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FROM FOOD ADDICTION TO MOTIVATION IN WEIGHT MANAGEMENT:

new perspectives in the tratment of obesity

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To Alessandro the love of my life for his endless and caring support, hope and motivation. Forever grateful.

To mother for sparing me after my famous phrase “Ma, if I’ll still be studying after Psychotherapy school, tear me down!”

To my dedication to Clinical Psychology… second love of my life.

Chapter 1: General Introduction

1.1 From disordered eating to Food Addiction (FA)

The first researcher who observed some aspecific eating behaviour towards one or more regularly consumed foods to which some individuals were highly sensitive, was Randolph in 1956. He recognised that some food is able to originate pattern of symptoms which are very similar to those descriptive of other addictive processes. In particular, he explained that the consumption of corn, wheat, coffee, milk, eggs, and potatoes could favour addictive eating (Randolph, 1956). Since these early days, the power of the addictive properties of food has been developed. Nonetheless, it is only in the last decade that the construct of 'food addiction' (FA) has been introduced to describe anomalous eating patterns mainly among obese and overweight individuals (Fortuna, 2012; Gearhardt et al., 2009; Davis and Carter, 2009).

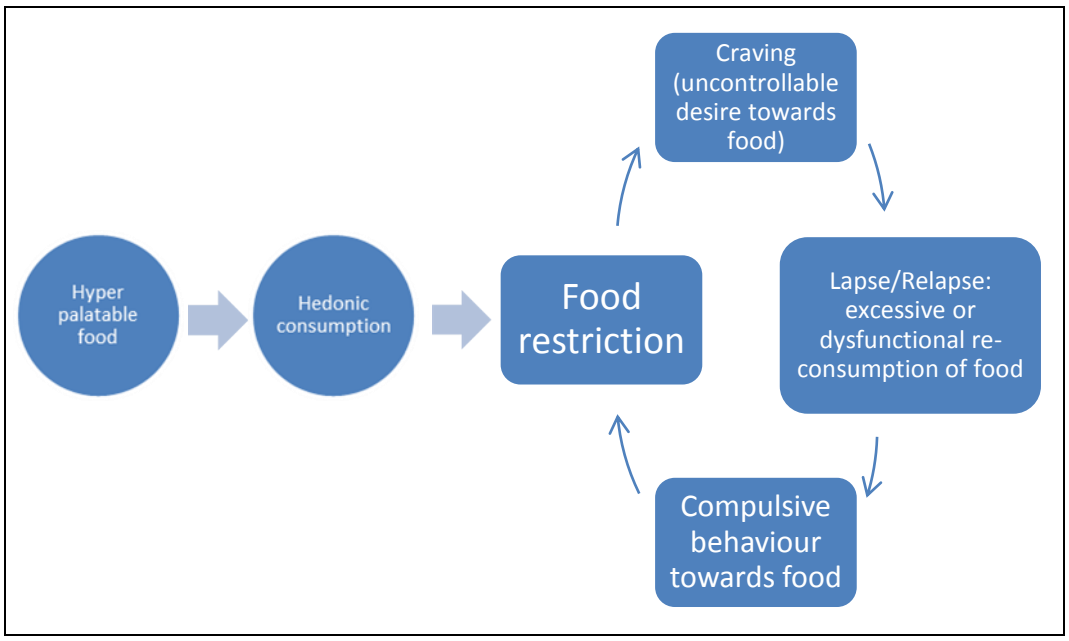
Up to date, there is growing evidence suggesting that some eating psychopathologies, especially binge eating-related disorders such as bulimia nervosa (BN), binge eating disorder (BED) and obesity, resemble classic addiction in both behavioural symptomatology and neurochemical changes (Volkow et al.,2008; Davis and Carter, 2009; Gearhardt et al., 2009; Pelchat, 2009). In fact, a large body of literature has documented through humans and animals studies a parallel trend between addictive behaviours, obesity and BED in particular (Gearhardt et al., 2009 and 2012).

From this food addiction model, it is possible to reconsider a more peculiar classification of obesity and binge eating disorder (BED) by taking into account a more complex concept of pathological eating and its compulsive relation towards food. Food addiction, which is more luckily to be elicited by some specific types food (i.e.: hyper-palatable food, high in sugar and/or fat), can be described the same way as other addictive behaviours. Over time, food, just like drugs, can induce tolerance (as increasing amounts are needed to reach and maintain intoxication or satiety), withdrawal symptoms (such as distress and dysphoria upon food intake discontinuation or dieting) and a high incidence of relapse. These symptoms in relation to food are to a remarkable extent those described in the *Diagnostic and Statistical Manual of Mental*

Disorders (DSM-V, Apa, 0214) for substance dependence, which has led research to suggest that food addiction should be considered a psychiatric illness (Taylor et al., 2009).

The addictive cycle of food could be summarised as in Fig. 1 below:

Fig. 1: The addictive cycle of food (adapted from Melchionda, 2014):



In this respect, food addiction symptomatology has become a clearly observable and measurable construct, as research using the Yale Food Addiction Scale (YFAS) questionnaire demonstrates (Gearhardt et al., 2009 and 2012; Innamorati et al., 2014). The scale is able to detect and discriminate between individuals with and without addictive eating patterns according to the DSM-V-TR substance dependence criteria (Apa, 2004). While some argue that only a small proportion of individuals could be described as food addicted (Rogers, 2011), many researchers agree that food addiction is not a rare phenomenon and that it implicates a compulsive pattern in the use of food, even in the face of negative health and social consequences.

Despite continuously rising proofs regarding the existence of food-addicted obese individuals, the food addiction debate is still opened. According to Kuhn, a scientific paradigm is a "universally recognized scientific achievements that, for a time, provide model problems and solutions for a community of practitioners" (Khun, 1996,

page 10). Within the clinical psychology practice, working with a food-addicted obese requires a substantially different paradigm than working with other eating disordered patients. When facing food addicted patients, the main focus is to deal with their addictive relationship with food. Thus, within the context of weight-loss specific treatments, interventions should aim at developing first, and later maintaining, an adaptive and functional relationship with food, with no subsequent re-establishment of an addictive cycle characterising food addiction. In this respect, the food addiction paradigm is still under construction. Its development and widespread consensus from the greater scientific community appears to be necessary and impellent, as the impact of food addiction with regard to new treatment approaches for obesity must be considered. This need not only emerges in the recent literature on obesity but also in the empirical studies outlined in this dissertation.

1.2 Incidence and aetiology of Obesity and Food Addiction (FA)

Worldwide obesity has nearly doubled since 1980. In 2008, more than 1.4 billion adults, 20 and older, were overweight; of these over 200 million men and nearly 300 million women were obese. Moreover, 35% of adults aged 20 and over were overweight in 2008, 11% were obese and 65% of the world's population live in countries where overweight and obesity kill more people than underweight. Overweight and obesity are leading risks for global deaths. Around 3.4 million adults die each year as a result of being overweight or obese. In addition, 44% of the diabetes burden, 23% of the ischaemic heart disease burden and between 7% and 41% of certain cancer burdens are attributable to overweight and obesity. Additionally, more than 40 million children under the age of 5 were overweight or obese in 2012 (WHO, 2014). While overweight and obesity were first considered a problem pertaining to high-income country, they are nowadays worldwide spread, and are therefore a global epidemic renowned as 'Globesity' (Wadden et al., 2002).

Generally, there has been an increased intake of energy-dense foods high in fat as well as an increase in physical inactivity due to the sedentary nature of many forms of work, changing means of transport, and growing urbanization. The main causes of

obesity and overweight are an energy imbalance between calories consumed and those which are expended (Wadden et al, 2002). Dietary changes and diminished physical activity are often the result of socio-environmental modifications associated with the lack of supportive policies within several sectors such as health, agriculture, transport, urban planning, environment, food processing, distribution, marketing and education (WHO, 2014).

In Italy, 33.1% of the population is overweight (41% of men and 25.7% of women) and 9.7% are obese. Although recent data are slightly encouraging, the incidence of overweight and obesity, especially in children, is still high. The phenomenon is more prevalent in Southern Italy (in Abruzzo, Molise, Campania, Puglia and Basilicata it covers more than 40% of the investigated sample involving 46,492 children), where eating patterns and poor perception of the problem play an important role. Additionally, in 2012, 22.1% of children aged 8-9 years were overweight compared to 23.2% in 2008-09 (-1.1%) and 10.2% were obese, compared to 12% of 2008-09 (- 1.8%), (ISTAT, 2012).

The data in the large Italian survey conducted in 2012, showed that 31% of the adult population surveyed (aged 18-69 years) was overweight and 10 % obese. A condition that seems to increase with age and it is more common in men, in people with lower educational level and among those who were more economically disadvantaged. The study highlights a preoccupying lack of awareness in the perception of being overweight: over 50% of the overweight sample believed that their weight was approximately right, a figure that drops down to 9% for what concerns the obese in the study (ISTAT, 2012).

For what concerns food addiction, there is increasing evidence suggesting that binge eating-related disorders are linked to addiction-like eating patterns due to the addictive potential of hyper-palatable foods (Blundell et al., 2014). The prevalence of food addiction is increased in obese individuals and even more so in obese patients with binge eating disorder, however, studies on the prevalence of food addiction are still rare and some are only descriptive (Meule, 2011). According to Melchionda (2014), in Italy there is no census on the prevalence of addictive disordered eating within the obese and overweight population, and no data which could help determining the real impact of food addiction in the county. This is due to the fact that the individual affected by

obesity and food addiction is treated by different structures: on one hand the centres for eating disorders and obesity and the addiction centres on the other.

The only Italian study evaluating the presence of food addiction in Italy is that conducted by Innamorati et al. (2014). Their research examined a sample of 300 obese/overweight patients attending low-energy diet therapy and 300 subjects from the greater population, using an Italian version of the Yale Food Addiction Scale (YFAS) questionnaire. Results showed that 21% of the obese/overweight sample displayed food addiction symptoms, against 1, 7% of the normal population. From this study it possible not only to detect the prevalence of food addiction (FA), but also the need to gather more research assessing addictive eating and its incidence as well as the FA construct in lower-weight classes. Nonetheless, standardized self-report measures such as the YFAS are definitely a very encouraging instrument for gathering more scientific evidence and a more in depth insight contributing to the understanding and investigation of the food addiction construct (Meule, 2011).

1.3 The treatment of Obesity and FA: Motivation in weight management

Recent studies show that alterations of cognitive functioning in both obesity and addictive disorders can possibly contribute to a lack of control in resisting consumption (Grosshans et al., 2011). The evidence that similarities between certain aspects of obesity and addictive disorders on a phenomenological and neurobiological level can be found, introduces new treatment possibilities. In this respect, treatment addressing obesity and FA should originate from a more careful reflection of obesity comparing certain aspects of addictive behaviour.

In the past decades the development of evidence-based psychological support for addictive disorders achieved a significant progress, even when applied to obesity (Pietrabissa et al., 2012). Interventions are mainly directed towards the enhancement of motivation to reach abstinence and the development of coping strategies to successfully deal with high-risk relapse situations. Motivational approaches are based on helping the patient carefully consider positive and negative consequences of his or her dysfunctional eating behaviour and to build up motivation for abstinence. Especially

when confronted with a more severe form of obesity such as the one associated with food addiction, mere knowledge healthy nutrition and dietary standard prescriptions along with regular physical activity programmes are not enough to reach and maintain a an optimal body weight.

The Transtheoretical Model (TTM), (Prochaska and Di Clemente, 1982) of behaviour change is currently one of the most promising models in terms of understanding and promoting behaviour change related to the acquisition of healthy living habits (Wilson and Schlam, 2004). This model integrates emotional, cognitive and behavioural processes, as well as principles of change from the main theories of psychotherapy, clinical and health psychology and has proven to be a useful basis for evaluating and monitoring change (Andres et al., 2007). Thus, if motivation to change seems to obtain interesting results within the field of classic addiction, it could be applied for tailoring interventions on obese food addicted patients. Addressing their motivational level towards excessive and compulsive eating cessation could not only help their full recovery but also the prevention of dropouts which often occur in the context of weight management (Seals, 2007).

In particular, motivation should be assessed for those who face the difficult task to maintain weight, which implies a double challenge: weight loss initially and its maintenance subsequently. In fact, weight control may be as problematic as smoking or drugs-taking cessation, since they share the commonality of being all highly refractory to change behaviours. Hence, assessing motivation and readiness to change may be a crucial step in promptly identifying psychological obstacles or resistance towards weight management in obese individuals with or without food addiction, since it may contribute to provide a more effective weight-control treatment intervention, especially in the long run.

There are many instruments which are able to effectively detect readiness to change in accordance with the Transtheoretical Model (TTM) of behaviour change. They focus on weight loss and weight maintenance and already demonstrated to be sound and valid (Rossi et al., 1995). Weight-management readiness to change is characterised by distinct psychological processes and stages of change reflecting the modification of a dysfunctional eating behaviours. However, research on the processes of change which underlie motivation towards behavioural changes in weight-loss has

not been fully developed yet. In Italy, motivational psychometric assessments mainly evaluate the 'stages of change' of the TTM, which focus on when people change, particularly in the field of classic addictions (Spiller and Guelfi, 1998; Guelfi et al, 1999; Spiller et al., 2006).

Nevertheless, up to date, there is no Italian tool which specifically assesses motivation to change in weight management accounting for both TTM 'stages of change' as well as 'processes of change', which refer to how people change and consist of overt and covert activities that individuals engage in when they attempt to modify problematic behaviours. A tool of such kind, especially if applied to obese food-addicted engaged in specific hospital treatment programmes, could be of great support in tailoring *ad hoc* interventions addressing both the obesity and the FA problem.

1.4 Research context and rationale

Weight-loss maintenance, particularly after weight-loss specific treatments, represents for the obese individuals the greatest challenge. However, empirical research demonstrated that the majority of obese subjects, who managed to lose weight during hospital-based interventions, go back to their original weight in three to five years after treatment (Castelnuovo et al., 2010). One of the causes which contribute towards the unsuccessful outcome in weight-loss maintenance of obese in-patients and in the greater population as well is the existence of food addiction topping up the obesity problem. Recent research indicates similarities between obesity and addictive disorders on both the phenomenological and neurobiological level.

Studies on interventions regarding obese food-addicted patients who are unable to lose a significant amount of weight or are at risk of re-lapsing into addictive eating should be further developed. Food addiction implicates forces driving food consumption which are beyond physiologic hunger since palatable foods may produce pleasure and reduce grief, similarly to other addictive substances. Furthermore, it must be considered that addictive eating is commonly used as a self-medication method in response to negative emotional states, depression, anxiety, loneliness, boredom, anger and interpersonal conflict (Taylor et al., 2009).

Certainly, a pattern of persistent weight gain can be interrupted not only by encouraging weight maintenance but also by directly tackling the food addiction condition. In order to gain the necessary expertise to effectively handle obese food addicted patients, this doctoral dissertation represents an effort to provide an important contribution towards the definition and understanding of the food addiction model. Moreover, this work assesses the prevalence of food addiction and the psychometric properties of an Italian version of the Yale Food Addiction Scale (YFAS), (Innamorati et al., 2014), in a sample of obese patients attending a hospital-based treatment for weight loss and related co-morbidities at the Saint Joseph Hospital of the Istituto Auxologico Italian.

When addressing obesity and food addiction at the clinical treatment level, particular attention should be given to personal motivation to change as it plays a fundamental role in modifying unhealthy eating patterns and related dysfunctional lifestyles. In addition, the dissertation investigates in depth the relationship between stages and processes of change in weight management, providing the Italian validation of two questionnaires in line with the Transtheoretical Model (TTM), respectively the S-Weight and P-Weight, designed to assess both aspects of behaviour change. The possibility to detect the level of FA using the Italian version of the YFAS and to evaluate readiness to change in weight management could give a substantial contribution to the multidisciplinary teams operating in the field of obesity and addictive eating.

1.5 Dissertation outline and objectives

This dissertation has five main goals:

1) To provide a theoretical model of Food Addiction (FA) associated with obesity.
2) To investigate the prevalence of Food Addiction in a sample of obese in-patients using the Italian version of the Yale Food Addiction Scale (Innamorati et al., 2014) and to evaluate the psychometric properties of the scale.

3) To validate in Italy two set of questionnaires, namely the S-Weight and P-Weight, measuring motivation in weight management following the stages of chance and processes of change according to the Transtheoretical Model (TTM).
4) To recommend new treatment perspectives considering the existence of morbid obesity associated with food addiction as important suggestions may come from the clinical and practical approaches and strategies used in the treatment of classic substance-related disorders (i.e.: motivation to change according to the TTM).

In Chapter 2, the role of Clinical Psychology in the field of addictions will be outlined, starting from the definition of addiction versus food addiction and the description of the overlapping areas which characterise both conditions. Moreover, an in depth analysis of food addiction from a psycho-somatic perspective will be offered as well as the explanation of psychological and biological aspects of addiction and food addiction. Also, the role of environmental triggers for obesity and food addiction will be highlighted. Lastly, the chapter will outline the current state of the art in terms of specific assessment and research on food addiction.

In Chapter 3 the literature regarding obesity and food addiction will be presented, paying particular attention to research on food addiction and psychological functioning. The quantitative research regarding an evaluation of the Italian version of the Yale Food Addiction Scale (YFAS) on obese adult inpatients will also be presented in this chapter. In Chapter 4, there will be a focus on the literature which takes into account motivation to change in weight management according to the Transtheoretical Model (TTM) of change. Additionally, an Italian translation and Validation study of the S-Weight and the P-Weight questionnaires assessing weight readiness to change according to the Transtheoretical Model will be presented.

In Chapter 5, literature regarding possible treatment interventions of morbid obesity associated with food addiction will be portrayed. The chapter will provide relevant suggestions on the best possible clinical practice and intervention when dealing with obese subjects who are also affected by food addiction. These considerations represent a link between what emerges from the empirical evidence previously outlined in both chapters 2 and 3, and what has been described in the theoretical framework and literature illustrated in the first and final chapters.

Finally in Chapter 6, the final discussions and conclusions will be presented. The main areas which constitute the food-addiction model will be utilised as a framework to present implications for the psychological handling of food-addicted obese patients which emerged from both the literature taken into consideration and the empirical studies presented.

In summary, the following questions have served as guidelines when carrying out this doctoral dissertation:

1. Does food addiction (FA) exist?
2. What are the consequences of food addiction associated with morbid obesity?
3. What measurements should be considered in assessing FA?
4. If FA is another form of addiction, should we consider readiness to change as described by the Transtheoretical Model (TTM) in evaluating food-addicted patients?
5. How do we specifically assess motivation to change related to weight management?
6. And finally, can the lesson be learnt from classic addiction treatments to give a valid contribution in the handling of obese food-addicted patients in a clinical setting?

Chapter 2: Clinical Psychology of addiction and food addiction

2.1 The Clinical Psychology of addictions

According to the definition proposed by the authoritative dictionary Merriam-Webster of the English language, the term 'addiction' refers to an uncontrollable need for, and a compulsive use of a substance which causes addiction (for example heroin, nicotine, alcohol etc.), characterized by tolerance and by physiological well-defined withdrawal symptoms when not taking the substance itself (APA, 2013). The consistent and repeated use of a specific substance gradually becomes more and more persistent and impellent, although addicted individuals are often aware of the disadvantages and damages that this consumption can cause. In fact, substance dependence implies some peculiar characteristics such as: the growing needs of the addicted individual to retake the substance, which over time leads to an overwhelming habit, the intense physical and psychological suffering when withdrawing from that substance and finally the individual's will to sacrifice anything for that substance (Peele, 1998).

The American Psychiatric Association (APA, DSM-IV-TR, 2004) and the international scientific community agreed that it is possible to diagnose a substance dependency when the substance has been used for at least twelve consecutive months and it involves three or more of the following symptoms:

1) Tolerance: the need to progressively increase the amount of substance taken in order to obtain the same effects, that is to say, a significant reduction of the substance direct effects compared to those given from previous habitual consumption.

2) Abstinence: a clinically significant distress due to the reduction or suspension of the substance used.

3) Loss of control: the substance is taken in amounts and for periods of time larger than intended, hence, its use is totally outside of the control of the addicted individual.

4) Ineffective attempts to control use: the addicted individual wishes to persistently stop or control substance use but he/she is unable to.

5) Concern: the person is continuously engaged in activities related to the substance procurement or its consumption.

6) Activity reduction: all social activities, work, leisure and professional or familiar duties are overshadowed by activities related to the substance use, which becomes the individual's main interest.
7) Adverse consequences: substance use is continued despite the onset of serious physical and psychological problems directly and indirectly caused by its persistent use.
All of the above symptoms cause clinically significant distress or impairment of social, occupational, or other important areas (APA, 2004).

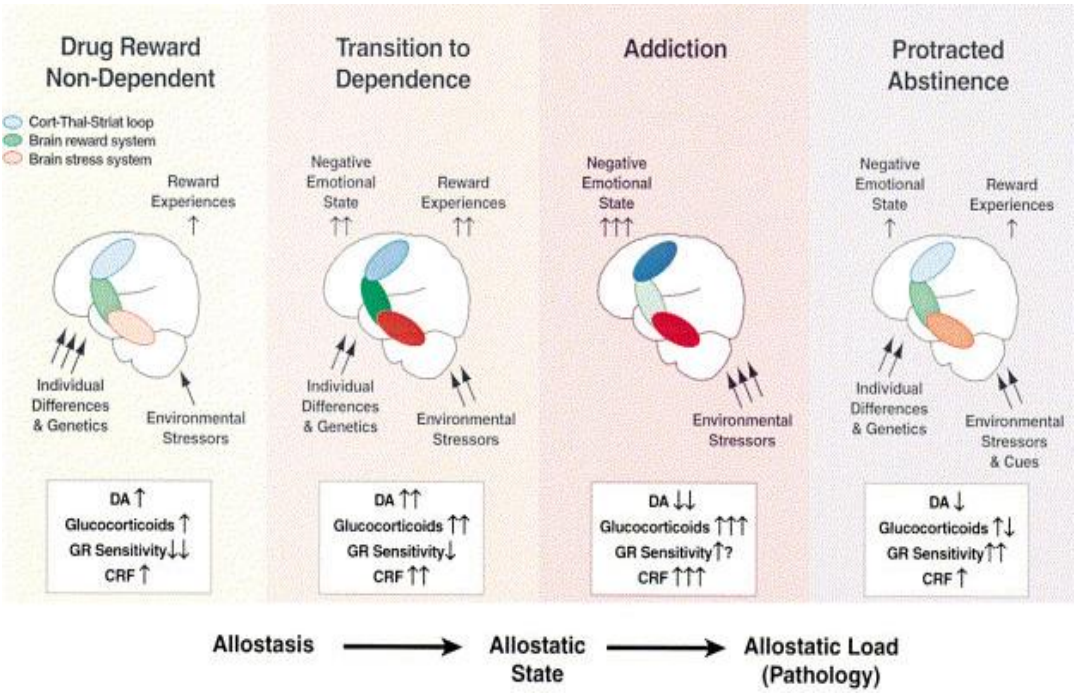
In the fifth and latest edition of the *Diagnostic and Statistical Manual of Mental Disorders* (DSM-V), the revised chapter of "Substance-Related and Addictive Disorders" includes substantive changes to the disorders and criteria of such conditions. Substance use disorder in DSM-5 combines the DSM-IV categories of substance abuse and substance dependence into a single disorder measured on a continuum from mild to severe. Each specific substance (for the exception of caffeine), is addressed as a separate use disorder although most substances are diagnosed based on the same criteria. A great difference with respect to the DSM-IV is that a diagnosis of substance abuse previously required the presence of only one symptom. In DSM-V, mild substance use disorder requires two to three symptoms from a list of eleven. Substance craving is included in the list, while problems with law enforcement are eliminated because of cultural considerations that make the criteria difficult to apply internationally (APA, 2013).

In this respect, the concept of 'dependence', traditionally used to describe physical dependence referring to the adaptations as a result of withdrawal symptoms when substances are discontinued, takes a new perspective. In fact, the adaptation processes associated with substance withdrawal is now considered to be intertwined with those that result in addiction, which refers to the loss of control over the intense urges to take the drug even at the expense of adverse consequences. In DSM-V it is rather clear how those who suffer from addictions are the mercy of the so-called 'craving', a very strong and compelling desire to take the drug, desire that, if not satisfied in the short term, can definitely cause extreme distress and severe psychological consequences. In fact, abrupt substance cessation results into subsequent intense mental and/or physical suffering, obsessive thinking (about the substance mainly), changes in the sense of hunger and thirst, irritability, anxiety, insomnia,

depression and, in severe cases, marked feelings of derealisation and depersonalization. The addicted individual would do anything to give into craving, to seek damage-avoidance caused by not taking the substance, and to re-encounter that pleasant and intense experience that can offer immediate gratification when using the substance again (Cloninger et al., 2000).

We can therefore talk about addictive disorders when, the interaction between an individual and his/her environment is affected by a specific behavioral and cognitive structure, characterized by a well-defined psychological functioning. First of all, addictions cause compulsive craving with neural changes in the brain at both functional and structural level, particularly regarding homeostatic and allostatic modifications as depicted by the following diagram extracted from Koob and Le Moal (2001), describing the relationship between the continuum from allostasis to pathology and the transition from substance-taking to addiction and to protracted abstinence:

Fig. 2: The continuum from allostasis to pathological addiction (adapted from Koob and Le Moal, 2001).



KEY:

DA = dopamine; **CRF** = corticotropin-releasing factor; **GR** = glucocorticoid receptor

The previous diagram (Fig. 2), explains how changes and influences contributing to the allostatic state in the brain reward system involve three main brain circuits, namely the reward system (in green), the stress systems (in red), and the cortico-thalamic-striatal (CTS) loop (in blue). Allostasis is the process of achieving stability through change while an allostatic state represents a chronic deviation of the regulatory system from its normal (homeostatic), operating level. An allostatic load is the immediate cost of the previously mentioned deviation affecting the brain and the whole organism. The allostatic load accumulates over time, and in many cases, it reflects pathological states and damage accumulation (Koob and Le Moal, 2001).

A non-addicted individual's brain is only slightly influenced by environmental stressors, reward experiences are standard level and the brain stress system and CTS loop are not activated. During the transition to the dependence state, all three circuits are engaged and in the state known as 'addiction', the brain reward system is greatly under-activated while both the brain stress system and the CTS loop are highly activated. Protracted abstinence is characterized by a return towards a standard 'baseline' state though with residual brain activation of stress systems and residual under-activation of the reward system. Moreover, if the hypothalamic pituitary adrenal axis is activated, this mechanism determines a significant modification in the brain stress axis generating the allostatic state of addiction (Koob and Le Moal, 2001).

Furthermore, addiction implies a certain level of 'mourning' regarding the loss of the substance, hence a great sacrifice when quitting. Such renunciation causes an altered affective state as well as a marked discontinuity of the whole self (of the sense of personal history and personal identity), with oscillations between feelings of hyper self-evaluations and feelings of being worthless (Caretti et al., 2008).

2.2 Definition of addiction versus food addiction

According to recent theoretical models and scientific research, addiction can appear in many different forms (Shaffer et al., 2004) and even express itself through excessive eating behavior (overeating), a dysfunctional and widespread behavior in modern society. Obesity and overeating can therefore be considered as syndromes

characterised by diagnostic criterion modeled on substance addiction (James et al., 2004; Volkow and O'Brien, 2007). In particular, binge eating disorder (BED), consisting of an uncontrolled consumption of large amounts of food in a limited period of time, might suggest the existence of a certain overeating disorder or 'food addiction' (Schag et al., 2013).

A recent meta-analytical study carried out by Schag and colleagues (2013), shows that impulsivity towards food is a major risk factor in those suffering from binge eating disorder and it results into a greater food consumption which may lead towards the increase of body mass index (BMI), especially in obese adults. In fact, individuals diagnosed with binge eating disorder (BED), form a specific subgroup within the obese population, characterized by a greater impulsivity level. The latter is to be associated with a high reward-dependence aimed at obtaining reinforcing stimuli, that is to say a certain 'sensitivity to reward', given by food consumption itself, along with a high tendency to act rashly and without considering later consequences, thus showing an uninhibited behavior and a significant loss of self-control (Schag et al., 2013).

Those who suffer from binge eating disorder perceive food as being highly rewarding, they experience craving when abstaining from food, in other words, they face an overwhelming desire to take the substance (food), and display a polarization of attentive processes towards it. Schag and colleagues (2013), also evidence the existence of obese subjects who eat in an excessively uncontrolled manner, and are characterized by a greater sensitivity to reward compared to both other obese without BED and to normal weight individuals (Schag et al., 2013). In addition, Avena et al., (2011 and 2012), showed that the principal cause of obesity and food addiction is the high availability of palatable food (high in sugar and/or fat). These authors also highlighted the use of food to soothe negative emotions and the alteration of mechanisms which regulate the sense of hunger and satiety as well as neurochemical circuits related to the obesity and food addiction condition.

Obesity associated with BED appears to be the condition which mostly reflects the phenomenological dynamics of classic addiction. More specifically, people suffering from binge eating disorder tend to describe themselves as 'food-dependent', they experience a significant impairment as a result of their bingeing, though they continue overeating despite being aware of the medical problems associated with such

dysfunctional behaviour. Craving is another key feature found in individuals suffering from uncontrolled eating behaviour, as they show a greater desire towards food than those without such disordered condition (Avena et al., 2011 and 2012). Although food, unlike drugs and alcohol, is necessary for survival and it is impossible to abstain from, the physiological and psychological characteristics of food dependence such as tolerance, withdrawal symptoms and craving, it can be associated with the loss of control that obese people with BED experience when they overeat and binge, a feature that is very similar to that observed in subjects with classic substance use disorders.

2.3 The psycho-somatic aspect of food addiction

The World Health Organization (WHO, 1998) classifies obesity as an endocrine, nutritional and metabolic disorder. From the clinical perspective, obesity is intertwined with some peculiar psychological variables within individuals who are affected by it, so strictly that it can take on characteristics which are typical of a psychosomatic syndrome *per se*. In fact, the International Classification of Diseases (ICD 10) describes morbid obesity as a 'psychogenic' disease, a condition which is profoundly related to pathological 'overeating' responsive to one or more stress factors (reactive obesity). Psychogenic obesity is therefore framed within the Eating Disorders classifications (ED), since its primary causes are of psychological nature and not due to medical conditions closely related to endocrine, metabolic or genetic factors (WHO, 1992).

In this context, the relationship with food is a relationship of dependence as well as ambivalence. Food is considered to be crucial because it can reassure and 'feed' not only nutritionally speaking but also in terms of self-esteem. Thus, eating serves to fill in a gap, to protect, to hide from difficulties or to reward oneself but, at the same time, it serves as a severe self-destructive behaviour. The personality of patients with this type of obesity generally implies low self-esteem and a highly compromised image of the whole self (Simon et al., 2006).

This psychosomatic hypothesis recognizes, in fact, that many obese people, in an attempt to cope with their emotional arousal, consume food in response to anxiety. Such eating behaviour has a positive immediate impact on one hand, but it promotes the

establishment of a vicious circle on the other, as weight gain leads to great dissatisfaction with the sense of self-identity and with personal body-image, leading to more feelings of inadequacy, sadness and grief (Lee and Shapiro, 2003).

In the clinical setting, one of the main problems encountered by obese patients is of course weight loss, however, treatments such as bariatric surgery which these individuals often undergo, are unsuccessful in the long run in half of such cases. This is due to the fact that already a few months after gastric bypass surgery, individuals return to consume large amounts of food and gradually increase their body weight, returning to the original weight in most cases. In this respect, surgery represents a somewhat over simplistic management of this eating psychopathology and it is not a definite and functional resolution of the problem, especially if we take into consideration the complexity of a disease like obesity and particularly when it is associated with a more severe condition represented by the presence of food addiction (Buchwald et al. 2004).

It is clear that food addiction is a complex matter for which there is neither simple cause nor simple solution. Food dependence is a serious eating disorder characterised by a dysfunctional and unhealthy relationship with nutrition; it is a no-win situation of disordered eating, which originates a strong sense of hopelessness and lack of self-control. This condition brings on an impellent desire to eat more and more food in order to numb uncomfortable feelings and negative emotional states. The amount and types of food eaten and the way in which such unhealthy eating occurs is variable from person to person. Some individuals reach a fast food restaurant and later eat ‘privately’ in their car, others are night-eaters and will get up to eat when no one can see them nor criticize their conduct, while others accumulate and hide food to consume it whenever a good opportunity comes along (Hill, 2012).

Thus, the decision to binge is not at all conscious for the food-addicted. They experience a major daily struggle and this is why many weight-loss surgery patients go back to their eating disorder after their medical operation. In fact, about 70% of those who undergo bariatric surgery re-encounter their food trouble just as before surgery. Though a reduced stomach and/or re-routed intestines could help controlling dysfunctional eating behaviour, the risk of compulsive eating, overeating or food obsessing thoughts are still present after surgery.

Those who use food in an addictive way have excessive preoccupations towards food; they may binge by eating as much as possible in a very short period of time or eat more than normal during the day and never a large quantity at one go, but still have an unhealthy relationship with food (Jay, 2006). The following table (table 1), summarises the differences between a healthy relationship with food and an unhealthy one, generally found in food addiction:

Table 1: Healthy vs. Unhealthy relationship with food (adapted from Jay, 2006)

Healthy relationship with food	**Unhealthy relationship with food (Food addiction)**
• Overeating • Compulsive eating • Food obsession • Secretive eating • Intense feelings of self-control loss while eating • Eating when not hungry • Eating to numb emotions • Eating past full, etc.	• Eating when hungry • Stopping when full • Eating without shame • Eating to live (rather than living to eat) • Not food obsessions • Not feeling of guilty regarding eating • Not eating secretively

It is therefore necessary to carefully consider the individual-food relationship and the results of the transformative effects of food as an addictive substance which one could be dependent on. In other words, the problem is not to start a diet but rather to continue it, avoiding regaining the previously lost weight and slipping into the vicious circle of addiction. Those who suffer from psychogenic obesity, whenever they face their emotional states are beset by anxiety and are not in a position to adequately manage their emotions and thus, they try to gain relief by using uncontrolled bingeing. This reactive overeating is set up as a sort of a maladaptive coping strategy, which aims at suppressing the emotional experience without being able to recognize and manage it (Dalle Grave, 2001).

In obese subjects with food addiction, overeating could be a compensatory mechanism originating from emotional dysregulation that they try to compensate through excessive food consumption. However, excessive, uncontrolled, chaotic and confused eating, carried out with the aim of addressing psychological discomfort, may lead to a real, fully blown addiction. The definition of somatization implies the presence of frequent impulsive actions and behaviour and intense but unstable relational patterns, characterized by rigid thinking and selective attention. The subject with psychosomatic disorders is seemingly complacent, but in reality he/she is the bearer of a great psychological distress and denial, although depression or anxiety symptoms are very often existent. The mechanisms of somatization imply a lack of integration and synthesis at the consciousness level regarding the components of the 'somatic' experience (such as motor or sensory functions), and are particularly present under stress conditions or are due to tensions and psychological conflicts which are too intense (Dèttore, 2008).

In this perspective, psychogenic obesity described above, which follows the footsteps of a real substance dependence, is closely related to a difficulty in mentalizing internal cognitive states and, therefore, it represents the inability in regulating emotions through cognitive processing. This leads obese individuals to release tension caused by unpleasant emotional states through impulsive acts or compulsive behaviors such as uncontrolled overeating that can therefore result in a form of overt food addiction. There are numerous studies that, to date, indicate similarities between obesity and addictive disorders at both phenomenological and neurobiological levels. These peculiar researches offer a greater understanding of eating disorders within a multi-theoretical perspective, better explained by the bio-psico-social model which takes into account biological, psychological and social issues in assessing the state of individuals' health (Cicognani and Zani, 2004).

2.4 Psychological and biological aspects of addiction and food addiction

According to Koob (2012), although no addiction animal model fully matches the human condition, animal research allows to carefully investigating specific elements

regarding the process of the addiction cycle. Scientific research has recently focused on the chronic administration, the acute and long-term neuro-adaptive changes in the brain that occur in the development, maintenance, and relapse to addiction. The addiction symptoms and syndrome are defined into different stages, namely the 'addiction cycle': binge/intoxication, withdrawal/negative affect, and preoccupation/anticipation. These three stages are highly interacting with one another; they gradually become more intense and eventually lead to the pathological conditions, that is to say, full addiction (Koob and Le Moal, 1997).

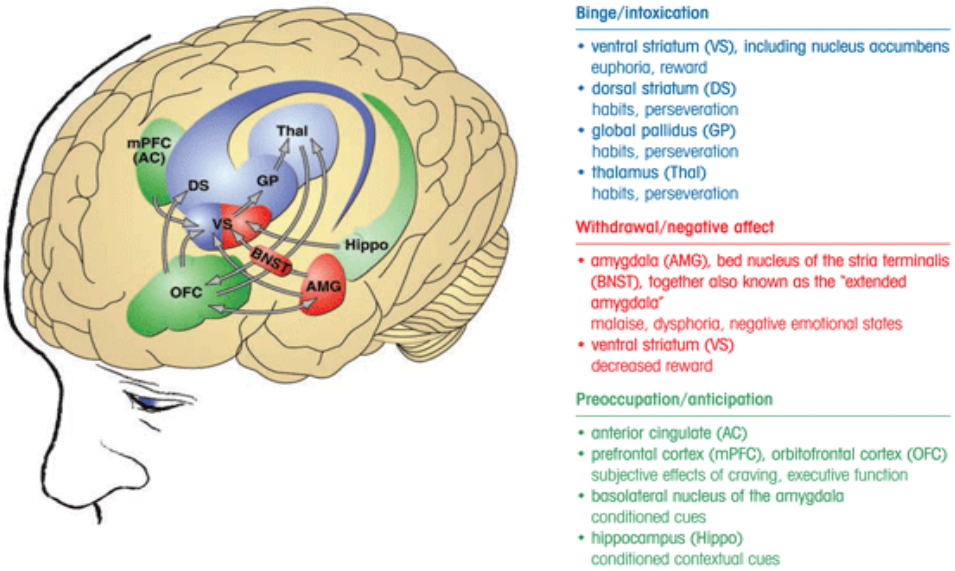
The neural circuitry associated with the three stages of the addiction cycle starts with the Binge/intoxication stage (see Fig. 2), in which the reinforcing effects of drugs trigger reward neurotransmitters and associative mechanisms in the nucleus accumbens (NAc). Such effects subsequently engage in stimulus–response habits depending on the dorsal striatum. At this stage, there are two major neurotransmitters mediating the rewarding effects of drugs and these are dopamine and opioid peptides (Koob and Volkow, 2010). During the Withdrawal/negative affect stage the extended amygdala is activated. The latter is composed of several basal forebrain structures, the bed nucleus of the stria terminalis, the central nucleus of the amygdala and possibly a transition zone in the medial portion (or shell) of the nucleus accumbens. Thus, the negative emotional state of withdrawal begins. At this stage, the most important neurotransmitters in the extended amygdala hypothesized to have a significant function in negative reinforcement are: the cortico-tropin releasing factor, norepinephrine, and dynorphin. Major projections of the extended amygdala occur towards the hypothalamus and the main brainstem (see Fig. 3), (Koob and Volkow, 2010).

The last stage is the Preoccupation/anticipation (craving) stage, (see Fig. 3), involving conditioned reinforcement processing in the basolateral amygdala (BLA) and the contextual information processing by the hippocampus. The prefrontal cortex is responsible for executive control which is related to outcomes and contingencies representation, as well as their value and subjective states (i.e.: craving and, seemingly, feelings), associated with the substance. The subjective effects which characterises drug craving in humans involve activation in functional imaging studies of the orbital and anterior cingulate cortices and temporal lobe, including the amygdala. A major neurotransmitter involved in the craving stage is glutamate and it is localized in

pathways which go from the frontal regions to the BLA and are able to project to the ventral striatum (Koob and Volkow, 2010).

Furthermore, the study of animal models of addiction in relation to specific substances such as stimulants, opioids, alcohol, nicotine, and Δ-tetra-hydrocannabinol represent the greatest progresses towards the understanding of the addiction neurobiology (Salamone et al., 2007). Such research found that the trajectory of the medial forebrain bundle connecting the ventral tegmental area (VTA) to the basal forebrain is the most sensitive site for eliciting stimulation reward in the brain, defined by the lowest thresholds. All drugs, if administered acutely, decrease brain stimulation reward thresholds thus increase reward. On the contrary, when drugs are chronically administered they increase reward thresholds during withdrawal and hence, they decrease reward. In fact, the brain stimulation reward in the medial forebrain bundle is mediated by norepinephrine and then dopamine as well as other non-dopaminergic systems (Koob, 2012).

Fig. 3: The neural circuitry associated with the three stages of the addiction cycle (adapted from Koob and Volkow, 2010).

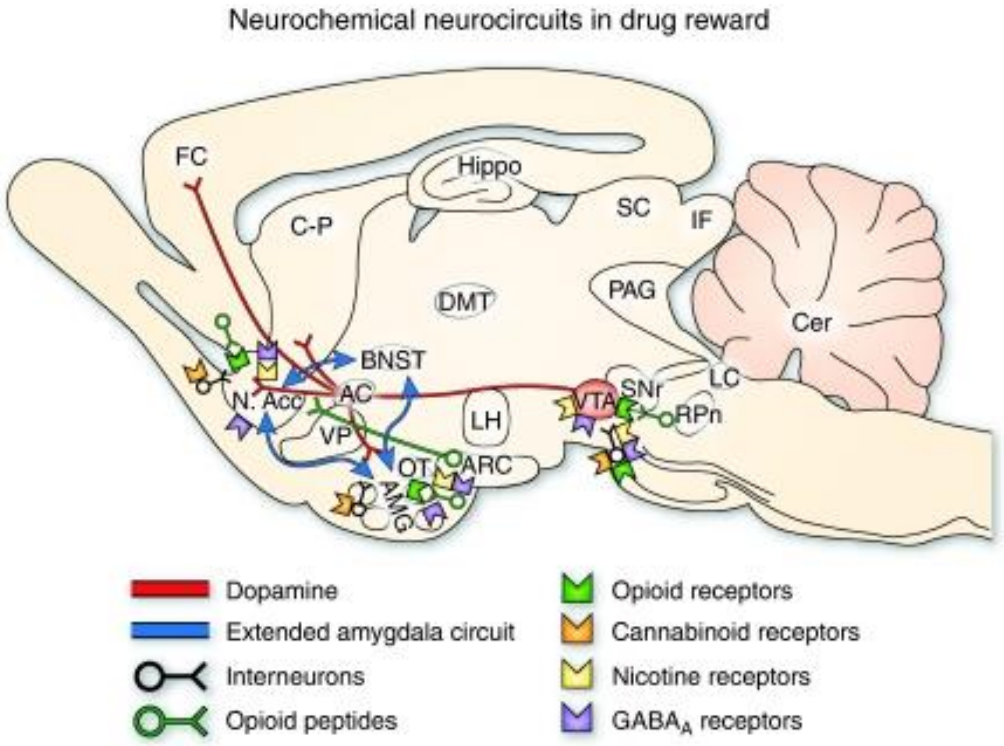


KEY:

Acb, nucleus accumbens; **BLA**, basolateral amygdala; **VTA**, ventral tegmental area; **SNc**, substantia nigra pars compacta; **VGP**, ventral globus pallidus; **DGP**, dorsal globus pallidus; **BNST**, bed nucleus of the stria terminalis; **CeA**, central nucleus of the amygdala; **NE**, norepinephrine; **CRF**, corticotropin-releasing factor

It has also been proved that activating the midbrain dopamine system has multiple outcomes: it facilitates incentive salience to environmental stimuli, it drives goal-directed performance behaviour and it promotes the general activation too. Work specifically addressing the acute reinforcing effects of drugs suggest that the mesolimbic dopamine system plays a very important role for the acute rewarding effects of psycho-stimulant drugs but also, it plays a more enabling function for all drugs of abuse (Volkow 1996), (see Fig.4 below).

Fig. 4: The Neurochemical Circuitry of substance reward (adapted from Koob, 2005).



KEY:

AC, anterior commissure; **AMG**, amygdala; **ARC**, arcuate nucleus; **BNST**, bed nucleus of the striaterminalis; **Cer**, cerebellum; **C-P**, caudate-putamen; **DMT**, dorsomedial thalamus; **FC**, frontal cortex; **Hippo**, hippocampus; **IF**, inferior colliculus; **LC**, locus coeruleus; **LH**, lateral hypothalamus; **N Acc.**, nucleus accumbens; **OT**, olfactory tract; **PAG**, periaqueductal gray; **RPn**, reticular pontine nucleus; **SC**, superior colliculus; **SNr**, substantianigra pars reticulata; **VP**, ventral pallidum; **VTA**, ventral tegmental area.

Laboratory studies on rodents' brain clarify the pathways and receptor systems implicated in the acute reinforcing actions of drug abuse. Cocaine and amphetamines activate dopamine release in the nucleus accumbens (NAc) and the amygdala via direct actions on dopamine terminals. Opioids activate opioid receptors in the ventral tegmental area, the nucleus accumbens (NAc), and the amygdala via direct actions or indirect actions through interneurons. Opioids facilitate the release of dopamine in the NAc taking action in the ventral tegmental area or in the NAc itself (Kalivas and O'Brien, 2008).

Alcohol activates γ-aminobutyric acid-A (GABAA) receptors or GABA release in the ventral tegmental area, NAc and amygdala. This occurs either directly at the GABAA receptor or through indirect GABA release. Alcohol seems to facilitate the release of opioid peptides in the ventral tegmental area, the NAc, and in the central nucleus of the amygdala. It also enables dopamine release in the NAc either in the ventral tegmental area or nucleus accumbens itself. Nicotine activates nicotinic acetylcholine receptors in the ventral tegmental area, the NAc, and the amygdala, directly or indirectly, via actions on interneurons. Cannabinoids activate cannabinoid CB1 receptors in the ventral tegmental area, the NAc, and the amygdala. Cannabinoids elicit dopamine release of in the NAc via an unknown mechanism in the ventral tegmental area or via nucleus accumbens (see Fig. 4), (Koob, 2005).

The neurochemical circuitry of substance reward is characterised by important interactions within the extended amygdala system hypothesized to play a key role in psycho-stimulant reinforcement (Koob, 2012). In the acute reinforcing effects of addiction, system neuro-adaptations to chronic substance exposure occur. These implicate that the neurotransmitter systems function decreases in the neuro-circuits. In this respect, dopamine systems are luckily to be compromised in crucial phases of the addiction cycle, such as withdrawal. Such malfunctioning leads to a highly decreased motivation for stimuli that are not related to the substance and to increased sensitivity to the abused drug (Melis et al., 2005).

It is important to also consider that imaging studies have proved that during prolonged withdrawal, once its acute signs have subsided, dopamine routes encounter a great deal of hypo-functioning as dopamine release decreases leading to hypohedonia and amotivation (Koob and Volkow, 2010). The first is a markedly reduced ability to

experience pleasure or enjoyment and hence a decreased sensitivity to reward; the second concerns a significant lack of any motivation to engage in an activity and lack of perceived competence and/or a failure to value such activity. This is due to the fact that several neurotransmitter systems are able to modulate the extended amygdala both from the stress-induction domain (vasopressin, substance P, orexin), and the anti-stress domain (nociceptin, endocannabinoids), (Koob, 2008).

This physiological dysregulation helps maintaining addictions and creates more prolonged changes in emotional responses (see Fig. 4), such as protracted abstinence. Furthermore, craving *per se* has not been clinically well measured and it often does not imply automatic relapse. Neurobiological mechanisms and medications progress for treatment, considering the stage of the addiction cycle in which the individual seeks for the substance after abstinence, are still not fully developed nor understood. Animal craving models can surely help clarification. These are classified into two broad groups: drug-seeking induced by drug or stimuli associated with drug taking, and drug seeking induced by a strong stressor or a residual negative emotional state given by protracted abstinence. Changes given by drug and induced replacement after extinction in the neuro-circuitry are influenced by glutamatergic pathways from the prefrontal cortex, baso-lateral amygdala (BLA), and hippocampus to the NAc core (Kalivas and O'Brien, 2008),

Evidence from imaging studies points out that during detoxification, sensitivity to conditioned cues increases: drug users assessed during protracted detoxification display frontal regions characterised by disrupted activity of dorsolateral prefrontal regions, the cingulate gyrus, and the orbitofrontal cortex. The latter is responsible for their impaired inhibitory control and impulsivity; hence it plays a fundamental role in relapse. Moreover, fronto-cortical regions anomalies seem to be linked to the inability to delay gratification and to tolerate frustrations, features which are generally associated with chronic addiction and other psychiatric disorders (Koob, 2012).

In simplified terms, the human brain functions to sense stimuli, control behavioural patterns, informs on whether something is needed and it operates such communication via neurotransmitters. In response to pleasurable stimuli, the neurotransmitter that is released is mainly dopamine, which is responsible for the pleasurable feelings encountered not only when consuming drugs, but also when having

sex, eating certain foods, consuming alcohol or gambling. Moreover, as seen so far, dopamine also serves to reinforce and to maintain behaviour over time. In other words, any perpetuating of actions like the previously mentioned produces a high dopamine release, which causes the individual to seek more of that specific behaviour in order to experience a progressively higher dopamine release.

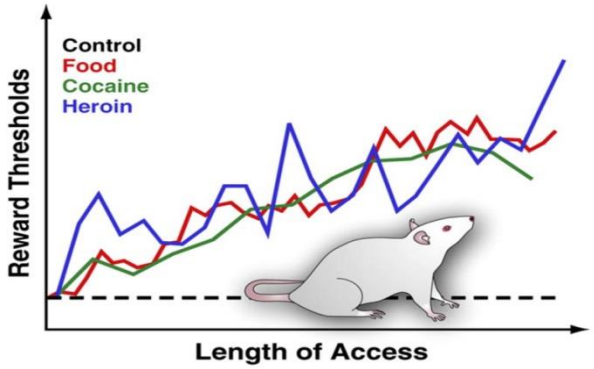
Both animal and human studies suggest that an addictive process is profoundly possible even when it comes to food. In fact, the problem of food addiction starts when some types of foods start taking over the brain generating a great biological demand. There is growing evidence that some foods may alter the brain like an addictive drug as identified by more and more animal and human research on the addictive impact of food, which have identified outstanding similarities between excessive food consumption and addictive behaviours since the exact same brain centres are at play (Gearhardt and Corbin, 2012).

People with a certain predisposition to addiction, become addicted to certain food and lose control over their consumption. Addiction and obesity associated with uncontrolled eating disorder (Binge Eating Disorder or BED) are both characterized by a persistent habit to look for the substance and use it, despite the threat of severe consequences. These habits are highly consolidated and are learned through preferences which have been impressed by the power of their reinforcing properties and repeated rewards. Tasty food activates reward circuits in the brain through slow, but regular, post-bingeing consequences such as glucose concentration in the blood and in the brain (Schag et al., 2013).

There is clear evidence that psychotropic substances are able to activate the same ‘route’ as food, primarily through their biochemical effects on the reward circuit. The repeated physiological stimulations of the reward circuit are not only susceptible to habits and stimuli, and as discussed earlier, but also by neurobiological adapters that may increase compulsive behaviour and lead to a total loss of control too (Manzoni et al., 2012). The hedonic properties of palatable food make it a substance which is consumed beyond its energy status or nutritional elements. Kenny (2011) evidenced that reward thresholds gradually elevate in rats with extended daily access to an energy-dense palatable diet consisting of tasty food items (e.g.: cheesecake, bacon, chocolate,

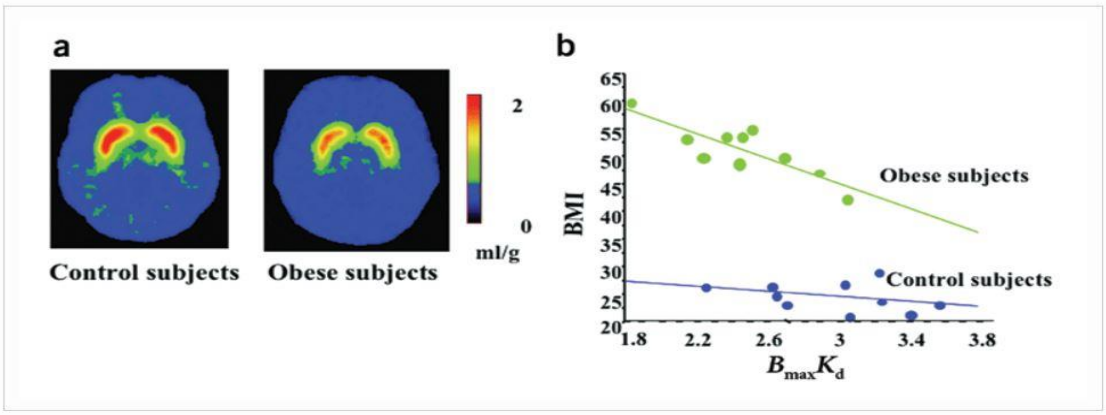
etc.). Similarly, reward thresholds become progressively elevated in rats that have extended daily access to intravenous cocaine or heroin infusions (see Fig. 5 below).

Fig. 5: Reward thresholds in rats with access to palatable food, cocaine or heroin (adapted from Kenny, 2011)



Latest scientific evidence correlates the problem of obesity to a dopamine deficiency, proportional to Body Mass Index (BMI): the higher the BMI, the lower the number dopamine receptor, a condition typically associated with addictive disorders, such as alcoholism and drug addiction (Volkow and Wise, 2005; Di Leo et al., 2012), (see Fig. 6 below).

Fig. 6: Dopamine receptors and BMI in obese vs. control subjects (adapted from Volkow and Wise, 2005)



(**a**) Dopamine D2 receptors in controls and in obese individuals. (**b**) Relationship between D2 receptors and body mass index (BMI).

The need to overeat is not just related to a response of the physiological stimulus at the basis of hunger, but also to the need of intensively stimulating the circuits of pleasure, which are particularly sensitive to *junk food*, working as a real 'drugs' for the brain (Garber and Lustig, 2011). For many obese individuals, giving in to food compulsion represents the great need to ingest a progressively greater amount of food in order to activate the neural gratification circuit (reward circuitry), that is not sufficiently stimulated by environmental interaction. The scarcity of dopamine receptors explains the lower level of self-efficacy of obese subjects and their difficulty in continuing and maintaining a diet, given by the effect of their lack of inhibition towards food (Volkow, 2005). Important epidemiological studies confirm a significant comorbidity between eating disorders and substance abuse.

Animal studies and neuroimaging studies in humans focus their attention on the gratification circuit in relation to food intake (Avena, 2009; Fortune, 2012). In particular, neuroendocrine and imaging studies suggest a close link between the homeostatic regulation of appetite, motivation and reward expectation. Results from additional neuropsychological studies demonstrate the presence of a cognitive impairment in obese people, which is responsible for the lack of control in resisting the consumption of excess food (Wang, 2002).

Micro dialysis and PET studies show that both psychotropic substances and food are able to activate the mesolimbic dopamine system and thus the level of pleasure subjectively experienced is correlated with the amount of dopamine released in the striatum, particularly in the Nucleus Accumbens (NAc). The subjective feeling of pleasure varies among individuals relatively to baseline dopaminergic activity. The increased release of this neurotransmitter is a crucial element when it comes to phenomena such as reinforcement, dependence and hedonic motivation. This circuit is implicated in both food abuse and in the use or abuse of drugs; the overlap of its mechanisms is particularly evident in overeaters during the bingeing phase (Umberg et al., 2012).

The hedonic circuit activated after food or substance intake provides reinforcing mechanisms to behaviours which are essential for the perpetuation of the species, such as sex and nutrition. Palatable foods, that is to say, high in sugar or in sugar and fat, lead to an increase of dopamine release in the NAc, as it is also possible to observe in

response to visual stimuli regarding food or simply to the perception of flavour (Avena et al., 2012). The molecule that, to a greater extent, generates the release of dopamine in the NAc is sugar. This is also noticeable at the behavioural level, as in obese subjects with food addiction, craving is generally found towards sweet food (Fortune, 2012). Moreover, sugar has been shown to be addictive more than any other molecule: in addition to bingeing behaviour, rodents deprived of sugar showed signs of withdrawal and craving. Furthermore, they evidenced a cross-sensitization with the transition from sugar consumption to that of amphetamines (Berner et al., 2008).

Thus, behavioural addictions lose their original evolutionary aspect, as they are subtended by a common additive process resulting from the alteration of three functional systems: motivation-gratification, emotional regulation and behavioural inhibition. In this sense, both substance dependence and food dependence are characterized by three distinct phases:

1) An initial phase of bingeing which plays a fundamental role towards the reinforcing properties of the substance itself

2) A withdrawal phase accompanied by negative emotional states and ambivalence

3) An anticipation phase, comprising of craving before substance re-consumption.

The very same three phases also seem to govern the intake of sugar and of other palatable foods, thus contributing to prove the existence of food addiction (Parylak et al., 2011).

2.5 Environmental Triggers for Obesity and food addiction

The increased prevalence of obesity and food addiction has obliged the scientific community to thoroughly examine what could be contribute towards the causes of the apparent proneness of individuals to spontaneously store more fat under apparently free-living conditions. There is a consensus among health professionals and scientists about the idea that environmental changes have promoted what has been ultimately described as a global epidemic, namely ‘Globesity’ (WHO, 1998). Such changes effect the compatibility between what is offered by the socio-psycho-economic living context and what is biologically needed by the human body to reach an optimal functionality (Brownell and Horgen 2004).

What contributes towards the development of obesity and food addiction with respect to environmental factors are two main issues: the toxins contained in food and the presence of palatable food in everyday nutrition. When body weight loss becomes a serious problem, it is certainly relevant to reconsider variations in body fat regarding the maintenance of body homeostasis, which are closely related to the environment we live in. In fact, specific chemicals such as Organochlorines (OCs) as well as *junk food* have been scientifically linked to the causes of overweight, obesity and food addiction.

Organochlorines (OCs) are any organic compound that contains carbon and hydrogen and shares electron pairs from one or more chlorine atoms through covalent bonding. Several chemicals fall into this category, including organochlorine pesticides. Recent research suggests that theoretically safe levels of body accumulation of OCs can produce subtle significant effects in obese individuals. Accordingly, OCs body accumulation is greater in obese than in normal-weight people, at least partly because the dilution space provided by their large fat mass presumably reduces their clearance rate over time (Brownell and Horgen 2004). The issue of progressively building up of such chemicals in the human body becomes relevant in the study of potential determinants of obesity (Kutz et al., 1991).

The environment that favours obesity and its underlying state of excessively positive energy balance has been described as ‘toxic’ because of its effect to promote practices that are not compatible with optimal body functioning and body weight stability. These practices may include the consumption of cheap low-nutrient foods that complicates appetite control and promotes overfeeding, sedentariness and its corollaries (such as reduced energy expenditure and body stimulation). Thus, although chemical toxins do not *a priori* modify consumer’s practice regarding obesity-related phenotypes, they nonetheless have the potential to affect them via more discrete strategies (Tremblay and Sanchez, 2012).

A careful investigation of weight loss induced by diet restriction combined with physical exercise by Pelletier and colleagues (2002) proved that, as authors expected, a significant increase of OCs concentrations in both plasma and adipose tissue (AT) was noted in obese individuals. Moreover, body weight loss was significantly correlated with changes in plasma OCs, indicating that the greater the success in terms of weight loss, the greater was the increase in the level of these circulating pollutants. Beyond the

demonstration that weight or fat loss predicts the severity of the OC hyper-concentration, the study highlights that these toxins are related to metabolic changes. In response to the diet or exercise inducing fat loss, the changes in the concentration of OCs compounds were correlated to a greater than predicted decrease in resting metabolic rate (Pelletier et al., 2002).

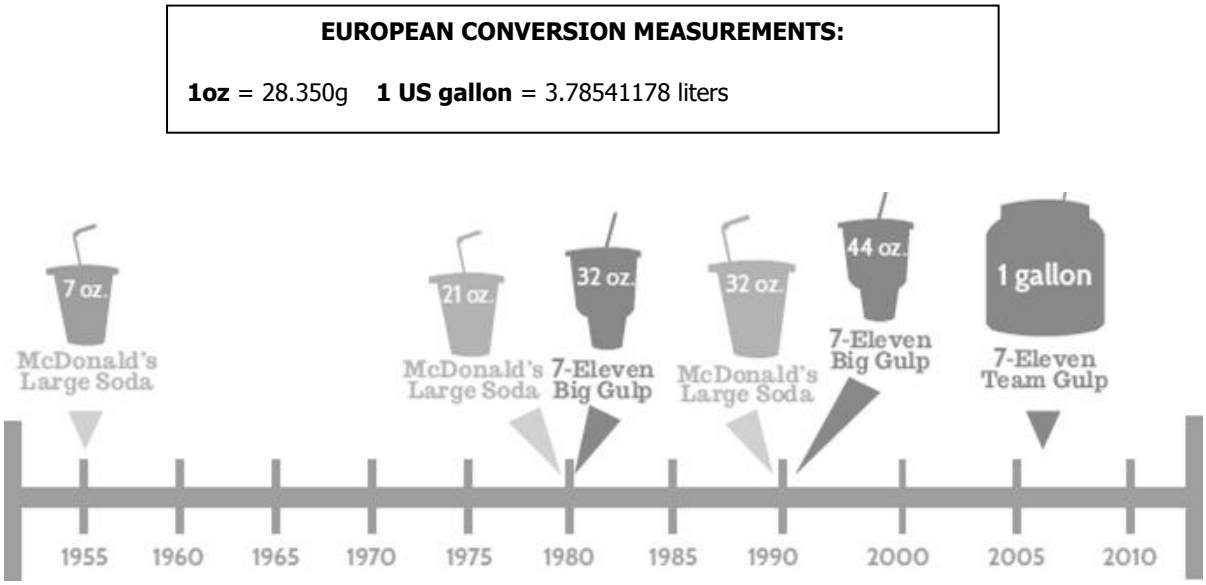
The difference between the predicted and measured change in sleeping metabolic rate (SMR), also known as adaptive thermo-genesis, was mostly predicted by changes in plasma OCs. In summary, these observations suggest that body weight-loss is an intervention that is useful to investigate in order to fully understand the impact of variations in body lipophilic pollutants on energy metabolism. This vision is reinforced by the fact that the quantitative importance of toxins variations predicts the severity of the deterioration of the body's metabolic ability to burn fats. Furthermore, the extent to which these variations can predict weight regain in previously obese individuals has not been documented and might remain unconsidered (Tremblay and Sanchez, 2012).

More to that, beside pesticides and toxins which are found to have detrimental effects on weight-loss success, another factor is relevant to the maintenance of morbid obesity, that is to say common food causing food-addiction. Avena and Talbott (2014) explain why, in many cases, diets fail. Very often, people who try to control their food intake encounter feelings of helplessness and powerlessness, this is because, as proved by several studies, certain types of food (i.e.: highly palatable foods), can produce similar addictive behaviours and brain patterns as in drugs and alcohol consumption. Due to the prevalence of highly palatable foods in our society, it is possible to develop an addiction to them, since they represent food that repeatedly triggers pleasure in the brain as it includes processed high-salt, high-fat, and high-sugar foods.

The difference between pleasurable activities versus addictive ones lies in the brain's reaction to such activities. However, just because a person craves sugar does not mean they are addicted to it; it is when the person feels an enormous lack of self-control with the substance that it is likely that their brain has been hijacked by the over-production of dopamine. Authors therefore suggest that hidden sugars (that is to say not easy to spot on the label), complex carbohydrates, sugary beverages and junk food are typical food to avoid if one might not wish to be prone to a pathological food-addiction (Avena and Talbott, 2014). The image in the next page (Fig. 7) shows how, across the

years, the food market progressively increased the size of fast food sodas contributing to also increase the size of Americans' waste-line. This suggests that to some extent, there is a need to raise public awareness concerning food's addictive properties, since a new market opportunity of the food industry today, may promote the growth of food addiction and its health-related problem tomorrow.

Fig. 7: Sodas increase across the years (adapted from Avena and Talbott, 2014).



When addressing the obesity epidemic and the concept of food addiction, it is important to consider recent developments in food technologies. These have created *ad hoc* significant modification of certain foods to artificially favour their rewarding properties, that is to say, their palatability level, in order to increase sales in a highly competitive market (Kessler, 2009).

2.6 Current assessment and research on food addiction

In the USA, Gearhardt and colleagues (2009) have developed and validated a self-administered questionnaire, the Yale Food Addiction Scale (YFAS), with the aim of assessing the existence and prevalence of food addiction in a sample of college

students. The questionnaire consist of 25 items investigating eating behaviour of respondents, with respect to certain types of food such as those high in fat and/or sugars, in the last 12 months. The instrument has 16 items answered on a 4-point Likert scale (ranging from 0–never to 4–four or more times or daily; e.g., *''I find that when I start eating certain foods, I end up eating much more than planned''*), a single item with a response on a 5-point Likert scale (rating the number of times respondents tried to cut down or stop eating certain foods in the last years, choosing from five alternatives: one or fewer times, two times, three times, four times, and five or more times), and finally 8 items with the option of a dichotomous answer 'yes' or 'no' (e.g.: *''My food consumption has caused significant psychological problems such as depression, anxiety, self-loathing, or guilt''*).

Scores on Likert-scales items are dichotomized in line with specific cut-offs developed by the authors. The questionnaire assesses the presence of food addiction following the diagnostic criteria of the *Diagnostic Manual and Statistical of Mental Disorders* (DSM-IV; APA, 2004), for substance dependence. The YFAS provides two scoring options: a count of the addiction symptoms detected and a food addiction diagnosis met when three or more symptoms are satisfied. The measure also assesses the presence of impairment or clinically significant distress, regardless of the presence of food addiction (Gearhardt et al., 2009).

The symptom count, following DSM-IV criteria for substance dependence '*substance taken in larger amount and for longer period than intended'* (APA, 2004), is assessed by three items (items number 1–3; e.g.: *''I find myself continuing to consume certain foods even though I am no longer hungry''*. The DSM-IV criterion '*persistent desire or unsuccessful attempts to quit'*, is assessed by four items (items number 4, 22, 24, and 25; e.g.: *''not eating certain types of food or cutting down on certain types of food is something I worry about'')*. DSM-IV criterion *'much time/activity to obtain, use, recover*, is assessed by three items (items number 5, 6, and 7; e.g.: *''I spend a lot of time feeling sluggish or fatigued from overeating''*); *'activities given up or reduced'* criteria is assessed by four items (items number 8, 9, 10, and 11; e.g.: *''There have been times when I avoided professional or social situations because I was not able to consume certain foods there''*).

'*Use continues despite knowledge of adverse consequences*' criterion is assessed by a single item, (number 19; *''I kept consuming the same types of food or the same amount of food even though I was having emotional and/or physical problems''*). DSM-IV '*tolerance'* criterion (APA, 2004), is assessed by two items (items number 20, and 21; e.g.: *''Over time, I have found that I need to eat more and more to get the feeling I want, such as reduced negative emotions or increased pleasure''*). *'Withdrawal symptoms and substance taken to relieve withdrawal'* criterion is assessed by three items (items number 12, 13, and 14; e.g.: *''I have found that I have elevated desire for or urges to consume certain foods when I cut down or stop eating them''*). Finally, *'impairment or distress'* is assessed by two items (items number 15, and 16; e.g.: *''my behaviour with respect to food and eating causes significant distress''*). Three items (items number 17, 18, and 23) are not scored because they are primers for other questions (Gearhardt et al., 2009).

More recently, Gearhardt and colleagues (2012) have administered the Yale Food Addiction Scale (YFAS) to a clinical sample of obese adult in-patients with binge eating disorder (BED), enrolled in a specialised weight-loss treatment. Of the 81 participants in the study, more than half, as much as 57% met the criteria for the diagnosis of food addiction. Also, those who were diagnosed as addicted to food on the basis of the scores obtained in the YFAS questionnaire displayed significantly higher scores in the other measures screening for depression, negative emotional states, and emotional dysregulation. Moreover, obese with food addiction showed greater eating psychopathology and lower self-esteem levels than those without such condition. Finally, the research pointed out that the scores obtained on the YFAS significantly predicted both the intensity and the frequency of binge-eating better than other psychometric measurements (Gearhardt et al., 2012).

It is therefore possible to observe that, within the obese population diagnosed with binge eating disorder (BED), there is a subgroup of individuals who are addicted to food and seem to present a much more severe eating disorder as well as psychopathology. Furthermore, the same research group has investigated the presence of food addiction in a sample of 117 children with a mean age slightly over eight. Authors created and validated a developmental version of the YFAS scale, namely the Yale Food Addiction Scale for Children (YFAS-C). Results from their empirical study

showed that it is possible to detect a form of food addiction in children too. These findings suggest that high scores on the YFAS-C questionnaire are significantly correlated to a high body mass index (BMI) and to a greater tendency to eat excessively in response to emotional stimuli. In addition, children with food addiction symptoms may be less sensitive to homeostatic indicators related to food consumption (Gearhardt et al., 2013).

Further studies using the Yale Food Addiction Scale (YFAS) were conducted by Clark and Saules (2013), who investigated the relationship between the existence of food addiction and weight-loss in obese subjects who had undergone surgery with the aim to reduce their weight. The authors found that food addiction was largely related to the presence of compensatory eating behaviours employed in order to counterbalance negative emotional states and bingeing. In addition, those who presented clear food addiction symptoms had a lower weight loss percentage following the surgical operation compared to those who did not meet the criteria of food addiction (respectively 32% vs. 27%), (Clark and Saules, 2013).

Another interesting study was conducted by Burmeister and colleagues (2013), who examined addiction food symptomatology and its relationship with eating psychopathology in a sample of obese adults undergoing a specific, short-term weight-loss treatment intervention. Participants were administered the Yale Food Addiction Scale (YFAS) as well as other psychometric instruments measuring psychological distress, disordered eating and prejudices and attitudes with respect to body weight. After seven weeks of treatment participants' weight loss was recorded. Results demonstrated that the severity of food addiction was closely linked to higher levels of depression, emotional eating, binge eating, negative attitudes towards obese people, internalization of negative bias towards the obese, feelings of shame about their body image and low levels of self-efficacy (Burmeister et al., 2013).

The research studies outlined so far noticeably demonstrate that food addiction could be encountered among some obese subjects and that the food addiction symptomatology can undermine efforts to lose weight and generally imply lower levels of subjective well-being and a poor quality of life in individuals who are affected by this condition. All of these findings suggest the importance of using a food addition measure like the YFAS during the assessment of overweight and obese individuals. In Italy,

there are nearly no studies regarding food addiction and its prevalence. In fact, until this year, there were no studies which have investigated the psychometric properties of the Yale Food Addiction Scale in a large sample of obese and overweight patients attending weight loss interventions in Italy.

However, an Italian version of the YFAS has been developed and validated by Innamorati et al., (2014). These researchers assessed the dimensionality and psychometric properties of an Italian version of the Yale Food Addiction Scale (YFAS) in a sample of 300 obese/overweight patients (54 males and 246 females), attending a low-energy diet therapy in a private medical centre in Italy. The control group was represented by 300 adults from the general population, (231 women and 69 men). All participants were administered the YFAS and the binge eating scale (BES). The original one-factor model with 22 items investigated by Gearhardt et al. (2009) in undergraduates did not fit the data of the Italian study. Thus, five items (that is to say items number 10, 11, 22, 24, and 25), were removed from the scale and a new item parcel from items 1 and 2 was created. A new one-factor model with the remaining 16 items had better fit to the data as indicated by the structural equation model.

The final version of the Italian YFAS show results which are in line with those reported by Meule et al. (2012), in their investigation of the psychometric properties of the YFAS in a small sample of obese patients attending bariatric surgery. Although their results supported a one-factor structure, authors suggested that items number 22, 24, and 25 could be problematic as they presented both low factor loadings and low item–total correlations. These items, investigating the persistent desire or repeated unsuccessful attempts to reduce or stop consuming certain foods, did not sufficiently discriminate between food-addicted and non-addicted obese individuals (Meule et al., 2012).

Moreover, the Italian research group also encountered problems with items 10 and 11: this could be due to cultural and ethnic factors which may influence eating behaviour and nutrition patterns. Thus, it must be considered that the construct of food addiction may not be equivalent across ethnic groups, implying construct bias. Additionally, the translation procedures of items may have produced some slight differences in the items meanings, implying items bias (Van de Vijver and Hambleton, 1996). However, the Italian 16-item YFAS overcame such obstacles, providing a valid instrument measuring all symptoms assessed by the original version of the YFAS.

Chapter 3: An evaluation of the Italian version of the Yale Food Addiction Scale (YFAS) in obese adult inpatients engaged in a one-month weight-loss treatment

3.1 What is already known about this subject and what does this study add

New obesity models explain that excessive food consumption has strong similarities with substance addiction (Gearhardt et al., 2012). A good percentage of obese hospitalized patients display addiction-like symptoms towards food, do not respond effectively to standard weight-loss intervention and are diagnosed with food-addiction (FA), particularly to palatable food (Avena et al., 2011). A fair prevalence of FA was also found in the following study on obese adult in-patients undergoing a hospital-based treatment for weight loss and related co-morbidities in an obesity-specific center in the northern Italy, the Saint Joseph Hospital of the Istituto Auxologico Italiano.

The study showed that those who were food addicted were more prone to bingeing, had higher emotional dysregulation, negative feelings, non-acceptance, poor goal-oriented behaviour and impulse control, difficulty in emotion recognition, attentional impulsivity and inability to concentrate compared to the non-food addicted. This research represents an evaluation of the Italian version of the Yale Food Addiction Scale (YFAS) by Innamorati et al. (2014), as well as an investigation on a clinical sample, proving that this tool is sound and reliable in identifying food addiction in adult obese in-patients.

3.2 Abstract

Addiction is a compulsive need for and use of a specific substance leading to a habit, tolerance and psycho-physiological symptoms. Excessive food consumption is similar to that of substance addiction. Some individuals who have trouble losing weight display addictive-eating symptoms. Objective: to investigate food addiction in a sample

of obese adults referred to hospital for a one-month weight-loss treatment. Method: the Italian version of the Yale Food Addiction Scale (YFAS-16) was used as a screening tool in 88 obese inpatients. The construct validity of the YFAS-16 was assessed by testing its correlations with measures of binge eating (Binge Eating Scale), impulsiveness (Barratt Impulsiveness Scale), and emotional dysregulation (Difficulties in Emotion Regulation Scale). Results: 34.1% of the sample was diagnosed with YFAS food addiction. Such diagnosis was also supported by strong associations between FA and psychological and behavioural features typically descriptive of classic addiction. Discussion: patients who endorsed the YFAS-16 criteria for food addiction had significantly higher binge eating levels, greater emotional dysregulation and non-acceptance of negative feelings; they lacked goal-oriented behavior; had little impulse control; had difficulty in emotion recognition and attentional impulsivity; they were unable to concentrate and lacked inhibitory control behavior, unlike participants who did not meet food addiction criteria. Further research is needed to support the reliability of the YFAS-16. This measure has the potential to be applied in epidemiological research estimating the prevalence of food addiction within the Italian population and to assess new treatments efficacy for obese patients with food-addiction symptoms seeking weight-loss treatments.

Keywords: binge eating, Body Mass Index, eating behaviours, food addiction, obesity, obesity treatment overweight.

3.3 Introduction

Addiction is a compulsive need for and a regular repeated use of a specific substance leading to habit, tolerance, and well-defined physiological and psychological symptoms (APA, 2013). Addictive behavior can occur in various forms, including overeating (Shaffer et al., 2004). In some obese people, compulsive overeating symptoms mirror those associated with other compulsive behaviors, like substance addiction (James et al., 2004; Volkow and O'Brien, 2007; Volkow and Wise, 2005; Gearhardt et al., 2011).

Evidence suggests that some obese individuals with no inherited metabolic vulnerabilities experience great weight-loss difficulties, and they may exhibit signs of 'food addiction' (FA), (Davis et al., 2011; Gearhardt et al., 2009; Gearhardt et al., 2012). Unlike drugs and alcohol, food consumption is necessary for survival. It is impossible to abstain from, though it can involve physiological and psychological aspects typically associated with substance dependence (i.e., tolerance, withdrawal, craving, loss of control, and impulsivity), (Volkow and Wise, 2005). In fact, appetizing 'junk food' can activate the brain reward circuits via fast input sensors and post-bingeing effects (i.e., glucose concentration in the blood and in the brain), (Garber and Lustig, 2011), Psychotropic substances can activate the same circuit directly (Di Leone, et al., 2012).

Gearhardt and colleagues (2009; 2012) have carried out relevant research on FA. The authors created and validated the Yale Food Addiction Scale (YFAS), the most accredited food addiction measure (Gearhardt et al., 2009). The 25-item questionnaire investigates respondents' eating behavior with respect to certain types of food (i.e., high in fat and/or sugars) in the last 12 months. The YFAS assesses food addiction symptoms based on substance-dependence diagnostic criteria of the Diagnostic Manual and Statistical of Mental Disorders (APA, 2004). Three or more symptoms indicate a food addiction diagnosis. In their validation study on 353 college students, 11.4% of the sample met the criteria for food dependence, as assessed by the YFAS, while 13.2% met suggested clinical cut-offs on the Binge Eating Scale (BES). Findings evidenced that the YFAS is a more reliable measure of binge eating compared to other eating pathology measures. The scale efficiently identifies eating patterns similar to the compulsive behavior of classic addictions, and it is able to discriminate between individuals with and without addictive tendencies toward food (Gearhardt et al., 2012).

Using magnetic resonance imaging activation, the YFAS was later used in a study on addictive processes implicated in the development and maintenance of obesity (Gearhardt et al., 2011). The results found that high food addiction scores on the YFAS were associated with high reward circuitry activation in response to palatable food cues and reduced activation of inhibitory regions in response to food intake. This may suggest the existence of similar neural activation patterns in addictive-like eating and substance dependence, as highlighted in previous neuroendocrine and imaging studies

(Volkow and Wise, 2005; Di Leone, et al., 2012; Gearhardt et al., 2011; Loeber et al., 2012; Avena et al., 2011 and 2012; Volkow 2005; Fortuna, 2012; Volkow et al., 2013). Recently, Gearhardt et al. (2012) administered the YFAS to obese in-patients with binge eating disorder (BED) enrolled in a weight-loss treatment. They found that 57% of participants met food addiction, as diagnosed by the YFAS, and had higher scores on measures of depression, negative emotional states and emotional dysregulation. Additionally, obese individuals with BED displaying YFAS food addiction symptoms showed greater eating psychopathology and lower self-esteem compared to obese individuals with BED not meeting FA criteria. YFAS scores also predicted binge-eating frequency and intensity better than other measures (Gearhardt et al., 2012). Similar results were found in a study on YFAS food addiction diagnosis and weight-loss in obese individuals who had undergone bariatric surgery (Clark and Saules, 2013).

Thus, among obese patients diagnosed with BED, there could be a subset of individuals classified as having YFAS food addiction symptoms with a more severe eating disorder (Gearhardt et al., 2012). Binge Eating Disorder and food addiction may be related. Some authors explained that obese individuals with BED form a specific subset of obesity characterized by greater impulsivity, high reward dependence, and high reward sensitivity (Schag et al., 2013). They found that these patients might have difficulty in delaying gratification from food, in countering cravings, and controlling overeating (Schag et al., 2013). Such aspects may parallel many features of substance-use disorders, as some obese individuals with BED could experience higher reward sensitivity compared to other obese individuals without BED and normal weight people (Schag et al., 2013).

Hence, the need to overeat may go beyond basic physiological hunger and may be related to the need to intensively and quickly stimulate pleasure circuits (Manzoni et al., 2012). Previous research has found that obesity, Body Mass Index (BMI), and specific cognitive correlates resulting from a dopamine shortage (i.e., ‘pleasure’ neurotransmitter) may be linked (Garber and Lustig, 2011). That is to say, the greater the BMI, the lower the number of dopamine receptors; this is a condition that has generally been associated with alcohol and drug dependence (Di Leone et al., 2012). The dopamine receptors scarcity in some obese individuals could also account for their

lower self-efficacy levels and their difficulty in continuing diets and long-term nutrition programs (Wang et al., 2002).

Obesity associated with BED may reflect the phenomenological dynamics of a more severe eating disorder (Avena et al., 2009). Obese binge-eaters often describe themselves as 'food-dependent', easily distressed, and unable to manage emotions, despite being aware of post-bingeing adverse consequences. They also report food craving, as opposed to other obese individuals without BED (Curtis and Davis, 2014). The relationship among obesity, BED, and food addiction (FA) remains unclear. More research is needed to clarify the connection between FA and obesity with or without BED (Gearhardt et al., 2012). Studies on food addiction (FA) prevalence are still rare, some are only descriptive and the incidence of FA amongst obese individuals with or without BED is still uncertain (Meule, 2011).

In Italy, there is nearly no research on FA and its prevalence. The only Italian study was developed by Innamorati et al. (2014), who validated an Italian version of the YFAS, namely, the YFAS-16. Participants were 300 obese/overweight patients engaged in a low-energy diet therapy in a medical center in Rome and 300 adults from the general population (control group). They were administered the YFAS-16 and the Binge Eating Scale (BES), (Gormally et al., 1982; Di Bernardo et al., 1998). The one-factor 22-item model of the original scale (Gearhardt et al., 2009) did not fit the Italian data. Thus, five items with low factor loadings and low item–total correlations (item 10, 11, 22, 24, and 25) were removed, and a new one-factor model with 16 items provided a better fit to the data (Innamorati et al., 2014).

The results from Innamorati et al. (2014) are in line with those reported by Meule et al. (2011) who investigated the psychometric properties of the YFAS on obese patients attending bariatric surgery. Though a one-factor structure of the test was supported, the results suggested that items 22, 24, and 25 could be problematic, as they had low factor loadings and low item–total correlations. These items, investigating persistent desire or repeated failed attempts to reduce/stop consuming certain foods did not sufficiently discriminate between obese individuals with and without food addiction, as diagnosed by the YFAS (Meule et al., 2011).

The following research intends to extend Innamorati and colleagues' work [27] by testing the convergent validity of the Italian YFAS-16 with measures previously

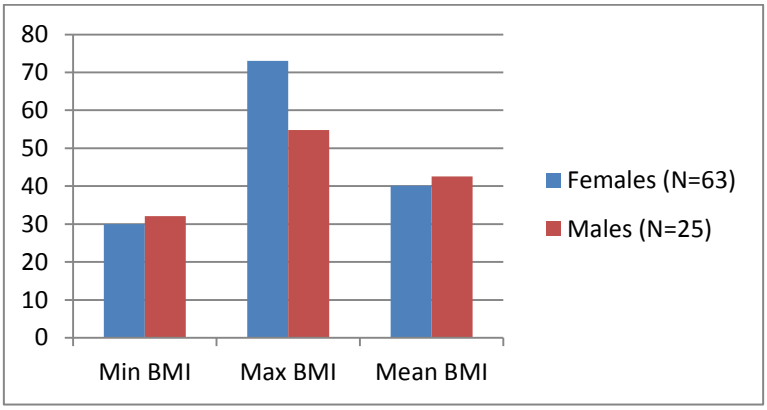
used in Gearhardt et al.'s original validation (2009). Currently, no research in Italy has ever assessed food addiction, disordered eating (Gormally et al., 1982; Di Bernardo et al., 1998), impulsiveness (measured by the Barratt Impulsiveness Scale, (Patton et al., 1995; Fossati et al., 2001), and emotional dysregulation (measured by the Difficulties in Emotion Regulation Scale, (Gratz and Roemer, 2004; Sighinolfi et al., 2010). The abovementioned instruments measure variables which have generally been assessed in classic substance-addiction, (Volkow and O'Brien, 2007). A further aim of the study was to estimate the FA prevalence in a sample of obese in-patients engaged in a one-month weight-loss treatment.

3.4 Methods and Procedures

3.4.1 Study population

A total of 88 men (N =25) and women (N =63) adult obese (BMI ≥ 30) in-patients undergoing a one-month weight-loss treatment at the Saint Joseph Hospital, Istituto Auxologico Italiano, were recruited (see Figure 7). The study sample size (N=88) was considered to be sufficient a priori in order to detect a correlation of 0.35 or above with an 80% of statistical power. Participants' Body Mass Index (BMI) ranged from a minimum of 30 to a maximum of 73, with an average of 40.82 (sd =7.1), (see Figure 8).

Fig. 8: Descriptive statistics of gender and BMI in the sample



The age-variable was measured on categorical scales according to the following age groups: 1) 18-24; 2) 25-34; 3) 35-44; 4) 45-54; 5) 55-64; 6) 65-74; 7) 74 or over. Most participants were between 45 and 54 years of age and between 55 and 64 years of age, both comprising 25% of the sample (see Figure 9). 56, 82% of the sample was married or cohabiting while the rest was single or widowed (see Figure 10). Most participants had siblings (62, 50%). Furthermore, 53.41% were unemployed or retired and few were self-employed (13, 64%), (see Figure 11 in the next page). Most participants had a High School Diploma (43, 18%), (see Figure 12 in the next page).

Fig. 9: Descriptive statistics of the sample age groups

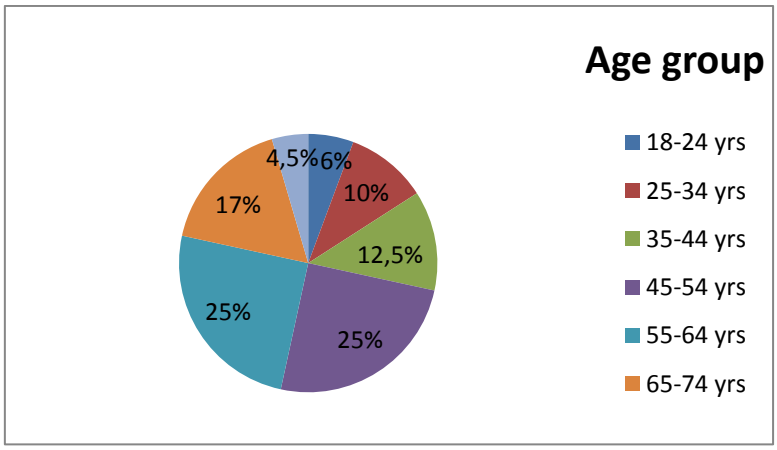


Fig. 10: Descriptive statistics of the sample marital status

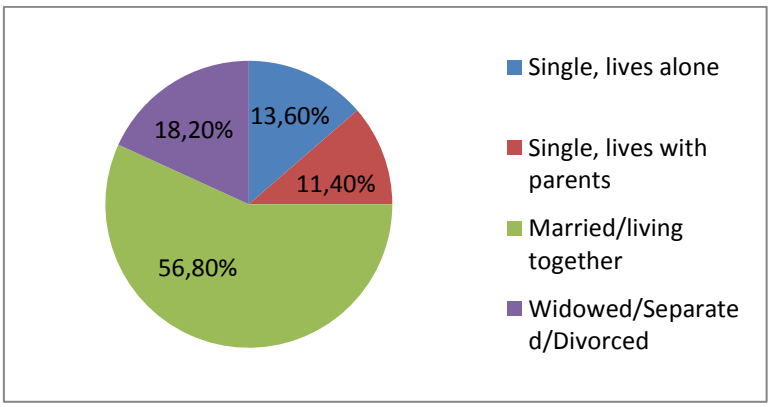


Fig. 11: Descriptive statistics of the sample employment status

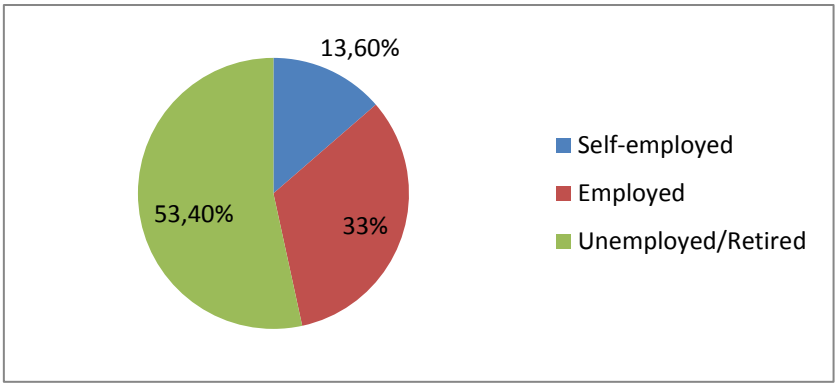
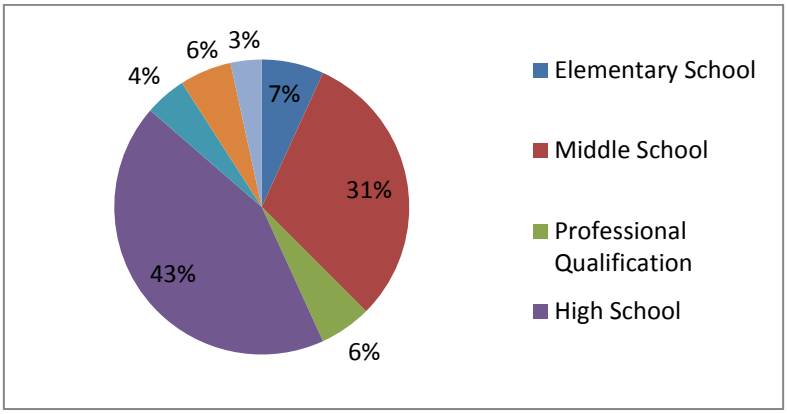


Fig. 12: Descriptive statistics of the sample scholar level



Subjects who had previously been engaged one or more times in a hospitalised treatment programme for weight-loss were in total 24, hence, just over 27% of the sample. Those who had undergone previous weight-loss hospital-based interventions were 7 males and 17 females. 12 subjects had already been hospitalised in the Saint Joseph Hospital itself, while the rest had previous weight-loss interventions elsewhere.

This study was conducted in accordance with the Declaration of Helsinki and respected legal, ethical, and practical research standards of the Saint Joseph Hospital. All participants were provided with the study protocol and an informed consent was obtained from each one of them. Participants initially completed a preliminary sheet assessing demographic information on gender, age, education, profession, marital

status, siblings, previous body weight-loss programs carried out, and physical measures, such as height in cm and weight in kilograms. Patients self-reported their weight and height. Such self-reported data were later cross-checked with objective measures previously taken by front-line physicians at the obesity centre. Body Mass Index (BDI) was calculated at baseline.

Patients were assessed for BED using the Binge Eating Scale (BES), and clinical interviews carried out by Psychologists/Psychotherapists at the centre. During assessment, both behavioural manifestations (eating large amounts of food) and feelings/cognitions following a binge episode (guilt, fear of being unable to stop eating) were examined. Participants were then administered four self-report questionnaires: the Italian version of the Yale Food Addiction Scale (YFAS-16) (Innamorati et al., 2014) the Barratt Impulsiveness Scale (BIS-11), (Patton et al., 1995, Fossati et al., 2001), the Difficulties in Emotion Regulation Strategies (DERS), (Gratz and Roemer, 2004; Sighinolfi et al., 2010), and finally, the Binge Eating Scale (BES), (Gormally et al., 1982; Di Bernardo et al., 1998).

3.4.2 Instruments

This study used the Italian version of a 16-item YFAS scale proposed by Innamorati et al. (2014) measured on a 4-point Likert scale ranging from 0–never to 4–four or more times daily. In their validation study, authors administered the YFAS-16 and the BES (Gormally et al., 1982; Di Bernardo et al., 1998) to participants. The one-factor model of the YFAS reported in previous studies did not fit the data (v2 209 = 466.69, p\0.001; RMSEA = 0.07; 90 % CI: 0.06/0.08; CFI = 0.91; WRMR = 1.40). Based on item analysis, 5 items (items: 10, 11, 22, 24, and 25) were removed from the scale, as they had low item–total correlations. A 16-item one-factor model revealed a better fit to the data (v2 104 = 174.56; p\0.001; RMSEA = 0.05; 90 % CI: 0.04/0.07; CFI = 0.96, WRMR = 1.01). The YFAS-16 turned out to have satisfactory internal consistency, ability to discriminate obese patients from controls, and a strong correlation with BES scores. The YFAS-16 yielded a lower percentage of food addiction diagnoses compared to the original questionnaire, although the scale assesses the same food addiction symptoms as the original YFAS (Gearhardt et al., 2012), and it

has satisfactory psychometric properties. The latter are described together with reliabilities and descriptive statistics for the YFAS-16 and the BES in the following table: (Table 2, adapted from Innamorati et al., 2014).

Table 2: Reliability indices of the 16-item version of the Italian YFAS-16

	Controls (n= 300) (%)	Obese/ overweight (n= 300) (%)	p	Cronbach's alpha	Inter-item correlations
Substance taken in larger amount and for longer period than intended (criterion 1)	3.3	15.3	\0.001	–	–
Original 22-item version	3.3	15.3	\0.001		
Persistent desire or repeated unsuccessful attempts to quit (criterion 2)	1.0	8.3	\0.001	–	–
Original 22-item version	78.0	91.0	\0.001		
Much time/activity to obtain, use, recover (criterion 3)	5.3	23.3	\0.001	–	–
Original 22-item version	5.3	23.3	\0.001		
Important social, occupational, or recreational activities given up or reduced (criterion 4)	1.7	16.7	\0.001	–	–
Original 22-item version	6.7	25.0	\0.001		
Use continues despite knowledge of adverse consequences (e.g., failure to fulfil role obligation use when physically hazardous) (criterion 5)	12.3	44.3	\0.001	–	–
Original 22-item version	12.3	45.1	\0.001		
Tolerance (criterion 6)	14.7	51.7	\0.001	–	–
Original 22-item version	14.7	51.7	\0.001		
Withdrawal (criterion 7)	4.3	24.7	\0.001	–	–
Original 22-item version	4.3	24.7	\0.001		
Impairment (criterion 8)	3.3	31.0	\0.001	–	–
Original 22-item version	3.3	31.0	\0.001		
YFAS food addicted	1.7	21.0	\0.001	–	–
YFAS food addicted (22 items' version)	11.0	52.3	\0.001		
YFAS score–M (SD)	0.43(0.80)	1.84(1.79)	\0.001**	0.85	0.29
BES–M (SD)	4.88(5.23)	14.10 (8.80)		0.89	0.35
BES 17	3.4	33.2	\0.001	–	–

YFAS Yale Food Addiction Scale, BES binge eating scale ** $t_{598} = -12.54$

The Barratt Impulsiveness Scale (BIS-11) assesses personological traits and behavioural constructs of impulsiveness (Patton et al., 1995). The Italian validated version used in this study is a 30-item scale describing common impulsive or non-impulsive (for reverse scored items) behaviors and preferences (Fossati et al., 2001). Items are scored on a 4-point Likert scale ranging from 1 (Rarely/Never) to 4 (Almost Always/Always). The total score is based on six first-order factors (attention, motor, self-control, cognitive complexity, perseverance, and cognitive instability

impulsiveness) and three second-order factors (attentional, motor, and non-planning impulsiveness). The scale measures three types of impulsivity (Fossati et al., 2001):

1) Attentional impulsivity (inability to focus attention or concentrate)
2) Motor impulsivity (acting without thinking)
3) Non-planning impulsivity (lack of future orientation or forethought)

The Difficulties in Emotion Regulation Scale (DERS) is a 36-item measure of emotion dysregulation (Gratz and Roemer, 2004). The test subscales tap into six aspects of emotion dysregulation:

1) Non-acceptance of emotional responses (Non-acceptance scale)
2) Difficulties engaging in goal directed behaviors (Goals scale)
3) Impulse control difficulties (Impulse scale)
4) Lack of emotional awareness (Awareness scale)
5) Limited access to emotion regulation strategies (Strategies scale)
6) Lack of emotional clarity (Clarity scale)

The Italian validated questionnaire has the same structure and uses a 5-point Likert scale scoring, with higher scores reflecting greater emotion dysregulation (Sighinolfi et al., 2010).

Finally, the Binge Eating Scale (BES) is a 16-item questionnaire evaluating both behavioural manifestations (i.e., eating large amounts of food) as well as feelings and cognitions associated with binging (i.e., guilt, fear of being unable to stop eating). The measure successfully differentiates among absent, moderate, and severe binge eating tendencies (Gormally et al., 1982). The Italian validated BES was used in this study (Di Bernardo et al., 1998).

3.4.3 Data Analysis

The Pearson's correlation index was used to test associations between the YFAS-16 symptom count scores and other measures. Independent-sample t-tests and chi-square tests were then used to compare patients who met food-addiction criteria on the Italian YFAS with those who did not meet such criteria. SPSS Statistics software Version 20 was used to analyze the data. G-Power 3.1.3 Software was used to calculate statistical power (Faul et al., 2009). The results showed that a sample size of 84

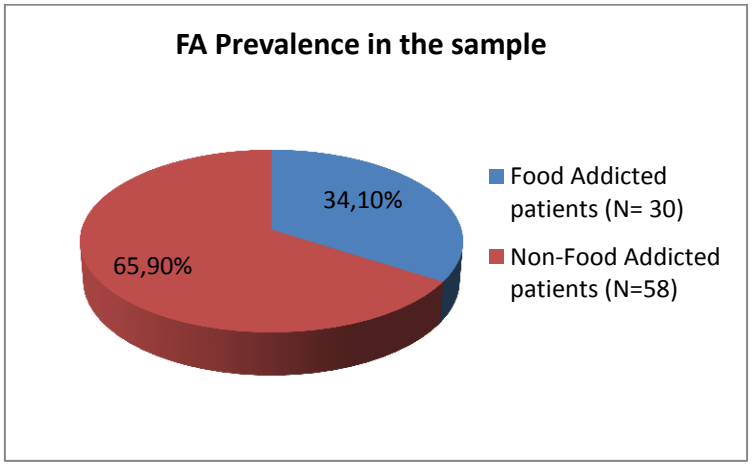
participants provides 80% of power to detect a moderate correlation of 0.3 or above at the 0.05 level (see sample section). Moreover, the classic Critical Alphas were adjusted (0.05) for multiple comparisons according to the number of tests performed only with the subscales of the DERS (alpha = 0.008) and the BIS (alpha = 0.016 for second-order factors and 0.008 for first-order factors). For the total scores of the BIS, the DERS, and the BES, critical alpha was maintained at the nominal level of 0.05.

3.5 Results

3.5.1 Descriptive statistics: Frequency of answers per YFAS Item

Overall, 30 patients (34.10%; 95% Confidence Intervals: 24.25% to 43.95%) met the diagnostic threshold for FA on the YFAS-16 (three or more FA symptoms endorsed and a clinically significant impairment), as depicted in the pie chart in Figure 13 below:

Fig. 13: Pie chart of food addicted vs. non-food addicted patients in the sample



Detailed characteristics of the frequency of answers for each item of the YFAS can be found in the table on the next page (Table 3).

Table 3: Frequency of answers for each YFAS Item (with percentages)

Item #	0	1	2	3	4	% 0	% 1	% 2	% 3	% 4
YFAS 1	14	11	32	23	8	15,91	12,50	36,36	26,14	9,09
YFAS 2	36	10	20	17	5	40,91	11,36	22,73	19,32	5,68
YFAS 3	51	16	6	12	3	57,95	18,18	6,82	13,64	3,41
YFAS 4	38	14	19	13	4	43,18	15,91	21,59	14,77	4,55
YFAS 5	27	18	26	9	8	30,68	20,45	29,55	10,23	9,09
YFAS 6	25	15	18	21	9	28,41	17,05	20,45	23,86	10,23
YFAS 7	51	14	10	11	2	57,95	15,91	11,36	12,50	2,27
YFAS 8	55	14	7	6	6	62,50	15,91	7,95	6,82	6,82
YFAS 9	49	16	11	7	5	55,68	18,18	12,50	7,95	5,68
YFAS 10	64	11	8	4	1	72,73	12,50	9,09	4,55	1,14
YFAS 11	68	7	10	2	1	77,27	7,95	11,36	2,27	1,14
YFAS 12	46	14	14	8	6	52,27	15,91	15,91	9,09	6,82
YFAS 13	36	13	19	13	7	40,91	14,77	21,59	14,77	7,95
YFAS 14	25	24	17	17	5	28,41	27,27	19,32	19,32	5,68
YFAS 15	30	13	17	16	12	34,09	14,77	19,32	18,18	13,64
YFAS 16	44	8	10	12	14	50,00	9,09	11,36	13,64	15,91

Further details on the frequency of answers for each of the YFAS Item can be found in Figure 11, indicating through a bar chart the number of times each response was chosen per item and Figure 12 showing the percentage of every scoring option provided, for each of the 16 items of the YFAS questionnaire (see Figure 14 below and Figure 15 on the next page).

Fig. 14: Bar chart of scoring frequencies on each of the YFAS-16 Items

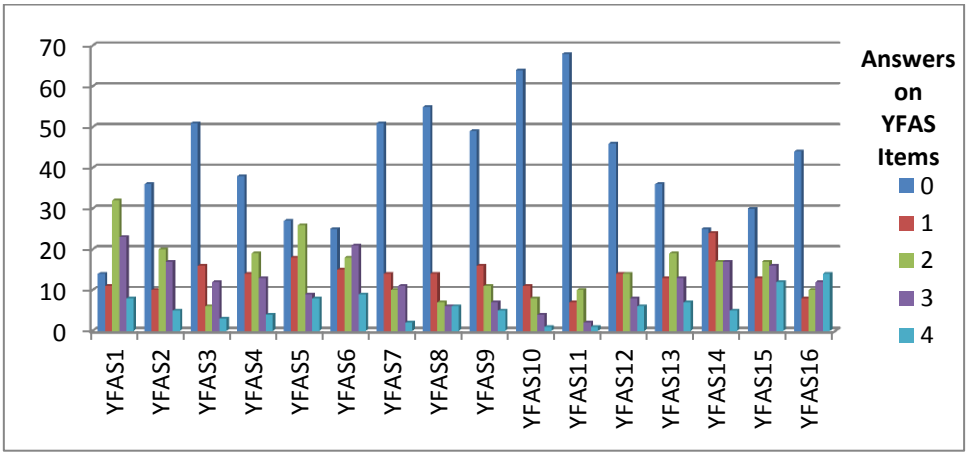
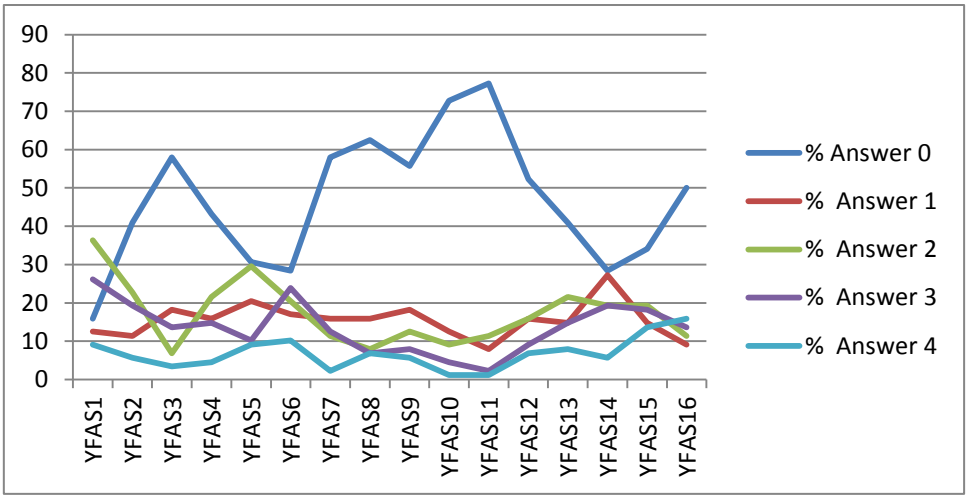


Fig. 15: Line chart of percentages of each scoring option per YFAS-16 Items



Endorsement rates of the seven food addiction symptoms of the YFAS-16 are summarized in Table 4 below.

Table 4: YFAS symptom count Independent samples T-Test

Subjects	With NO Food Addiction N = 58					With Food Addiction N = 30					
*Indep. Samples T-Test	Mean	s. d	Median	Min	Max	Mean	s. d.	Median	Min	Max	P*
YFAS Symptoms	**2,7**	1	2,5	0	6	**4**	1,1	4	3	7	**<.001**
BMI	40,4	6	39,7	30,4	59,5	41,6	8,8	39,9	29	73	**.0458**
Weight (in Kg)	109,2	18,9	108	73	138	114,7	24,2	111,5	85	180	**.24**

The mean number of food addiction symptoms for participants diagnosed as not having YFAS-16 food addiction criteria was 2.7 (sd = 1) with a median value of 2.5, a minimum of 0 and a maximum of 6. The mean number of FA symptoms on the YFAS-16 was 4 (sd = 1.1) for those diagnosed with YFAS-16 food addiction criteria, with a median value of 4, a minimum of 3 and a maximum of 7. The difference between patients meeting YFAS-16 FA criteria and patients not meeting such criteria was statistically significant (p = < 0.01) (see Table 4). No statistically significant difference was found in weight, height, BMI, (see Table 3), age, gender, employment, and scholar level between participants classified with and without food addiction on the YFAS-16.

Statistically significant differences were found between patients with FA and those without in the Binge Eating Scale (BES), Difficulties in Emotion Regulation Scale (DERS) total scores, and "impulse" subscale of the latter (p = < 0.01), with patients diagnosed with food-addiction on the YFAS-16 showing higher means (see Table 5).

Table 5: Independent samples T-Test of Other Measures (BES, DERS, BIS)

Subjects	**With NO Food Addiction N=58**					**With Food Addiction N=30**					
* Indep. samples T-Test	Mean	s.d.	Median	Min	Max	Mean	s.d.	Median	Min	Max	P*
BES Total score	**9,4**	6,7	7	0	30	**20,0**	9,3	22,5	3	42	**<.001**
Non acceptance	13,9	6,4	13	6	30	18,1	6,2	19,0	6	28	.005
Goals	11,6	4,3	10	5	23	15,0	4,7	15,5	7	24	.001
Strategies	16,5	6,2	16	8	35	20,7	5,6	20,5	9	30	.003
Impulse	**10,7**	4,7	9,5	6	27	**15,8**	6,6	15,0	6	26	**<.001**
Clarity	9,8	4,0	10	5	18	12,9	4,5	13,0	5	22	.002
Awareness	6,7	3,3	6	3	15	7,6	2,8	7,0	3	13	.227
DERS Total score	**69,3**	21	67	33	130	**90,1**	23,7	92,0	44	132	**<.001**
Attention	9,5	2,6	9	5	15	10,5	2,8	10,5	5	17	.094
Motor Impulsiveness	13,2	3,3	13	7	22	14,0	4,8	13,0	8	28	.361
Self-Control	12,5	4,2	12	6	22	14,3	4,1	14,5	6	22	.061
Cognitive Complexity	12,3	2,3	12	7	18	13,6	2,9	14	5	17	.033
Perseverance	7,2	1,8	7	4	11	7,8	1,9	8	4	11	.153
Cognitive Instabil./Impulsivity	6,3	1,5	6	3	9	6,3	2,0	6	3	10	.922
Attentional Impulsivity	15,7	3,0	16	9	23	16,8	4,2	17	10	26	.182
Motor Impulsivity	20,4	3,8	20	14	29	21,8	5,4	20,5	14	37	.21
Non-planning Impulsivity	24,9	5,6	24	13	36	27,9	6,4	28,5	11	38	.026
BIS Total score	61	9,7	60	38	86	66,5	13,5	68	35	95	.032

The YFAS-16 symptom count positively correlated with participants' total scores on the Binge Eating Scale (BES), (r = .331; p = < 0.01) and on the Difficulties in Emotion Regulation Scale (DERS) (r = .317; p = < 0.01). Four subscales of the Difficulties in Emotion Regulation Scale (DERS) correlated positively and significantly with the YFAS-16 symptoms. These subscales were Non-acceptance (r = .257; p = < 0.05), Goals (r = .211; p = < 0.05), Impulse (r = .378; p = < 0.01), and Clarity (r = .237, p = < 0.05). Positive correlations were also found between the YFAS-16 symptoms and the Barratt Impulsiveness Scale (BIS-11) total score (r = .261; p = < 0.05).

Three subscales of the Barratt Impulsiveness Scale (BIS-11) were found to positively and significantly correlate with the YFAS-16 symptom count. The three subscales were Attention (r = .261, p = < 0.05), Cognitive Instability (r = .218, p = < 0.05), and Attentional Impulsivity (r = .305, p = < 0.01). After applying critical adjusted alphas (see data analysis), only the DERS Impulse subscale (r = .378; p = < 0.008), and the BIS Attentional Impulsivity subscale (r = .305, p = < 0.016) maintained statistical significance. The YFAS Symptom Count Pearson's Correlations are summarised in table 6 in the following page.

Table 6: YFAS Symptom Count Pearson's Correlations (Sig. 2-tailed)

BES Tot	,331**			0,002▪					
DERS Tot	Non Accept.	Goals	Strategies	Impulse	Clarity	Aware			
,317**	,257*	,211*	0,197	,378**	,237*	0,119			
0,003▪	0,016▪	0,048▪	0,066▪	0▪	0,026▪	0,27▪			
BIS Tot	Attent	Mot. Imp.	Self-Control	Cogn. Compl.	Persev	Cogn. Instab	Attention Impulsiv	Motor impulsiv	Non-plan impulsiv
,261*	,261*	0,161	0,156	0,202	0,059	,218*	,305**	0,165	0,196
0,015▪	0,015▪	0,137▪	0,149▪	0,06▪	0,59▪	0,043▪	0,004▪	0,126▪	0,069▪
Symptom count Pearson Correlations: ▪ Sig. 2-tailed; ** Correlation is significant at the 0.01 level (2-tailed); * Correlation is significant at the 0.05 level (2-tailed).									

Cronbach's alpha was used to assess the internal consistency of the Italian YAFS-16 scale. The Alpha coefficient was 0.903.

3.6 Discussion

This study investigated the convergent validity of the Italian YFAS-16 [27], with measures assessing disordered eating. Also, this research examined the divergent validity of the YFAS-16 with measures assessing other psychopathology, which have previously been used in the original YFAS validation (Gearhardt et al., 2012). The current research extended the validation of the YFAS-16 (Innamorati et al., 2014) in Italy, where there is currently a lack of psychometric measures designed to assess food-addiction. The study estimated the FA prevalence in a sample of obese adult in-patients engaged in a brief weight-loss program. Furthermore, this work assessed food addiction

as measured by the YFAS-16, disordered eating, as well as impulsiveness and emotional dysregulation, which are often found in classic substance-addiction (Volkow and O'Brien, 2007; Bonn-Miller et al., 2008).

In the sample 34.1% of participants met the full YFAS-16 criteria for food-addiction while patients who did not meet such criteria, endorsed on an average three symptoms (2.7). This result may imply a possible association between obesity and food-addiction symptoms, as diagnosed by the YFAS-16. Additionally, some participants classified without food addiction on the YFAS-16 went over the threshold, reaching up to six symptoms, although without clinical significance. This may suggest the need to further investigate eating patterns that are similar to those found in classic substance addiction in obese individuals with and without Binge Eating Disorder (BED), as suggested by previous research (Garber and Lustig, 2011; Schag et al., 2013; Wang et al., 2002; Avena, 2009).

Moreover, the mean scores on the BES of patients who were diagnosed with food-addiction on the YFAS-16 were significantly higher compared to those who did not meet food-addiction criteria. This could suggest the possible existence of a particular subset of obese patients with BED characterized by a greater eating psychopathology compared to those who do not have signs of food-addiction, as evidenced in other studies (Gearhardt et al., 2012; Schag et al., 2013). Findings may suggest the presence of obesity associated with BED, which may resemble psychological distress and behavioral manifestations typically related to substance-dependence, as research already highlighted (Gearhardt et al., 2011 and 2012; Loeber et al., 2012, Schag et al., 2013; Curtis and Davis, 2014). This could indicate that participants who met an FA diagnosis on the YFAS-16 might have more difficulty in losing weight and may be at a risk for future weight-gain (Gearhardt et al., 2011).

Patients who met the YFAS-16 food-addiction criteria in this sample paid greater attention to food as opposed to those who did not meet such criteria. This could somewhat resemble the biased attention towards psychotropic substances in substance-use disorders (Di Leone et al., 2012; Volkow, 2005; Fortuna, 2012). Those classified as meeting the food addiction criteria on the YFAS-16 may be predisposed to experience emotional dysregulation, general emotional instability, and negative emotional states compared to those who did not endorse the YFAS-16 food addiction criteria (Gearhardt

et al., 2011b). Thus, some individuals may find a strategy to regulate negative emotional affects and achieve more positive emotional states in a sort of 'self-healing' attempt through excessive food consumption (Gearhardt et al., 2011 b and 2012; 38]. This behavior seems to echo classic substance-use, which is triggered by negative mood and emotion dysregulation (Bonn-Miller et al., 2008).

Patients who met food-addiction criteria, as measured by the YFAS-16, were more likely to experience non-acceptance of emotional responses, negative secondary emotions in response to primary negative emotions, or non-acceptance reactions to psychological discomfort, as revealed by their DERS scores. They also experienced greater difficulty in adopting a goal-oriented behavior, concentrating and carrying out a task when feeling negative emotions, and controlling impulses compared to those who did not display FA criteria on the YFAS-16. Finally, a food-addiction YFAS-16 diagnosis may be related to lower emotional lucidity and a greater difficulty in recognizing emotions. The results suggest that in some cases of morbid obesity, investigating emotional deregulation may be relevant to gain a better understanding of binge eating triggers. Negative affect and mood dysregulation, rather than overly restrictive dieting (Gearhardt et al., 2012), may drive some obese individuals to eat more, perhaps as a coping strategy for the heightened emotional distress (Ceccarini et al., 2014).

Furthermore, it was found that a food-addiction YFAS-16 diagnosis it is possibly associated with a higher tendency to act rapidly and instinctively in response to environmental/internal stimuli, without considering negative consequences, as demonstrated by the BIS scores. Hence, obese adults with YFAS-16 food addiction may show higher attentional impulsivity and inability to complete tasks as well as lower inhibitory control behavior compared to patients who were not diagnosed with food-addiction on the YFAS-16. Such features are signs of addictive-like behavior, similar to those found in alcohol and drug misuse (Volkow and O'Brien, 2007). These findings suggest the need to further investigate obesity and food addiction to provide patients who meet FA criteria with the best possible treatment. Specific weight-loss programs should consider the existence of a particular type of obesity in hospitalized patients, as promptly identifying FA symptoms may lead to more efficient weight-loss interventions (Avena et al., 2012; Wang et al., 2002).

If strong similarities existed between certain phenomenological and neurobiological correlates of food-addiction in obesity and addictive disorders (Davis et al., 2011; Gearhardt et al., 2009 and 2011b; Loeber, et al., 2012), the treatment of obesity associated with food-addiction might need to utilize interventions, which are traditionally employed in treating substance-addiction (Di Leone et al., 2012). Food addiction treatment should consider specific interventions aimed at diminishing the power of food reinforcing properties on the one hand, and the development of more functional alternative reinforcers on the other (Fortuna, 2012). As Volkow and Wise (2005) suggested, food addiction interventions should contemplate treatment strategies and techniques that are generally successful in substance-use disorders. These strategies provide continuous care that varies according to the specific rehabilitation stage and the patients' personal resources, enhanced abstinence motivation, relapse prevention and problem-solving development (Volkow and Wise, 2005), Tailored interventions on morbid obesity associated with FA should also promote the functional inhibition of conditioned learned associations to enhance motivation for non-food-related activities and the development of specific coping strategies to overcome stressful events, mood instability, low self-control, as well as low frustration tolerance (Volkow et al., 2013).

Overall, this research shows that the YFAS-16 (Innamorati et al., 2014) has good construct validity with measures of disordered eating (BES), impulsiveness (BIS) and emotional dysregulation (DERS). In the light of such findings, it appears that future research on obesity and binge eating associated with food-addiction should address emotional dysregulation and impulsiveness, as they may be directly influencing such condition. This study could provide suggestions for future research to further explore the role of disinhibition, emotional eating, and loss of control in FA, as this could be relevant for early and efficient interventions and relapse-prevention.

3.7 Study Limitations

Although this work has potential implications for improving weight-loss interventions in obesity associated with FA symptoms, it has some limitations. First, the psychometric assessment was only carried out in a clinical setting with a convenience

sample of participants engaged in a brief treatment program, and it is not representative of the original population from which it was drawn. Moreover, the sample comprised a relatively small number of participants, and the results may not be generalizable to other groups of patients (e.g., bariatric surgery patients). Second, the study did not include a control-group, which could have been useful to make more accurate or precise conclusions on the YFAS-16 properties.

Additionally, the experimental design may not have been fully satisfactory as only self-reported measures were administered, and these could be susceptible to social desirability bias (Arnold and Feldman, 1981). Third, measures of depression, which have been found to be closely related to FA (Gearhardt et al., 2012), were not administered. Finally, the diagnostic sensitivity and specificity of the YFAS-16 were not assessed, as at the time of this study, there was no other valid and reliable instrument for a food addiction diagnosis in Italy. Future assessments should investigate the appropriateness of the Italian YFAS-16 in relation to the new Diagnostic and Statistical Manual of Mental Disorders (5th edition), (APA, 2013) substance dependence criteria, which this study could not include.

Considering the above, the results still have important implications for the food-addiction problem by offering an evaluation of a specific tool, such as the YFAS-16. Future studies on obesity may benefit from the use of a measure that would identify dependence symptoms concerning certain types of food. Overall, the YFAS-16 demonstrated to be a sound measure for identifying food addiction symptoms in adult obese inpatients. More evaluations of this scale in Italy are strongly recommended, as they could provide further evidence of the reliability and validity of the scale. This could also provide crucial clinical and psychometric data on ‘food addiction’ amongst Italian obese and non-obese individuals.

3.8 Conclusion

The present study suggests that food addiction, as assessed by the YFAS-16, is a condition that can affect obese adults engaged in weight-loss programs. The study also provides psychometric and clinical evidence that food-addiction, as measured by

YFAS-16, may be associated with binge eating, higher emotion dysregulation lower self-control, and higher impulsivity. These findings may suggest that the clinical implications concerning the subset of obese individuals who meet food-addiction criteria, as defined by the YFAS-16, are not yet known. It is important to identify addiction to food in obese individuals to develop a well-tailored treatment for these patients. Future research should carefully explore the food addiction phenomenon using reliable and valid psychometric measures to better assess disordered eating and to fully understand psychological, emotional, and behavioral implications associated with such condition.

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Chapter 4: Italian translation and validation of the S-Weight and the P-Weight questionnaires: assessing weight-management readiness to change according to the Transtheoretical Model (TTM)

4.1 What is already known about this subject and what does this study add

The growing prevalence of eating disorders, especially overweight and obesity has created major health problems and health-related costs at a worldwide level. It must be considered that overweight and obesity are often associated with various other harming diseases such as cardiovascular disorders, hypertension, type-II diabetes, certain forms of cancer, sleep apnea and metabolic diseases (WHO, 2014). Despite numerous health preventions and good practices campaigns within eating, the strategies adopted to avoid the obesity epidemic are still not producing sufficient effects that are able to stop its progression (Wolk and Somers, 2006).

The Transtheoretical Model (TTM) of behaviour change (Di Clemente and Prochaska, 1982; Prochaska and Di Clemente, 1983; Prochaska and Di Clemente, 1984; Prochaska et al., 1992) represents the most promising model in addressing, understanding and promoting behaviour change related to the acquisition of healthy lifestyles, even up to date. Many studies have shown that the role of motivation and of the stages of change of the TTM can be applied to the treatment of eating disorders and weight-loss (Wilson and Schlam, 2004). In particular, the TTM has been successfully used to treat various aspects associated with obesity: eating low fat foods, weight-control, diabetes, eating fruit and vegetables and doing physical exercise (Miilunpalo et al., 2000; Siero et al., 2000; Steptoe et al., 2000; Feinstein and Feinstein, 2001; Kirk et al., 2001).

The present study describes an Italian translation and validation of two sets of questionnaires specifically designed to assess motivation in weight-management: the S-Weight and the P-Weight questionnaires. These tools are able to detect readiness to change in weight-maintenance according to the Transtheoretical Model, highlighting the relationship between stages and processes of change. No measures of such kind are currently validated in Italy.

4.2 Abstract

Weight-management readiness to change is characterised by distinct psychological processes and stages of change reflecting the modification of dysfunctional eating behaviours. Psychometric tests on readiness to change following the Trans-theoretical Model (TTM) already demonstrated to be sound and valid. However, research on the processes of change which underlie motivation towards behavioural changes in weight-loss has not been fully developed yet. In Italy, there are no measures which clearly detect such processes. **Objective**: this study wants to investigate the relationship between stages and processes of change and to validate two questionnaires in line with the TTM, designed to assess them (respectively the S-Weight and P-Weight).

Design and Methods: A total of 423 adults (177 men and 246 women) were recruited. 203 participants were enrolled from an obesity-specific center in Northern Italy. They were all obese adult in-patients undergoing a hospital-based weight-loss and related co-morbidities treatment (87 men and 116 women), while 220 adults (90 men and 130 women) were randomly recruited from the Northern Italy community. They were mostly aged between 35-44 (38, 81%), and they were mostly married or living with the partner (52, 29%), with a mean weight of 90, 67 kg (SD = 30, 16) and a mean BMI of 32, 43 (SD = 10, 69) kg/m2. Participants were subministered the S-Weight (stages of change questionnaire) and the P-Weight (processes of change questionnaire) and two subscales from the Eating Disorders Inventory-3 and the Eating Attitudes Test-40 questionnaires on dieting concern.

Results: A confirmatory factor analysis (CFA) on the sample revealed that the model of four freely correlated first-order factors representing the four processes of change showed a good fit (Chi2 = 2086.973 d.f.= 521, p= ≤0.001, RMSEA= 0.084, SRMR= 0.05). Corrected item-total correlations (0.379–0.862) and Cronbach's alpha coefficients were adequate, ranging from 0.77 to 0.94 with a total of 0.97 for the whole scale. The relationship between the P-Weight and the S-Weight and the concern with dieting measures from other questionnaires supported the validity of the scale.

Conclusion: The study identified processes of change involved in weight management and reports the adequate psychometric properties of the S-Weight and P-

Weight. It also reveals the relationship between processes and stages of change and other external variables.

4.3 Introduction

The successful management of chronic diseases (such as cardiovascular pathologies, diabetes, obesity, BPCO, chronic pain, etc.), typically requires that patients are motivated to make significant lifestyle behavior changes in order to improve health outcomes, quality of life and well-being. Clinical Psychology has developed many useful motivational strategies based on different theoretical and practical approaches (such as motivational interviewing, transtheoretical model of change, self-management, mHealth monitoring and treatment strategies, Chronic Care Model, etc.). The current practice of Clinical and Health Psychology for enhancing motivation in patients with chronic conditions such as overweight and obesity is essential to obtain patients' adherence to long-term monitoring and efficient treatment protocols as well as to ensure their functional empowerment and engagement.

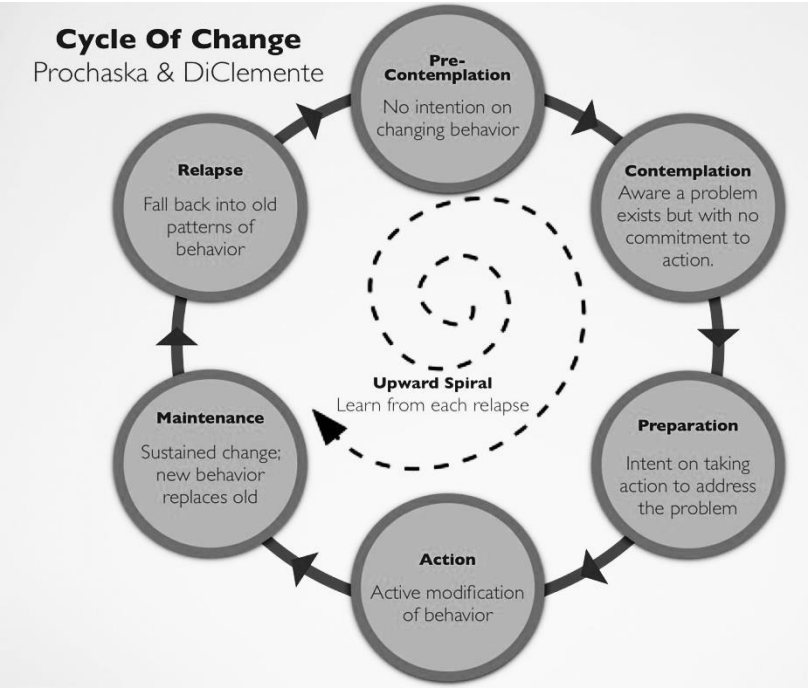
A professional approach specifically addressing motivation for change can influence the intervention choice, adherence and partially the treatment outcome (Ryan et al., 2011). Nevertheless, the majority of obese patients do not continue with weight-loss programmes, and only a few of them manage to lose weight without re-gaining it afterwards (Bautista-Castaño et al., 2004). The transtheoretical model (TTM) (Prochaska and Di Clemente, 1982) provides a strong theoretical framework that is useful to determine readiness to change and to tailor interventions according to the patient's motivation in weight-management, also preventing dropouts (Seals, 2007; Norcross et al., 2011).

Assessing overweight or obese patients' motivational readiness to change in weight-management assumes an important role in their willingness to listen to dietary changes messages and to act on healthy advice. By exploring the patients' readiness to change, it is possible to determine the most appropriate level of treatment intervention and to effectively tackle more severe forms of obesity as the one associated with food addiction. The vast majority of motivational assessment tools used within the clinical

setting have been primarily developed in the field of substance abuse. Such instruments frequently represent the Readiness to Change (RTC) concept described by Prochaska and Di Clemente in their Stages of change model or Trans-theoretical Model (TTM) (Prochaska et al., 1992). The assessment of RTC is generally made by verifying at which specific stage of the TTM the individual falls into, in order to gain crucial information regarding the level of the problem consciousness (reasons for change), of willingness/decision to change (commitment for change) and the actual behaviour changes (actions for change), (Prochaska and Di Clemente, 1984).

The TTM can therefore be described as an integrative and comprehensive model of behaviour change, and it is strongly supported by empirical evidence on the reliability and validity of its core constructs such as the stages of change and the processes of change. Studies have also demonstrated the predictive soundness of the TTM in conditions which involve the cessation of negative behaviours such as drug use or those which have important implications on mental and health consequences such as overeating (Prochaska et al., 1994). The cornerstones of the model are the six Stages of Change, the steps individuals use to progress through an intended behaviour change (see Figure 14 below).

Fig. 16: The TMM stages of change (adapted from Prochaska and Di Clemente, 1982):



To successfully change a dysfunctional behaviour it is necessary to progress through each of the proposed stages. The stages include: Precontemplation, Contemplation, Preparation or Determination, Action, Maintenance, though Preparation was a later addition to the earlier model (Prochaska, et al., 1994). Relapse can occur at any stage, (Redding et al., 2000). The first stage, Precontemplation, describes a stage in which individuals are not ready to consider a behaviour change as they do not recognise the behaviour as being problematic, or they have no desire to modify it within the next six months. At this level, the rewards from keeping up with the new behaviour are higher that the costs implicated in changing it. The Contemplation stage is characterised by a consideration of changing a behaviour within the next six months but also by a great deal of ambivalence regarding the change. That is to say that the individual partially wishes to change although he/she is still waiting for the ideal time to make a commitment, or he/she may feel intense fear of the unknown changes to derive (Prochaska and Di Clemente, 1982).

Those in Preparation or Determination are ready to change a behavior within one month; they are conscious about the fact that change is essential. At this stage, it is likely that individuals already attempted to make changes in the past, and are slowly moving towards ending their negative behaviour. The fourth stage is Action; it encompasses dynamic behaviour change in a time ranging from one day to six months (Prochaska and Velicer, 1997). The risk for relapse is rather high at this stage since people are engaged in something totally new. The final stage is Maintenance and it represents a continuation of the Action one, for six months or more; some never manage to reach this stage, as cravings may exist throughout lifetime. The newly acquired behaviour gradually becomes routine and relapse potential is lower than in the previous stages. The dysfunctional behaviour at this level has progressively become a smaller temptation or threat (Prochaska and Di Clemente, 1984).

Some individuals relapse or recycle through previous steps and they may even return to the initial Precontemplation stage. It must be noted that contrarily to cigarette smoking or drug use, unsuccessful weight-loss may be related to being unable to terminate unhealthy or compulsive overeating as changing such behaviour cannot involve complete abstinence from food. In fact, it is often easier to eliminate something completely rather than just altering it. The fundamental aspect of the stage model is

flexibility, since it allows for progression and regression while changing behaviour (Prochaska and Norcross, 2006).

This change process has therefore a cyclical nature; individuals repeatedly move once, or more likely more times, across the five stages before attaining a state of sustained change, in which relapse is an integral part of the movement towards constant change. Hence, individuals could move within each of the five proposed stages over time and with repeated attempts according to their readiness to change and to eventual relapse. They could re-enter the phases from the start, therefore, the best way to define the TTM stages is depicting it as a change spiral (Prochaska, Di Clemente, et al., 1992). Each different stage is qualitatively different in the sense that each one could be "regarded as reflecting a distinct motivational posture" (Velicer et al., 1995 p. 300), although stages are mutually exclusive and individuals can only belong to a single stage at a time. Moreover, each stage is characterized by a specific balance between the pros and cons of dysfunctional behaviour change; the pros increase when individuals go from the Precontemplation to the Action stage, since they gain a strong principle of change as opposed to the cons which decrease against change, (Velicer et al., 1995).

The stages of change model (SOC) works at its best when the therapeutic principles and intervention strategies are fit into the individual's optimal motivation corresponding to each particular stage (Prochaska and Di Clemente, 1982). Moreover, the framework of the SOC is transtheoretical as it is not strictly rooted into a specific theoretical approaches but it can be embraced into different frameworks and techniques. In fact, the TTM originated from 24 leading psychotherapy models, thus explaining its transtheoretical nature. Additionally, individuals who wish to attain behaviour change will go through 5 main cognitive processes: consciousness raising, dramatic relief, environmental re-evaluation, social liberation and self-evaluation and five main behavioural processes: stimulus control, helping relationships, counterconditioning, contingency management and self-liberation (Prochaska and Di Clemente, 1986).

More to that, the individual is likely to prevalently use the cognitive/experiential processes in initial, more motivation-oriented stages while the behavioural processes would be most commonly used in action-oriented stages, which are related to the later stages of the model. The processes of change explain how behaviour change takes place and are hence a set of constructs that show how individuals evolve along the stages of

change (SOC), which indeed represent the temporal dimension of a target behaviour change (Guo et al, 2006). While the stages of change focus on when people change, the processes of change describe how people change through overt and covert activities that are involved in attempting to modify problematic behaviours (Prochaska and Di Clemente, 1985).

Literature recognised up to twelve processes of change involved in definite stages of change, thus, at present, there is no consensus regarding the number of processes of change that are involved in behaviour change within the field of addiction and weight-control (Prochaska et al., 1992). What is known is that in certain stages of change some processes of change are more effective: experiential processes are most useful during earlier stages, whereas processes associated with behavioural components are most useful during the final stages of change (Prochaska and Di Clemente, 1983). Moreover, the TTM model assumes that the processes of change use is very low during precontemplation and gradually increases along later stages, regardless of the type of behaviour one wishes to modify (Prochaska, et al., 1994).

Studies on nutrition, physical activity behaviours and weight-management interventions regarding the effectiveness of the TTM are rather uncommon and have generally failed to present convincing findings (Norcross et al., 2011). As reported by Prochaska et al., (1992), previous research demonstrated that the SOC at baseline were not associated with weight-loss over a three-year period in a large sample, though during the more active stages of change, weight-loss was greater. At present, only very few empirical investigations have assessed how weight change during obesity-specific treatment programs is influenced by change in psychosocial variables included in health behaviour change theories as the TTM and the SOC models (Norcross et al., 2011).

Berrigan et al., (2003) highlighted that the most common health behaviours in U.S. adults involve a lack of adherence to exercise, to dietary fat and to fruit and vegetable recommendations. This suggests the need to tackle the alarming and multiplicative nature of health consequences given by overweight and obesity. Health behaviour change in weight-loss and in weight management could help maximizing health benefits and reducing healthcare costs (Prochaska, Spring and Nigg, 2008). In this respect, the study conducted by Johnson et al., (2008) on over twelve-hundred overweight and moderately obese adults is worth mentioning. Researchers randomly

assigned participants to treatment groups receiving a multiple behaviour change, weight-management interventions based on healthy eating (low fat dietary intake), moderate exercise and emotional distress management without eating. For each of the three experimental conditions, a matched control group who received no intervention was established. Follow-ups were conducted after 6, 12, and 24 months.

Findings revealed that after 24 months, participants who were initially in a pre-Action stage for healthy eating were significantly more likely to have reached Action or Maintenance compared to matched controls, after treatment. Moreover, those who were in a pre-Action stage for exercise at baseline and received treatment were also significantly more likely to progress towards the final stages of the SOC model. Similar results were also found for emotional distress management (without eating). Weight-loss also encountered a significant difference between treatment and control group (respectively 30% vs. 18.6%). Those in a pre-Action stage who received intervention managed to lose 5% or more of their body weight compared to the non-treatment groups. This research proved that TTM-based interventions can favour healthy eating, exercise, emotional distress management and weight-loss in overweight and obese subjects (Johnson et al., 2008).

Another interesting study was conducted by Palmeira et al., (2007), who examined how changes in exercise and weight-management were influenced by interventions related to the TTM stages of change. Findings suggest that health behaviour change models like the SOC would significantly predict weight change in an obesity treatment short-term intervention. Promising outcomes when using the TTM applied to weight-loss interventions are also found in a research carried out by Suris and colleagues (1998) on Mexican American women, whose incidence of obesity is greater in than in Caucasians. Researchers explained that the TTM application on their sample allowed determining five different stages of change profiles, similar to those described in previous studies on smoking, psychotherapy, alcoholism, and overeating. More to that, results demonstrated that the therapeutic use of stages, processes, and profiles of change consistently and positively influenced weight-loss. Therefore, the study supports the use of the Transtheoretical Model across different cultures providing further evidence towards successful weight-management when incorporating the stages and processes of behaviour change in specific weight-loss interventions (Suris et al., 1998).

The TTM is thus a sound paradigm for behaviour change in individuals, even in the field of weight-management, and it represents the theoretical background that guided this research. Although the constructs or framework encompassed in the TTM are found to be robust across literature (Prochaska, et al., 1994; Redding, Rossi, Rossi, Velicer and Prochaska, 2000), the relationship between Stages of Change and Processes of Change, beyond the field of addictions, is still somewhat unclear, especially for what concerns weight-management (Horwath 1999; Suris et al., 1998). This occurs as generally, assessing the stages and processes of change in this field coincides with the evaluation of specific dietary behaviours, weight-loss and exercise, as separate elements (Horwath 1999). Consequently, there is a strong need to provide appropriate assessment tools specifically developed in the context of weight-management that are able to detect both TTM stages and processes of change constructs and dietary/exercise behaviour.

This study has the objective to identify the stages and processes of change implied in weight management by validating the Italian version of a stages of change questionnaire, namely the S-Weight and a processes of change questionnaire, the P-Weight, previously developed in the weight-management setting (Andrés et al., 2009). Moreover, the research has the intent to provide evidence regarding the reliability of the P-Weight questionnaire and to assess the processes of change use across stages of change in weight-management. Finally, the aim of the study was to investigate the relationship between the processes of change in weight-management and other specific measures assessing dieting.

4.4 Methods and Procedures

The questionnaires S-Weight and P-Weight, previously developed in line with the TTM in English (Andrés et al., 2009), were translated and adapted onto Italian. I translated the original English version and a second researcher blindly back-translated the measures to the source language. The back-translated version was submitted to one of the original authors of the S-Weight and P-Weight (Dr. Ana Andrés), who found no discrepancies with the original version of the questionnaire and gave permission for validation to be carried out in Italy, exclusively.

4.4.1 Study population

A total of 423 men (N =177) and women (N =246) normal weight, overweight and obese (BMI ≥ 30) individuals were recruited. 203 participants were non-randomly recruited as they were enrolled from an obesity-specific center in the Northern Italy, the Saint Joseph Hospital of the Istituto Auxologico Italiano. These were all obese adult in-patients undergoing a hospital-based treatment for weight-loss and related co-morbidities (87 men and 116 women). The rest of the sample, 220 adults (90 men and 130 women), was randomly recruited from the Northern Italy community.

Participants were all Italian mother tongue, of Italian citizenship and over 18 years old. They were asked to sing a written informed consent in order to participate. The study was approved by the ethical committees of the medical centre where recruitment had partially taken place. Exclusion criteria were having learning disabilities and/or cognitive or genetic syndromes which would have not allowed participants to complete the questionnaires. The non-randomly recruited participants consisting of obese adult in-patients were included only if they had a Body Mass Index (BMI) of at least 30. Participants were all subministered the S-Weight (stages of change questionnaire) and the P-Weight (processes of change questionnaire) and two subscales from the Eating Disorders Inventory-3 and the Eating Attitudes Test-40 on dieting concern.

Participants' BMI ranged from a minimum of 15, 94 to a maximum of 62, 67, with an average of 32, 43 (sd =7, 1). In women, BMI ranged from a minimum of 15, 94 to a maximum of 62, 67 and an average of 31, 84, while in men BMI ranged from a minimum of 18, 17 to a maximum of 61, 98 and was on average 33, 25 kg/m2 (SD = 10, 69), (see Figure 17 in the next page). The mean weight of the sample was 90, 67 kg (SD = 30, 16). Participants were mostly aged between 35-44 (38, 81%), (see Figure 18 in the next page), and they were mostly married or living with the partner (52, 29%), (see Figure 19 in the next page).

Fig. 17: Descriptive statistics of gender and BMI in the sample

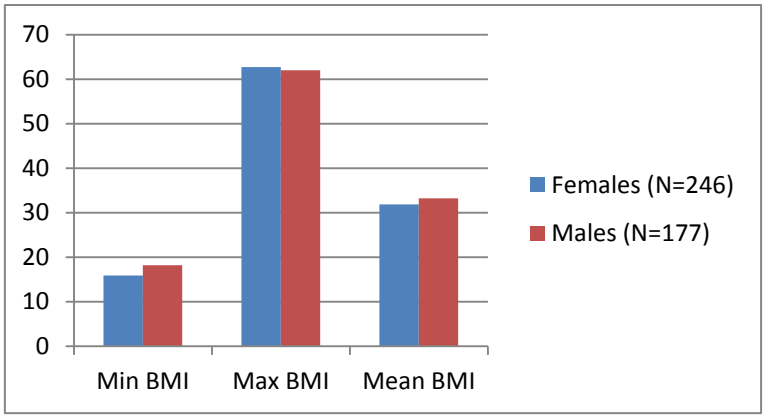


Fig. 18: Descriptive statistics of the sample age groups

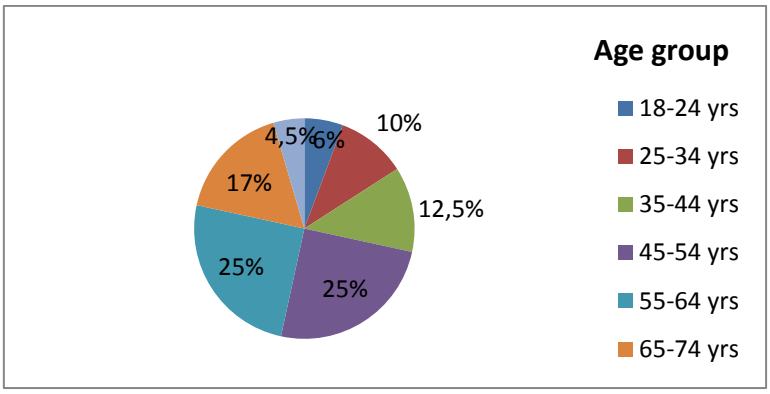
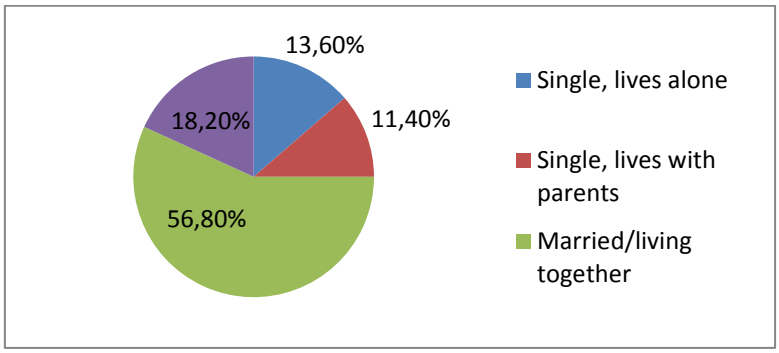
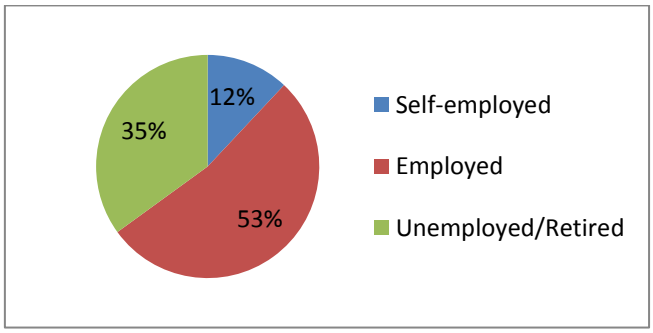


Fig. 19: Descriptive statistics of the sample marital status



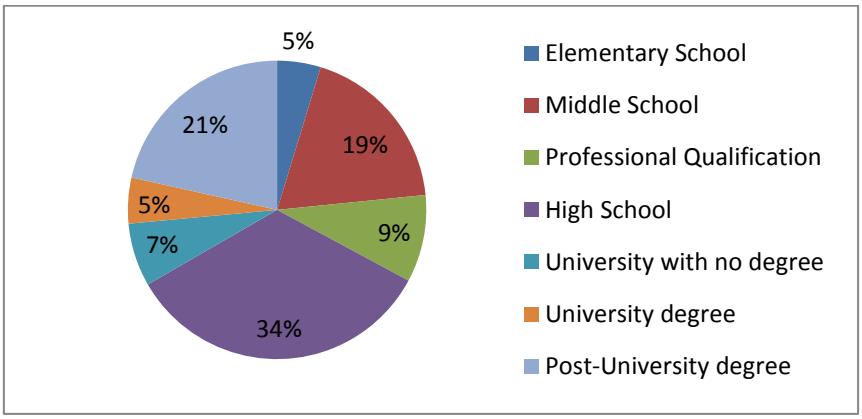
Most participants had siblings (54%); they were mostly employed (53%), only few were self-employed (12%), while 35% was unemployed or retired, (see Figure 20).

Fig. 20: Descriptive statistics of the sample employment status



Participants mostly had a High School Diploma scholar level (34%), just over a fifth had a Post-University degree and the rest had other qualifications (see figure 21).

Fig. 21: Descriptive statistics of the sample scholar level



This study was conducted in accordance with the Declaration of Helsinki and respected legal, ethical, and practical research standards of the Saint Joseph Hospital of the Istituto Auxologico Italiano (IRCCS). All participants were provided with the study protocol and a signed informed consent was obtained from each one of them. Fully trained doctoral-level clinicians performed the assessment. Participants initially completed a preliminary sheet assessing demographic information on gender, age, education, profession, marital status, siblings, and physical measures, such as height in

cm and weight in kilograms. Participants recruited from the Saint Joseph Hospital of the Istituto Auxologico Italiano (IRCCS) also self-reported their weight and height. Such self-reported data were later cross-checked with objective measures previously taken by front-line physicians at the obesity center. Body Mass Index (BDI) was calculated at baseline. All participants were later administered four self-report questionnaires: the S-Weight and the P-Weight (Andrés et al., 2009; 2011).

4.4.2 Instruments

4.4.2.1 The S-Weight and the P-Weight

The S-Weight and P-Weight are two self-report questionnaires respectively investigating the stages of change and the processes of change defined by Prochaska and Di Clemente (1985). The S-Weight consists of five mutually exclusive items; respondents are asked to choose one of the five stages of change to be allocated to, that is to say, Precontemplation, Contemplation, Preparation, Action and Maintenance (Di Clemente et al., 1991). The S-Weight is designed to measure the stages of change as applied to weight-management asking respondents to choose the answer that best corresponds to their current weight-loss situation (Andrés et al., 2009). The P-Weight consists of 34 items measuring individuals' readiness to engage in a diet and in physical activity. The questionnaire is based on the hypothesised processes which individuals use across the stages of change in order to manage their body weight (Andrés et al., 2011).

On the P-Weight, answers are given on a five-point Likert scale ranging from 1 (strong disagreement) to 5 (strong agreement). The four processes of change measured by the P-Weight and implicated in weight-management are: Emotional Re-evaluation (EmR), Weight Management Actions (WMA), Environmental Restructuring (EnR) and Weight Consequences Evaluation (WCE). The EmR process scale has 13 items, the WMA process scale has 7 items, and the WCE process scale consists of 9 items while the EnR process scale is evaluated by 5 items. EmR and WCE are experiential process, whereas WMA and EnR are behavioural process. Scores for each of the four processes of change can be calculated by summing up the scores obtained on items belonging to the same subscale. None of the items are reverse scored (Andrés et al., 2011).

The measurement structure has four freely correlated first-order factors as revealed by the principal component analysis (PCA) and the confirmatory factor analysis (CFA) of the original validation. Four scores corresponding to the four processes of change can therefore be obtained from this questionnaire. Scores from the different subscales should be transformed onto a scale from 0 to 100 in order to be comparable with one another. A higher use of a process is represented by scores above 50 (Andrés et al., 2011). The P-Weight has good internal consistency with Cronbach's alpha coefficients ranging from 0.781 to 0.938 for the different factors, while it has excellent internal consistency when considering the whole scale (the Cronbach's alpha for the total scale is 0.960). Corrected item-total correlations of the measure are also adequate, ranging from 0.322 to 0.865.

The measure also has satisfactory convergent validity with the 'drive for thinness' subscale of the EDI-3 (Garner, 2004; Giannini et al., 2008), and the 'diet' subscale of the EAT-40 (Garner and Garfinkel, 1979; Cuzzolaro and Petrilli, 1988). That is to say, the four subscales of the P-Weight positively correlate with other scales measuring concern with dieting. This has been demonstrated by the original validation study conducted on 556 University students and on 167 overweight and obese patients enrolled in a hospital-based weight-management program (Andrés et al., 2011). The S-Weight and the P-Weight questionnaires are thus able to assess the relationship between stages and processes of change in weight-management. In this respect, the two measures allow identifying which processes of change (from the P-Weight), individuals use the most according to the stage of change they are in (from the S-Weight), for what concerns weight-control (Andrés et al., 2011).

4.4.2.2 The EDI-3 'drive for thinness' subscale

The Eating Disorder Inventory-3 (EDI-3) is a self-report questionnaire consisting of 91 items measuring psychological domains relevant to the understanding and treatment of eating disorders (Garner, 2004). The EDI-3 has twelve scales: three of which directly pertain to eating disorders while the remaining nine are not eating-disorders specific but are strongly correlated. Participants rate responses on a six-item scale that ranges from 1 (never) to 6 (always), (Garner, 2004). The Drive for Thinness

(DT) subscale has 7 items and it belongs to the three eating-disorders specific scales. The DT subscale refers to an irrational need to be thin and it concerns dieting behaviour, preoccupation of diet restrictions and the fear to gain weight. High scores on this subscale indicate that the participant is overly concerned about being thin and he/she has strong concerns on weight-gain (Garner, 2004). The DT subscale scores range from 0 to 4 for each item and from a minimum of 0 to a maximum of 28 for the whole scale, with higher numbers reflecting a stronger drive for thinness. Reliability scores for the 3 eating disorder risk scales are high (alpha coefficient ranging from 0.90 and 0.97 for the Italian version used in this study (Giannini et al., 2008).

4.4.2.3 The EAT-40 'diet' subscale

The Eating Disorder Attitude Test (EAT-40) is a widely used screening instrument for detecting eating disorders. It is a 40 item multidimensional self-report scale designed to assess attitudes, behavior and traits pertaining to eating disorders. Responses are rated on a Likert scale ranging from 1 (Never) to 6 (Always). The test has good internal consistency as demonstrated by an alpha coefficient of 0.94. The Dieting Behaviour subscale has 13 items and it relates to food avoidance and the preoccupation with being thinner (Garner and Garfinkel, 1979). Responses on this subscale are assigned a score from 0–3 with non-symptomatic answers (sometimes, rarely, never) given a score of 0, and symptomatic answers (always, usually, often) scored 3, 2, and 1 respectively. The psychometric properties of the EAT-40 are very good in both its original version and its Italian validation. The test has also good internal validity with an alpha coefficient of 0.81 in both versions (Garner and Garfinkel, 1979; Cuzzolaro and Petrilli, 1988).

4.4.3 Data Analysis

Descriptive and exploratory analyses and comparisons of means were performed using PASW Statistics 22 software (IBM SPSS Inc, 2013), while the R package Lavaan (R Core Team, 2013), and was used for the confirmatory factor analyses (CFA). Firstly, a cross-validation procedure was applied to the data in order to assess the internal

structure of the questionnaire, as Floyd and Widaman (1995) recommended. The factor structure of the questionnaire was then confirmed with a CFA applied to the whole sample, using the covariance matrix. Before carrying out the CFA, data were tested in order to verify if they were multivariate normal by means of Mardia's estimate for multivariate kurtosis (Mardia, 1970). According to Bentler (2005), values above 5.0 for Mardia's normalised estimate are indicative of non-normal data. Since the data from this study were multivariate non-normal, the robust unweighted least squares (ULSM) estimation method was applied, and the following goodness-of-fit indices were obtained: chi-square test, standardised root mean square residual (SRMR) and root mean squared error of approximation (RMSEA).

Secondly, a reliability analysis was conducted for the sample by means of Cronbach's alpha and corrected item-total correlations, applying the criteria suggested by Nunnally and Bernstein (1994). Analysis of variance (ANOVA) and Tukey post-hoc comparisons were applied to assess the relationship between processes (taken as the dependent variables) and stages of change (taken as the independent variable). Polynomial contrast analyses were conducted to analyse the trend in the use of processes of change across the stages of change. Pearson's correlations were subsequently used to assess the relationship between the P-Weight and the measures of concerns with dieting.

4. 5 Results

4.5.1 Internal Structure

A CFA was carried out to test the four-factor structure of the P-Weight previously described in the original validation study (Andrés et al., 2011). The assessment of multivariate normality revealed that the data did not fit multivariate normality, since Mardia's estimate for multivariate kurtosis was 47.3. The measurement model that fitted data the most in Andrés et al.'s study (2011), was also tested in this research. The model consisted of four freely-correlated first-order factors. A good fit of data to this 34-item and four-factor model is shown in table 7 in the next page.

Table 7: Goodness-of-fit indices obtained in the confirmatory factor analyses

Goodness-of-fit indices	Indices	χ^2	d.f.	RMSA	SRMR
	Model 1	2086.973	521	0.084	0.05
χ^2 = Chi-square test; d.f. = degrees of freedom; SRMR = standardised root mean square residual, RMSE root mean squared error of approximation.					

Standardised regression weights ranged from 0.408 (item 5 of the P-Weight) to 0.875 (item 4 of the P-Weight), while correlations between factors were between 0.731 (co-variance between EnR and WCE) and 0.960 (co-variance between WMA and EnR). Four scores corresponding to the four processes of change found in this analysis can therefore be obtained from the P-Weight. The path diagram representing this structure as well as the standardised factor loadings and the factor co-variances are shown in figure 20, in the next page. The diagram represents the four first-order factors model for processes of change in weight management in the P-Weight.

4.5.2 Internal Consistency

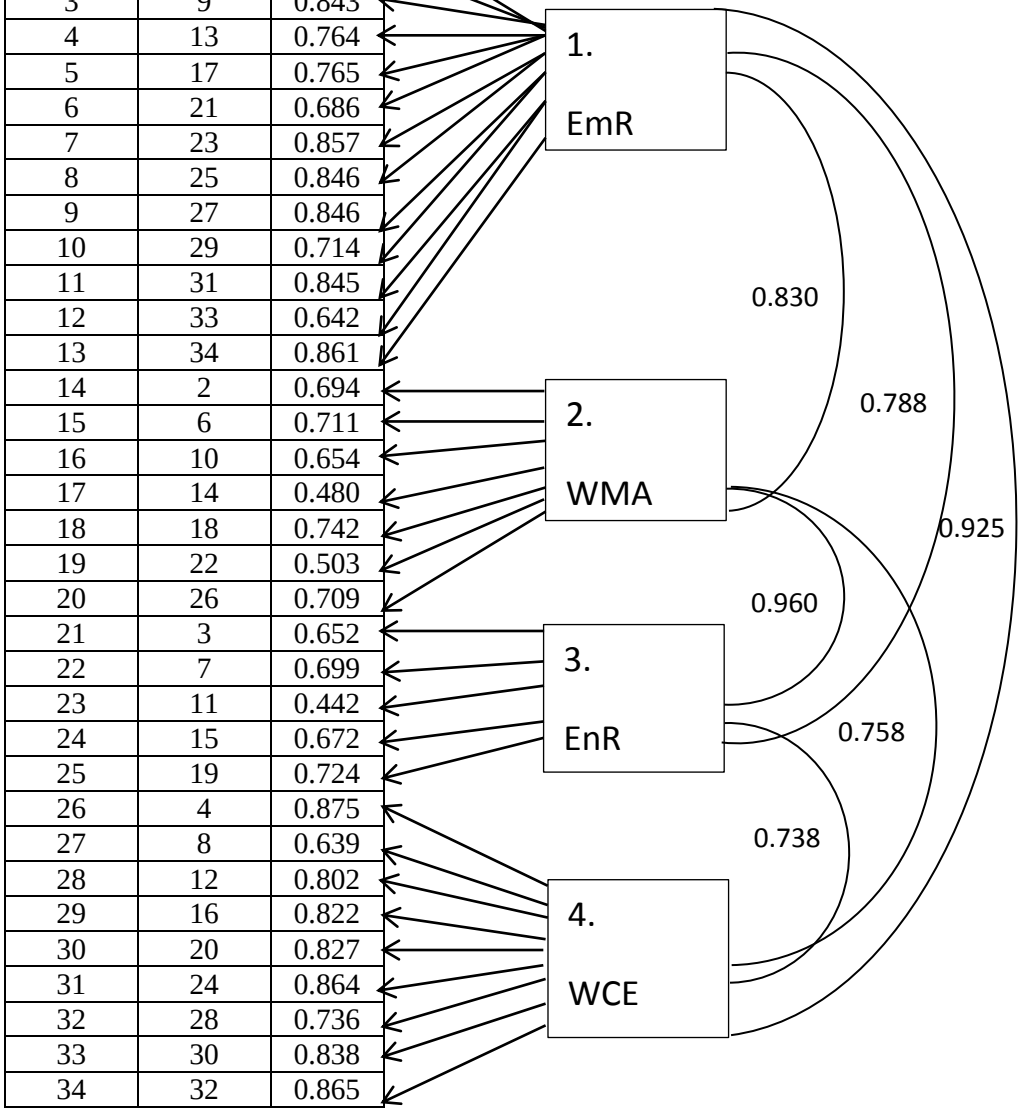
Cronbach's alpha coefficients and corrected item-total correlations were then calculated in the sample. Cronbach's alpha reached acceptable values, ranging from 0.77 to 0.94 for the different factors (see table 8). All items contributed to the internal consistency of their subscale. Internal consistency was excellent considering the whole scale (0.97). Corrected item-total correlations were fair, ranging from 0.379 to 0.862.

Table 8: Internal consistency analysis of the 34-item questionnaire in both samples

Processes of Change	Number Of items	Sample 1 (n = 423)		
		Alpha	I-T corr. (range)	I-T corr. (mean)
1. EmR	13	0.94	0.379–0.841	0.607
2. WMA	7	0.84	0.508–0.598	0.585
3. EnR	5	0.77	0.386–0.623	0.544
4.WCE	9	0.94	0.542–0.862	0.780
Total	34	0.97	0.4 – 0.819	0.668
I-T corr.= Item-total correlations; EmR= emotional re-evaluation; WMA= weight management actions; EnR= environmental restructuring; WCE= weight consequences evaluation.				

Fig. 22: Path diagram of Emotional re-evaluation (EmR), Weight management actions (WMA), Environmental restructuring (EnR) and Weight consequences evaluation (WCE).

Order	Item #	Value
1	1	0.515
2	5	0.408
3	9	0.843
4	13	0.764
5	17	0.765
6	21	0.686
7	23	0.857
8	25	0.846
9	27	0.846
10	29	0.714
11	31	0.845
12	33	0.642
13	34	0.861
14	2	0.694
15	6	0.711
16	10	0.654
17	14	0.480
18	18	0.742
19	22	0.503
20	26	0.709
21	3	0.652
22	7	0.699
23	11	0.442
24	15	0.672
25	19	0.724
26	4	0.875
27	8	0.639
28	12	0.802
29	16	0.822
30	20	0.827
31	24	0.864
32	28	0.736
33	30	0.838
34	32	0.865



4.5.3 Relationship between Processes and Stages of Change

Since processes of change are attitudes and behaviours that facilitate a person's progress across the stages of change towards the acquisition of a healthy behaviour, it is important to analyse the relationship between these two features. Scores for each of the

four processes of change on the P-Weight were calculated for the whole sample (n = 423) by summing up the scores obtained on items belonging to the same subscale. None of the items were reverse scored. In order to make scores from the different subscales comparable, these were transformed onto a scale from 0 to 100 (0 reflecting no use of a given process of change and 100 being full-use of that process). The ANOVA revealed statistically significant differences for the use of processes across stages of change, as shown in table 9 in the following page and in figure 21 by the line graph.

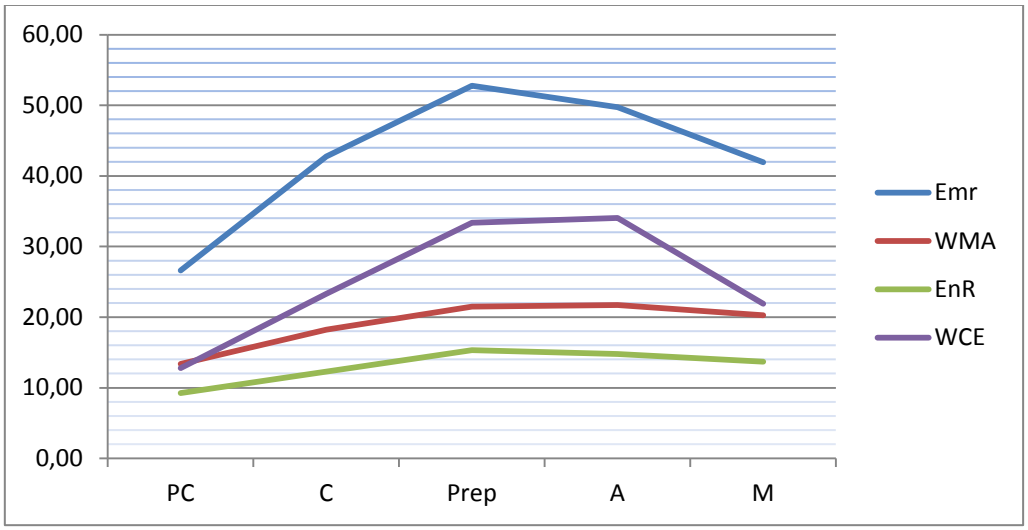
Tukey post-hoc comparisons showed that in the Precontemplation stage all processes were used less than during later stages. This trend was similar to the pattern of scores obtained in the Contemplation stage, which were lower than those obtained in the Preparation and in the Action stages for all subscale, as in the comparison between Action and Maintenance (for sub-scales EmR and WMA), (see table 9). The use of the EnR and WCE processes remains stable between the Action and Maintenance stages, with higher scores being observed in the Action stage compared to the Maintenance one, for the EmR and WMA processes. Polynomial contrast analyses revealed a quadratic trend in the use of every process of change across the four stages ($p < 0.001$).

Table 9: Analysis of variance (ANOVA) and post hoc comparisons of processes of change scores across stages of change

	PCmean (SD)	**C mean (SD)**	**Prep mean (SD)**	**A mean (SD)**	**M mean (SD)**	**F (4,418)**	**Tukey comparisons**
EmR	26.60	42.74	52.76	49.75	41.93	59.40 ***	PC < C***, Prep***, A***, M***, C < Prep***, A**; Prep> M*** A>M ***
	(9.48)	(13.92)	(10.70)	(11.60)	(14.55)		
WMA	13.39	18.24	21.51	22.71	20.25	34.09 ***	PC<C***, Prep***, A***, M***, C<Prep*, A*** A> M*
	(5.19)	(6.17)	(5.70)	(5.93)	(6.74)		
EnR	9.25	12.28	15.31	14.79	13.70	20.81 ***	PC<C**, Prep***, A***, M***, C<Prep**, A**
	(4.10)	(5)	(4.61)	(5.12)	(5.23)		
WCE	12.80	23.29	33.49	30.04	21.89	53.01 ***	PC < C***, Prep***, A***, M***, C < Prep***, A*** Prep> M***, A***
	(5.34)	(12.80)	(9.70)	(10.54)	(10.63)		

EmR = Emotional re-evaluation; WMA = weight management actions; EnR = environmental restructuring; WCE = weight consequences evaluation; PC= pre-contemplation; C= contemplation; Prep= preparation; A= action; M= maintenance. *p < 0.05, **p < 0.01, ***p < 0.001.

Fig. 23: Scores on the processes of change subscales across the stages of change. EmR= Emotional re-evaluation; WMA= weight management actions; EnR= environmental restructuring; WCE= weight consequences evaluation; PC= pre-contemplation; C = contemplation; Prep = preparation; A = action; M = maintenance.



4.5.4 Relationship of Processes of Change with Other Variables

The four subscales of the P-Weight were correlated with other external variables measuring concern with dieting, in the whole sample (n = 423). Specifically, they were correlated with the 'drive for thinness' subscale of the EDI-3 and with the 'diet' subscale of the EAT-40 questionnaire, as shown in table 10. Pearson's correlation coefficient was statistically significant ($p < 0.001$) between the four processes of change subscales and both the 'drive for thinness' and 'diet' subscales.

Table 10: Pearson's correlations between processes of change and dieting concern

	EmR	**WMA**	**EnR**	**WCE**
Drive for thinness (EDI-3)	0.673***	0.438***	0.492***	0.593***
Diet (EAT-40)	0.703***	0.606***	0.571***	0.608***

EDI-3 = Eating Disorder Inventory-3; EAT-40 = Eating Attitudes Test-40; EmR= emotional re-evaluation; WMA= weight management actions; EnR= environmental restructuring; WCE= weight consequences evaluation. *p < 0.05, **p < 0.01, ***p < 0.001.

4.6 Discussion

Healthy eating and regular exercise are surely important factors in preventing overweight and obesity (Britt et al., 2004). However, the mere knowledge of healthy nutrition and dietary prescriptions and of physical activity programs is not enough to reduce excessive food-consumption and bodyweight (Resnicow et al., 2008). In fact, the majority of obese and overweight individuals fail to carry on weight-loss programmes, and go back to their original weight in three to five years after weight-loss hospital treatments (Castelnuovo et al., 2010). Readiness to change appears to be one of the most powerful tools in promoting behavior change and encouraging weight-loss and adherence to weight-management programs, with positive results (Pietrabissa et al., 2012; Ryan et al., 2011, Wilson and Schlep, 2004). In this respect, the use of the TTM constructs can favour individuals' motivation towards behaviour change, although the processes of change directly influencing weight-management still need to be well investigated.

Most motivational measures within the clinical setting arising from Prochaska and Di Clemente's TTM (1985) and have been specifically developed for substance-addiction. Thus, such measures could lack accuracy for what concerns the evaluation of weight management interventions. Many clinician-rated and patient-rated instruments have been developed to measure readiness to change in the clinical setting during the last twenty years. However, a motivational assessment in obese hospitalised in-patients does not always correspond to an early, accurate use of suitable tools. According to Horwath (1999), using specific measures of both dietary behavior and exercise can contribute to provide a reliable and efficient assessment in weight-management, in accordance with the TTM constructs. In the context of weight management, the assessment of readiness to change or of the stages of change has generally been carried out with separate evaluations of dietary beavior change and physical exercise.

This research represents an official validation in Italy of two sets of questionnaires, namely the S-Weight and the P-Weight, respectively assessing the stages and processes of change of the TTM model. These measures, originally developed in English and Spanish, are designed to be applied to the weight management setting. Thus, this work is also an investigation of the psychometric properties of an

Italian version of the S-Weight and the P-Weight questionnaires. Structural equation modeling indicated that the original four-factor model of 34-item P-Weight proposed by Andrés et al., (2011) in University students and overweight/obese in-patients attending a weight-loss treatment, did fit the same data presented by this research.

Thus, the Italian version of the P-Weight questionnaire also identified four processes of change (EmR, WMA, EnR, WCE) implied in weight management, that are able to assess individuals' readiness to change in relation to both dietary and exercise behaviors. Therefore, the data in this study support the original four-correlated-factor model with no distinction between experiential and behavioural processes. Such structure has been found to be valid in dietary behaviour (Lamb and Joshi, 1996; Greene et al., 1999), and in a study conducted by Prochaska et al. (1992). The authors specified that, along time, only some of the initially proposed processes of change produced statistically significant changes.

Moreover, both experiential and behavioural processes were highly correlated (see Figure 20), displaying adequate Goodness-of-fit indices (see Table 7), which indicates that a simple model not including experiential and behavioural processes as separate entities, is the most suitable for weight management, as previously reported in literature (Prochaska et al., 1983; Lamb and Joshi, 1996; Prochaska et al., 2008; Guo et al., 2009). The present work, did not find evidence towards the hypothesis that experiential and behavioural processes have a different impact on weight management. On the contrary, the EmR and WCE processes (experiential process) are not more strongly correlated with one another just as the WMA and EnR (behavioural process), than with the other processes.

Furthermore, P-Weight was found to have a good corrected item-total correlations and high internal consistency coefficients, thus, an adequate reliability both on the four subscales and the total scale. This demonstrates that the questionnaire has satisfactory psychometric properties and it is therefore an adequate assessment tool for what concerns weight-management. In addition, statistical analyses displayed a significant lower use of processes of change during the first precontemplation stage than in other stages. Specifically, participants had a peak use of processes of change during the Preparation stage, particularly for what concerns EmR and WCE. This could be due to the fact that during the Preparation stage these experiential processes can favour

readiness to change (Prochaska, et al., 1994), as people are more aware that weight-management behavior is necessary. A slight decline is later found in the Action and Maintenance stages, particularly in the same processes, possibly because they are less pertinent to the weight-management change that has already been operated. In fact, a less evident decline in the use of behavioural processes, namely WMA and EnR has been found in this sample. Perhaps this could be as such since in later stages of the TTM, the commitment for change has already been established, while individuals may wish to maintain change through keeping their healthy behavior strategies in order to avoid relapse (Prochaska and Di Clemente, 1984).

Overall, the pattern of process use across stages in weight-control differs from the linear structure found in smoking cessation (Di Clemente et al., 1991). For what concerns weight-management readiness to change in this research, the pattern primarily evidenced a peak use of processes of change in the initial stages, with a gradual decline in the later ones, therefore fitting a quadratic trend. Moreover, correlations between the processes of change scores and the dieting concern scores showed an adequate convergent validity of the P-Weight questionnaire. Generally, the Italian version of the P-Weight displayed good psychometric properties supporting its application in weight-management TTM-based assessments and interventions. The questionnaire can efficiently detect readiness to change in weight-maintenance underlining the use of specific processes of change, according to the TTM stages of change.

In weight-management, the availability of reliable and valid measures based on the TTM can support clinicians and professionals in providing overweight and obese people with the most suitable weight-loss assessment and treatment. In this respect, the use of the Italian version of the S-Weight and P-Weight can offer a complete and comprehensive appraising of readiness to change in weight-management. This is possible since these measures can provide crucial information on which stages of change individuals are in, and on which processes of change they are using or they need to empower. Therefore, successful weight-management strategies could be implemented within the clinical setting, according to tailored interventions based upon patients' assessments of motivational level and the processes of change utilization (Suris et al., 1998). All in all, the prompt evaluation of readiness to change may be a crucial step in clearly identifying psychological obstacles or resistance in the weight-management

context. The use of specific motivational instruments such as the Italian versions of the S-Weight and the P-Weight can contribute to provide a more effective weight-control treatment intervention in overweight or obese hospitalised individuals.

4.7 Study Limitations

Although the current work has potentially important implications for weight-management assessment and subsequent treatment interventions in overweight and obesity, it presents some limitations. Firstly, the psychometric assessment was partially carried out in a clinical hospitalised setting with a convenience sample of subjects engaged in a short-term treatment program, and it is not representative of the original population from which it was drawn. Thus, results may be different in other groups of patients (e.g., bariatric surgery patients). In addition, the present sample included both normal-weight and overweight and obese patients. This could imply that the use of the S-Weight and the P-Weight to different populations attempting to lose weight should be carried out with care, as clinical cut-offs in yet to be fully examined.

Secondly, the study experimental design may not be fully satisfactory due to the fact that only self-reported measures were administered, and these could be susceptible to social desirability bias (Arnold and Feldman, 1981). Thirdly, the diagnostic sensitivity and specificity of the S-Weight and P-Weight were not assessed as there is no other valid and reliable available instrument for the evaluation of weight-management readiness to change according to the TTM model, at the time of this study. Lack of a golden-standard diagnostic instrument and the true diagnostic properties are thus still unknown. Considering the above, results still add important evidence towards the food-addiction problem, by offering an evaluation of a specific tool such as the YFAS-16 in Italy. Future appraisals in the obesity area may benefit from the use of a measure identifying dependence symptoms with regards to certain types of food. Overall, the Italian version of the Yale Food Addiction Scale (YFAS) proved itself to be a sound tool for identifying food addiction in adult obese patients. Other appraisals on this scale are strongly needed in Italy as they could provide a sound confirmation of the reliability and validity of the questionnaire. This could also add important empirical

research on ‘food addiction’ amongst Italian obese individuals, clinically and psychometrically.

4.8 Conclusion

Motivation plays a very important role towards successful weight-management across time. The stages and process of change of the TTM can be applied to the treatment of eating disorders such as overweight and obesity and can also be used in assessing readiness to change in weight-control. The present study represents the Italian translation and validation of the S-Weight and the P-Weight questionnaires which are specially designed to assess motivation in weight management. Such instruments can help identifying stages and processes of change involved in weight management and are able to discover readiness to change in TTM-based weight-maintenance.

Up to date, there are no validated questionnaires of the kind, which can provide clear and sound information concerning the relationship between stages and processes of change as well as dieting concern. More to that, the results of this research evidence that the P-Weight has good psychometric properties and it is thus a reliable and valid measure assessing readiness to change in weight-control. By determining readiness to change in weight management it is possible to create ad-hoc interventions for overweight and obese people engaged in specific weight-loss treatment programs. Identifying stages and processes of change in this context can help developing interventions that are in line with the patient’s motivation and understanding which behaviors an individual should target for change, at various points during treatment. In this respect, the S-Weight and P-Weight seem to be very advantageous.

Chapter 5: Treating overweight and obesity according to Addiction Models

5.1 Why using the Addiction Model?

From what has been highlighted in previous chapters, it is clear that more than just an observational link exists between food addiction, overweight and obesity. It is therefore possible to highlight a strong causal relationship between these factors (Avena et al., 2011 and 2012). Some authors pointed out that this peculiar causality is rather week or inexistent (Peters, 2012) and that a direct link between them should be considered with great attention (Ziauddeen et al., 2012). Nevertheless, this caution in conceptualizing obesity and food addiction can be reconsidered in the light of many findings describing similar effects in drug addiction and food addiction on the dopaminergic system (Volkow et al., 2008; Gearhardt et al., 2009, 2011 and 2012). Since in human subjects food addiction has been clearly associated with similar patterns of neural activation as substance addiction, a sound and evident "overlap" (Avena et al., 2012) is present in both these conditions, and it is visible in the anterior cingulated cortex, the medial orbitofrontal cortex, and the amygdala (Gearhardt et al., 2011b). Thus, as Johnson and Kenny (2010) specified, obesity and drug addiction may be underlined by common hedonic mechanisms.

Explanations regarding obesity and food addiction should therefore contemplate these new emerging models pointing out the core role of food addiction in obesity and the conceptualization of obesity not only as an effect of an unhealthy life-style but also as a result of specific underlying psychological factors (Avena et al., 2012; Di Leone et al., 2012; Gearhardt et al., 2009, 2011 and 2012). According to these models, excessive food consumption has strong similarities with substance addiction (Gearhardt et al., 2012). In fact, a good percentage of obese patients, display high levels of "food craving", addiction-like symptoms towards food, and do not respond effectively to weight-loss interventions. Frequently, these individuals can be diagnosed with food-addiction, particularly to palatable food (Avena et al., 2011).

New frontiers in weight-loss treatments should therefore consider the central role of food addiction as a fundamental psychological factor underlying a difficult weight management (Gearhardt et al., 2013 and 2014; Innamorati et al., 2014) and should foster appropriate addictive-behavior interventions. Similar lines of research (Barnes and Tantleff-Dunn, 2010; Schuck et al., 2014) investigated factors linked to successful or unsuccessful weight management to the extent of designing programs to target these factors. Individuals who regain the previously lost weight present a narrow range of coping skills; in fact, they tend to be avoidant, impulsive and, in many cases, to eat emotionally (Schag et al., 2013). Such characteristics are often found in individuals with addictive disorders (Riva et al., 2006).

According to Volkow and O'Brien (2007), the discrepancy between successful treatments of the metabolic consequences of obesity and treatment failures in preventing or reversing the development of obesity, highlights the fact that this condition is not only a metabolic disorder, but also a brain disorder. Taylor et al., (2010) explained that obesity can be a sort of addiction; however, such strong statement involves much more than just a semantic change. The change suggests that screening for addiction-like symptoms towards food in obese people with binge eating disorder, should become part of the routine obesity treatment. Moreover, authors add that the current mentality tied to classic dietary and exercise interventions to tackle the obesity problem, which is often applied to obese individuals in hospital-based interventions, must be reviewed. In this respect, traditional therapies used in substance-use disorders may be useful for weight-management in overweight and obesity.

5.2 The treatment of overweight and obesity associated with food addiction

The traditional model for obesity can be subdivided into two main contributions: nutrition and thermogenesis. The latter refers to the process of heat production in organisms involving energy expenditure and fat oxidation. The food addiction model, including rat models for binge eating, adds an important third factor, that is to say perception, which contributes to the non-homeostatic or hedonic aspects of food addiction (Hoebel et al., 2009). Perception represents the basis of hedonic homeostasis,

which can straightforwardly supersede natural homeostasis that would otherwise prevent the organism from becoming overweight or obese. The power of reinforcing properties that affects the perceptions of food explains how the food addiction model is a robust and useful conception. Hoebel et al., (2009) argue that feeding rats with either glucose or sucrose in order to simulate a 'sugar bingeing' alternating these elements with normal food, leads to subsequent escalations of sugar intake. The bingeing behaviour alternating with normal food-intake patterns creates feeding behaviors that are not distinguishable from the binge eating behaviour often witnessed in humans. Interestingly, this behavioural pattern does not occur if genetically similar rats are given constant access to these same carbohydrate solutions. Thus, binge-eating sugar addiction is empirically visible.

This research has an obvious impact on the way food addiction is explained in humans. This sugar addiction model highlights that if these same rats which were induced to be bingers by a few weeks of scheduled intermittent sugar feedings, were unexpectedly limited to their sugar access, they showed classical signs of opioid-like withdrawal (Hoebel et al., (2009). On the contrary, the fat binged rats did not demonstrate this same type of carbohydrate-induced withdrawal similar to that given by opioids. This information is extremely relevant towards the research and treatment of obesity, diabetes, and metabolic syndromes. Carbohydrates, in particular, may be just as addicting as cocaine, opioids, alcohol, and other psychotropic substances. In fact, all of these substances share a common trend by activating the same dopamine and opioid channels which stimulate the nucleus accumbens and other neuro-circuits of reward and addiction (Koob and Volkow, 2010). The role of perception, reward-expectancy, reinforcement and withdrawal, is a fundamental one for what concerns the relationship between food, addiction and excessive body-weight in both animals and humans.

New treatments and new paradigms for the treatment of overweight and obesity are obviously needed to address the obesity epidemic. If some forms of morbid obesity can be described as an addiction, some suggestions may come from the approaches and strategies used in the treatment of substance-related disorders (Manzoni et al., 2012). Riva et al., (2009) on questioning whether obesity can be viewed as a form of addiction, explain that the Patient Placement Criteria for the Treatment of Substance-Related Disorders (PPC, PPC-2R) is a valid tool that can be used in the field of obesity-related

interventions. More specifically, authors point out that this approach is very useful in providing efficient guidelines as to the type and intensity of care, and in systematizing the care of patients and in-patients who suffer from addictive diseases. The main features of the PPC-2R are both applicable at different levels of care and in the choice of multifactorial assessment dimensions. The method represents a bio-psycho-social treatment (Zani and Cicognani, 2004), based on the so-called five 'M's' (Riva et al., 2009), that is to say:

1) Motivate: motivational enhancement towards change
2) Manage: optimizing family relations and with the significant others, improve efficacy or solve problems at work, school or other social situations (i.e.: legal aspects).
3) Medication: detox, anti-craving methods, dual diagnosis medications if required.
4) Meetings: organizations and associations promoting weight-loss and weight-loss maintenance (i.e.: the twelve-step program of Overeaters Anonymous or other self-help approaches such as Weight Watchers).
5) Monitor: Continuity of care, relapse prevention, help from families and significant others.

Using this type of framework in addressing overweight and obesity, particulalry if associated with food addiction, can be very fruitful, especially in the light of important reseach findings. Many studies evidence that recidivism in such conditions is rather high and weight cycling, that is to say repetitive body-weight loss and regain, is a prevalent phenomenon in the history of obese patients. In fact, although weight-loss interventions for overweight and obese individuals are commonplace, only approximately 20% of individuals are successful in maintaining long-term weight-loss (Castelnuovo et al., 2010).

Volkow and Wise (2005) share the vision that some of the behavioral interventions that are beneficial in the treatment of classic addiction are also helpful in the treatment of obesity, especially if associated with food addiction. The authors suggest that all addictions could be treated by focusing on continuous care based on multidisciplinary interventions aimed at improving coping strategies and overcome difficult situations in different critical phases such as for example abstinence, withdrawal or relapse. Considering that some important similarities have been found

between certain phenomenological and neurobiological correlates of food-addiction in obesity and addictive disorders (Davis et al., 2011; Gearhardt et al., 2009 and 2011b; Loeber, et al., 2012), the treatment of obesity associated with food-addiction may really benefit from interventions which are usually employed in treating substance-addiction disorders (Di Leone et al., 2012).

In particular, when addressing obesity and food addiction treatment, it is relevant to take into account the subjective experience of craving, which often involves a cycle of cognitive elaboration of dysfunctional, uncontrollable thoughts elicited by drug or food-related stimuli (Volkow et al., 2013). That is to say that the success of a specific intervention for an addiction can be used to suggest and design an effective treatment program to reduce obesity associated with food-addiction. The latter should include education regarding healthy eating and exercising (as sedentary lifestyles also contribute to the increase of weight gain in obesity), and generally involves the medical community, which should be prepared to evaluate and treat food addiction and obesity (Volkow and Wise, 2005).

Additionally, just as in the treatment of drug addiction, a multimodal approach to the treatment of obesity associated with food addiction would need to imply a common scientific knowledge about the involvement of diverse brain circuits that influence reward, motivation, learning and cortical inhibitory control. For obesity as well as for addiction, positive results may also derive from the use of specific pharmacological interventions which could promote a sort of interference with important implicated processes, including the reinforcing value of food and the conditioned responses to these processes. Also, pharmacotherapy could avoid a stress induced relapse after temporary successes are achieved.

Large-scale prevention and treatment programs for obesity associated with food addiction just like those for classic substance-use disorders will therefore require the participation of the medical community as a whole. A successful treatment of obesity and food addiction can definitely arise from the prompt engagement of pediatricians and family physicians in the early detection and treatment of food addiction in childhood and adolescence. Unfortunately, as with classic addiction, physicians, nurses and other health care professionals receive little training in the management of obesity (Melchionda, 2014).

Volkow and Wise (2005) also explain that in some instances the same medications that are effective in interfering with (or reducing) food consumption in animal models of obesity are also effective in interfering with (or reducing) drug consumption by self-administration in animal models of drug abuse (for example, cannabinoid CB1 antagonists). Similarly, some of the behavioral interventions that are advantageous in the treatment of addiction are also helpful in the treatment of obesity. These include incentive motivation, cognitive-behavioral therapy and 12-step programs. However, the interventions for what concerns food addiction and obesity are much more complex since it is basically impossible to abstain from eating, as it is frequently recommended and also possible for drug addiction. In fact, for relapse to drug-seeking, the priming effects of the drug are very strong this is the reason why, for example, the program proposed by the 12-step focus on absolute abstinence, a strategy that avoids the danger of priming. In the case of food, a similar effect is more difficult to achieve because food consumption is essential and long periods of total abstinence are not feasible.

However, strategies that avoid food rich in carbohydrates or fats, or their combination, should help at-risk individuals to overcome priming effects that trigger compulsive eating. Like addiction, obesity with food addiction is a chronic condition with periods of protracted abstinence corresponding to the restriction of seductive foods such as for example palatable food, alternated by periods of relapse characterised by compulsive eating. Thus, the most effective treatment strategy will in most cases require continuous care (Volkow and O'Brien, 2007). At present, psychotherapeutic treatments in the field of addictions, which are therefore also applicable in the field of food addiction, are mainly directed at combining different evidence-based interventions to enhance abstinence motivation and to help patients developing coping strategies in order to successfully handle high-risk relapse situations (Grosshans et al., 2011).

Motivation enhancing techniques such those pertaining to Prochaska and Di Clemente's (1984) Transtheoretical Model (TTM) based on Readiness to Change (RTC) and on the Stages of Change (SOC), offer an effective and comprehensive approach in treating addictions. In fact, determining readiness to change and promoting tailored interventions according to the patient's motivation in weight management as well as favoring change through both cognitive behavioural interventions are among the

interventions with highest efficacy (Grosshans et al., 2011).

The TTM uses several constructs from other health behavior theories, in a model that offers a view of when, how, and why people change their behavior. This model includes the stages of change (SOC), which reflect the temporal dimension of the behavior, divided in six consecutive stages and a set of constructs that explain how people evolve along the SOC. These are named processes of change, and are cognitive and behavioral activities that individuals use to modify their experiences and environments to obtain the desired behavior (Di Clemente et al., 1991). Also included in this model are the decisional balance, representing the pros and cons of engaging in the target behavior, and self-efficacy, reflecting the person's confidence in performing the healthy behavior change. The TTM has been extensively used both in nutrition and exercise settings, mainly because of its practical use in building stage-tailored interventions (Greene et al., 1999).

For what concerns weight-loss and weight-management, the use of the TTM can be highly recommended. This is because motivation and readiness to change are important factors in individuals who wish to face the difficult task to maintain weight, which implies a double challenge: weight loss initially and its management subsequently. In fact, weight-control may be as problematic as smoking or drugs-taking cessation, since they all share the commonality of being highly refractory to change behaviors (Wang et al., 2002). Assessing motivation and readiness to change may be a crucial step in promptly identifying psychological obstacles or resistance towards weight-management in overweight or obese hospitalised individuals, and it may contribute to provide a more effective weight-control treatment intervention, especially in more adverse conditions such as those related to food addiction and obesity.

5.3 Pharmacotherapy

Interestingly, there are over one hundred different drugs available for overweight and obesity-related diseases like for example hypertension, but only four medications have been approved from the scientific community for the long-term treatment of obesity (Turk et al., 2009). For individuals who are overweight or obese,

weight-loss solely based on lifestyle changes can be very difficult to achieve and even more challenging to maintain. Supporting strategies, such as obesity prescriptions, can be important tools for effectively treating obesity in some individuals. Given the complex nature of the disease, no single drug is likely to fix the epidemic (Perri et al., 2008). Another method used to enhance weight-loss outcomes is to couple behavioral and pharmacotherapy approaches. It can be argued that behavioral treatment modifies the external environment, whereas pharmacological approaches modify the internal environment either centrally (i.e., phentremine) or peripherally (i.e., orlistat). To test this hypothesis, Wadden et al. (2005) compared weight-loss outcomes in 224 obese adults randomly assigned to one of four groups:

1) A group of subjects received 15 mg of sibutramine alone, given by a primary care provider in eight visits of about 10 minutes;

2) Another group received 30 group lifestyle-modification counseling sessions;

3) A group received sibutramine plus 30 group lifestyle-modification counseling sessions (i.e., combined therapy);

4) The last group received sibutramine plus brief life-style-modification counseling delivered by a primary care provider in eight visits of 10 minutes each.

All subjects followed a calorie-controlled diet of 1,200 to 1,500 kcal per day with a weekly exercise regimen. After 1 year, subjects who received combined therapy had significantly greater weight losses than all other groups (Wadden et al., 2005). These data suggest that the combination of medication and group lifestyle modification resulted in more weight-loss than either lifestyle modification or medication alone. These findings may highlight the importance of combining weight-loss medications and lifestyle modification and not just using one of them per se.

One of the main challenges in weight-loss interventions for overweight or obese people is how to maintain the weight-loss. Approximately one-third of the weight that was lost is often regained within the first year after treatment and more weight is regained over time (Castelnuovo et al., 2010). Recent literature reviews propose that weight-loss maintenance may be improved using drug therapy with either orlistat or sibutramine in combination with lifestyle modification, caffeine or protein supplementation, consumption of a low-fat diet, commitment to physical activity regimens, continued contact with participants, problem-solving therapy, and even

alternative treatments such as acupressure (Perri, 2008). Wing et al.'s (2008) study supports that a self-regulation models incorporating regular weighing can be useful for facilitating weight-loss maintenance. Despite these positive signals, it is important to note that the most frequent outcome of weight-loss treatment is often weight regain and there is no pharmacotherapy that is able, alone, to prevent this process as such.

5.4 Surgical Treatments for Obesity and weight maintenance

Bariatric procedures such as gastric banding that reduce the functional volume of the stomach when swallowing food are at least partly based on the premise that inflating the remaining pouch results into eating less food (Thaler and Cummings, 2009). In recent years, after the major rise of the obesity pandemic and the relevant discovery of the existence of food addiction, bariatric surgery has become an increasingly popular treatment option especially in the USA. In fact, in the United States alone, over 220,000 bariatric surgery procedures were performed in 2008 (Taylor, 2008). At present, bariatric surgery is the only therapy that produces mean long-term weight losses of 15% or more of the initial weight (Colquitt et al., 2009).

Nonetheless, non-surgical interventions should be implemented first, with surgery reserved for individuals who fail to achieve clinically significant weight-loss and weight-maintenance results. Bariatric surgery appears to fail, for example, when an addiction towards food such as ice cream or alcohol is present. Thus, some people may of course regain weight after bariatric surgery (Magro et al., 2008). There is a growing consensus in the literature with respect to the idea that bariatric surgery is the treatment of choice for patients who have failed in previous weight-loss management using behavioral and pharmacological interventions. However, bariatric surgery procedures are risky and involve substantial behavioral changes that also impact on post-operative results. For this reason, the selection, evaluation and psycho-education of patients both before and after surgery require a multidisciplinary approach that includes careful psychological evaluation (Adami et al., 2005).

Obesity, which is commonly regarded as caused by a discrepancy between energy in-taken and energy consumed, has important behavioral implications. Current

surgical methods for obesity require a guarantee of a positive outcome as well as permanent behavioral changes, which of course, go beyond the merely physical state. In other words, following any type of obesity surgery or any kind of medical intervention aimed at stabilizing weight-loss, means that the therapeutic success of the intervention depends substantially on the change the person operated on his or her eating habits. The patient should hence have the capacity to adapt to new anatomical and functional situations that the surgery has determined itself: in this process of adaptation psychological aspects do play a very important role (Castelnuovo et al., 2012). In some cases, the profound change in the morphology of the somatic self, determined by a substantial slimming, may cause difficulty in reprocessing self-identity and re-adapting into a new reality. This process may require the help of a specialist to promote a better adaptation in the surrounding environment (Adami et al., 2005).

On the other hand, the long-term success of this type of procedures and the quality of food that these patients manage to consume without difficulty have been greatly criticized by several authors (van Hout et al., 2008). Especially if taking into account the food-addiction problem topping up some forms of obesity, surgical interventions may not be the final solution in order to treat this peculiar kind of condition. In fact, if readiness to change is not implemented in these patients in the long run and it is possible that all in all, the medical operation effects will turn out to be futile. As explained earlier, there are multifaceted behavioural, cognitive and emotional processes which underlie the food addiction problem, just as in classic addictions. Thus, it is fundamental to bear in mind the need to regard food addiction as a complex matter for which there is no one cause and no simple solution as it profoundly involves an unhealthy relationship with food with similar patterns of neural activation and behavioural components more similar to substance dependence.

5.5 Future directions in treating food addiction

Healthcare providers can deliver a great service to obese patients by reminding them that their worth is not measured on the scale. Patients should be encouraged to take themselves, their health, thus their weight, seriously rather than attempting to lose

weight so they can like themselves. Reaffirming the patient's self-worth, independent of body weight, is perhaps one of the most powerful intervention a healthcare provider can offer to an obese patient. As Stunkard (1993) suggested, "As with any chronic illness, we rarely have an opportunity to cure, but we do have an opportunity to treat the patient with respect. Such an experience may be the greatest gift that [we] can give an obese patient".

The integrated pathogenic view of addiction has profound implications for the treatment of drug abuse, and the best therapeutic approaches include social, behavioral and biological aspects, in combination with pharmacotherapies. Behavioral treatments have been traditionally viewed as effective in helping prevent relapse while a limited number of effective pharmacological treatments have proven effective in that. Similarly, the treatment of food addiction should move towards this direction, hence considering that food addiction and obesity each result from foraging and ingestion habits that persist and strengthen despite the threat of catastrophic consequences (Volkow et al., 2013). Moreover, large-scale prevention and treatment programs for obesity associated with food addiction (like those for classic addiction), will therefore require motivation enhancement to change unhealthy eating patterns as well as the development of coping strategies aimed at reducing the use of food as a powerful reinforcer.

Chapter 6: Discussions and conclusions

6.1 Understanding the concept of addictive food consumption

The main focus of this dissertation, was to examine the construct of food addiction (FA) which has been introduced in the last decades to better understand addictive eating patterns among some obese and overweight individuals (Volkow et al.,2008; Davis and Carter, 2009; Gearhardt et al., 2009 and 2012; Pelchat, 2009). Moreover, this work aimed at evaluating the possible effects and clinical implications of food addiction associated with obesity. Research regarding the incidence of food addiction demonstrates that this phenomenon is increasing within the obese population and particularly in individuals who also suffer from Binge Eating Disorder (BED), (Gearhardt et al., 2009, 2012 and 2013).

Food addiction is a very serious condition which is often triggered by certain types of food such as hyper-palatable food, high in sugar and or fat. Those suffering from food addiction show similar behavioural patterns to those who have other addiction such as alcohol, drugs and so on (Avena et al., 2012). Food can in fact implicate some specific features such as tolerance, craving and withdrawal symptoms and a high incidence of relapse, elements that are commonly found in classic addiction. Surprisingly enough, studies concentrating on the prevalence of food addiction are still not so common and they often lack strong scientific evidence or methodological rigour (Meule, 2011).

However, the symptomatology of food addiction can be evaluated using the Yale Food Addiction Scale (YFAS) questionnaire (Gearhardt et al., 2009 and 2012; Innamorati et al., 2014) which is precisely designed to asses FA and it represents a sound measure of such construct. As food addiction is an observable and measurable phenomenon, more research is needed in order to better investigate its nature amongst obese individuals with or without BED. The FA assessment could help preventing the rise of food addiction and to provide obese patients who are also food-addicted to have the best possible treatment interventions. Also, the prompt identification of addictive-

like behaviour towards food can be fundamental to avoid more severe forms of overweight and obesity.

6.2 Clinical implications for the psychological treatment of food addiction

There is growing and significant evidence for food-related dependence criteria from studies using the Yale Food Addiction Scale (YFAS) questionnaire (Gearhardt et al., 2009 and 2012; Innamorati et al., 2014) in the USA in particular. These researches evidence the existence of food addiction in some obese and overweight individuals accompanied by some specific psychological features such as loss of control, unsuccessful efforts to reduce consumption, and continued use despite negative consequences (Avena et al. 2011; Garber e Lustig, 2011; Fortuna, 2012; Umberg et al., 2012). These data support the idea that a great deal of time is spent, and that other important activities are given up, due to excess consumption of food in a subgroup of obese individuals assessed on the YFAS.

Further exploration is also needed to understand the role that subclinical symptoms of food addiction may have on public health. Additionally, it could also be important to assess the role of food addiction and eating disorders such as BED that share many overlapping characteristics. It will be fundamental to fully comprehend the relationship between these disorders and the extent to which they are distinct disorders as opposed to different manifestations of a single underlying problem. In the Italian context, the only study assessing the existence of food addiction is that carried out by Innamorati et al., (2014), who implemented an Italian version of the YFAS on clinical and non-clinical subjects.

The study on food addiction presented in this work highlighted some relevant factors regarding the psychological and behavioural characteristics of some obese hospitalized individuals displaying sings of food addiction as assessed by the YFAS-16 proposed by Innamorati et al., (2014). This evaluation of the Italian YFAS-16 carried out in obese adult inpatients engaged in a one-month specialised weight-loss treatment showed that 34.1% of the sample was diagnosed with YFAS food addiction. Such

diagnosis was also supported by strong associations between FA and psychological and behavioural features typically descriptive of classic addiction.

Moreover, findings presented in this dissertation showed that obese individuals who were food addicted and therefore met FA criteria on the YFAS-16 were more prone to bingeing, had higher emotional dysregulation, negative feelings, non-acceptance, poor goal-oriented behaviour and impulse control, difficulty in emotion recognition, attentional impulsivity and inability to concentrate compared to participants who did not endorse the food addiction on the YFAS-16. The research also represents an evaluation of the Italian version of the YFAS by Innamorati et al. (2014), as well as an investigation on a clinical sample, proving that this tool is sound and reliable in identifying food addiction in adult obese in-patients.

Further research is needed to estimate the prevalence of food addiction within the Italian population and to subsequently propose well-tailored and ad hoc treatments aimed at tackling food-addiction symptoms in obese seeking weight-loss interventions. Nonetheless, in order to implement interventions that could be successful in diminishing the power of addictive-like eating, it would be crucial to consider the overlapping psychological characteristics outlined above, between FA and classic addiction, as already pointed out by Grosshans et al., 2011.

6.3 Readiness to change and food addiction

New treatment possibilities for the management of food addiction can be implemented by taking into account the scientific evidence proving important phenomenological and neurobiological similarities between addictive eating and substance dependence disorders. If food addiction can be clinically observed as any other addictive disorder, then readiness to change specifically addressing weight-management should be carefully taken into account when it comes to treating food addiction symptoms. First of all, readiness to change based on the Trans-theoretical Model (TTM) is characterised by peculiar psychological processes and stages of change reflecting the modification of dysfunctional behaviours. This concept has been

successfully applied since many years to the treatment of classic addictions (Prochaska and Di Clemente, 1982).

Readiness to change-based interventions can achieve interesting results, even in the obesity field, and especially in obesity associated with FA. In fact, excessive and compulsive eating cessation could be favoured also monitoring the motivational level of obese people with FA in order to provide them with appropriate strategic interventions aimed at reaching full recovery and guaranteeing the continuity of weight management actions (Seals, 2007). Assessing readiness to change according to the Trans-theoretical Model (TTM) in the weight-management context is strictly linked to investigating the processes of change and stages of change which underlie motivation towards weight-loss. In Italy, there are no measures which clearly detect both stages and processes of change in weight-management readiness to change.

The study presented in chapter four, represents the full-validation of the Italian version of two sets of questionnaires (namely the S-Weight and P-Weight), in line with the TTM, designed to assess processes and stages of change. The research was conducted on a total of 423 adults (177 men and 246 women) of which 203 were enrolled from an obesity-specific center in Northern Italy and therefore constitute a clinical sample, while the rest were randomly recruited from the Northern Italy community. The S-Weight (stages of change questionnaire) and the P-Weight (processes of change questionnaire) were subministered together with two subscales from the Eating Disorders Inventory-3 and the Eating Attitudes Test-40 questionnaires on dieting concern. Findings revealed that the relationship between the P-Weight and the S-Weight and the concern with dieting measures from other questionnaires supported the validity of the scales.

Thus, the S-Weight and P-Weight seem to provide an adequate assessment of readiness to change in weight-control in-patients and they can therefore be of great help to clinicians and professionals who wish to deliver patients the best and most suitable weight-loss intervention, according to their motivational level. In fact, the S-Weight and P-Weight seem to be sound instruments in appraising readiness to change in weight-management, by giving a clear picture of which stages of change individuals are in, and of the processes of change they are using. This information could favour the decrease or minimization of resistant and ambivalent behavior towards change. All in all, the S-

Weight and P-Weight are reliable and beneficial tools in assessing readiness to change in individuals engaged in weight-loss programs, and could be very helpful within the field of obesity associate with food addiction.

6.4 Future research and final considerations

Food is consumed in order to maintain bodily energy balance and the appropriate homeostasis. This adaptive use of food is sometimes mislead as witnessed by the repeated use of palatable food that is primarily consumed for its hedonic properties independent of energy status. The latter is greatly related to a reward-related consumption that can result into excessive caloric intake and therefore into overweight or obesity, in the long run. The view that overeating and obesity could be directed related to food addiction needs further studies testing this proposed link and providing directions for future inquiries in the field.

The application of the food addiction model can greatly help future research gaining influential evidence on compulsive eating patterns and their impact on the rise of overeating and consequent obesity. More scientific evidence is needed to better clarify how, why and particularly in which cases excessive food consumption resembling addiction can hijack the brain circuitry sub-serving the motivation for food. Also, precise indications should be given in order to better explain what would distinguish an addictive food from a non-addictive one.

Additionally, more research should be carried out to carefully evaluate the idea that food addiction is a behavioural phenotype that is seen in a subgroup of people with obesity and resembles drug addiction. This view which was drawn from the parallels between the DSM-IV criteria for a substance-dependence syndrome and observed patterns of overeating should be fully supported by evidence and possibly updated according to the recent DSM-V version of the manual. Finally, more consensus should be achieved in the understanding of the extent to which obesity might be within the same neurobiological and psychological framework of addictions. This is very important as research, investigations, treatments and policy should be shaped accordingly.

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