other resources that the subject thinks he/she is lacking.

4.2. Implementation intentions

Implementation intentions serve as a form of self-instructions, which anchor intentions in concrete time, place and circumstances of action [20, 58]. They are formulated as implications: "Whenever situation x arises, I will initiate the goal-directed response y!" Gollwitzer, author of implementation intentions concept, assumes [8] that this special form of planning delegates the control of goal-directed responses to anticipated situational cues, which, in the situation they appear, elicit these responses automatically (so-called cue-to-action [6]).

Meta-analysis of 94 studies conducted by Gollwitzer and Sheeran [59] showed that implementation intentions facilitated effective goal attainment with medium-to-large effect of d = 0.65. Implementation intentions showed protective role in the process of performance initiation, in guarding ongoing action from distractors and threats, shielding disengagement implied by temporary failures and preserving resources for future goal attainment [59]. The effectiveness of implementation intentions was proved in many studies (for the review: [8, 59]). Among others, it was demonstrated that this form of planning enhanced breast self-examination during the next month [60], vitamins intake [61], recovery of patients prior to joint replacement surgery [62] or regular exercise activity [7]. Also effectiveness in dieting behaviors has been attributed to applying implementation intentions [63].

4.3. Mental simulations and implementation intentions in weight loss and weight-related behaviors: the research review

Since neural substrates of self-control ("cool system") are being attributed to hippocampus and the frontal lobe [42, 45, 64], it seems to be obvious that effortful and effective self-control assumes brain's health. Researchers who scrutinize determinants of the brain's health and longevity propose SEEDS model referring to following five scientifically verified factors, which strongly contribute to subjective and objective well-being [65]: social support (S), exercise (E), education (long-life, E), diet (D) and sleep (S). Although all five health factors (SEEDS) stay in two-way relation with effective self-control (reciprocal relation) in this section, we focus on weight loss and weight maintenance implied by two factors: appropriate diet and physical activity. Those two factors showed to be absolutely crucial to sustain health, including mental and neurological conditions (e.g. [66–68]).

If it is already obvious that appropriate diet and exercise (thus in turn, adequate weight) are crucial to regain or maintain health (also brain's health) and, at the same time, volitional processes are indispensable for effective goal achievement (e.g. to losing or maintaining weight), it is time to present specific studies devoted to this relation. Studies exposing the use of mental simulations and implementation intentions in weight loss, diet change and exercise will be disclosed later.

4.3.1. Mental simulations in weight loss process

In our research project, two experimental studies were conducted [52]. We tested the influence of various mental simulations on the effectiveness in weight loss process.

In study 1, we expected that participants who imagined the structure of the weight loss relevant performance would reduce more weight than those imagining only the result of activity, either positive (success) or negative (failure). We also tested an influence of mixed type of simulation: negative outcome followed by process. This condition was implemented based on the assumption that fear caused by the image of failure would motivate and energize subjects to avoid the adverse result. At the same time, plan of action triggered by the process simulation following the negative outcome was supposed to strengthen the volitional resources of participants. This assumption reflected the Leventhal et al.'s results of studies referring to fear-arousing communications and their influence on peoples' behavior [69, 70].

In study 1, 40 female students from universities in Warsaw were participated (19–27 years old, M = 23). The criterion to join the research was the desire to lose weight and signing informed consent to take part in the 5-week program. Subjects were randomly allocated to one of four conditions: positive outcome simulation, process simulation, mixed simulations (process followed by negative outcome simulations) and control (no simulations). Participant from all groups received written instructions portraying the content of respective simulation. Instructions in positive outcome group referred to the very final stage of losing weight. Participants were supposed to imagine themselves as being slimmer, wearing smaller size clothes, walking on the beach in the bikini and receiving many compliments regarding their new, better look. Subjects in the process simulation group, instead, were instructed to imagine quite another content. Their task was to imagine themselves in the specific actions imprinted in the weight loss process. In detail, the scenario of simulations illustrated step-by-step activities, which should be implemented to reduce body weight like buying low-fat and low-calorie foods, avoid junk food, preparing diet meals and exercising. In the mixed simulations condition, participants were first instructed to imagine that they gained even more weight. Just after that suggestion, the process simulation was provided. The content of the scenario was directly copied from the one adopted in the former group. The control group did not receive any instructions and was supposed to lose weight in their typical form or just as they wished.

Subjects from all experimental groups agreed to use this mental training for 5–10 minutes everyday in 5-week period. Additionally, there was a direct contact (via telephone or e-mail) between experimenter and subjects during the time of experiment, and once a week, there were meetings to measure the effects of weight reduction process.

The results showed that participants from mixed group (process followed by negative outcome simulation) and process simulation group lost significantly more weight than those from the positive outcome simulation and control group. At the same time, there was no significant difference between mixed and process simulations group (see **Figure 1**).

In study 2, we tested five scenarios of mental simulations. The experiment was targeted to verify the effectiveness of two additional treatments: sole negative outcome simulations and mixed simulations of process following positive outcome simulations. Although the dependent variable in the study 2 – weight loss was the same as in study 1, the procedure was quite different. First, the study was conducted via internet. An information about the study was located at its website and included a statue of participation. About 274 female subjects were entered into the study and signed informed consent, while 106 (aged 19–45, M = 29) out of

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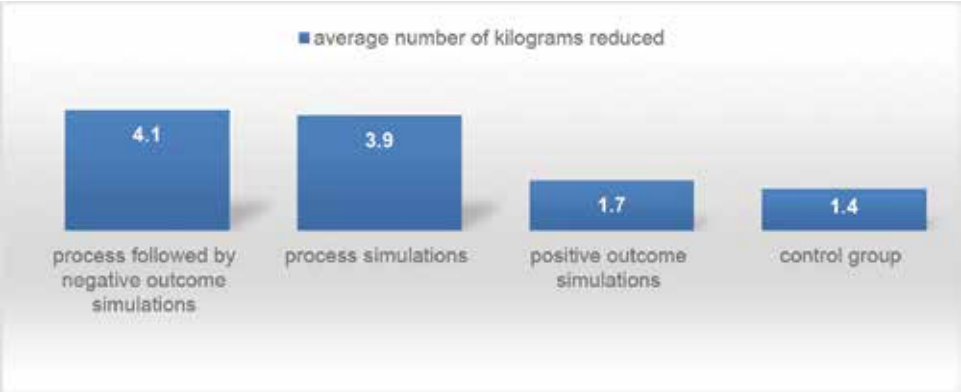

Figure 1. Average number of kilograms reduced within groups.

initial number logged into the study at least twice so their results were included in the statistical analysis. Second, besides the effectiveness of the simulations on the weight loss process, we also implemented other dependent variables which were persistent. This variable was measured by the number of logins to the study website. Each person who decided to enroll 5-week weight loss program was randomly assigned to one of six conditions: five simulation groups or control group. The scenarios for positive outcome, process and process followed by negative outcome simulations were directly taken from the previous study. The instruction for negative outcome simulation group was served by the first part of the instruction used in the process followed by negative outcome condition (without the process part). In the process followed by positive outcome simulation, subjects were supposed to imagine first the positive result of weight loss (being slimmer) and then the process of activities which would enable them to reach this desired goal. All subjects were asked to log into the system as frequently as they can and write down their weight at that moment. The number of logins was a measure of persistence. We assumed that each time the subject needs to declare her weight, and she has to overcome a discomfort implied by this moment of sensitive data verification.

The results showed that the most persistent were subjects assigned to the process followed by positive outcome simulation group, who logged into the website significantly more often than subjects from the negative outcome and control groups (see **Figure 2**).

In terms of weight loss effects, the results from the first study were quite replicated. Participants from the process followed by negative outcome simulation group lost significantly more weight than subjects from the negative outcome and control groups. There was also a trend ($p < 0.08$) showing that participants from the process followed by negative outcome group were more effective in weight loss than those from the positive outcome group. Also subjects from the process simulation group achieved significantly better result than those from the negative outcome and control groups. Additionally, those participants who simulated first the positive outcome and then process of reaching the favorable effect (process followed by positive outcome group) performed better than negative outcome and control subjects (trend $p < 0.07$). The summary of results concerning number of kilograms reduced within groups is presented in **Figure 3**.

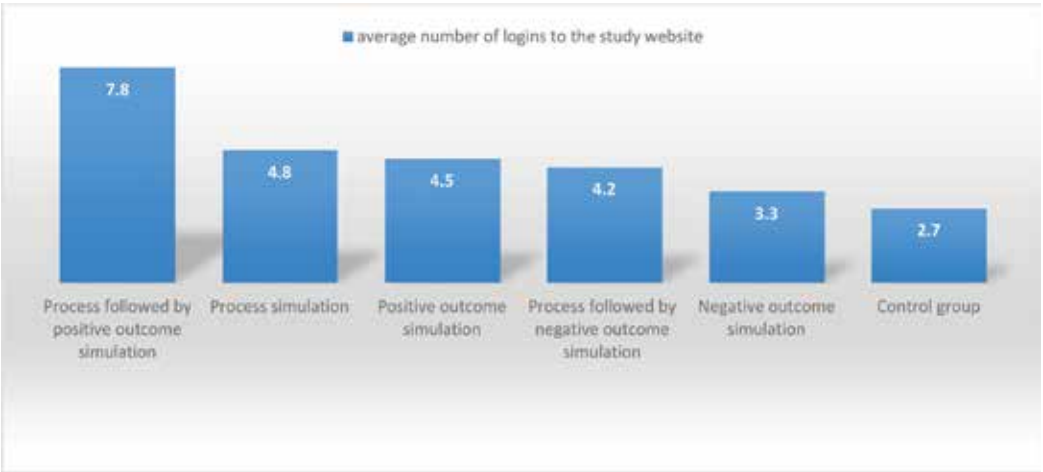

Figure 2. Average number of logins into the website within groups.

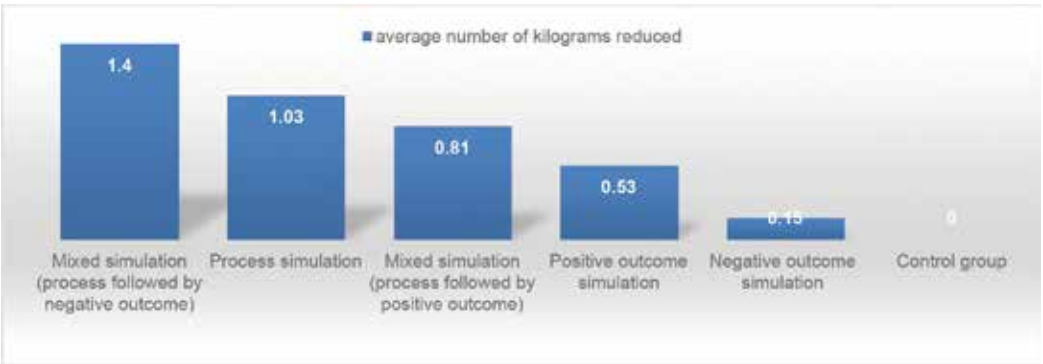

Figure 3. Average number of kilograms reduced within groups.

Based on the results above, it can be concluded that imagining the process of performance increases both effectiveness and persistence in intention enactment. Studies also showed that combination of simulations (process and outcome) can be a beneficial technique of self-control enhancement. Additionally, we noted the effect that cannot be dissembled but was observed as a kind of artifact of implied methodologies. This effect refers to the fact that participants in study 1 achieved generally greater results of weight loss comparing to participants in study 2. The main difference between methodologies used in both studies was that in study 1 there were personal, relatively frequent meetings of subjects with experimenter, while in the study 2, the contact between participants and experimenter was only via internet (except the meetings at the beginning and at the end of the study when the subjects were weighted). Most probably face-to-face meetings function as a form of the "social mirror" activating self-consciousness, which induce the need to meet the personal standards [71].

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4.3.2. The role of implementation intensions and mental contrasting in dietary behaviors

Healthy diet means not only reduction in calories intake but also consumption of appropriate foods like vegetables and fruits [1]. Thus, it becomes extremely important to find the way of persuading people to change their dietary behaviors.

In the study conducted by Stadler et al. [63], training combining implementation intentions and mental contrasting was adopted. In this study, 255 females aged 30–55 were participated. At the beginning of the study, all participants had a meeting with experimenter who in 2-hour session presented significant health-related benefits of increasing the intake of fruits and vegetables (information intervention). Then, participants were divided into two groups: experimental (information & mental contrasting & implementation intentions) and control (information). In the experimental condition, subjects were asked to write down their biggest wish due to the diet which should have been challenging but feasible (e.g. I want to eat more fruit and vegetables). Then subjects were supposed to state the benefits of this positive change (e.g. I will increase my well-being) and anticipate the obstacles standing in the way to enact this desired future (e.g. There is a lack of vegetable and fruits at my workplace). This procedure of comparing the positive, desired future with negative aspects of reality (obstacles to be overcome) is named mental contrasting. As a next step, participants were instructed to prepare three implementation intentions regarding this prospective change: (1) Where and when will obstacles occur and what can I do to cope with it? (2) Where, when and how can I predict and prevent those obstacles not to occur? (3) Where, when and under what circumstances there will be a suitable moment to perform goal-directed behaviors? Fruits and vegetables intake was measured by servings (handfuls) of cut raw, frozen, cooked or canned fruits or vegetables or one glass of fruit or vegetable juice (with 100% fruit or vegetable content). Subjects noted the number of consumed portions in the daily diary reports form. The study lasted for 24 months.

The results showed that in both groups participants increased the number of consumed fruit and vegetable portions (especially at the beginning of the study). However, in the control group who received informative training only, after visible growth especially in the first month following the session, at the end of 24-month program, participants resumed to the initial level of fruit and vegetable consumption. In the experimental group, who besides information intervention received also volitional training (mental contrasting and implementation intentions), the number of consumed portions was not only higher than in control group but also very stable in time.

Two issues deriving from this experiment are additionally worthy to highlight. First, subjects from control group showed accelerated tendency to increase fruits and vegetables intake at the beginning of the study. In means that indeed, this commonly used motivational technique—persuasion can be effective to prompt individuals to start the activity. In terms of time persistence, however, mere information referring to benefits of diet change proved to be insufficient. The second issue is a number of consumed fruit and vegetable portions. At the end of the study in control group, the number of weekly consumed portions was about three portions per day. In the experimental group, although it was higher (about four portions per day), but still below recommended intake [1].

The effective weight management requires one more dietary behavior—abandonment of unhealthy snacking. Indeed, the weight increase is an adverse condition, but still, this is not the only reason why to resign from chips, chocolate bars or cookies. Although our brain depends on its main fuel—glucose, both too low and too high glycemic index cause many health problems [65].

In two studies conducted by Adriaanse et al. [72], mental contrasting and implementation intentions were used to foster the subjects in the process of declining the number of consumed unhealthy snacks. Female students who wanted to change their dietary habits were participated in the study. They were divided into two groups: experimental with mental contrasting and implementation intentions and control. In the first group, participants were asked to close their eyes and imagine the positive future (decrease in unhealthy snacking) and then obstacles standing in the way to reach this desired goal. The subjects assigned to the control group, however, were only informed that one of the possible ways to cut down unhealthy snacking is to replace them with healthier substitutes (e.g. chocolate bar with orange). In the next 7 days, all participants noted in their diaries how many and what kind of snacks they consumed everyday. As a measure of unhealthy snacking, not only the number of snacks was accounted but also their caloric value. The results showed that after 7 days participants from the experimental condition assimilated significantly less calories from unhealthy snacking comparing to subjects from the control group. The average number of calories from unhealthy snacking in the mental contrasting and implementation intentions group was 1745 for the week period. In the control condition, the weekly value was much higher (2870 calories).

The goal of the study 2 [72] was to determine the primacy of the two volitional techniques. The question was: What is more effective, mental contrasting or implementation intentions, or maybe the synergic effect of combining both techniques? The subjects were divided into three groups: with the use of implementation intentions, with the use of mental contrasting and mixed with the use of both techniques. The results of the study disclosed that the technique combining implementation intentions and mental contrasting provided with significantly better effect than each of the techniques itself. Nonetheless, there were no significant differences in efficiency of the two techniques used separately.

4.3.3. The role of implementation intentions and mental contrasting in regular exercise

Lack of regular exercise is being attributed to many mental and physical health problems [65, 66]. On the other hand, regular physical activity predicts well-being and longevity (Anders Hansen, The Real Happy Pill: Power Up Your Brain by Moving Your Body, 2017).

In the study conducted by Milne et al. [7], implementation intentions were used to increase the regular exercising among 248 university students. They were divided into three groups: motivational training, motivational plus volitional training and no intervention groups. At the beginning of the study, subjects assigned to the two experimental conditions were provided with the leaflets informing about the health threats implied in the lack of regular exercise and also about the benefits that can be gained following the regular physical activity. This procedure served as a motivational support, supposed to awake the desire to change current habits and formulate an intention to attain the desired goal (to exercise regularly). Besides the informative support, subjects from the second experimental condition (combined motivational and volitional support) were asked to generate implementation intensions of when and

where they were going to exercise in the following week. Participants from the control group did not receive any treatment—they were only asked to engage in regular physical activity in following weeks of research program. In the first week of study, there were no differences between groups in terms of number of workouts. Nonetheless, after second week of the study, significant effects started to appear. Subjects from the second experimental group (combined training) exercised more frequently than those from the first experimental (motivational training) and control groups. Interestingly, there were no differences between the first experimental and control groups. This result proves again that intention induced by awareness of adverse consequences of not changing the behavior and favorable effects following the change is not enough to actually enact this intention.

Sheeran et al. conducted the study with low-SES, middle age, overweight fishermen from North England [73]. The goal of the experiment was to help them to form positive habit of regular physical exercise. About 467 males in their middle ages (M = 54 y. o.) were participated in the study. At first, participants were asked about their attitude toward regular activity, and then they were randomly assigned to one of the two groups: experimental (mental contrasting) and control. The subjects from the experimental condition were invited to imagine the gains that regular activity could supply. Most participants considered such results as weight loss or better health. Then, the subjects were instructed to think about major obstacles that stand in the way to reach the desired goal. The main problems foreseen by the participants were lack of time and lack of company during the trainings. In the control condition, no instructions were used to induce favorable change but only the actual level of physical activity was monitored. The measurement of exercise level was conducted three times: at the beginning of the study, after a month and after 7 months of treatment. At the beginning of the study, there were no differences between participants in their activity (or rather inactivity, because most of them denoted that they exercised rarely or not at all). Nonetheless, just after 1 month of joining research program, observable differences started to appear. Subjects from the experimental condition exercised more than those in control group. After 7 months, however, the difference between groups became even greater. Indeed, participants who imagined the benefits of regular physical activity prior to considering the obstacles standing in the way to reach this goal exercised more regularly than those who did not mentally contrast the desired future with unfavorable reality full of obstacles. Subjects from the control condition stayed as inactive as they were at the beginning of the research program.

5. Individual differences in self-control of weight loss process

Most of the studies exploring the individual differences in effective intention enactment, especially in the health-related area, refer to the self-efficacy construct [74, 75]. Proposed by Bandura [76], concept of self-efficacy assumes that a sense of personal control over behavior facilitates effective goal attainment. For example, in the study with diabetes patients motivated to increase their exercise level, the results showed that people lacking self-efficacy benefit from planning strategies significantly less than those who exert high self-efficacy [75]. There are also some other attempts to appoint the dispositional factors influencing effective intention enactment. In the study of 43 dieters, Big Five personality factors were measured to verify the relation between conscientiousness as personality trait and effectiveness of weight

loss [77][1]. The results showed that after 8 weeks of research program women who manifested high level of conscientiousness lost average 1.43 kg more than those who revealed low level of this personality factor.

5.1. The role of *processuality* as type of *mental simulativeness* in effective weight loss

Not only, however, self-efficacy and conscientiousness seem to influence humans' ability to struggle with goals. Since different types of mental simulations lead to diverse effects in intention enactment, the personal, individual tendency to imagine either outcome of action or the process of reaching it should result in varied achievements. To test this hypothesis, Jarczewska-Gerc [78] constructed the Questionnaire of Goals dedicated to measure the individual difference in the way people imagine the goals and the process of attainment, called *mental simulativeness*. This construct can be defined as an individual tendency to imaginatively think about the goals either in the structural or outcome mode. The analysis based on the representative for Polish population sample (1005 of Poles) showed that the questionnaire accounts for two factors: the structural factor (processuality: focusing on outcome versus process of action) and the affective factor (the valance of emotions which accompany the action: positive versus negative). This two factor construction of questionnaire enables to distinguish four types of mental simulativeness:

1. "Persistent"—People who manifest high processuality when set their goals and experience predominantly positive emotions while achieving them. Subjects representing this type easily set plans for their actions and imagine step-by-step activities which are imprinted in successful performance. Once analyzed, they do not dwell on past failures but effectively move on. They are characterized by rather positive affectivity. Objectively, they are very effective and persistent in actions.
2. "Defensive pessimists"—Subjects who display high processuality, though at the same time they tend to fall into ruminations. They imagine the structure of performance but not so much to gain the goal but rather to avoid the failure. Prior to prevent potential adversity, they imagine the obstacles standing in the way to attain the goal. They experience more often negative affect and tend to ruminate over past misfortunes. Objectively, they usually succeed in their actions but the cost of performance is very high, sometimes exceeds the gains.
3. "Depressives"—Persons who reveal low processuality and high ruminations. They focus their attention on the outcomes of performance—especially negative ones—failures. Subjects representing this type rarely set or plan to attain their goals since they settle on defeats and ruminate over them.
4. "Wishful optimists"—People who display low processuality but still experience mostly positive affects (at least, for a time). Persons representing this type fall into positive

[1]The study was conducted within MA seminar supervised by Ewa Jarczewska-Gerc at SWPS University of Social Sciences and Humanities in Warsaw, Poland.

fantasies (conf. [79]); they daydream about eligible outcomes but do not think much about how to enter the action and actually reach the goal. Objectively, most of times they loudly speak about their desires and resolutions but rarely enact them later on.

In the study of dieters, those who represented "persistent" type of mental simulativeness showed the highest weight loss comparing to other types after 5 weeks of research program [80]. Also research with bariatric patients confirms the relation between simulativeness and effectiveness in action [81][2]. In the longitudinal study with 38 obese subjects (with BMI 34–60) who decided to undergo bariatric surgery, the effects of the operation were measured after a following year. The results showed significant correlation between individual tendency to processuality and weight loss in the group of female patients ($r = 0.62$, $p < 0.05$).

5.2. The role of motivational (internal versus external) and volitional dispositions in weight loss

In our latest applied studies with dieters, conducted in 2017 [82], we intended to identify main factors, which drive people to go on a diet and then to assess the influence of those factors on the actual diet effectiveness. The subjects were recruited from the dietary internet portal DietaOxy, which provides with prescriptions and dietary supplements.

In the first step of our research program, we designed the questionnaire to measure types of motivation for weight loss, called the *Motivation for Weight Loss Questionnaire*. The construction of this questionnaire was based on the general assumption that to enter the diet and persist in its enactment depend much on the motivational factors (What drives us? Why are we doing this?), volitional factors, i.e. the ability to delay of gratification (resist a temptation) [42] and ability to affect regulation [33].

In this research program, 853 subjects were participated (aged 16–81, M = 37), women in majority (N = 816 females aged 16–68, M = 36). The factor analysis of the results from the *Motivation for Weight Loss Questionnaire* revealed six factors related to weight loss process: three motivational and three volitional.

Within motivational factors, the following factors were distinguished: (1) *internal motivation*, (2) *positive external motivation* and (3) *negative external motivation*. *Internal motivation* factor refers to the global and long-term desire to change lifestyle including dietary behaviors. Persons receiving high results on this factor decided to go on diet because they want to maintain or regain health. Diet is not a temporary whim for them, they tend to internalize behaviors attempted to lose weight. They consider overweight and obesity as adverse health conditions. *Positive external motivation* is a factor strictly related to the positive outcomes expected following the diet. Persons who receive high results on this factor motivate themselves by focusing on benefits, especially appearance related, derived from the weight loss. They also have high need for positive appraisal from relatives and significant others (especially from the partner). The last motivational factor—*negative external motivation* operates when the subject perceives

[2]The study was conducted within MA seminar supervised by Ewa Jarczewska-Gerc at SWPS University of Social Sciences and Humanities in Warsaw, Poland.

own decision about dieting as a kind of punishment for sins. The necessity to change everyday menu makes them quite nervous, because they did not internalize the reasons for dieting. This happens because most people rebel against the behaviors which they though planned but still do not accept. People scoring high on this factor look forward to finish the diet and go back to the previous, unhealthy habits.

Within volitional factors, the following factors were distinguished: (1) *the ability to delay of gratification* and two different affect regulation strategies, *i.e.* (2) *task-oriented* and (3) *avoidance-substitutional* strategy. Subjects who score high on the *ability to delay of gratification* factor declare that they can resign from the temporary pleasure in order to achieve greater and more valuable goal in a while. For them, the necessity to employ the diet and abandon previous bad habits constitutes a natural path to attain the desired goal. The *task-oriented strategy* factor means facing the challenge, planning the action and avoiding eating unhealthy food as a coping behavior. In turn, the *avoidance-substitutional strategy* factor is a tendency to mentally and/or physically escape from the difficulties and effort, focusing on the stimuli and activities unrelated with ongoing action. The subject scoring high on this factor when exposed to a stressful condition tends to attenuate negative affect by binging on tasty foods, alcohol or excessive shopping.

The cluster analysis based on this six factors solution revealed three types of dieters, which we operatively named: "Masters of self-control," "Motivated" and "Waiting for a miracle."

"Masters of control" (N = 223) exactly know why they decided to go on diet; they want to permanently change the lifestyle to gain or regain health, well-being and happiness. They are internally motivated, thus external rewards or gratifications (like attractive "bikini look") are not so important for them. They can easily delay of gratification and generate plans and strategies of goal implementation. They can both initiate advantage behaviors and inhibit adverse activities. While faced with difficulties, they most usually use task-oriented strategies of coping. They rarely obey to impulses when stressed or anxious.

"Motivated" (N = 296) are also effective in their pursuance of weight loss. They are motivated and their willpower is high, but at the same time they are driven by diverse motives. Being healthy and happy are much of their desire, but besides that they yearn for external attention and appreciation. They daydream about the positive results of losing weight, like attractive, thin figure, being praised by relatives and strangers. In stressful situations, they chose task-oriented strategies at first, but sometimes they also fall into substitutive or avoidance behaviors.

"Waiting for a miracle" was the most represented type in the study sample (N = 334). The subjects representing this type are motivated externally and their motives are in majority negative. They experience many various problems while enacting their intentions, because they have problems with delay of gratification and planning. They perceive dieting as a punishment and look forward for a diet to terminate. They daydream about an attractive appearance but without restrictions. Most usually they use avoidance-substitutional strategies of coping when faced with stress.

Figure 4 shows the average results on respective factors dependently to the type of dieter (1–7 scales were used, where 1 means *this statement does not suit me at all* and 7 means *this statement totally suits me*).

The last step of analysis was aimed to verify the differences in actual weight loss between subjects representing particular types of dieters (measured by declarations of subjects provided in the internet). The analysis (one-way ANOVA) indeed revealed the main effect of the type of dieters ($F(2, 755) = 15.5$, $p < 0.001$) showing that subjects who were qualified to "Masters of self-control" and "Motivated" lost significantly more weight than those representing "Waiting for the miracle" group. The results are presented in **Figure 5**. The differences are a, b–c, $p < 0.001$.

The results of the study enabled to distinguish three different types of dieters and denote their effectiveness in weight loss process. As we assumed, people differ in terms of the drivers which steer them to go on a diet and later determine efficiency in implementing their weight loss-related intentions. The results comply with the theoretical assumptions, which formed the basis for our expectations. People differ in both: the source of the dietary motives (external versus internal) and volitional ability to realize these motives in factual action. Those differences, as it was confirmed in the statistical analysis, influence the effectiveness in goal attainment, also in weight loss area. It should also be remarked that the majority of our sample were females, thus the conclusions can be only attributed to this group of subjects. In further studies, we intend to account for more male participants and verify the legitimacy to include them to respective types of dieters. Furthermore, in following steps, we plan to generate appropriate feedbacks for subjects representing particular types to help them effectively pursue their dietary goals. Especially, we will focus on the "Waiting for a miracle" type, which occurred to be the least effective while dieting.

6. Concluding remarks

In this chapter, we presented theories and research concerning the problem of self-control in weight-related behaviors. We intended to demonstrate what the self-control is, what are its manifestations and how successes and failures of self-control can be explained. We depicted techniques which can increase self-control: mental simulations, mental contrasting and implementation intentions. We indicated benefits of those techniques but also marked the threats which are imprinted in inappropriate forms of using them (e.g. adverse effects of outcome mental simulations). Additionally, we presented data, especially from our studies revealing the role of individual differences in effective weight loss.

Our review of selected theories and empirical data presented in this chapter enables to formulate following global conclusions and remarks:

1. However, self-control, as a significant factor in effective intention enactment (including weight loss intention), requires effort, the mechanisms rooted at its core are diverse and go beyond ego strength thesis comprehended as restricted and depletable self-regulatory, energetic resource.
2. The effort necessary for effective intension enactment depends on the modes of self-management, what precisely means the degree to which the regulation standard (goal, intention) is integrated with the self. There are two self-management modes: democratic

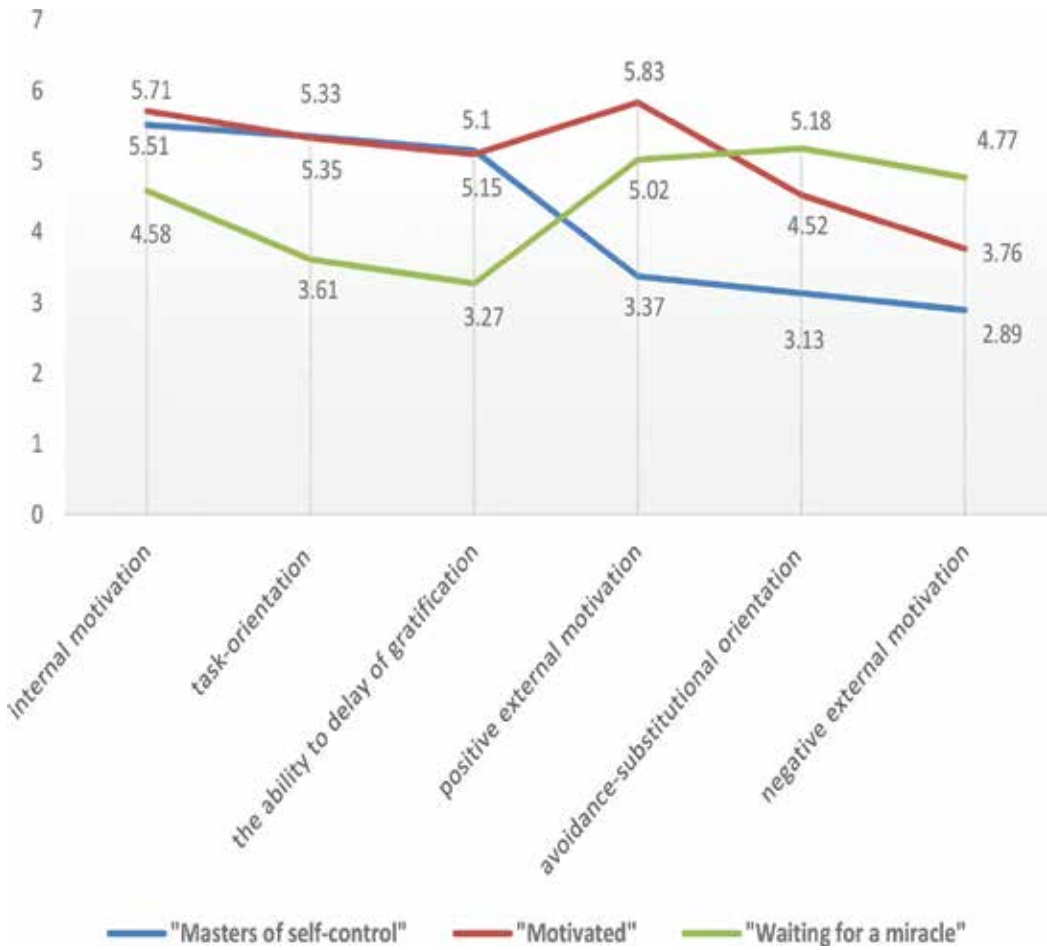

Figure 4. The average results on respective factors dependently to the type of dieter.

and autocratic. First one—democratic mode (named by Kuhl self-regulation)—enables performance consistent with the self (goal/intention is integrated with the system representing own needs, value preferences and autobiographical memory) and allows for the self-system's integration. Autocratic mode in turn (named by Kuhl self-control) excludes the influence on the performance of significant aspects of the self like feelings, needs or values. The person in the self-control mode implements the intentions which are not integrated with the self at all or are integrated in small extent.

3. Affect regulation (the ability to activate positive and/or neutralize negative affect) plays a significant role in effective intension enactment.

4. Alike mental simulations, mental contrasting and implementation intentions are beneficial techniques of self-control enhancement.

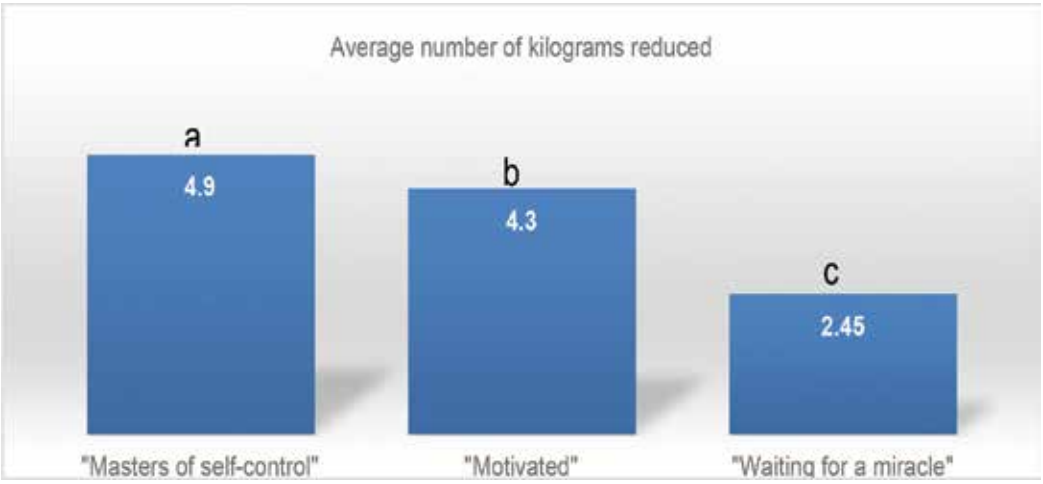

Figure 5. The average weight loss (in kilograms) dependently to the type of dieters.

5. Research results prove as far that in weight-related behaviors, the technique combining implementation intentions and mental contrasting is more beneficial (provided with significantly better effect) than each of the techniques itself.
6. The results of our studies referring to the influence of various mental simulations on the effectiveness in weight loss process evidenced that imagining the process of performance increases both effectiveness and persistence in intention enactment. Our studies also showed that combination of simulations (process and outcome simulations) can be the most beneficial technique of self-control enhancement.
7. There are individual differences in the way people imagine the goals and the process of their attainment. An individual tendency to imaginatively think about the goals either in the structural or outcome mode is called mental simulativeness. The results of our studies presented that the subjects representing so-called persistent type of mental simulativeness, who are characterized by the high processuality (i.e. strong tendency to imagine the process of goal attainment) accompanied with experiencing positive emotions while achieving the goal—showed the highest weight loss after 5 weeks of dietary program.
8. In the search for main factors which drive people to go on a diet and individual differences in this domain, we entered the research program which takes into account motivational factors (internal versus external motivation), volitional factors (the ability to delay of gratification) and affect regulation strategies as well (task-oriented and avoidance-substitutional strategy). The data gathered as far evidenced that type of dieters, which we operatively named "Waiting for a miracle," is the most represented type in the study of Polish sample. The subjects representing this type are motivated externally and their motives are in majority negative. They have problems with delay of gratification and planning. They perceive dieting as a punishment and look forward for a diet to terminate. Most usually they use avoidance-substitutional strategies of coping when faced with stress.

Hopefully, the theoretical and empirical review presented in this chapter was at least in some part exhaustive and contributed to better understanding of processes, which are involved in humans' attempts to struggling with goal. Further studies should focus on possible sources (e.g. energetic, neural, etc.) of interindividual differences in self-control abilities and suggest the ways in which psychological interventions could compensate unequal chances for success in health-related behavioral change. Additionally, virtual reality seems to be an interesting area of further explorations. Currently, in Poland, there are conducted studies which are dedicated to examine the possibility of using virtual reality in the phobias area (the results have not been published yet since the studies are still carried on). Research concerning implementation of virtual reality could open a new path to scrutinize mechanisms of will power and later on inspire practitioners to create diverse and complex interventions dedicated to everyday struggles with self-control problems.

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Section 2

Gender and Ethnic Topics Related to Weight Loss

Chapter 3

The Eating Attitudes and Mental Health in Japanese Female University Students

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Additional information is available at the end of the chapter

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Abstract

First, the relationship between eating attitudes and anxiety in Japanese female university students was examined. The results of the analysis show that especially trait anxiety significantly relates with eating disorder tendency. Following this, the interrelationship of eating attitudes, body-checking behavior cognition, and depression was examined. The results show that the obsessive thoughts body image score increases as the eating disorder tendency score also increases, indicating that inappropriate eating attitudes have a strong impact on obsessive thoughts. Finally, the relationship between eating attitudes, trust, and isolation was examined. The results of the analysis show that inappropriate eating behavior significantly correlates with distrust and isolation.

Keywords: eating attitudes, university students, anxiety, depression

1. Introduction

Eating disorders associated with a distorted body image include anorexia nervosa (AN) and bulimia nervosa (BN) (DSM-5, American Psychiatric Association, [1]). BN is characterized by a cycle of bingeing and compensatory behaviors, such as self-induced vomiting, designed to undo or compensate for the effects of binge eating. In contrast, the patients with AN deliberately lose a lot of weight through abnormal eating habits; however, there are several other physical and psychological signs related to this problem.

Nozoe et al. [2] reviewed eating disorders in Japan and showed AN exploded during the 1960s and 1970s. BN has also increased since the late 1970s. The number of patients in the younger generation (under 14 years of age) and older generation (over 30 years old) was increasing

around the millennium. Nozoe et al. [2] theorized that the change related to eating disorders was affected by the economical and social situation of the time. For instance, during this time, there was an increase in the number of nuclear families, a decrease in communication with neighbors and relatives, increased expectations for academic achievements for children, and new diversity in mothers' and fathers' roles in the families. Past studies note a risk factor in relation to eating disorders is family issues: the divorce of the parents and lack of attachment between children and their mothers [3], overcohesiveness of family members [4], and generation gap [5].

There are other psychological factors in Japanese culture that may be potential reasons for eating disorders. Ono and Shimada [6] found that an irrational belief about dependence and self-expectation could affect eating disorders. Adolescents with highly disturbed eating patterns show stronger attitudes concerning the need to eat nutritionally balanced food and know information about food and restaurants [7]. This evidence suggests that the reason(s) for eating disorders is complex. The problem concerning inappropriate eating attitudes not only is connected with eating disorder patients but also may be with ordinary adolescents and adults.

Okabe and Inoo [8] investigated AN patients' body images and showed that they believed their body weight was heavier than it was. The same study showed that AN patients had higher demands regarding dieting behavior than the control group. In the current Japanese society, this tendency is common in nonclinical people as well. Kashima [9] states that Japanese young women daily accept information about diet behavior through magazines and TV programs. It could be argued dieting behavior is at times necessary for health, but many people seem to adapt dieting behaviors because of fashion practices rather than health matters. The number of people having inappropriate eating attitudes and behavior is increasing [10]. However, while they do not satisfy the clinical criteria of having an eating disorder, the tendency does affect their mental health.

Recent findings in other countries also suggest a significant relationship between eating attitudes and psychological aspects in adolescents and young adults. Baş and Kiziltan [11] showed female adolescents in Turkey may be more likely to display abnormal eating attitudes and dieting behaviors than males. They also found that female dieters had higher social physique anxiety and lower self-esteem than non-dieters. Bacopoulou et al. [12] showed a significant positive relationship between inappropriate eating attitudes and anxiety in Greek adolescents. This evidence tells us that investigating the relationship between eating attitudes and psychological factors and the relationship's effect on mental health is an important research topic.

Mental health is affected by physical health, and relationships between psychological and physiological factors are an important research topic in current psychology as shown above. The symptom of weight loss is no exception. It is important to investigate how we recognize our physical situation and behavior. Therefore, this study also focuses on the cognition of eating attitudes and body image and investigates how they affect our psychological aspects, such as depression and anxiety. We hypothesize that the cognition of our eating behavior affects not only our personal but also interpersonal factors. Based on the hypothesis, we use the trust and loneliness as dependent variables in the study and examine the relationship among eating attitudes and the dependent variables.

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2. Eating attitudes, body image, and depression in Japanese female university students

2.1. Introduction

The relationships between eating attitudes, body image, and depression are mainly examined through the scope of Yoshie et al.'s [13] work in this section. Body image is defined as the cognition of one's own body. Many reports have shown that the desire to be slim and tendency to obsess over one's body image are increasing [14–16] showed body dissatisfaction is associated with a greater risk of having body image distortions, which in turn is associated with being underweight or overweight. This tendency exists in female Japanese adolescents. Tazaki [17] indicated that the number of young Japanese women who skip regular meals due to dieting is increasing. He argued that as female adolescents tend to view their body image more negatively, their desire to diet increases.

Earlier studies conducted surveys that revealed the relationship between the desire for thinness and body image. Brunch [18] mentioned AN is a serious disorder because patients cannot recognize their body image correctly and become overly thin. Mountford et al. [19] studied eating disorder patients and concluded body-checking behavior was a representation of the distorted cognition in eating disorder patients. Consequently, these researchers developed the Body Checking Cognition Scale (BCCS). One engages in body-checking behavior to judge one's shape or weight [20, 21]. Body-checking behavior includes several behaviors as follows. A representative one is weighing oneself and looking at the mirror to check one's specific body parts frequently. Another examples are checking clothes whether they fit to one's body or not and compare one's body with other person [21, 22]. Further, negative body image significantly drives a wish for thinness among ordinary Japanese females [23]. As these previous studies show, cognition of body image might influence our eating attitudes, and this relationship is not specific to eating disorder patients. Thus, it is important to explore how an ordinary person's eating attitudes interrelate with body image.

Jackson et al. [24] showed the relationship between body image satisfaction and depression in midlife women. Naylor et al. [25] also found an association between exercise beliefs, obsessive beliefs, and obsessive-compulsive behaviors in an eating-disordered group. While these studies are based on the data of a specific generation and clinical groups, the tendency might apply to ordinary female university students. Therefore, the purpose of this study is to examine the interrelationship of eating attitudes, cognition of body-checking behavior, and depression in Japanese female university students. The following hypotheses are proposed:

Hypothesis 1: Eating attitudes in young Japanese women influence their body image, body-checking behavior, and mood state.

Hypothesis 2: Inappropriate eating attitudes strongly impact obsessive thought patterns more than other factors of body-checking behavior.

Body-checking behavior includes behavioral aspects, such as body control and cognitive aspects (e.g., obsessive thought). Previous studies indicated the significant correlation

between the risk of an eating disorder and obsessive thought [25]. Therefore, we hypothesized that inappropriate eating attitudes particularly impact obsessive thought patterns.

Hypothesis 3: Inappropriate eating attitudes negatively impact depression.

Furthermore, a significant correlation between eating disorders and depression has been found in clinical samples [26, 27]; the tendency is considered acceptable in eating attitudes of ordinary university students.

2.2. Method

2.2.1. Participants

Participants were 198 female Japanese university students who voluntarily took part in the study (median age = 19.98, SD = 1.38). They were recruited in a psychology class at the university, and the purpose and ethical considerations of the study were explained to them. They agreed to the informed consent to participate in the survey.

2.2.2. Measures

2.2.2.1. Eating attitudes test

The Eating Attitudes Test (EAT-26 Japanese edition; [28]) is an inventory that diagnoses eating disorders and measures eating attitudes using a six-point scale ranging from 1 (nothing) to 6 (always) and includes 26 items. All items consist of one factor, and the reliability of the scores has been confirmed (α = .85).

2.2.2.2. Body image cognition scale

Yoshie [29] developed the Body Image Cognition Scale (BICS) based on the BCCS [19]. The BCCS comprises four subscales: objective verification, reassurance, safety beliefs, and body control. The BICS measures cognition of body-checking behavior and basic factor structure consistently with the BCCS, but some items were added and revised to account for Japanese culture. The scale includes 22 items and 4 subscales: objective verification (α = .75), obsessive thought (α = .64), reassurance-confidence (α = .79), and body control (α = .79). All items were tested on a five-point scale ranging from 1 (disagree) to 5 (agree).

2.2.2.3. Depression scale

The Center for Epidemiologic Studies Depression Scale (CES-D), Japanese version [30, 31], is used to measure depression. It is a standardized inventory that includes 20 items using a 4-point scale ranging from 0 (disagree) to 3 (agree) to measure participants' levels of depression. The sum of the scores is treated as the depression score. Because the CES-D is a standardized inventory and its reliability and validity have been proven, the current study utilized the original version.

2.2.2.4. Procedure and data analysis

Participants were asked to answer the EAT-26, BICS, and CES-D questionnaires. Then, they were divided into three subgroups based on their EAT scores. The high group (EAT-H,

N = 14) scored three points or higher, the middle group (EAT-M, N = 78) scored between two and three points, and the low group (EAT-L, N = 105) scored two points or lower. The scores of BICS and CES-D were compared among EAT-H, EAT-M, and EAT-L groups.

2.3. Results

Based on the hypothesis, the scores of BICS and CES-D were compared among EAT subgroups using one-way analysis of variance. There were significant differences in all BICS's subscales: objective verification ($F(2,194) = 18.19$, $p < .01$, $\eta^2 = 0.16$), obsessive thought ($F(2,194) = 30.05$, $p < .01$, $\eta^2 = 0.24$), reassurance-confidence ($F(2,194) = 3.28$, $p < .05$, $\eta^2 = 0.03$), and body control ($F(2,194) = 23.33$, $p < .01$, $\eta^2 = 0.19$). The result of multiple comparisons showed that in objective verification, reassurance-confidence, and body control, the mean score for the EAT-M group was larger than for the EAT-L group ($p < .05$). In addition, the score of EAT-H group was higher than the EAT-L group ($p < .05$) in objective verification and body control. Regarding obsessive thought, the highest scorer was the EAT-H group, followed by the EAT-M and EAT-L groups, respectively ($p < .05$). There were also significant differences in depression scores ($F(2,194) = 5.31$, $p < .01$, $\eta^2 = 0.05$). Depression scores in the EAT-M and EAT-H groups were higher than those of the EAT-L group ($p < .05$). **Table 1** shows the interrelationship of eating attitudes, body image cognition, and depression.

2.4. Discussion

The general hypothesis (Hypothesis 1) of this study is that inappropriate eating attitudes influence body image, body-checking behavior, and mood state. We confirm the results of this study based on the hypothesis and evidence from previous studies.

First, the results show that the scores of the EAT-L group are lower than those of the other groups with respect to objective verification, body control, and depression. Objective verification is a factor that reflects the motivation to consider one's own body image accurately and continually. The EAT-L group does not run a risk of developing an eating disorder and maintains healthy eating behaviors. It suggests that participants with healthy eating attitudes have low levels of body checking. Body control is a matter of adjusting the amount of food or exercise to control one's weight. The EAT-L group could maintain a balance without excessively

	EAT-H	EAT-M	EAT-L	
	Mean (SD)	**Mean (SD)**	**Mean (SD)**	
Objective verification	4.11 (0.50)	3.86 (0.63)	3.32 (0.74)	L < M*, H*
Obsessive thought	3.63 (1.03)	2.87 (0.79)	2.22 (0.72)	L < M < H*
Reassurance confidence	2.45 (0.96)	2.72 (0.92)	2.38 (0.84)	L < M*
Body control	3.97 (0.43)	3.52 (0.70)	2.91 (0.78)	L < M*, H*
CES-D	21.07 (12.58)	17.11 (11.19)	13.41 (8.94)	L < M*, H*
				*p <.05

Table 1. The interrelationship of eating attitudes, body image cognition, and depression.

worrying about their weight or body image. Mitsui [32] showed that depressive tendencies are present in people with middle and high levels of eating disorders. This study also showed that depression was more frequent in the EAT-H and EAT-M groups. These results support Hypothesis 3 and indicate inappropriate eating attitudes facilitate depression not only in clinical data but also in ordinary university students. In addition, Shima et al. [30] mentioned that there is a risk of depressive disorders with participants who score over 16 points on the CES-D. Both the EAT-H and EAT-M groups satisfied these criteria. Mitsui [32] stated that self-identity is threatened because of strong anxiety and depression caused by a lack of basic trust. As these results show, participants with high EAT scores have difficulty treating their emotions as an integrated inner experience, with the result that a depressive mood increases significantly. Therefore, the hypothesis (1) that inappropriate eating attitudes increase excessive body-checking behavior and depression was supported by the results of this study.

Second, the scores for obsessive thought increase based on the participants' EAT results. This study indicates that the effect size of the analysis is the largest in obsessive thought and that inappropriate eating attitudes strongly impact obsessive thought more than any other factors of the BICS. This result supports Hypothesis 2. Halmi et al.'s [33] work showed the relationship between AN, perfectionism, and obsession. It is believed that the participants with eating disorder tendencies also have general obsessive tendencies, which extend to body-checking behavior. Yoshie et al. [34] showed that participants with high EAT scores also exhibited high levels of trait anxiety. Trait anxiety is the tendency to feel anxious and is a part of an individual's personality. As the results of this study and Yoshie et al.'s [34] outcomes reveal, people with inappropriate eating attitudes have a tendency to feel anxious easily, and such tendencies may facilitate obsessive thoughts and behaviors. These results prove Hypothesis 2 that inappropriate eating attitudes facilitate obsessive thought patterns.

The results of the analysis provided another finding. Reassurance-confidence scores were higher in the EAT-M group than in the EAT-L group. As mentioned previously, the EAT-L group did not have eating disorder tendencies and could be considered a healthy group. Alternately, the EAT-L group could also be interpreted as being careless about their eating attitudes or body image. Therefore, they rarely require reassurance and do not seek confidence through body checking. In contrast, the EAT-M group showed a moderate interest in eating attitudes. According to these results, while the EAT-L group had a low motivation to body check due to indifference, the EAT-M group sufficiently cared about their body image in daily life, and this habit brought them reassurance and confidence. Cooley et al. [35] established a relationship between eating behaviors and the seeking of reassurance. This past research supports the results of this study and also indicates that it will be necessary for future studies to investigate how reassurance seeking through body-checking behavior is suppressed in the EAT-L group.

In conclusion, results of this study provided evidence that eating disorder tendencies correlate with a risk of excessive body-checking behavior, depression, and obsessive behaviors. In addition, while previous studies focused on patients with eating disorders, this study explored the behaviors of normal participants without eating disorders, such as the individuals in the EAT-L group. Although they do not have inappropriate eating attitudes, their

carelessness about eating behavior may be a factor in suppressing the reassurance or confidence they seek through body-checking behaviors.

2.5. Limitations and directions for future study

This study has some limitations with regard to its settings and outcomes. First, only women participants were included in this study. Previous studies have shown the detail of symptoms in eating disorder that differ between males and females [36]. Therefore, we need to collect the data of male participants and compare the results. Second, we employed the EAT for measuring eating attitudes, but other scales have been developed to assess eating disorder tendencies from several aspects. For instance, the Eating Disorder Inventory [37] measures eating disorder tendencies using multiple factors, such as drive for thinness and body dissatisfaction. Using these other scales and further confirming the relationships between eating attitudes, body-checking behavior, and depression could supply more detailed and useful data.

3. Eating attitude and anxiety in Japanese female university students

3.1. Introduction

This section focuses on anxiety and show the relationship between eating attitudes and anxiety based on Yoshie et al.'s [29] research. Eating disorders are common in adolescents and young adults, and the tendency toward eating disorders in those age groups is increasing. Clinical criteria originally divided such disorders into anorexia nervosa and bulimia nervosa. However, there are pathologies that do not directly satisfy the criteria of eating disorders, such as obsessive dieting, a type of inappropriate eating behavior. Oshima et al. [10] showed that eating attitudes are influenced by body dissatisfaction and femininity especially in female university students. In addition, self-image, mood, and personality are the related factors of eating attitudes, too. As shown in the study of previous section, eating attitudes significantly relate with obsessive thought about body image. In the age of adolescence and emerging adult, people are sensitive to body image and often obsessive to keep their ideal body shape. Such obsessive thought and behavior sometimes drive them to the overdieting behavior and weight loss. In the period of those generations, they face the crisis of establishing their own identity as a developmental task. They feel anxious through the process, and such anxiety may be one of the predictors of inappropriate eating attitudes. Therefore, this study focused on anxiety and examined its relationship with eating attitudes in Japanese female university students. We use State-Trait Anxiety Inventory (STAI-JYZ; Hidano et al. [38]) to measure the anxiety of participants in this study. STAI includes two subscales of state and trait anxiety. The former is temporary anxiety, and the latter is constant and deeply concerns with personality and habit of the participants in contrast. The finding of the previous section showed that eating attitudes relate with objective verification and reassurance of body image in addition to obsessive thoughts. Therefore, such factors are daily and constant habits of the participants; they are considered to relate especially with trait anxiety more than state anxiety. Hence, the hypothesis of the study is that inappropriate eating attitudes are facilitated by state anxiety.

3.2. Method

One hundred and ninety-eight Japanese female undergraduate students (M = 19.98 years old, SD = 1.38) participated in this study. Participants were asked to answer the Eating Attitudes Test (EAT-26 Japanese edition; Mukai et al. [28]) and State-Trait Anxiety Inventory (STAI-JYZ; Hidano et al. [38]). EAT-26 is an inventory that diagnoses eating disorders and measures eating attitudes using a 6-point scale (1 (nothing) to 6 (always)) and includes 26 items. STAI is a standardized inventory that measures both state and trait anxieties. For each type of anxiety, it includes 20 items along a 4-point scale (1 (disagree) to 4 (agree)).

3.3. Results and discussion

According to the score of EAT-26, participants were divided into subgroups. EAT-H (N = 14) is a high group, and they had a mean score of three points and above. EAT-M (N = 78) is a middle group and the score is between 2 and 3. EAT-L (N = 106) is a low group with score of less than two points. EAT is a scale for the criteria of AN, and EAT-H group is the most risky group of inappropriate eating attitudes and AN tendency. One-way analysis of variance is conducted to compare the score of STAI among EAT-H, EAT-M, and EAT-L groups. As a result, there is a significant difference in the trait anxiety score ($F(2,195) = 3.45$, $p < .05$), and multiple comparisons showed that the trait anxiety in the EAT-H was significantly higher than in the EAT-L ($p < .05$). There was no significant difference in the state anxiety ($F(2,195) = 0.36$, ns) (**Table 2**).

The main finding of the study is that trait anxiety strongly relates to eating attitudes. The findings in previous studies support this result. As mentioned before, Baş and Kiziltan [11] found female dieters had higher social physique anxiety and lower self-esteem than non-dieters. Bacopoulou et al. [12] showed the significant positive relationship between inappropriate eating attitudes and anxiety. Becker et al. [39] especially focused on trait anxiety and examined the relationship with eating attitudes. They showed that inappropriate eating attitudes, such as fasting frequency and excessive exercises, significantly correlate with trait anxiety. Wagner et al. [40] also showed that trait anxiety was significantly higher in the AN and BN group than the control group.

Trait anxiety is the tendency to feel anxiety easily and is part of an individual's personality. In contrast, state anxiety is a temporary mood. However not all participants categorized in the EAT-H group satisfied the criteria to be diagnosed with an eating disorder; they have a certain amount of inappropriate eating attitudes and risk of AN. The result of the study indicated that these students with AN tendency live with constant and continuous anxiety and these viewpoints are useful for future clinical support.

	EAT-H		**EAT-M**		**EAT-L**		
	M	***SD***	***M***	***SD***	***M***	***SD***	
State anxiety	42.79	12.96	40.67	12.62	40.00	11.32	
Trait anxiety	51.43	14.09	45.73	12.23	43.21	11.05	EAT-H > EAT-L*
							*$p < .05$

Table 2. Relationships between eating attitude and anxiety.

4. The relationship among eating attitude, trust, and loneliness in Japanese female university students

4.1. Introduction

We focus on the effect of eating attitudes on the relationship with others from the viewpoint of trust and isolation. From the clinical viewpoint, both trust and isolation are important factors to understand the cognitive style of eating disorder patients. Takii et al. [41] mentioned that it is difficult to recover from an eating disorder because a patient has an obsessive belief that their family and therapist do not understand their feelings. However, they cannot live without being taken care of by their family and therapists, and this process increases their isolation and helplessness. Therefore, people with eating disorders have a basic and continuous anxiety based on the belief of not being accepted by others.

Takaku and Moriya [42] showed that children who are accepted well by their parents express negative feelings to others more than children that lack acceptance. This result indicates that the basic trust and security established through the attachment relationship between children and their parents promote the expression of children's feelings and self-disclosure. In contrast, many eating disorder patients do not have the experience of being accepted by others, and this is the cause of distrust for their family and therapists. Takezawa and Kodama [43] focused on the positive aspect of dependency and developed the Interpersonal Dependency Scale and found the dependency is divided into two factors: affectional dependency and instrumental dependency. Based on their theory, excessive dependency is not good for mental health, but an adequate level of dependency is necessary to maintain good relationships with others in our daily lives. They also investigated the relationship between dependency and trust. The result of the study found that participants with high dependency have higher trust in others than participants with a lack of dependency. As the evidence shows, trust affects how we communicate and depend on each other. This mechanism might be the same in eating disorder patients and people with inappropriate eating attitudes.

The positive relationship between isolation and eating disorder tendencies in Japanese university students has been revealed [44]. Goto [44] states the recognition of individuality in the phase of adolescence, and emerging adulthood strongly concerns the relationship between isolation and eating attitudes. The relationship is not specific in the clinical samples, and it is important to investigate the mechanism of how eating attitudes affect the promotion of isolation in nonclinical samples.

4.2. Method

4.2.1. Participants

Two hundred and three Japanese female university students (Mage = 19.18, SD = 1.10) participated in the study. Six data points were removed because they included errors. Therefore, a total of 197 data points were analyzed in the next step.

4.2.2. Measures

4.2.2.1. Eating attitudes test

The Eating Attitudes Test (EAT-26 Japanese edition; Mukai et al. [28]) is an inventory that diagnoses eating disorders and measures eating attitudes using a 6-point scale ranging from 1 (nothing) to 6 (always) and includes 26 items. However, all items of the EAT-26 originally consist of one factor; the result of the factor analysis based on the present samples showed that the loading of six items is less than 0.40. Therefore, these items were removed, and a total of 20 items were used in this study. The reliability of these 20 items was acceptable (α = .91).

4.2.2.2. Trust scale

A scale developed by Amagai [45] was used to measure trust. It includes 24 items that are divided into three factors: trust for others, trust in oneself, and distrust. Like the EAT-26, two items were removed because of the low loading (less than 0.40). The reliabilities of each factor were acceptable (trust for others (α = .86), trust in oneself (α = .89), and distrust (α = .90)).

4.2.2.3. Isolation scale

The Loneliness Scale (LSO) by Ochiai [46] was used to measure loneliness. The LSO includes two factors: LSO-U and LSO-E. LSO-U refers to empathy, and participants with a high score of LSO-U tend to believe that people have empathy and understand each other. For example, the item of "People can understand the feelings that they have for each other" is included on the scale. In contrast, LSO-E is concerned with individuality and loneliness as noted with items like "I have no one to depend on without myself." As a result of removing 2 items because of the low loading (less than 0.40), a total of 14 items were used in the following analysis. The reliabilities of LSO-U (α = .92) and LSO-E (α = .79) were acceptable.

4.3. Results and discussion

First, participants were divided into three groups using the EAT score. The total mean score of the EAT was 45.81, and the standard deviation (SD) was 13.30. We categorized that the average minus 1/2 SD and less was the EAT-L group (N = 63) and the average plus 1/2 SD and more was the EAT-H group (N = 46). The participants with scores between the EAT-L and EAT-H groups were divided into the EAT-M group (N = 88).

The scores of trust for others, trust in oneself, and distrust were compared between the EAT-L, EAT-M and EAT-H groups using one-way ANOVA. The results showed that there was a significant difference in distrust ($F(2,194) = 11.12$, $p < .05$) and trust for others ($F(2,194) = 3.13$, $p < .05$). Multiple comparisons showed that the score of distrust in the EAT-H group is higher than the EAT-M and EAT-L groups. The score of trust for others in the EAT-M group was higher than the EAT-L and EAT-H groups. There was no significant difference in trust in oneself ($F(2,194) = 0.69$, n.s.).

Like the trust scale, the LSO-U and LSO-U scores were compared among the EAT-L, EAT-M, and EAT-H groups. There were significant differences in LSO-U ($F(2,194) = 2.69$, $p < .05$) and LSO-E ($F(2,194) = 3.68$, $p < .05$). The LSO-U score in the EAT-M group was higher than the EAT-H group, and the LSO-E score was higher in the EAT-H group than the EAT-L and EAT-M groups (**Table 3**).

The score of distrust was the highest in the EAT-H group than the other groups. This result indicates that participants who are obsessive about their body image and eating behavior have difficulty with trusting themselves and others. The distrust factor includes items concerned with the personality trait of being suspicious of another person. This trait facilitates excessive self-consciousness, and it makes a person aware of their body image and eating attitudes at an obsessive level. The score of trust for others in the EAT-M group was higher than the other groups. Based on the categorization of this study, the EAT-H group was overly conscious of eating attitudes and in risk of developing eating disorders. In contrast, participants in the EAT-L group had no or very low interest in their eating behavior and body image. The EAT-M is group was average; they had concerns about eating attitudes at a satisfactory level. Therefore, it is possible to view this group as the healthiest with ordinary eating behaviors. Participants in the EAT-M group have confidence in their body images, and it may facilitate their self-efficacy. This promotes trust for others and establishes good relationships with others.

As with trust for others, the score of LSO-U is higher in the EAT-M group. LSO-U is connected to empathy, and it means that participants with a high LSO-U score have a feeling of being accepted and understood by others. It also means that they can share their feelings with others. The EAT-M group is viewed as people who have adequate concerns about their eating attitudes and body image. Therefore, the result of the analysis is interpreted as students who can deal with their eating attitudes appropriately have the confidence to make good relationships with others as opposed to others having obsessive and inappropriate thoughts about eating behavior. In contrast, LSO-E in the EAT-H group is the highest. LSO-E means awareness of individuality and loneliness. It mainly includes items concerned about not being accepted by others. Goto [44] examined the relationship between loneliness and eating attitudes using the LSO and showed that participants with a high LSO-E score tend to have an

	EAT-H		**EAT-M**		**EAT-L**		
	M	***SD***	***M***	***SD***	***M***	***SD***	
Distrust	34.98	7.91	28.86	7.63	27.92	9.18	EAT-H > EAT-M, EAT-L*
Trust in oneself	30.85	7.24	32.17	5.39	31.16	8.30	
Trust for others	20.26	3.84	21.88	3.82	20.32	5.38	EAT-M > EAT-H, EAT-L*
LSO-U	33.70	7.19	36.64	6.38	35.59	7.40	EAT-M > EAT-H*
LSO-E	17.30	4.31	15.49	4.28	15.10	4.59	EAT-H > EAT-M, EAT-L*
							*p < .05

Table 3. Relationships among eating attitude, trust, and anxiety.

eating disorder tendency. This evidence supports the result of this study. Goto [44] noted that the conflict that occurs in the process of establishing an identity during adolescence is a reason for the relationship between loneliness and inappropriate eating attitudes. In connection to what Goto [44] pointed out, the participants in the EAT-H group also have conflicts in their identities, and it facilitates anxiety in relation to their self-image and body image. Further, the eating behavior obsession occurs as a reaction formation to the anxiety.

5. General discussion and future application

In this chapter, we investigated the relationship among eating attitudes, body image cognition, depression, anxiety, isolation, and trust especially using the Japanese female university student samples. The results of the studies showed that inappropriate eating attitudes significantly concern with irrational belief of body image and mental health problem such as depression, anxiety, distrust, and isolation. Three studies based on different samples were conducted in this chapter. We can link these findings because all studies used same measures EAT for the index of eating attitudes. EAT is originally developed for the purpose of screening AN patients. AN patients are oversensitive to their body image and avoid to gain weight. The samples of the present study are ordinary university students, and not all participants satisfy the criteria of AN. However, EAT-H group of the present studies has a tendency of AN and risk of weight loss. The findings of the chapter indicated that the risk behavior of weight loss and inappropriate eating attitudes are not special symptoms, but they are familiar problem for adolescents and emerging adults. In addition, the symptoms have physical and psychological aspects including depression, anxiety, and loneliness. The psychological support from the viewpoint of such psychological aspects is necessary for weight loss problem of young generation.

The findings are based on limited cultural background and generation. The studies from the viewpoint of cultures, several generations, and gender difference are required for future clinical application.

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Chapter 4

Impact of Body Image Perception on Weight Status: A Refuelling of Non-communicable Disease in Urban South African Zulu Women: Not Just Calipers, Tapes and Scales

Rynal Devanathan and Viveka Devanathan

Additional information is available at the end of the chapter

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Abstract

The purpose of this study was to determine Zulu women's perceptions of their body image relative to weight status attending a noncommunicable diseases (NCDs) clinic in South Africa. A cross-sectional exploratory study design was used and included 328 (91%) Zulu women who were sampled systematically. The women were subjected to anthropometric measurements and engaged the Stunkard's body image figures to determine perception. The study showed that 61% of the sample was in the 40–59 age strata. The mean body mass index (BMI) was 37 kg/m^2 (±9.41 kg/m^2) with over 90% being overweight or obese. A discrepancy between Zulu women's perceived body image and actual (BMI) existed in all weight status categories with overweight and obesity demonstrating the widest variations ($p < 0.000$). Women perceived themselves to be thinner than their actual BMI. More than 99% associated an underweight body image to one with disease. Diabetes mellitus (72%) was the most frequent NCD encountered. Only 23% with this condition correctly perceived their body image. It was shown that the negative impact of preferring a larger body image in Zulu women with preexisting NCD's could be refueling their existing comorbidities.

Keywords: Zulu women, body image, noncommunicable diseases (NCDs), weight status

1. Introduction

1.1. Definitions

Body image: Is the subjective perception people feel about their bodies, encompassing self-knowledge and attitudes towards their physical appearance [1].

Perceptions: These are ideas that exist in the minds of people as the result of careful mental activity, and ideas about how they are viewed by other people [1].

Zulu: A member of a race of black people who live in South Africa [2].

1.2. Statement of the problem

The global prevalence of overweight and obesity in the adult population is estimated to be 1.1 billion of which 312 million are obese. This represents approximately 26% world's population [3, 4].

A national survey, The South African Demographic and Health Survey (SADHS), conducted in 1998 provided the first insight into the anthropometric profile of South African adults [5]. The survey showed that in a locality of the globe where corpulence is infrequent high degrees of excess body weight were observed particularly among South African females [3]. The prevalence of obesity was extremely above what is usual among women (30%), being higher in metropolitan than rural (25%) areas [5].

Reports indicate that many South African womenfolk fail to adhere to a healthy lifestyle behaviour modification, such as weight reduction [6, 7]. This may be due to socio-cultural norms, and it may be related to an observation that weight loss is associated with diseases for example HIV/AIDS [1, 6, 7]. In the past surplus body mass has been regarded as a problem of westernisation connected to privileged circumstances, presently it is also acknowledged as a principal risk factor for non-communicable diseases (NCDs) in middle income nations, and is of evolving significance in low income nations [**8**]. Concerning a contemporary study which explored adult female patterns of overweight and underweight in emerging regions, overweight surpassed underweight in over 50% of the world's countries undergoing industrialisation [9].

The situation is generally accepted that extra body weight is associated with an escalated threat of illness [10]. Obesity has been quantified aptly by the International Statistical Classification of Disease as a distinctive disorder [11]. The Comparative Risk Assessment Study (Global CRA) of The World Health Organisation (WHO) reckons that in adults 30 years and older, rises in BMI beyond 21 kg/m^2 were linked with a projected 58% of type 2 diabetes mellitus (T2DM), 21% of ischemic heart disease (IHD), 39% of hypertensive disorders, 23% of ischemic cerebrovascular accidents, 12% of colonic cancer, 8% of postmenopausal related breast cancer, 32% of uterine cancer, and 13% of osteoarthritis [11–16].

In the study 'Estimating the burden of disease attributable to excess body weight in South Africa in 2000' the frequency of excess body weight in South African adults aged 30 years and older was reported to be predominantly high in the female population [17]. Women exhibited

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double the number of mortalities and disability-adjusted life years (DALYs) ascribed to excess body weight than did men. Excess body weight and its devastating sequele resulted in 10% of female deaths in the populace. The magnitudes of T2DM, circulatory disorders and certain cancers ascribed to excess body weight in South Africa were much higher than approximates in women chiefly [17].

There are no studies to date, assessing perceptions of weight and body image, in KwaZulu Natal despite organisations like The World Health Organisation (WHO) and European Union highlighting the significance of considering the social, cultural, political, physical and structural (environmental) impacts for successful deterrence and controlling of overweight and obesity [6, 18].

1.3. Rationale for the study

Overweight and obesity are both avoidable conditions. These conditions are a key public health quandary among women, and particularly in South African Zulu women [5]. The health outcomes of overweight and obesity are fuelled morbidity and mortality which negatively impacts on the escalating health care cost [1]. Ascertaining and tackling patient barriers to behavioural change may assist in the development of effective interventions.

It may well be that, in a high HIV prevalence area, women may perceive themselves to be thinner than their actual body image and therefore more reluctant to lose weight as they do not wish to be stigmatised by HIV disease? It was therefore imperative that perception of body figure be probed in devising intervention approaches for tackling obesity in South African Zulu women with chronic diseases.

1.4. Conceptual framework

Figure 1 provides an overview of how misperception of body weight can result in further burdening of existing NCD's.

1.5. An overview of weight categories

The United States Centres' for Disease Control and Prevention (CDC) defines overweight, obesity and morbid obesity in adults as body mass index (BMI) of 25–29.9, 30–39, and 40 or more respectively. The BMI is computed by dividing an individual's weight in kilogrammes by height in meters squared [19].

1.6. Prevalence of overweight and obesity

The occurrence of obesity is mounting precipitously all over the globe, in mutually developed as well as developing nations, and it impinges on all sectors of the public [20]. The SADHS of 1998 examined the anthropometric pattern of over 13,000 South Africans between the ages of 15 and 95 years and found that the pattern of malnutrition in South Africa was predominantly one of over- nutrition rather than under- nutrition, a paradox when South Africa is undergoing economic transition. This study found that the general frequency of overweight and obesity in

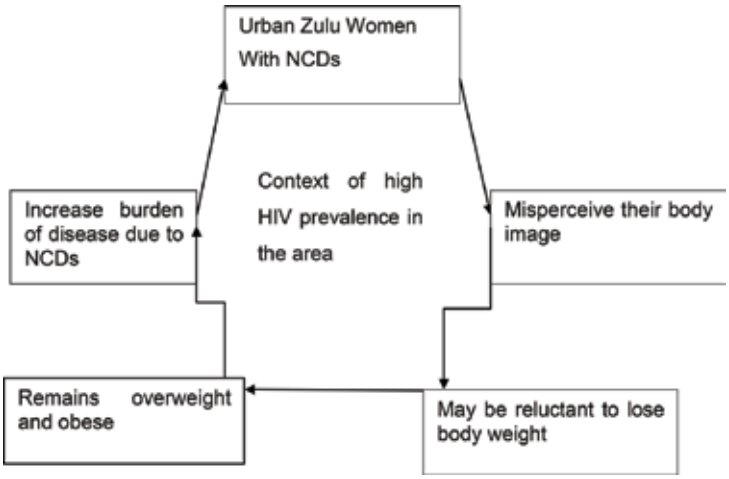

Figure 1. Conceptual framework of this study.

the South African general population was excessive with more than 29% of men and 56% of women labelled as overweight or obese [5, 21].

1.7. Perceptions of weight

The SADHS suggested that a major challenge facing the management of obesity, in South Africa, is that of people's perceptions of their weight. The SADHS revealed that people generally underestimated their weight especially among the overweight and obese categories. A minority of men (9.7%) considered themselves to be overweight or obese, when in fact their measured weight fell within the overweight to obese category. Similarly, a quarter of women (22.1%) perceived themselves as overweight, whereas a half (56.6%) had measured weights within the overweight to obese categories [5].

In South Africa the Acquired Immune Deficiency Syndrome (AIDS) which is the chief cause of death represented by 30% of mortality, followed by cardiovascular disorders (CVD) at 17%. In the list of the top twenty specific causes of premature mortality burden, women over men were found to have a greater fraction of deaths due to HIV/AIDS, CVA's, hypertensive heart complications and diabetes mellitus [22]. An intervention, to address obesity in this susceptible group of individuals is lacking.

A South African study by Puoane et al. established that women have an inaccurate perception about their weight with 22% of the females of all races distinguished themselves as overweight whereas 56.6% were essentially overweight. This study also showed that a minority (16%) of black females identified themselves as being overweight whereas in fact half (26.7%) were overweight and a third (31.8%) were obese [7].

A black women's` perceptions of an ideal weight appear to be influenced by factors such as culture, it has been stated that being overweight and even obese is advantageous and has many positive implications [1]. A perception that being overweight is desirable may be related to the

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HIV/AIDS epidemic. There may be a perception that thinness is associated with a positive HIV status. A Western-based study indicates that African women in America, who were affected with HIV endeavoured to put on instead to lose weight so as to avoid being stigmatised [6].

A preference for a large body dimension among HIV-infected women has likewise been reported in an African setting. In the study titled "Big is Beautiful" the researchers looked at a number of the observed gains of being overweight and reported that being overweight signified that one was taken excellent care of by their spouse. It also meant that one was "able to stir big pots and would not be blown away by the strong Cape Town winds." On the other hand being thin was linked with melancholy, poor treatment and most importantly stigmatised having HIV/AIDS. The women were concerned about the association between thinness and HIV/AIDS and preferred to be overweight to avoid being looked down upon by society [1].

1.7.1. Instruments

Studies have considered variables, other than weight, such as "body image." Body image pictures have been used to explore peoples` perceptions about their body. A tool to determine people's perceptions of their body image, "Body shape drawings" was created by Stunkard et al. [23]. This tool has been authenticated and modified for application in the South African populace by Mciza et al. The findings validated that weight status (BMI) in black female women associated positively with the designated silhouettes based on size. It was resolved that silhouettes ranging from very thin (1) to very obese (8) are age linked, culturally complex and could be used in future intervention analyses to understand body appeal [24].

Some of the dilemmas are that if Zulu women perceive that their weight is not a risk to their health, when in fact it may be so, then they may be resistant to undertake interventions to assist them to lose weight. A misperception, regarding weight, may be regarded as a barrier to weight loss and therefore overcoming such barriers may contribute to effectiveness of weight loss interventions. There is a paucity of studies particularly in South Africa, regarding perceptions of weight and body image involving other race categories such as White, Coloured or Indian. Some studies have indicated that black women are at a greater risk of overweight and obesity than black men [5].

No research has been done in this high risk group to establish whether misperception of one's body image influences the decision to engage in a weight loss programme which is a major objective of this study. Therefore this study focused on Zulu women only.

2. Body image perception relative to weight status in Zulu women

2.1. Aim of the study

The purpose of this study was to determine whether urban Zulu women attending a NCD clinic, which emphasise conventional weight loss strategies, misperceive their body size in comparison to their derived BMI.(Weight Status).

2.2. Key objectives for this study

The key objectives of this study were as follows:

1. To determine if women's perception of their body image differed from their calculated BMI.
2. To relate the above in terms of their underlying medical conditions.
3. To describe the women's perception of their preferred body image, a healthy body image and one that represents disease and HIV/AIDS.
4. To suggest recommendations to policy makers, health managers, health researchers and clinicians regarding potential weight loss interventions based on the findings.

2.3. Type of research

This was an exploratory study.

2.4. Study design

A cross-sectional exploratory study design incorporating quantitative research methodology was used to review perceptions of body image in subjects having underlying NCD's.

2.5. Study population

The sampling reference was Zulu women (over the age of 18 years) who attended a chronic clinic based at Wentworth Hospital in Durban. This hospital was selected for convenience because it has a clinic which specifically reviews women who have chronic diseases. The clinic chosen is not an antiretroviral clinic. The attendees are multiracial and women have a range of chronic medical conditions.

2.6. Sample size and sampling method

It was estimated that 2000 Zulu women attend this clinic in a year obtained from the chronic patient booking register. This record is kept at the booking clerk who issues the appointments for the chronic attendees. A sample of approximately 10% (n = 328) will allow a 5% margin of error in estimating categorical population parameters with 95% confidence [25]. This was determined by a statistician to avoid underestimation of the sample size.

All Zulu women who attended the clinic during June 2010 to October 2010 were given an opportunity to participate in this study. A systematic sampling method was employed. The calculated sampling fraction was: 328 (sample size)/2000 (study population) =1/6.This resulted in a sampling interval of 6.The number of the first participant included in the sample was chosen randomly, by blindly picking one of the six pieces of paper, numbered 1 to 6. The first participant to be chosen corresponded to the number chosen and then every sixth participant was included until 328 participants were selected.

An additional 32 (10%) patients were sampled to anticipate drop offs during the study period. A record was kept of all patients who refused to participate and the reasons for their non-participation [25, 26].

A large sign on the clinic wall inviting all Zulu women to participate in the study. Clinic sisters briefed all clinic attendees on the nature of the study.

The study information sheet was translated into isiZulu, which is the main language spoken by most participants. IsiZulu was then translated back into English to ensure that the translator captured the meaning. Clinic sisters in general spoke isiZulu and were able to assist participants to make a decision regarding partaking in the study.

The majority of patients attending the clinic were from the urban and surrounding areas. These patients have had some form of formal education. For those who were unable to read and write, a dedicated clinic sister fluent with isiZulu and English explained all information contained in the patient information and the informed consent at a level of a grade 4. Those patients who were willing to participate in the study produced a right thumb print in place of a signature on the informed consent form. All patients still not clear of the process of the study after several failed attempts in bringing clarity were excluded.

The information sheet was translated in the language the patient requested for family members to read to the participant if the participant so desired.

If a woman agreed to participate, she signed a consent form and the researcher then interviewed her in a private consulting room at the clinic.

2.7. Inclusion criteria

- Ages between 18 and 70 years.
- Having chronic non-communicable diseases.
- Attending the clinic for more than 1 year.

2.8. Exclusion criteria

Exclusion criteria were all pregnant women and those subjects not willing to participate.

2.9. Data sources

The data sources used for this study included the following:

- Case file record
- Body image pictures
- Anthropometric measurements to determine weight status

2.9.1. Case record files (CRF)

A case record file was used to record demographic and medical details on participants. Variables included age and medical condition/s. The researcher reviewed the clinic records to determine the primary chronic medical condition/s.

2.9.2. Body image pictures

Delineations of body image were used to investigate perceptions about body weight and body image. These pictures have been selected as a method because the silhouettes may allow women, who are not literate, to express their perception of their body image. This tool has been ratified and tailored for application in the South African populace. Body image silhouettes 7 and 8 representing obesity, 5 and 6 overweight, 3 and 4 normal weight with 1 and 2 being underweight.

2.9.3. Anthropometric measurements

The height was logged to the closest 0.1 cm by means of a metal gauging tape. This was positioned alongside a level hedge, with a straight crown board secured at 90° to the hedge. All subjects were assessed with no head gear and footwear with their vertebral column, rear end and heels placed as close to the hedge as feasible to obtain a reliable approximation.

The subject's weight was ascertained by means of a standardised automated load cell numerical scale with a ceiling weight of 136 kg (UC-Precision Health Scale, accurate to 0.05 kg). An equivalent scale was utilised to establish the masses of those weightier than 136 kg (Soehnle Medica, accurate to 500 g, maximum 150 kg). For subjects weighing above 150 kg, two equivalent scales were used with a single foot on each one respectively. Every woman was weighed using light clothes without shoes and head gear. The same scale was used to measure weight throughout the study. All measurements were made and recorded by the health promotion sister so as to ensure internal validity of the measuring instrument.

The waist and hip circumference was determined using a standard flexible tape measure. The waist perimeter determined to the closest centimetre was used as estimation for the abdominal girth. The thinnest part of the trunk observed from the anterior side of the women's body was quantified with the tape measure held at a two-finger digit gap above the umbilicus. The hip circumference was measured using a flexible measuring tape over the midpoints where the femur attaches to the pelvis on both sides.

2.10. Data analysis

Data was entered in Microsoft Excel spreadsheet which was then transferred onto SPSS-16 statistical package for analysis with the assistance of a statistician from the department of Biostatistics- University of KwaZulu Natal. Descriptive analysis of quantitative variables included mean, median, range and mode, while categorical variables were summarised and displayed on frequency tables and bar charts. Outcome variables such as measured BMI and

actual body image were linked to perceived body image using the Student's *t*-test. A p value <0.05 was considered as statistically significant at the 95% confidence interval.

2.11. Ethical considerations

Permission to carry out this study was obtained from the University of KwaZulu Natal Ethics Committee and Postgraduate Committee. The study only commenced when full approval to conduct the study was obtained. Permission to carry out the study was obtained in writing from Clinic Managers and relevant authorities at the Provincial Department of Health. (Reference number: BE181/09).

Ethical issues around confidentiality. No names of participants were used on any of data collection tools. Consent forms were stored in a locked up cupboard separate from all other data. Only the researcher had access to the data and signed consent forms.

Voluntary participation. All participants were informed that participation was voluntary and they had the option to decline the offer of participating in this research. Their refusal would not prejudice them from the quality of healthcare they received in the future. Further, even after they had given consent to participate they were free to stop the interview at any stage or refuse a certain measurement to be taken from them. All patients who felt a sense of discomfort when talking about their weight were offered counselling, guidance and education for overweight and obese patients.

Care was taken not to stigmatise women in relation to their medical condition (including HIV disease) as all women who attended the clinic were invited to participate. All recommendations made by the ethics and postgraduate committee were strictly adhered.

2.12. Results

2.12.1. Demographic data of study subjects

A total of 360 urban black Zulu women were recruited using a systematic sampling method, from a chronic disease clinic, of which only 328 participated in the study giving a response rate of 91%. The age of the Zulu women ranged from 19 to 70 years with a mean of 49 years (SD ± 12.05). Approximately 61% of the study subjects were between the ages of 40 and 59 years with the minority (19%) being within the 19–39 age strata (**Table 1**).

2.13. Anthropometric measurements

Anthropometric measurements were obtained from all the study subjects. The body weight ranged between 40.4 and 193.9 kg. The mean weight in kilogrammes (kg) was 88.44 (SD ± 23.44) and the mean height in meters (m) was 1.54 (SD ± 0.057).The mean BMI was 37.24 (SD ± 9.41). **Table 1** shows that BMI increased with age for the exception of the above sixties where a decrease was noted. The participants calculated average Waist/Hip(W/Hip) and Waist/Height(W/Ht) ratio were 0.85 (SD ± 0.102) and 0.62 (0.113) respectively (**Table 2**).

Age in (years)	Number of subjects	Percentage in each category (%)	Mean BMI	Standard deviation (SD)
19–29	28	9	27	±7.64
30–39	35	10	34	±9.54
40–49	73	22	36	±9.70
50–59	127	39	39	±8.75
≥60	65	20	37	±7.98
TOTAL	*N*=328	100		

Table 1. Mean BMI of 328 Zulu women suffering from chronic conditions categorised by age strata.

Variable	Number of subjects	Mean	Std deviation
Weight	328	88.44	23.440
Height	328	1.54	0.057
BMI	328	37.24	9.406
Waist circumference	328	94.92	17.353
Hip circumference	328	111.35	15.386
W/HIP ratio	328	0.85	0.102
W/Ht ratio	328	0.62	0.113

Table 2. Anthropometric results of 328 Zulu women.

BMI category	%
Underweight	0
Normal	8
Overweight	16
Obese	76
Total	**100**

Table 3. The body mass index (BMI) pattern of 328 subjects.

Table *3* describes the weight categories of the study sample with only 8% of participants having a normal BMI with over 90% being either overweight or obese (**Figure *2***).

2.14. Subject's perception of body image in relation to BMI

A discrepancy between perceived body image and actual body image existed in all weight categories with the overweight and obese categories demonstrating the widest variations. Approximately 52% of females perceived they being overweight with 76% having a BMI ≥ 30 kg/m^2 indicating that 49% misperceived their body size in the obese group (**Table 4**).

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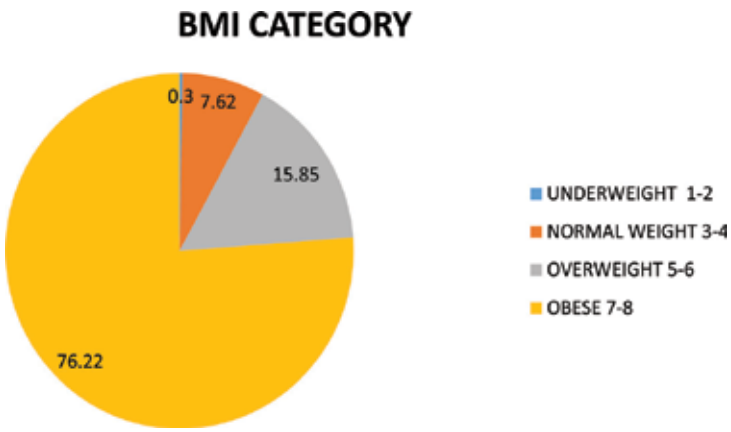

Figure 2. Pie graph showing the BMI distribution of the study population.

Perceived weight	Derived BMI					
	Underweight ≤18.5	**Normal 18.5–24.9**	**Overweight 25–29.9**	**Obese ≥30**	**Total N = 328**	**100%**
Underweight	1 (0.30%)	9 (2.74%)	8 (2.44%)	3 (0.91%)	21	6.4
Normal	0	13 (3.96%)	15 (4.57%)	19 (5.79%)	47	14.33
Overweight	0	4 (1.22%)	26 (7.93%)	141 (42.99%)	171	52.13
Obese	0	0	2 (0.61%)	87 (26.52%)	89	27.13
Total	1 (0.30%)	26 (7.93%)	51 (15.55%)	250 (76.22%)	328	100

Table 4. Subjects perception of body image in relation to the BMI.

2.15. Chronic conditions in relation to actual BMI

The most frequent chronic medical condition encountered was that of diabetes mellitus (72%) with less than 1% suffering from ischemic heart disease. The weight categories mostly associated with diabetes mellitus was that of the overweight and obese groups representing 71% of the study population (**Table 5**).

2.16. Chronic conditions in relation to perceived body image

In those subjects who had diabetes mellitus they misperceived themselves to be thinner than their actual BMI (**Table 5**). Only 23% perceived themselves to be obese and having diabetes mellitus as compared to 64% with a BMI ≥ 30 kg/m^2 with the same medical condition (**Tables 5** and **6**). A similar trend was noted for the overweight category with diabetes mellitus. Those with a normal BMI and having underlying diabetes mellitus were under 1% in comparison to approximately 9% who perceived themselves to be of normal weight with the same health profile.

Chronic medical condition/s	BMI					
	Underweight	Normal	Overweight	Obese	Total	%
Hypertension	0	1 (0.30%)	2 (0.61%)	4 (1.22%)	7	2.1
Hypertension and osteoarthritis	0	0	0	4 (1.22%)	4	1.2
Diabetes	0	2 (0.61%)	10 (3.05%)	62 (18.9%)	74	22.6
Diabetes and ischemic heart disease	0	0	0	2 (0.61%)	2	0.6
Diabetes and osteoarthritis	0	0	4 (1.22%)	54 (16.46%)	58	17.7
Hypertension and diabetes co-morbidity	0	1 (0.30%)	9 (2.74%)	53 (16.16%)	63	19.2
Diabetes, hypertension and osteoarthritis	0	0	1 (0.30%)	38 (11.59%)	39	11.9
Ischemic heart disease	0	0	0	1 (0.30%)	1	0.3
Osteoarthritis	0	13 (3.96%)	14 (4.27%)	22 (6.71%)	49	14.9
Other	1 (0.30%)	9 (2.74%)	11 (3.35%)	10 (3.05%)	31	9.5
Total (%)	1 (0.3)	26 (7.9)	51 (15.6)	250 (76.2)	N = 328	100%

Table 5. Medical condition in relation to actual BMI.

Medical condition/s	Perceived body image					
	Underweight	Normal	Overweight	Obese	Total	%
Hypertension	2 (0.61%)	1 (0.30%)	4 (1.22%0	0	7	2.1
Hypertension and osteoarthritis	0	0	2 (0.61%)	2 (0.61%)	4	1.2
Diabetes	2 (0.61%)	10 (3.05%)	45 (13.72%)	17 (5.18%)	74	22.6
Diabetes and ischemic heart disease	0	1 (0.30%)	1 (0.30%)	0	2	0.6
Diabetes and osteoarthritis	0	6 (1.83%)	29 (8.84%)	23 (7.01%)	58	17.7
Hypertension and diabetes co-morbidity	6 (1.83%)	9 (2.74%)	26 (7.93%)	22 (6.71%)	63	19.2
Diabetes, hypertension and osteoarthritis	0	3 (0.91%)	24 (7.31%)	12 (3.66%)	39	11.9
Ischemic heart disease	1 (0.30%)	0	0	0	1	0.3
Osteoarthritis	6 (1.83%)	6 (1.83%)	25 (7.62%)	12 (3.66%)	49	14.9
Other	5 (1.52%)	11 (3.35%)	14 (4.27%)	1 (0.30%)	31	9.5
Total (%)	22 (6.7)	47 (14.3)	170 (51.8)	89 (27.1)	N = 328	100

Table 6. Medical condition in relation to perceived body image.

2.17. Zulu women's perception of body image

The subjects in this study population preferred an overweight body image as compared to a normal body size. A small proportion opted for either an underweight or an obese body silhouette. An almost equal number of subjects associated being healthy and free of disease to that of a normal body image and overweight body image (**Figure 3**). Almost 100% of participants chose the underweight silhouettes to represent a sufferer with HIV/AIDS.

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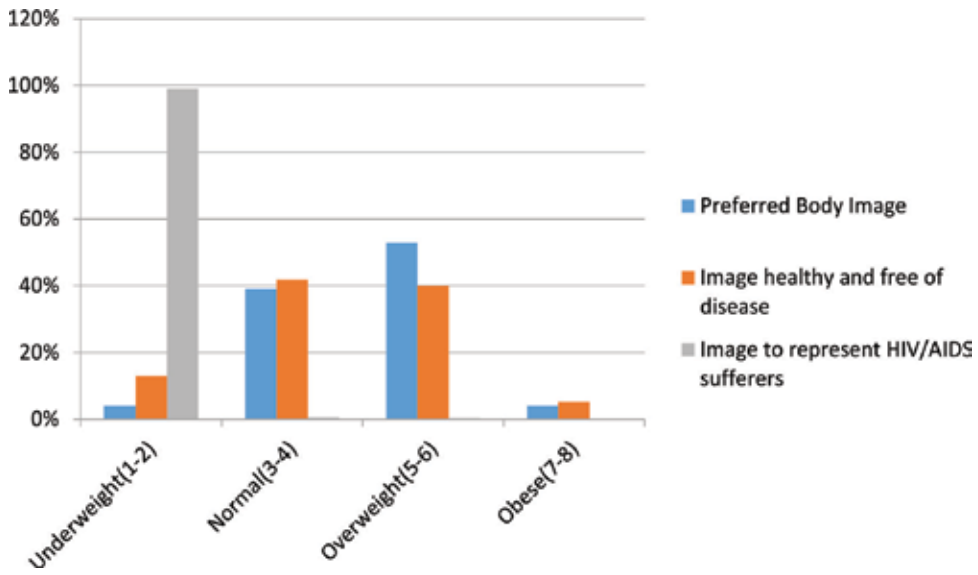

Figure 3. Subjects perception of body image in relation to preferred body image, healthy and free of disease body image and body image representing disease and HIV/AIDS sufferers.

2.18. Statistical analysis

2.18.1. Zulu women's perception of their body image compared to actual BMI

A one sample t-test between proportions was performed to determine whether there was a significant difference between women's perception of their body weight and the derived BMI across all weight categories. The t-statistic was significant at the .05 critical alpha level across the weight categories (**Table 7**).

2.19. Discussion

The Moscow Declaration which stemmed from the initial global governmental discussion on healthy way of life and NCD regulation held during April 2011 emphasised that a paradigm

Weight categories	Actual BMI, %	Women's perception of body image, %	One Sample t-test, p-value
Underweight	0.3	6.4	.0000[#]
Normal	7.62	14.33	.0092[#]
Overweight	15.85	52.13	.0000[#]
Obese	76.22	27.13	.0000[#]
Total	100	100	—

[#]Significance at the .05 critical alpha level.

Table 7. Comparison of Zulu women's perception of their body image and actual BM.

swing was critical in addressing challenges arising from the burden due to NCD. The key objective promoted was that NCDs are triggered by not only biomedical dynamics, but also greatly predisposed by behaviour, ecological, societal and fiscal factors [27, 28].

In the South African context, urban Zulu women are inevitably faced with urbanisation and globalisation which has caused a transition from traditional foods low in fat and high in protein towards one high in saturated fats and reduced fibre. With urbanisation comes the risk of changes in conventional eating habits, physical inactivity, introduction to tobacco products, alcohol and foods rich in fats. These are all risk factors for developing NCDs [29].

Obesity, in the 1998 nationwide survey, was strongly linked with residential area, ethnicity, level of education and age [5]. Studies have shown that culture dictates one's body image. In the black communities, perceptions and beliefs of their body weight have a direct impact on their body image. Black women demonstrated a discrepancy in perception of their body image in relation to actual BMI. In the obese and overweight categories less women actually identified themselves correctly [1, 5, 30]. There is also an increasing pressure to be obese and overweight because of the association of thinness to one being sick or having HIV/AIDS [1].

The key objective of this study was to investigate urban women's perception of their body image against a milieu of preexisting NCDs against a backdrop of high HIV prevalence. This is a pioneer study addressing the challenges posed by NCD in a context of KZN which has the highest prevalence of HIV in the country [1].

This study showed a higher prevalence of overweight and obesity than previous studies conducted in South Africa [5, 31]. This demonstrates that the prevalence of NCDs is on the rise and particularly among the vulnerable urban Zulu women. Studies have shown that a higher prevalence of obesity existed among urban black female dwellers and that they are at a higher risk of progressive cardiovascular complications [32–35].

It was previously widely accepted that urban black women have a decreased mortality from ischemic heart disease (IHD) than white women and the black race group has a favourable lipid profile in comparison to their white counterparts [29, 36]. The notion that because there was no association between obesity and IHD which was held for almost three decades resulted in neglecting the association of obesity with other co-morbidities. This includes glucose intolerance and T2DM, hypertensive disease, strokes and peripheral vascular disease. It was assumed that due to the black populace having a favourable lipid profile that obesity had no significance [29, 36]. Ever since, advances in medical science have shown that these are distinctive indicators of the metabolic syndrome [29]. Though black South Africans may still be guarded because of advantageous blood lipid profile, however the increased consumption of western diets which are connected with increase in BMI of men and women and serum cholesterol may predispose to a higher risk of cardiovascular events in the future [37, 38].

Vast work led by Puoane et al. on black women's perception of their body image in urban settings found that under 50% of the overweight woman really saw themselves as being overweight [1]. This misperception between perceived body image and actual body image whereby individuals who perceived themselves being obese were above a third as contrasted to more than two thirds having a BMI ≥ 30 kg/m^2. Similar trends were described in nationwide

and worldwide surveys, which found that a smaller number of women perceived they being obese compared to their actual BMIs [4, 31]. These findings were supported by this study.

In South Africa we face a quadruple burden of disease with one of them pertaining to NCD with overweight and obesity fortifying its foundations [39]. It is widely accepted that overweight and obesity predisposes to hypertension, glucose intolerance and diabetes [40]. The risk of T2DM surges with the magnitude and extent of overweight and the intensity of central adiposity [31, 41, 42]. The Nurses' Health Study indicated that the risk of diabetes mellitus soared 40-fold when the BMI rose from 22 to 35 kg/m^2 [41].

This was consistent to the findings of our study which demonstrated a frequency of T2DM of more than two thirds in patients with a BMI ≥ 25 kg/m^2. The concept of 'benign' or 'healthy' obesity in the black South African population is a paradox. Ischemic heart disease was prevalent in under 1% of our study populace coherent with the outcomes by Seedat et al. [43, 44]. This denotes that black women are at a lower risk of IHD due to their favourable lipid profile but at a higher risk of developing T2DM [37, 38].

Harold et al. centred on the outcomes of the US Study to Help Improve Early evaluation and management of risk factors Leading to Diabetes (SHIELD) showed that major discrepancies existed in body image between women with T2DM with a misperception of one's own weight-related appearance was more frequent [45]. Our study reinforces these findings where the prevalence of diabetes in the obese group was under two thirds with just over a third underestimating their body size. If women perceive herself thinner than her actual BMI she may be more disinclined to lose weight which is a necessity for successful blood glucose control. Failure to appreciate the need for weight loss could be fuelling fatal complications thereby increasing the healthcare burden related to NCDs [29].

Hypertension on the hand was the second frequent chronic condition accounting for over a third of the study population. Other studies also demonstrated that the risk of hypertension was compellingly associated with overweight and obesity [46]. The high overweight and obesity prevalence found in this study may explain the elevated hypertension morbidity in this patient population [29, 47–49].

Kwazulu-Natal (KZN) has recorded the highest HIV prevalence (16%) compared to any other province in South Africa [50]. Recent studies by Matoti-Mvalo and Puoane which investigated the insight among urban women that skinny people are disease-ridden with HIV found that more than two thirds of the women connected the malnourished figures with individuals infected with HIV [35]. Due to the high prevalence of HIV it could well be that women are considerably sensitised about weight, HIV and AIDS which may explain the high level of perception in this study.

The study 'Big is Beautiful' highlighted that a huge body bulk was preferred among urban black women. They saw this to signify material comfort and contentment in direct contrast to westernised societies where a women is stigmatised for being obese or rounded [1, 51]. Matoti-Mvalo and Puoane established that a normal weight body image was preferred over overweight or obese body image in urban black women [35]. This could be due to the lower HIV prevalence (6%) in the province compared to that of KZN [50].

In urban black women with established NCD a preference towards an overweight body image goes contrary to weight loss strategies. This is disconcerting given that these women have prior knowledge of the health benefits associated with weight loss but choose to be overweight and even obese instead. This preference for a larger than normal body size, in this group of patients could be strongly influenced by the high HIV prevalence in the area [1, 50].

These findings differed from other studies which showed a higher percentage associating normal weight body image with health and free from disease followed by overweight body image [35]. The reason for our finding could be due to the complex interplay of socio-behavioural factors related to HIV and AIDS which could have altered their perception for a normal to overweight body image to avoid the social stigma connected with HIV and AIDS [1, 35].

2.20. Limitations of the study

This study acknowledges its limitations in a number of ways. The population included only urban Zulu women and hence cannot be generalised to women living in rural areas. The race group chosen was that of Zulu and the outcome of the study may be different in other race and ethnic groups.

The prevalence in our study could have been overstated by the fact that the sample was drawn from an already established NCD clinic and therefore the results cannot be generalised.

Further the study setting was that of a chronic clinic which deals with conditions associated with obesity and overweight and therefore the prevalence of overweight and obesity in our study was much higher than the general population. The participants' HIV status was not explored in this study and this could have influenced the women's choice of body image.

3. Conclusion

This study described women's perception of their body image who have preexisting NCD's.

Urban Zulu women attending a NCD clinic do indeed misperceive themselves to be thinner than their actual BMI. The reasons for this distorted perception are multifaceted and could be due to the awareness that slenderness is related to having disease. To avoid stigmatisation urban women often preferred a larger body size over a healthy body size. A misperception of one's body image may be used as a surrogate risk marker in the early detection of weight gain in prone urban Zulu women.

In a NCD clinic where weight loss programmes forms an integral part of the management of lifestyle changes most Zulu women preferred a larger body image instead of a normal body image. This indicates that unless a socio-behavioural and cultural approach is employed in the consultation, attempts to engage this group of women into a weight loss programme may be rendered fruitless.

Zulu women living in an area of high HIV prevalence may be adamant to shed those extra kilos so as to avoid community level pressure. This vicious cycle of fear of stigmatisation,

failure to follow a diet prescription, further weight gain, complications associated with NCD and increased healthcare cost could only be intercepted if there is full commitment from all the relevant stakeholders.

Greater emphasis should be placed on preventing the devastating complications arising from poorly treated NCDs. An ounce of prevention is worth more than a pound of cure holds true in an already resource constraint setting to curb the rising healthcare cost attributed to the refuelling of NCDs amongst vulnerable Zulu women with already established NCD's living in South Africa. An etho-cultural specific approach to weight loss management in this populace will be more beneficial over traditional strategies.

3.1. Recommendations

1. A larger study is required to include other comparative race and ethnic groups.
2. Patient education on the negative outcomes of obesity and NCDs.
3. Patient education on diet, exercise and the positive outcomes.
4. Use of the body image silhouettes in NCD clinics to establish perceived versus actual body image for effective weight loss intervention.

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Conflict of interest

The authors declare that they have no material benefit or personal relationship(s) that may have inappropriately influenced them in writing this paper.

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Chapter 5

Male Obesity and Reproductive Health

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Additional information is available at the end of the chapter

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Abstract

Obesity has reached epidemic proportions globally, and all this evidence suggests that the situation is likely to get worse ahead. A combination of an increasingly sedentary lifestyle and unfavorable diet in the western world has resulted in increasing numbers of overweight and obese children and adults. According to the WHO, approximately 1.6 billion adults were classed as being overweight and 400 million adults were obese in 2005. Also gaining attention is the reported decline in semen quality and male reproductive potential over the past 50 years. Surprisingly, such decreases have not been reported in regions where obesity is less prevalent. Since this decline in fertility has occurred in parallel with increasing rates of obesity, the possibility that obesity is a cause of male infertility and reduced fecundity should be addressed. Effects of obesity on female fertility have been studied extensively. Weight loss in anovulatory women restores fertility and increases the likelihood of ovulation and conception. In contrast to the extensive knowledge of the effects of obesity on female fertility, male factor infertility as a result of obesity has been overlooked, even after the discovery of a threefold increase in the incidence of obesity in patients with male factor infertility, demanding the concern over m ale obesity with respect to infertility.

Keywords: obesity, reproduction, infertility, weight loss in men

1. Introduction

Obesity has reached epidemic proportions globally, and all this evidence suggests that the situation is likely to get worse ahead. In developed nations such as Europe, the United States of America, and Australia, the prevalence is high and increasing, but in some developing countries, the situation is even worse.

A combination of an increasingly sedentary lifestyle and unfavorable diet in the western world has resulted in increasing numbers of overweight and obese children and adults. According to the WHO, approximately 1.6 billion adults were classed as being overweight and 400 million adults were obese in 2005 [1].

Also gaining attention is the reported decline in semen quality and male reproductive potential over the past 50 years. It is reported that the quality of semen has substantially declined, with the consequent negative effect of poor semen quality on male fertility conceivably contributing to an overall decrease in male reproductive potential. It is estimated by some studies that male sperm counts continue to decrease by as much as 1.5% per year in the USA; similar findings pertaining to other western countries have also been reported [2]. Surprisingly, such decreases have not been reported in regions where obesity is less prevalent [2]. Since this decline in fertility has occurred in parallel with increasing rates of obesity, the possibility that obesity is a cause of male infertility and reduced fecundity should be addressed.

Effects of obesity on female fertility have been studied extensively. Obesity in women is known to contribute to anovulation, a reduced conception rate and an increased risk of miscarriage and prenatal complication [3]. Weight loss in anovulatory women restores fertility and increases the likelihood of ovulation and conception [4]. In contrast to the extensive knowledge of the effects of obesity on female fertility, male factor infertility as a result of obesity has been overlooked, even after the discovery of a threefold increase in the incidence of obesity in patients with male factor infertility [5], demanding the concern over male obesity with respect to infertility.

2. Fertility

The term "fertility" is the natural capability of producing offspring, the capacity to conceive given unprotected intercourse, in contrast to demographic fertility, the actual number of children. Sometimes the alternative term "fecundity" is used for this purpose, but others use these terms the other way around. As a measure, "fertility rate" is the number of children born per couple, person or population. Fertility is difficult to study in humans. It can be looked at from a functional perspective, by the use of biomarkers, or from a mechanistic viewpoint. Functional fertility refers to how easy or difficult a couple find it to conceive, given that they are having unprotected intercourse, and tends to be assessed by looking at how long this takes, since more fertile couples tend to conceive more quickly.

Concern is increasing about impact of the environment on public health, including reproductive ability. Controversy has arisen from some reviews which have claimed that the quality of human semen has declined [6]. However, only little attention has been paid to these warnings, possibly because the suggestions were based on data on selected groups of men recruited from infertility clinics [7], from among semen donors [8], or from candidates for vasectomy [1]. It is, however, noteworthy that the lower reference value for a "normal" sperm count has changed from 60×10^6/ml in the 1940s to the present value of 15×10^6/ml [1]. As a decline in semen

quality may have serious implications for human reproductive health, it is of great importance to elucidate whether the reported decrease in sperm count reflects a biological phenomenon or, rather, is due to methodological errors.

2.1. Infertility

According to World Health Organization (WHO) and the American Society for Reproduction Medicine (ASRM) Practice Committee, infertility is the inability of the sexually unprotected, active couple to achieve pregnancy in 1 year [9]. Infertility is a major concern among married couples when they fail to achieve conception even after 1 year of regular unprotected intercourse [9]. About 25% of couples do not achieve pregnancy within 1 year, less than 5% remain unwillingly childless and 15% seek medical treatment for infertility. Approximately in 50% of the cases, the underlying etiology lies in men alone [10]. In addition, no causal factors are found in 60–75% of the cases in men, and therefore, the cause is idiopathic. Despite these statistics, male infertility has received little research and public health attention in comparison with female fertility.

Infertility can be permanent (irreversible) or subfertility which means the probability of spontaneous conception may be decreased. All men who are sterile would be considered infertile, but not all men who are infertile are sterile because an infertile man can father a child with medical help or with simple change in his life style. Infertility can either be primary or secondary; primary male infertility is when the man has never impregnated a woman, while secondary male infertility is when a man has impregnated a woman irrespective of the outcome of the pregnancy. Men with secondary infertility, in general, have better chance of future fertility. Reduced male fertility can be the result of congenital and acquired urogenital abnormalities, genital tract infections, increased scrotal temperature due to varicocele or occupational exposure, endocrine disruptors, genetic abnormalities and immunological factors.

3. Diagnosis of infertility in men

The most important steps in diagnosis of infertile men are a careful history taking and a physical examination. One-quarter of cases are related to the medical history of the patients. Specific childhood illnesses may result in problems in the reproductive system like delayed or failed testicular descend, post pubertal mumps-orchitis (mumps accompanied with swelling of one or both testis), time of puberty, surgical history especially around the reproductive tract, therapeutic medications, and systemic diseases.

Physical examination is the second step in diagnosing abnormalities that causes infertility in men. Measurement of height, weight, and blood pressure will also give some information about systemic diseases. Body hair distribution gives an indication of androgen production, breasts should be inspected for the abnormal enlargement in males known as gynecomastia.

4. Biology of obesity

In a world where food supplies are intermittent, the ability to store energy in excess of what is required for immediate use is essential for survival. Fat cells, residing within widely distributed adipose tissue depots, are adapted to store excess energy efficiently as triglyceride and, when needed, to release stored energy as free fatty acids for use at other sites. This physiologic system, orchestrated through endocrine and neural pathways, permits humans to survive starvation for as long as several months. However, in the presence of nutritional abundance and a sedentary lifestyle, and influenced importantly by genetic endowment, this system increases adipose energy stores and produces adverse health consequences.

4.1. Definition and measurement

Obesity is a medical condition in which excess body fat, or white adipose tissue, accumulates in the body to the extent that this accumulation of fat might adversely affect health. Although often viewed as equivalent to increased body weight, this need not be the case—lean but very muscular individuals may be overweight by numerical standards without having increased adiposity. Body weights are distributed continuously in populations, so that choice

Classification	BMI (kg/m^2)	
	Principal cut-off points	Additional cut-off points
Underweight	**<18.50**	**<18.50**
Severe thinness	<16.00	<16.00
Moderate thinness	16.00–16.99	16.00–16.99
Mild thinness	17.00–18.49	17.00–18.49
Normal range	**18.50–24.99**	**18.50–22.99**
		23.00–24.99
Overweight	**≥25.00**	**≥25.00**
Pre-obese	25.00–29.99	25.00–27.49
		27.50–29.99
Obese	**≥30.00**	**≥30.00**
Obese class I	30.00–34.99	30.00–32.49
		32.50–34.99
Obese class II	35.00–39.99	35.00–37.49
		37.50–39.99
Obese class III	≥40.00	≥40.00

Source: Adapted from WHO, 1995, WHO, 2000 and WHO 2004. BMI - Body Mass Index.

Table 1. The international classification of adult underweight, overweight and obesity according to Body Mass Index (BMI).

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of a medically meaningful distinction between lean and obese is somewhat arbitrary. Although not a direct measure of adiposity, the most widely used method to gauge obesity is the body mass index (BMI), which is equal to weight/height^2 (in kg/m^2). An individual can be defined as being overweight if their BMI is 25–30 kg/m^2, and obese if their BMI exceeds 30 kg/m^2. The WHO Expert Consultation concluded that the proportion of Asian people with a high risk of type 2 diabetes and cardiovascular disease is substantial at BMI's lower than the existing WHO cut-off point for overweight (= 25 kg/m^2). However, the cut-off point for observed risk varies from 22 to 25 kg/m^2 in different Asian populations and for high risk; it varies from 26 to 31 kg/m^2. The Consultation, therefore, recommended that the current WHO BMI cut-off points (**Table 1**) should be retained as the international classification. However, the distribution of body fat specifically in the central abdominal region has also been used to diagnose a patient as obese. However, these definitions should only be considered as guidelines, as the risk of developing chronic diseases increases progressively when the BMI increases above 21 kg/m^2 [11].

Other approaches to grade obesity include anthropometry (skin-fold thickness), densitometry (underwater weighing), computed tomography (CT) or magnetic resonance imaging (MRI), and electrical impedance. A BMI of 30 is most commonly used as a threshold for obesity in both men and women. Most but not all large scale epidemiologic studies suggest that all-cause, metabolic, cardiovascular morbidity, and cancer begin to rise when BMIs are ≥25. Most authorities use the term overweight (rather than obese) to describe individuals with BMIs between 25 and 30. A BMI between 25 and 30 should be viewed as medically significant and worthy of therapeutic intervention in the presence of risk factors that are influenced by adiposity, such as hypertension and glucose intolerance.

4.2. Prevalence

According to the World Health Organization (WHO), obesity is one of the most common, yet among the most neglected, public health problems in both developed and developing countries. According to the 2012 WHO World Health statistics report, one in six adults is obese and nearly 2.8 million individuals die each year due to overweight or obesity globally.

Selected statistics on overweight and obesity from most recent national prevalence surveys in adults for both developed and developing countries illustrates several well-known features of the pandemic: (1) that the highest rates of obesity are concentrated in several of the Pacific Islands with record rates in Nauru where 79% of adults were recorded as obese (BMI > 30 kg/m^2) in 1994; (2) the lowest rates are in the lesser developed countries of Asia where India records just 0.5% obesity, China, Japan, and the Philippines record 3%, and Singapore records 6%; (3) that rates in Europe and North America are generally high but with some striking contrasts (for instance, 15% of Canadians are obese compared with 28% of US citizens, and 21% of Germans are obese compared with only 5% of Norwegians); (4) that rates are high in many Middle Eastern countries though again with considerable heterogeneity (for instance, Iran has 10% of obese adults, whereas Bahrain has 29%); and (5) that rates in Africa are very variable and reflect the stage of transition of each country.

4.3. Physiological regulation of energy balance

There has been a belief that adipose tissue is merely a storage site for energy, but the fact is that adipose tissue plays an active role in energy homeostasis and various processes [12]. There are two types of adipose tissue present in mammals: brown adipose tissue (BAT) and white adipose tissue (WAT). BAT plays an important role in energy metabolism in many mammals. While as white adipose tissue is used to store energy in the form of lipids, BAT expends stored energy as heat. The predominant type of adipose tissue in mammals is white adipose tissue (WAT). WAT is comprised mostly adipocytes, surrounded by loose connective tissue that is highly vascularized and innervated, fibroblasts, adipocyte precursors and contains macrophages, and various other cell types. The largest WAT depots are found in the subcutaneous region and around viscera. WAT can store enormous amount of triglycerides vital for survival. The concurrent rise in insulin, glucose, and lipids during and after meals stimulates triglyceride formation and storage in liver and WAT. Conversely, during fasting, the insulin also falls triggering glycogen breakdown and lipolysis through activation of the sympathetic nervous system and elevation of glucagon, epinephrine, and glucocorticoids to maintain glucose supply to the brain and other vital organs. Fatty acids released from adipose tissue during fasting are partially oxidized by muscle and liver, generating ketones that serve as alternate source of energy for the brain and peripheral organs.

Evidence suggests that body weight is regulated by both endocrine and neural components that ultimately regulate the energy intake and expenditure. This energy regulatory system has to function normally because even small imbalances between energy intake and expenditure will ultimately have large effects on body weight. It is not easy to monitor this regulation system by calorie-counting in relation to physical activity. Rather, body weight regulation or dysregulation depends on a very complex interaction of hormonal and neural signals.

If a person tries to alter his weight by changing the diet, there will be physiological changes. With weight loss, body will compensate with increase in appetite and decrease in energy expenditure. If the person does overfeeding, appetite falls and compensatory energy expenditure increases. This latter compensatory body mechanism frequently fails, and allows the obesity to develop when food is consumed in excess and physical activity is limited. Adipocyte derived hormone leptin plays a major regulatory role which acts through a complex brain circuits (predominantly in the hypothalamus) to influence appetite, energy expenditure, and neuroendocrine function. Appetite is integrated in brain especially in hypothalamus, influenced by many factors. Neural afferent signals, hormones, and some metabolites act on hypothalamic center as stimulants. Vagal inputs from gut are particularly important in modulating the hypothalamic center especially gut distention. Hormonal signals include leptin, insulin, cortisol, and gut peptides like ghrelin. Ghrelin is secreted in the stomach and stimulates feeding and peptide YY (PYY) and cholecystokinin which is made in the small intestine can signal the brain either directly or via the vagus nerve. Metabolites, like glucose, can influence appetite, as seen by the effect of hypoglycemia which induces hunger; however, glucose is not normally a major regulator of appetite. These diverse hormonal, metabolic, and neural signals act by influencing the secretion and inhibition of various hypothalamic peptides.

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There is continuous energy expenditure in the body which includes the following components: resting or basal metabolic rate (BMR), energy cost of metabolizing and storing food, thermic effect of exercise; and adaptive thermogenesis. Normally, the basal metabolic rate accounts for ~70% of daily energy expenditure, whereas other physical activity contributes 5–10%. Thus, a major component of daily energy consumption is fixed (~70%).

Leptin influences the metabolic activity of BAT acting through the sympathetic nervous system that heavily innervates this tissue. BAT deficiency in rodents causes obesity and diabetes, while as stimulation of BAT with a specific adrenergic agonist (β3agonist) protects against diabetes and obesity. BAT also exists in humans (especially neonates) although less in percentage, but its physiologic role is not yet established. Beige fat cells, which resemble BAT cells have been recently described, in expressing UCP-1. They are scattered throughout the white adipose tissue, but their thermogenic potential is still uncertain.

4.4. The adipocyte and adipose tissue

White adipose tissue carries out a much more integral role other than maintaining physiological homeostasis, regulating metabolism and storing energy. It constitutes up to 20% of male bodyweight and the constituent cells contain a single, large fat droplet [12]. It comprises lipid-storing and lymphocytes, making it an important mediator of inflammation and metabolism [13]. Adipose tissue mass increases by enlargement of adipose cells in volume through lipid deposition, as well as by an increase in the number of adipocytes. Apart from this obese adipose tissue is also infiltrated by macrophages. Adipose cells are derived from a mesenchymal preadipocyte which involves a series of differentiation steps mediated by a cascade of specific transcription factors. Peroxisome proliferator-activated receptor γ (PPARγ), a nuclear receptor is one of the key transcription factor that binds the thiazolidinedione class of insulin-sensitizing drugs used in the treatment of type 2 diabetes.

4.5. White adipose tissue as an endocrine organ

It is now well known that adipose tissue is highly active and complex metabolic and endocrine organ [14]. Apart from adipocytes, adipose tissue also contains connective tissue matrix, nerve tissue, stromovascular cells, and immune cells [14]. Adipocytes express and secrete several endocrine hormones such as leptin and adiponectin, although many secreted proteins are derived from the nonadipocyte fraction of adipose tissue [15]. These components function in a well-coordinated integrated unit, making adipose tissue a true endocrine organ. All the proteins secreted by adipose tissue are represented by their respective receptors. Adipose tissue is classified under two broad categories: (1) secreted proteins that have metabolic effects on distant cells or tissues and (2) enzymes involved in the metabolism of steroid hormones.

The discovery of the protein hormone leptin confirmed the endocrine role of white adipose tissue [16]. Apart from leptin, white adipose tissue also secretes a number of adipocyte derived proteins; angiotensinogen, resistin, adipsin, acylation-stimulating protein, adiponectin, retinol-binding protein and tumor necrosis factor, among many others, are also secreted [17]. Therefore, accumulation of excessive fat characteristic of obesity can result in the altered release of adipose derived hormones and proteins (**Figure 1**).

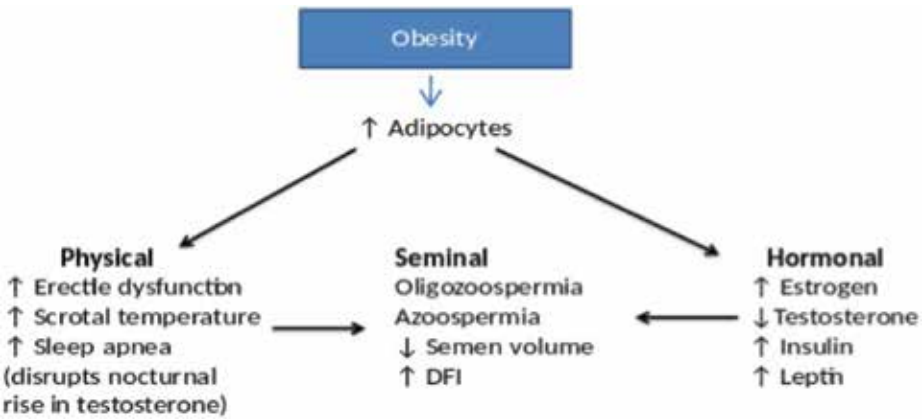

Figure 1. Impact of adipocytes on male fertility. Obesity results in increase in size and number of adipocytes, which can result in physical and hormonal changes altering seminal parameters.

4.5.1. Protein Leptin

Protein leptin is mainly synthesized in white adipose tissue and studies document a strong positive correlation between the levels of serum leptin and percentage of fat in body. Leptin is encoded by the ob gene, that is secreted by adipocytes is basically a 16 kDa adipokine. Leptin is secreted by adipocytes during the fed state and it causes stimulation of satiety center in the brain. Although leptin is mainly produced by adipose tissue, but a small amount can also be synthesized by the placenta, gastric fundic epithelium, intestine, mammy epithelium, brain, and skeletal muscles [18]. Leptin is a potential satiety stimulus. Apart from this Leptin also has a role in neuro endocrine system regulation, angiogenesis, hematopoiesis, and reproductive functions [19]. Obese individuals have higher serum leptin levels than nonobese individuals [13].

Although leptin plays an important role in energy regulation by controlling food intake and energy expenditure via hypothalamus. Leptin secretion increases with increase in white adipose tissue. Thus, change in leptin concentrations in obese men can alter normal physiological functions. Majority of obese individuals with elevated levels of serum leptin has leptin resistance in which there is no mutations in the leptin receptors. Mutation in ob gene can result in leptin deficiency which can also lead to obesity. Leptin is important for normal functioning of reproductive system [20]. The presence of leptin receptors in testicular tissue especially plasma membrane of sperm and leptin in semen has proven a link between this hormone and male reproductive function [18]. Excess concentrations of leptin from adipose tissue in obese men can have deleterious effect either directly on sperm or indirectly via HPG axis. Increased levels of leptin might suppress the testosterone secretion by inhibiting the Leydig cell function. Testosterone therapy has been proven to decrease leptin secretion, but its effects on semen parameters are not reported. By decreasing elevated leptin levels, it might be possible to reverse some of the potential effects of excess leptin on sperm membrane functioning and HPG axis to restore normal spermatogenesis and sperm function. Obesity is associated with increased leptin production subsequently high plasma leptin concentration [21].

4.5.2. Adiponectin

Adiponectin is exclusively produced by mature adipocytes and its serum concentration is about 1000 times the concentration of other polypeptide hormones [22]. In contrast to leptin, adiponectin concentration is higher in women than men. In male obesity, leptin is increased while as adiponectin concentration decrease. Adiponectin increases in response to severe weight loss [22]. A longitudinal study revealed a strong relation between low adiponectin level and development of the metabolic syndrome [23]. Decreased adiponectin has been associated with insulin resistance, dyslipidemia, and atherosclerosis in humans [22]. Injection of recombinant adiponectin peripherally stimulates oxidation of fatty acids which results in decrease of body weight, specifically WAT [24]. Leptin is positively associated with increase in WAT mass while as adiponectin is negatively associated with WAT mass [25].

4.5.3. Resistin secretion and insulin resistance

WAT secretes another adipose tissue-specific factor resistin, which is reported to induce insulin resistance. There is a strong association between obesity and type 2 diabetes. Almost 80% of men with type 2 diabetes men are also obese. Owing to a higher number of adipocytes in obese men, resistin secretion increases leading to type 2 diabetes [26]. Because of insulin resistance in type 2 diabetes males, high levels of insulin are present in the bloodstream leading to hyperinsulinemia. Hyperinsulinemia is known to have an inhibitory effect on normal spermatogenesis and can be linked to decreased male fertility. Insulin levels have also been shown to influence the levels of sex hormone binding globulin (SHBG). SHBG is a glycoprotein that has a strong affinity toward sex hormones, specifically testosterone and estradiol. Impaired levels of SHBG affect the levels of sex hormones. High circulating insulin levels inhibit the secretion of SHBG in the liver. Weight loss has been shown to increase SHBG levels by decreasing the insulin secretion [27]. In obese males, testosterone is converted to estrogen owing to the presence of high levels of enzyme aromatase present in the membranes of adiposites, the decrease in SHBG means that less estrogen will be bound, resulting in more biological active, free estrogen which can have an inhibitory effect on gonadotrophic secretions. This failure to maintain homeostatic levels of gonadotropins and sex hormones might further affect the negative feedback effect of elevated total estrogen levels. Even if the levels of SHBG are unaffected, an independent impact of insulin resistance on testosterone production can still be demonstrated [28]. Therefore, the levels of SHBG can be considered only as a marker of altered hormone profiles in obese infertile men. Both testosterone and SHBG are negatively correlated with insulin levels in the bloodstream, even after adjusting for BMI and WHR values [29]. Such an inverse relationship is due to the ability of high levels of insulin to inhibit hepatic SHBG synthesis in the liver.

5. Obesity and infertility

Obesity and nutritional habits are mainly associated with significant disturbance in the plasma hormonal milieu, such as a decrease in total and free testosterone levels, decreased gonadotropin levels, decreased binding capacity of sex hormone-binding globulin, and hyperestrogenemia

[30]. All these alterations might affect the male reproductive system and gamete quality. In support of this idea, some studies have documented a decrease in sperm quality associated with increased BMI [31]. Infertility may be more prevalent among men with elevated BMI's. About 40% of men presenting to one infertility clinic were overweight [32]. However, the relationship between male obesity and other fertility parameters has not been well established. Besides lifestyle changes, the genetics also plays a role in increasing obesity. India and most of Asia-Pacific population have mutation of MC4R genes which essentially puts them into high risk population [33].

It is unclear to what extent obesity affects a man's reproductive potential. There may be a causal link between male obesity and disturbed reproductive hormonal milea reflecting on semen quality. However, they may also share a common etiological factor.

5.1. Proposed mechanisms

The main cause of obesity epidemic is sedentary lifestyle and/or increased caloric intake. More often, these factors occur in conjunction with an unfavorable genotype that predisposes the individual to obesity. Although all these factors might explain the growing numbers of obese adults, there is less evidence explaining how exactly obesity causes male infertility. The mechanisms responsible for effects on male fertility are mostly ambiguous. Although several mechanisms have been proposed, but the most important mechanism is the contribution to the dysregulation of the hypothalamic–pituitary-gonadal (HPG) axis, one of the most important hormonal axis to regulate spermatogenesis.

5.1.1. Aromatase overactivity

As already mentioned above that obesity is associated with an increased number and size of adipocytes, so abnormal levels of adipose derived hormones and adipokines related to reproductive hormones. These abnormal levels of hormones may impact on fertility by many proposed mechanisms. Obesity has been associated with low levels of free and total testosterone in men, and most infertile obese men present with a decreased ratio of testosterone to estrogen. This decrease is explained by over activity of the aromatase cytochrome P450 enzyme, which is present at high levels in the cell membrane of white adipose tissue and is responsible for a key step in the biosynthesis of estrogens by converting testosterone to estrogen. Owing to the high bioavailability of these aromatase enzymes, high levels of estrogens in obese males result from the increased conversion of androgens into estrogens. Dysregulated levels of sex hormones can affect HPG axis which can cause further detrimental changes in both spermatogenesis and other aspects of male reproduction. Since estrogen is biologically more active than testosterone, a small change in the levels of circulating estrogen can, therefore elicit large downstream effects on gonadotropin secretions which can affect spermatogenesis. High levels of circulating estrogen have been shown to have direct deleterious impact on spermatogenesis in animal models. The discovery of estrogen receptors in the male hypothalamus has indicated that estrogen might control the secretion of testosterone levels through a negative feedback mechanism [34]. Estrogen also acts negatively on the hypothalamus to regulate the release of gonadotropin releasing hormone (GnRH) as well as the release of luteinizing hormone (LH) and follicle stimulating

hormone (FSH) from the anterior pituitary gland. Estrogen agonists have been shown to have an inhibitory effect on androgen biosynthesis. This observation indicates that normal levels of estrogens are vital for regulating the HPG axis, suggesting that any amount of excess or deficient levels of estrogen could be detrimental to spermatogenesis.

5.1.2. Environmental toxins and oxidative stress

Most of the environmental toxins are fat soluble and might disrupt the normal reproductive hormone profile because it has been proved that such toxins are endocrine disruptors and affect male fertility. Their accumulation not only around the scrotum and testes, but also elsewhere in the body can have deleterious effect on spermatogenesis. As morbidly obese males present with excess fat around the scrotal region, the environmental toxins that accumulate in the white adipose tissue might have a direct deleterious effect on spermatogenesis in the testes. Such toxins have been reported to be associated with decreased sperm production and thus decreased male reproductive potential, irrespective of the location of fat in the body [30].

Reactive oxygen species (ROS) is the other toxic compound that can affect sperm quality. ROS are highly reactive and unstable molecules that may result in oxidative stress on sperms and that can induce significant cellular damage throughout the body including sperm cell membrane. It is documented in many studies that obesity and several of its causative agents, namely insulin resistance and dyslipidemia, are associated with increased oxidative stress. Mitochondrial DNA is very sensitive to ROS, which can lead to DNA damage and plasma membrane integrity of sperm.

5.1.3. Erectile dysfunction

Erectile dysfunction is significantly associated with obesity. Overweight or obese patients attending to infertility centers make up 76% of men who report erectile dysfunction and a decrease in libido [35]. Many studies have reported an association between erectile dysfunction and an increase in BMI. Disturbed hormonal milea is the basic cause of erectile dysfunction and obesity. Erectile dysfunction is highly common in men with obesity associated with type 2 diabetes. Improved diabetes control and weight loss have been found to improve erectile function.

5.1.4. Elevated scrotal temperature

Excess fat deposition around the scrotum and in the upper parts of thighs cause increase in scrotal temperature impairing the spermatogenesis. Many reports consider heat as one of the potential cause of sperm impairment affecting the semen quality overall. Frequent fewer and varicocele also leads to the generation of excess heat [35]. Even moderate elevation of scrotal temperature above physiological range affects the quality of semen parameters [36].

5.1.5. Sleep apnea

Obese people are often suffering from sleep apnea which is characterized by disturbed sleep owing to repeated episodes of upper airway obstructions leading to hypoxia. Patients with sleep

apnea have lower mean levels of testosterone and LH owing to disrupted nightly rise in testosterone levels compared to lean patients. So, it is concluded that disturbance in sleep is associated with HPG axis disturbance consequently leading to decrease in testosterone secretion which is further decreased in obesity and ultimately leading to compromised spermatogenesis.

6. Obesity and reproductive disorders

In morbidly obese men, plasma testosterone and sex hormone binding globulin (SHBG) are often reduced and plasma estrogen levels are increased due to the overactivity of the aromatase cytochrome P450 enzyme, responsible for the biosynthesis of estrogen, highly expressed in white adipose tissue. Due to high bioavailability of these aromatase enzymes in obese males, androgens are converted to estrogen resulting in high levels of plasma estrogen levels and low levels of testosterone. Although in majority of men libido, potency, spermatogenesis and masculinization may not be affected, but few obese men get affected. Some of them may show signs of gynecomastia. Total testosterone is mainly decreased in morbidly obese men because of decreased SHBG. Most obese men seeking infertility treatment present with a decreased ratio of testosterone to estrogen.

Total body fat, intraabdominal fat and subcutaneous fat have all been associated with low levels of free and total testosterone in men, and most obese men seeking infertility treatment present with a decreased ratio of testosterone to estrogen [28]. Dysregulated levels of sex hormones especially testosterone can cause negative impact on both spermatogenesis and other aspects of male reproduction. Estrogen is biologically more active than testosterone. A small change in the levels of circulating estrogen can, therefore, elicit strong down regulating effects on hypothalamus as well as pituitary, which can lead to decreased secretion of gonadotrophins which can lead to suppression of spermatogenesis.

6.1. Male obesity and reproductive hormones

It is understood from various studies that obesity affects the hormonal regulation of spermatogenesis via hypothalamic pituitary gonadal (HPG) axis deregulation. It is also documented that increased male body mass index (BMI) is associated with decreased plasma concentrations of sex hormone binding globulin (SHBG) and SHBG bond testosterone.

The Sertoli cell has very important role in spermatogenesis as it is the only somatic cell responsible for upbringing of sperm from germ cell stage to mature spermatozoa. Testosterone is important for the normal functioning of Sertoli cells, which in turn plays a major role in spermatogenesis. Decreased concentration of testicular testosterone leads to the retention and phagocytosis of developing spermatozoa and reducing sperm counts [37]. Changes in testosterone metabolism through 5-reductase activity have been reported as the major cause in male obesity.

Other hormones like FSH, LH, inhibin B and SHBG involved in the regulation of Sertoli cell function and spermatogenesis, have all been observed to be lower in obese males compared with normal weight males. In obese males total and free testosterone blood concentration

levels progressively decrease with increasing body weight, mostly associated with a progressive decrease of SHBG concentrations. Spermatogenesis and fertility are not necessarily being impaired in obese men as all obese men are not suffering from systemic syndrome. However, these hormones levels have been described as being reduced in subjects with massive obesity [38].

The absence of clinical signs of hypogonadism in obese men can be explained by the fact that the fraction of free testosterone represents only 2% of total testosterone. Obesity predominantly affects circulating bound testosterone, owing to the decrease levels of SHBG production.

Some studies reported reduced levels of principal metabolites, such as androsterone glucuronide, and 5-androstane-3,17-diolglucuronide, particularly in the presence of massive obesity. On calculation, it was notices that that conversion rates from precursors, chiefly testosterone and DHEAS, was found to uniquely depend on decreased precursor levels rather than on altered 5-reductase activity. Although testosterone levels are negatively associated with obesity, it is still under unclear whether they correlate with fat distribution in male obesity.

As mentioned above, both SHBG and testosterone are negatively correlated with insulin levels. Such an inverse relationship is due to the inhibitory effect of insulin on hepatic SHBG synthesis. Therefore, reduced levels of testosterone in obese males appear to be caused by several complementary factors, including reduced gonadotropin secretion and the negative effects of insulin on SHBG and testosterone itself.

6.2. Male obesity and semen parameters

6.2.1. Altered semen parameters

Obesity does not just only alter the physical manifestations and sexual function but can affect spermatogenesis in most of men leading to infertility. Obesity does not affect the fertility of men without systemic syndrome like hyperinsulinemia. There have been several studies trying to entangle the relationship between obesity and infertility and most of the studies show an inverse correlation between the two.

6.2.2. Sperm count and concentration

It is well documented in both humans as well as in animal models that obesity has a negative impact on semen parameters (count, motility and morphology). A recent systematic review found a J-shaped curve correlation with male BMI and abnormal sperm count, overweight and obesity was also associated with higher rates of oligozoospermia and azoospermia through evaluation of 21 studies [39]. The previous systematic review conducted in 2010 stated that there is no such effect [40].

6.2.3. Sperm morphology

Measuring differences in the morphology of sperm can be difficult due to high individual variability within individual patient samples. However, most studies have shown no correlation

between obesity and abnormal sperm morphology. Some studies have shown that BMI is negatively correlated with sperm morphology [31], while as other studies reported no change [41].

6.2.4. Male obesity and DNA fragmentation

In recent years DNA integrity has gained importance in evaluating the potential of sperm to generate a healthy pregnancy. Reactive oxygen species (ROS) is known as one of the main contributing factor for sperm DNA impairment. It is also well documented that obese infertile men have higher levels of ROS compared to normal weight men and fertile obese men. Sperm is deficient in antioxidant defense mechanism so highly susceptible to ROS.

Hyperinsulinemia has an inhibitory effect on normal spermatogenesis directly as well as indirectly to affect male fertility. In a study it was presented that, in a group of diabetic men, semen parameters (concentration, motility and morphology) did not differ from the control group, but the percentage of nuclear and mitochondrial DNA damage in the sperm was significantly higher in diabetic group. This high sperm DNA damage can impair male fertility and reproductive health. A study found that increased BMI is accompanied by higher DFI, demonstrating that obesity might be the cause of compromised DNA integrity [42]. Males presenting with a high DFI will have reduced fertility or repeated miscarriages as a consequence.

7. Male obesity and hypogonadism

Alterations in gonadotropin secretion have also been documented in male obesity. Gonadotropin (FSH and LH) levels are usually normal or slightly reduced in mild obese men. Obese men with high BMI values may show a reduction of LH secretion, probably due to impaired secretion of GnRH at hypothalamic level. The absence of clinical signs of hypogonadism can be explained by the fact that the Free testosterone fraction represents only 2% of total testosterone, which could be the reason for absence of hypogonadism signs. Obesity predominantly affects circulating bound testosterone, owing to the concurrent decrease of SHBG production.

7.1. Decreased inhibin B

The most accurate marker for spermatogenesis is inhibin B, and it can be used to predict the fertility of obese individuals. Normal values of inhibin B reflects normal sertoli cell function and associated spermatogenic activity. Decreased inhibin B levels are indicative of subnormal spermatogenesis. Animal studies revealed that inhibin B levels correlate positively with sertoli cell number and function, and indicate that reduced levels of inhibin B in obese men are likely to signify fewer or unhealthy sertoli cells than in men of normal weight. The consensus is that obese men have significantly lower inhibin B values than normal BMI men.

7.2. Decreased testosterone: estrogen

Obese infertile men show typically a decrease in the testosterone: estrogen ratio. It was documented in a study that obese men had 6% higher levels of estradiol and 25–32% lower

levels of testosterone compared to normal weight men [30]. The severity of obesity determines the degree to which levels of estradiol are increased and testosterone decreased. The increased conversion of testosterone into estrogens, a characteristic of obesity, suppresses the function of the pituitary gland by disturbing normal feedback in the testis.

8. Discussion

High BMI is not only associated with increased risk of cardiovascular disease [43] and type 2 diabetes [44], but also with other endocrine symptoms including changes in reproductive hormones. Obesity has been implicated to have direct and indirect impacts that could reduce male fertility including decreased sperm motility and increased DNA fragmentation [45].

Weight reduction among men with obstructive sleep apnea secondary to obesity increased testosterone levels. Physical inactivity negatively impacts on erectile function, and exercise interventions have been shown to improve sexual responses. A reduction in caloric intake has also been found to improve erectile function in men with aspects of the metabolic syndrome, including obesity and diabetes.

Hormonal alterations and diminished sexual quality of life have both been reported to improve after gastric bypass surgery [46]. Even though natural weight loss and even gastric bypass has shown promising results in terms of restoring fertility and surgical treatment has been shown to restore reproductive hormones to normal levels, some studies indicate that gastric bypass procedure and the drastic weight loss might induce secondary infertility.

Excess adiposity leads to increased aromatization of androgens in the adipose tissue leading to higher circulating estradiol levels [47]. Hyperinsulinemia, secondary to obesity related insulin resistance, decreases SHBG production in the liver [48]. Low testosterone levels are thought to be the result of decreased SHBG binding capacity [49], direct action of leptin, and other adipocyte derived hormones on Leydig cells [50].

Further, testosterone increases after weight loss in massively obese men [51]. The observed lower testosterone:LH ratio among the most obese men also suggests decreased Leydig cell function among these men and is consistent with a report of impaired LH-stimulated testosterone production among morbidly obese men [18]. The consistency of these findings across studies and the reversibility of this pattern following weight loss suggest a causal role of increased body weight on the hormonal pattern described above.

Weight loss should be considered during the initial work up with the infertile couple and advised before initiating the ART treatment to improve the pregnancy chances. Physiological levels of reactive oxygen species (ROS) are necessary to maintain normal sperm function but if reactive oxygen levels increase they lead to deteriorating function or reduced survival [52]. Oxidative stress has long been implicated as the major etiological factor in sperm DNA damage. In contrast to somatic cells, sperm are very vulnerable to oxidative stress [53] due to their unique membrane structures combined with limited antioxidants or protective enzymes [54].

Additionally, it has been claimed that rather than the overweight per se, the metabolic syndrome (MetS) could be the underlying mechanism of a high DFI in obese men. MetS and several of its components like abdominal obesity, insulin resistance and dyslipidemia, are associated with a systemic proinflammatory state and increased oxidative stress. Thus, among overweight subfertile men, those having both subnormal testosterone levels and associated low grade systemic inflammation [55], due to their overweight, MetS or both, might be over represented. Consequently, this could lead to increased DFI in this subgroup.

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Chapter 6

Men's Body Image: The Effects of an Unhealthy Body Image on Psychological, Behavioral, and Cognitive Health

Amanda Baker and Céline Blanchard

Additional information is available at the end of the chapter

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Abstract

In the past two decades, growing empirical efforts have illuminated the need to understand body image disturbances and preoccupations associated with the male experience. Scholars, practitioners, and more recently, public policy are increasingly interested in the nature, causes, and consequences of men's body image apprehensions and weight concerns. This accession is largely due to the fact that men are progressively becoming more visible in popular culture (especially through exceedingly lean and muscular depictions) and concurrently, severe body image-related disorders such as anorexia nervosa among men are on the rise. This chapter aims to provide a review of the consequences associated with men's unhealthy body image including the psychological (e.g., weight distortions and emotional valence), behavioral (e.g., dieting/fasting, substance use, and cosmetic surgery), and cognitive health outcomes particular to the male experience (e.g., appearance schemas, cognitive performance, and cognitive load/malnutrition on cognitive functioning).

Keywords: men's body image, weight, psychological consequences, health-compromising behaviors, cognition

1. Introduction

Until recently, empirical and theoretical research pertaining to the realm of body image was largely restricted to the female experience [1, 2]. However, contemporary efforts have illuminated the need to understand body image disturbances and preoccupations associated with the male experience [3, 4]. Indeed, academics, health practitioners, and public policy authorities

are increasingly interested in the nature, causes, and consequences of men's body image apprehension because ample empirical research indicates the irrefutable rise in weight concerns and eating disorders among men [5–10]. According to researchers, [11] this accession is largely due to the fact that men are progressively becoming more visible in popular culture (especially through exceedingly lean and muscular depictions).

Scholarly and mainstream research reveals that one third of those suffering from anorexia nervosa and one fourth from bulimia nervosa are men and nearly equivalent numbers of men and women suffer from binge eating disorders [12]. Ultimately, the notion that body image is a predominantly female-oriented domain has lifted given that current evidence suggests that males are approaching parity in terms of the pervasiveness of body dissatisfaction and body dysmorphia [13, 14].

Furthermore, while cultural differences exist in body ideals (e.g., sub-Saharan African cultures desire larger body ideals for both men and women), a lean, muscular, V-shaped figure with broad shoulders and a narrow waist (i.e., the "muscular ideal") is the current ideal for men in Western cultures [15]. According to Owen and Laurel-Seller, [16] Western gender-specific body ideals are associated with wealth, virtue, control, and attractiveness. Yet, the adverse effects of societal norms around ideal body sizes on psychological, behavioral, and cognitive well-being powerfully overshadow these perceived and sometimes observed advantages (see [17] for a review). Men's body image disturbance is therefore recognized as a complex matter, though means to understand and reduce the negative repercussions associated with such body ideals are under investigation [11, 18].

The purpose of this chapter is to contribute to this emerging body of research by providing a comprehensive review of the common consequences associated with men's unhealthy body image. A number of electronic databases including PsychINFO, MEDLINE, and PubMed were searched for relevant studies published between 2000 and 2017. For literature on male cognitive experiences and the effects related to malnutrition, the search was extended to include the 1990s given the relative size of the domain.

The chapter begins by defining the concept of body image and is subsequently divided into three sections to elaborate on the psychological (e.g., weight distortions and emotional valence), behavioral (e.g., dieting/fasting, substance use, and cosmetic surgery), and cognitive health outcomes particular to the male experience (e.g., appearance schemas, cognitive performance, and cognitive load/malnutrition on cognitive functioning).

2. Body image defined

Today, body image is a refinement of previous delineations and defined loosely as the multifaceted and "profound human experience of embodiment". [19] Specifically, body image is the complex mental image of one's own body including the perceptions an individual has of their body such as attitudes and feelings about their shape and weight, beliefs about their own appearance (e.g., from past experiences and assumptions), and the sensations experienced such as how one feels in their body and not merely the feelings about their body [20]. Body

image may be assessed in a variety of ways including measures of body satisfaction and dissatisfaction, body esteem, body-related shame, body image avoidance, appearance schemas, body distortions, weight misrepresentations, and eating disorder inventories (see [21] for a review). The development of scales explicitly for the evaluation of the male experience have surfaced especially in the last decade including, but not limited to, the Muscle Appearance Satisfaction Scale [22] and the Revised Male Body Attitudes Scale [23]. The fact that body image may be assessed in a variety of ways highlights the complexity of the construct.

In addition, there are healthy body images and unhealthy body images, each a unique paradigm. A negative or unhealthy body image is characterized by a distorted perception of the body and adverse feelings toward the entire body or body parts such as shame, appearance anxiety, body dissatisfaction, or self-consciousness. On the other hand, a positive or healthy body image is characterized by an accurate perception of the body's natural shape and size, and feelings of satisfaction and confidence with one's appearance without concerns or over-investment in weight and physical appearance [24].

Negative body image is associated with a number of adverse effects such as low self-esteem, depression, and eating disorders, to name a few. [14] Neumark-Sztainer et al. [25] uniquely explored the potential benefits of a negative body image to expand the literature in the domain. Their five-year longitudinal study of male and female adolescents investigated the associations between body satisfaction at Time 1 and health outcomes at Time 2. They explored whether some degree of body dissatisfaction would benefit individuals by enhancing their motivation to engage in healthier eating, weight maintenance, and physical activity. The findings revealed that low levels of body satisfaction did not serve as a motivator for engaging in healthier behaviors but actually predicted poorer weight management, which in turn increased the risk of weight gain and poorer overall well-being. Specifically, they found that less body satisfaction predicted increased levels of dieting and binge eating, and decreased levels of physical activity among boys and girls. Overall, their efforts further support the notion that body/weight satisfaction and body image in general play a role in shaping health outcomes.

It is well-established that Western societal norms influence men's unhealthy body image. Two recent meta-analyses based on correlational and experimental designs have documented that muscular ideal images, as portrayed in mass media, can have a significant impact on many boy's and men's unhealthy body image [26, 27]. Although relatively small effect sizes, Barlett et al. [26] found that across 15 correlational studies, pressure from the media was significantly related to negative self-images, Cohen's $d = .19$, and across 10 experimental studies, exposure to muscular ideal images had a significant negative effect on men's body image through negative body esteem, $d = .40$, and body dissatisfaction, $d = .25$. Blond [27] also explored the relative impact of exposure to the muscular ideal on men's body and weight dissatisfaction. Across 15 studies of various designs, the findings yielded an average effect size of $d = .42$, thereby indicating that exposure to male ideal images has a small but statistically significant effect on men's body and weight dissatisfaction.

In addition, review articles have examined the impact of the ideal images on boy's and men's body image resulting in a number of health-compromising behaviors [5, 28]. These reviews have recognized that exposure to media portrayals of the muscular ideal often lead to detrimental behaviors including harsh dieting regimes and compulsive exercise. Due to

the concerning number of consequences associated with such mass messages, scholars have emphasized the need to further understand the effects of societal norms on boys and men to extend theory and provide optimal therapeutic aid.

3. Psychological consequences

In general, while the prevalence for body dissatisfaction rises among men in Western cultures, consequently so does the frequency of various adverse psychological outcomes. For example, findings reveal that body dissatisfaction among men is associated with lower self-confidence, depressive symptomatology, [14] greater appearance anxiety, [29] social anxiety, muscle dysmorphia, [2] increased loneliness, [30] over-investment in self-appearance (e.g., clothing/apparel), [31] increased motivation or drive for muscularity, [9] and greater distorted body perceptions [32]. Overall, common body image experiences include weight distortions/misperceptions and negative affect.

3.1. Weight distortions

A recent study [33] assessed the association between body distortion and depressive symptoms among adolescent boys over time, into early adulthood. Extracted from the United States National Longitudinal Study of Adolescent Health, the data included 2139 adolescent boys (on average 16 years of age) who were followed from 1996 to 2009. The results showed that boys who classified as average weight (using BMI) and viewed themselves as very underweight or overweight (i.e., having a distorted view of the self), reported significantly higher levels of depressive symptoms compared to boys who accurately viewed their weight as average. Moreover, this distorted self-view was maintained over the 13-year study period. Therefore, the findings indicate that male distorted weight perceptions, particularly extreme distortions, are risk factors for increased depressive symptomatology among adolescent boys, which persist even into adulthood.

Current evidence also suggests that men who are underweight or who are in the normal weight range are more accurate in categorizing themselves compared to overweight and obese men who, evidently, report underestimations of their size [34]. For example, a recent study examined weight misperceptions among a large sample (n = 655) of Spanish adolescents [35]. Consistent with previous studies, the authors found that males were more likely than females to perceive themselves as having a normal weight when in reality, they were overweight. Conversely, females were more likely to perceive themselves as overweight despite having a normal weight. They also found that for men who have a normal weight, only 22% considered themselves as overweight. Collectively, the results indicate that body and weight misperceptions can cause some men to believe that they practice healthy behaviors when, in fact, they should be practicing more self care.

Conversely, Gardner [36] found that obese and normal-weight men detect changes in their body size relatively reliably and hold more accurate views of the self. Although research is largely inconsistent, and requires attention using new approaches, prospective analyses that consider the mediating factors will help shed light on the psychological processes that trigger weight and body size distortions. For instance, body-esteem, the degree of self-consciousness, and neuroticism may moderate weight perceptions.

3.2. Emotional valence

Self-discrepancy theory identifies and explains how diverse forms of incongruities between self-state representations are related to different kinds of affective vulnerabilities [37]. Essentially, a facet of the self (actual, ideal, or ought) combined with an outlook on the self (own versus other) form different kinds of self representations. The theory also proposes that experiencing self-discrepancies uncover emotions that are associated with various degrees of discomfort. For example, incongruities between the actual/own self (i.e., the self-concept) and ideal self tend to yield melancholic emotions such as disappointment or sadness. On the other hand, incongruities between the actual/own self and ought self emit undesirable tension-related emotions such as feeling restless. Essentially, experiencing self-discrepancies are expected to instigate different kinds of negative emotional responses.

Self-discrepancy theory is particularly exhaustive in body image-related research. For example, the theory was applied to further understand body dysmorphic disorder patients compared to non-patient participants in their beliefs about their own appearance [38]. The results revealed that body dysmorphic disorder patients displayed significant discrepancies between their actual and both their ideal and ought self. In addition, patients did not experience discrepancies between their actual/own and actual/other perspectives. At large, the findings demonstrate that body dysmorphic disorder patients have an unrealistic appearance ideal. The authors proceeded to compare the findings with the general literature in the sphere of disorders and advocate that patient participants showed analogous self-discrepancy patterns as depressed patients (rather than social phobic patients or bulimic patients) as they were more concerned with the failure to achieve their own esthetic standard than with the perceived ideals of others.

In 2003, the circumplex model of affect was developed to explain the vast number of empirical observations from studies in affective neuroscience to emotive psychopathologies. [39] The model is visually represented with a horizontal axis representing the valence dimension and a vertical axis representing the arousal dimension. Emotions fall into one of four quadrants; pleasant valance/high arousal (e.g., happy, excited), pleasant valance/low arousal (e.g., relaxed, satisfied), unpleasant valence/low arousal (e.g., sad, depressed), and unpleasant valence/high arousal (e.g., stressed, anxious) [40].

The circumplex model of affect is considered to be more consistent with many recent findings from behavioral, cognitive neuroscience, neuroimaging, and developmental studies of affect. Hence, future research may integrate concepts from the circumplex model of affect to investigate the multifaceted emotional responses associated with men's weight and body image experiences.

4. Behavioral consequences

In terms of the behavioral outcomes, negative body image is associated with increased disordered eating, [41] greater dietary supplement use, [42] increased use of dieting regimes, [28] compulsive exercise, [43, 44] and the use of performance-enhancing drugs [45].

Research demonstrates that while young adults frequently feel dissatisfied with their body weight and size, in many situations body image disturbances are reported by those with a healthy weight [46]. More specifically, in adolescent and college samples, between 28 and 68% of

normal-weight men perceive themselves as underweight and report the desire to increase their muscle mass through dieting and strength training [7, 47]. Olivardia et al. [14] found that college men selected the ideal body to be 25 pounds (11.34 kg) more muscular than their own level of muscle. They further examined whether lower levels of perceived muscularity and perceived fatness were associated with depressed mood and body dissatisfaction. Results showed that only perceptions of low muscularity were related to such negative attitudes and mood. Perceptions of fatness or heaviness did not predict such negative effects thereby indicating that muscularity may be more important to some men. Similarly, new efforts [48] found that more muscular body types were the desired feature among both sexual minority and heterosexual men.

Several researchers infer that many men who strive for greater muscularity tend to hold stricter gender-role principles and conform to societal male norms [49]. In fact, minimal muscularity among men was found significantly related to body dissatisfaction and less perceived masculinity [14]. Researchers [50] also recognize that there are indeed gay men who value muscularity norms. Even in same-sex romantic relationships, many men perceive pressures to be physically attractive and pressures to appear highly muscular and masculine in order to be accepted by society and perceived as desirable by other gay men [51]. Consequently, pressure to gain muscle mass can be experienced by men regardless of weight status or sexual orientation.

4.1. Eating disorders, dieting, and fasting regimes

Frequently, body image is discussed in terms of weight loss and eating disorders such as anorexia and bulimia nervosa. In some cases, however, weight gain, obesity and binge eating are consequences of negative body image [52]. When exploring the body images of obese and non-obese men, the most common aspects of physical appearance that contribute to body dissatisfaction for both obese and non-obese men are the waist or abdomen followed closely by chest, arms, and the body as a whole [53]. There is also strong evidence suggesting that obesity is related to poor body image, but that not all obese persons suffer from this problem or are equally vulnerable. Although properly monitored and regulated weight-control eating practices may be appropriate for obese individuals, extreme weight control and weight loss regimes can cause physical and mental degradation [54]. For example, severe dieting or fasting can cause fatigue, sinus problems, bloodshot eyes, gallbladder disease, seizures, dehydration, malnutrition, and atrophy of muscles (i.e., when muscles fade). Psychological consequences of dieting and fasting may include irritability, depression, lower sex drive, and the risk of falling vulnerable to eating disorders like bulimia nervosa, anorexia nervosa, or binge eating which typically contributes to the issue of obesity rather than help the person shed weight and improve their body image [55].

Furthermore, eating disorders can affect body image quality of life. A cross sectional survey study with 311 participants examined the differences between groups in quality of life among a clinical sample with eating disorders (n = 70; 15.7% men), a clinical sample with other psychological disorders such as anxiety and depression (n = 106; 36.8% men), and a non-clinical student sample (n = 135; 40% men). [56] The findings revealed that the eating disorder group experienced the lowest body image quality of life, followed by the clinical group with other psychiatric disorders who experienced modest body image quality of life, and the student group who experienced the highest quality of life. Contrary to most previous studies, they also

found that men with an eating disorder experienced poorer body image quality of life compared to women with an eating disorder. Today, some studies suggest that boys report more body dissatisfaction than girls and hence, might explain the gender difference observed in this study. Additional research is required to further explore the impact of male body image and eating disorders on quality of life measures and vice versa.

4.2. Substance use (steroids, prohormones, and ephedrine)

In response to body dissatisfaction and general body image disturbances, some men seek ways to modify their body, which often leads to extreme and harmful actions. Some men use anabolic-androgenic steroids (AASs), prohormones, and/or ephedrine to improve their appearance through muscle augmentation [5, 44]. A study based on data collected in 2001 and 2002 from the Health Behaviour in School-Aged Children National Research Project in Canada found that 4% of boys in the ninth and tenth grade reported anabolic steroid use [57]. The practice of using anabolic steroids forecasts many psychological and physiological risks such as fluctuations in mood and changes in the level of low-density lipoproteins (LDL) and high-density lipoproteins (HDL) in the blood stream [14]. Explicitly, AASs cause an increase in LDL (lipoproteins that deposit cholesterol in the arteries), and a decrease in HDL (lipoproteins that cleanse the arteries) thereby increasing the risk of heart disease. In general, anabolic steroid use can have serious deleterious effects on psychological and somatic well-being.

Prior to the 1980s, AAS use was largely limited to elite athletes. Since then, the dissemination of mainstream books and online information has contributed to a shift in AASs usage from athletes to the general population [58]. In fact, a recent analysis estimated that 2.9 to 4.0 million individuals in the United States, nearly all of whom are male, have used AASs at some time in their lives [59]. Within this growing new population of users, even the oldest members, who first initiated AAS use as youth in the 1980s, are now entering middle age and beginning to experience the combined effects of long-term steroid abuse.

Emerging research has connected several adverse health effects with AAS use. For example, there is an increased risk of psychiatric effects, prolonged suppression of the hypothalamic–pituitary-testicular axis, premature death, cardiovascular disorders, and potential lasting neurotoxic effects [60]. Long-term exposure to supraphysiologic doses of AASs (extremely high doses than typically recommended) has been linked to myocardial dysfunction, stroke, severe cardiomyopathy, and acceleration of atherosclerotic disease in young individuals [61]. In addition, users may develop manic or hypomanic symptoms that are sometimes associated with aggression, violence, and even homicide.

AAS users sometimes combine supraphysiologic doses with other appearance- and performance-enhancing substances such as human growth hormone, thyroid hormones, insulin, and clenbuterol in their attempts to gain muscle and drop body fat [59]. Furthermore, a large percentage of individuals consume over-the-counter herbal or dietary supplements that claim to enhance performance and appearance. Unfortunately, the retail of such supplements is largely unregulated and many merchandise have been found to contain illegal AASs, other anabolic compounds (e.g., androgen receptor modulators), and even toxic contaminants [62]. In these occurrences, users may not be aware of the damage being elicited.

4.3. Cosmetic surgery

Men are also increasingly likely to use cosmetic surgery to modify their appearance [63]. Although Canadian statistics are not yet available through the Canadian Society of Plastic Surgeons, the United States and the United Kingdom generate national cosmetic surgery statistics. According to the American Society of Plastic Surgeons 2015 documentation, the most popular procedures for men are rhinoplasty (nose reshaping), blepharoplasty (eyelid surgery), breast reduction, liposuction, and facelift. Although these same procedures were the top five surgical procedures in 2005, the rate of occurrence has increased. Likewise, according to the British Association of Esthetic and Plastic Surgeons the most common procedures in order of popularity are blepharoplasty, rhinoplasty, breast reduction, liposuction, ear correction, and facelift.

Botox anti-wrinkle injections are also increasing in popularity [64]. Between 2002 and 2006, the number of total surgical cosmetic procedures for men in the United States grew by 5% while less invasive methods (such as collagen fillers) increased by 41%. Evidently, men are using various surgical methods and injection treatments to modify their appearance.

5. Cognitive consequences

Although attention dedicated to the psychological and behavioral consequences of men's body image disturbances has proliferated, a great deal is still unknown. In particular, the effects on cerebral processes and cognitive performance are scarce. To date, articles investigating the relationship between men's body image and cognitive health are scarce.

5.1. Appearance schema

The notion of appearance schema has been suggested by a number of authors particularly in their discussions of societal ideals on body image and weight-related ailments. Based on self-schema theory, [65] appearance schemas are the mental structures that organize and determine the processing of appearance and self-related information [66]. Exposure to schema-relevant information, for instance attractive models in the media, can activate a schema, leading to a heightened sense of self-awareness and increased attention to further schema-relevant information. This schema activation subsequently primes cognitive-affective processing corollaries such as changes in mood, body dissatisfaction, or additional impediments in mental ability. It is important to recognize that while nearly everyone develops an appearance-related schema, the complexity and importance of appearance and weight is much more developed in some individuals, thus increasing their likelihood of being selectively attentive to appearance-related stimuli in their everyday lives.

According to recent work, [67] exposure to the media's renowned male muscular ideal led to increased appearance schema activation in a sample of male university students as a function of increased levels of state self-objectification (heightened level of self monitoring). Likewise, others [68] found that exposure to male focused appearance-related commercials significantly stimulated the appearance schema among adolescent boys. Interestingly, even exposure to

opposite sex body ideals can prime boys and men's cognitive schemas. In particular, [69] found that exposure to idealized images of women in commercial ads had a significant negative effect on men's cognitive functioning. Not only did male participants recall significantly more commercials in the female 'thin ideal' condition, they also generated significantly more appearance words on the word-stem completion task compared to the control group, thereby indicating more appearance schema activation. Similarly, [70] revealed that exposure to the female 'thin ideal' increased the number of appearance-related words generated on the word-stem completion task among young adult men compared to the control group. Findings reiterate that heterosexual men exposed to the female thin ideal tend to also experience biases in cognitive schema.

As a whole, the results support the utility of self-schema theory in proposing schema activation as the underlying process through which the media and other sociocultural pressures can increase body dissatisfaction and appearance schematicity. It also provides an explanation for why some men are more vulnerable than others to weight- and body image-related information.

5.2. Cognitive performance

Studies have also explored the relationship between negative body image and academic performance among undergraduate men [71, 72]. Results have revealed that academic interference, such as lower levels of concentration in school, were associated with body dissatisfaction as well as eating and appearance apprehensions. Another study explored the effects of an induced state of appearance self-awareness on math performance (the GRE test) among college men [73]. Essentially, students were assigned to either the body objectification condition (i.e., induced state of self-awareness and monitoring) or the neutral condition. The results showed that men in the objectifying gaze condition performed similar to men in the control condition. However, the limitations suggested that men typically score relatively high on math related tasks and therefore future studies should explore similar body image-related manipulations using different cognitive function tests.

Accordingly, scholars [74] investigated whether set shifting performance and a weak central coherence were associated with the drive for muscularity and muscularity-oriented disordered eating in college men. Set shifting (the ability to switch between mental tasks) was measured using the Wisconsin Card Sorting Test (WCST) which relies on cognitive functions including attention, working memory, and visual processing. Central coherence (the ability to "see the big picture" without fixating on details) was measured using the Matching Familiar Figures Test, a measure of detail-processing ability. The findings revealed that set shifting difficulties and a weak central coherence were both positively associated with the drive for muscularity, and set shifting difficulties were positively associated with muscularity-oriented disordered eating. Hence, cognitive performance based on attention, working memory, and global integration was poorer among men who reported a higher drive for muscularity and muscularity-oriented disordered eating.

In general, extant research has uncovered the notion that conditions which heighten body image awareness and/or instigate weight disturbances may interfere with optimal cognitive

functioning. When adolescent and young adult men are primed to focus on their appearance, their performance may be undermined, indicating that body image disturbances can prevent some men from achieving their full potential mentally.

5.3. Cognitive load and malnutrition on cognitive functioning

A variety of perspectives have investigated the relationship between body image and cognitive functioning. Some studies indicate that body image preoccupations, weight loss strategies, or contexts that enhance body image apprehensions may increase cognitive load by directing attention inward onto the self (increasing self-consciousness and self-monitoring) thereby limiting cognitive resources and impairing cognitive performance on alternative tasks [75]. Other studies found that body dissatisfaction led to poorer self-esteem [76] and poorer self-assessments [71] which in turn, distracted and thwarted student efforts to succeed in school. Lastly, some research has demonstrated the deleterious effects of malnutrition in clinical samples (e.g., anorexia patients), [77] non-clinical samples, [78] and dieters [79] on cognitive functioning. For example, [80] found that compared to non-dieters, dieters and restrained eaters displayed impaired performance on a visual–spatial processing vigilance task, short-term memory task, and motor control test. The authors proposed that the effect of food restriction on energy metabolism or other physiological mechanisms might explain the impairments in neurocognitive functioning.

Recently, a study compared the neuropsychological function of patients with anorexia nervosa, bulimia nervosa and healthy controls [81]. Though gender was not controlled for, the authors found that patients suffering from anorexia nervosa demonstrated severe impairment in executive functioning, motor ability, and visuospatial proficiency. Consistent with research in the sphere, [82] severe malnutrition may impede neuropsychological function in men and women. According to a sophisticated meta-analysis, [83] neuroimaging such as magnetic resonance imaging (MRI) and computer tomography (CT scans) show that the brain structure in anorexia patients is actually quite remarkable compared to that of a healthy person. The brain of an anorexia patient structurally suffers a loss of white and gray matter. Importantly, a loss of white matter is associated with poor executive functioning and reduced processing abilities. A comprehensive review by Jáuregui-Lobera et al. [84] noted that hormonal and metabolic mediators can also influence the severity of neuropsychological symptoms. On the contrary, chronic high fat diets and high saturated fat consumption are also associated with cognitive deficits [85]. Overall, cognitive consequences are, quite seemingly, affecting adolescent and adult men and should therefore be a priority for future investigations [86].

6. Conclusion

The ever-increasing number of men who experience body image- and weight-related issues is indeed a concern and priority for public policy [8]. According to an analysis of three North American large-sample surveys (conducted in 1972, 1985, and 1996), negative body image among men has become increasingly widespread [87]. Over the 24-year period, appearance dissatisfaction grew from roughly 15 to 43%. A more recent Canadian analysis based on two large-scale surveys (collected in 2002 and 2012) reported that the prevalence of eating disorders

significantly increased among men and significantly decreased among women. Men between 15 and 64 years of age who reported seeking professional help for an eating disorder increased from approximately 20,000 to more than 27,000 over the 10-year period while women who reported seeking professional help for an eating disorder decreased from roughly 102,000 to approximately 85,000 [88]. Consistent with previous findings, the prevalence of eating disorders in North America is regarded as approximately one third men and two thirds women.

Research findings across Western nations also demonstrate increasingly higher rates of body image disturbances in men including Australia, [89] the United States, [90] and the United Kingdom [91]. Health practitioners assert that men in many Western cultures are facing an epidemic of eating disorders since research reveals widespread proportions across different communities. Fundamentally, the problems associated with negative body image and weight concerns have reached new records among men and therefore, current research undertakings, health practitioners, and policy leaders are advocating for the development of new research initiatives specific to the male experience and intervention programs to help alleviate the issues.

Given the numerous consequences of men's unhealthy body image discussed herein, there is considerable consensus for the psychological, behavioral, and cognitive effects. Although the literature is dominated by a focus on unhealthy body image that aims to understand various pathologies, current efforts have begun to explore how to promote positive body image in order to attain a comprehensive understanding of the construct. Solely focusing on relieving symptoms of negative body image without taking into consideration how to foster positive body image essentially limits knowledge and inadvertently diminishes the efficacy of treatment programs [24]. Scholars have called for new research initiatives [21] to investigate the development and experience of positive body image by probing its resilience and protective factors as well as by exploring individual defense factors against negative body image.

In general, experts in the field emphasize that failing to explain why some individuals are more resistant than others to the deleterious effects associated with cultural body ideals and weight concerns continues to remain a large gap in the literature. Future investigations, prevention strategies, and intervention efforts aimed at reducing and deterring negative body image outcomes among men will benefit from the inclusion of protective factors.

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Section 3

Physical Fitness and Weight Loss

Chapter 7

Physical Fitness and Body Shape (Physical Shape)

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Additional information is available at the end of the chapter

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Abstract

The purpose of this study was to determine Zulu women's perceptions of their body image relative to weight status attending a noncommunicable disease (NCD) clinic in South Africa. A cross-sectional exploratory study design was used and included 328 (91%) Zulu women who were sampled systematically. The women were subjected to anthropometric measurements and engaged the Stunkard's body image figures to determine perception. The study showed that 61% of the sample was in the 40–59 age strata. The mean body mass index (BMI) was 37kg/m^2 (±9.41 kg/m^2), with over 90% being overweight or obese. A discrepancy between Zulu women's perceived body image and actual BMI existed in all weight status categories with overweight and obesity demonstrating the widest variations ($p < 0.000$). Women perceived themselves to be thinner than their actual BMI. More than 99% associated an underweight body image to one with disease. Diabetes mellitus (72%) was the most frequent NCD encountered. Only 23% with this condition correctly perceived their body image. It was shown that the negative impact of preferring a larger body image in Zulu women with preexisting NCDs could be refueling their existing comorbidities.

Keywords: Zulu women, body image, non-communicable diseases (NCD's), weight status

1. Introduction

Overweight and obesity are conditions which have had an increase in children, teenagers and adults in recent years. According to the World Health Organisation (WHO), obesity has had a

300% increase since 1975, and in 2016, 39% of adults presented overweight, 13% presented obesity and more than 4 million children presented both conditions. Such conditions are more troubling at a young age, for they can trigger a metabolic memory, which can make adults more prone to obesity and to present more adipose tissue at organic and body levels. This may condition the person to suffer metabolic syndrome consequences or complications.

Overweight and obesity have a multifactorial aetiology, and in order to eradicate such diseases, there have been different unsuccessful attempts. Healthy eating and exercise are frequently encouraged, but there are other factors which determine and influence the optimal results with regard to weight loss, the main purpose of which is losing fat in the organs and, of course, in the body. Physical activity and nutritional advice should be optimal to achieve the expected results; however, maybe due to poor training of health personnel, the population results have not been satisfactory.

It is well known that carbohydrates and fat intake increase carbohydrates and fat at body and organic levels. Fat can be chronically increasing and being stored if it is not metabolised or "wasted" as energy. The obesity and overweight appear to directly impact organs and systems. Different systems like the cardiorespiratory systems, the haematology/circulatory system, the endocrine-metabolic system, the muscle skeletal system and the psycho neural system suffer a decrease in homeostasis, and malfunction in these systems may influence vital organ functions, even at a personal development level.

Fat and lipids metabolism is carried out regularly; however, a percentage of these are stored in the body for future needs, but such storing should not become chronic. Physical activity carried out on a regular basis has impacted physical condition, which can be considered healthy or unhealthy and which is an important morbidity mortality indicator and predictor. Healthy physical fitness protects against metabolic diseases. Physical fitness turns healthy with adequate organ systems and organs, that is, through physical adequacy: discipline and body exercises which improve health.

Physical activity should be carried out by any person able to do it, regardless of the age, and independently from overweight or obesity, for, besides helping reduce fat tissue (reach and keep the ideal weight), it helps create a healthy physical condition. Exercise produces benefits at hormonal level, releasing endorphins and serotonin, known as "happiness hormones". Besides the regulation of systems like satiety and appetite, which help reach the ideal weight.

2. Physical fitness and physical shape

According to the World Health Organisation (WHO), overweight and obesity are on the rise on a global scale, reaching pandemic proportions, and killing 2.8 million people each year [1]. It is well known that overweight and obesity are non-transmittable, chronical, metabolic diseases whose causes are multifactorial and where weight increase is due to fat excess in the fat tissue.

These ailments have enormous repercussions in public health and were previously limited to first world countries. However, nowadays even developing countries are suffering from such complications. Such effects used to be seen only in adults, but can now be seen at any stage of life: childhood and adulthood alike. Hearth diseases, intestine cancer, cerebrovascular events, dyslipidaemia, musculoskeletal disorders, type II diabetes mellitus, obstructive sleep apnoea, hypertension, metabolic syndrome and productivity and quality of life decrease stand out among potential complications, affecting significantly children's and adults' physical wellness and physical performance [2, 3].

Despite the ethology in these procedures, there are precedents that support physical activity that can help reach and keep our ideal weight. Regular physical activity seems to be a protective factor in the decrease in accumulation of subcutaneous fat [4, 5], while a sedentary lifestyle is one of the factors that contributes the most to gaining weight and it is associated with lower physical fitness levels [5–7]. In the last years, the latter has gained ground when it comes to health, but it used to be used only as a tool in sports areas.

Specifically, the physical fitness is the ability of the skeletal muscle system to act as a result and in synchrony of the integration of other systems and that will allow movements appropriate to sex, age and maturation of the central nervous system as well as the development of motor skills. These movements can be achieved in favour of or against the severity and the ease with which they are made which can depend on muscle tone, the amount of muscle fibres and the level of muscular strength.

On the other hand, the physical shape of the body can be considered from two points of view. The first is the category according to the body mass index (BMI) established by international standards where a person can be in the category of undernutrition, underweight, overweight or obesity. However, the one considered in this chapter refers to the physical shape of the healthy or unhealthy body, which is established from specific tests of physical fitness and therefore not based on body weight.

In this sense, physical fitness connected to health is defined as the ability someone has to perform everyday activities vigorously, delaying fatigue and avoiding injuries [8]. It is also defined as the ability a person has to do physical activity or exercise and it brings musculoskeletal, cardiorespiratory, haematology and circulatory, endocrine-metabolic and psychoneurological [9, 10] functions together. Physical fitness is an important predictor of the health of an individual; it is also an important mortality and morbidity predictor [11, 12]. It is true that in the sports field, physical fitness has been categorised as good, regular or bad or low, average or high [13, 14], but physical fitness has not yet been defined. However, in a stricter, more connected to health way, physical fitness could be considered as healthy or unhealthy, taking into account clinical factors and physical evaluation factors.

Up until now, the "healthy weight" paradigm states that a person with an average or ideal weight, according to the standard body mass index (BMI), is an apparently healthy individual who can be related to good health statistics [1, 15], either present or future, with the small possibility of suffering a metabolic disease or even others, such as dyslipidaemia, which may manifest in obesity or overweight but are not caused by them.

Recent studies warn that a normal weight does not precisely protect against metabolic diseases [16, 17], for such "healthy weight" indicates the adequate mass of the individual according to their sex and age. However, it is to be considered a not-so-close relation to health, nor present or future. In consideration, independent of the BMI, the combination with regular physical activity would help improve physical fitness, turning it from not healthy to healthy, and that would have a direct impact on the individual's health. This information could be presented in a practical way in **Figure 1**.

The predisposition to a metabolic disease could be inferred through physical fitness and not through body physical shape, the latter depending on the BMI. An appropriate physical fitness could help the individual have a healthy physical shape (ideal weight) and an appropriate physical fitness; it would favour an unhealthy physical shape greatly: overweight and obesity; malnutrition and low weight. On the contrary, a healthy or unhealthy physical shape does not suggest an appropriate or inappropriate physical fitness (**Figure 2**).

Similarly, there might be people with an apparent appropriate physical fitness and an unhealthy physical shape, thus there might also be people with a healthy physical shape who have an inappropriate physical fitness [16, 17]. This could be exemplified with a Zumba instructor who is over 90 kilos (198 lb) with an apparent appropriate physical fitness when performing flexibility movements, an apparent muscle resistance and an adequate cardiorespiratory resistance, without considering his body complexion. On the contrary, there are people with an adequate body complexion whose flexibility, muscle resistance and cardiorespiratory capability, when trying to dance, are not in optimal conditions. This may suggest that there are overweight or obese people who have an appropriate physical fitness and that there are people in shape but unhealthy (**Figure 3**).

Physical fitness is evaluated through specific components within batteries (set of physical tests) for children, teenagers and adults, respectively [18–20]. Such evaluations determine the physical aptitudes connected to the health of the individual, which is the main approach of this section. They are also related to the motor skills and to sport performance, respectively [18–22]. There are five physical aptitudes to do with health, a medical approach can be observed in those five aptitudes, and this can be used as a health predictor of the individual (**Table 1**). An adequate physical fitness is reached through physical activity. Exercise is

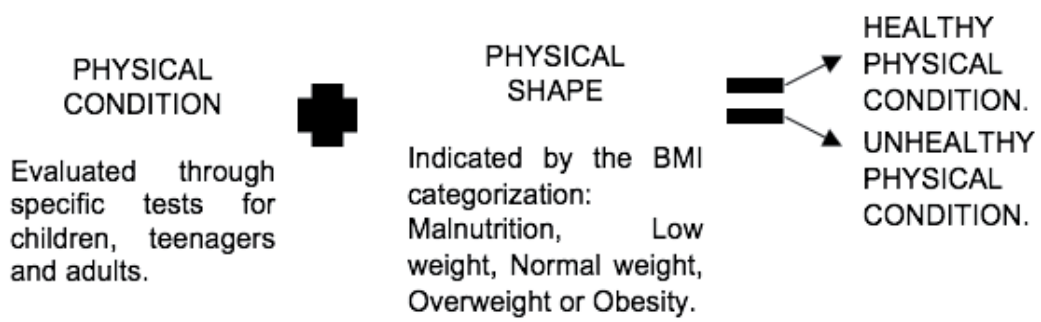

Figure 1. Physical fitness and physical shape graphic analysis with which it may be determined if there is a healthy or unhealthy physical fitness.

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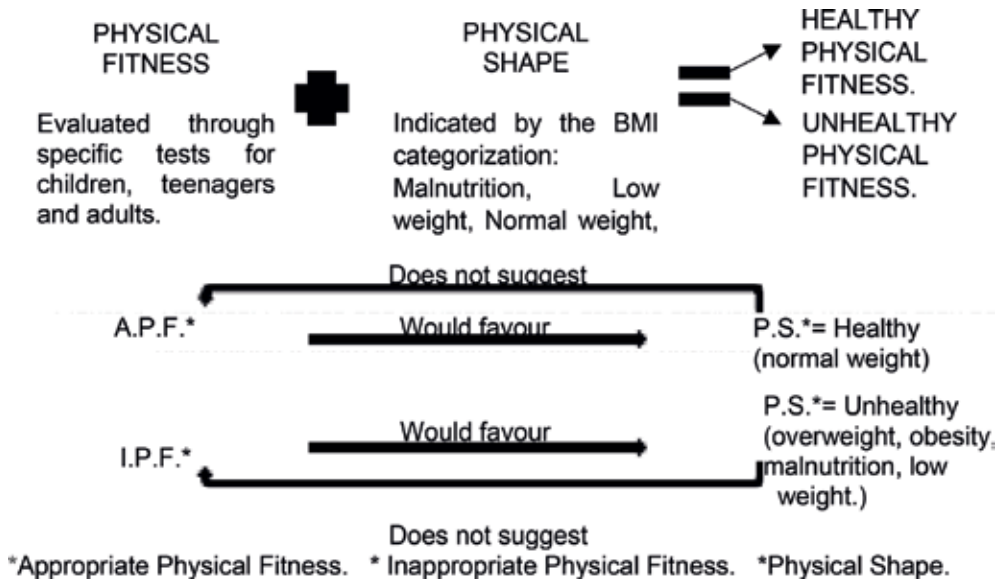

Figure 2. Graphic inference of the appropriate and inappropriate physical fitness that would favour a healthy and unhealthy physical shape.

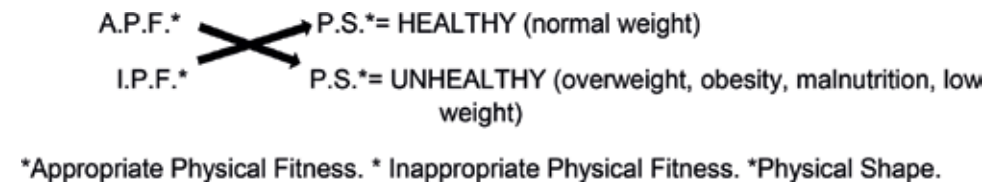

Figure 3. Graphic proposition of an appropriate physical fitness in an unhealthy physical shape and vice versa, inappropriate physical fitness in a healthy.

essential in order to make neuromuscular and metabolic training contribute and favour the adequate organic and systemic operation and adequate physical fitness that may be a protective factor for health.

It is well known that the main objective for public health of the governments in all countries has been the promotion of healthy eating habits and, above all, a balanced diet, as well as doing exercise. However, this objective has not been reached, for not a single country has seen a decrease in obesity rates in the last 30 years [23] which has led to thinking twice about the benefits of physical activity in weight loss and about the inefficiency of exercise and exclusive diets.

Shook et al. studied the relation between the intake of energy, physical activity, appetite and weight increase, and it was discovered that people with less physical activity showed higher levels of appetite in comparison with people who had high levels of physical activity. The authors noticed that an energy balance could be reached with an activity corresponding to 7116 steps a

1. Cardiorespiratory resistance	Resistance to an aerobic effort. It requires the adaptation of different systems: cardiorespiratory, haematology and circulatory, endocrine-metabolic, musculoskeletal, etc. The energy obtained is through the aerobic metabolism where carbohydrates (aerobic glycolysis) and fats (Krebs cycle) oxidise in oxygen presence, that is, there is an equilibrium between the intake of oxygen and its consumption
2. Muscle strength	Manifestation of the muscle contraction, isometric and isotopic in favour or against gravity. The effort is proportional to the strength it has: more strength, less required effort
3. Muscle resistance	Repeated below maximum tension capability in a period of time. It allows us to perform everyday activities avoiding tiredness and delaying muscle fatigue
4. Physical composition	Evaluations and measurements in the individual based on four basic components: mass, fat, lean mass, water, and minerals. It helps in the detection of the nutritional state, growth, physical activity and as a tool for timely diagnosis and detection of overweight and obesity and its possible complications for health
5. Flexibility	Muscle capability to perform the maximum joint effort without injuries. Flexibility does not generate movement, but allows it

Table 1. Aptitude connected to health and their clinical approach.

day [24]. This might suggest that a sedentary person, despite following a diet for losing weight, may be less successful if no physical activity is carried out, for exercise is the most important factor in everyday energy consumption and it could directly affect the energy balance [25].

Physical fitness is closely related to physical activity, which includes muscle activity during exercise [26–28]. The approach of the physical activity must be prescribed by experts in a multidisciplinary group, according to BMI, age and sex, for there are neuroendocrine and metabolic indicators that refer to the cardiac cycle and hormonal regulation, as well as the equilibrium of dietary intake to lose weight and to keep the ideal weight. For prevention, modification and control, some studies state that physical activity may have an important contribution for weight control [29].

Children and adults are affected differently by obesity and overweight. It has been proved that less physical activity is associated with obesity and that regular activity in children and adults improves physical fitness, which helps treating obesity and overweight. According to the component of physical fitness related to health, cardiorespiratory aptitude has been more frequently studied and it has been associated to obesity, impacting cardiovascular risks [30]. For this reason, and in order to plan and promote physical activity that favours physical fitness more accurately, it is necessary to understand the parameters that affect the energy consumption in the physical composition and that may help prevent overweight and obesity or that may help improve weight to achieve the ideal weight.

3. Fat tissue and muscle mass modification for physical activity

In order to be aware of the process that modifies fat tissue (FT), it is important to know that the total energy consumption (TEC) represents a 100% and it is the result of three primary

components: basal metabolic rate (BMR) = 60% + thermic effect of food (TEF) or dietary-induced thermogenesis (DIT) = 5–10% and thermic effect of exercise (TEE) = 15–20% of the TEC.

The studies of physical activity and TEC during adolescence and adulthood show evident changes in habits, factors that may be associated with a risk increase to suffer from overweight or obesity and from comorbidities [31]. In sedentary people, more that 75% of the TEC is consumed by basal metabolism and only 15–20% is consumed in physical activity, increasing the possibility of accumulating fat tissue and thus being obese or overweight. Such fat tissue will not only affect the body image, but it will, at molecular and organic level, take visceral space and other anatomic places that compromise biological homeostasis.

From a biological point of view, lipids play a very important role due to their diverse and irreplaceable functions: they make up cell membranes, they help transport fat-soluble vitamins and other substances like hormones. Due to their high caloric content (9 kcal/g), they are the most important energy reserve. However, they are metabolised more slowly, they are stored almost in an anhydrous way and they need the presence of oxygen, in comparison to carbohydrates, which are metabolised faster, may or may not use oxygen and are stored in the presence of water.

The primary cell of the fat tissue (FT), the adipocyte, works as a real endocrine organ. Individuals with a high storage of central or deep visceral fat would be more sensible to the B-adrenergic stimulation of the adipocytes, which would increase the production of fat acids (FA) which are digested in the liver and generate dyslipidaemia, insulin resistance, and hepatic steatosis, among other effects [32]. Such problems, when combined with obesity or overweight, create complications in the health of the individual, thus making the oxidation of such fat acids essential.

The oxidation of fat acids takes place in three steps, one depending on the other: (1) the transportation of fat acids from fat tissue, (2) the transportation of fat acids to the muscle and (3) the muscle cell consuming the fat acids, which through physical activity allows energy expenditure.

Such energy expenditure will depend on the time and the intensity of the activity and on the prescribed physical activity. Only a few observational studies have included details on the kind of physical activity that should be carried out, or the duration or the frequency. The total amount of the activity is generally determined by the coaches or by the individual itself without taking into account health factors or the medical history, which are important matters always to be considered in a programme designed to lose body fat.

During physical activities and our everyday movements, the FA are perennially moving in the adipocyte, while triglycerides are transported to the cytoplasm. This process may be triggered by catecholamines, where some receptors known as B-adrenergic (B-AR), situated in the plasma membrane, allow its entrance. The stimulation of the B-AR generates cyclic adenosine monophosphate (cAMP) through the activation of adenylate cyclase. A rise in the intracellular cAMP activates the kinase A (PKA), which stimulates the hormone-sensitive enzyme (LHs). Once activated, it is translocated to the lipid vacuole and hydrolyses the FT, resulting in two fat acids and a monoacylglycerol, which can be spread into the circulation. The latter will be hydrolysed into glycerol and another fat acid [33].

Unlike glycerol, once FA are in the cytoplasm of the muscle cell they can be stored in intracellular FT or re-esterified to form new FT through the triacylglyceride. For this to happen, glycerol-3-phosphate (G3P) must be present; however, by reducing the glycerol kinase enzyme, the G3P results in glucose [33]. Once the FT molecule has been hydrolysed inside the adipocyte, fat acids can passively go through the cell membrane, or associated to the FA transporting protein, located in the membrane of the adipocyte. FA are transported by passive diffusion and facilitated through the plasmatic membrane linked to FA linking proteins (FALP) through the sarcolemma of the muscle cell. Albumin will join in the interstitial space, which is responsible for transporting 99.9% of the FA in the plasma. FA transport conditions seem to be the saturation of the complex fat albumin acid and the proper perfusion of the tissue. Cardiac muscle and skeletal muscle depend the most on fat acids as source of energy. However, the content of FT can vary due to internal and external factors, among which are diet and physical exercise. A lack in the consumption of energy of this fat acids may lead fat tissue to increase. There are two ways this may happen: (1) an already existing increase in the size of the adipocyte (hypertrophy) or (2) a rise in the number of adipocytes (hyperplasia).

The use of fat as the main source of energy will be conditioned to the intensity of exercise. During low-intensity exercise (25% VO2 max), fat acids and plasma glucose seem to be the most important substrates. For the muscle triglycerides (MTG) contribution to energy provision is minimal. On the other hand, with moderate exercise (65% VO2 max), substrates in the muscle (triglycerides and glycogen) are essential, for they were oxidised at high rates, while fat acids were used at lower rates. Finally, with high-intensity exercise (85% VO2 max) the predominant substrate was muscle glycogen, with a decrease in the MTG and plasmatic FA (**Table 2**) [33].

Several studies have shown that the loss of fat induced by exercise seems to be higher in the abdominal region or the arms than in the femoral region [34, 35]. This suggests that the changes in fat tissue triggered by training vary in different regions of the body, and that exercise may reduce the adipose tissue reservoir and modify fat distribution. However, this is not yet settled. Such knowledge of the lipid cell brings the possibility of correctly programming exercise to people who suffer from obesity or overweight and with the primary objective of reducing adipose tissue.

As previously stated, body weight is determined by a percentage of water, minerals, fat and muscle. It is important to remember that the human body has more than 650 muscles, which make up half the body weight of a person (50%), however, when dealing with obesity or

Intensity exercise	VO2 max (%)	Substrate use			
		Plasma glucose	Plasma fat acids	Muscle triglycerides	Muscle glycogen
Low-intensity exercise	25	●	●		
Moderate intensity exercise	65			●	●
High-intensity exercise	85				●

Table 2. Substrate use at different intensity of exercise.

overweight, this percentage is lower, with more fat tissue. It is important to prepare the neuromuscular system to be adapted and used to regular physical activity through regular exercise. The objective of training when obese or overweight is to lose fat tissue or to maintain the ideal weight while increasing and improving physical fitness. This will depend on the efficiency with which chemical energy can be transformed into mechanical energy, energy consumption and the modification of fat tissue and its adaptation in the neuromuscular system (physical fitness).

When performing physical activity, fat tissue transforms, and the same happens to skeletal muscle. The modifications that take place in the muscle cells due to training are known as chronic or acute, and will depend on the evolution of the activity. Such modifications occur through an increase in the blood flow and through the liberation of autocrine and paracrine muscle factors, which stimulate receptors on the cell surface and activate torrents of signals and muscle contraction per se. One of the main signals in the metabolic adaptation of the skeletal muscle is the activation of the protein sensing the cell energy state represented by the adenosine monophosphate-kinase (AMPK), whose activation depends on the energy state induced by exercise and favours the density of mitochondrion and capillary, as well as the increase in the enzymatic, activity.

Added to this biochemical aspect is the importance of the characteristics of the physical activity, as well as the intensity in the training session. It is believed that an increase in the intensity could trigger a change in the muscle recruitment pattern, which would go from a predominance of slow-twitch oxidative fibres (type I) to the predominance of fast-twitch glycolytic fibres (type II). Recent studies have shown that athletes who trained for speed have more type II fibres in their muscles, while athletes who trained for endurance have a higher percentage of type I fibres. Endurance training brings a higher glycolytic flow in the skeletal muscle, thus provoking a decrease in the maxim activity of the glycolytic enzymes. This adaptation favours fat oxidation over carbohydrates during exercise [36]; in this way, training for resistance with moderate-high-intensity decreases the production, consumption and oxidation of plasma glucose.

Low-moderate density exercise (50–60% VO2 max) has been suggested to treat obesity and overweight; however, the reduction of the fat mass has been insufficient for health purposes, thus intermittent high density exercise (HIIT) is considered an alternative, for it has bigger effects on the subcutaneous and abdominal fat due to the throbbing release of lipolytic factors through the secretion of catecholamine and peptide natriuretic which produces the segregation of fat acids from body fat reserves [37]. The main characteristic of this form of exercise is the short periods of exercise (seconds or minutes) carried out at high density (equal or less to 100% VO2 max), followed by rest (more dark mass and less fat tissue quantity), which is proportional to the intensity of the exercise.

Adequate prescription of exercise may produce changes at organic and physical levels in people who suffer from overweight or obesity, in which the continuous state of tissue inflammation (lipoinflammation) also generates a hormonal imbalance, in which the adipocyte alters its segregation, producing less leptin and more adiponectin, and a decrease in insulin sensibility which, in the end, has an impact on the mitochondrial functioning accompanied by a more

stressed endoplasmic reticulum in the presence of fat tissue. For this reason, it is important to acknowledge the importance of the endocrine system when exercising and its relation to overweight and obesity.

4. Overweight and obesity: neuroendocrinology of exercise

The hypothalamus is made up of nuclei specialised in the elaboration and segregation of hormones to stimulate the hypophysis. The hypophysis, or pituitary gland, is located in the Sella, and it is divided into the anterior lobe, or adenohypophysis. In normal situations, the hypothalamus-pituitary system, which is made up of minuscule blood vessels, is in charge of transporting such factors.

The term hormone derives from the Greek root 'Hormón', which means 'to move'. Hormones are protean chemical substances, produced by organs with secretory functions, which are transported by the bloodstream to different parts of the body and produce inhibitors and activators. Hormones are classified in three groups: (1) steroid hormones. Synthesised from cholesterol and are not stored. They are fat-soluble (2) non-steroid hormones. They are hydrosoluble; thus, they cannot go through membranes with the permeability mechanism, using the activation of the receptors of the membrane and (3) hormones originating in the thyroxine.

The secretion of a hormone may be fast (Ad and NAd) or gradual (GH), and for this reason, there might be different hormone levels during the day, derived from the circadian system, for each hormone secretion is regulated by a negative feedback through the hypothalamus-hypophysis, interconnecting with peripheral sensors that indicate how an activity is being carried out. Thanks to this information, the system decides which hormone group is to be secreted into the bloodstream. It is important to mention that hormones are eliminated from the bloodstream in different ways: (1) by the metabolic destruction of tissue, (2) by the bonding of tissue (3) by the excretion of bile or hepatic transformation and (4) urine.

In normal conditions, the neuroendocrine system tends to be balanced, that is, there is a catabolism process after an anabolism process or vice versa. However, in certain pathologies the endocrine system is disturbed and it is not strange that in cases where there is an excess of fat tissue, the subcutaneous adipose tissue is not capable of storing the energy excess, while the adipose tissue visceral becomes the main triglyceride storage. Such conditions require an energy balance, along with appetite and anxiety, where the neuroendocrine system becomes important in order to regulate, but it is disturbed by the toxic conditions of overweight and obesity.

The adipose tissue secretes specific hormones, and the adipocyte is the main effector of the lipogenesis and lipolysis. While the mature white adipocyte produces leptin, the brown adipocyte produces adiponectin which raises sensibility to insulin in the muscles, liver and other organs and favours the oxidation of fat acids. Adiponectin is an important hormone for exercise, for its production increases during physical activity, improving fat tissue reserves metabolism [38].

People with higher concentrations of this hormone seem to have less risks of suffering from cardiovascular and metabolic diseases [39], and people who do more physical activity often have higher levels of adiponectin, in comparison with sedentary people, improving resistance to insulin, glycaemia, and lipidema.

Exercise brings immediate hormone responses and adaptation in the long term. These endocrine responses are linked to external factors such as the time in which the physical activity is carried out, in which the circadian cycle plays an important role, because the knowledge that the biological clock in the hypothalamus times the functions in the body was established by studying this cycle [39]. In this sense, exercising during hours when a person should be resting disturbs the metabolic circadian rate coordination with regard to the biological clock.

It is vital that certain hormones are present and active when doing physical activity. The growth hormone (GH), a small protean molecule which contains 191 amino acids, is essential for hormonal growth in kids and also plays an important role in the increase of fat acids transportation in the adipose tissue; it increases the quantity of free fat acids in blood as well, favouring its use as a source of energy.

In exercise, GH modulates the adaptations to the training of strength. Most studies seem to indicate that GH may perform directly on the tissue. It mainly enhances other hormones known as somatomedins or insulin growth factor (IGF), whose main actions are to increase and decrease protein synthesis, stimulate cartilage growth and the retention of nitrogen, sodium, potassium and phosphorus [40]. The importance of some particular mineral salts when exercising becomes more important, like potassium ion responsible for the nervous excitability along with sodium, calcium and magnesium, which contribute to keeping neuromuscular health and can improve the physical capability, or at least keep its level, which would favour muscle resistance.

It is important to mention that the quantity of GH during a workout depends on the intensity, amount and resting time in between series. A higher secretion of GH is through a higher hypertrophy stimulus (maximum of muscle twitching). GH response decreases as we age. However, after 21 weeks of strength training there has been an increase in GH response, which may continue high up to 30 min after exercising [40].

On the other hand, testosterone is a steroid hormone with anabolic effect on the tissue and whose production depends on the luteinizing hormone (LH). It has been observed that patients with higher cardiovascular risk, metabolic syndrome, hypertension, diabetes mellitus type II and obesity have lower levels of testosterone [41]. Such deficiency in overweight and obesity may have it grounding in low sex hormone binding globulin (HGB) due to the hyperinsulinemia state, creating a lipid profile.

Testosterone in the blood enters muscle cells in its free form, biologically active, through a diffusion mechanism. It is believed that this connection with the genetic code may be the main factor for the increase in size of the muscle cell observed after strength training. Testosterone stimulates, on the one hand, nervous elements (a rise in transmitters and receptors) and, on the other hand, type II muscle fibres (turning them into type IIx, stronger, less resistant and with

more glycolytic) [40], improving dark mass increase and reducing fat mass through physical activity.

There is not always an increase in the basal blood concentration of testosterone and/or an increase in the proportion of testosterone/cortisol when a strength-training programme is carried out. Some authors suggest that such an increase is observed after training for 8 weeks or more, but it is not observed when the training is short. When sportsmen have been training intensively for years, the increase of basal blood concentration of testosterone is no longer evident, and it is probably close to the hormonal adaptation limit.

The known stimuli capable of acting at hypothalamus level, reducing appetite and increasing energy expense, comes from the gastrointestinal system (glucagon, bombesin, cholecystokinin, and glucose); from the endocrine system (insulin, adrenaline through its b-adrenergic effects and oestrogen); from fat tissue (leptin); from the peripheral nervous system (noradrenalin b-adrenergic effects) and from the central nervous system (dopamine, serotonin and gamma amino butyric acid).

The hypothalamus produces most integration and interpretation of the humoral and neural afferent signals for the coordination of the ingestion (hunger and satiety) and the energy expenditure (increases or decreases basal metabolism and thermogenic efficiency of the brown adipose tissue, as well as changing the secretion patterns of different hypophysis hormones) in response to conditions that modify the energy balance in the organism.

The arcuate nucleus, where all these mediators arrive, is situated in the base of the hypothalamus and has two main types of cell systems: (1) those which reduce appetite or neurons containing proopiomelanocortin (POMC) and (2) those which stimulate appetite and have neuropeptide Y neurons (NPY) and the peptide related to the agouti protein (AgRP), which acts as antagonist endogenous of the MC3 and MC4 receptors.

This integration unleashes mediators, which, through the stimulation of the sympathetic and parasympathetic nervous systems, and through the secretion of thyroid hormones, regulate the sense of hunger, the ingestion of nutrients, the type of selected nutrients, the basal metabolism and the necessary energy expenditure for growth and physical activity [41].

Like the previously mentioned hormones, leptin, made up of 167 amino acids and belonging to the cytokines family, is primarily synthesised by white fat tissue and in less quantity by muscle tissue, placenta, adenohypophysis, central nervous system, mammary gland, stomach and tumour tissue. Synthetisation occurs after a flow of nutrients into the adipocyte which guarantees the generation of triglycerides, but also by hormones such as insulin, glucocorticoids, oestrogens, melatonin and transition factors which positively regulate the expression of the adipocyte "ob" gene, while inhibited by androgens, tumour necrosis factor alpha and by thyroid hormones [41]. Plasma leptin concentrations are directly proportional to total fat mass. The biggest receptor is located mainly in the hypothalamus, hippocampus and cerebellum, while small molecule receptors are located mainly in the choroid plexus and its function seem to be to facilitate leptin circulation into the brain.

Leptin biological actions can be classified into two groups: (1) central nervous system tissue (hypothalamus) regulates corporal weight, reduces food intake, increases basal energy

expenditure and modifies some endocrine functions and (2) peripheral tissue: has effects on tissue metabolism proliferation, differentiation and peripheral tissues.

There is another hormone that is related to overweight and obesity: adiponectin, which is a hormone secreted specifically in the adipocytes, involved in the regulation of the metabolism of glucose and fat acids and in the protection of artery walls against atherosclerosis. Low adiponectin levels are associated with insulin resistance and breast cancer, for this hormone may directly control the growth of the cancer cells, and it also has anti-inflammatory properties. Individuals with higher concentration of adiponectin have a lower risk of suffering metabolic or cardiovascular diseases. On the other hand, lower serum levels are associated with obesity and metabolic syndrome [42, 43]. Among the activities that produce changes in adiponectin concentration are aerobic exercise and endurance exercise.

Exercise is beneficial, for it increases the serum level of different hormones, and the expression of their receptors. Thus, exercise benefits must be considered on insulin resistance, glycaemia and lipidemia, for besides regulating important endocrine systems, it favours the secretion of other hormones such as serotonin and endorphin, which produce benefits for our health.

In the same way exercise is important for losing fat tissue, gaining lean mass, and improving physical condition, proper diet is also necessary in order to reach these objectives, thus the importance of studying food and diet when overweight or obese.

Healthy eating is based on the nutritional pyramid, who consider demographic characteristics, not taking into account the characteristics of the individual [44] (genetic and metabolic profile), which affect the absorption process, distribution, metabolisation, and elimination of each nutrient. For instance: triglycerides, sterols and tocopherols guarantee a variety of effects, with different metabolic and cell procedures [45, 46]. In overweight and obesity conditions, this metabolic situacion is counterproductive by the concentration of fat acids, which during low-energy expenditure, are stored in big quantities and impact directly body image.

The existence of metabolic memory may explain why kids may suffer from overweight or obesity in their adolescence or adulthood and that kids with normal weight reach their adolescence or adulthood with the ideal weight. It is advisable to work such metabolic memory through healthy eating and physical activity so as to keep the ideal weight, and to carry out such recommendation for population groups susceptible to overweight or obesity of any age in order to improve their health and reduce the risk of illnesses, consequences or complications.

5. Physical activity and endocrine effects

Like metabolic memory, endocrine memory plays an important role in the appropriate hormonal functioning and its efficiency on molecular, neuromolecular and on specific systems level. The effects of exercise for the brain to function properly have been reported in a variety of studies. Psychology studies have reported the beginning of disorders in emotional states, depression and anxiety in people who suffer from obesity or overweight [47, 48] and which affect performance with family, work and at a personal level, which may compromise their health even more.

There are reports of exercise influences at a genetic level, and that more than 500 genes are located in the muscle, skeletal, vascular and neuronal tissue, among others [49]. In the same way, exercise may decrease sodium/potassium ATPasas, increasing the resistance to oxidative stress through the expression of proteins such as superoxide dismutase 1 (SOD1), catalase and Bcl-2, which suppress oxidative stress, regulating the ATP levels in the neurons, prompting enzymes into the Krebs cycle [50–52].

The exercise increases the level of substances such as lactate and glucose, constituting an indirect measure in cell activity through physical activity at glial and neuronal level; and oxygen, metabolism and blood flow are modified by physical activity.

Muscular training through physical exercise produces hormone changes, regulating growth, metabolism and reproduction; responding to circadian cycles and, presenting immediate responses in short or long terms. The endocrine system is controlled by a negative feedback.

All changes produced during exercise are beneficial, for they control blood sugar and ensure that energy is transported all through the nervous system and muscles. Exercise also improves the cardiorespiratory parameters; it increases the size and quantity of mitochondria. It also produces muscle hypertrophy and the electrolytic regulation impedes dehydration. Thus, exercise and exercise intensity are decisive in hormone secretion. The active participation of the neuroendocrine system helps eliminate fat tissue, improving physical fitness and physical composition.

It is known that the regions of the brain involved in the release of hormones during exercise are the motor-sensor systems: cerebellum, primary cortical areas and the basal ganglia; as well as the hypothalamus, hypophysis, the hippocampus, among others. With the knowledge of neuroendocrine effects, the characteristics of physical exercise could be determined in terms of frequency, intensity and duration, achieving a weight loss.

6. Conclusions

Muscle and adipose tissue are benefited from the presence of regular, acute and chronic physical activity, in kids, teenagers and adults. Physical activity is essential to improve body composition in obesity and overweight conditions, and also to keep the ideal weight, which will serve as protection against metabolic disease. It will also improve the emotional state and physical fitness of any person who practices it. Thus, being sedentary, even with the ideal weight, will reduce organic functions, favouring weight increase. It is important to continue this research, analysing the level of exercise of people with normal weight, overweight and obesity, in order to determine neurotransmitter levels, clinical health state and physical fitness in general.

The main consequence of fat tissue excess in the organs and in the body is that, at anatomical and physiological levels, such fat occupies space, which limits or disables organs and keeps them from performing adequately. Take, for instance, the “fatty liver”, known as hepatic steatosis. Fat surrounding the heath predicts cardiovascular diseases and diabetes mellitus

type II. This is a risk factor which can be associated to an excess of fat around the myocardium and the limitation of coronary blood vessels. Our pancreas is also affected by high levels of triglycerides in the blood and by the excess of fat, among others.

Sleep apnoea and pulmonary embolism and pulmonary fibrosis are among the complications of sleep apnoea. The skeletal muscle suffers from the excess of body weight, mainly in the joints in the knees with chronic gonarthrosis, lower limb bursitis, herniated discs, mainly lumbar, thus posing a difficulty or impeding carrying out every day personal work, family and social activities. Organ and physical affectation may impact the emotional state, where at a psychological level, depression, anger or anxiety may be triggered by a lack of health.

However, considering the previous information, there are complications derived from an excess of organic fat and body fat and that arise independently from the weight category: malnutrition, low weight, normal weight, overweight or obesity. Thus, aside from the weight category, regular physical activity is necessary for the following reasons: (1) regular physical exercise helps reach a balance between the O_2 intake and the CO_2 disposal, (2) it favours blood circulation, in which proteins such as haemoglobin have higher participation in the cells, (3) the arcs of movement are generally within joint ranges in normal conditions, allowing more flexibility, strength and endurance, among others, (4) mitochondrion production is higher and of more quality, improving lean tissue which substitute fat tissue, (5) organs and systems keep a homeostasis, mainly in the cardiorespiratory and neuroendocrine-metabolic systems, (6) carbohydrates and fat acids intake as main sources of energy, (7) improving of physical performance, (8) physical fitness turns healthy, being an indicator and predictor of morbidity mortality in all ages, (9) protection against metabolic diseases and (10) releases endorphin and serotonin, known as "happiness hormones", which allows a better self-perception, better performance and better quality of life.

To sum up, carrying out regular, physical activity may help achieve the ideal weight and, at the same time, stay in it, for it works as a protective factor by doing the following: it prevents the storage of fat in the organs and in the body, it helps keep a healthy physical fitness, it improves body weight, increasing lean mass and decreasing fat mass, it keeps the ideal weight, it improves the immune system, it improves the neuroendocrine system, it improves the cardiorespiratory system, it improves the haematology/circulatory system, it improves self-perception and it helps to become a productive, active person who carries out everyday regular activities with more ease and enthusiasm.

With this data it will be possible to determine the characteristics of physical exercise with regard to frequency, intensity and duration, which may also be appealing and beneficial for sedentary people with normal weight, and for sedentary people with overweight and obesity, offering efficient methods for them to adopt a healthy, more active lifestyle.

Conflict of interest

The authors inform no conflict of interest.

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Child Obesity

Chapter 8

Parenting Influences on Child Obesity-Related Behaviors: A Self-Determination Theory Perspective

Roberta Di Pasquale and Andrea Rivolta

Additional information is available at the end of the chapter

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Abstract

The relationships between parenting behaviors and child obesity-related behaviors have been extensively investigated through the use of different constructs such as parenting styles, domain-specific styles and specific parenting practices, but there is currently a need for a more comprehensive and integrative theoretical framework. This chapter argues about the usefulness of self-determination theory, and in particular of the specific dimensional parenting model related to the theory, as a framework to conceptually organize parenting practices relevant to children's obesity-related behaviors. The three parenting dimensions of autonomy support, provision of structure and parental positive involvement, identified by self-determination theory as particularly relevant to the process of child's internalization of socially desired behaviors and values, will be applied as a framework to conceptually organize the parenting practices in the feeding and physical activity domains.

Keywords: child obesity, parenting styles, feeding practices, food parenting practices, physical activity parenting practices, self-determination theory, autonomy support, provision of structure, parental positive involvement

1. Introduction

Childhood obesity, viewed from a systemic and ecological standpoint, could be regarded as a complex and dynamical clinical condition based on a dysfunctional pattern of ineffective regulation of eating behavior coupled with diminished physical activity and increased sedentary time, which develops within a specific physical and social environment often characterized by the presence of obesogenic elements [1, 2]. Child overweight and obesity, in turn, are likely to produce social and psychological consequences [3–6] that could further reinforce

and perpetuate the aforementioned dysfunctional pattern. Parents, as the primary socializing agents of children's eating and physical activity-related behaviors, are crucially—although not exclusively—responsible for preventing and contrasting the onset of this condition.

The crucial role played by parenting influences in either favoring or discouraging child obesity-related behaviors and ultimately childhood obesity seems conceptually clear, empirically well-supported and generally shared within the scientific community. Nevertheless, research findings on the relationship between child overweight or obesity and single constructs such as parenting styles, feeding styles or specific parenting practices are generally weak and sometimes mixed or inconsistent [7, 8]. Indeed, many different factors intertwined in a complex causal network contribute to childhood obesity, among those factors, parenting behavior is likely to play an equally complex and multifaceted role.

Therefore, there seems to be a need for a more articulated theoretical framework to organize the parenting constructs relevant to child obesity-related behaviors and to guide future investigations. A particularly useful theoretical framework can be found in self-determination theory [9], a general theory of human motivation which addresses parenting influences on child social development by providing a socialization model based on children's autonomous internalization of socially prescribed/endorsed behaviors and values, with a focus on the specific parenting behaviors suitable for facilitating versus hindering such process of internalization. The aim of this chapter is to argue about the usefulness of self-determination theory as a theoretical framework for conceptualizing the role of parenting in influencing child obesity-related behaviors. To this scope, first, an overview of parenting constructs used in the study of parenting influences on child obesity-related behaviors is provided; then, a brief outline of self-determination theory's basic tenets and of the related parenting model is presented; finally, the self-determination theory-based parenting model is used as a framework for conceptually organizing the parenting practices in the feeding and physical activity domains.

2. Parenting constructs in the study of child obesity-related behaviors: parenting styles, domain-specific styles and parenting practices

The construct of parenting styles [10] has been widely used as a theoretical framework to investigate the relationship between parenting and child overweight/obesity or child obesity-related behaviors.

In particular, the typology originally developed by Baumrind [11] and refined by Maccoby and Martin [12], based on the two dimensions of parental responsiveness and parental demandingness, has been extensively adopted in a conspicuous number of studies.

In the model proposed by Maccoby and Martin [12], parental *responsiveness* is defined as the degree of warmth, acceptance and involvement displayed by the parent toward the child; on the other hand, parental *demandingness* is defined as the degree of maturity demands, control and supervision used by the parent in socializing the child. These two dimensions are

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combined in order to obtain a fourfold typology of parenting styles. The *authoritative style* is typical of parents who show both high demandingness and high responsiveness toward their child; this style is characterized by parental positive involvement, nurturance, use of reasoning and provision of negotiable rules. The *indulgent style* in typical of parents who show high responsiveness but low demandingness; this style is characterized by warmth and acceptance toward the child, together with a lack of maturity demands and control of the child's behavior. On the contrary, the *authoritarian style* is typical of parents who show low responsiveness but high demandingness; such a style is characterized by rejecting attitude toward the child, coupled with directive, restrictive and punitive behaviors. Finally, the *uninvolved style* is typical of parents who show both low responsiveness and low demandingness, and is characterized by little affection and involvement with the child, as well as by little efforts to control the child's behavior. The conceptual relevance of such parenting style typology for the study of parental influences on child obesity-related behaviors is based on the analogy with other child behaviors that typically need to be socialized by parents such as good manners, school homework, household chores, prosocial behaviors, responsible conduct, and so on. The guiding hypothesis is that the same relationship between different parenting styles and child outcomes regarding the socialization of the aforementioned behaviors may hold true also for children's obesity-related eating and physical activity behaviors. Research results [13–16] on the relationship between parenting styles and child obesity-related behaviors indicate that an authoritative parenting style tends to be linked to a healthier child's eating behavior, and to a physically active lifestyle, and therefore can be viewed as protective against obesity, while indulgent and uninvolved parenting styles are associated with a higher risk of obesity.

Alternatively, the parenting style typology proposed by Parker [17, 18] and based on the notion of parental bonding has also been adopted in studies on adolescent overweight/obesity [19, 20]. Parker's typology is widely used in the broader field of studies investigating parenting influences on eating disorders [21, 22] and on psychopathology in general [23], in which the supportive and emotional aspects of parenting are thought to play a more prominent role than the socializing ones. In fact, unlike Maccoby and Martin's typology, which is mainly focused on the parent as a socializing agent, Parker's typology hinges on the construct of parental bonding, conceptualized as the parental contribution to the parent-child relationship, and defined by the two dimensions of parental *care* and parental *overprotection*. Parental care refers to the amount of material and emotional support, acceptance and positive affection provided to the child by the parent; on the other hand, parental overprotection refers to the amount of parental intrusive, controlling behaviors and limitations on the child's physical and psychological autonomy. By combining the two aforementioned dimensions, a fourfold typology has been created: high levels of care coupled with low levels of overprotection delineate an *optimal parenting* style; high levels of care and high levels of overprotection outline a style defined as *affectionate constraint*; on the other hand, low levels of care and high levels of overprotection outline a style defined as *affectionless control*; finally, low levels of care and protectiveness delineate a *neglectful parenting* style. Parental bonding style in eating disorders appears to be generally characterized by low levels of care and high levels of overprotection [21, 22], and a similar association has been found in studies on youth overweight/obesity [19, 20].

Besides, along the lines of general parenting styles, a more specific construct of *feeding styles* has been developed [24], which to some extent can be considered as an adaptation of the Maccoby and Martin typology of parenting styles [12] to the particularity of the feeding domain. To that scope, the same dimensions of parental responsiveness and demandingness have been adapted to fit the specificity of the feeding context. In particular, demandingness has been redefined in terms of how much parents prompt their children to eat, whereas responsiveness has been redefined in terms of the forceful and parent-centered versus sensitive and child-centered way in which such encouragement to eat is provided. Research results [8, 14, 25] suggest that, similar to general parenting styles, an authoritative feeding style plays a protective role against obesity, while an indulgent style is associated to a higher risk of obesity.

Finally, the most widely adopted construct in the study of parental influences on child obesity-related behaviors is that of specific *parenting practices*. Located at a lower level of abstraction as compared to general parenting styles and domain-specific parenting styles, the construct of parenting practices denotes the more specific and goal-directed behaviors used by parents to directly influence their children's behaviors.

Regarding parenting influences on child's eating behavior, the role of *feeding practices*, alternatively known as *food parenting practices*, has been extensively investigated. This construct comprises the concrete strategies adopted by parents to regulate their child's eating behavior and weight, for instance, by increasing or decreasing the intake of certain foods.

Research has especially concentrated on two opposite and complementary feeding practices: *pressure to eat* and *restriction* of food consumption [26, 27]. Pressure to eat refers to parents' demands and insistence that the child eats more food, or a greater amount of healthy foods such as fruits and vegetables, and involves the use of strategies like demanding that the child cleans the plate, prompting the child to eat even in the absence of hunger, or even physically struggling with the child to force him/her to eat. On the other hand, food restriction typically denotes parental efforts to limit the child's consumption of foods, especially energy-dense palatable foods, by restricting the child's access to or by otherwise reducing the opportunities to consume such foods. The practice of restriction is typically thought to be carried out by the parent in a self-centered way, and through the use of an overtly authoritarian type of control.

However, besides pressure to eat and food restriction, a list of common specific feeding practices investigated in studies on child obesity-related eating behaviors could include rewarding the consumption of healthy food with desired objects and activities, rewarding positive behaviors with palatable food, directly modeling healthy or unhealthy eating behaviors in front of the child, as well as making certain types of food more or less easily available and accessible at home. Such a list, far from being exhaustive, is suffice to demonstrate the remarkable variety and conceptual heterogeneity existing among feeding practices. Consequently, there have been several attempts to classify and to cluster singular feeding practices into broader functionally homogeneous constructs or categories.

For instance, a very general categorization of feeding practices is based on the distinction between *responsive* and *nonresponsive* feeding practices [28]. Responsive feeding practices are those characterized by the parent's recognition of and respect for the child's cues of hunger

and satiety. On the contrary, nonresponsive feeding practices are characterized by a lack of reciprocity between the parent and child; this can take the shape of an excessive parental control of the feeding situation (especially by pressuring or restricting food consumption); alternatively, it can take the shape of an almost complete control of the feeding situation by the child. Such categorization closely matches the concepts of authoritative, authoritarian and indulgent styles presented in parenting styles and feeding styles typologies.

Another general categorization is based on the distinction between *controlling* feeding practices [29] and *instrumental* feeding practices. Controlling feeding practices are defined as those in which all the decisions regarding the kind, the quantity, the time and other aspects of child food consumption are seen to reflect unilateral choices made by the parent. Feeding practices like parental pressure to eat and food restriction are considered part of this category. On the other hand, instrumental feeding practices are defined as those parenting practices aimed at regulating either the behaviors or the emotions of the child by using food as a reward.

Recently, there have been efforts to map food parenting practices more systematically [30, 31]. In a recent contribution, Vaughn and colleagues [32] proposed a very articulated model, clustering several feeding practices into three general constructs named *Coercive control*, *structure*, and *autonomy promotion/support*. These constructs, as it will become evident later, recall and partially make reference to analogous parenting dimensions underlined by self-determination theory. The first construct, Coercive control, has been defined by the authors as characterized by parent-centered goals, parental dominance and determination to impose their will upon the child in the feeding domain. Coercive control comprises practices such as food restriction, pressure to eat, threats and bribes and using food to control negative emotions. On the other hand, structure has been defined as a type of parental control that involves the use of noncoercive parenting practices, aimed at fostering the child's competence in the feeding domain. Structure includes practices such as rules and limits setting about what and how much the child should eat, offering to the child limited or guided choice relative to food preferences, monitoring of the child's eating behavior and consumption of food, parental modeling of healthy eating behaviors, adequate availability and accessibility of healthy food at home; furthermore, a category named "unstructured practices" has also been considered part of the construct. Finally, the construct of autonomy promotion/support has been defined in terms of facilitating the child's independence around food and promoting the child's capacity to self-regulate and to autonomously conform to parental-endorsed norms relative to food consumption in the absence of the parent. Autonomy promotion comprises food parenting practices such as nutrition education, child involvement in food purchase and preparation, encouraging the child to consume healthy food, praising the child for healthy eating behavior, the use of reasoning to convince the child to adopt healthy eating habits and, finally, negotiation between parent and child about the amount and the kind of food to be consumed.

Regarding parenting influences on child physical activity and sedentary behavior, the role of several parenting practices such as encouraging the child to engage in physical activity and directly modeling an active lifestyle has been investigated in several studies [33–35].

A model for conceptually organizing parenting practices relative to the physical activity domain, partially overlapping to that presented by Vaughn et al. [32] in the feeding domain,

has been recently proposed by Mâsse et al. [36]. The model clusters physical activity-related parenting practices into three general constructs named *control/neglect*, *structure* and *autonomy support*. Control/neglect is conceived as a bipolar construct: it refers, on the one hand, to coercive parental attempts aimed at pushing or pressuring the child to engage in physical activity without any consideration for the child's interests and attitudes; on the other hand, it refers to an opposite parental attitude in which the parent neglects to structure the child's participation in physical activity and allows the child to reject physical activity and to indulge in sedentary behavior. The construct of autonomy support is defined in terms of attunement and sensitivity to the child's requests in order to foster the child's individuality and self-assertion. Autonomy support comprises practices such as encouraging the child to be physically active, especially by virtue of reasoning, guided choice of physical activities by providing different options and allowing negotiation, parent's involvement in the child's physical activity, by watching or otherwise showing interest; and praise and rewards to the child for being physically active. The construct of structure is described in terms of parental efforts to organize the child's environment in order to promote desired childrearing outcomes. Structure is seen as encompassing practices such as communicating clear expectations about the amount of physical activity that the child should engage in, facilitating the child's physical activity by providing occasions and material resources; monitoring the child's actual engagement in physical activity and directly modeling an active lifestyle in front of the child.

3. Self-determination theory as a framework for conceptualizing parenting influences on child obesity-related behaviors

A basic, although often implicit, conceptual premise common to most studies investigating parenting influences on child obesity-related behaviors is that children need to be motivated by their parents to engage in healthy eating and physical activity-related behaviors and to avoid unhealthy ones. Such implicit relevance of motivational processes seems to render self-determination theory particularly suitable as a framework for conceptualizing the role of parents in effectively motivating their children to establish healthy habits.

In fact, self-determination theory [9, 37] can be regarded as a general theory of human motivation that pivots upon the dichotomy between self-determined, volitional behaviors versus externally coerced or internally pressured behaviors. Another fundamental distinction made by the theory is that between intrinsically and extrinsically motivated behaviors. Intrinsically motivated behaviors are those which the person performs by their own sake, that is, for the interest, pleasure or satisfaction they provide; and as such they represent fully self-determined behaviors. On the other hand, extrinsically motivated behaviors are defined as those behaviors that are performed because they are perceived as instrumental to some separable consequence. Typically, the behaviors performed in order to conform to social norms (i.e., adopting a healthy pattern of eating and physical activity behavior) are extrinsically motivated. This does not mean that such behaviors must always be necessarily perceived by the person as coerced or pressured. According to self-determination theory, even such behaviors can become self-determined, by virtue of what is defined as a process of internalization.

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Internalization is conceptualized as proactive process, consisting of the progressive transformation of behaviors regulated by external contingencies (i.e., material rewards and punishments, praises and reproaches, etc.) into behavior regulated by internal processes (i.e., inherent interest or congruence with the person's values). The process of internalization is seen as fostered by the inherent motivation to integrate within the self externally regulated behaviors as long as they are perceived by the person as useful for an effective functioning in the social world.

Furthermore, according to self-determination theory, the process of internalization is facilitated by the fulfillment of three basic psychological needs: the need for autonomy, broadly defined in terms of perceiving to be the origin of one's own behaviors; the need for competence, broadly defined in terms of mastery over one's own environment and the need for relatedness, broadly defined in terms of experiencing an adequate amount of interpersonal contact, warmth and affection.

Therefore, to view parenting influences on children's obesity-related behaviors through the lenses of self-determination theory means to emphasize the role of parenting in promoting versus undermining children's self-regulation and internalization of healthy norms and behaviors in the feeding and physical activity domains. Self-determination theory offers a detailed conceptualization of such process of behavioral self-regulation and internalization of social norms and, furthermore, can provide a comprehensive model of the parenting behaviors that can facilitate the achievement of this objective and those that are likely to hinder it.

4. Parenting dimensions relevant to the child's internalization process in the light of self-determination theory

Conceptually developed along the lines of self-determination theory is a tripartite dimensional model of parenting [38, 39], based on the parenting dimensions of *autonomy support*, *provision of structure* and *parental involvement*. These parenting dimensions are supposed to be strongly connected to the three basic human psychological needs for autonomy, competence and relatedness, which are seen to facilitate the autonomous, integrated internalization of social norms and values by the child.

Autonomy support is characterized by the parents' transmission of social norms and demands to the child in ways that recognize the child's perspective and point of view, allows the child the possibility of making choices, encourage the child's participation in decisions and foster the child's initiative and independent problem solving. An autonomy supportive parenting style is thought to promote the child's internalization of behaviors and values by fostering his/her sense of autonomy. On the contrary, a *coercive* parenting style is characterized by the unilateral consideration of the parent's perspective, and by parental attempts to motivate their child's behaviors through the use of controlling threats and rewards, punitive disciplinary techniques, and/or various types of psychological pressure such as guilt induction or love withdrawal. Such a coercive style is thought to undermine the child's experience of

him/herself as an autonomous agent, and consequently, to hinder the child's autonomous internalization of parental norms and values.

Provision of structure conceptualized in terms of the parents' provision of clear and consistent guidelines, expectations and rules for the child's behaviors, in combination with clear feedback and consistent follow-through on contingencies. This condition is seen to facilitate the child's sense of competence in pursuing socially desired norms and behaviors. In particular, Farkas and Grolnick [40] identified several components of an adequate provision of structure, with specific reference to the school/academic domain. These components consist of the provision of (1) clear and consistent rules, guidelines and expectations relative to child's academic life; (2) opportunities to meet parental expectations; (3) predictability of consequences; (4) informational feedback on the child's performance; (5) provision of rationales for parental rules and requests and finally (5) parent's willingness to exert an adequate level of parental authority to enforce rules.

Finally, *parental positive involvement* is a construct which encompasses parental warmth and affection, but can be better conceptualized as the parent's degree of positive attention and dedication to the child and to foster its optimal development [41]. Positive involvement is reflected in parents who show interest in, are knowledgeable about, and take an active part in the child's life. Through those behaviors, positively involved parents are seen to provide emotional and as well as concrete resources to foster a sense of confidence and self-direction in the child. In this respect, positive involvement can be regarded as similar to the dimension of parental care in Parker's conceptualization of parental bonding and related parenting style typology [17, 18]. Furthermore, by satisfying the child's fundamental need for relatedness, positive involvement is hypothesized to facilitate the child's identification and autonomous internalization of social requests and values promoted by parents. It is important to note that, besides lack of involvement, inadequate forms of parental involvement have also been identified [42–45], and that such forms of involvement are likely to undermine the child's autonomous internalization of parental norms.

Finally, a fundamental point to underscore is that, according to self-determination theory, autonomy support and provision of structure are conceived as virtually independent parenting dimensions. Consequently, parents may provide an adequate structure either in an autonomy supportive or in a coercive and controlling way [40]. On the contrary, parental involvement seems to represent, at least in part, a precondition of both autonomy support and provision of adequate structure. In fact, autonomy supportive parenting behaviors (such as recognition of the child's perspective, providing options and allowing negotiation) are likely to require a greater amount of material, temporal and psychological resources than their coercive counterparts such as threats and bribes or psychological pressure. Similar considerations can be done regarding the resources necessary for an adequate provision of structure as compared to unstructured parenting behaviors (i.e., lack of consistent rule setting and follow-through, lack of monitoring).

5. Autonomy support versus coercion in the feeding and physical activity domains

According to a self-determination theory perspective, parental autonomy support is crucial to promote children's self-regulation and autonomous, integrated motivation in engaging in not

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intrinsically motivated healthy behaviors (such as consumption of fruit and other nutrient foods or engaging in some kind of physical activity) as well as in the determination to avoid unhealthy, obesity-inducing habits (such as junk food consumption and prolonged sedentary behavior).

Several feeding practices associated with child's healthy eating and physical activity behavior can be interpreted as autonomy supportive techniques through which parents can better promote the child's autonomous internalization of healthy norms regarding eating behavior and physical activity. For example, feeding practices such as allowing the child to choose among several healthy foods for a snack, or discussing and negotiating with the child food choices and preferences, could easily be located within the parenting dimension of autonomy support, as defined by self-determination theory.

The polar opposite of an autonomy supportive parenting is represented by coercive or controlling parenting, in which parents' efforts to socialize their children are based on external or internalized forms of coercion. Accordingly, in the specific feeding and physical activity domains, autonomy supportive feeding practices can be contrasted with *coercive or controlling parenting practices* such as parental pressure to eat healthy food and pressure to practice physical activity as well as forceful restriction of unhealthy food or forceful restriction of screen media use.

6. Provision of adequate structure versus lacking or inadequate structure in the feeding and physical activity domains

From a self-determination theory standpoint, parental provision of structure in the feeding and physical activity domains is crucial to promote children's competence in self-regulating eating and physical activity-related behaviors, in conforming to parental norms and engaging in healthy habits. This, in turn, represents a facilitating condition for the child's development of an integrated, autonomous motivation to adopt healthy and to avoid obesity-related eating and physical activity behavior.

The importance of parental provision of structure has been increasingly acknowledged as a pivotal construct especially in the literature on feeding practices [30–32]. Anyway, in such literature, the concept of structure appears to be not fully recognized as a bipolar construct, not clearly contrasting adequate with inadequate provision of structure. Instead, it seems more useful to view parental structure both in the feeding domain and in the physical activity domain as a bipolar construct characterized by effective versus lacking or ineffective practices through which such structure is provided.

The same components identified by Farkas and Grolnick [40], applied to the feeding and physical activity domains, may represent a useful template to organize different food parenting practice and physical activity parenting practices explored in the literature in a meaningful conceptual pattern, distinguishing those practices that contribute to an adequate provision of structure from those which represent a lacking or inadequate structure.

In the feeding domain, parental provision of clear and consistent rules about the kind and the quantity of foods that that child is allowed to eat represents an obvious instance of adequate provision of structure; but also feeding practices such as the use explicit didactic techniques to

encourage consumption of healthy foods or the direct modeling of healthy eating behavior by the parents should be assigned to this parenting dimension. Correspondingly, in the physical activity domain, clear and consistent rules and expectations about physical activity, and the use of television and other screen media, including limitations regarding their accessibility, can be regarded as prototypical instances of adequate provision of structure.

On the contrary, absent or inconsistent rules about food consumption and screen media use, the modeling of unhealthy eating and sedentary behavior and the availability and accessibility of unhealthy food and screen media in the house represent instances of inadequate parental structure in the feeding and physical activity domains.

7. Positive involvement versus lacking or inadequate involvement in the feeding and physical activity domains

The last parenting dimension underlined by self-determination theory authors, parental positive involvement (versus lacking or inadequate involvement), appears to be the least considered and explored in studies investigating parental influences on child obesity-related behaviors. Instead, parental positive involvement, both in general and in the specific feeding and physical activity domains, can be viewed as the most fundamental prerequisite of a health-promoting and obesity-protecting parenting style. In fact, positive involvement can be regarded as a precondition both for an effective autonomy supportive style and for an effective provision of structure suitable for facilitating autonomous self-regulation and the internalization of norms relative to healthy eating and physical activity-related habits in children.

In this regard, feeding practices such as eating meals together as a family as well as asking the child to help in preparing food or engaging the child in food purchasing and in selecting healthy foods can be regarded as typical instances of parental positive involvement in the feeding domain. Similarly, parenting practices such as showing interest for the child's physical activity, providing practical and emotional support and co-participating can be regarded as prototypical manifestations of parental positive involvement in the physical activity domain.

Besides, some of the parenting practices contributing to promote child's healthy eating behavior, such as availability of healthy foods, usually placed in the parenting dimension of structure [30–32], could better be reframed in terms of parental positive involvement in the feeding domain. Similar considerations can be made regarding parental provision of opportunities and material resources to the child to engage in some kind of sport or physical activity [36]. The aforementioned practices, in the light of self-determination theory, are clearly suitable to convey to the child the parent's interest and positive involvement, thus fostering the child's sense of relatedness and facilitating the autonomous internalization of the healthy habits endorsed by the parents.

On the contrary, parental lack of positive involvement in the feeding and physical activity domains can be characterized in terms of the absence of the aforementioned parenting practices and resources. Besides, even specific negative parenting practices such as parents' use of unhealthy food (i.e., sweets) or allowance of prolonged screen media time to regulate children's

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negative emotions could be interpreted as a lack of positive involvement, in the form of a negative, rejecting-neglectful parenting, in that parents resort to tasty food or screen media time to compensate for the lack of emotional support and emotional coaching to the child.

Lack of involvement or inadequate involvement can undermine parental efforts to transmit healthy dietary and physical activity-related norms and behaviors to the child even in the presence of a sufficient autonomy supportive parenting style and of an adequate provision of structure.

8. Conclusion(s)

Many efforts have been dedicated to develop comprehensive models of parenting influences on child obesity-related behaviors. Self-determination theory can provide a conceptual framework specifically designed to account for the motivational processes implicated in the child's internalization of healthy behaviors and values in the feeding and physical activity domains. Furthermore, it can provide a parenting model especially suitable for conceptualizing parenting influences on children's obesity-related behaviors in the feeding and physical activity domains, and for organizing several food parenting practices and physical activity parenting practices in a powerful and comprehensive conceptual structure. From a self-determination theory perspective, an optimal parenting style in a specific domain is characterized by the simultaneous presence of autonomy support, adequate provision of structure and positive parental involvement. Similarly, optimal parenting practices in the feeding and physical activity domains can be described as those which convey autonomy support, adequate structure and positive involvement, fostering the child's autonomous internalization of healthy eating and physical activity behaviors. The focus on the parenting dimension of positive involvement versus absent or inadequate involvement provided by self-determination theory appears to be especially meaningful since the crucial role of such parenting dimension appears to be rarely considered in contemporary models of food and physical activity-related parenting practices.

Conflict of interest

The authors declare no conflicts of interest.

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Epidemiological studies show that weight loss has many health benefits, so different strategies have been explored to lose weight, with health and esthetic reasons being the base of those strategies. Weight loss may be the result of pathologies, so both intentional and unintentional weight loss are different situations, each being a relevant focus of study. Along with that distinction, gender and ethnic topics are also relevant aspects, and different chapters of this book are related to male vs. female topics as well as to cultural differences related to weight loss. Childhood obesity from a parenting style perspective is also developed in this book. Finally, it must be noted that activity is essential to improve body composition and also to keep an ideal weight.

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