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Review

Unveiling the Interrelationship between Eating Patterns and Metabolic Syndrome

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Abstract: Given that metabolic syndrome, along with obesity as one of its key components, remains one of the leading yet insufficiently addressed public health issues, what contributes to the development and maintenance of the disorder must certainly attract the attention of professionals and scientists. Precisely because of this phenomenon, eating patterns associated with metabolic syndrome should be studied and attempts should be made to uncover patterns in occurrence. The aim of this study is to review the literature and consider the connection between metabolic syndrome and eating patterns such as emotional and compulsive eating, as well as through the lens of food addiction. Furthermore, we have attempted to uncover the role of psychiatry and psychotherapy in the treatment of metabolic syndrome and delve into the complexity of recognizing these patterns and emphasize the importance of a multidisciplinary approach in the treatment of metabolic syndrome.

Keywords: metabolic syndrome; obesity; eating patterns; binge eating; emotional eating

1. Introduction

Since obesity is one of the most prevalent risk factors for type 2 diabetes mellitus and serious cardiovascular diseases it remains one of the biggest public healthcare concerns of our time. It is necessary to examine the complexity of the disorder itself. Today we recognize that obesity is but one hallmark of a more complex clinical entity – Metabolic Syndrome (MetS). MetS is defined as a cluster of abdominal obesity, high blood pressure, high blood sugar, high serum triglycerides and low serum HDL. Thus, while it is clear that obesity itself represents a significant risk to an individual's health, the psychological factors that might contribute to it or be significant in these conditions remain less known, recognizable, and universal [1]. Exploring the psychological mechanisms that induce eating disorders like compulsive overeating why some patients prefer unhealthy dietary choices under while in heightened emotional states might present a new perspective and possibly lead to novel treatment pathways in these patients. In this review we will examine the current literature on different eating patterns and how these might impact individuals with metabolic syndrome as well as psychiatric patients and ways that psychotherapists may approach treatment in these patients.

2. Materials and Methods

This narrative review aims to examine eating patterns and their association with metabolic syndrome, which is a significant health issue today. To this goal, four authors (F.M., T.G., M.Š., T.P.) independently identified articles they deemed relevant in this field, which were then collectively

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reviewed and categorized into thematic units outlined in the article, aiming for a more relevant and contemporary approach to the subtitle's theme. The analyzed articles were predominantly in English, mostly recently published, with preference given to those with larger sample sizes. Following consultations, primarily via telephone, we extracted and structured the results of studies we considered pivotal into a narrative review format to present them in a more readable and understandable manner.

3. Eating Patterns and the Metabolism

Several types of eating patterns, behaviors and trends have been researched and looked into to discern common links between them and the development of MetS. While further research is needed to ascertain the exact correlation between different eating habits paired with meal skipping and the timing of the development of MetS. Certain diets have been associated with a higher risk of developing MetS. Pacifico et al. [2] as cited in Wang et al. [3] list diets that include meals which are low in fiber but high in calories, cholesterol, saturated fats, sodium and simple carbohydrates. Alkhulaifi et al. [4] reviewed studies that observed the effects of skipping meals on the development of certain risk factors associated with the development of MetS. The studies which they cite found that the modern lifestyle leads to people skipping meals more often [5,6], the meal most often skipped being breakfast followed by lunch and dinner [7]. Skipping breakfast is particularly linked to a higher body weight, a higher insulin resistance [8,9], Watanabe et al. [10], as cited in Yoshida et al. [11] also draws parallels between skipping breakfast and a higher BMI and waist circumference which are all risk factors associated with MetS. They also concluded that people who eat multiple meals a day had a lower obesity rate than people who ate fewer than three meals a day. They stated that some studies established a correlation between eating more than six or less than three meals a day and fasting plasma glucose levels [12] but another study found that there is no correlation [13] so this remains unclear. Świątkiewicz et al. [14] found that erratic eating patterns like eating over a longer period per day and eating more than just three meals a day are widespread [15–20] and are associated with obesity, T2DM, MetS, and CVD [21–24]. They also found that misalignment between daily rhythms of food consumption and circadian timing system can contribute to circadian rhythm disruption which results in abnormal metabolic regulation, disruption of metabolic homeostasis, and increased cardio-metabolic risks [25–29]. They presumed that time restrictive eating (TRE) would help patients with metabolic disorders restore the normality of their circadian rhythms which would positively affect regulation of the metabolism. The studies they cite concluded that the metabolism operates at a higher and more efficient rate in the morning rather than later in the day [26,28,30–32], and that by favoring higher energy intakes in the morning and keeping them low in the evening might help with losing weight and keeping glucose and lipid levels in check [33,34]. Although some review articles indicated that TRE strategies might be helpful in addressing cardio-metabolic disorders [21,26,30,35–39] a lot of the cited studies were not conducted on patients with MetS and as such further research is needed. The study published by Yau et al. [40] referenced research that was conducted on animals [41,42] and humans [43–45] which bore no correlation between stress and the amount of food consumed, because some subjects became hypophagic while others became hyperphagic. They suspected this was due to different types of stressors and the duration of the stressful period. Another study suspects that lower amounts of stress induced hyperphagia while bigger stressors induced hypophagia [46]. They also state that under stressful situations animals prefer foods that are high in saturated fats and rich in sugars [47–49], while humans preferred hyperpalatable, calorie-rich foods [50–52] even though there was no metabolic need for higher energy intake [53]. This effect might be more pronounced in obese individuals [45,54]. Repeated, uncontrolled and prolonged stress can dysregulate the hypothalamic-pituitary-adrenal (HPA) axis which is responsible for secreting glucocorticoids such as cortisol thus influencing energy homeostasis and eating behavior. Chronic activation of the HPA axis has an effect on glucose metabolism, promoting insulin resistance and altering some appetite-related hormones [55]. Prolonged secretion of glucocorticoids promotes fat accumulation in the abdominal region which is one of the risk factors for MetS. Those under chronic stress eat hyperpalatable, energy dense, high fat foods more often during acute stress episodes [56].

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HPA activation is linked with the activation of the reward system. A diet rich in high fat foods sensitizes the reward system which can promote cravings and a higher intake of said foods [57]. Continued stimulation of those reward pathways progressively promotes more compulsive behavior [58]. Obese individuals have shown a stronger activation of the reward system when exposed to food while under stress compared to lean individuals [54]. Animal models demonstrated that obesity often has an effect on adipose receptors [59] which are important for the negative feedback loop and the cessation of eating. People with higher BMI scores have an increased probability of weight gain while under chronic stress compared to individuals under the same amount of stress but who have lower BMI scores [45]. Chronically high levels of insulin and insulin resistance, which is more prevalent in obese individuals [55], can impair the insulins' ability to suppress motivational pathways, resulting in higher levels of stress. Yau et al. [40] state that individuals in negative affective states have been shown to favor the consumption of hedonically rewarding foods high in sugar and/or fat, whereas intake during happy states favor less palatable dried fruits" [60]. Sleep deprivation may contribute to higher levels of stress which puts people at a higher risk of developing metabolic conditions, a bigger abdominal circumference, insulin resistance and higher blood pressure which are all closely related to cardiovascular conditions and type II diabetes mellitus [61,62]. Yoshida et al. [11] found that there is a significant correlation between both individuals who eat snacks after dinner and those who eat dinner before bed and a higher BMI score, higher LDL cholesterol and abdominal circumference, while those who exhibit both behaviors have an even higher chance of presenting with the same afflictions. In some patients with MetS we find comorbid binge eating disorder, where a person has the urge to consume enormous amounts of food at once just to satisfy an unbearable need rooted in the experience of stress and anxiety that overwhelms the person. After such binge eating episodes patients feel temporary relief and reduction in stress, which over time may become a compulsive pattern of behaviour. This form of release represents a kind of acting out, after which an aggressive impulse is discharged, which shows that personality traits like impulsivity can also play a significant role in pathological eating patterns. Considering a person's circadian rhythm and the tendency of individuals prone to anxiety and depressive moods to be more overwhelmed with negative thoughts and feelings towards the end of the day, just before usual bedtime, it is not surprising that this phenomenon is often found in a modified form known as night-eating syndrome [63]. These eating patterns play a significant role in the lives of these individuals, contributing to weight gain and obesity. Furthermore, Yoshida et al. [11] studied night eating habits and found that they are associated with dyslipidemia in both men and women. Therefore, besides addressing internal medical conditions, mental health plays an extremely important role and should be central to health. In accordance with this, treatment interventions should focus on improving the mental health of individuals with metabolic syndrome, especially those linked with compulsive overeating, as this is currently undervalued in treatment of these patients. Thus, treatment should encompass complex psychopharmacological and non-pharmacological/psychotherapeutic interventions. Some possible pharmacological approaches include antidepressants, particularly selective serotonin reuptake inhibitors, and newer psychopharmaceuticals like Lisdexamphetamine [63].

4. Psychiatry and Treatment of Metabolic Syndrome

The definition of MetS includes a cluster of factors such as abdominal obesity, insulin resistance, dyslipidemia, and elevated blood pressure [64]. Considering MetS a complication of obesity, losing body weight is crucial in reducing risk of obesity-related diseases [65]. According to Berkovskaya et al. obesity is seen as a multi-factorial disease where lifestyle traits are the most important pathogenic factors, as well as a combination of genetic, epigenetic, biological and psychological factors that cause weight gain and disable reduction and retention of healthy body weight [66]. First of all, when thinking in terms of psychiatry, Bhuvaneswar et al. emphasized that the clinical use of psycho-pharmacological agents necessitates the recognition, monitoring, and management of potential adverse metabolic impacts. Switching to medications with a reduced risk of weight gain and associated metabolic issues is recommended [67]. Elevated incidence of MetS has been noticed in some groups of psychiatric patients. As de Almeida et al. stressed, patients with bipolar disorder

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have higher rates of MetS. Other than adverse effects of psychotropic drugs, unhealthy lifestyle choices, shared neuroendocrine and immunoinflammatory disorders, and genetic predispositions are also contributing factors. A significant neuroendocrine anomaly, the hyperactivity of the hypothalamic–pituitary–adrenal axis, predominantly associated with major depression, is implicated in the neurobiological mechanisms governing the switch processes in bipolar disorder [68]. Moreira et al. found that subjects with depression and anhedonia exhibit elevated levels of glucose, triglycerides, total cholesterol, and LDL-cholesterol, alongside reductions in HDL-cholesterol levels, which indicates a higher prevalence of MetS among those individuals [69]. As suggested by Räikkönen et al. psychosocial factors are predictive of the risk for developing MetS across various definitions, suggesting a potential causal role in the etiological pathway leading to MetS. Women experiencing high levels of depressive symptoms coupled with significant stressful life events at the outset of a longitudinal study demonstrated an elevated risk for developing MetS over an average follow-up period of 15 years [70]. According to Pigsborg et al. the success of weight loss interventions is influenced not only by genetics and biological processes but also by psychological and behavioral constructs. Factors related to eating behavior, societal norms, and personal psychological aspects like motivation, self-efficacy, locus of control and self-concept play significant roles, as well as major life events [71–73]. Curis et al. emphasized that ingestion of food not only fulfills the basic need for nutrient and energy intake but also serves as a source of pleasure. Emotional instability is frequently linked to unhealthy behaviors and irrational cognitions regarding eating habits often resulting in a cascade which leads to obesity [66,73]. According to Conti et al. alexithymia, a personality trait with difficulties in recognizing and processing emotions, may also contribute to the development of MetS through binge eating and psychological distress [66,74]. Conti et al. [74] found that individuals with MetS are older, have a higher body mass index, have had obesity for a longer duration, and scored higher on scales measuring alexithymia like TAS-20, suggesting that binge eating might play a mediating role between alexithymia and metabolic syndrome.

Furthermore, in our previous research, we investigated the association between alexithymia, obesity, and diabetes mellitus type 2. The paper demonstrated that recognizing and raising awareness of alexithymia, along with psychotherapy, particularly of a psychodynamic nature, could significantly impact improving the quality of an individual's relationships and insight into their own personality. Consequently, this may have repercussions on better diabetes mellitus control. Similarly, in the case of metabolic syndrome, it is expected that better insight and recognition of certain intrapsychic phenomena will positively affect cooperation in the treatment process [75].Camacho-Barcia et al. suggested that excessive consumption of energy-dense foods is driven by heightened food reward sensitivity, problems with self-control, or emotional states. Implementing individual-specific psychological strategies is crucial for ensuring and sustaining weight loss. High reward sensitivity, preference for unhealthy foods, and overeating in patients with binge eating disorder and obesity underscore the need for interventions that strengthen self-control and conscientiousness, as well as developing emotion regulation skills [76]. Furthermore, non-invasive deep magnetic brain stimulation has shown promise in reducing impulse-related behaviors linked to obesity. Mindfulness-based interventions have demonstrated positive outcomes in treating obesity by altering eating behaviors leading to mindful eating [76,77]. According to many studies cognitive-behavioral weight-management treatment leads to improvements in measures of self-regulation, self-efficacy and mood with development of abilities to redirect attention, and the management of the physiological consequences of the emotions [76,78–81]. As Slabá et al. mentioned that the most common character traits of obese patients include predominantly neuroticism, which manifests as anxiety, depression, impulsiveness, anger and hostility [79]. Marčinko et al. stressed the significant role of the spectrum of the "master emotion" of shame, as well as the importance of psychodynamic psychotherapy in management of obesity [79,82]. Other studies recommend different psychotherapeutic approaches, such as existential therapy [79] and acceptance and commitment therapy which was found to be effective in improving weight loss in terms of BMI, psychological flexibility and weight-related stigma [83]. In summary, the interplay of psychological, emotional, and

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lifestyle factors plays a significant role in the etiology and management of obesity and MetS, emphasizing the need for integrated and multifaceted therapeutic approaches [84].

5. Discovering Unhealthy Eating Patterns

Nearly 80 % of eating disorders go undetected which is why it is crucial to develop the tools to correctly diagnose them as they can be connected to various other serious medical conditions, such as MetS. What is even more problematic is that often people are unaware of the eating disorder or unwilling to accept it, which results in poorer treatment outcomes [85]. Therefore, the knowledge about warning signs or "red flags" could be very helpful for both doctors and patients. One of the first warning signs would be extreme dietary restrictions which can offer insights into individuals' complex relationships with food, hinting at potential eating disorder risks. Examples include fasting diets, juice cleanses, caloric restriction, rigid food rules, prolonged fasting, excessive detox diets, and obsessive meal planning. Underneath this behaviour lies fear of weight gain, feeling like one is overeating, feelings of guilt, thinking about dieting, and a desire for thinness which all serve as a prediction of eating disorder severity [86]. Embracing balanced nutrition, considering both physical and mental well-being, is essential. Seeking guidance from healthcare professionals ensures a respectful approach to nutrition. It's vital to prioritize well-being and avoid diets that overly restrict food variety or exclude entire food groups. Rapid weight fluctuations can be another indicator as they stem from a complex interplay of physical, psychological and social factors in eating disorders. Distorted body image perceptions, societal pressures, and underlying emotional issues drive the desire for rapid weight changes. Such fluctuations can lead to nutritional deficiencies, weakened immunity, and cardiovascular problems with rapid weight loss, while weight gain may result in metabolic issues and chronic illnesses. Emotionally, shifts in body weight exacerbate self-esteem and body image concerns. Achieving lasting recovery entails addressing body image and self-esteem issues alongside physical healing. Cultivating self-acceptance and self-love is crucial in this journey, supported by empathy and understanding. It is a holistic approach that fosters enduring healing by acknowledging and confronting the root causes of negative body image. The pursuit of control which usually manifests as constant preoccupation with food, weight, and appearance serves as a coping mechanism in times of stress and anxiety, intertwining self-esteem with body image. Another thing to consider is the fact that studies have shown that about 50% of preadolescent girls and 30% of preadolescent boys dislike their body which shows the severity of this issue [87]. These behaviors disrupt daily life, elevating stress levels and affect decision-making. This focus can strain social interactions and contribute to feelings of isolation. Other warning signs include frequent body checking, comparison with others, seeking affirmation, clothing insecurity, avoidance of social situations, and negative self-talk. Effective treatment requires a multidimensional approach, including therapy and support groups, to address underlying emotional and psychological factors. These interventions foster healthier relationships with food, body image, and self-esteem. Another important aspect to consider is the individuals' relationship with exercising. Balancing a healthy fitness routine with potential obsession is challenging. A growth-positive routine involves regular exercise for physical and mental well-being, with flexibility and joy in activities. Unhealthy obsession arises when exercise becomes compulsive, driven by control or body image concerns. It also seems that ~39%–48% of people with eating disorders engage in compulsive exercise, indicating a common overlap between the two [88]. Warning signs in this domain include rigid schedules, exercising to change body shape, social isolation, compulsive behavior, denial of rest, viewing exercise as punishment, and emotional distress when unable to exercise. Recognizing this balance requires understanding emotional and psychological factors. Guiding towards a balanced approach, incorporating rest and diverse activities, and nurturing positive body image are crucial for a healthy fitness routine.

6. Conclusions

In conclusion, the complex dynamic between eating patterns, pathologic behaviors and the development of metabolic syndrome highlights the critical need for a holistic approach to managing

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this condition. While consumption of food high in calories, cholesterol, saturated fats, carbohydrates have been linked to a higher risk of MetS, this is exacerbated by meal skipping by contributing to higher body weight and insulin resistance. We highlight the interplay of food intake with circadian rhythms and the potential benefits of time-restricted eating in metabolic regulation. The interplay between psychological well-being and metabolic health is particularly significant. Chronic stress and poor mental health can lead to maladaptive eating behaviors, further compounding the risk of MetS. Effective treatment strategies must therefore include robust mental health support in addition to lifestyle interventions. Addressing emotional issues and implementing psychotherapeutic approaches are essential for holistic care of MetS. Furthermore, recognizing and addressing unhealthy eating patterns early on is crucial. Warning signs such as extreme dietary restrictions, compulsive exercise and rapid weight fluctuations should be recognized and timely interventions should be implemented. Early diagnosis enables more effective treatment, addressing root causes and preventing escalation. Awareness helps dismantle the stigma surrounding eating disorders and obesity, encouraging open conversations and improving understanding. Creating a safe environment for individuals to express their struggles fosters empathy and promotes well-being, both mentally and emotionally, extending beyond physical health. In this aspect, psychiatrists and psychotherapists step in as indispensable components in treating patients with metabolic syndrome, especially in cases where there is suspicion or confirmation of disordered eating patterns. Ultimately, reducing the prevalence and impact of MetS requires a multifaceted approach that integrates medical, psychological, and lifestyle interventions. By prioritizing both physical and mental health, we can better support individuals in achieving sustainable improvements in their overall well-being. Further research is essential to refine these strategies and ensure they are effective for diverse populations, paving the way for a healthier future.

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