EXAMINING RELATIONSHIPS AMONG INFORMATION PROCESSING SPEED, SELECTIVE ATTENTION, WORKING MEMORY, AND SET SHIFTING IN OBESE PEOPLE WITH REGULAR BINGE EATING

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ABSTRACT

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This study aims to compare the neuropsychological test profiles that are sensitive to information processing speed, selective attention, working memory, and set shifting processes in obese and normal weight individuals with and without regular binge eating patterns, and to increase the generalizability of the findings obtained from previous studies by increasing the number of male participants. In the present study, these executive functions, which are responsible for purpose-oriented high-level cognitive skills, and the cognitive impairments associated with these functions were systematically examined according to factors such as Body Mass Index (BMI) value, which determines the presence of obesity, regular binge eating behavior and gender. 176 volunteers between the ages of 18 and 35 participated in the study. Participants were divided into four groups according to their BMI values and the presence of regular binge eating behaviors. Due to the COVID-19 pandemic, the participants completed five different neuropsychological tests, which were Paced Auditory Serial Addition Test (PASAT), Serial Digit Modalities Test (SDMT), Stroop Test TBAG Form, Wechsler Memory Scale-Revised (WMS-R)'s Information and Orientation Questions, Digit Span, and Visual Memory Span subscales, and Trail Making Test, completely online through a website created with PHP 4.0 language specifically for the study. As expected, the obese groups showed significantly lower cognitive performance on the neuropsychological tests than the normal weight group. While a significant difference was found between the groups with and without regular binge eating in terms of information processing speed and working memory performance, which is associated with information processing speed, however, no significant difference was found in attention and set shifting performances in general. However, there were significant differences in cognitive and sub-cognitive performances between men and women in their neuropsychological test profiles. The regular binge eating patterns and eating attitudes of the groups were also compared. The findings were evaluated in terms of the cognitive and sub-cognitive functions that each scale and neuropsychological test measured and were discussed in terms of suggestions for future studies and implications for applications.

Keywords: Obesity, Binge eating, Information processing speed, Executive functions

ÖZ

SÜREKLİ TIKINIRCASINA YEME EĞİLİMİ OLAN OBEZ BİREYLERDE BİLGİ İŞLEME HIZI, SEÇİCİ DİKKAT, ÇALIŞMA BELLEĞİ VE SET DEĞİŞTİRME SÜREÇLERİ ARASINDAKİ İLİŞKİLERİN İNCELENMESİ

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Bu çalışma, sürekli tıkınırcasına yeme örüntüsüne sahip olan ve olmayan obez ve normal kilolu bireylerde bilgi işleme hızı, seçici dikkat, çalışma belleği ve set değiştirme süreçlerine duyarlı nöropsikolojik test profillerini karşılaştırmayı ve erkek katılımcı sayısını arttırarak önceki çalışmalardan elde edilen bulguların genellenebilirliğini arttırmayı amaçlamaktadır. Çalışma, amaca yönelik üst düzey bilişsel becerilerden sorumlu olan yürütücü işlevlerin ve bu işlevlerle ilişkili bilişsel bozulmaların bireylerdeki sürekli tıkınırcasına yeme davranışı, obezitenin varlığını değerlendiren Beden Kütle İndeksi (BKİ) ve cinsiyet gibi faktörlere göre nasıl farklılaştığını sistematik olarak incelemiştir. Çalışmaya 18 ila 35 yaş arası 176 gönüllü katılmıştır. Katılımcılar BKİ değerleri ve sürekli tıkınırcasına yeme davranışlarının varlığına göre dört ayrı gruba ayrılarak incelenmiştir. COVID-19 pandemi süreci sebebiyle katılımcılar Adımlı İşitsel Seri Ekleme Testi (PASAT), Sembol Sayı Modaliteleri Testi (SDMT), Stroop Testi TBAG Formu, Wechsler Bellek Ölçeği-Geliştirilmiş Formu’nun Genel Bilgi ve Yönelim Soruları, Sayı Uzamı, Görsel Bellek Uzamı alt testleri ile İz Sürme Testi olmak üzere beş farklı nöropsikolojik testi, çalışmaya özel olarak PHP 4.0 kodlama dili ile oluşturulmuş bir web sitesi üzerinden online olarak tamamlamışlardır. Beklenildiği üzere, obez gruplar normal kilo grubuna göre nöropsikolojik testlerde anlamlı derecede düşük bilişsel performans sergilemiştir. Sürekli tıkınırcasına yiyen ve yemeyen gruplar arasında bilgi işleme hızı ve bilgi işleme hızı ile ilişkili olan çalışma belleği performansı açısından anlamlı bir fark bulunurken, dikkat ve set değiştirme performanslarında genel olarak anlamlı bir fark bulunamamıştır. Bununla birlikte nöropsikolojik test profillerinde kadın ve erkekler arasında bilişsel ve alt-bilişsel performansları açısından anlamlı farklar bulunmuştur. Gruplar arası tıkınırcasına yeme örüntüsü ve yeme tutumları da ayrıca karşılaştırılmıştır. Bulgular her bir ölçeğin ve nöropsikolojik testin ölçtüğü bilişsel ve alt-bilişsel süreçler açısından değerlendirilmiş; gelecekteki çalışmalar için öneriler ve uygulamalara yönelik çıkarımları açısından tartışılmıştır.

Anahtar Kelimeler: Obezite, Tıkınırcasına yeme, Bilgi işleme hızı, Yürütücü işlevler

To my beloved family…

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LIST OF SYMBOLS AND ABBREVIATIONS

ADHD	: Attention Deficit Hyperactivity Disorder
BIS-11-SF	: Short Form of Barratt's Impulsivity Scale, Version 11
BMI	: Body Mass Index
CNS	: Central Nervous System
CR	: Cognitive Restraint (TFEQ-R21's subscale)
EDE-Q	: Eating Disorder Examination Questionnaire
EE	: Emotional Eating (TFEQ-R21's subscale)
EF	: Executive Function
NW-RBE	: Normal Weight Group with Regular Binge Eating
NW-w/RBE	: Normal Weight Group without Regular Binge Eating
OB-RBE	: Obese Group with Regular Binge Eating
OB-w/RBE	: Obese Group without Regular Binge Eating
PASAT	: Paced Auditory Serial Addition Test
RBE:	: Regular Binge Eating
SDMT	: Symbol Digit Modalities Test
TFEQ-R21	: Three-Factor Eating Questionnaire-Revised 21 Item
TMT	: Trail Making Test
UE	: Uncontrolled Eating (TFEQ-R21's subscale)
WMS-R	: Wechsler Memory Scale – Revised

CHAPTER I

INTRODUCTION

“No food will ever hurt you as much as an unhealthy mind.” **—** *Brittany Burgunder (2016: 231)*

Eating disorders are medical conditions of individuals who have severe issues with their eating behaviors, thoughts, and attitudes (National Institute of Mental Health 2018). The Diagnostic and Statistical Manual of Mental Disorders, 5th edition (DSM-5)’s Feeding and Eating Disorder category includes pica, rumination disorder, avoidant/restrictive food intake disorder, anorexia nervosa, bulimia nervosa, and binge eating disorder (American Psychiatric Association [APA] 2013). Besides, this category also includes two extensive diagnoses that are other specified feeding or eating disorder (OSFED) and unspecified feeding or eating disorder (UFED) (APA, 2013). Unlike the text revision of the Diagnostic and Statistical Manual of Mental Disorders, in the 4th edition (DSM-4-TR), binge eating disorder was removed from the eating disorders as a not otherwise specified (EDNOS) category (APA 2000), which the current name is OSFED, and made a separate diagnosis, and anorexia nervosa and bulimia nervosa disorders’ diagnostic criteria are updated in DSM-5 (APA 2013). Also, it is stated that pica, rumination disorder, and avoidant/restrictive food intake disorder cannot belong to the “Feeding and Eating Disorders of Infancy or Early Childhood” section and these diagnoses can be made at any age (Call et al. 2013). Comparison of DSM-4-TR and DSM-5 Feeding and Eating Disorders category diagnoses are summarized in Table 1.

Table 1. Comparison of DSM-4-TR and DSM-5 Feeding and Eating Disorders Category Diagnoses

DSM-4-TR

1. Anorexia Nervosa
    a. Restrictive Anorexia Nervosa
    b. Binge Eating/Purging Anorexia Nervosa
2. Bulimia Nervosa
    a. Purging Bulimia Nervosa
    b. Non-Purging Bulimia Nervosa
3. Eating Disorder Not Otherwise Specified (EDNOS)
    a. Restricting Without Low Weight
    b. Binging Without Purging
    c. Purging Without Binging
    d. Low Weight Without Loss of Menses

DSM-5

1. Pica
2. Rumination Disorder
3. Avoidant/Restrictive Food Intake Disorder
4. Anorexia Nervosa
    a. Restrictive Anorexia Nervosa
    b. Binge Eating/Purging Anorexia Nervosa
5. Bulimia Nervosa
6. Binge Eating Disorder
7. Other Specified Feeding or Eating Disorder (OSFED)
    a. Atypical Anorexia Nervosa
    b. Bulimia Nervosa of Low Frequency and/or Limited Duration
    c. Binge Eating Disorder of Low Frequency and/or Limited Duration
    d. Purging Disorder
    e. Night Eating Syndrome
8. Unspecified Feeding or Eating Disorder (UFED)

In general, eating disorders are known to be developed in adolescence and young adulthood periods. The age of onset of eating disorders is gradually decreasing and the prevalence is increasing for girls and boys suffering from this disorder (Micali et al. 2013). Along with recent studies, it is observed that eating disorders are widespread, especially among females and in Western societies (Qian et al. 2022). The incidence rates of anorexia nervosa as 1 to 4%, bulimia nervosa as 1 to 2%, and binge eating disorder as 1 to 4% have been notified in female patients admitted to hospitals in Europe. On the other hand, the incidence rate of eating disorders was notified as 0.3 to 0.7% in males admitted to hospitals in Europe (Keski-Rahkonen and Mustelin 2016). It is known that incidence rates of eating disorders are increased in non-Western societies, but there is no definite information about them. Changes in incidence rates are thought to result from sociocultural factors that may vary for each non-Western community (Hoek 2016).

From 2000 to 2018, the global prevalence of eating disorders multiplied from 3.5% to 7.8% (Galmiche et al. 2019). According to the number of hospital admissions, the lifetime prevalence of anorexia nervosa in women is about 4%, and bulimia nervosa is about 3%. In the number of hospital admissions of men, the lifetime prevalence is about 0.3% for anorexia nervosa, and over 1% for bulimia nervosa (Van Eeden et al. 2021). In one study, it was found that binge eating disorder symptoms appear in around 2% of men and %3.5 of women at some moment in their lives unlike other eating disorders (Hudson et al. 2007). However, recent findings report that the lifetime prevalence of binge eating disorder for women ranged from 0.6% to 1.8%, and 0.3% to 0.7% for men, although the rate of hospital admissions for binge eating disorder is very low. It is thought that 1.5% of women and 0.3% of men worldwide suffer from an undiagnosed binge eating disorder (Keski-Rahkonen 2021). According to Patton and colleagues' (1999) study, women are diagnosed with eating disorders nine times more than men and, adolescent girls on a strict diet are eighteen times more susceptible to develop an eating disorder than non-dieters. Also, they found that adolescent girls who do not have a strict style while dieting are five times more susceptible to develop an eating disorder than non-dieters.

Obesity is known as one of the important public health problems of recent years (World Health Organization [WHO] 2021a). Between 2020 and 2050, it is estimated that 5 to 14% of average annual health expenditures per capita in developed countries will be spent on obesity and various health problems related to obesity such as type 2 diabetes mellitus, cardiovascular diseases, lipid disorders like high blood cholesterol, stroke, hypertension, polycystic ovary syndrome, non-alcoholic fatty liver disease, gastrointestinal diseases, osteoarthritis, obstructive sleep apnea, some cancer types and depression (McCarthy 2019; Turkish Endocrinology and Metabolism Society [TEMS] 2018). Among the preventable causes of death, obesity ranks second after smoking (TEMS 2018).

According to WHO's research conducted in 2016, it was found that more than 650 million adults (13%) in the world population are obese (WHO 2021a). Obesity is a serious health problem in Turkey too. According to the obesity report prepared by The Organisation for Economic Co-Operation and Development (OECD), obese people spend money approximately 2.5 times more on their health problems compared to normal-weight people, and OECD countries including Turkey allocate 8.4% of total health expenditures to the treatment of obesity-related chronic diseases (OECD 2019). According to the WHO Regional Office for Europe: Gender and Noncommunicable Diseases in Turkey Report (2020), obesity prevalence rates among individuals were reported at 35.9% for females, 21.6% for males, and 28.8% overall. The rates of obesity prevalence in Turkey for adult males and females according to their age ranges are presented in Table 2.

Table 2. Obesity Prevalence Rates in Turkey for Adults According to Age Ranges

	Men			**Women**		
	30-44 yrs.	**45-59 yrs.**	**60-69 yrs.**	**30-44 yrs.**	**45-59 yrs.**	**60-69 yrs.**
Obesity prevalence (%)	19.7	32.5	40.6	30.1	55.9	66.9

It is known that the rate of regular binge eating behaviors in obese cases applied for the treatment ranges from 18% to 46%, sometimes up to 55% (Wilfley and Cohen 1997; Kinzig 2018; Yüksel 2014: 481). The relationship between eating disorders and obesity has been investigated in various studies, but no definite findings have been found. According to the findings of Molinari and colleagues (1997), there was no significant difference between the obese group and the normal-weight group in terms of their eating attitudes and psychopathological disorders. However, according to Marcus and colleagues' (1985) study of obese groups applied to weight management programs, 25 to 45% of applicants have regular binge eating patterns.

Although it is known that a significant proportion of obesity cases have regular binge eating patterns, further studies are needed to determine the relationship between them. The treatments to be applied in obese groups should not be limited to strict diet plans and exercise, but also their underlying regular binge eating patterns and cognitive impairments should be examined. Recent studies have shown that people with eating disorders, especially anorexia nervosa and binge eating disorder, have more cognitive impairments than people without eating disorders, and people suffering from binge eating disorder have more attention deficits and cognitive flexibility difficulties than people suffering from other eating disorders (Aloi et al. 2015). Therefore, it is thought that the determination of cognitive impairments in obese patients with regular binge eating behaviors and their treatment methods and psychotherapeutic techniques to cure these disorders may reduce the rate of obesity in the world by breaking the mold.

Despite the high worldwide prevalence rate of obesity, there is not much information in the literature about regular binge eating patterns in obese people. Additionally, executive functions (EF) studies for binge eating disorder were mostly conducted on women participants and the number of male participants in these studies was very low. This situation reveals the lack of studies in this field because it is known that indefinite eating disorder symptoms such as regular binge eating or purging and mortality rates in eating disorders are common in men as well as women (Mitchison et al. 2014; Raevuori et al. 2014).

Considering that this behavioral pattern in obese people should be determined in terms of recovery, this study aims to examine cognitive dysfunctions in some specific purpose-oriented domains such as information processing speed, attention, working memory, and set shifting by distinguishing people in terms of the presence of regular binge eating pattern, body mass index values (the presence of obesity) and gender differences. Also, this study aims to support the existing literature lacking in this field by increasing the number of male participants in the study.

1.1. OBESITY

1.1.1. Definition of Obesity

Obesity is not a DSM-5 (APA 2013) diagnosis in Feeding and Eating Disorder section but it is one of the most remarkable health problems in recent years. Although it has different definitions, obesity is generally defined as “an abnormal or excessive fat accumulation that may impair health and a person with a Body Mass Index (BMI) of 30 or more is generally obese (WHO 2021a)”. BMI is used to have a certain standard of definition of obesity. To measure BMI, a person's body weight (kg) is divided by his/her height ($(m)^2$) squared.

According to WHO worldwide classification, people with BMIs below 18.5 are considered as underweight, those between the range of 18.5 to 24.9 are considered as normal-weight, those between the range of 25 to 29.9 are considered as overweight (pre-obese), and those 30 and higher are considered as obese (WHO 1995). Obesity classification according to BMI values for adults is presented in Table 3.

Table 3. Obesity Classification According to BMI Values for Adults

Classification	BMI Values (kg / m^2)
Underweight	< 18.5
Normal-weight	18.5 – 24.9
Overweight (Pre-obese)	25 – 29.9
Obese	≥ 30
Obese Class 1 (Moderate)	30 – 34.9
Obese Class 2 (Severe)	35 – 39.9
Obese Class 3 (Very Severe)	≥ 40

However, a higher BMI value does not always indicate obesity. For instance, people with high muscle mass such as bodybuilders, have a high BMI too. Therefore, obesity can be defined as having up to 20% more than normal weight according to people's height and gender (Yüksel 2014: 481). Therefore, it is not always sufficient to evaluate obesity only over BMI values.

When evaluating obesity, the unhealthy eating behaviors of people should also be taken into consideration because knowing that individuals have unhealthy eating behaviors allows intervention towards both eating psychopathology and healthy weight loss (Bryant et al. 2019). In some studies, it was found that obese people suffering from binge eating disorder had weak cognitive task performance than obese people without binge eating disorder (Duchesne et al. 2010; Mobbs et al. 2011). Also, some studies found no significant difference in the cognitive performance of obese people with binge eating disorder and obese people without binge eating disorder groups, including those with morbid obesity (Danner et al. 2012; Galioto et al. 2012).

Nevertheless, unhealthy eating behavior patterns and their relationship with obesity have been investigated with eating attitude scales such as the Dutch Eating Behavior Questionnaire (Van Strien et al. 1986) or Yale Food Addiction Scale (Meule et al. 2017). Many studies conducted with the Three-Factor Eating Questionnaire (TFEQ) (Stunkard and Messick 1985), a well-known scale for evaluating weight status and obesity-related eating attitudes, have shown that individuals who score high on the Uncontrolled Eating (UE) and Emotional Eating (EE) subscales are more likely to have higher BMI values (e.g., obesity), more unhealthy eating behaviors (e.g., binge eating), and adopt a more unhealthy lifestyle. Similar studies have shown that those who score high on the Cognitive Restraint (CR) subscale are prone to obesity and binge eating patterns, although their restricted eating seems to be associated with lower BMI values (Bryant et al. 2019). A recent study conducted in Turkey showed that obese individuals with higher scores on TFEQ’s UE and EE subscales are more prone to develop type 2 diabetes mellitus (Ulaş-Kadıoğlu and Soylar 2021).

However, many studies found that women score higher than men on three subscales of the TFEQ (Davison 2013; Ernst et al. 2015; Verzijl et al. 2018). Although this suggests that there is a difference in eating attitudes between men and women, some studies did not find a significant difference between men's and women's eating attitudes, except that women scored high on the EE subscale (Leblanc et al. 2015). Therefore, more studies should focus on the links between BMI and unhealthy regular eating behaviors in obese people, based on gender.

1.1.2. Epidemiology of Obesity

Obesity is recognized as a very common health problem in almost every region of the world. According to NCD-RisC's (2016) study with 19.2 million participants in 200 countries, the prevalence of global obesity in adult individuals aged 18 and over increased from 3.2% for men and 6.4% for women in 1975 to 10.8% for men and 14.9% for women in 2014. According to the estimates made for 2025 in the same study, the prevalence of global obesity is expected to approach 18% in men and exceed 21% in women (NCD-RisC 2016).

According to the WHO, the prevalence of global obesity almost tripled between 1975 and 2016. While the prevalence of global obesity among children and adolescents between the ages of 5 and 19 in 1975 was only 1%, in 2016 this rate reached 6% for girls and 8% for boys. Looking to the data of the WHO for 2016, approximately 13% of adults were obese (11% of men and 15% of women), while more than 340 million children and adolescents between the ages of 5 and 19 were overweight and obese, and 41 million children under the age of 5 were overweight and obese (WHO 2021a). The findings show that the prevalence of obesity is increasing in children and adolescents, just like in adults (TEMS 2018).

Changes in the lifestyle of people in Turkey have a negative impact on society in terms of health and have contributed to the prevalence of obesity. In Turkey, the obesity prevalence is higher in women; however, a rapid increase has been observed in men in recent years (TEMS 2018). The prevalence of obesity in Turkey has been examined by the Turkish Diabetes Epidemiology Study (TURDEP-I), which is one of the most comprehensive studies in this field, between the years 1997 and 1998, at 540 centers in 15 cities, with 24.788 participants aged 20 and over. As a result of the study, the prevalence of obesity in the general population was determined to be 22.3% (12.9% of men and 29.9% of women) (Satman et al. 2002). In 2010, this study was repeated in the same centers with a similar number of participants under the name TURDEP-II. After 12 years, the prevalence of obesity in the general population was determined to be 35% (27% of men and 44% of women) (Satman et al. 2013). When the results obtained from TURDEP-II were standardized according to the TURDEP-I sample, it was found that the prevalence of obesity increased by 34% in women and 107% in men. After 12 years, the proportion of people with a normal-weight BMI value decreased from 41% to 26%, and no significant change was observed in the proportion of overweight (pre-obese) individuals, but the proportion of people in the very severe obese category (≥ 40 BMI value) increased from 1% to 3.1% (Satman et al. 2002; Satman et al. 2013). According to the 2019 statistics of the European Society of Cardiology, Turkey ranks 25th in the number of obese men and, 3rd in the number of obese women among the 54 member countries (Timmis et al. 2020).

1.1.3. Causes of Obesity

There are no definite reasons responsible for the widespread outbreak of obesity, but genetic, environmental, and/or psychological factors may be important (Babayiğit 2007). Thanks to the easier access to every opportunity through developing technology (e.g., smartphones, computers, tablets, etc.), decreasing physical activity, preferring a more sedentary lifestyle, changes in their eating habits of people, and their tendency to fast-consuming foods containing more fat and carbohydrates (e.g., fast-food meals) are among the important causes of obesity (TEMS 2018). It is also known that insufficient intake of breast milk in infancy and emotional eating in some obese individuals are the factors in the prevalence of obesity (Yüksel 2014: 482). The complex nature of obesity should be considered for diagnosis and treatment, and many factors should be examined together.

1.1.3.1. Biological/Genetic Factors

Eating is a behavior that occurs as a result of the interaction of neural, hormonal, and neurochemical signals with the central nervous system (CNS). Eating behavior is important for regenerating our cells and adjusting our body temperature.

Our cells need food and oxygen to survive. We burn what we eat through the digestive system and turn it into energy. When there is no food to burn in our digestive system (especially in the mornings), there should be a separate system for storing nutrients to feed the cells, and this system is called a reservoir (Carlson and Birkett 2016). When the digestive system is empty, we are in the fasting process; when the digestive system is full, we go through the absorptive process. Carbohydrates are held in the short-term reservoir, while fats are held in the long-term reservoir. The long-term reservoir is activated after the short-term reservoirs are depleted by extended fasting (Carlson and Birkett 2016). An example of how the reservoirs are used in the CNS is presented in Table 4.

Table 4. Use of Reservoirs in the CNS

Time	Activity	Process	Reservoir Used by the CNS
Day 1 – 0:00	Sleeping	Fasting	Short-term
7:00	Eating breakfast	Absorptive	-
10:00	Working	Fasting	Short-term
12:30	Eating lunch	Absorptive	-
18:30	Exercising	Fasting	Short-term
21:00	Skipping dinner	Fasting	Short-term
Day 2 – 0:00	Sleeping	Fasting	Long-term
7:00	Eating breakfast	Absorptive	-

Any disturbances in the long and short-term reservoirs for fasting or absorptive processes affect food intake negatively. Negatively affected food intake is also one of the conditions that can cause obesity. For example, ghrelin is an efficient hormone for food consumption, as well as food-related thoughts. One study found that even a single dose of the ghrelin hormone increased appetite, while also creating a vivid image of the foods that the participants liked (Schmid et al. 2005). On the other hand, Prader-Willi syndrome, which is an inherited disease, is an obesity syndrome caused by eating continuously. One of the reasons for overeating seen in this syndrome is the high level of ghrelin hormone in the blood. It is known that the level of the ghrelin hormone in the blood of people suffering from Prader-Willi syndrome remains high even after eating (DelParigi et al. 2002). Excessive secretion of insulin hormone in the blood can also lead to obesity. As a result of the excessive secretion of insulin hormone in the person, the person's blood sugar falls, and experiences a condition called hypoglycemia. It then turns more to nutrients to tolerate this fall (Dizon et al. 1999).

Melanocortin receptor helps suppress appetite. Therefore, disruptions in the melanocortin receptor can lead to binge eating behavior and/or obesity (Carlson and Birkett 2016).

Genetics is also a factor that may be important in the development of obesity. If any of the parents of the child is obese, the probability of their child being obese is around 40%. If both parents are obese, this rate goes up to 80% (Yüksel 2014: 481). In another study on children whose parents were obese, their risk of developing obesity is increased even at the age of 0-3 (Grube et al. 2013). Also, a recent twin study showed that genetic predisposition mediates the association of eating behavior patterns with obesity (Masip 2021).

People gain weight when the number and size of fat cells increase. When fat cells grow, this condition is called hypertrophic obesity, and when fat cells increase, it is called hyperplastic obesity (Yıldırım et al. 2017). Genetic factors are generally important in hyperplastic obesity. It is also stated that organic causes of obesity include hyperthyroidism and some rare genetic diseases (Yüksel 2014: 481).

1.1.3.2. Environmental/Behavioral Factors

In addition to biological factors, the effects of environmental or behavioral factors cannot be ignored in obesity (Mahan et al. 2017). How the baby is fed from the gestational period significantly affects the feeding style in the following years. For example, the rate of obesity in babies fed with cow's milk or infant formula is high in the first 6 months of infancy, but this rate is considerably lower in babies fed with breast milk (Tezcan 2009). Children of families with high socioeconomic status are more prone to obesity due to overeating, while children of families with low socioeconomic status are more prone to obesity due to irregular eating habits. Besides, when children and adolescents with irregular eating habits are hungry, they tend to prefer foods that are easily accessible, high in fat, sugar, and salt, and contain processed substances such as fast foods or snacks (Özenoğlu et al. 2000).

Especially in recent times, the adoption of a sedentary lifestyle plays an important role in the increase of the obesity rate in society. Children's preference for attractive devices such as smartphones and computers increases their physical inactivity levels. According to the Turkish Nutrition and Health Survey (TBSA), 52.2% of men in Turkey, 54.1% of women have mild activity levels/sedentary lifestyle (T.C. Sağlık Bakanlığı Halk Sağlığı Genel Müdürlüğü 2019).

The relationship between smoking behavior and obesity is quite complex. While some studies did not find a significant relationship between smoking and BMI values of individuals (Jitnarin et al. 2014); in some studies, it was revealed smokers had lower BMI values (Sneve and Jorde 2008), while in others, BMI values of those who quit smoking increased (Kadowaki et al. 2006). It is not surprising that obesity is common in people who quit smoking because with smoking cessation, a person's appetite increases (Sims 1989). Therefore, findings suggest that more studies are needed to examine the link between smoking and obesity.

Family and social environment are also important in the development of obesity. It is claimed that binge eating in obese individuals is a behavior that can be modeled among family members (Chaput et al. 2014). According to a study, it was found that the risk of developing obesity in the following years was approximately 10 times higher than the children of families who were neglected and uninterested, compared to children of families who provided sufficient care and protection (Lissau and Sørensen 1994). In another study, individuals with childhood obesity stated that their communication within the family was weak and their family conflicts were high (Halliday et al. 2013).

1.1.3.3. Psychological Factors

Since the emergence of humanity, eating behavior has become one of the important parts of both social and life adaptation. According to Hilde Bruch, a psychoanalyst who is known for her studies on eating disorders, especially obesity, people's attitudes towards food and eating behaviors create a strange contradiction in themselves. The contradiction is that people who have suffered from famine and malnutrition throughout the ages tend to become obese as their populations expanded, and later, as they Europeanize, they humiliate those who were overweight. Especially young and noblewomen from upper socioeconomic status were exposed to the pressure of being thin (Bruch 1975). For this reason, she said that the binge eating behavior seen in obese people has existed since the cornerstone of humanity and would be of great importance as a psychological factor in the coming years (Bruch 1964).

There are no clear psychological and behavioral characteristics responsible for the occurrence of obesity, but psychological factors in obesity are frequently emphasized because depression and anxiety are common in obese individuals (Yüksel 2014: 482). Some obese individuals have behaviors related to emotional eating according to their mood (e.g., stressed, sad, etc.), and when these people restrict their food consumption, it is seen that their depression levels also increase (Yüksel 2014: 482). In studies examined with TFEQ, it has been reported that obese individuals with high UE and EE scores were found to have excessive food cravings and a sense of guilt, which are linked to bingeing and obesity (Jeanes et al 2017; Van Gucht et al. 2014). Approximately 10% of obese women exhibit binge eating behavior, especially if they get up in the morning without getting their sleep. These behaviors are generally associated with negative life stressors, and when the stress factors in a person's life disappear, the binge eating behavior also disappears (Yüksel 2014: 481). In a considerable part of obese individuals, constant binge eating episodes are observed, in which they have extreme difficulty stopping themselves (Kessler et al. 2013).

Obese individuals have serious problems, especially with their body image perception. They can be quite dissatisfied with their body's appearance and therefore their self-esteem is low and their self-perception is negative (Weinberger et al. 2016; Yüksel 2014: 481). Although there are many studies in which the self-confidence and self-esteem of obese individuals are low and their self-perception is negative (Ogden and Evans 1996; Weinberger et al. 2016; Yüksel 2014: 481), there are also studies showing that self-perception is positive in obese individuals (French et al. 1996), and some studies showed that there is no relationship between self-perception and weight gain (Gortmaker et al. 1993). Body perception in obese people is not objective so they may find their bodies uglier than they are (Sarwer et al. 1998). However, one study found that the value of BMI did not contribute at all to body image dissatisfaction (Caldwell et al. 1997).

1.1.3.4. Sociodemographic Factors

Gender, age, marital status, economic level, urban residence, grown culture, and education level are also effective in the development of obesity (Antipatis and Gill 2001).

Obesity is more common in women than men because of some social and psychological processes (Patton et al. 1999). Being overweight or obese in women is more related to concerns about their body image rather than their health status. Because of this situation, women engage in weight loss more often and apply to clinics more often to lose weight (Phelan et al. 2015). Weight gain in women and men increases especially between the ages of 25-34 because the basal metabolic rate decreases with the increase of age (Antipatis and Gill 2001). Especially women between the ages of 35-44 focus more on their weight and body shape, but as they get older, their occupation with their weight decreases (Williamson et al. 1990).

Long-term weight gain may differ according to the marital status of the individuals. According to a study conducted in the past years, married men gain more weight than single men (Antipatis and Gill 2001). Besides, couples living together or married tend to gain and lose weight together. Therefore, choosing obese individuals as spouses also affects the maintenance of unhealthy eating behavior and may predispose them to obesity (Gortmaker et al. 1993).

The prevalence of obesity in economically developed countries varies depending on people’s education level. Individuals with a high level of education in industrialized countries are not affected much by environmental conditions that predispose them to weight gain (O’Rahilly and Farooqi 2008). On the other hand, individuals with low socio-economic and educational levels in developed countries consume cheap and high-calorie foods more frequently and are more prone to gain weight as their physical activity decreases (Antipatis and Gill 2001).

Obesity is more common in the urban population than in the rural population, especially in underdeveloped countries. While there is a more active lifestyle in rural areas due to agriculture and animal husbandry, urbanization has led people to a more sedentary lifestyle (Antipatis and Gill 2001). Instead of walking and cycling, people started to use motorcycles and vehicles more frequently (Gopalan 1998). In many countries, urbanization has led to consuming smaller amounts of carbohydrates, more fat and animal products, more sugar, more processed food, and eating out (Seidell 1995).

1.1.4. Complications of Obesity

According to WHO's (2020b) data, at least 2.8 million people die each year due to the secondary causes of obesity. According to the report published by the OECD (2019), obesity and related diseases will cause 92 million deaths in the next 30 years and shorten the average life expectancy by approximately 3 years.

Many health problems accompany obesity, such as cardiovascular diseases, prediabetes, type 2 diabetes mellitus, non-alcoholic fatty liver disease, polycystic ovary syndrome, female infertility, male sexual hormone deficiency (hypogonadism), sleep apnea/asthma/reactive airway diseases, osteoarthritis, lipid disorders like high blood cholesterol, certain cancer types, some neurological and psychological diseases and so on (TEMS 2019). Besides, the COVID-19 pandemic, the biggest global health problem since 2019, also seriously affects obese people too. The report prepared by Public Health England (2020) found that having a higher BMI value does not increase the likelihood of being infected with COVID-19, but the likelihood of exacerbation of the disease and the risk of death increases with the BMI value. In another study conducted in the USA, it was found that obese people infected with COVID-19 have a 113% risk of hospitalization, 74% risk of the need for intensive care, and a 48% risk of death compared to obese people who do not have the infection (The University of North Carolina at Chapel Hill 2020).

1.2. BINGE EATING DISORDER

1.2.1. Definition of Binge Eating Disorder

“Binge eating syndrome” first was described in 1959 by Albert J. ‘Mickey’ Stunkard, a pioneer in obesity research, as “enormous amounts of food in relatively short periods, followed by severe discomfort and expressions of self-condemnation (as cited in Allison et al. 2016; Reas 2017)”. In descendent studies, it was defined as a concept of eating disorder, which is similar to bulimia nervosa, but without bulimia-specific “compensatory” behaviors such as vomiting and laxative misusing (Spitzer et al. 1992). In DSM-4, binge eating is defined as “eating an amount of food that is larger than most people would eat in a similar time under similar circumstances (APA 1994)”.

1.2.2. Diagnostic Criteria of Binge Eating Disorder

In DSM-4 (APA 1994), binge eating disorder is mentioned as a disorder in which further studies are needed, but it has taken its place as a separate diagnosis in the Feeding and Eating Disorders section in DSM-5 (APA 2013). To be diagnosed with a binge eating disorder, people must have recurrent binge-eating episodes. During these episodes, a person must eat in a separate period (2 hours), which is much more than most people can eat at a similar time under similar conditions (APA 2013).

When evaluating binge eating episodes, the environment should be taken into consideration. For instance, binge eating during a special event (e.g., celebration dinner) or snacking frequently but in small amounts throughout the day must not be considered an eating disorder (Şen-Demirdöğen 2015: 13). At the same time, a sense of loss of control must be experienced. In other words, people suffering from binge eating disorder must have difficulty stopping them during eating episodes. This sense of loss of control does not have to be everlasting. In some cases, people may stop themselves (e.g., ringing the doorbell during binge-eating episodes) (Şen-Demirdöğen 2015: 13).

Binge eating episodes are determined by the presence of three or more of the symptoms which are “eating much faster, eating until feeling uncomfortable, eating excessively when feeling full, eating secretly because of the discomfort about how much one eats, depressive symptoms, feeling of guilt or disgust after binge eating”. People suffering from binge eating disorder must feel uncomfortable during these episodes and these binging episodes must be seen at least once a week for three months.

Compensatory behaviors that are similar to bulimia nervosa are not found in binge eating disorder, and if the symptoms occur during anorexia nervosa or bulimia nervosa, no binge eating disorder diagnosis is made (APA 2013). The DSM-5 diagnostic criteria for binge eating disorder are shown in Table 5.

Table 5. DSM-5 Diagnostic Criteria for Binge Eating Disorder

A. Recurrent episodes of binge eating. An episode of binge eating is characterized by both of the following: 1. Eating, in a discrete period (e.g., within any 2 hours), an amount of food that is larger than most people would eat in a similar period under similar circumstances 2. A sense of lack of control over eating during the episode (for example, a feeling that one cannot stop eating or control what or how much one is eating) B. The binge-eating episodes are associated with three (or more) of the following: 1. Eating much more rapidly than normal 2. Eating until feeling uncomfortably full 3. Eating large amounts of food when not feeling physically hungry 4. Eating alone because of feeling embarrassed by how much one is eating 5. Feeling disgusted with oneself, depressed, or very guilty afterward C. Marked distress regarding binge eating is present. D. Binge eating occurs, on average, at least once a week for three months. E. Binge eating is not associated with the recurrent use of inappropriate compensatory behavior (e.g., purging) and does not occur exclusively during anorexia nervosa or bulimia nervosa.	
<u>Severity Grading</u> Mild: 1 to 3 episodes per week Moderate: 4 to 7 episodes per week	 Severe: 8 to 13 episodes per week Extreme: 14 or more episodes per week

1.2.3. Features of Binge Eating Disorder

Binge eating disorder shows similar features to both obesity and bulimia nervosa. Bulimia nervosa also has binge eating episodes, but compensatory behaviors are not observed for binge eating disorder. The most common triggering mechanism of binge eating episodes is negative affect. Stress in personal relationships, limiting herself/himself on food intake (e.g., diet), or negative attitudes about weight or body shape may be other triggering events (Şen-Demirdöğen 2015: 14).

The eating habits of people diagnosed with binge eating disorder are fast and excessive. Their appetite is not dependent on hunger or metabolic requirements. Their BMIs are high because their stomach capacities are increased. Binge eating disorder is seen as an important health problem because it is often comorbid with obesity and depression (Succurro et al. 2015).

1.2.4. Obese Groups with and without Binge Eating

Although the number of hospital admissions is low, binge eating disorder is more common in the population than other eating disorders (Hudson et al. 2007). Besides that, obese people are more likely to suffer from binge eating disorder regardless of gender (Kessler et al. 2013). 7 to 12% of patients who applied for obesity treatment meet binge eating disorder diagnostic criteria (Dalle Grave 2011), and binge eating disorder is frequently seen in patients who applied to bariatric surgery centers (Ivezaj et al. 2017). Obese people are not usually diagnosed with binge eating disorder but about 40% of people diagnosed with binge eating disorder are also obese (Hudson et al. 2007).

It is known that obese people with binge eating have lower self-esteem and show more depressive symptoms than those without binge eating. It has been reported that obese people diagnosed with binge eating disorder have more body dissatisfaction than those without binge eating disorder (Yüksel 2014: 478). In Kuehnel and Wadden’s study that is conducted in 1994, they reported that obese people with binge eating disorder had more dietary restrictions, more body shape dissatisfaction, and more difficulty in understanding their hunger and satiety signals. Spitzer and his colleagues (1992) reported that obese patients with binge eating disorder tend to gain weight at a younger age, and their diet attempts are generally failed.

DSM-5 (APA 2013) does not include a binge eating disorder criterion related to body image, but some studies indicate that obese women with binge eating disorder are perceived as overweight than they are, as against non-obese (Mussell et al. 1996; Yüksel 2014: 478).

1.3. CONCEPTUAL FRAMEWORKS FOR UNDERSTANDING EATING PATTERNS

1.3.1. Metabolic and Hedonic Eating

Two main regulatory systems in our bodies determine the weight of individuals. The first is the homeostatic system that strives to fix the individual's weight within the normal range, in other words, the "set point weight (Harris 1990)". The second is the non-homeostatic system which takes the body away from the set point weight. Unlike the homeostatic system, which controls food intake and energy consumption to keep the body balanced and stable, the non-homeostatic system breaks all balances in the body. For example, the reward system is one of the important non-homeostatic systems that affect body weight and deals only with how much pleasure food is, namely how hedonic it is (Berridge et al. 2010).

Eating is not only a functional behavior that enables us to survive, but also has the quality of pleasure and reward. The reward system is located in the brain region called the cortico-limbic system of the brain and activates reward/pleasure regulation processes by using dopamine pathways to provide the pleasure needed. These two systems, which regulate both energy balance and reward/pleasure capacity, are necessary for survival (Yu 2017). The cortico-limbic system includes various brain regions such as the nucleus accumbens, amygdala, hippocampus, dorsolateral prefrontal cortex, anterior cingulate cortex, and hypothalamus (Comte et al. 2014). Therefore, this situation is linked to regular binge eating behaviors to relax when they experience emotions such as stress, sadness, fear, or anxiety. These are non-homeostatic eating behaviors and people can increase their BMI values by moving away from their set point weight (Yu 2017).

Homeostatic and non-homeostatic systems are always in conflict with each other. Although the homeostatic system tries to take the body to the set-point weight through the feeling of hunger and satiety, sometimes this effort is not enough (Leibel et al. 1995). No matter how much leptin (satiety) hormone and how little ghrelin (hunger) hormone secretes, a person may not be able to resist the urge to eat sweets or carbohydrates, even if they do not have an eating disorder (Johannsen et al. 2012). If weight gain is no longer "automatically regulated", the person is classified as obese (Yu 2017).

It is mentioned that there are two different reasons for weight gain that are not automatically regulated to cause obesity. The first reason is that the body weight is no longer balanced by the homeostatic system for the default set point. The default set point weight has been increased to BMI values classified as obese. This situation is called metabolic obesity. Second, the homeostatic system begins to no longer cope with the impaired reward/pleasure regulation system and this regulation system becomes dominant, it is leading to impaired behaviors such as regular binge eating. This is called hedonic obesity (Yu 2017).

The homeostatic system of obese individuals cannot resist their reward/pleasure system, and even if they experience a feeling of satiety, they tend to eat hedonic when stimulated with attractive foods. When people eat hedonically, the process is enjoyable, and food is a reward for them (Murray et al. 2014). An environment that has existed since childhood and is promoted by binge eating and inactivity (obesogenic environment), also reinforces the hedonistic eating behavior pattern (Çelebioğlu and Yayan 2018). The lack of resistance of obese individuals to tasty and tempting foods is called "appetitive motivation" in the literature and is associated with hedonistic eating behavior. As mentioned before, although leptin, the satiety hormone, is secreted excessively and ghrelin, the hunger hormone, is secreted less, the hedonistic eating behavior characterized by the reward system still occurs in obese individuals and the feeling of hunger cannot be stopped by physiological interventions (Zheng and Berthoud 2007). In other words, hedonistic eating is a problematic behavior that provides pleasure and dysfunctional reward gains.

Hedonistic eating behavior is associated with EFs such as response inhibition and, consequently, impulsivity (Appelhans 2009). Some impairments in EFs can lead to regular binge eating behavior and obesity (Stoeckel et al. 2013). There is evidence that activation of some neuroanatomical structures such as dorsolateral prefrontal cortex, dorsal striatum, orbitofrontal cortex, etc. associated with EFs (e.g., working memory, selective attention, set shifting, etc.) is associated with binge eating behaviors (Curtis and D'Esposito 2003; DelParigi et al. 2007; Gluck et al. 2017; Le et al. 2007).

Besides, obese individuals are particularly attracted to high-calorie foods (Stice et al. 2008). Therefore, the high pleasure/reward quality of high-calorie foods and attentional bias may cause increased impulsivity and hedonic eating behavior in obese individuals (Nijs et al. 2010).

1.3.2. The Triadic Systems Model

The Triadic Systems Model, developed by Gray (1972) and used for the first time in behavioral research by Pickering and Gray (2001), was created to draw up a diagram that demonstrates the neurocognitive basis of risk-taking decisions and behaviors based on a specific goal. Developed on the neurocognitive basis of addiction and other problematic behaviors, this model has recently begun to be adapted to problematic eating behavioral patterns such as regular binge eating (Chen et al. 2018).

Strack and Deutsch (2004) discussed the function of impulsivity and associated EFs in many eating patterns as a model with two components: impulsive system and reflective system. The impulsive system is the system that processes excessively the tendency to avoid or approach that stimulus automatically, according to the motivational and emotional value of the stimulus. The reflective system, on the other hand, is a system that helps the decision-making process in line with long-term goals and personal standards, performs the processing in a controlled manner, and response inhibition is dominant (Strack and Deutsch 2004).

When the impulsive system is active, amygdala and mesolimbic cortical structures are also stimulated in individuals consuming high-calorie foods. The activation is low in the ventromedial and orbitofrontal areas of the reflective system that provides response inhibition. Therefore, when the impulsive system dominates the reflective system, a binge eating pattern is observed in individuals (He et al. 2014; Hofmann et al. 2009; Strack and Deutsch 2004). Attention bias toward high-calorie foods also triggers food intake (Bongers et al. 2015).

However, recently, in addition to these two systems, the existence of a revised interoceptive awareness system has also been mentioned. The interoceptive awareness system combined homeostatic signals with this dual system and thus becomes a modulator in this system. After exposure to food stimuli, the impulsive system creates automatically, quickly, and unconsciously motivated to intake the food (Evans 2007). If the reflective system is intact, it takes into account the future consequences of this motivation and prevents this impulse. The interoceptive awareness system takes an active role in bringing the impulsive and reflective system effects together at the midpoint (Chen et al. 2018; Noël et al. 2013). Activation of this system both stimulates the impulsive system and "captures" the cognitive resources that the reflective system needs to prevent food intake based on the pleasure/reward system (Chen et al. 2018; Turel and Bechara 2016). Therefore, excessive food consumption is also based on the imbalance between this triple system. The explanation of the behavior defined as "problematic eating" by Chen and colleagues with the Triadic Model is shown in Figure 1 (Chen et al. 2018: 3).

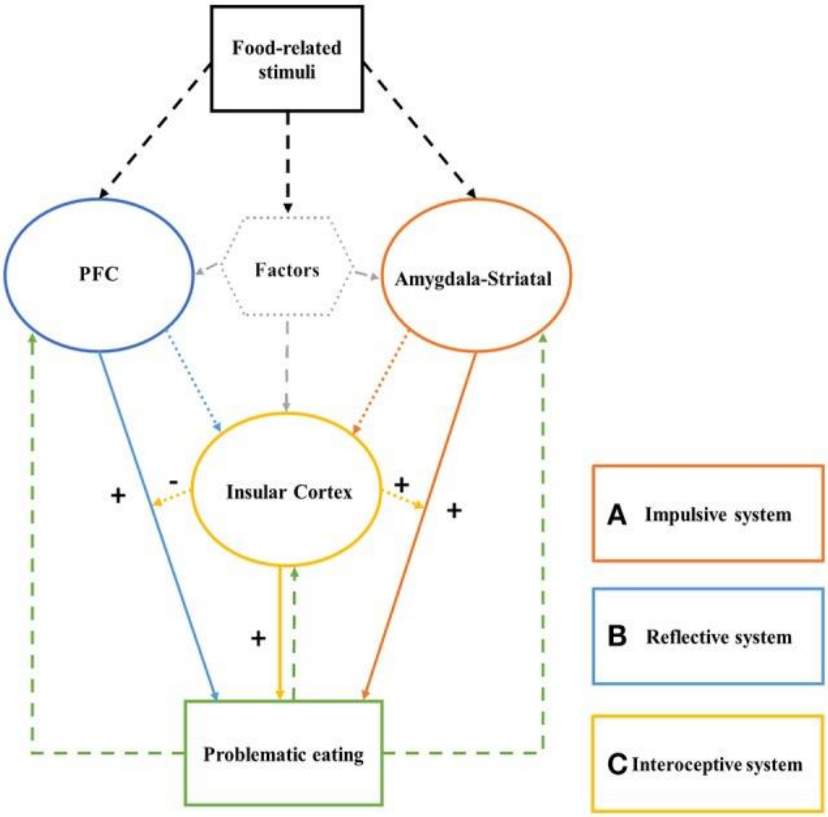

Figure 1. The Explanation of Problematic Eating Behavior with the Triadic Systems Model (Chen et al. 2018: 3)

1.3.3. Kaplan & Kaplan's Obesity Theory (Psychosomatic Theory)

Many studies investigating the relationship between negative mood and binge eating show that emotional stimuli differentiate eating behavior patterns. Emotional eating does not arise from the feeling of hunger or when it is time to eat or social needs It is a kind of eating behavior pattern that occurs in response to the emotion that a person feels at that moment (Bekker et al. 2004). This behavior is often triggered by negative emotions such as loneliness, depression, anxiety, stress, and anger (Lyman 1982). Although it is not known exactly how the relationship between negative affection and binge eating is, there are also theories explaining emotional eating behavior as a type of eating disorder. The contribution of emotional eating behavior to weight gain cannot be denied, it also limits the effect of weight-loss interventions and leads to obesity (Sevinçer and Konuk 2013).

According to Kaplan and Kaplan's (1987) obesity theory, obese individuals show binge eating behavior to reduce this anxiety when they are in a distressed and nervous mood. There is no precise information about the neural mechanism through which anxiety decreases, but researchers have stated that protein and carbohydrate intake may affect serotonin secretion. In childhood, these people learned to establish a link between nutrition and pleasure in neutral situations in which they are not anxious. Therefore, it is difficult for them to differentiate between feelings of hunger and anxiety (Kaplan and Kaplan 1957). Obese people have learned to eat to reduce their anxiety just as they eat to suppress their hunger. Therefore, compulsive binge eating behavior that reduces anxiety is also a factor that causes obesity (Ruderman 1983).

1.3.4. Schachter's Externality Theory of Obesity

According to Schachter's (1968) theory, the physiological symptoms of anger, fear, and anxiety suppress the need to consume food in individuals of normal weight under normal conditions. Although the person does not have a metabolic need, instant mood affects the need to eat, their food selection (fast-food, sweets, carbs, etc.), and eating speed (Macht 2008). This is called internal eating. However, obese individuals are insensitive to internal stimuli. Unlike individuals with normal weight, these people do not have a physiological need, but they need to eat to cope with their emotional state and overcome stress (Ozier et al. 2008).

External eating, on the other hand, is defined as eating because it attracts physical characteristics such as taste, smell, and appearance of the food, although the individual is not metabolically hungry (Schachter 1968; Van Strien et al. 1995). Obese individuals are not sufficient to understand internal physiological stimuli, so they need external stimuli to start and stop eating behavior. According to this theory, obese individuals eat not because of a feeling of hunger or satiety, but because of external stimuli (Schachter 1968). However, it is known that obese individuals with an external eating pattern continue to imagine food despite being full (Eiler et al. 2012).

1.3.5. Restraint Theory

The Restraint Theory, first introduced by Herman and Mack (1975), and later developed by Herman and Polivy (1978), is defined as the desire to overeat against food and the cognitive restraint effort against this desire. Individuals with a restricted eating tendency tend to overeat as a result of their failure to control their eating behaviors. Individuals who display this behavior pattern complain about eating too much and constantly restrict their eating behavior in order not to gain weight (Sevinçer and Konuk 2013). However, they have binge eating attacks after a slight feeling of satiety or after losing weight (Braet et al. 2008). With the deteriorating dietary restraint, their BMI values also increase in long term (Herman and Polivy 1978; Van Strien et al. 1995). Although obese individuals try to show restrictive eating behaviors, their cravings and intense emotional arousal for food prevent this and their cognitive control is impaired (Dong et al. 2015).

1.4. EXECUTIVE FUNCTIONS (EFs)

1.4.1. Information Processing Speed

Information processing speed is not an EF ability but has a significant effect on EFs such as working memory, set-shifting, and decision making. If people take longer to process information, problem-solving, and decision-making skills, their completion time of specific tasks also takes longer. However, this is not due to problems in the working memory, set-shifting, or decision-making areas; they are slow to process information. Therefore, the degradation of EF performance is associated with information processing speed (Rosen 2019). In research examining the information processing speed in obesity, it was found that adult obese people had slower information processing speed than the healthy group (Cournot et al. 2006; Cserjési et al. 2009; Eneva et al. 2017).

Hypothesis 1a: Obese groups will be more likely to have slow information processing speed than normal-weight groups.

However, there is hardly any research examining information processing speed for obese people with and without regular binge eating. According to the recent study by Eneva et al. (2017), the normal-weight group shows faster-processing speed performance than the overweight group, but no difference was found between the binge eating and non-binge eating groups.

Hypothesis 1b: There will be no significant difference in the information processing speed between the groups with regular binge eating and without regular binge eating.

1.4.2. Attention and Inhibitory Control

Certain cognitive tasks such as the Stroop task, Stop-Signal task, or Go-No Go task were used to examine selective attention, inhibitory control, and impulsivity in obese people (Fitzpatrick et al. 2013). The results obtained from the studies using the Stroop task are varied. One of the most well-known findings is that with the increase in BMI value, deterioration in cognitive skills is observed such as executive functions, complex attention, and information processing speed. For example, several studies have found that a higher BMI value is associated with lower EF skills such as slower information processing speed and attention performance compared to those with values in the normal BMI range (Boeka and Lokken 2008; Cournot et al. 2006; Gunstad et al. 2007), and even when the values of individuals with high BMI decreased, their performance in the Stroop test increased (Smith et al. 2010). Fergenbaum and colleagues (2009) discovered that obese individuals were approximately four times more likely to have executive function impairments than non-obese individuals, and another study similarly observed that obese individuals had slower information processing speed, poorer sustained attention, and EF performance than normal-weight individuals (Cserjési et al. 2009).

There have also been studies that have obtained results opposite to these findings. Some studies found no significant difference between morbid obese-with binge eating disorder and morbid obese-without binge eating disorder in terms of their Stroop task performances (Galioto et al. 2012). On Delis-Kaplan Executive Function System Color-Word Interference Test (2004), which measures similar cognitive functions to the Stroop test, no significant difference was found between the participants in normal-weight and obese groups, and participants with and without binge eating disorder groups in terms of their test performances (Eneva et al. 2017).

Hypothesis 2a: Obese groups are more likely to exhibit poor attention task performances than normal-weight groups.

Hypothesis 2b: There will be no significant difference in attention task performances between the groups with regular binge eating and without regular binge eating.

Assessment of inhibitory control in obese people may be important to comprehend how well people are capable of stopping regular binge eating episodes even when they are full. Studies on inhibitory control in binge eating disorder patients also have different findings just as in attention studies for binge eating behavior. For instance, Some studies have found that individuals with binge eating behavior have impaired EF skills, such as difficulty in inhibitory control and motor processing speed, regardless of gender (Duchesne et al. 2010; Grant and Chamberlain 2020; Manasse et al. 2014; Mobbs et al. 2011). A later study found that adult obese females with binge eating behavior have difficulties in inhibitory control and behave more impulsively than those without binge eating behavior (Kelly et al. 2013). In contrast, a study found that there is no difference between obese groups with and without binge eating disorder in terms of inhibitory control (Wu et al. 2013). In a study that gets a different result than the previous studies, the obese group with binge eating disorder had more inhibitory control than the obese group without binge eating disorder, and the obese group without binge eating behave more impulsively compared to the obese group with binge eating (Mole et al. 2015). In a recent study in which binge and non-binge eating patterns were analyzed in overweight and normal-weight groups, it was discovered that the normal weight binge eating group performed better than the overweight binge eating, overweight healthy control, and normal weight healthy control groups (Eneva et al. 2017).

Hypothesis 3: People without regular binge eating will exhibit better attention and inhibitory control performance than people with regular binge eating, regardless of gender.

1.4.3. Working Memory

Working memory is an EF ability of a person's capability to remember the given information correctly for a certain time. It can be thought that the working memory task performance of the people is decreased with slow information processing speed which is a feature of obese people. The most common task for working memory is digit span, which is one of the subtests of the Wechsler Adult Intelligence Scale-III (WAIS-III) and Wechsler Memory Scale-III (WMS-III) (Fitzpatrick et al. 2013). The studies examining working memory deteriorations in obese and binge eating groups are not sufficient and the limited findings are contradictory. According to some studies, the obese with binge eating disorder group performs poorly in working memory tasks than the non-obese with binge eating disorder group (Duchesne et al. 2014; Manasse et al. 2014; Volkow et al. 2008). On the other hand, some studies stated that there is no significant difference between obese with binge eating disorder and non-obese with binge eating disorder groups (Galioto et al. 2012; Gonzales et al. 2010).

In a study, the normal-weight without binge eating disorder group showed better working memory task performance than those with binge eating disorder (Eneva et al. 2017). However, when the working memory performance is examined, it is seen that the obese group performs significantly lower than the non-obese group (Fitzpatrick et al. 2013).

Hypothesis 4a: Obese groups will perform lower in working memory than normal weight groups.

Hypothesis 4b: There will be a significant difference in working memory performance between the obese group with regular binge eating and the normal weight group with regular binge eating.

1.4.4. Set Shifting

Set shifting is the ability to move from one task, operation, or set to another without using a rigid thinking style and, as with most EF skills, is closely related to information processing speed (Rosen 2019). Studies have been conducted on set-shifting abilities in obese subjects and indicated that the most commonly used tasks are Trail Making Test Part A and B and the Wisconsin Card Sorting Test (Wu et al. 2014). In the studies involving binge eating disorder, there were contradictory results due to the limited sample size. In some studies, it was found that obese people with binge eating disorder showed poor set shifting performance compared to non-obese people (Aloi et al. 2015; Boeka and Lokken 2008), and some studies examining these two groups similarly found no significant difference between them (Duchesne et al. 2010; Gonzales et al. 2010).

In a recent study, binging did not affect participants' performances, but normal-weight groups were found to have better set shifting ability compared to overweight groups (Eneva et al. 2017). Generally, BMIs were evaluated instead of evaluating eating behaviors in studies, and researchers concluded that as BMI increased, people's set shifting abilities were inadequate (Boeka and Lokken 2008; Kelly et al. 2013).

Hypothesis 5a: The set-shifting task performance of obese groups will decrease significantly compared to normal-weight groups.

Hypothesis 5b: There will be no significant difference in set-shifting performances between the groups with regular binge eating and without regular binge eating.

1.4.5. Other Factors That May Have an Impact on EFs and Information Processing Speed

The effects of obesity on EFs (attention, memory, set shifting, etc.), and information processing speed performances of some factors such as age, gender, education, income levels, or BMI values have been evaluated in various studies. For example, under normal conditions, it is generally known that a high level of education or high income is associated with high cognitive skills (Lee 2003). In the National Health and Nutrition Examination Survey (NHANES) III study conducted between 1988 and 1994, it was found that gender, education level, and race factors had a significant effect on EF skills for the three neurocognitive tests which are measuring reaction time, attention, perception, and motor speed (Krieg et al. 2001). However, in a study examining the effects of BMI value and education level on cognitive skills, it was found that an increase in BMI value rather than education level causes cognitive impairments (Ho et al. 2016). Another study did not find a significant interaction effect between BMI and age on cognitive skills (Gunstad et al. 2007). Besides, there are studies in which the effect of age on cognitive impairments was not found to be significant (Fergenbaum et al. 2009; Gunstad et al. 2005). However, studies on eating attitudes in obesity, especially on uncontrolled eating behavior, have been limited to a few. A study on obese people (Hay and Fairburn 1994) showed that the severity of psychopathological disorders was not indicated by the degree of obesity but by the number of binge eating episodes. Therefore, it can be said that the examination of regular binge eating patterns in obese people will loom large in the diagnosis and treatment process.

Hypothesis 6: There will be a significant difference in the number of binge eating episodes between obese people with regular binge eating and normal-weight people with regular binge eating.

Considering the eating attitudes factor, the studies examining the participants' eating attitudes with TFEQ-Revised 21-Item (TFEQ-R21) have shown that obese individuals get high scores on uncontrolled eating, emotional eating, and cognitive restraint subscales, which could affect their predisposition to obesity and binge eating patterns (Bryant et al. 2019; Jeanes et al. 2017). Another study examining the differences between men's and women's eating attitudes with the Three-Factor Eating

Questionnaire (TFEQ) scale found that women had higher emotional eating scores than men (Leblanc et al. 2015). However, the number of studies examining binge eating behavior is insufficient, and most of these studies did not include male participants (Hirst et al. 2017; Wu et al. 2014).

Hypothesis 7a: Obese groups will have higher scores on the three subscales of the TFEQ-R21 than normal-weight groups.

Hypothesis 7b: Women with regular binge eating behavior will have higher emotional eating scores than men.

Considering the mood of individuals as a factor, studies are showing that obese people have higher depression levels compared to non-obese people and obese people with binge eating behavior compared to obese people without binge eating behavior (Fassino et al. 2003; Spitzer et al. 1992). In the study of Fassino et al. (2003), the way individuals express their anger was also evaluated with the State-Trait Anger Expression Inventory (STAXI) and observed that obese individuals with binge eating tend to express their anger more, while obese individuals without binge eating tend to suppress their anger, and they emphasized the importance of impulsivity in obese individuals with binge eating. In another study, it has been observed that obese people with binge eating behavior were found to be more depressive and anxious than obese people without binge eating behavior and healthy controls, but this situation did not affect their cognitive performances (Şen-Demirdöğen 2015).

Although obesity is not classified as an eating disorder in the literature, it does have certain psychological traits with eating disorders, such as impulsivity. It is known that individuals with binge eating behavior exhibit impulsive behavior in many areas such as response inhibition, decision making, concentration, addiction, etc. (Atalayer 2018). Studies have shown that high impulsivity affects emotional eating patterns, which can progress to obesity in binge eating disorder, as well as difficulty in inhibitory control and negative mood (Atalayer 2018). Some studies view impulsivity as a neurocognitive genetic marker that predisposes a person to binge eating and possibly obesity (Robbins et al. 2012). In a study of obese women, when individuals were examined for the presence of diagnostic criteria such as episodes of regular binge eating and a sense of loss of control while eating, obese women were found to be more impulsive and had less awareness of their regular binge eating behaviors (de Zwaan et al. 1994). In another study, it was observed that individuals with binge eating disorder experienced deterioration in response inhibition compared to the healthy control group (Grant and Chamberlain 2020). In addition, it is known that obese individuals have increased rates of attention deficit hyperactivity disorder (ADHD) (Fassino et al. 2003; Gunstad et al. 2007). People diagnosed with ADHD, which is characterized by impulsivity, have more binge eating tendencies than expected (Cortese et al. 2007; Reinblatt et al. 2014). Impulsivity may play an important role in the relationship between ADHD and regular binge eating (Steadman and Knouse 2016).

Hypothesis 8: Regular binge eating groups will have higher impulsivity scores than the groups without regular binge eating.

One of the earliest studies examining the difference in cognitive performance between men and women was conducted with the Symbol Digit Modalities Test (SDMT) (Smith 1973). In this study, in which the effects of gender and hand predisposition on cognitive performance were examined, it was found that women performed better than men, and it was thought that this gender difference might be related to differences in the cerebral organization (Polubinski and Melamed 1986). Considering the gender factor, the studies on eating disorders are mostly on anorexia nervosa and bulimia nervosa, which were common among women. Although the number of studies comparing the clinical features of obesity and binge eating disorder between men and women is high (Hudson et al. 2007; Kessler et al. 2013; Lydecker and Grilo 2018), there are no studies that directly compare the effects of obesity and binge eating behavior on cognitive performances between men and women, as we as is known. Therefore, cognitive performance differences between men and women is another variable that needs to be examined considering that the neurocognitive studies on eating disorders, especially binge eating disorder, are conducted between female participants than male participants. Although it is not known for certain, one of the reasons for that it is easy to reach women who admit to the hospital and diagnosed with any eating disorder, and studies on eating disorders in men are limited due to their certain unconscious prejudices such as “Eating disorders are a female disease (Thapliyal et al. 2018)”. A second reason for this, according to a study conducted with fMRI, is that women are more likely than men to experience brain activity related to negative body image and body dissatisfaction (Preston and Ehrsson 2016). Therefore, it is thought that the inclusion of one or more of the above-mentioned factors (gender, impulsivity, eating attitudes, etc.) in the study may yield more accurate results.

Hypothesis 9: A significant difference will be observed in the cognitive performances measured by the five neuropsychological tests between men and women in the four groups (obese people with RBE, obese people without RBE, normal-weight people with RBE, and normal-weight people without RBE).

CHAPTER II

METHOD

2.1. PARTICIPANTS

The present data were from the supervisor and the graduate student's project was funded by Çankaya University's Scientific Research Projects Council (Project Number: FEF.20.002). This study was conducted online on a total of 176 male and female participants between the ages of 18 and 35, who volunteered to participate in the study between 2021 and 2022. The study consisted of two stages. The first stage was conducted with an online survey to divide the participants into groups suitable for the research design. As discussed in detail below, the exclusion criteria for the first stage were medical and psychological diagnoses, which are thought to affect cognitive processes, and hearing and vision problems. Hence, a total of 282 people participated in the first stage and 66 people were excluded. In the second stage, 216 people were invited to participate in which the neuropsychological tests were applied. A total of 179 people participated in the second stage and 3 people were excluded because of significant agitation or technical problems with the website. The 176 participants who met the inclusion criteria were divided into four groups according to their BMI values and the existence of their regular binge eating patterns. These groups are obese participants with regular binge eating (n = 39, 19 males and 20 females), obese participants without regular binge eating (n = 38, 19 males and 19 females), normal-weight participants with regular binge eating (n = 43, 20 males and 23 females), and normal-weight participants without regular binge eating (n = 56, 21 males and 35 females). Participants are volunteers selected based on the inclusion criteria specified below. Exclusion and grouping criteria information was accepted based on personal statements.

Participants consisted of volunteers who applied to various nutrition and diet clinics in Ankara, İstanbul, and İzmir for consulting services, people who want to participate in the study voluntarily through social media announcements, or volunteer students from Çankaya University. Participants were balanced in terms of their education levels and socioeconomic status (SES). Obesity was determined based on the World Health Organization's (2021a) definition to differentiate between obese and normal-weight groups. The BMIs of normal-weight participants should generally range from 18.5 to 24.9 kg/m^2 and the BMIs of obese participants should of 30 kg/m^2 and more. So, the BMI values of the participants in the obese group were 30 and above, and the BMI values of the participants in the normal weight group were between 18.5 and 24.9. All participants have received ₺30 digital shopping coupons from a supermarket or course bonus points according to their preferences as a participation incentive. Digital shopping coupons for participant incentives were provided by Çankaya University Scientific Research Projects Unit's Funding Program.

Participants with medical conditions such as epilepsy, head injury, and/or any lifetime psychiatric disorders (e.g., those with diagnoses such as major depression disorder, anxiety disorders, etc., and use drugs that can affect their cognitive processes), hearing, and visual problems (except myopia, hyperopia, and astigmatism) were not included in the study. Considering that obese individuals may also have diabetes, the evaluation of the participants with diabetes according to their Hemoglobin A1c (Hb A1c) Blood Test level, and those who had Hb A1c levels below 7% (pre-diabetes and non-diabetes levels), and have no secondary health complications due to diabetes (e.g., eye diseases, kidney damage, nerve injuries, etc.) were planned to be included in the study (American Diabetes Association 2019; Turkish Diabetes Foundation 2014). However, no one with a diagnosis of diabetes participated in the study. Based on the report for the American Heart Association's Clinical Practice Guidelines Task Force, participants with medical conditions such as high blood pressure or hyperthyroidism were included in the study provided that they must undergo treatment and their clinical condition must be stable for at least 6 months (Whelton et al. 2018). For the second stage, a total of three participants who showed significant agitation during the experiment or those who could not complete the study due to technical problems were excluded from the study.

Firstly, written consent was obtained from all participants in both stages about their participation in the research. For this purpose, the Informed Consent Form used for all individuals who volunteered to participate in the study is presented in Appendix

B. Afterwards, a link to the experiment website was sent to the participants, who were placed in four different groups, and The Clarification Text on Personal Data Processing and Protection Law was presented on the website. The Clarification Text on Personal Data Processing and Protection Law is presented in Appendix C.

2.2. MEASURES

2.2.1. Experiment Website

The data collection procedure has been changed because of the COVID-19 pandemic. Because of the unusual circumstances related to the pandemic, it is not convenient to collect data in person. Since the participants in the obese group are in the risk groups determined by the Turkish Ministry of Health in terms of mortality and morbidity (T.C. Sağlık Bakanlığı Halk Sağlığı Genel Müdürlüğü 2021), it was thought that collecting data through an online platform instead of a face-to-face laboratory environment and paper-and-pencil assessment both reduce the risk for the participants and speed up the data collection process. Under such circumstances, we plan to build a website. The developed website (https://mythesislab.com/) performs a neuropsychological test battery that is used for the cognitive assessment of the participants. Before entering the website, participants' BMI values and regular binge eating patterns must be determined so that they can be assigned to the groups mentioned above. For this reason, the participants completed the Demographic Information Form, three eating behavior scales that determine their regular binge eating patterns (Eating Disorder Examination Questionnaire, REZZY Eating Disorder Scale, Three-Factor Eating Questionnaire-Revised 21-Item), and the Short Form of Barratt's Impulsiveness Scale-Version 11, which is used for screening, through Qualtrics survey software.

The neuropsychological test battery to be applied to the participants in the study was designed for paper-and-pencil assessment and was not currently computer-based. We team up with a software developer specialized in PHP language for the design of the experiment website and the proper adaptation of neuropsychological tests, which are normally administered with paper-and-pencil, to the online platform, similar to the paper-and-pencil application format. The domain name "mythesislab.com" was taken for the website. Our website is built with PHP 4.0 language and MySQL is used as a database. The Hypertext Markup Language (HTML), Cascading Style Sheets (CSS), and JavaScript technologies which are cross-browser supported are used in the front-end development. A page that calculates the BMI has been integrated into our website to see which group the participants are in while evaluating the cognitive processes. After the necessary infrastructure for our server, which is suitable for the database and PHP codes, was prepared and database normalization in MySQL was carried out, the website was opened for the data collection phase. All data on the website server is saved in this database created specifically for the study, and all data traffic between users (participants) and the server is encrypted.

None of the test results available in the current neuropsychological test battery depend on millisecond precision. However, it is known that it is possible to measure small reaction time effects of about 20 milliseconds on web-based platforms (Hansen et al. 2015). In the current study, stimuli are designed to withstand low bandwidth by pre-loading the website, thus avoiding the limitation of the hardware and software-induced data capacity, volume, and speed. After the data collection process was completed, the website was also closed.

Then, 176 participants were divided into four groups according to their BMI values and the presence of their regular binge eating patterns. The participants logged into the experiment site with a 36-digit disposable user number, which was randomly generated by the experiment website system and sent to the e-mail addresses they determined for communication. The informed consent form was presented to the participants who were eligible to proceed to the second stage of the study and their consent was obtained. Afterward, the participants wrote their user numbers on the entry screen, and before starting the tests, they entered their age, gender, height, and weight information using the login menu page. The BMI values of the participants were calculated automatically by the website. Screenshots of the informed consent form and login menu page are presented in Figure 2 and Figure 3, respectively.

Sayın Katılımcı,

"Sürekli Tıkınırcasına Yeme Eğilimi Olan Obez Bireylerde Bilgi İşleme Hızı, Seçici Dikkat, Çalışma Belleği ve Set Değiştirme Süreçleri Arasındaki İlişkilerin İncelenmesi" başlıklı bu çalışma, Dr. Öğr. Üyesi Hande Kaynak danışmanlığında Çankaya Üniversitesi Psikoloji Bölümü Anabilim Dalı kapsamında Bilişsel Psikoloji Yüksek Lisans programı öğrencisi Psk. F. Öykü Çobanoğlu tarafından yürütülen bir tez çalışmasıdır. Çalışmanın amacı, bilgi işleme hızı, seçici dikkat, çalışma belleği ve set değiştirme gibi kişilerin amaca yönelik üst seviye bilişsel becerilerinden sorumlu olan yürütücü işlevler ve bu işlevler ile ilişkili olarak görülen bilişsel bozulmaların, kişilerdeki tıkınırcasına yeme davranışları ve/veya obezitenin varlığı ile birlikte ne kadar farklılık gösterdiğini incelemektir.

Çalışmaya katılım tamamen gönüllülük esasına dayanmaktadır ve sizden hiçbir kimlik bilginiz istenmemektedir. Çalışmada yeme tutumlarınızı ölçen çeşitli formları doldurmanız ve bunun sonrasında beş nöropsikolojik testi tamamlamanız beklenmektedir. Sağlayacağınız bilgiler tamamen gizli tutulacak ve sadece araştırmacılar tarafından değerlendirilecektir. Elde edilecek bilgiler bilimsel amaçla kullanılacaktır. Çalışmada dolduracağınız formlar çalışmanın amacına uygun ve genel olarak kişisel rahatsızlık verecek sorular içermemektedir. Ancak çalışma sırasında kendinizi rahatsız hissederseniz yarıda bırakabilirsiniz. Çalışma iki aşamalı olup, dolduracağınız formlar çalışmanın birinci kısmını oluşturmaktadır. Çalışmanın ikinci kısmına katılmaya hak kazanmanız hâlinde, sizinle iletişime geçebilmemizi sağlayacak bir elektronik posta adresine nöropsikolojik testleri tamamlayacağınız internet sitesinin linki gönderilecektir. Çalışmanın ikinci kısmını tamamlandığınızda size araştırma ile ilgili bilgi verilecek, ardından varsa sorularınız cevaplanacaktır. Son olarak, emeğinizin karşılığı olarak markette veya sanal alışverişte kullanabileceğiniz 30 TL tutarında Migros çeki hediye edilecektir.

Bu çalışmaya katıldığınız için şimdiden teşekkür ederiz. Çalışma ile ilgili daha fazla bilgi almak isterseniz bizimle elektronik posta yolu ile iletişime geçebilirsiniz:

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Yukarıda yer alan ve araştırmadan önce katılımcıya verilmesi gereken bilgileri okudum ve katılmam istenen çalışmanın kapsamını ve amacını, gönüllü olarak üzerime düşen sorumlulukları tamamen anladım. Bu çalışmaya tamamen gönüllü olarak katılıyorum ve çalışmayı istediğim zaman bırakabileceğimi biliyorum. Bu koşullarda söz konusu araştırmaya kendi isteğimle katılmayı ve sağladığım bilgilerin bilimsel çalışmada kullanılmasını kabul ediyorum.

☐ Kabul Ediyorum.

Devam Et

Figure 2. The Website Screenshot of the Informed Consent Form Page

Figure 3. Website Screenshots of the Login Menu Pages

2.2.2. Demographic Information Form

In the first stage of the study, a standard Demographic Information Form was applied to all volunteer participants. The Demographic Information Form is designed to collect data about participants' age, gender, marital status, education level, occupation, the existence of chronic or hereditary diseases such as color blindness, the use of medications and/or dietary supplements (vitamins, fish oil, protein shakes, etc.) they're currently taking and, their current height and weight. The Demographic Information Form is presented in Appendix D.

2.2.3. Measures of the Identification of Regular Binge Eating Pattern

In the study, three different eating disorder screening forms were used to divide the participants into four groups according to the presence or absence of regular binge eating patterns to be determined based on their scores.

2.2.3.1. Eating Disorder Examination Questionnaire (EDE-Q)

The questionnaire was developed in 1994 by Fairburn and Beglin. It consists of 5 subscales and 28 items that represent the severity of individuals' eating disorder psychopathology. These 5 subscales are restraint, binge eating, eating concern, shape concern, and weight concern (Fairburn and Beglin 1994). The Restraint subscale includes items that measure some conditions such as limiting over-eating, avoidance of eating and/or foods, dietary rules and regulations, the desire to keep the stomach empty, etc., and, unlike other subscales, it evaluates both behavioral and cognitive restraint (Şen-Demirdöğen 2015: 15). The Binge Eating subscale includes items that measure some behaviors such as eating an unusual amount of food, a feeling about losing control during eating, self-vomiting, using laxatives excessively or overexercising, etc. The Eating Concern subscale includes items that measure some conditions such as extreme mental activity about eating or calories, the fear of losing control of eating, secret and/or social eating, feeling guilty about eating, etc. The Shape Concern subscale includes items that measure some conditions such as the desire to have a flat stomach, extreme mental activity about body shape or weight, the importance of body shape, fear of gaining weight, feeling fat, etc. The Weight Concern subscale includes items that measure some conditions such as excessive mental activity about body shape or weight, body weight dissatisfaction, and the desire to lose weight.

In this questionnaire, there is a 7-point Likert scale in which the severity of the eating disorder is scored between 0 and 6 in the last 28 days, except for the Binge Eating subscale. On the Binge Eating subscale, the presence and frequency of binge eating episodes are evaluated by giving an objective and/or subjective numerical value. To obtain a score for a certain subscale, the scores given to each question of the related subscale are collected and divided by the total number of questions in this subscale. For the total EDE-Q score, the scores obtained from four subscales (except for the Binge Eating subscale) are collected and divided into four.

In some studies, a cut-off score is not determined for the scale, higher values are indicating a more severe eating disorder psychopathology. However, in some studies, a cut-off score was created for each subscale. Individuals who score 2.3 or higher on the EDE-Q Binge Eating subscale are considered to have a binge eating pattern (Mond et al. 2004). In recent studies, this score for men has been determined as 1.7 and above due to their eating attitudes (Schaefer et al. 2018). In our study, these cut-off scores were taken into account when assigning the participants to the groups.

The EDE-Q was adapted to Turkish by Yücel et al. (2011), and its validity and reliability studies were conducted on adolescents. Internal consistency, test-retest, item, and confirmatory factor analyses were performed. The total internal consistency coefficient of the scale is .93 and the internal consistency coefficient for each subscale is .70 and above (Yücel et al. 2011). To evaluate participants according to the binge eating disorder criteria in DSM-5 (APA 2013) and to calculate the occurrence and duration of their regular binge eating pattern, the Binge Eating subscale consisting of only 6 items (13th to 18th) is used in the study. In the present study, the internal consistency coefficient of the EDE-Q Binge Eating subscale was found .80. The EDE-Q Binge Eating form is presented in Appendix E.

2.2.3.2. REZZY (SCOFF) Eating Disorder Scale

This scale was developed in 1999 by Morgan, Reid, and Lacey. The scale's name, SCOFF, is derived from an acronym that consists of the initials of some words (sick, control, one, fat, food) in the content of the original form. The name of the scale may be changed while translating to various languages. The name of the Turkish form to be used in the study is REZZY. The 5-item scale measures the tendency to develop an eating disorder, and as mentioned before, a high BMI value does not always indicate obesity (Yüksel 2014: 481), so it was included in the study as a differential criterion for obesity and regular binge eating behavior. People get 1 point for each item that they answered "yes". The maximum score that can be taken from the scale is 5. People who have 2 or more points are evaluated in the eating disorder risk group. In our study, participants with a score of 2 or more for the obese group were included in the study.

The scale was adapted to Turkish by Aydemir, Köksal, Yalın Sapmaz, and Yüceyar (2015), and its validity and reliability studies were conducted on female university students. Internal consistency, item, explanatory, and confirmatory factor analyses were performed. The total internal consistency coefficient of the scale is .74 (Aydemir et al. 2015). Besides, there is no change in the number and content for the Turkish form. In the present study, the total internal consistency coefficient of the REZZY scale was found .64. The REZZY form is presented in Appendix F.

2.2.3.3. Three-Factor Eating Questionnaire-Revised 21-Item (TFEQ-R21)

This questionnaire was developed in 1985 by Stunkard and Messic to evaluate the behavioral and cognitive factors underlying eating attitudes and consists of 51 items. The first developed form of the scale consists of three subscales: cognitive restraint of eating, disinhibition, and hunger. Then, the TFEQ was revised by Karlsson, Persson, Sjostrom, and Sullivan (2000) as an 18-item scale named TFEQ-R18. Later, it was rearranged as a three-factor scale consisting of 21 items by Tholin, Rasmussen, Tynelius, and Karlsson (2005), and renamed TFEQ-R21. Due to studies with obese and non-obese participants, 3 items from TFEQ-R21 were removed (17th, 18th, and 21st items) and the scale was re-revised consisting of 18 items, which is called TFEQ-R18V2 (Cappelleri et al. 2009). For the TFEQ-R21 the internal consistency coefficient for .84 for the Uncontrolled Eating subscale, .92 for the Emotional Eating subscale, and .68 for the Cognitive Restraint subscale (Tholin et al. 2005)

The TFEQ-R21 evaluates three factors that are uncontrolled eating (UE), cognitive restraint (CR), and emotional eating (EE) by scoring between 0 and 100 on a 4-point Likert scale. The scores are calculated with the converted into a standardized scaled score as shown in Table 6 (Karakuş et al. 2016), and high scores from any factors on the scale indicate that the eating behavior associated with that factor is high too (Tholin et al. 2005).

Table 6. Standardized Scale Scores for TFEQ-R21 (Karakuş et al. 2016)

Factors	The Lowest and Highest Possible Raw Scores	Possible Raw Score Range	The Rating Formula
Uncontrolled eating (UE)	9-36	27	UE=[(UE-9)/27] x100
Cognitive restraint (CR)	6-24	18	CR=[(CR-6)/18] x100
Emotional eating (EE)	6-24	18	EE=[(EE-6)/18] x100

It is known that individuals who show regular binge eating behaviors have difficulty stopping themselves while eating (APA 2013) and some studies are showing that overweight and obese individuals exhibit regular binge eating behaviors in negative moods such as anxiety, shame, guilt, and unhappiness (Craven and Fekete 2019; Gianini et al. 2013; Ricca et al. 2009). Therefore, the scale was included in the study because it reliably measures the eating behaviors that may affect individuals' tendencies towards obesity and binge eating.

Turkish adaptation of the TFEQ-R21 was performed by Karakuş, Yıldırım, and Büyüköztürk (2016), and it consisted of 21 items with three factors: uncontrolled eating, cognitive restraint, and emotional eating. The TFEQ-R21's validity and reliability studies were conducted on adult individuals and their families. The internal consistency coefficient of the UE subscale of TFEQ-R21 was .79, .87 for the EE subscale, and .80 for the CR subscale (Karakuş et al. 2016). In the present study, the internal consistency coefficient was found to be .92 for the UE subscale, .95 for the EE subscale, and .84 for the CR subscale. The TFEQ-R21 form is presented in Appendix G.

2.2.4. Measures Used for Screening

Impulsivity scores, which are likely to affect regular binge eating behaviors of the participants, were measured with the scale mentioned below.

2.2.4.1. Short Form of Barratt's Impulsiveness Scale, Version 11 (BIS-11-SF)

Barratt's Impulsiveness Scale (BIS) was developed in 1959 by Barratt, and BIS - Version 11 (BIS-11) is the latest form developed by Patton, Stanford, and Barratt in 1995. The BIS-11 is a scale that is very effective in evaluating impulse control and plays a key role in studies examining biological, psychological, and behavioral aspects of impulsivity (Reise et al. 2013). The BIS is a self-report measure that consists of 30 items evaluating impulsivity. However, a 15-item short form of BIS has been developed under the name BIS-11-SF for ease of use for practitioners in clinical and non-clinical group studies. The BIS-11-SF has a total of three sub-scales: Attentional impulsivity (including attention and cognitive instability factors), motor impulsivity (including motor and perseverance factors), and non-planning impulsivity (including self-control and cognitive complexity factors) (Patton et al. 1995). Items scored on a 4-point Likert scale. When evaluating BIS-11-SF, 4 different points are obtained: Total impulsivity score, attentional impulsivity score, motor impulsivity score, and non-planning impulsivity score. This scale has no cut-off point, higher total BIS-11-SF scores indicate higher impulsivity (Tamam et al. 2013).

Turkish standardization of the BIS-11-SF was completed by Tamam, Güleç, and Karataş (2013). The total internal consistency coefficient of the scale is .82 and the internal consistency coefficient for each subscale is .64 and above (Tamam et al. 2013). It is known that individuals who suffer from binge eating disorder have higher impulsivity levels than individuals who suffer from other eating disorders (Fitzpatrick et al. 2013; Şen-Demirdöğen 2015: 63), and as their impulsivity levels increase, their decision-making performances deteriorate and they act more carelessly (Aloi et al. 2015). Therefore, the BIS-11-SF was also included in the study, since taking the impulsivity measurements of the participants would provide additional information in terms of evaluating all data. In the present study, the total internal consistency coefficient of the scale was .82, and the internal consistency coefficient for each subscale is .55 and above. Therefore, in the present study, the total impulsivity score with higher reliability was used instead of evaluating it over subscales. The BIS-11-SF is presented in Appendix H.

2.2.5. The Test Battery Used for Cognitive Assessment

The neuropsychological test battery was applied to measure and evaluate the cognitive processes (such as basic and complex attention, working memory, response inhibition, set shifting, and information processing speed) of individuals. The tests performed are the Paced Auditory Serial Addition Test (PASAT), the Symbol Digit Modalities Test (SDMT), the Stroop Test TBAG Form/Version, the Wechsler

Memory Scale (WMS-R)’s “Information and Orientation Questions, Digit Span, and Visual Memory Span” subscales, and the Trail Making Test (TMT)’s Form A and B.

2.2.5.1. Paced Auditory Serial Addition Test (PASAT)

The test was developed to assess the neurocognitive functionality in traumatic brain injuries, and it measures working and/or short-term memory capabilities and executive functions such as auditory information processing speed, level of alertness, divided and sustained attention, and calculation ability (Gronwall and Sampson 1974). In the current study, PASAT was used to evaluate the information processing speed of individuals. It has also been evaluated that it may affect EF skills such as working memory (Rosen 2019). As is generally known, it is a test that is frequently used to evaluate the cognitive processes of multiple sclerosis patients (Brooks et al. 2011). According to the instruction, every three seconds, a single digit is present to subjects, and each new digit must be added to the previous one. For example, assuming that 9, 1, 3, and 5 are given numbers. The subject adds the first two numbers (9 + 1) and answers 10. Then, the subject adds the second two numbers (1 + 3) and answers 4. Afterward, the subject adds the third two numbers (3 + 5) and answers 8, and so on (Strauss et al. 2006). After making sure that the participant has understood the instruction correctly, the test took a total of 61 digits presented in random order with an uttermost of 60 correct answers to measure the total score (Özakbaş et al. 2016). The total correct number indicates the person's general attention span. Digits are presented using the audio recording to ensure standardization. The test has two different forms, which are Form A and Form B, and Form A was used in our study. The PASAT Record Form A is presented in Appendix I.

The validity study of PASAT in the Turkish population was conducted by Özakbaş and colleagues (2016) with healthy individuals between the ages of 18 to 55 years, and in our country sample, normative PASAT data were adapted for use in both healthy populations and clinical applications.

2.2.5.2. Symbol Digit Modalities Test (SDMT)

The SDMT was developed by Smith in 1973 and it evaluates cognitive functions such as divided attention, visual scanning and visual tracking skills, perceptual and motor speed, sustained visual attention, and visual-spatial information processing speed (Strauss et al. 2006). It is also known that the original task existed in the Army Beta Test in 1915 (Tulsky et al. 2003). The test items consist of blocks divided by symbols, which contain nonsensical geometric figures and written numbers. At the top of the test page, there is a key that matches numbers and symbols in the divided blocks. The subjects quickly match the numbers to the symbols. The number of items that the subjects wrote correctly in 90 seconds is scored. Each item is 1 point and a maximum of 120 points can be obtained (Benedict et al. 2017). The standardization study of the SDMT was conducted by Smith (1982) on healthy adults. In this study, correlation coefficients calculated for the SDMT's with the test-retest (29 days interval) technique was found to be .80 for the written version (Smith 1982). The manual of the SDMT form is presented in Appendix J.

2.2.5.3. Stroop Test TBAG Form/Version

The Stroop Test is developed to evaluate frontal region activity such as selective attention and cognitive flexibility, and it measures the ability to inhibit cognitive interference when the processing of a stimulus feature affects the processing of another feature of the same stimulus at the same time. This situation is called the "Stroop interference effect (color-word interference effect)" (Stroop 1935). This effect occurs when the subject sees any word that indicates a color name, the color which is used in the writing of this word is required to say its name. If there is a contradiction between the color that is used in the writing of this word and the color which is expressed by the word, there is a longer reaction time to tell the color name as compared to a congruent color word. People focus on telling the color of the word, they also tend to read the color's name (Burke and Light 1981). The Stroop effect is considered a reliable behavioral phenomenon because this effect can be observed under different stimulus and reaction conditions in all situations where there are facilitating and inhibiting effects (MacLeod 1991).

The Stroop Test is defined as a task related to shifting the perceptual processing or perceptual set (MacLeod 1991). It reveals the ability to shift the perceptual set in line with changing demands under an interference effect and to suppress a usual behavior pattern on behalf of unusual behavior (Karakaş et al. 1999). The Stroop Test TBAG Version (Karakaş et al. 2013), which is the Turkish adaptation of the Stroop Color and Word Test, is used in this study.

The Stroop Test TBAG Form is a combination of the original Stroop Test and the Stroop Test Victoria Version. It consists of four 14 x 21.5 cm white cards, each containing 24 items (arranged in 6 rows of 4 items each) a total of five tasks that were evaluated individually and in a specific order. The first card has color names (blue, green, red, and yellow words) printed in black, and, in the first task, the subject is asked to read these words. The second card contains color names (blue, green, red, and yellow words) printed in blue, green, red, and yellow. In the second task, the subject is asked to read these color words. The third card contains colored dots with a diameter of 0.4 cm (printed in blue, green, red, and yellow), and in the third task, the subject is asked to say the ink color of these circles. The fourth card contains neutral words (kadar, zayıf, ise, orta) printed in different colors, and, in the fourth task, the subject is asked to say the ink color of these words. In the fifth task, the second card is presented again to the subject and the subject is asked to say the ink color of color words. 5th Task is also the section where the Stroop interference effect is measured. The duration of the Stroop interference effect is calculated by subtracting the reaction time of the subject to say the ink color of the word from the subject's reading time of the colored words (Karakaş et al. 2013).

The ability of a person's resistance to interference, in other words, the ability to inhibit the reading tendency, can be evaluated in this way. It takes approximately 10 minutes to perform the test, and three types of scores are calculated that are trial time, errors, and corrects, and interference scores for the five cards (Karakaş et al. 2013).

It was observed that the test-retest correlation coefficients obtained for the time scores in the five trials in the Stroop Test TBAG Form varied between 0.26 and 0.88, and these correlation coefficients were statistically significant ($p < .05$). The test-retest reliability coefficient was found to be .56 for the fifth trial (second card), where the Stroop interference effect was measured, and this was acceptable considering the long time interval (Karakaş et al. 1999). This result shows that the Stroop Test TBAG Form can be used as a reliable measurement tool in our country's sample in terms of trial time scores. The Stroop Test TBAG Form's manual is presented in Appendix K.

2.2.5.4. Wechsler Memory Scale-Revised (WMS-R)

The Wechsler Memory Scale, which was developed by Wechsler in 1945, has been revised as WMS-R in 1987 by Wechsler to make a more comprehensive measurement. The scale was revised again in 1997 by a group of experts connected with Pearson as the Wechsler Memory Scale-III. The last revision is the Wechsler Memory Scale-IV, which was revised in 2009 by the previous same experts. WMS-R (Wechsler 1987) can measure verbal and visual memory, memory for concrete and abstract materials, and immediate and delayed memory activities simultaneously and is considered the most comprehensive and psychometrically developed neuropsychological test used in the literature due to its ability the measurement of memory (D'Elia et al. 1989; Karakaş et al. 1999). It can also provide measurements of attention and concentration, which are closely related to memory processes (Karakaş et al. 2013).

The WMS-R consists of 13 subtests including "Information and Orientation Questions, Mental Control, Figural Memory, Logical Memory-I (Story A and B), Visual Paired Associates-I, Verbal Paired Associates-I, Visual Reproduction-I, Digit Span (Forward and Backward), Visual Memory Span (Forward and Backward), Logical Memory-II (Story A and B), Visual Paired Associates-II, Verbal Paired Associates-II, Visual Reproduction-II", and 21 points calculated from these subtests.

The application for all of the subtests takes approximately 60 minutes (Karakaş et al. 2013). Information and orientation questions, digit span, and visual memory span subtests were used in this study. Information and orientation questions are included some questions about the subject's background and orientation. It contains 16 questions (only the first 14 are scored) that can reveal information in the subject's long-term memory and are used to make a clinical pre-evaluation. In this subtest, 1 point is given for each correct answer and 0 points for each wrong answer. Since our study was conducted online, it was used to objectively evaluate the mental status of the participants and was not included in the general memory scoring. In the digit span subtest, a sequence of digits is read to the subject and asked to count in a forward series. Then, another sequence of digits is read to the subject and asked to count in a backward series. In this subtest, 2 points are given to the correct answers in both trials, and 1 point is given to the correct answer in only one trial. It is used to evaluate working memory, verbal short-term memory, and attention. In the visual memory span subtest, the colored squares are touched in 1-second intervals and a forward series, and the subject is asked to touch them in the same order. Then, the colored squares are touched in a backward series and the subject is asked to touch the same order again. In this subtest, 2 points are given to the correct answers in both trials, and 1 point is given to the correct answer in only one trial. This subtest aims to measure visual short-term memory (Karakaş et al. 2013; Kent 2016).

The scale was adapted to Turkish by Öktem and Baltaş, but standardization studies were not completed (Öner 1997). The standardization studies of this scale for our country were completed as a part of Neuropsychological Test Battery for Cognitive Potentials: BILNOT Neuropsychological Test Battery (2013), and its construct and congruent validity, and test-retest reliability studies were conducted. The lowest correlation coefficient in this scale was found to be .55 for the Verbal Paired Associates-II subtest; the highest correlation coefficient was found to be .87 for the Digit Span subtest. The correlation average for verbal memory is .80, and the correlation average for figural memory is .54. Test-retest reliability correlation coefficient averages related to delayed memory test scores (.66) were lower than the immediate memory correlation coefficient averages (.74) (Karakaş et al. 2013). According to all of these findings, the WMS-R's Turkish version could be used as a reliable measurement tool in our country's sample. The manual of the subtests of the WMS-R used in the present study is presented in Appendix L.

2.2.5.5. Trail Making Test (TMT)

The test was developed in 1944 by the United States of America (USA) army psychologists to evaluate visual-motor and visual-conceptual activities as part of the Army Individual Test Battery (Reitan 1955). Neuropsychologist Ralph M. Reitan (1955) put it into clinical use to identify organic brain damage. The TMT is sensitive to frontal region activities and it is used in the assessment of cognitive functions such as working memory, complex attention, cognitive flexibility, response inhibition, abstract thinking, planning, and set-shifting (Crowe 1998). Motor speed, agility, and attention skills are required to be successful in this test (Türkeş et al. 2015). There are two forms which are A and B. In Form A, the subject is expected to merge the numbers (from 1 to 25) in mixed and rounded figures as quickly as possible. In Form B, the subject is expected to merge the numbers (from 1 to 25) in mixed and rounded figures with the alphabetically ordered letters (from A to L) as quickly as possible (e.g, 1-A, 2-B, 3-C,…). Form A measures the information processing speed depending on the visual scanning capacity and Form B measures the ability to follow set-shifting and sequences. Form B has a longer completion time compared to Form A because Form B measures the skills required to perform the test effectively in contrast to Form A (Türkeş et al. 2015). TMT is an individually administered test and has no time limitation, but can usually be completed between 5 and 10 minutes (Bowie and Harvey 2006).

Although different methods have been suggested for the scoring of TMT, it was observed that a maximum of 7 points was calculated in seconds. These are the completion times for Form A and B, the number of errors for Form A and B, the sum of completion times for Form A and B (A+B), and the time difference obtained by subtracting Form B completion time from Form A completion time (B-A), and the time ratio divided by Form B completion time by Form A completion time (B/A) (Cangöz et al. 2009; Türkeş et al. 2015). In the paper and pencil version of the test, the number of errors is not recorded, but if an error is made it is assumed that it will be reflected in the completion time (Bowie and Harvey 2006). Therefore, the number of errors was also recorded. Since the effect of the speed component is eliminated with the B-A score, attention, cognitive flexibility, and set-shifting are measured more consistently, in line with the purpose of this study (Holtzer et al. 2005).

The standardization and norm determination study of the TMT was conducted by Cangöz, Karakoç, and Selekler (2009) on individuals aged 50 and above. On the other hand, the normative data study of the TMT on individuals between the ages of 20 and 49 was conducted by Türkeş and colleagues (2015). In Türkeş and colleagues' study (2015), the Pearson correlation coefficient calculated for the time scores with the test-retest (30 days interval) technique was found to be .87 for Form A and .77 for Form B. In the same study, the level of education was shown to significantly affect ($p < .01$) the total completion time of Form B and the associated subtest scores (A+B, B-A, B/A). The manuals of TMT forms are presented in Appendix M.

2.3. RESEARCH DESIGN

The experimental study had a 2x2x2 between-subjects factorial design. In the present study, the scores of the participants were divided into four different groups according to their BMI classification (obese and normal-weight), gender (male and female), and the presence of a regular binge eating pattern (with and without), from the five neuropsychological tests that measure memory (the WMS-R), attention, and executive functions (the PASAT, the SDMT the Stroop TBAG, and the TMT) were compared.

While there were four levels (obese participants with RBE, normal-weight participants with RBE, obese participants without RBE, and normal-weight participants without RBE) in the research, the scores are dependent variables obtained from the five neuropsychological tests. While conducting the study, the research design used in research is presented in Table 7.

Table 7. The Design of the Research

				REGULAR BINGE EATING PATTERN		
				Yes	**No**	**Total**
BMI	**30 ≥ BMI (Obese)**	**GENDER**	**Female**	n 20	n 19	39
			Male	n 19	n 19	38
	18.5-24.9 BMI (Normal Weight)		**Female**	n 23	n 35	58
			Male	n 20	n 21	41
			Total	82	94	**176**

2.4. PROCEDURE

The ethical approval was obtained from the Scientific Research and Publication Ethics Board of the institution to research at Çankaya University (21 June 2019, issue: 195). The study was conducted via an online platform because of the unexpected COVID-19 pandemic conditions. All participants in the normal-weight and obese groups were selected among the ones who applied to various diet clinics in metropolitan cities from Turkey for consulting services, people who want to participate in the study voluntarily through social media announcements, or volunteer students from Çankaya University. All neuropsychological tests or scale administrations were conducted online. Before applying the neuropsychological tests to participants who log in to the website, The Clarification Text on Personal Data Processing and Protection Law has been prepared to protect the legal rights of the participants.

The neuropsychological tests used in the research were integrated into the experiment website under supervision with maximum similarity to the paper-pencil version. The application and scoring training of all neuropsychological tests to be applied in the study was completed before starting the study. After the participants filled out the forms in the Qualtrics survey software, they completed the neuropsychological tests using a unique user number sent to their contact e-mail at a time that was convenient for them. Participants who had technical problems with the website contacted the researcher via e-mail, and the researcher provided the necessary information and support depending on the situation. A brief informative instruction page was shown to each participant who logged into the website about the environmental conditions where the tests would be conducted, how to operate the computer keyboard and mouse, sound level, and permissions to access the microphone. In addition, instructions were provided for each neuropsychological test before starting, with information on how to present stimuli and how the participant would use the computer keyboard, mouse, or microphone to respond.

In the first stage, the Informed Consent Form was presented to all participants, the purpose of the research and other information related to the research was clearly explained, then the informed consent form was approved by participants who volunteered to participate in the study. Afterward, the Demographic Information Form, eating disorder identification forms, and the screening form were presented to the participants through Qualtrics. After the participants fill out the forms, no identifying personal data was requested from them, only a contact e-mail was requested to convey the website link and personal user number for the next session (neuropsychological test battery session). General information about the participants, and their height and weight data were taken as self-reports. After the participants filled out the Demographic Information Form, the scales for determining their eating attitudes and the impulsivity scale, their BMIs [BMI = weight (kg) / [height (m)]^2 (WHO 2021a) were calculated according to their height and weight data, and their binge eating scores were calculated through the scales that determined their eating attitudes. According to all this information, the participants were divided into four different groups.

After the unique user number was sent to the contact e-mails of the participants who were divided into groups to access the experiment website, the sessions in which the web-based self-administered neuropsychological test battery was applied to the participants from four different groups were initiated. The user number, which the experiment website automatically identifies randomly, enabled us to easily match the data obtained from Qualtrics with the cognitive data of the person. The PASAT, Stroop TBAG, WMS-R, TMT, and SDMT were applied to the participants in two separate sessions (session-I: Stroop TBAG, WMS-R; session-II: PASAT, TMT, SDMT), and the test order in these sessions was fixed due to the nature of the structure of websites. There was a 15-minute break between sessions due to the possibility that a single session may have a disruptive effect on test performance. In all neuropsychological tests, participants interacted with the website to give their answers.

Unlike the face-to-face manual of the Stroop TBAG Form, in the present study, as shown in the images below, the participants responded by saying the congruent or incongruent color words and neutral words as if the test was administered face-to-face. An audio recording was taken with the permission of the participants to use their microphones, and they were given 5 seconds to prepare themselves for the recording. Participants were instructed to click the button labeled "Record/Kaydet" on the screen to continue with the next trial when they finished recording. There is no time limit for participants, but their reaction times were calculated from the time difference between the 5-second countdown and the “Record” button click. In this way, it was possible to record and analyze the error and correction scores of the participants, as in the face-to-face Stroop test.

The web-based Stroop Test TBAG Version consists of 5 trials as a face-to-face manual and each trial card contains 24 items (arranged in 6 rows of 4 items each). The first trial has 24 congruent items that were the names of four colors (yellow, blue, green, and red), written in black and small letters, Genera Alt Regular font, size 28. Participants were expected to read each word as quickly as possible. The second trial contains the same letters, font, and size of color words as in the first trial, but the items are incongruent (e.g., the word “blue” was written in yellow letters). Participants were expected to read the words, ignoring the ink on which the colors were written. In the third trial, 24 colored circles were presented in the same colors as the previous two trials (printed in yellow, blue, green, and red). Similar to the first trial, the participants were expected to name the colors of the circles. In the fourth trial, 24 neutral words (kadar, zayıf, ise, orta), were printed in yellow, blue, green, and red, written in small letters, Genera Alt Regular font, size 28, were presented. The participants were expected to name the ink color of these neutral words. In the fifth trial, the web page of the second trial was presented to the participants exactly (24 incongruent items, printed in yellow, blue, green, and red, small letters, Genera Alt Regular font, size 28), but the participants were expected to name the ink color of the words, not read the words. A total of 17 screens, including instructions and 5-second countdown pages, were presented to the participants for the Stroop Test TBAG Form. Example screenshots of the website adaptation of the Stroop Test TBAG Form are presented in Figure 4.

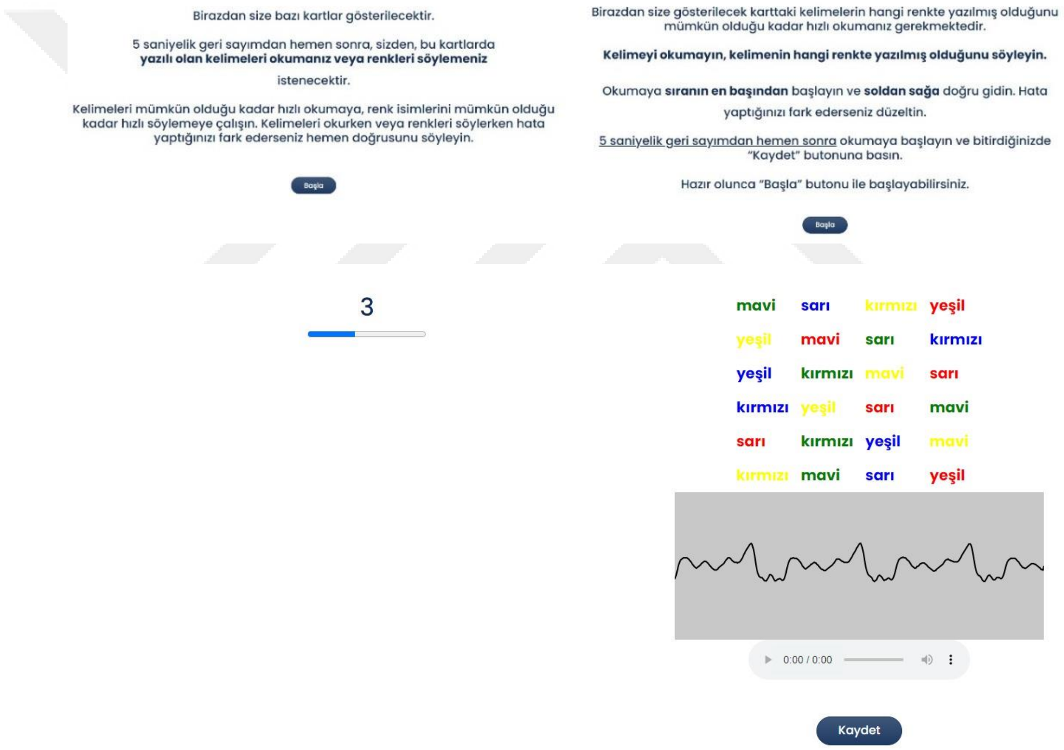

Figure 4. Website Screenshots of Stroop Test TBAG Form

When the administration of each neuropsychological test was finished, the participants were informed that the next test was in progress. Likewise, they were informed that there would be a break between the two sessions and that the sessions would end. A total of 7 information screens were presented to the participants. The example website screenshot of the information page is presented in Figure 5.

İlk test oturumumuz sona ermiştir.

15 dakika sonra ikinci test oturumuna "Başla" butonu ile başlayabilirsiniz.

Başla

Figure 5. Website Screenshot of an Information Page

In the WMS-R subtests, the participants answered WMS-R's General Information and Orientation Questions in a trial using their computer keyboards. In the manual form of the subtest, how quickly the participants gave the answers or whether they gave correct or incorrect answers was not taken into account in the WMS-R scoring, and the answers were used only for preliminary evaluation of general memory performance. Therefore, the speed of writing the answers of the participants in the web-based version was not taken into account. Also, there was no time limit for this subtest. After the participants finished typing, they clicked the button on the screen labeled "Record/Kaydet" to continue with the next WMS-R subtest. Participants were not informed about their scores. A total of two screens, including the instruction page, were presented to the participants. The screenshot of the website adaptation of WMS-R's General Information and Orientation Questions subtest is presented in Figure 6.

GENEL BİLGİ VE YÖNELİM SORULARI		
SORULAR	Cevaplar	Puan
1. Kaç yaşındasınız ?		
2. Doğum tarihiniz ?		
3. Doğum yeriniz neresi ?		
4. Annenizin adı nedir ?		
5. Şu anki Cumhurbaşkanımız kimdir ?		
6. Ondan önceki Cumhurbaşkanımız kimdi ?		
7. Hangi yıldayız ?		
8. Hangi aydayız ?		
9. Bugün ayın kaçı ?		
10. Şu anda neredesiniz?		
11. Hangi şehirdeyiz ?		
12. Bugün günlerden ne ?		
13. Saatinize bakmadan saatin kaç olduğunu söyleyebilir misiniz ?		

Devam

Figure 6. Website Screenshot of WMS-R General Information and Orientation Questions

In the WMS-R Digit Span subtest, the participants heard a series of numbers aloud and gave their answers via their computer keyboard or the created virtual keyboard. To ensure standardization, all digits are presented on tape at one digit per second. After all the numbers in a trial were presented, the participants were instructed to use the keyboard to type the digits in a text box in the same or backward order as instructed, and when they finished, click the "Next" button on the screen to continue with the next trial. The test consisted of 24 trials (12 trials for Digit Span and 12 trials for Reverse Digit Span), starting with three digits on the first trial (two digits for Reverse Digit Span) and ending with eight digits for the final trial (seven digits for Reverse Digit Span), with each trial increasing by one the number of digits to be remembered. The test was terminated when participants gave two consecutive incorrect answers in a particular trial, and the participants did not know of this as in the face-to-face manual. Participants received two points for two correct answers, one point for one correct answer, and zero points for no correct answers in each trial. The total score is the participants' WMS-R Digit Span subtest scores. A total of 26 screens, including the instruction pages for Digit Span and Reverse Digit Span, were presented to the participants. The example screenshots of the website adaptation of WMS-R’s Digit Span subtest are presented in Figure 7.

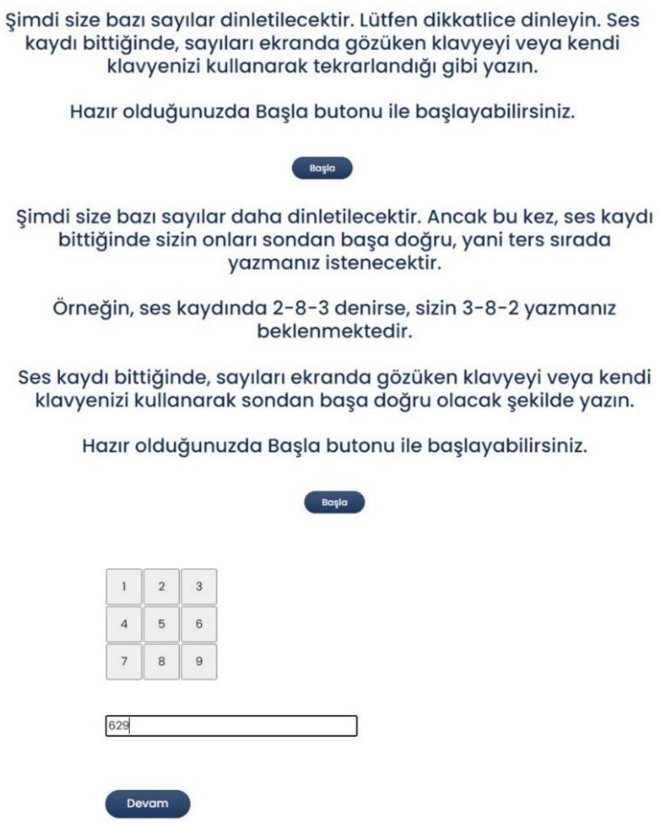

Figure 7. Website Screenshots of WMS-R Digit Span Subtest

In the WMS-R Visual Memory Span subtest, the participants clicked with their mouse on the red or green boxes in which numbers from 1 to 8 were in the order shown (same or backward order) presented consecutively for two seconds each on the screen. After all the numbers in a trial were presented, the participants were instructed to click with their mouse to the boxes in the same or backward order as instructed, and when they finished, click the "Next" button on the screen to continue with the next trial. It should also be noted that the numbering was arranged for scoring and only the researcher can see the numbers, and the participants saw boxes without numbers. Unlike the face-to-face version which is done by touching the cards, the participants understood which boxes they would choose by changing the color of the box according to the span's sequence order (red to yellow for the Visual Memory Span subtest, and green to red for the Reverse Visual Memory Span subtest). The test consisted of 26 trials (14 trials for Visual Memory Span and 12 trials for Reverse Visual Memory Span), starting with two boxes on the first trial, and ending with seven digits for the final trial with each trial increasing by one the number of digits to be remembered. The test was terminated when participants gave two consecutive incorrect answers in a particular trial, and the participants did not know of this as in the face-to-face manual. Participants received two points for two correct answers, one point for one correct answer, and zero points for no correct answers in each trial as in the WMS-R Digit Span subtest. The total score is the participants' WMS-R Visual Memory Span subtest scores. A total of 28 screens, including the instruction pages for Visual Memory Span and Reverse Visual Memory Span, were presented to the participants. Example screenshots of the website adaptation of the WMS-R's Visual Memory Span subtest are presented in Figure 8.

Figure 8. Website Screenshots of WMS-R Visual Memory Span Subtest

In the PASAT, the participants heard the numbers aloud presented consecutively for three seconds from the standardized audio recording and entered their answers through their keyboard in one trial. In the face-to-face version of the test, participants verbally report their answers. However, in the present study, the participants wrote their answers in the boxes below in parallel with the audio recording. The instruction was also visually supported to ensure that the participants could fully understand the instruction. After the participants finished typing the answers, they clicked the button on the screen labeled "Record/Kaydet". The participants were allowed to make errors, but they were not informed about their errors, except for three practice trials. Performance was scored as the number of correct responses. A total of five screens, including the instruction page, were presented to the participants. Screenshots of PASAT's website adaptation are presented in Figure 9.

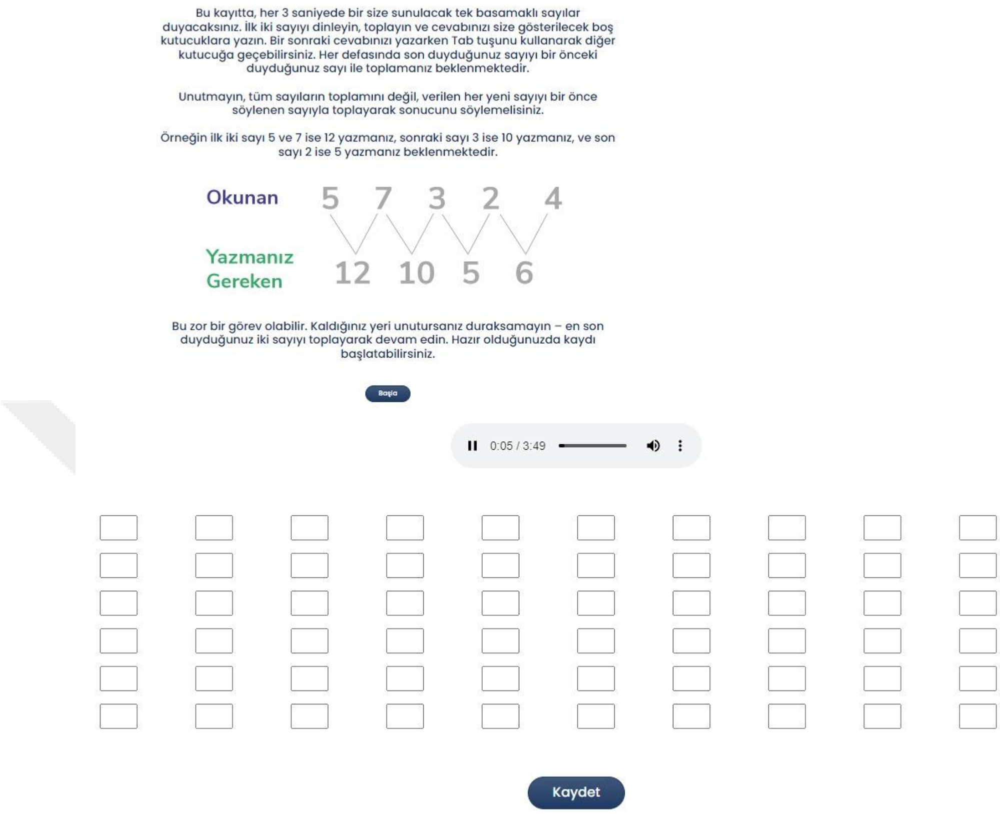

Figure 9. Website Screenshots of PASAT

In the TMT, the participants followed the sequences of numbers (Form A) and numbers and letters (Form B) by clicking the buttons with their mouse as stated in the instructions. The test consists of one trial for each form and the incorrect answers of the participants were recorded. In the practice trials for each form, the participants were informed when they made an error and could not proceed to the test trial until they learned the correct sequences as stated in the instructions. Performance was scored as the number of correct responses. A total of four screens, including the instruction pages, were presented to the participants. Screenshots of the website adaptation of TMT Form A and B are presented in Figure 10.

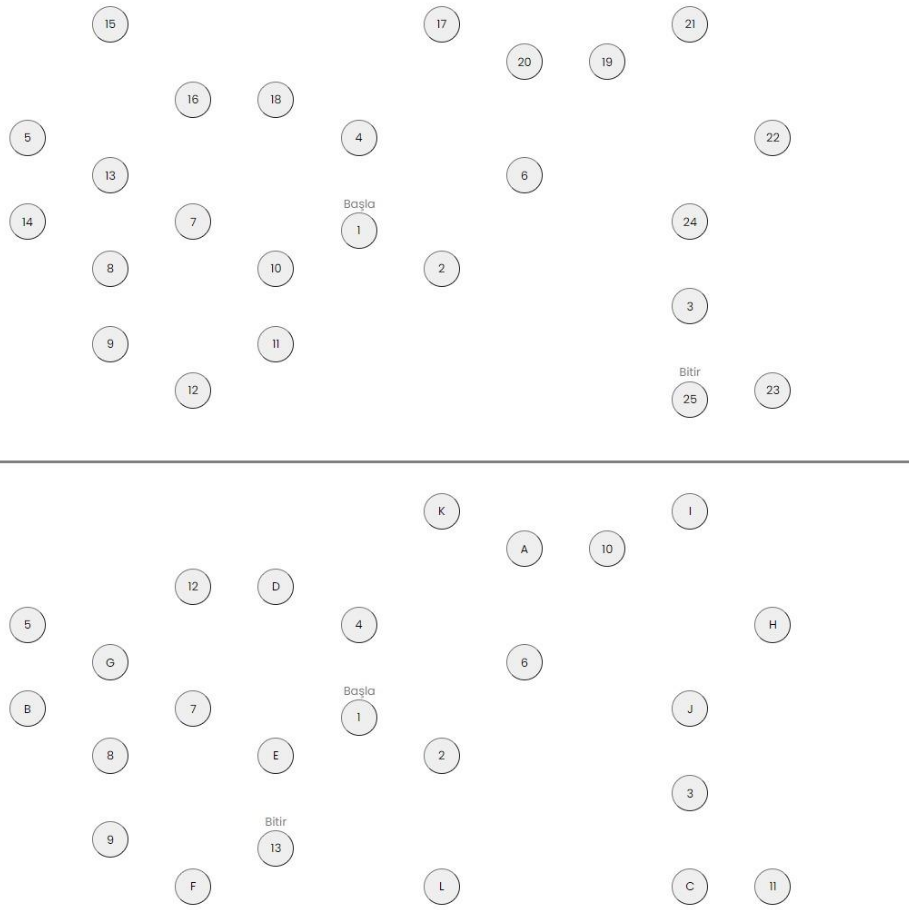

Figure 10. Website Screenshots of TMT Form A and B

For the SDMT, participants wrote in the boxes within 90 seconds which number corresponds to the symbols on the key listed from single-digit numbers which are 1 to 9 at the top of the screen via their computer keyboards in one trial. After the participants finished typing their responses, they clicked the button on the screen labeled "Record/Kaydet". The participants were allowed to make errors, but they were not informed about their errors. The participants were allowed to make errors, but they were not informed about them. Performance was scored as the number of correct responses. A total of three screens, including the instruction page, were presented to the participants. Website screenshots of the website adaptation of SDMT are presented in Figure 11.

Figure 11. Website Screenshots of SDMT

For the neuropsychological test battery application, the time between two sessions was determined as 15 minutes. In this context, it is planned to complete the entire study in three sessions. Considering the application conditions of these tests, it was especially emphasized that before starting the tests, the participants were to be in a comfortable and quiet room away from the environmental confounders, and if they were wearing glasses or contact lenses, they should not start without wearing them. Then, the participation incentives (digital shopping coupons or bonus points) offered to all participants who completed both stages were sent to the participants' contact e-mail addresses and the study was terminated. The application time of the tests lasted between 50 minutes and 1 hour on average, including the break. Following the administration of the tests, the participants were given clear and comprehensive information about the research, and their questions were answered to avoid misunderstandings. The screening measurements applied in the research and the cognitive functions measured by the neuropsychological tests, the information about the standardization studies, and the approximate application times are given in Table 8 and Table 9, respectively.

Table 8. Screening Measurements Used in the Research, Cognitive Functions, Application Times, and the Standardization Studies

	Short Form of Barratt's Impulsiveness Scale, Version 11 (BIS-11-SF)	**Eating Disorder Examination Questionnaire (EDE-Q)**	**SCOFF (REZZY) Eating Disorder Scale**	**Three-Factor Eating Questionnaire-Revised 21 Item (TFEQ-R21)**
Cognitive functions	Not being able to plan, impulsivity in motor and attention	The severity of eating disorder psychopathology	The tendency to develop an eating disorder	Behavioral and cognitive factors underlying eating attitudes
Developers	E. S. Barratt (1959)	C. G. Fairburn and S. J. Beglin (1994)	J. F. Morgan, F. Reid, and J. H. Lacey (1999)	A. J. Stunkard and S. Messick (1985)
Turkish standardization studies	Tamam, Güleç, and Karataş (2013)	Yücel et al. (2011)	Aydemir, Köksal, Yalın Sapmaz, and Yüceyar (2015)	Karakuş, Yıldırım and Büyüköztürk (2016)
Approximate application time (for healthy individuals)	5-7 minutes	For the Binge Eating subscale: 2-5 minutes	2 minutes	10 minutes

Table 9. Neuropsychological Tests Used in the Research, Cognitive Functions, Application Times, and the Standardization Studies

	Scales / Tests				
	Paced Auditory Serial Addition Test (PASAT)	**Stroop Test TBAG Form/Version**	**Wechsler Memory Scale-Revised (WMS-R)**	**Trail Making Test (TMT) (Form A and B)**	**Symbol Digit Modalities Test (SDMT)**
Basic cognitive functions	Attention and executive functions	Attention and executive functions	Different types of memory	Attention and executive functions	Attention and executive functions
Sub-cognitive functions	Auditory information processing speed, level of alertness, divided and sustained attention, calculation ability	Selective attention, complex attention, response inhibition, set-shifting, cognitive flexibility, information processing speed	Memory (verbal and visual memory, immediate and delayed memory), the capacity of attention, concentration	Sustained attention, visual-spatial information processing speed, set shifting cognitive flexibility, response inhibition, planning	Divided attention, visual scanning, visual tracking, perceptual and motor speed, sustained visual attention, visual-spatial information processing speed
Developers	D. M. Gronwall (1977)	J. R. Stroop (1935)	D. Wechsler (1987)	M. R. Reitan (1958)	A. Smith (1982)
Turkish standardization	-	Karakaş, Erdoğan Bakar, and Doğutepe Dinçer (2013)	Karakaş (2004)	For 20-49 years old: Türkeş, Can, Kurt and Elmastaş Dikeç (2015)	-
Approximate application time (for healthy individuals)	5-10 minutes	10 minutes	For subscales to be used in the study: 15-20 minutes	5-10 minutes	1.5 minutes

CHAPTER III

RESULTS

3.1. DATA PROCESSING AND DATA CLEANING

Data were analyzed by using the Statistical Package of Social Sciences (SPSS) for Windows, Version 23 (IBM SPSS Statistics for Windows Version 23, IBM Corp.). In the statistical analysis phase of the study, frequency analysis, descriptive statistics, and mean comparison tests were presented.

Firstly, the participants were divided into four different groups, which are the obese group with regular binge eating (OB-RBE), the obese group without regular binge eating (OB-w/RBE), the normal-weight group with regular binge eating (NW-RBE), and the normal-weight group without regular binge eating (NW-w/RBE), to obtain the frequency analysis findings and descriptive statistics values. These four groups were crossed over the factors of BMI classification and the presence of regular binge eating patterns. Frequency analyses related to the demographic characteristics of individuals and descriptive statistical findings of the variables used in the study were shown over these groups. Percentage (%) and frequency (*n*) values of the groups were given together. Among descriptive statistics, mean (*M*), standard deviation (*SD*), minimum (Min), and maximum (Max) values were presented. Finally, a three-way between-subjects factorial 2x2x2 ANOVA analysis was performed to examine the main and interaction effects of the BMI classification (obese and normal weight), gender (male and female), and the presence of regular binge eating patterns (with and without) on the five neuropsychological test's scores.

Before starting the 2x2x2 ANOVA analysis, the outliers were detected on the study variables whose effects were examined on the eight groups obtained. The measured values in these groups were standardized, and it was examined whether the standardized values were above 3.29 in absolute value (the z-value of each score).

Values above 3.29 in absolute value were determined as outliers and these values were removed during the analysis phase (Tabachnick and Fidell 2013).

In the outlier analysis, the existence of outliers was examined in all the variables used in the study. Considering these findings, a total of 2 outliers were observed in each of the Stroop3Time (1 in OB-RBE group, and 1 in NW-w/RBE group), WMS-R Reverse Visual Memory Span, and WMS-R Total Visual Memory Span (1 in OB-RBE group, and 1 in NW-w/RBE group for both), and SDMT (2 in NW-w/RBE group) variables. Also, it was observed that there was 1 outlier in each of the WMS-R Reverse Digit Span (in NW-w/RBE group), WMS-R Visual Memory Span (in NW-w/RBE group), REZZY scale (in NW-w/RBE group), and Barratt's Impulsivity Scale (in OB-w/RBE group) variables. Accordingly, a total of 9 values were determined as outliers and these values were removed during the main analysis phase.

For the assumption of normality, it is known that the violation of the normality assumption does not produce significant issues when sample sizes are big enough ($n \geq 30\text{-}40$); this means that we may perform parametric procedures even if the data is not normally distributed (Elliott and Woodward 2007; Field 2013). The central limit theorem, states that normality can be assumed regardless of the shape of the sample data (Lumley et al. 2002), if the sample data is around normal, the distribution of the sample is normal as well (Field 2013). Large samples ($n \geq 30\text{-}40$) have a normal sampling distribution regardless of the form of the data (Elliott and Woodward 2007; Field 2013). Normality assumption is important in small samples, but as mentioned, this assumption is not expected to pose a serious problem in large samples because of the central limit theorem (Field 2013).

Nevertheless, it is stated that if the sample is large enough, it is more important to evaluate the outliers rather than the normal distribution (Field 2013). As stated above, in the dataset where outliers are evaluated and removed, it is seen that the sample size is 30 and above for all four groups. Based on these statements, it was decided that appropriate parametric tests could be used for data analysis.

The margin of error in the evaluation of the hypothesis tests obtained within the scope of the research was determined as 5%.

3.2. DESCRIPTIVE STATISTICS

3.2.1. Demographic Characteristics of the Obese Group with Regular Binge Eating (OB-RBE)

When the demographic findings of the OB-RBE group consisting of 39 people were examined, 51.3% of the individuals were female and 48.7% were male. Their mean age was found to be 27.05 years (*SD* = 5.24), and their mean BMI value was found to be 32.7 (*SD* = 3.6). When the relationship status of the group was examined, 41% of them were married, 46.2% were single, 7.7% were in a relationship/engaged, and 5.1% were widowed/divorced. According to their education level, 2.6% with a secondary school diploma, 10.3% with a high school diploma, 66.7% with a bachelor's degree, 17.9% with a master's degree, and 2.6% with a doctoral degree. On the other hand, the socioeconomic status (SES) of the group was examined, it was determined that 10.3% of them were low level, 17.9% were low-middle level, 43.6% were middle level, and 25.6% were middle-high level, and 2.6% were high level. The frequency analysis results of the demographic findings of the OB-RBE group are shown in Table 10.

Table 10. Demographic Characteristics of the Obese Group with Regular Binge Eating

Variables	*n*	%
Gender		
Female	20	51.3
Male	19	48.7
Age*	27.05±5.24	
BMI Value*	32.7±3.6	
Relationship Status		
Married	16	41.0
Single	18	46.2
In a relationship / Engaged	3	7.7
Widowed / Divorced	2	5.1
Education Level		
Secondary school	1	2.6
High school	4	10.3
University / Bachelor's Degree	26	66.7
Master's Degree	7	17.9
Doctorate / PhD	1	2.6
Socioeconomic Status (SES)		
Low	4	10.3
Low-middle	7	17.9
Middle	17	43.6
Middle-high	10	25.6
High	1	2.6

*Mean±Standard Deviation

3.2.2. Demographic Characteristics of the Obese Group without Regular Binge Eating (OB-w/RBE)

When the demographic findings of the OB-w/RBE group consisting of 38 people were examined, 50% of the individuals were female and 50% were male. Their mean age was found to be 28.03 years (*SD* = 4.68), and their mean BMI value was found to be 31.9 (*SD* = 3.1). When the relationship status of the group was examined, 42.1% of them were married, 50% were single, and 7.9% were in a relationship/engaged. According to their education level, 10.5% with a high school diploma, 81.6% with a bachelor's degree, 5.3% with a master's degree, and 2.6% with a doctoral degree. On the other hand, the socioeconomic status (SES) of the group was examined, 7.9% of them were low level, 10.5% were low-middle level, 36.8% were middle level, and 42.1% were middle-high level, and 2.6% were high level. The frequency analysis results of the demographic findings of the OB-w/RBE group are shown in Table 11.

Table 11. Demographic Characteristics of the Obese Group without Regular Binge Eating

Variables	***n***	**%**
Gender		
Female	19	50.0
Male	19	50.0
Age*	28.03±4.68	
BMI Value	31.9±3.1	
Relationship Status		
Married	16	42.1
Single	19	50.0
In a relationship / Engaged	3	7.9
Education Level		
High school	4	10.5
University / Bachelor's Degree	31	81.6
Master's Degree	2	5.3
Doctorate / PhD	1	2.6
Socioeconomic Status (SES)		
Low	3	7.9
Low-middle	4	10.5
Middle	14	36.8
Middle-high	16	42.1
High	1	2.6

*Mean±Standard Deviation

3.2.3. Demographic Characteristics of the Normal-Weight Group with Regular Binge Eating (NW-RBE)

When the demographic findings of the NW-RBE group consisting of 43 people were examined, 53.5% of the individuals were female and 46.5% were male. Their mean age was found to be 24.72 years (*SD* = 3.24), and their mean BMI value was found to be 22.7 (*SD* = 2.1). When the relationship status of the group was examined, 9.3% of them were married, 65.1% were single, and 25.6% were in a relationship/engaged. According to their education level, 14% with a high school diploma, 81.4% with a bachelor's degree, and 4.7% with a master's degree. On the other hand, the socioeconomic status (SES) of the group was examined, 2.3% of them were low level, 18.6% were low-middle level, 39.5% were middle level, and 32.6% were middle-high level, and 7% were high level. The frequency analysis results of the demographic findings of the NW-RBE group are shown in Table 12.

Table 12. Demographic Characteristics of the Normal-Weight Group with Regular Binge Eating

Variables	***n***	**%**
Gender		
Female	23	53.5
Male	20	46.5
Age*	24.72±3.24	
BMI Value*	22.7±2.1	
Relationship Status		
Married	4	9.3
Single	28	65.1
In a relationship / Engaged	11	25.6
Education Level		
High school	6	14.0
University / Bachelor's Degree	35	81.4
Master's degree	2	4.7
Socioeconomic Status (SES)		
Low	1	2.3
Low-middle	8	18.6
Middle	17	39.5
Middle-high	14	32.6
High	3	7.0

*Mean±Standard Deviation

3.2.4. Demographic Characteristics of the Normal-Weight Group without Regular Binge Eating (NW-w/RBE)

When the demographic findings of the NW-w/RBE group consisting of 56 people were examined, 62.5% of the individuals were female and 37.5% were male. Their mean age was found to be 24.41 years (*SD* = 3.81), and their mean BMI value was found to be 21.3 (*SD* = 1.9). When the relationship status of the group was examined, 10.7% of them were married, 48.2% were single, and 41.1% were in a relationship/engaged. According to their education level, 10.7% with a high school diploma, 78.6% with a bachelor's degree, 8.9% with a master's degree, and 1.8% with a doctoral degree. On the other hand, the socioeconomic status (SES) of the group was examined, 1.8% of them were low, 8.9% were low-middle level, 55.4% were middle level, and 33.9% were middle-high level. The frequency analysis results of the demographic findings of the NW-w/RBE group are shown in Table 13.

Table 13. Demographic Characteristics of the Normal-Weight Group without Regular Binge Eating

Variables	*n*	%
Gender		
Female	35	62.5
Male	21	37.5
Age*	24.41±3.81	
BMI Value	21.3±1.9	
Relationship Status		
Married	6	10.7
Single	27	48.2
In a relationship / Engaged	23	41.1
Education Level		
High school	6	10.7
University / Bachelor's Degree	44	78.6
Master's Degree	5	8.9
Doctorate / PhD	1	1.8
Socioeconomic Status (SES)		
Low	1	1.8
Low-middle	5	8.9
Middle	31	55.4
Middle-high	19	33.9

*Mean±Standard Deviation

3.2.5. Descriptive Features of the Study Variables

The descriptive features of the study variables were analyzed in four different groups (OB-RBE, OB-w/RBE, NW-RBE, NW-w/RBE). The mean (*M*), standard deviation (*SD*), minimum (Min), and maximum (Max) scores of the participants in these groups from the five neuropsychological tests that measure memory (the WMS-R), attention, and executive functions (the PASAT, the Stroop TBAG, the TMT, and the SDMT) are presented in Table 14, Table 15, Table 16, and Table 17, respectively. The scale scores examining the participants' regular binge eating patterns are also presented in the following tables.

Table 14. Study Variables of OB-RBE

OB-RBE Study Variables	*M*	*SD*	Min	Max
Stroop Test TBAG Form*				
1st Trial/Card				
Trial Time (Stroop1TIME)	11.57	3.58	6.28	24.83
Trial Error Scores (Stroop1ERR)	0.03	0.20	0.00	1.00
Trial Correction Scores (Stroop1CORR)	0.00	0.00	0.00	0.00
2nd Trial/Card				
Trial Time (Stroop2TIME)	11.85	3.33	6.41	24.27
Trial Error Scores (Stroop2ERR)	0.64	3.84	0.00	24.00
Trial Correction Scores (Stroop2CORR)	0.1	0.38	0.00	2.00
3rd Trial/Card				
Trial Time (Stroop3TIME)	14.52	5.34	8.97	26.99
Trial Error Scores (Stroop3ERR)	0.13	0.47	0.00	2.00
Trial Correction Scores (Stroop3CORR)	0.26	0.60	0.00	3.00
4th Trial/Card				
Trial Time (Stroop4TIME)	16.62	4.13	8.24	26.90
Trial Error Scores (Stroop4ERR)	1.23	5.36	0.00	24.00
Trial Correction Scores (Stroop4CORR)	0.26	0.50	0.00	2.00
5th Trial/Card				
Trial Time (Stroop5TIME)	22.95	5.03	12.05	35.60
Trial Error Scores (Stroop5ERR)	0.13	0.34	0.00	1.00
Trial Correction Scores (Stroop5CORR)	1.05	1.32	0.00	4.00
WMS-R				
Digit Span Scores	8.46	2.14	3.00	12.00
Reverse Digit Span Scores	7.61	2.1	3.00	11.00
Total Digit Span Scores	16.08	3.48	8.00	23.00
Visual Memory Span Scores	6.67	2.19	0.00	11.00
Reverse Visual Memory Span Scores	5.95	2.11	4.00	9.00
Total Visual Memory Span Scores	12.61	3.79	5.00	20.00
PASAT	27.10	20.76	0.00	59.00
TMT*				
Form A				
Completion Time (FormATIME)	42.80	7.42	26.72	53.66
Error Scores (FormAERR)	1.69	2.65	0.00	10.00
Form B				
Completion Time (FormBTIME)	119.12	16.24	86.30	159.45
Error Scores (FormBERR)	6.00	3.63	0.00	13.00
B-A Time Difference Scores	76.07	11.56	59.20	106.45
SDMT	103.90	9.88	77.00	120.00
EDE-Q Binge Eating Subscale	6.24	3.88	1.33	17.33
REZZY Scale	2.72	0.86	2.00	5.00
TFEQ-R21 Scale				
Uncontrolled Eating (UE) Scores	69.61	24.16	0.00	100.0
Emotional Eating (EE) Scores	65.10	31.37	0.00	100.0
Cognitive Restraint (CR) Scores	31.90	19.06	0.00	66.60
Barratt's Impulsivity Scale				
Total Scores	31.21	6.41	18.00	46.00

M: Mean, *SD*: Standard Deviation, Min: Minimum, Max: Maximum
*Time scores are calculated in seconds.

Table 15. Study Variables of OB-w/RBE

OB-w/RBE Study Variables	*M*	*SD*	Min	Max
Stroop Test TBAG Form*				
1st Trial/Card				
Trial Time (Stroop1TIME)	11.65	2.81	6.35	20.23
Trial Error Scores (Stroop1ERR)	0.00	0.00	0.00	0.00
Trial Correction Scores (Stroop1CORR)	0.03	0.16	0.00	1.00
2nd Trial/Card				
Trial Time (Stroop2TIME)	11.74	2.68	6.81	17.53
Trial Error Scores (Stroop2ERR)	0.66	3.89	0.00	24.00
Trial Correction Scores (Stroop2CORR)	0.05	0.23	0.00	1.00
3rd Trial/Card				
Trial Time (Stroop3TIME)	13.30	3.04	7.66	22.20
Trial Error Scores (Stroop3ERR)	0.03	0.16	0.00	1.00
Trial Correction Scores (Stroop3CORR)	0.26	0.83	0.00	3.00
4th Trial/Card				
Trial Time (Stroop4TIME)	14.76	2.87	9.82	20.42
Trial Error Scores (Stroop4ERR)	0.66	3.89	0.00	24.00
Trial Correction Scores (Stroop4CORR)	0.18	0.46	0.00	2.00
5th Trial/Card				
Trial Time (Stroop5TIME)	20.24	4.71	10.28	32.22
Trial Error Scores (Stroop5ERR)	0.79	3.90	0.00	24.00
Trial Correction Scores (Stroop5CORR)	0.66	0.67	0.00	2.00
WMS-R				
Digit Span Scores	9.18	2.13	4.00	12.00
Reverse Digit Span Scores	7.97	2.48	0.00	12.00
Total Digit Span Scores	17.16	3.89	10.00	24.00
Visual Memory Span Scores	8.55	2.00	4.00	12.00
Reverse Visual Memory Span Scores	6.39	2.90	3.00	11.00
Total Visual Memory Span Scores	14.95	4.13	7.00	23.00
PASAT	30.18	18.55	0.00	60.00
TMT*				
Form A				
Completion Time (FormATIME)	39.56	6.28	18.15	51.55
Error Scores (FormAERR)	1.05	1.94	0.00	9.00
Form B				
Completion Time (FormBTIME)	114.74	11.63	92.60	134.70
Error Scores (FormBERR)	3.57	3.64	0.00	15.00
B-A Time Difference Scores	75.04	7.59	63.24	93.00
SDMT	111.50	10.23	72.00	120.00
EDE-Q Binge Eating Subscale	0.62	0.55	0.00	2.00
REZZY Scale	2.13	0.34	2.00	3.00
TFEQ-R21 Scale				
Uncontrolled Eating (UE) Scores	43.66	22.50	11.11	88.88
Emotional Eating (EE) Scores	44.29	29.47	0.00	100.00
Cognitive Restraint (CR) Scores	38.01	22.80	0.00	88.88
Barratt's Impulsivity Scale				
Total Scores	26.95	7.32	17.00	44.00

M: Mean, *SD:* Standard Deviation, Min: Minimum, Max: Maximum
*Time scores are calculated in seconds.

Table 16. Study Variables of NW-RBE

NW-RBE Study Variables	*M*	*SD*	Min	Max
Stroop Test TBAG Form*				
1st Trial/Card				
Trial Time (Stroop1TIME)	10.18	3.46	6.00	21.20
Trial Error Scores (Stroop1ERR)	0.00	0.00	0.00	0.00
Trial Correction Scores (Stroop1CORR)	0.00	0.00	0.00	0.00
2nd Trial/Card				
Trial Time (Stroop2TIME)	10.42	2.91	6.22	16.84
Trial Error Scores (Stroop2ERR)	0.00	0.00	0.00	0.00
Trial Correction Scores (Stroop2CORR)	0.07	0.34	0.00	2.00
3rd Trial/Card				
Trial Time (Stroop3TIME)	11.43	2.02	7.35	18.11
Trial Error Scores (Stroop3ERR)	0.00	0.00	0.00	0.00
Trial Correction Scores (Stroop3CORR)	0.05	0.21	0.00	1.00
4th Trial/Card				
Trial Time (Stroop4TIME)	13.04	2.93	7.40	20.88
Trial Error Scores (Stroop4ERR)	3.35	8.41	0.00	24.00
Trial Correction Scores (Stroop4CORR)	0.12	0.32	0.00	1.00
5th Trial/Card				
Trial Time (Stroop5TIME)	18.95	4.48	10.48	30.49
Trial Error Scores (Stroop5ERR)	0.35	1.41	0.00	9.00
Trial Correction Scores (Stroop5CORR)	0.67	0.90	0.00	4.00
WMS-R				
Digit Span Scores	8.44	2.48	4.00	12.00
Reverse Digit Span Scores	8.28	2.55	2.00	12.00
Total Digit Span Scores	16.72	4.52	6.00	24.00
Visual Memory Span Scores	8.33	2.72	0.00	12.00
Reverse Visual Memory Span Scores	7.17	2.83	2.00	12.00
Total Visual Memory Span Scores	15.51	5.10	2.00	24.00
PASAT	35.28	22.97	0.00	60.00
TMT*				
Form A				
Completion Time (FormATIME)	34.56	4.98	25.85	45.40
Error Scores (FormAERR)	0.37	1.02	0.00	5.00
Form B				
Completion Time (FormBTIME)	68.63	8.15	51.16	84.00
Error Scores (FormBERR)	3.60	4.01	0.00	19.00
B-A Time Difference Scores	33.90	7.88	14.42	55.20
SDMT	115.93	5.35	100.00	120.00
EDE-Q Binge Eating Subscale	3.99	2.78	1.67	11.67
REZZY Scale	1.70	1.17	0.00	4.00
TFEQ-R21 Scale				
Uncontrolled Eating (UE) Scores	52.36	22.68	3.70	100.00
Emotional Eating (EE) Scores	48.06	26.14	0.00	100.00
Cognitive Restraint (CR) Scores	42.09	22.27	0.00	94.44
Barratt's Impulsivity Scale				
Total Scores	29.21	5.61	18.00	39.00

M: Mean, *SD*: Standard Deviation, Min: Minimum, Max: Maximum
*Time scores are calculated in seconds.

Table 17. Study Variables of NW-w/RBE

NW-w/RBE Study Variables	*M*	*SD*	Min	Max
Stroop Test TBAG Form*				
1st Trial/Card				
Trial Time (Stroop1TIME)	9.69	2.36	5.37	17.17
Trial Error Scores (Stroop1ERR)	0.00	0.00	0.00	0.00
Trial Correction Scores (Stroop1CORR)	0.02	0.13	0.00	1.00
2nd Trial/Card				
Trial Time (Stroop2TIME)	9.93	2.46	5.90	17.16
Trial Error Scores (Stroop2ERR)	0.00	0.00	0.00	0.00
Trial Correction Scores (Stroop2CORR)	0.00	0.00	0.00	0.00
3rd Trial/Card				
Trial Time (Stroop3TIME)	11.59	1.88	7.66	16.18
Trial Error Scores (Stroop3ERR)	0.04	0.27	0.00	2.00
Trial Correction Scores (Stroop3CORR)	0.14	0.35	0.00	1.00
4th Trial/Card				
Trial Time (Stroop4TIME)	12.37	2.88	6.24	21.71
Trial Error Scores (Stroop4ERR)	3.00	8.01	0.00	24.00
Trial Correction Scores (Stroop4CORR)	0.09	0.29	0.00	1.00
5th Trial/Card				
Trial Time (Stroop5TIME)	18.78	4.88	10.48	34.51
Trial Error Scores (Stroop5ERR)	0.30	1.39	0.00	10.00
Trial Correction Scores (Stroop5CORR)	0.52	0.79	0.00	3.00
WMS-R				
Digit Span Scores	8.55	2.21	0.00	12.00
Reverse Digit Span Scores	8.73	2.42	5.00	12.00
Total Digit Span Scores	17.29	3.92	9.00	24.00
Visual Memory Span Scores	8.40	2.32	0.00	12.00
Reverse Visual Memory Span Scores	7.41	2.22	3.00	12.00
Total Visual Memory Span Scores	15.80	3.78	3.00	23.00
PASAT	37.46	22.27	0.00	60.00
TMT*				
Form A				
Completion Time (FormATIME)	32.14	5.03	20.72	45.10
Error Scores (FormAERR)	0.52	1.98	0.00	14.00
Form B				
Completion Time (FormBTIME)	66.20	6.62	51.54	81.50
Error Scores (FormBERR)	4.45	3.87	0.00	15.00
B-A Time Difference Scores	33.84	5.20	24.18	41.57
SDMT	113.96	16.32	102.00	120.00
EDE-Q Binge Eating Subscale	0.24	0.33	0.00	1.17
REZZY Scale	0.45	0.66	0.00	2.00
TFEQ-R21 Scale				
Uncontrolled Eating (UE) Scores	31.54	16.01	0.00	66.66
Emotional Eating (EE) Scores	28.87	21.82	0.00	94.44
Cognitive Restraint (CR) Scores	33.63	23.48	0.00	83.33
Barratt's Impulsivity Scale				
Total Scores	26.91	5.21	18.00	41.00

M: Mean, *SD*: Standard Deviation, Min: Minimum, Max: Maximum
*Time scores are calculated in seconds.

3.2.6. Findings Regarding Mean Comparisons Between Groups

The eight groups obtained through the variables of BMI classification (obese and normal weight), gender (male and female), and the presence of RBE (with and without) were examined in terms of whether they differ according to demographic characteristics such as age, education level and socioeconomic status (SES). Mean comparisons in more than two groups were made with one-way ANOVA. The difference between the groups was determined by the post hoc Tukey test. *p* values less than .05 were considered statistically significant in all mean comparison tests.

There was no statistically significant difference between the education level and SES of the groups obtained according to the variables of BMI classification, gender, and the presence of RBE (p >.05 for all of them). On the other hand, when the Kruskal Wallis-H test results of the eight groups are examined, it is seen that there is a statistically significant difference between the age of the individuals ($F(1,168) = 2.40$, $p < .05$, $\eta_p^2 = .090$). According to the post hoc Tukey test, the age of normal-weight men without RBE ($M = 24.18$, $SD = 3.32$) is higher than obese men with RBE ($M = 22.84$, $SD = 4.21$).

3.3. RESULTS OF PACED AUDITORY SERIAL ADDITION TEST (PASAT)

To compare the effects of BMI classification (obese and normal weight), gender (male and female), and the presence of RBE (with and without), a 2x2x2 ANOVA was performed on the PASAT scores.

The results of ANOVA analysis revealed a significant main effect of BMI on the PASAT scores ($F(1,168) = 4.64$, $p < .05$, $\eta_p^2 = .027$), reflecting higher scores for normal-weight individuals ($M = 36.51$, $SD = 22.48$) as compared to obese individuals ($M = 28.62$, $SD = 19.63$) out of a maximum 60 points. No main effect of gender and the presence of RBE was found, $F(1,168) = .002$, $p > .05$, and $F(1,168) = .34$, $p > .05$, respectively. Besides, all interaction effects did not yield a significant result, $F(1,168) \leq 2.20$, $p > .05$.

Therefore, Hypothesis 1a, which suggested that obese groups would have slower information processing speed than normal weight groups, was fully supported. Hypothesis 1b, which suggested that there would be no significant difference in the information processing speed between the groups with RBE and without RBE groups, was supported only for PASAT scores, which evaluate auditory information processing speed.

3.4. RESULTS OF SYMBOL DIGIT MODALITIES TEST (SDMT)

To compare the effects of BMI classification (obese and normal weight), gender (male and female), and the presence of RBE (with and without), a 2x2x2 ANOVA was performed on the SDMT scores.

The results of ANOVA analysis revealed that there was a main effect of BMI on total score, $F(1,166) = 51.18$, $p < .01$, $\eta_p^2 = .236$, indicating higher score for normal-weight individuals ($M = 116.23$, $SD = 5.1$) than obese individuals ($M = 107.65$, $SD = 10.7$). The main effect of gender on total score was not significant, $F(1,166) = 1.36$, $p > .05$. RBE had a main effect on total score ($F(1,166) = 11.49$, $p < .01$, $\eta_p^2 = .065$), reflecting higher score for individuals without RBE ($M = 114.41$, $SD = 7.9$) compared to individuals with RBE ($M = 110.21$, $SD = 9.8$).

Results for BMI and gender factorial ANOVA indicated a significant two-way interaction on total score, $F(1,166) = 11.71$, $p < .01$, $\eta_p^2 = .066$. Simple main effect analysis showed that BMI had a statistically significant effect on the SDMT scores in females, $F(1,172) = 24.01$, $p < .01$. Obese women ($M = 105$, $SD = 1.87$) had lower scores than normal-weight women ($M = 116.86$, $SD = 1.53$). There was also an interaction effect between BMI and RBE, $F(1,166) = 9.98$, $p < .01$, $\eta_p^2 = .057$. Simple main effect analysis showed that BMI had a statistically significant effect on the SDMT scores in individuals with RBE, $F(1,172) = 21.73$, $p < .01$. Normal-weight individuals with RBE ($M = 115.93$, $SD = 5.35$) had higher scores than obese individuals with RBE ($M = 103.9$, $SD = 9.88$). All other interaction effects did not yield a significant result, $F(1,166) \leq .62$, $p > .05$. The interaction effect between BMI and gender, and BMI and RBE are presented in Figure 12 and Figure 13, respectively.

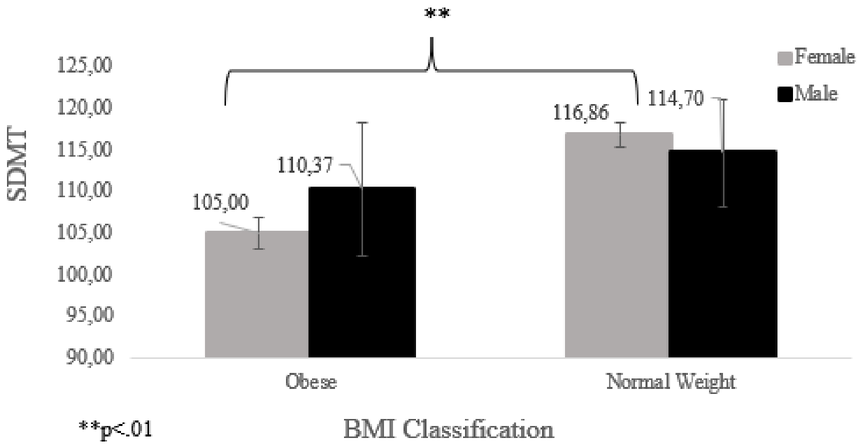

Figure 12. The Interaction Effect between BMI and Gender on the SDMT Scores (To show the significant results, the asterisk is used).

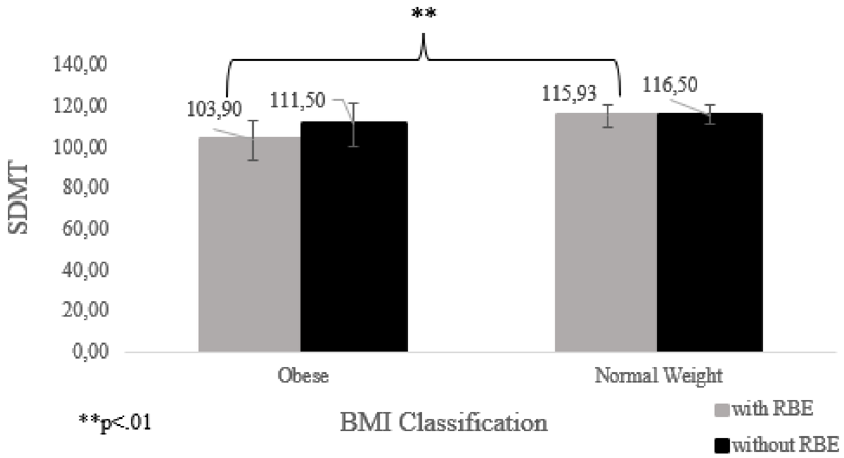

Figure 13. The Interaction Effect between BMI and RBE on the SDMT Scores (To show the significant results, the asterisk is used).

Therefore, Hypothesis 1a, which suggested that obese groups would have slower information processing speed than normal weight groups, was fully supported. Also, Hypothesis 1b, which suggested that there would be no significant difference in the information processing speed between the groups with and without regular binge eating, was partially supported. As mentioned before, PASAT scores, which evaluate auditory information processing speed, supported the hypothesis. However, SDMT scores, which evaluate visual-spatial information processing speed, did not support it.

3.5. RESULTS OF THE STROOP TEST TBAG FORM/VERSION

To compare the effects of BMI classification (obese and normal weight), gender (male and female), and the presence of RBE (with and without), a 2x2x2

ANOVA was performed on the Stroop Test TBAG Version subtest scores regarding completion time.

The results of ANOVA analysis revealed a significant main effect of BMI classification on the Stroop Task 1's completion time ($F(1,168) = 13.81$, $p < .01$, $\eta_p^2 = .076$), reflecting longer completion time for obese individuals ($M = 11.60$, $SD = 3.20$) as compared to normal weight individuals ($M = 9.90$, $SD = 2.88$). Also, gender had a main effect on the Stroop Task 1's completion time ($F(1,168) = 9.40$, $p < .05$, $\eta_p^2 = .053$), reflecting the longer completion times of females ($M = 11.12$, $SD = 3.55$) compared to males ($M = 10.07$, $SD = 2.44$). There was no main effect of RBE on the Stroop Task 1's completion time, $F(1,168) = .056$, $p > .05$. All interactions effects did not yield a significant result, $F(1,168) \leq .62$, $p > .05$. However, there was a significant 3-way interaction effect between BMI, gender, and RBE on the Stroop Task 1's completion time, $F(1,168) = 9.24$, $p < .05$, $\eta_p^2 = .052$.

Simple main effects analysis showed that BMI had a statistically significant effect without RBE on the completion time of Stroop Task 1 in females, $F(1,96) = 17.26$, $p < .01$. Obese women without RBE ($M = 13.08$, $SD = 2.52$) had a significantly longer completion time of Stroop Task 1 than normal-weight women without RBE ($M = 9.39$, $SD = 2.52$). For males, simple main effects analysis showed that BMI had a statistically significant effect with RBE on the completion time of Stroop Task 1, $F(1,78) = 9.97$, $p < .05$. Obese men with RBE ($M = 11.15$, $SD = 2.91$) had a significantly longer completion time for Stroop Task 1 than normal weight men with RBE ($M = 8.80$, $SD = 2.01$), The interaction effect on the Stroop Task 1's completion time for females and males is presented in Figure 14, respectively.

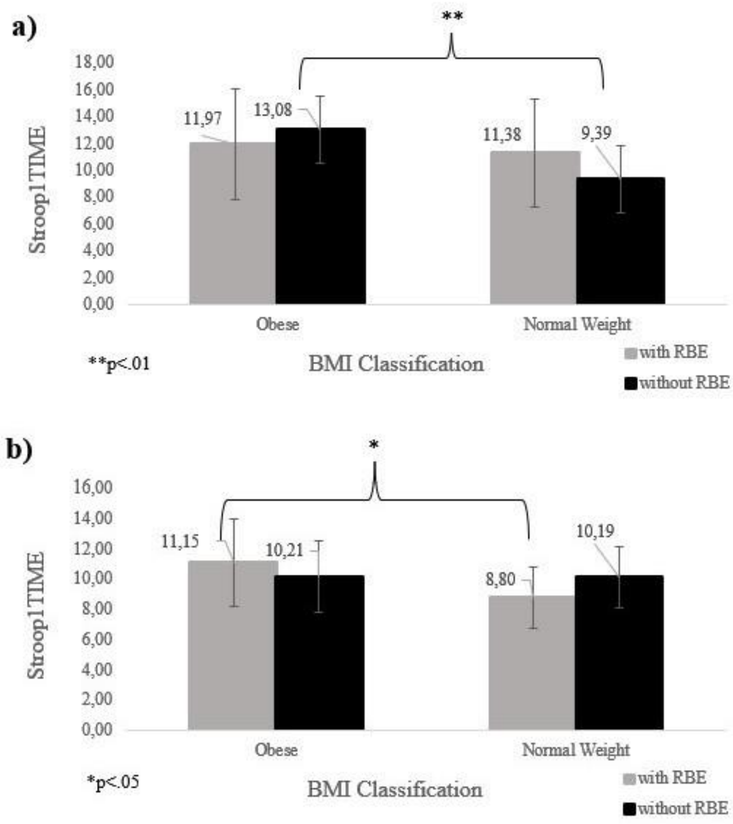

Figure 14. The Interaction Effect on the Stroop Task 1's Completion Time.
a) Females graph, b) Males graph (To show the significant results, the asterisk is used.)

The findings of the ANOVA analysis indicated a significant main effect of BMI on the Stroop Task 2's completion time (F(1,168) = 15.22, $p < .01$, $\eta_p^2 = .083$), showing that obese people took much longer to complete the task (M = 11.80, SD = 3) than those of normal weight (M = 10.14, SD = 2.66). Gender also had a main effect on the completion time of the Stroop Task 2 (F(1,168) = 9.97, $p < .05$, $\eta_p^2 = .056$), with females taking longer (M = 11.32, SD = 3.34) than males (M = 10.31, SD = 2.22). There was no main effect of RBE on the Stroop Task 2's completion time, F(1,168) = .33, $p > .05$. All interaction effects did not yield a significant result, F(1,168) ≤ 1.82, $p > .05$. However, there was a significant 3-way interaction effect between BMI, gender, and RBE on the Stroop Task 2's completion time, F(1,168)= 8.64, $p < .05$, $\eta_p^2 = .049$.

According to simple main effects analysis, BMI had a statistically significant effect without RBE on the completion time of Stroop Task 2 in females, F(1,96) = 17.43, $p < .01$. Stroop Task 2 took substantially longer for obese women without RBE (M = 13.33, SD = 2.07) than normal-weight women without RBE (M = 9.78, SD =

2.77). Simple main effects analysis revealed that BMI had a statistically significant effect with RBE on the completion time of Stroop Task 2 for males, $F(1,78) = 9.91$, $p < .05$. Obese men with RBE ($M = 11.55$, $SD = 2.45$) took substantially longer to complete Stroop Task 2 than normal-weight men with RBE ($M = 9.41$, $SD = 1.91$). In addition, simple main effects analysis showed that RBE had a statistically significant effect on obese class BMI on the completion time of Stroop Task 2, $F(1,78) = 3.91$, $p < .05$. Obese men with RBE ($M = 11.55$, $SD = 2.45$) had a significantly longer completion time of Stroop Task 2 than obese men without RBE ($M = 10.15$, $SD = 2.26$). The interaction effect on the Stroop Task 2's completion time for females and males is presented in Figure 15, respectively.

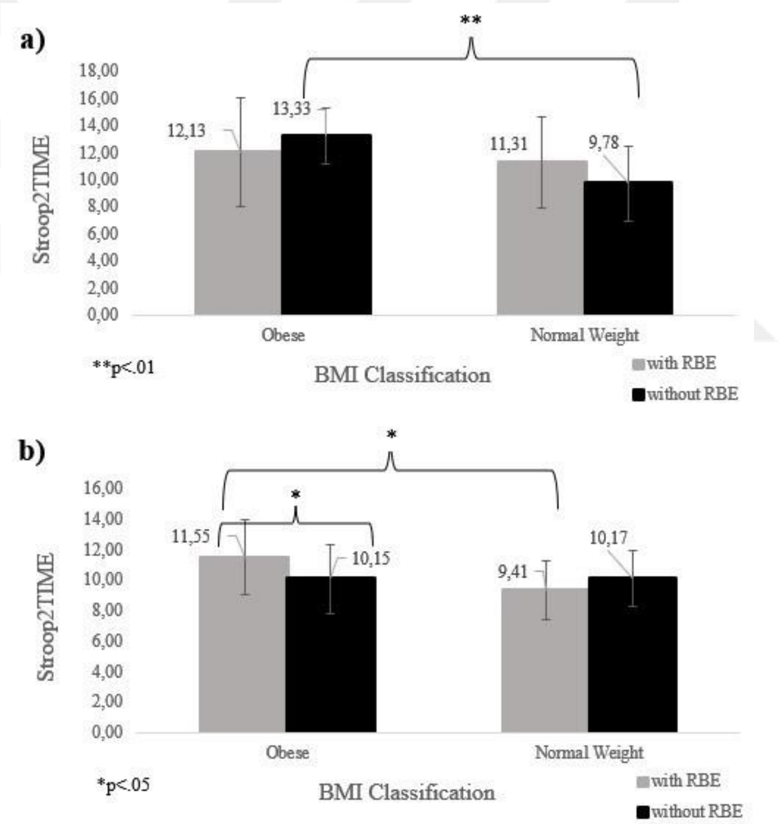

Figure 15. The Interaction Effect on the Stroop Task 2's Completion Time.
a) Females graph, b) Males graph (To show the significant results, the asterisk is used.)

The results of ANOVA analysis revealed a significant main effect of BMI on the Stroop Task 3's completion time ($F(1,166) = 31.37$, $p < .01$, $\eta_p{}^2 = .159$), reflecting longer completion time for obese individuals ($M = 13.59$, $SD = 3.33$) as compared to normal weight individuals ($M = 11.44$, $SD = 1.80$). Also, gender had a main effect on the Stroop Task 3's completion time (F(1,166)= 11.76, p < .01, η_p^2= .066), reflecting the longer completion times of females (M = 12.84, SD = 2.98) compared to males (M = 11.82, SD = 2.43). There was no main effect of RBE on the Stroop Task 3's completion time, F(1,166) = .45, p > .05. All interactions effects did not yield a significant result, F(1,166) ≤ 2.79, p > .05.

The findings of the ANOVA analysis indicated a significant main effect of BMI classification on the Stroop Task 4's completion time (F(1,168) = 37.51, p < .01, η_p^2= .183), showing that obese people took much longer to complete the task (M = 15.70, SD = 3.66) than those of normal weight (M = 12.66, SD = 2.90). There were no main effects of gender on the Stroop Task 4's completion time, F(1,168) = .39, p > .05. RBE had a main effect on the completion time of the Stroop Task 4 (F(1,168) = 6.17, p < .05, η_p^2= .035), reflecting longer completion time for individuals with RBE (M = 14.74, SD = 3.96) than the individuals without RBE (M = 13.34, SD = 3.09). All interaction effects did not yield a significant result, F(1,168) ≤ 1.85, p > .05. However, there was a significant 3-way interaction effect between BMI, gender, and RBE on the Stroop Task 4's completion time, F(1,168) = 6.85, p < .05, η_p^2= .039.

According to simple main effects analysis, BMI had a statistically significant effect without RBE on the completion time of Stroop Task 4 in females, F(1,96) = 17.21, p < .01. Stroop Task 4 took substantially longer for obese women without RBE (M = 15.55, SD = 2.53) than normal-weight women without RBE (M = 12.19, SD = 2.70). Also, the analysis showed that RBE had a statistically significant effect with normal weight class BMI on the completion time of Stroop Task 4 in females, F(1,96) = 59.94, p < .05. Normal weight women with RBE (M = 13.78, SD = 2.86) had a significantly longer completion time for Stroop Task 4 than normal weight women without RBE (M = 12.19, SD = 2.70). For males, simple main effects analysis showed that BMI had a statistically significant effect with RBE on the completion time of Stroop Task 4, F(1,78) = 23.40, p < .01. Obese men with RBE (M = 17.37, SD = 3.87) had a significantly longer completion time of Stroop Task 4 than normal-weight men with RBE (M = 12.19, SD = 2.85), The analysis also showed that RBE had a statistically significant effect with obese class BMI on the completion time of Stroop Task 4 in males, F(1,78) = 8.31, p <.05. Obese men with RBE (M = 17.37, SD = 3.87) had a significantly longer completion time of Stroop Task 4 than obese men without

RBE (*M* = 13.97, *SD* = 3.04). The interaction effect on the Stroop Task 4's completion time for females and males is presented in Figure 16, respectively.

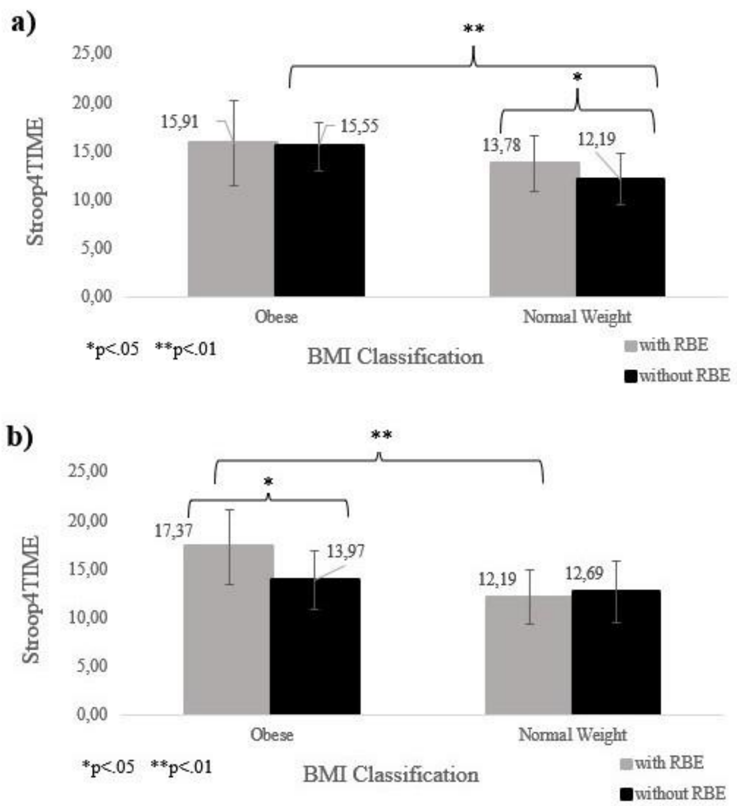

Figure 16. The Interaction Effect on the Stroop Task 4's Completion Time.
a) Females graph, b) Males graph (To show the significant results, the asterisk is used.)

The results of ANOVA analysis revealed a significant main effect of BMI on the Stroop Task 5's completion time ($F(1,168) = 15.25$, $p < .01$, $\eta_p{}^2 = .083$), reflecting longer completion time for obese individuals (*M* = 21.61, *SD* = 5.03) as compared to normal weight individuals (*M* = 18.85, *SD* = 4.68). There were no main effects of gender and RBE on the Stroop Task 5's completion time, $F(1,168) = .42$, $p > .05$, and $F(1,168) = 3.8$, $p > .05$, respectively. All interaction effects did not yield a significant result. However, there was a significant 3-way interaction effect between BMI, gender, and RBE on the Stroop Task 5's completion time, $F(1,168) = 7.45$, $p < .05$, $\eta_p{}^2 = .042$.

According to simple main effects analysis, BMI had a statistically significant effect without RBE on the completion time of Stroop Task 5 in females, $F(1,96) = 79.62$, $p < .05$. Stroop Task 5 took substantially longer for obese women without RBE (*M* = 21.01, *SD* = 4.89) than normal-weight women without RBE (*M* = 18.81, *SD* =

5.40). For males, simple main effects analysis showed that BMI had a statistically significant effect with RBE on the completion time of Stroop Task 5, $F(1,78) = 25.01$, $p < .01$. Obese men with RBE ($M = 24.54$, $SD = 5.71$) had a significantly longer completion time of Stroop Task 5 than normal-weight men with RBE ($M = 17.17$, $SD = 3.66$), The simple main effects analysis also showed that RBE had a statistically significant effect with obese class BMI on the completion time of Stroop Task 5 in males, $F(1,78) = 10$, $p < .01$. Obese men with RBE ($M = 24.54$, $SD = 5.71$) had a significantly longer completion time of Stroop Task 5 than obese men without RBE ($M = 19.47$, $SD = 4.53$). The interaction effect on the Stroop Task 5's completion time for females and males is presented in Figure 17, respectively.

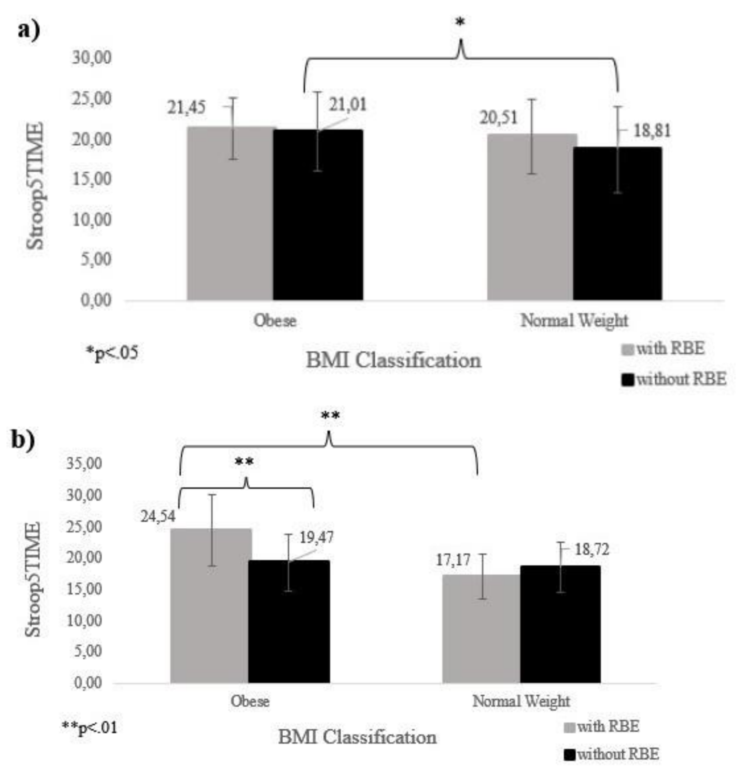

Figure 17. The Interaction Effect on the Stroop Task 5's Completion Time.
a) Females graph, b) Males graph (To show the significant results, the asterisk is used.)

Therefore, Hypothesis 2a, which suggested that obese groups would exhibit poorer attention task performances than normal-weight groups, was fully supported. However, Hypothesis 2b, which suggested that there would be no significant difference in attention task performances between groups with and without RBE, was not supported. In the current study, it was found that there was a significant difference between the two groups in all tasks except Stroop Task 3. Besides, Hypothesis 3, which suggested that individuals without RBE would have better attention and inhibitory control performance than individuals with RBE, regardless of gender, was partially supported. In Stroop Task 4 and Task 5, which are predicted inhibitory control, it was supported only for Stroop Task 4, and for Task 5, it was supported regarding gender.

3.6. RESULTS OF THE WECHSLER MEMORY SCALE-REVISED (WMS-R)

To compare the effects of BMI classification (obese and normal weight), gender (male and female), and the presence of RBE (with and without), a 2x2x2 ANOVA was performed on the Wechsler Memory Scale-Revised subtest scores. Only the Information and Orientation Questions, Digit Span, and Visual Memory Span subtests of the WMS-R battery were used in the current study. Information and Orientation Questions were used to pre-evaluate the current mental state of the participant, and the results were not included in the analysis, as in the administration of the test. Digit Span and Visual Memory Span subtests were included in the analysis.

3.6.1. WMS-R Digit Span Subtest Scores

The results of the ANOVA analysis did not find any significant main effects and interaction effects for WMS-R Digit Span, $F(1,168) \leq 1.52$, $p > .05$. However, there was a significant 3-way interaction effect between BMI, gender, and RBE on the WMS-R Digit Span scores, $F(1,168) = 8.48$, $p < .05$, $\eta_p^2 = .048$.

According to simple main effects analysis, RBE had a statistically significant effect with normal weight class BMI on the digit span scores in females, $F(1,96) = 3.51$, $p < .05$. Out of a maximum of 12 points, normal-weight females without RBE ($M = 9.06$, $SD = 1.95$) had higher scores than normal-weight females with RBE ($M = 7.87$, $SD = 2.58$). For males, simple main effects analysis showed that BMI had a statistically significant effect without RBE on the digit span scores, $F(1,78) = 5.23$, $p < .05$. Out of a maximum of 12 points, obese men without RBE ($M = 9.32$, $SD = 1.89$) had higher scores than normal-weight men with RBE ($M = 7.71$, $SD = 2.39$). The simple main effects analysis also showed that RBE had a statistically significant effect with obese and normal weight BMI classes on the digit span in males, $F(1,78) = 3.91$, $p < .05$, and $F(1,78) = 4.04$, $p < .05$, respectively. Out of a maximum of 12 points, obese men without RBE ($M = 9.32$, $SD = 1.89$) had higher scores than obese men with RBE ($M = 7.89$, $SD = 2.33$), and normal-weight men with RBE ($M = 9.10$, $SD = 2.24$)

had higher scores than normal weight men without RBE (*M* = 7.71, *SD* = 2.39). The interaction effect on the WMS-R's Digit Span subtest scores for females and males is presented in Figure 18, respectively.

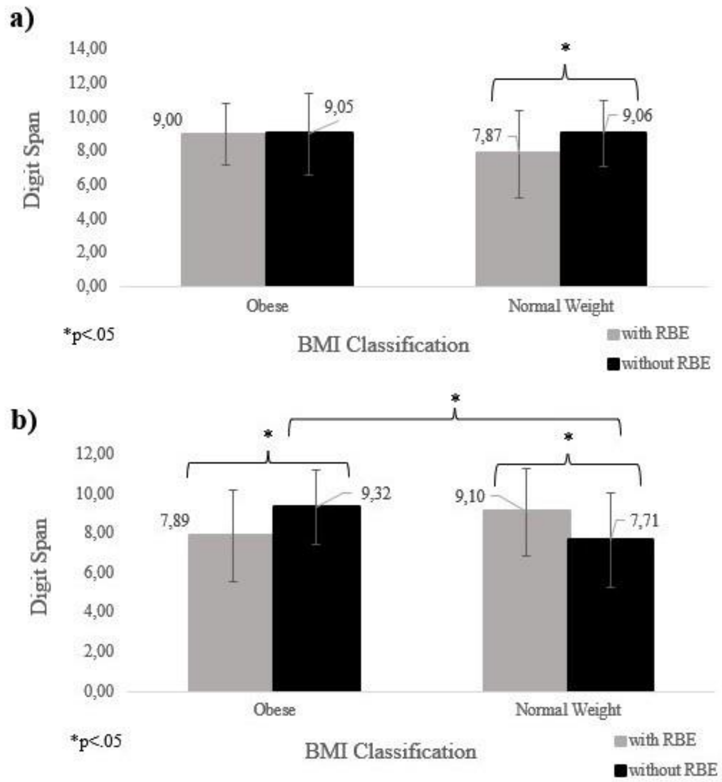

Figure 18. The Interaction Effect on the WMS-R Digit Span Subtest Scores.
a) Females graph, b) Males graph (To show the significant results, the asterisk is used.)

The results of ANOVA analysis revealed a significant main effect of BMI on the WMS-R Reverse Digit Span scores ($F(1,167) = 4.88$, $p < .05$, $\eta_p^2 = .028$), reflecting higher scores for normal-weight individuals (*M* = 8.62, *SD* = 2.33) as compared to obese individuals (*M* = 7.79, *SD* = 2.28) out of a maximum 12 points. All other main and interaction effects did not yield a significant result, $F(1,167) \leq 2.96$, $p > .05$.

The results of the ANOVA analysis did not find any significant main effects and interaction effects for WMS-R Total Digit Span scores, $F(1,168) \leq 1.48$, $p > .05$. However, there was a significant 3-way interaction effect between BMI, gender, and RBE on the total digit span scores, $F(1,168) = 6.44$, $p < .05$, $\eta_p^2 = .037$.

According to simple main effects analysis, RBE had a statistically significant effect with normal weight class BMI on the total digit span scores in females, $F(1,96) = 5.58$, $p < .05$. Out of a maximum of 24 points, normal-weight women without RBE

(M = 17.94, SD = 3.97) had higher scores than normal-weight women with RBE (M = 15.43, SD = 4.36). For males, simple main effects analysis showed that BMI had a statistically significant effect without RBE on the total digit span scores, $F(1,78) = 5.28$, $p < .05$. Out of a maximum of 24 points, normal-weight men with RBE (M = 18.20, SD = 4.34) had higher scores than obese men with RBE (M = 15.37, SD = 3.88). The interaction effect on the WMS-R's Total Digit Span scores for females and males is presented in Figure 19, respectively.

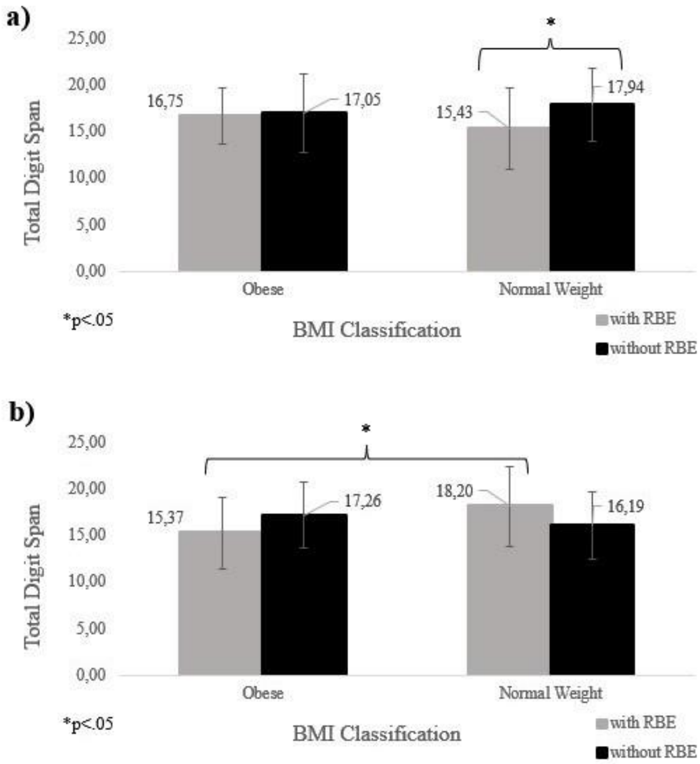

Figure 19. The Interaction Effect on the WMS-R Total Digit Span Scores.
a) Females graph, b) Males graph (To show the significant results, the asterisk is used.)

3.6.2. WMS-R Visual Memory Span Subtest Scores

The results of ANOVA analysis revealed a significant main effect of BMI on the WMS-R Visual Memory Span scores ($F(1,167) = 6.37$, $p < .05$, $\eta_p^2 = .037$), reflecting higher scores for normal weight individuals (M = 8.45, SD = 2.36) as compared to obese individuals (M = 7.60, SD = 2.29) out of a maximum 12 points. There was no significant main effect of gender on the WMS-R Visual Memory Span scores, $F(1,167) \leq 3.56$, $p > .05$. RBE had a main effect on the WMS-R Visual Memory Span scores ($F(1,167) = 9.31$, $p < .01$, $\eta_p^2 = .053$), reflecting the higher scores for individuals without RBE (*M* = 8.55, *SD* = 2.01) compared to individuals with RBE (*M* = 7.54, *SD* = 2.61) out of a maximum 12 points. However, results for the interaction effect between BMI and RBE factorial ANOVA indicated a significant two-way interaction on visual memory span scores, ($F(1,167) = 6.83$, $p < .05$, $\eta_p^2 = .039$). Simple main effect analysis showed that BMI had a statistically significant effect on the WMS-R Visual Memory Span scores on individuals with RBE, $F(1,96) = 4.04$, $p < .05$. Normal-weight individuals with RBE (*M* = 8.33, *SD* = 2.72) had higher scores than obese individuals with RBE (*M* = 6.67, *SD* = 2.19). The other two-way interaction effects did not yield a significant result, $F(1,166) \leq 1.11$, $p > .05$. The interaction effect between BMI and RBE on the WMS-R Visual Memory Span scores is presented in Figure 20.

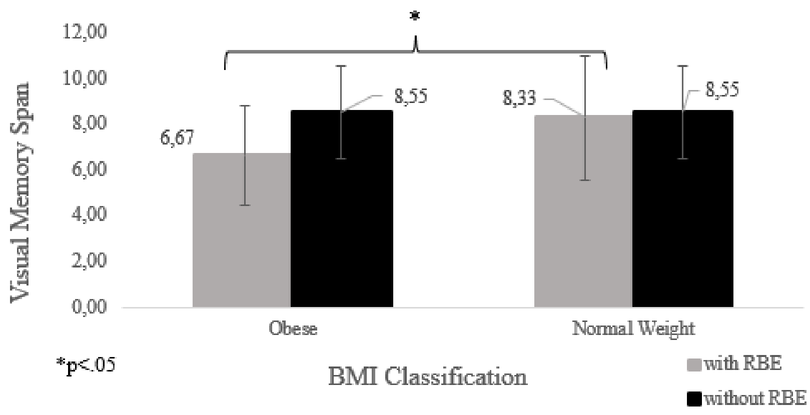

Figure 20. The Interaction Effect between BMI and RBE on the WMS-R Visual Memory Span Scores. (To show the significant results, the asterisk is used.)

Also, there was a significant 3-way interaction effect between BMI, gender, and RBE on the WMS-R Visual Memory Span scores, $F(1,167) = 12.22$, $p < .01$, $\eta_p^2 = .068$. For females, there is no significant interaction effect on the visual memory span scores. For males, simple main effects analysis showed that BMI had a statistically significant effect with RBE on the visual memory span scores, $F(1,78) = 13.53$, $p < .01$. Out of a maximum of 12 points, normal-weight men with RBE (*M* = 9.10, *SD* = 2.92) had higher scores than obese men with RBE (*M* = 6.21, *SD* = 2.02). The simple main effects analysis also showed that RBE had a statistically significant effect with obese BMI class on the visual memory span in males, $F(1,78) = 20$, $p < .01$. Out of a maximum of 12 points, obese men without RBE (*M* = 9.63, *SD* = 1.42) had higher scores than obese men with RBE (M = 6.21, SD = 2.02). The interaction effect on the WMS-R Visual Memory Span scores for males is presented in Figure 21.

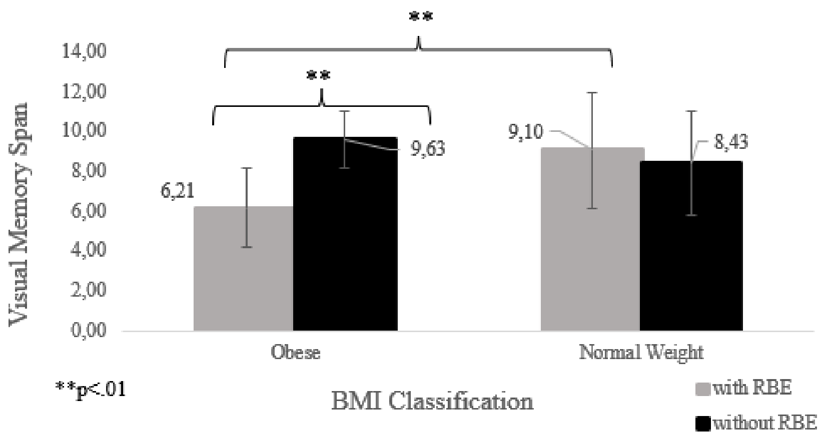

Figure 21. The Interaction Effect on the WMS-R Visual Memory Span Scores for Males. (To show the significant results, the asterisk is used.)

The results of ANOVA analysis revealed a significant main effect of BMI on the WMS-R Reverse Visual Memory Span scores ($F(1,166) = 9.66$, $p < .01$, $\eta_p^2 = .055$), reflecting higher scores for normal-weight individuals (M = 7.39, SD = 2.39) as compared to obese individuals (M = 6.25, SD = 2.43) out of a maximum 12 points. There was no significant main effect of gender and RBE, $F(1,166) = 3.16$, $p > .05$ and, $F(1,166) \leq .74$, $p > .05$, respectively. Also, the interaction effects did not yield statistically significant results on the WMS-R Reverse Visual Memory Span scores, $F(1,166) \leq 1.76$, $p > .05$. There was a significant 3-way interaction effect between BMI, gender, and RBE on the WMS-R Reverse Visual Memory Span scores, $F(1,166) = 6.13$, $p < .05$, $\eta_p^2 = .036$.

According to simple main effects analysis, BMI had a statistically significant effect without RBE on the reverse visual memory span scores in females, $F(1,96) = 10.39$, $p < .01$. Out of a maximum of 12 points, normal-weight women without RBE (M = 7.50, SD = 1.50) had higher scores than obese women without RBE (M = 5.32, SD = 2). For males, simple main effects analysis showed that BMI had a statistically significant effect with RBE on the reverse visual memory span scores, $F(1,78) = 4.35$, $p < .05$. Out of a maximum of 12 points, normal-weight men with RBE (M = 7.70, SD = 2.87) had higher scores than obese men with RBE (M = 5.79, SD = 2.42). The simple main effects analysis also showed that RBE had a statistically significant effect with obese BMI class on the visual memory span in males, $F(1,78) = 3.33$, $p < .05$. Out of a maximum of 12 points, obese men without RBE (*M* = 7.47, *SD* = 3.27) had higher scores than obese men with RBE (*M* = 5.79, *SD* = 2.42). The interaction effect on the WMS-R's Reverse Visual Memory Span scores for females and males is presented in Figure 22, respectively.

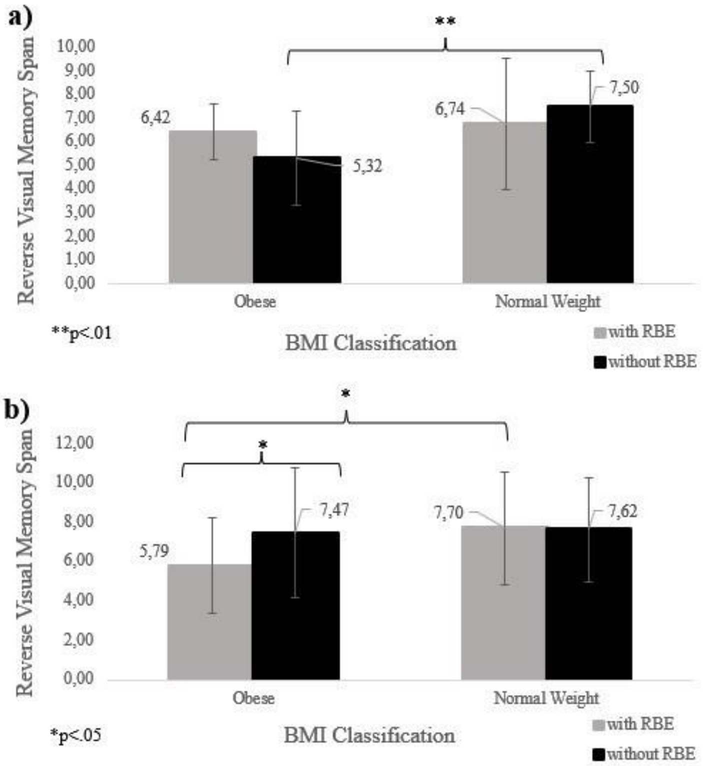

Figure 22. The Interaction Effect on the WMS-R Reverse Visual Memory Span Scores. a) Females graph, b) Males graph (To show the significant results, the asterisk is used.)

The results of ANOVA analysis revealed a significant main effect of BMI on the WMS-R Total Visual Memory Span scores ($F(1,166) = 9.94$, $p < .01$, $\eta_p^2 = .056$), reflecting higher scores for normal-weight individuals (*M* = 15.81, *SD* = 4.21) as compared to obese individuals (*M* = 13.95, *SD* = 3.81) out of a maximum 24 points. Gender had a main effect on the total visual memory span scores, ($F(1,166) = 4.18$, $p < .05$, $\eta_p^2 = .025$), reflecting higher scores for males (*M* = 15.52, *SD* = 4.79) compared to females (*M* = 14.56, *SD* = 3.46) out of a maximum 24 points. Also, RBE had a main effect on the total visual memory span scores ($F(1,166) = 4.24$, $p < .05$, $\eta_p^2 = .025$), reflecting the higher scores for individuals without RBE (*M* = 15.59, *SD* = 3.72) compared to individuals with RBE (*M* = 14.31, *SD* = 4.48) out of a maximum 24 points. All interaction effects did not yield a significant result, $F(1,166) \leq 2.59$, $p >$

.05. However, there was a significant 3-way interaction effect between BMI, gender, and RBE on the total visual memory span scores, $F(1,166) = 13.15$, $p < .01$, $\eta_p^2 = .073$.

According to simple main effects analysis, BMI had a statistically significant effect without RBE on the total visual memory span scores in females, $F(1,96) = 8.04$, $p < .05$. Out of a maximum of 24 points, normal-weight women without RBE ($M = 16.03$, $SD = 2.67$) had higher scores than obese women without RBE ($M = 12.79$, $SD = 3.01$). For males, simple main effects analysis showed that BMI had a statistically significant effect with RBE on the total visual memory span scores, $F(1,78) = 10.69$, $p < .01$. Out of a maximum of 24 points, normal-weight men with RBE ($M = 16.80$, $SD = 5.32$) had higher scores than obese men with RBE ($M = 12$, $SD = 3.76$). The simple main effects analysis also showed that RBE had a statistically significant effect with obese BMI class on the total visual memory span in males, $F(1,78) = 12.26$, $p < .01$. Out of a maximum of 24 points, obese men without RBE ($M = 17.11$, $SD = 4.01$) had higher scores than obese men with RBE ($M = 12$, $SD = 3.76$). The interaction effect on the WMS-R's Total Visual Memory Span scores for females and males is presented in Figure 23, respectively.

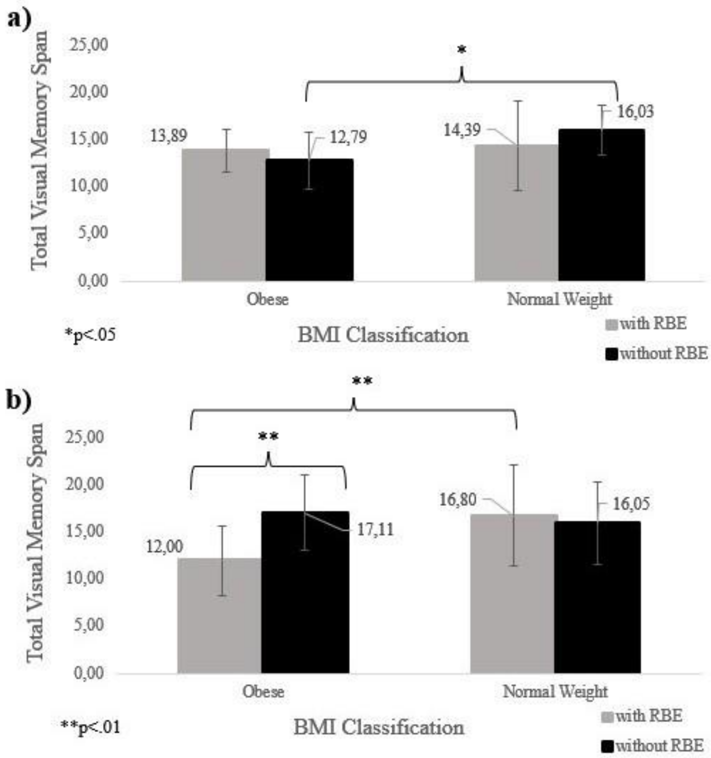

Figure 23. The Interaction Effect on the WMS-R Total Visual Memory Span Scores.
a) Females graph, b) Males graph (To show the significant results, the asterisk is used.)

Therefore, Hypothesis 4a, which suggested that obese groups would have lower working memory performance than normal weight groups, was fully supported. PASAT results, which also predict working memory, also support this. In addition, Hypothesis 4b, which suggested that there would be a significant difference in working memory performance between the obese group with RBE and the normal weight group with RBE, was partially supported. WMS-R Digit Span and Reverse Digit Span subscales' results would not support this hypothesis. In addition, there is no significant difference between the two groups according to the PASAT results.

3.7. RESULTS OF THE TRAIL MAKING TEST (TMT)

To compare the effects of BMI classification (obese and normal weight), gender (male and female), and the presence of RBE (with and without), a 2x2x2 ANOVA was performed on the TMT scores. The completion time and error scores of the two forms (Form A and B) and the difference between the completion time of the two forms (B-A) were included as dependent variables in the analysis. First, Form A and then Form B were evaluated.

The results of ANOVA analysis revealed that there was a main effect of BMI on completion time in Form A, $F(1,168) = 89.96$, $p < .01$, $\eta_p^2 = .349$, indicating longer completion time for obese individuals ($M = 41.20$, $SD = 7.02$) than normal weight individuals ($M = 33.19$, $SD = 5.13$). The main effect of gender on completion time was significant, $F(1,168) = 19.72$, $p < .01$, $\eta_p^2 = .105$, reflecting longer completion time for females ($M = 38.93$, $SD = 7.07$) than males ($M = 34.88$, $SD = 6.84$). Also, the main effect of the RBE on completion time was found to be significant, $F(1,168) = 12.09$, $p < .01$, $\eta_p^2 = .067$, reflecting longer completion time for individuals with RBE ($M = 38.48$, $SD = 7.47$) compared to individuals without RBE ($M = 35.14$, $SD = 6.64$). Results for the two-way interaction effect between BMI and gender factorial ANOVA on TMT Form A's completion time, $F(1,168) = 15.37$, $p < .01$, $\eta_p^2 = .084$. Simple main effect analysis showed that BMI had a statistically significant effect on the completion time of Form A in females, $F(1,172) = 17.53$, $p < .01$, and males, $F(1,172) = 78.05$, $p < .01$. Obese women ($M = 37.78$, $SD = 7.35$) had longer completion time than normal weight women ($M = 32.93$, $SD = 5.76$), and obese men ($M = 44.71$, $SD = 4.57$) had longer completion time than normal weight men ($M = 33.57$, $SD = 4.11$). All other interaction effects did not yield a significant result, $F(1,168) \leq 3.13$, $p > .05$. The interaction effect between BMI and gender on the TMT Form A’s completion time is presented in Figure 24.

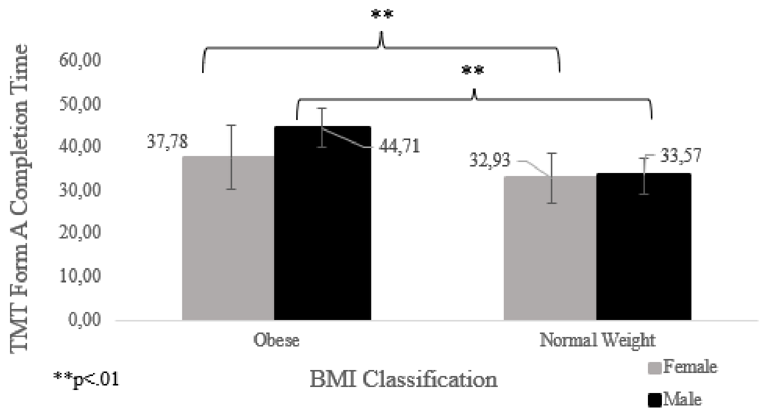

Figure 24. The Interaction Effect between BMI and Gender on the TMT Form A’s Completion Time. (To show the significant results, the asterisk is used.)

According to the results of ANOVA analysis, only the main effect of gender on error score was significant in Form A, $F(1,168) = 5.25$, $p < .05$, $\eta_p^2 = .03$, reflecting more error score for females (M = 1.23, SD = .20) than males (M = .54, SD = .22). All other main and interaction effects did not yield a significant result, $F(1,168) \leq .21$, $p > .05$.

The results of ANOVA analysis revealed that there was a main effect of BMI on completion time in Form B, $F(1,168) = 1082.6$, $p < .01$, $\eta_p^2 = .866$, indicating longer completion time for obese individuals (M = 116.96, SD = 14.2) than normal weight individuals (M = 67.25, SD = 7.38). The main effect of gender on completion time in Form B was not found to be significant, $F(1,168) = .86$, $p > .05$. Also, RBE had a main effect on the completion time of the Form B, $F(1,168) = 6.01$, $p < .05$, $\eta_p^2 = .035$, reflecting longer completion time for individuals with RBE (M = 92.64, SD = 28.32) compared to individuals without RBE (M = 85.82, SD = 25.56). Results for a significant two-way interaction between BMI and gender factorial ANOVA on Form B’s completion time, $F(1,168) = 33.69$, $p < .01$, $\eta_p^2 = .167$. Simple main effect analysis showed that BMI had a statistically significant effect on the completion time of Form B in females, $F(1,172) = 407$, $p < .01$, and males, $F(1,172) = 682.7$, $p < .01$. Obese women (M = 113.31, SD = 14.42) had longer completion time than normal weight women (M = 71.3, SD = 5.3), and obese men (M = 120.70, SD = 13.2) had longer completion time than normal weight men (*M* = 61.53, *SD* = 6.01). All other interaction effects did not yield a significant result, $F(1,168) \leq .67$, $p > .05$. The interaction effect between BMI and gender on the TMT Form B's completion time is presented in Figure 25.

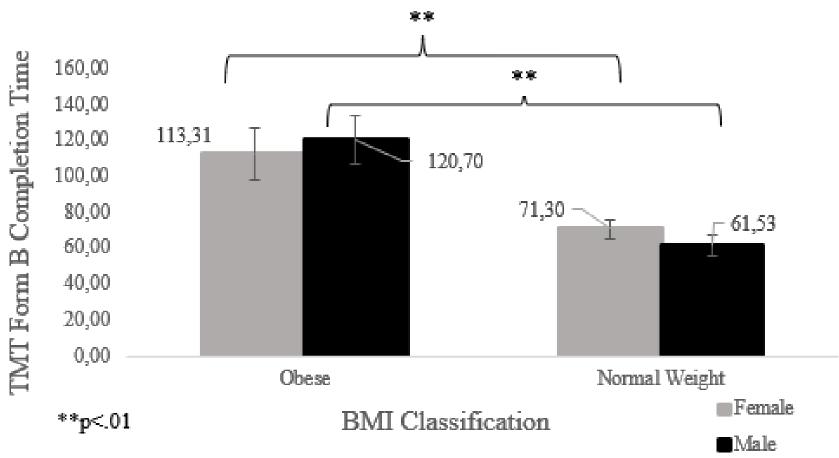

Figure 25. The Interaction Effect between BMI and Gender on the TMT Form B's Completion Time (To show the significant results, the asterisk is used.)

According to the results of ANOVA analysis, no main effect of BMI, gender, and RBE was found for Form B's error scores, $F(1,168) \leq 1.01$, $p > .05$. Besides, all interaction effects did not yield a significant result, $F(1,168) \leq .63$, $p > .05$.

On the other hand, the results of ANOVA analysis revealed that there was a main effect of BMI on the completion time difference of the two forms (B-A), $F(1,168) = 1531$, $p < .01$, $\eta_p^2 = .901$), indicating longer time difference for obese individuals (*M* = 75.56, *SD* = 9.75) than normal weight individuals (*M* = 33.86, *SD* = 6.47). The main effect of gender on completion time difference was significant $F(1,168) = 22.68$, $p < .01$, $\eta_p^2 = .119$, reflecting longer time for females (*M* = 53.14, *SD* = 19.47) than males (*M* = 50.84, *SD* = 25.32). The main effect of the presence of RBE on completion time was not found to be significant, $F(1,168) = .57$, $p > .05$. Results for BMI and gender factorial ANOVA indicated a significant two-way interaction on completion time difference, $F(1,168) = 26$, $p < .01$, $\eta_p^2 = .134$. Simple main effect analysis showed that BMI had a statistically significant effect on the completion time difference of Form B and Form A in females, $F(1,172) = 636.6$, $p < .01$, and males, $F(1,172) = 891.1$, $p < .01$. Obese women (*M* = 75.41, *SD* = 9.05) had longer time difference than normal weight women (*M* = 38.16, *SD* = 4.04), and obese men (*M* = 75.72, *SD* = 10.55) had longer time difference than normal weight men (*M*

= 27.79, *SD* = 3.83). There was also an interaction effect between gender and RBE, $F(1,168) = 6.60$, $p < .05$, $\eta_p^2 =.038$. Simple main effect analysis showed that gender had a statistically significant effect on the completion time difference of Form B and Form A in individuals with RBE, $F(1,172) = 2.84$, $p < .05$. Females with RBE (M = 57.40, SD = 20.43) had a longer time difference than males with RBE (M = 50.15, SD = 25.89). Besides, all other interaction effects did not yield a significant result, $F(1,168) \leq .23$, $p > .05$. The interaction effects between BMI and gender, and between gender and RBE on the completion time difference of the two forms are presented in Figure 26 and Figure 27, respectively.

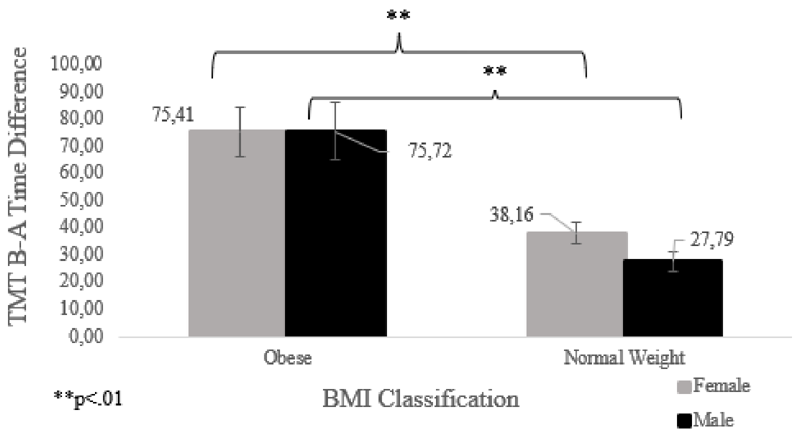

Figure 26. The Interaction Effect between BMI and Gender on the B-A Time Difference Score. (To show the significant results, the asterisk is used.)

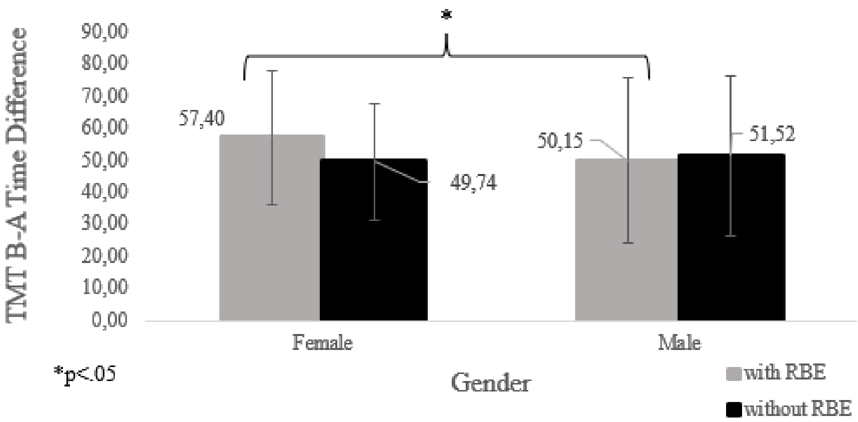

Figure 27. The Interaction Effect between Gender and RBE on the B-A Time Difference Score. (To show the significant results, the asterisk is used.)

Therefore, Hypothesis 5a, which suggested that the set shifting task performance of obese groups would decrease significantly compared to normal weight groups, was fully supported. However, Hypothesis 5b, which suggested that there would be no significant difference in set shifting performances between the groups with and without RBE, was not supported. On the other hand, TMT, which is known to predict information processing speed, was fully supported by Hypothesis 1a but gives results that were not supported by Hypothesis 1b. Also, TMT, which is known to measure attention, was fully supported by Hypothesis 2a but was not supported by Hypothesis 2b.

3.8. RESULTS OF THE OTHER STUDY VARIABLES

3.8.1. The Scores for Identifying the Regular Binge Eating Pattern

3.8.1.1. Eating Disorder Examination Questionnaire (EDE-Q) Binge Eating Subscale Scores

To compare the effects of BMI classification (obese and normal weight), gender (male and female), and the presence of RBE (with and without), a 2x2x2 ANOVA was performed on the EDE-Q Binge Eating subscale scores.

The results of ANOVA analysis revealed that there was a main effect of BMI on the scale scores, $F(1,168) = 13.73$, $p < .01$, $\eta_p^2 = .076$, indicating higher scores for obese individuals ($M = 3.47$, $SD = 3.95$) than normal weight individuals ($M = 1.87$, $SD = 2.62$). The main effect of gender on the scale scores was not found to be significant, $F(1,166) = .73$, $p > .05$. The main effect of the RBE on the scale scores was found to be significant $F(1,168) = 174.3$, $p < .01$, $\eta_p^2 = .509$, reflecting higher scores for individuals with RBE ($M = 5.06$, $SD = 3.51$) compared to individuals without RBE ($M = .40$, $SD = .47$). Results for BMI and RBE factorial ANOVA indicated a significant two-way interaction on the scale scores, $F(1,168) = 6.58$, $p < .05$, $\eta_p^2 = .038$. Simple main effect analysis showed that BMI had a statistically significant effect on EDE-Q Binge Eating subscale scores in individuals with RBE, $F(1,172) = 19.44$, $p < .01$. Obese individuals with RBE ($M = 6.24$, $SD = .37$) had higher scores than normal-weight individuals with RBE ($M = 3.99$, $SD = .35$). All other interaction effects did not yield a significant result, $F(1,168) \leq 1.23$, $p > .05$. The interaction effect between BMI and RBE on the EDE-Q Binge Eating subscale scores is presented in Figure 28.

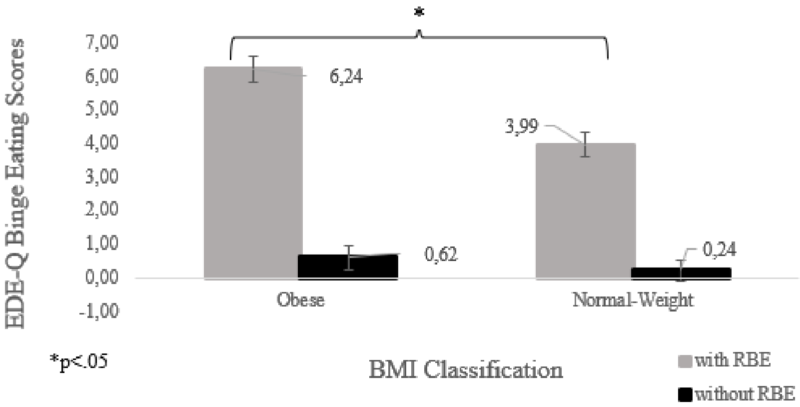

Figure 28. The Interaction Effect between BMI and RBE on the EDE-Q Binge Eating Scores (To show the significant results, the asterisk is used.)

Therefore, Hypothesis 6, which suggested that there would be a significant difference in the scores of binge eating episodes between obese people with regular binge eating and normal weight people with regular binge eating, was fully supported.

3.8.1.2. REZZY (SCOFF) Eating Disorder Scale Scores

To compare the effects of BMI classification (obese and normal weight), gender (male and female), and the presence of RBE (with and without), a 2x2x2 ANOVA was performed on the REZZY Eating Disorder Scale scores.

The results of ANOVA analysis revealed that there was a main effect of BMI on the scale scores, $F(1,167) = 13.73$, $p < .01$, $\eta_p^2 = .457$, indicating higher scores for obese individuals ($M = 2.43$, $SD = .71$) than normal weight individuals ($M = .97$, $SD = 1.09$). The main effect of gender on scale scores was significant, $F(1,167) = 9.60$, $p < .01$, $\eta_p^2 = .054$, reflecting higher scores for females ($M = 1.7$, $SD = 1.26$) than males ($M = 1.51$, $SD = 1.1$). Also, the main effect of the RBE on the scale scores was found to be significant $F(1,167) = 62.60$, $p < .01$, $\eta_p^2 = .273$, reflecting higher scores for individuals with RBE ($M = 2.18$, $SD = 1.14$) compared to individuals without RBE ($M = 1.11$, $SD = .98$). Results for BMI and RBE factorial ANOVA indicated a significant two-way interaction on the scale scores, $F(1,167) = 9.07$, $p < .05$, $\eta_p^2 = .052$. All other interaction effects did not yield a significant result, $F(1,167) \leq 1.47$, $p > .05$.

Simple main effect analysis showed that BMI had a statistically significant effect on REZZY scores in individuals with RBE, $F(1,172) = 32.36$, $p < .01$, and without RBE, $F(1,172) = 97.72$, $p < .01$. Out of a maximum of 5 points, obese individuals with RBE (*M* = 2.72, *SD* = .86) had higher scores than normal-weight individuals with RBE (*M* = 1.70, *SD* = 1.17). Also, obese individuals without RBE (*M* = 2.13, *SD* = .34) had higher scores than normal-weight individuals without RBE (*M* = .40, *SD* = .56) out of a maximum of 5 points. The interaction effect between BMI and RBE on the REZZY scores is presented in Figure 29.

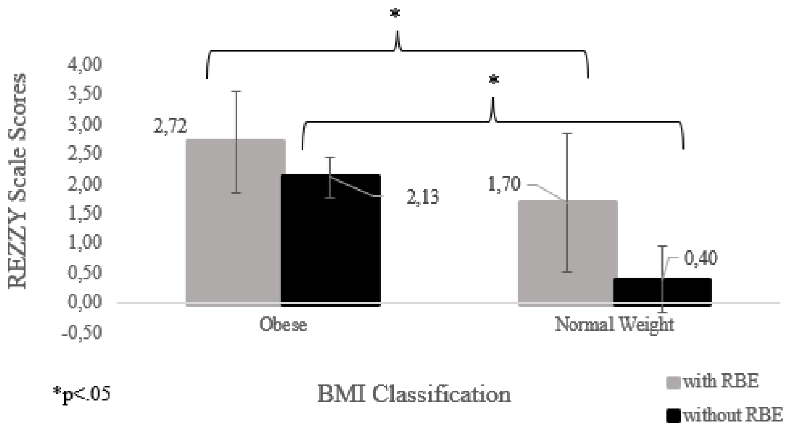

Figure 29. The Interaction Effect between BMI and RBE on the REZZY Scores (To show the significant results, the asterisk is used.)

3.8.1.3. Three-Factor Eating Questionnaire (TFEQ-R21) Subscale Scores

To compare the effects of BMI classification (obese and normal weight), gender (male and female), and the presence of RBE (with and without), a 2x2x2 ANOVA has performed on the TFEQ-R21's Uncontrolled Eating, Emotional Eating, and Cognitive Restraint subscale scores by scoring between 0 and 100.

The results of ANOVA analysis revealed that there was a main effect of BMI on the Uncontrolled Eating subscale scores, $F(1,168) = 20.37$, $p < .01$, $\eta_p^2 = .108$, indicating higher scores for obese individuals (*M* = 56.80, *SD* = 26.62) than normal-weight individuals (*M* = 40.58, *SD* = 21.72). The main effect of gender on the subscale scores was not found to be significant, $F(1,168) = .16$, $p > .05$. The main effect of the RBE on the subscale scores was found to be significant, $F(1,168) = 51.66$, $p < .01$, $\eta_p^2 = .235$, reflecting higher scores for individuals with RBE (*M* = 60.56, *SD* = 24.81) compared to individuals without RBE (*M* = 36.44, *SD* = 19.71). All interaction effects did not yield a significant result, $F(1,168) \leq .61$, $p > .05$.

The results of ANOVA analysis revealed that there was a main effect of BMI on the Emotional Eating subscale scores, $F(1,168) = 19.69$, $p < .01$, $\eta_p^2 = .105$, indicating higher scores for obese individuals (M = 54.83, SD = 32) than normal weight individuals (M = 37.20, SD = 25.52). The main effect of gender on scale scores was significant, $F(1,168) = 15.13$, $p < .01$, $\eta_p^2 = .083$, reflecting higher scores for females (M = 50.91, SD = 27.16) than males (M = 37.55, SD = 31.33). Also, the main effect of the RBE on the scale scores was found to be significant $F(1,168) = 28.37$, $p < .01$, $\eta_p^2 = .144$, reflecting higher scores for individuals with RBE (M = 56.16, SD = 29.82) compared to individuals without RBE (M = 35.10, SD = 26.17). All interaction effects did not yield a significant result, $F(1,168) \leq 2.11$, $p > .05$.

The results of ANOVA analysis revealed that the main effect of the BMI on the Cognitive Restraint subscale scores was not found to be significant, $F(1,168) = .31$, $p > .05$. There was a main effect of gender on the subscale scores, $F(1,168) = 7.95$, $p < .01$, $\eta_p^2 = .045$, indicating higher scores for females (M = 40.37, SD = 21.66) than males (M = 31.21, SD = 22.13). The main effect of the RBE on the subscale scores was not found to be significant, $F(1,168) = .35$, $p > .05$. Results for BMI and RBE factorial ANOVA indicated a significant two-way interaction on the scale scores, $F(1,168) = 5.91$, $p < .05$, $\eta_p^2 = .034$. Also, results for gender and RBE factorial ANOVA indicated a significant two-way interaction on the scale scores, $F(1,168) = 6.03$, $p < .05$, $\eta_p^2 = .035$. All other interaction effects did not yield a significant result, $F(1,168) \leq 3.23$, $p > .05$.

Simple main effect analysis showed that BMI had a statistically significant effect on TFEQ-R21's Cognitive Restraint subscale scores in individuals with RBE, $F(1,172) = 4.34$, $p < .05$. Obese individuals with RBE (M = 31.90, SD = 3.54) had lower scores than normal-weight individuals with RBE (M = 42.09, SD = 3.37). Also, gender had a statistically significant effect on TFEQ-R21's Cognitive Restraint subscale scores in individuals without RBE, $F(1,172) = 12.41$, $p < .01$. Females without RBE (M = 42.18, SD = 2.95) had higher scores than males without RBE (M = 26.25, SD = 3.43). The interaction effects between BMI and RBE, and between gender and RBE on the TFEQ-R21's Cognitive Restraint subscale scores are presented in Figure 30 and Figure 31, respectively.

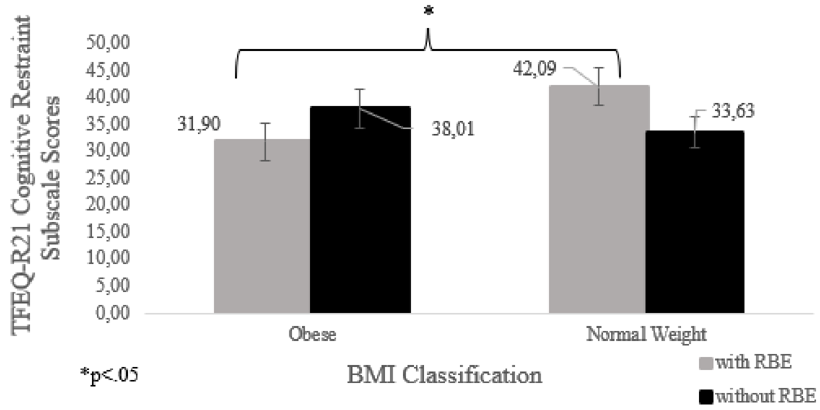

Figure 30. The Interaction Effect between BMI and RBE on the TFEQ-R21's Cognitive Restraint Subscale Scores (To show the significant results, the asterisk is used.)

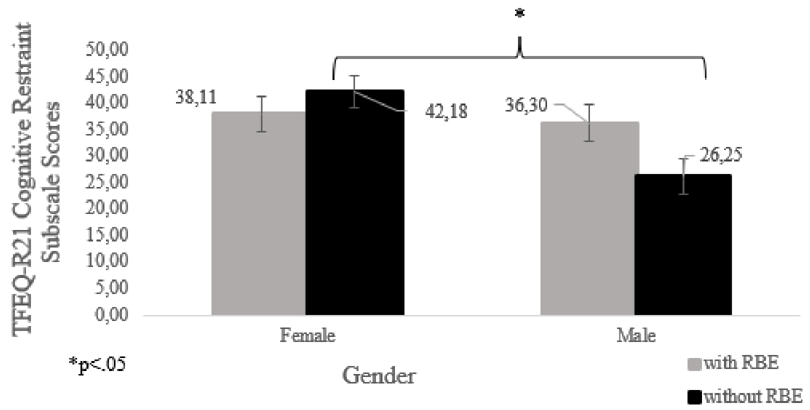

Figure 31. The Interaction Effect between Gender and RBE on the TFEQ-R21's Cognitive Restraint Subscale Scores (To show the significant results, the asterisk is used.)

Therefore, Hypothesis 7a, which suggested that obese groups would have higher scores than normal weight groups on the three subscales of the TFEQ-R21 was partially supported. It does not support TFEQ-R21's Cognitive Restraint subscale. Hypothesis 7b, which suggested that women with RBE would have higher emotional eating scores than men were partially supported. Separately, women have higher emotional eating scores than men, and individuals with RBE have higher emotional eating scores than individuals without RBE.

3.8.2. Impulsivity Scores

To compare the effects of BMI classification (obese and normal weight), gender (male and female), and the presence of RBE (with and without), a 2x2x2

ANOVA was performed on the Barratt's Impulsivity Scale, which calculates the total impulsivity scores.

The results of ANOVA analysis revealed that there was a main effect of RBE on the scale scores, $F(1,167) = 16.63$, $p < .01$, $\eta_p^2 = .091$, indicating higher impulsivity scores for individuals with RBE ($M = 30.16$, $SD = 6.05$) compared to individuals without RBE ($M = 26.66$, $SD = 5.55$). The main effect of BMI and gender was not found to be significant, $F(1,167) = 3.88$, $p > .05$, and $F(1,167) = .72$, $p > .05$, respectively. On the other hand, all interaction effects did not yield a significant result, $F(1,167) \leq 2.16$, $p > .05$.

Therefore, Hypothesis 8 which suggested that RBE groups would have higher impulsivity scores than without RBE groups was fully supported. However, analyses of five neuropsychological tests measuring different cognitive processes showed that Hypothesis 9, which suggested that a significant difference would be observed in cognitive performances measured by the five neuropsychological tests between men and women in the four groups (OB-RBE, OB-w/RBE, NW-RBE, and NW-w/RBE) was partially supported. The results of neuropsychological tests which are PASAT, SDMT, Stroop TBAG Form's Task 3, WMS-R's Reverse Digit Span subtest, and TMT Form B, did not reveal a significant difference between male and female cognitive task performances.

The summary of hypotheses, results, and neuropsychological tests and scales used in hypothesis testing are presented in Table 18.

Table 18. Summary of Hypothesis, Results, and Neuropsychological Tests and Scales Used in Hypothesis Testing

Hypothesis	Results	Neuropsychological Tests / Scales
1a. Obese groups will be more likely to have slow information processing speed than normal-weight groups.	S	PASAT SDMT TMT
1b. There will be no significant difference in the information processing speed between the groups with regular binge eating and without regular binge eating.	S~	PASAT SDMT TMT
2a. Obese groups are more likely to exhibit poor attention task performances than normal weight groups.	S	Stroop TBAG WMS-R TMT
2b. There will be no significant difference in attention task performances between the groups with regular binge eating and without regular binge eating.	NS	Stroop TBAG WMS-R TMT
3. People without regular binge eating will exhibit better attention and inhibitory control performance than people with regular binge eating, regardless of gender.	S~	Stroop TBAG TMT (B-A)
4a. Obese groups will perform lower in working memory than normal weight groups.	S	WMS-R PASAT
4b. There will be a significant difference in working memory performance between the obese group with regular binge eating and the normal-weight group with regular binge eating.	S~	WMS-R PASAT
5a. The set shifting task performance of obese groups will decrease significantly compared to normal-weight groups.	S	TMT

Table 18. (Continued)

Hypothesis	Results	Neuropsychological Tests / Scales
5b. There will be no significant difference in set shifting performances between the groups with regular binge eating and without regular binge eating.	NS	TMT
6. There will be a significant difference in the number of binge eating episodes between obese people with regular binge eating and normal-weight people with regular binge eating.	S	EDE-Q Binge Eating Subscale
7a. Obese groups will have higher scores on the three subscales of the TFEQ-R21 than normal-weight groups.	S~	TFEQ-R21
7b. Women with regular binge eating behavior will have higher emotional eating scores than men.	S~	TFEQ-R21
8. Regular binge eating groups will have higher impulsivity scores than the groups without regular binge eating.	S	BIS-11-SF
9. A significant difference will be observed in the cognitive performances measured by the five neuropsychological tests between men and women in the four groups (OB-RBE, OB-w/RBE, NW-RBE, and NW-w/RBE).	S~	PASAT SDMT Stroop TBAG WMS-R TMT

S: Supported NS: Not Supported S~: Partially Supported

CHAPTER IV

DISCUSSION

The main aim of the current study was to compare the neuropsychological test profiles that are sensitive to information processing speed, attention (divided, selective, sustained, etc.), working memory, and set shifting processes in obese (30 ≥ BMI) and normal weight (18.5–24.9 BMI) individuals with or without the regular binge eating pattern, and to increase the generalizability of previous findings. The study systematically examined how EFs that are responsible for purpose-oriented high-level cognitive skills such as information processing speed, attention, working memory, and set shifting, and cognitive impairments associated with these functions differ according to factors such as regular binge eating behavior, BMI values (the presence of obesity), and gender in individuals. Despite the prevalence of obesity worldwide, there are not enough studies in the literature on the regular binge eating pattern in obese individuals. It is known that binge eating behavior is not sufficiently included in the analyzes in existing studies and the number of male participants is very low in these studies (Hirst et al., 2017). One of the main contributions of the study is the evaluation of EFs and related areas for individuals with a regular binge eating behavior pattern, taking into account their current BMI values. The second main contribution of the study is to support the existing literature, which has just begun to develop, by increasing the number of male participants in the study, considering that studies on eating disorders and obesity, especially binge eating patterns, are conducted on female participants and there are very few eating disorder studies with male participants. In addition, considering that neurocognitive studies on eating disorders are mostly conducted on women, examining the cognitive performance differences between women and men is another important contribution. The findings supported the expectations that the obese groups showed poorer cognitive performance compared to the other group, the eating attitudes of the obese group were significantly different, the individuals with regular binge eating behavior were more impulsive, and accordingly, their cognitive performance was negatively affected in certain sub-cognitive functions. However, to the best of our knowledge, there are few studies in the literature focusing on the neuropsychological profile of regular binge eating behavior. Findings from the current study explored the relationship between regular binge eating behavior and BMI in detail based on sub-cognitive functions and revealed new links.

4.1. RELATIONSHIPS BETWEEN INFORMATION PROCESSING SPEED PERFORMANCES OF THE GROUPS

Information processing speed, which is not defined as an EF skill, is defined as the period required for a response to a stimulus, and it has a great impact on EF skills such as working memory, and decision making. Although individuals with slow information processing speed do not normally have problems in EF areas such as problem-solving and decision making, it has been deduced that their performance in these areas would decrease as the time to complete that task is prolonged (Rosen 2019). When reviewing the related literature, it is seen that PASAT and SDMT are frequently used tests to measure information processing speed. While PASAT measures auditory information processing speed, SDMT measures visual-spatial information processing speed in the current study. In PASAT, when participants hear two consecutive numbers, they are required to answer the sum of the first two numbers before the other number comes up. In SDMT, participants are required to match the symbols with numbers within 90 seconds. However, it has been observed that TMT, which requires participants to quickly match digit-number or digit-letter, is also used to measure information processing speed (Leavitt et al. 2011).

According to the PASAT findings obtained from the current study, it was observed that the obese group's PASAT scores were significantly lower than the normal weight group, regardless of gender. Again, according to the SDMT findings obtained from the present study, it was observed that the SDMT scores of the individuals in the obese group were significantly lower than those in the normal weight group, regardless of gender. However, when the TMT scores of the participants were examined, it was seen that the obese group completed both TMT Form A and Form B in a longer time than the normal weight group. Therefore, despite the limitations of studies examining information processing speed in obesity in the literature, the findings are consistent with previous studies showing that obese individuals have slower information processing speed compared to normal-weight individuals (Cournot et al. 2006; Eneva et al. 2017).

However, studies examining the information processing speed in regular binge eating behavior in the literature are very insufficient. According to the findings of the current study, in contrast to Eneva and colleagues (2017), which found no difference between the groups with regular binge eating and without regular binge eating, it was observed that the SDMT scores of individuals with regular binge eating behavior are significantly lower scores than those without regular binge eating behavior, and individuals with regular binge eating behavior complete both TMT Form A and Form B longer than those without regular binge eating behavior. As an alternative explanation, in neuropsychological tests measuring information processing speed, it is known that the harder the task, the longer the information processing process (Hughes et al. 2011). According to the findings of the current study, it was observed that individuals with regular binge eating behavior are more impulsive and have difficulty in inhibitory control than individuals without regular binge eating behavior (which is explained in detail in the following sections). Therefore, it is thought that since individuals with regular binge eating behavior are more impulsive, they may not want to do it as the task becomes more difficult, and their information processing speed may be slowed down because they have difficulty in inhibitory control. At the same time, these findings are a contribution to the limited literature on cognitive performance in the binge eating pattern.

4.2. RELATIONSHIPS BETWEEN ATTENTION AND INHIBITORY CONTROL PERFORMANCES OF THE GROUPS

Attention is generally defined as a process that ignores other stimuli by choosing what is necessary for the mind against more than one stimulus that appears at the same time, and focusing, concentration, and alertness predominate in this process (James 1890). Neuropsychological tests used to measure attention are very diverse. For example, TMT and SDMT measure sustained and divided attention, and concentration by ensuring that attention is sustained over a period of time. It is known that the completion time difference between TMT Form B and Form A measures attention and set shifting performance more consistently (Holtzer et al. 2005). According to the findings of the current study, it was observed that the time differences between TMT Form B and Form A were higher in the obese group than in the normal weight group. In addition, the present study found that the obese group completed both TMT Form A and Form B in a longer time than the normal weight group. In addition, considering regular binge eating behavior, individuals with regular binge eating took longer to complete TMT Form A and Form B than those without regular binge eating, and the B-A disparity was bigger in women with regular binge eating than in men without regular binge eating.

The tests such as Digit Span and Visual Memory Span, which are also included in WMS-R as subtests, are used to measure attention capacity by keeping track of increasingly longer sequences (Strauss et al. 2006). When reviewing the related literature, it was observed that obese people with regular binge eating have poor performance in the Reverse Digit Span subtest than those without regular binge eating, but there is no significant difference between the two groups in Digit Span subtest (Duchesne et al. 2010). According to the findings of the current study, in the Reverse Digit Span subtest, obese individuals performed poorer than normal weight individuals. However, in the Digit Span subtest, obese women and obese men without regular binge eating scored higher than those with but normal weight men with regular binge eating scored higher than those without. As far as is known, it is an expected finding that obese individuals exhibit lower cognitive performance than normal-weight individuals, but the presence or absence of regular binge eating behavior still contains conflicting results in the literature, and more studies are needed.

Although certain cognitive tasks such as the Stroop Test, the Stop-Signal Test, or the Go-No Go Test are used to examine attention, inhibitory control, and impulsivity in obese individuals (Fitzpatrick et al. 2013), studies are showing that PASAT not only predicts information processing speed but also measures divided and sustained attention (Strauss et al. 2006). However, as far as is known, no study measures attention in obese individuals with PASAT.

The Stroop Test, which is seen as a “gold standard” for attention in the literature (MacLeod 1991), measures the ability to suppress a usual behavior and perform an unusual behavior under an interference effect, as well as complex attention processes (Karakaş et al. 1999). Studies examining attention with the Stroop Test in obese and binge eating samples are not sufficient in the literature and these limited studies present contradictory findings. According to the findings of the current study, it was observed that the obese group completed all the five tasks of the Stroop Test longer than the normal weight group. Although there are opposite results in the literature (Galioto et al. 2012), when attention performance is examined with the Stroop Test, as expected, it is seen that the obese group performs significantly lower than the non-obese group (Gunstad et al. 2007; Smith et al. 2010).

The limited number of studies examining attention with the Stroop Test between individuals with regular and non-regular binge eating behavior also reveal different findings from each other. In some studies, it has been observed that obese people with binge eating disorder perform poorer than obese people without binge eating disorder (Duchesne et al. 2010), while in some studies it has been observed that the presence or absence of binge eating behavior does not affect the performance of individuals (Eneva et al. 2017). According to the findings of the current study, in Stroop Task 1 and Task 2, regular binge eating did not affect the performance of men and women, with one exception. In Stroop Task 2, obese men with regular binge eating took longer to complete than obese men without regular binge eating. The same pattern was observed for Stroop Task 4 and Task 5, where the interference effect started to appear. In other words, obese men with regular binge eating exhibited poorer attention performance compared to obese men without regular binge eating and normal-weight men without regular binge eating. Studies with men are limited, but given previous findings, BMI may be an alternative explanation for these findings. In studies that found no significant difference between the group with regular binge eating and the group without regular binge eating, the average BMI of the participants was higher [*M*= 34.2 (Eneva et al. 2017); *M* = 45 (Galioto et al. 2012)] than the average BMI of the participants in the studies that found poor cognitive performance in the obese group with regular binge eating [*M*= 31.72 (Duchesne et al. 2010)]. In the current study, the mean BMI values of the obese group with regular binge eating and the obese group without regular binge eating were 32.7 and 31.9, respectively. According to literature, BMI values have a strong correlation with neurocognitive results (Kerwin et al. 2010), therefore groups with higher BMI averages may also have greater cognitive problems and disguise more minor group differences (Galioto et al. 2012).

On the other hand, the assessment of inhibitory control, which is revealed in the 4th and 5th tasks of the Stroop Test, in obese people might help researchers figure out how effectively people can stop binge eating even when they're full. Similar to attention studies for regular binge eating patterns, studies on inhibitory control in individuals with regular binge eating offer inconsistent results. When reviewing the related literature, some studies have found that individuals with regular binge eating have inhibitory control difficulties and behave more impulsively (Manasse et al. 2014; Mobbs et al. 2011), while some studies have not found a significant difference between individuals with regular binge eating and those without (Eneva et al. 2017; Wu et al. 2013). According to the Stroop Task 4 findings obtained from the current study, it was observed that individuals with regular binge eating take longer to complete the task than those without. In the Stroop Task 5, it was observed that obese men with regular binge eating take longer to complete the task than those without, regarding gender. As an alternative explanation, the relationship between inhibitory control and impulsivity has been demonstrated. Studies show that both obesity and binge eating is caused by a lack of inhibitory control for binge eating behavior. In neuroimaging studies, it has been observed that there is deterioration in frontostriatal regions related to response inhibition in both obese individuals and individuals with regular binge eating behavior (Michaelides et al. 2012).

4.3. RELATIONSHIPS BETWEEN WORKING MEMORY PERFORMANCES OF THE GROUPS

When reviewing the related literature for working memory, which is defined as an EF area that is associated with a person's capability to recall the given information correctly for a certain period of time, it has been observed that some studies measure working memory with WMS-R's Digit Span and Visual Memory Span subtests (Fitzpatrick et al. 2013), and some studies with PASAT (Mungas et al. 2014). In WMS-R's Digit Span and Visual Memory Span subtests, participants are required to memorize the presented sequence and repeat it in the same way. Especially for the Reverse Digit Span and Reverse Visual Memory Span subtests, as the sequences get longer, it becomes more difficult for the participants to repeat the numbers exactly. This is due to the limited capacity of working memory. On the other hand, in PASAT, participants are required to memorize each number heard in a group number sequence and add it to the previous number on the list and say it. Therefore, the participant performs two simultaneous tasks by both keeping the previous number in mind and saying the sum of the two numbers, activating the working memory.

Studies examining working memory impairments in obese and binge eating samples are not sufficient in the literature and these limited studies present contradictory findings. According to the findings of the current study, the normal weight group scored higher in both the WMS-R subtests (Digit Span and Visual Memory Span) and PASAT than the obese group. As expected, when working memory performance is examined in the literature, it is seen that the obese group performs significantly lower than the non-obese group (Cserjési et al. 2009; Fitzpatrick et al. 2013). As another explanation for this, it can be thought that the working memory task performance of obese individuals decreases due to slow information processing (Rosen 2019).

Regarding the binge eating pattern, the findings of the current study showed that normal-weight men with regular binge eating have higher scores than obese men with regular binge eating on both the WMS-R's Digit Span and Visual Memory Span's all tasks. Also, on the Visual Memory Span subtest, the normal weight group with regular binge eating has higher scores than the obese group with regular binge eating. These findings are consistent with the literature suggesting that the obese group with binge eating disorder performed poorly on working memory tasks than the normal weight group with binge eating disorder (Duchesne et al. 2014; Manasse et al. 2014; Volkow et al. 2008).

The limited literature has suggested that the normal weight group without regular binge eating performed better on working memory tasks than those with regular binge eating (Eneva et al. 2017). The present study partially supported this. On the WMS-R's Digit Span and Total Digit Span sub-scores, normal weight women without regular binge eating performed better than normal weight women with regular binge eating. For the Visual Memory Span's all sub-scores, the findings of the current study showed that obese men without RBE have higher scores than the obese men with RBE. Contrary to expectation, on the Digit Span subtest, normal-weight men with RBE performed better than the men without RBE. An alternative explanation is the relationship between inhibitory control and working memory, which is associated with impulsivity. Studies show that response inhibition affects working memory performance in both children (Traverso et al. 2015), and adults (Friedman and Miyake 2004), and most of the tasks that evaluate response inhibition involve activated working memory as well (Traverso et al. 2015). It has been found that the working memory performance of ADHD patients, who are known to be impulsive, and patients with frontal lobe damage, decrease due to reaction inhibition (Clark et al. 2007). Therefore, impaired working memory performance in regular binge eating behavior may be associated with deterioration in frontostriatal regions due to response inhibition (Michaelides et al. 2012). As a second alternative explanation, it is known that as individuals get older, their cognitive capacities also slow down/deteriorate (Cournot et al. 2006; Holtzer et al. 2005). According to mean comparison tests in the present study, normal-weight men without RBE are significantly older than obese individuals with RBE. In the current study, normal-weight men with RBE scored higher on the Digit Span subtest than without the ones. As mentioned above, an alternative explanation for this result, which differs from the literature, may be due to the significant mean age difference between these two groups. However, more studies are needed in this field for consistent information, as literature studies in this area often do not include men.

4.4. RELATIONSHIPS BETWEEN SET SHIFTING PERFORMANCES OF THE GROUPS

Known closely related to information processing speed, set shifting is defined as an EF ability to switch from one task to another with cognitive flexibility. When reviewing the related literature, it is seen that TMT is frequently used in tests to measure set shifting skills in obese samples. It is known that TMT Form B scores measure cognitive flexibility (Strauss et al. 2006), and the completion time difference between TMT Form B and Form A (B-A) scores attention and set shifting task performance more consistently (Holtzer et al. 2005). However, studies examining the regular binge eating pattern have yielded conflicting results due to the limited sample.

When the literature on set shifting abilities in obese people is examined, some studies have found that obese people with regular binge eating behavior have poorer set shifting performance than non-obese people (Aloi et al. 2015; Boeka and Lokken 2008; Eneva et al. 2017). Some studies did not find a significant difference between the two groups in terms of their set shifting performances (Duchesne et al. 2010; Gonzales et al. 2010). In general, studies looked at individuals' BMI values rather than their eating patterns, and researchers concluded that individuals with high BMI values have poor set shifting ability.

According to the findings of the current study, as expected, the obese group completed Form A and Form B in a longer time, and their B-A scores were higher compared to the normal weight group. As mentioned before, it was observed that individuals with regular binge eating behavior completed Form A and Form B in a long time compared to those without regular binge eating behavior, and the B-A difference was greater in women with regular binge eating than men with regular binge eating. These findings are consistent with previous studies suggesting that obese people with regular binge eating exhibit poorer set shifting performance (Aloi et al. 2015; Eneva et al. 2017). Although studies examining regular binge eating patterns have produced inconclusive results, as an alternative explanation, individuals with regular binge eating behavior may have more negative mood and show more depression and anxiety symptoms compared to individuals without regular binge eating behavior (Dingemans et al. 2015; Şen-Demirdöğen 2015; Yüksel 2014). Set shifting is an EF ability that also expresses cognitive flexibility. Individuals who have binging episodes cannot control their eating behavior (Bryant et al. 2019; Jeanes et al. 2017) as examined in the current study. Although binge eaters are not severe enough to be diagnosed with a mood disorder, they may have what might be termed acute negative mood or melancholic mood. It can be said that they do not have enough cognitive flexibility because their loss of control over uncontrolled eating behavior is high (Dingemans et al. 2015).

4.5. RELATIONSHIPS BETWEEN THE OTHER STUDY VARIABLES OF THE GROUPS

While examining the effects of obesity on executive functions and information processing speed performances, the effects of factors such as gender, eating attitudes such as regular binge eating behavior, and impulsivity were also examined.

First of all, previous studies show that the number of binge eating episodes rather than the degree of obesity in obese individuals indicates the severity of psychopathological disorders (Hay and Fairburn 1994). Therefore, examining the regular binge eating habits of obese people is important in terms of contributing to both the diagnosis and treatment processes of these people. When reviewing the related literature, it has been observed that the EDE-Q Binge Eating subscale is used to evaluate the number of subjective binge eating episodes in obese individuals (Şen-Demirdöğen 2015). According to the EDE-Q Binge Eating subscale scores obtained from the current study, it was observed that the EDE-Q score of the obese group was higher than the normal weight group, and the group with regular binge eating had higher scores than the group without regular binge eating, and the obese group with regular binge eating had higher scores than the normal weight group with regular binge eating.

As far as is known, the REZZY/SCOFF Eating Disorder Scale, which measures the tendency to develop an eating disorder, has been used in only one study in obese individuals. When reviewing the related literature, it was seen that both binge eating disorder and night eating syndrome, which are frequently seen as comorbidities in obesity, were detected in obese individuals evaluated with SCOFF (Arnal-Couderc et al. 2020). According to the REZZY/SCOFF scale scores of the current study, it was observed that the REZZY score of the obese group was higher than the normal weight group, the group with regular binge eating had higher scores than the group without regular binge eating, the obese group with regular binge eating had higher scores than the normal weight group with regular binge eating, and the obese group without regular binge eating had higher scores than the normal weight group without regular binge eating. According to all these findings, it can be said that these two eating disorder scales can detect both obesity and regular binge eating behavior pattern. At the same time, it can be said that these findings are a contribution to the limited literature.

In the current study, the eating attitudes of the groups were examined, as well as the measurement of eating disorder tendencies and the number of binge eating episodes in the groups. When reviewing the related literature, studies evaluating individuals' eating attitudes with the TFEQ-R21 scale revealed that obese individuals scored high on the subscales of Uncontrolled Eating, Emotional Eating, and Cognitive Restriction, which could predict an individual's predisposition to obesity and binge eating (Bryant et al. 2019; Jeanes et al. 2017). According to the findings of the current study, obese people score higher than normal weight people, and people with regular binge eating behavior score higher than people without regular binge eating behavior for the UE subscale. For the EE subscale, obese people score higher than normal weight people, and people with regular binge eating behavior score higher than people without regular binge eating behavior. For the CR subscale, obese people with regular binge eating behavior score lower than normal weight people with regular binge eating behavior. As expected, the increase in the BMI value of obese individuals (as they eat uncontrollably) and the inability of regular binge eaters to control their eating behaviors may have increased their TFEQ-R21's UE, EE, and CR subscale scores.

In addition, there are studies examining the differences between men's and women's eating attitudes, although studies on eating attitudes are mostly conducted on women. When reviewing the related literature, shows that women have higher emotional eating scores than men (Leblanc et al. 2015). However, the number of studies examining eating attitudes in the binge eating pattern is few, and most of the existing studies do not include male participants (Hirst et al. 2017; Wu et al. 2014). According to the findings of the current study, women have higher EE and CR subscale scores than men. Also, women without regular binge eating have higher CR subscale scores than men without regular binge eating. When reviewing the related literature, it is seen that studies are showing that women are more inclined to restricted, uncontrolled, and emotional eating behaviors, and that they are more likely to eat unhealthy foods, which lead to weight gain (Du et al. 2022). Therefore, the findings of the present study are compatible with the literature.

Impulsivity may be an important factor in mediating the relationship between obesity and regular binge eating pattern. Other factors such as depression or anxiety may also be critical for the development of this comorbidity (Steadman & Knouse, 2016). When reviewing the related literature, shows that some psychological disorders characterized by impulsivity (e.g., ADHD or binge eating disorder), tend to binge eat more than expected (Cortese et al. 2007; Reinblatt et al. 2014). According to the findings of the current study, people with regular binge eating behavior score higher than people without regular binge eating behavior, as an expected result.

4.6. LIMITATIONS AND CONCLUSIONS OF THE STUDY, AND SUGGESTIONS FOR FUTURE RESEARCH

There are limitations in every study, and this one is no exception. First of all, due to the COVID-19 pandemic conditions, the nature of the tests normally scheduled for face-to-face testing has been adjusted for online administration. As in face-to-face applications, the test environment of the participants should be in a quiet environment away from distracting factors. Due to the nature of online administrations, it was not possible to fully control the environmental conditions in which the participants performed the tests. Since the tests were applied to the participants via a web page, the results were hardware dependent. Therefore, both the participants and the psychologist administering the tests should have the appropriate equipment (computer, camera, microphone, etc.), but these situations are valid for all studies conducted online through the website or application. For example, the reaction times of the participants were recorded in the Stroop Test TBAG Form. Hardware problems such as the microphone not getting enough volume or receiving unwanted ambient sounds, and slow internet connection of people may have prolonged their reaction times and/or caused more errors or corrections. In PASAT, participants were asked to write the sum of the last two numbers they heard from the tape in the boxes below. However, some participants may not have been able to follow the order while trying to add two numbers and write them in the boxes, and therefore they may have received low scores. In future studies, it may be useful to get answers from the participants by voice recording instead of writing the answers in the boxes. However, it should also be taken into account that similar limitations (e.g., hardware problems or problems due to slow internet connection) may be experienced in every voice recording test, just as in the Stroop Test TBAG Form. For WMS-R, especially in the Visual Memory Span subtest, participants may not have been able to follow the blinking boxes due to their slow internet connection. Besides, in TMT, participants were asked to give their answers by clicking on the buttons with their mouse. However, some participants could not follow the correct order due to the click button of their mouse not working and their answers may have been taken as an error. It can be thought that this situation may have been reflected in the completion times of the participants. The participants' higher scores on the tests may also indicate better computer use skills because the results are hardware dependent. Furthermore, in a study comparing the face-to-face and online application of neuropsychological tests, it was stated that the tests in which the answers were received verbally such as digit span and verbal learning, were applied more effectively than the visual and motor tests (Brearly et al. 2017). In the present study, the records of the tests that were answered verbally were taken more easily. In the same study, it was stated that the administration of neuropsychological tests by videoconferencing could help both to obtain more consistent answers from the participant and to enable the psychologist to make better observations (Brearly et al. 2017). Therefore, it is important to consider this situation in future studies.

The second limitation is that the standardization studies of the neuropsychological tests used in the present study were carried out through paper-pencil administrations. All validity and reliability studies of the scales and tests mentioned in the present study are for paper-pencil versions. We did not have validity and reliability studies for data collected online on a website. For all self-administered studies, it is a matter of consideration whether participants complete the tests validly. However, since this is the first study to administer a neuropsychological test battery online for the first time via a website and analyze neuropsychological test profiles, it is a big step in terms of collecting data and increasing the validity and generalizability of the findings by administrating neuropsychological tests to more people from many different places. Future research should include performance validity tests, which might reveal unusually poor or high performance or unanticipated performance differences among tests.

The third limitation is that the present study, which is one of the aims of increasing the generalizability of the findings by increasing the number of male participants, had to be terminated when more male participants could be obtained due to the COVID-19 pandemic process and the time constraints experienced during the data collection phase of the study. In the current study, according to mean comparison tests, the age difference was statistically significant between the groups of normal-weight men without RBE and obese men with RBE, so increasing the number of male participants in future studies may partially explain the age-related differences in certain male groups.

Another limitation is using the BMI value to distinguish groups between obese and normal weight and taking the height-weight values as self-reports. Although the REZZY Eating Disorder Scale was used to assess whether the participants had any eating disorders, the high BMI value may be due to the excess lean muscle mass, which is the total body weight excluding body fat mass. Since the study was conducted online without seeing the participants, it was not possible to determine their fat-muscle mass. Using different indices such as body composition, waist-hip ratio, waist-height ratio, or waist circumference measurement together with BMI may reveal different findings in both face-to-face and online studies. In a study comparing different techniques used in the determination of obesity, it was found that the waist-hip ratio is insufficient to provide information about obesity and that it may be useful to use the waist circumference method in addition to BMI in the determination of obesity (Taşlı and Sağır 2021).

Obesity is accepted as one of the most important health problems worldwide, including in our country. It is known that obese individuals worldwide benefit from health services (for medical conditions such as heart attack, diabetes, cancer, bariatric surgery, etc.) more than the population (OECD 2019). Pregnant women with obesity may experience many pregnancy complications (hypertension, cardiovascular diseases, shoulder dystocia, etc.) during pregnancy. This situation both increases health care costs and endangers the health of mother and baby (Morgan et al. 2014). However, the increase in the obesity rate in society decreases the employment rate and working efficiency and increases the rates of absenteeism and early retirement (OECD 2019). In addition, it is known that obesity negatively affects academic achievement (OECD 2019). For all these reasons, it is very important to both invest in the prevention and treatment of obesity and reduces the burden on individuals and society.

In conclusion, the first piece of evidence to emerge from the present study was that obese individuals performed lower in cognitive task performances (cognitive domains such as information processing speed, attention, working memory, and set shifting) compared to normal-weight individuals. The second piece of evidence was that a significant difference was found between the groups with regular binge eating and without regular binge eating in terms of information processing speed and working memory performance, which is associated with information processing speed, but no significant difference was found in attention and set shifting performances in general. The third piece of evidence was that a partially significant difference in cognitive performances as measured by the five neuropsychological tests was observed between men and women in the four groups. PASAT, SDMT, Stroop TBAG Form's Task 3, WMS-R's Reverse Digit Span subtest, and TMT Form B results did not reveal a significant difference between male and female performances. The fourth piece of evidence emerging from the present study was that among the groups with binge eating patterns, the number of binge eating episodes in obese individuals was higher than in normal-weight individuals, and individuals with regular binge eating were more impulsive than individuals without regular binge eating. The last piece of evidence emerging from the present study was that obese individuals had higher scores in all subscales of TFEQ-R21, except for the CR subscale. In the TFEQ-R21's EE subscale, it was seen that the scores of women were higher than men, and individuals with regular binge eating had higher scores than those without regular binge eating.

When the relevant literature is examined, obesity has been examined in the aspects of medical, social, aesthetic, and clinical psychopathology, but studies on cognitive processes in obesity have only recently begun to intensify in the literature. As mentioned before, it is known that there is a regular binge eating pattern in a significant portion of obesity cases. Despite this, it is known that there are very few studies in the literature focusing on the neuropsychological assessment of eating disorders, that the binge eating pattern/binge eating disorder is not sufficiently included in existing studies, and the number of male participants in these studies is very low. This study examined the binge eating pattern in obese individuals and the contribution of BMI to executive functions, which has not been studied much in previous studies, and increased the generalizability of the findings by increasing the number of male participants. However, studies examining obesity and eating disorders like binge eating that included men are still needed. Therefore, it is thought that the present study may be important in terms of both drawing attention to the cognitive dimensions of obesity and contributing to the developing literature with new findings. These results may serve as a guide for future studies that will examine binge eating behaviors in obesity.

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APPENDICES

APPENDIX A: APPROVAL OF THE SOCIAL AND HUMANITIES ETHICS COMMITTEE OF CANKAYA UNIVERSITY

Çankaya Üniversitesi - ÜNİVERSİTE ETİK KURULU
Tarih: 24.07.2019
Sayı: 80281877-050.99-E.00000040787

E.0000040787

ÇANKAYA ÜNİVERSİTESİ
REKTÖRLÜK

Sayı : 80281877-050.99
Konu : Etik Kurul Raporu

FEN EDEBİYAT FAKÜLTESİ DEKANLIĞINA

**İlgi : **26.06.2019 tarihli ve 76373453-605.01/00000039147 sayılı yazı.

Fakülteniz Psikoloji Bölümü öğretim elemanlarından Dr. Öğr. Üyesi Hande KAYNAK ve yüksek lisans öğrencisi F. Öykü ÇOBANOĞLU'nun "Sürekli Tıkınırcasına Yiyen Obez Bireylerde Bilgi İşleme Hızı, Seçici Dikkat, Çalışma Belleği ve Set Değiştirme Süreçleri Arasındaki İlişkilerin İncelenmesi" başlıklı tezi kapsamında yürütecekleri araştırmalarının Etik Kurul tarafından değerlendirilmesi talebi, Üniversitemiz Bilimsel Araştırma ve Yayın Etiği Kurulu tarafından değerlendirilmiş ve uygun görülmüştür.

Bilgilerinizi ve ilgiliye bilgi verilmesini rica ederim.

e-imzalıdır
Prof. Dr. Can ÇOĞUN
Rektör

Ek: 21.06.2019 tarih ve 195 sayılı Araştırma ve Yayın Etiği Kurulu Proje Onay Formu

Evrakın elektronik imzalı suretine https://e-belge.cankaya.edu.tr adresinden 344e755b-0c48-4376-b415-50d3ba0066da kodu ile erişebilirsiniz.
Bu belge 5070 sayılı Elektronik İmza Kanunu'na uygun olarak Güvenli Elektronik İmza ile imzalanmıştır.

Merkez Kampüs: Yukarıyurtçu Mah. Mimar Sinan Cad. No:4 06790, Etimesgut-ANKARA / Balgat Kampüsü : Çukurambar Mah. Öğretmenler Cad. No: 14, 06530 - ANKARA Tel:0 (312) 233 10 00/1134 / 0 (312) 284 45 00 / 134 Faks:0 (312) 233 11 49 / 0 (312) 286 96 31 E-Posta:genelsekreterlik@cankaya.edu.tr

APPENDIX B: THE INFORMED CONSENT FORM

Sayın Katılımcı,

"Sürekli Tıkınırcasına Yeme Eğilimi Olan Obez Bireylerde Bilgi İşleme Hızı, Seçici Dikkat, Çalışma Belleği ve Set Değiştirme Süreçleri Arasındaki İlişkilerin İncelenmesi" başlıklı bu çalışma, Dr. Öğr. Üyesi Hande Kaynak danışmanlığında Çankaya Üniversitesi Psikoloji Bölümü Anabilim Dalı kapsamında Bilişsel Psikoloji Yüksek Lisans programı öğrencisi Psk. F. Öykü Çobanoğlu tarafından yürütülen bir tez çalışmasıdır. Çalışmanın amacı, bilgi işleme hızı, seçici dikkat, çalışma belleği ve set değiştirme gibi kişilerin amaca yönelik üst seviye bilişsel becerilerinden sorumlu olan yürütücü işlevler ve bu işlevler ile ilişkili olarak görülen bilişsel bozulmaların, kişilerdeki tıkınırcasına yeme davranışları ve/veya obezitenin varlığı ile birlikte ne kadar farklılık gösterdiğini incelemektir.

Çalışmaya katılım tamamen gönüllülük esasına dayanmaktadır ve sizden hiçbir kimlik bilginiz istenmemektedir. Çalışmada yeme tutumlarınızı ölçen çeşitli formları doldurmanız ve bunun sonrasında beş nöropsikolojik testi tamamlamanız beklenmektedir. Sağlayacağınız bilgiler tamamen gizli tutulacak ve sadece araştırmacılar tarafından değerlendirilecektir. Elde edilecek bilgiler bilimsel amaçla kullanılacaktır. Çalışmada dolduracağınız formlar çalışmanın amacına uygun ve genel olarak kişisel rahatsızlık verecek sorular içermemektedir. Ancak çalışma sırasında kendinizi rahatsız hissederseniz yarıda bırakabilirsiniz. Çalışma iki aşamalı olup, dolduracağınız formlar çalışmanın birinci kısmını oluşturmaktadır. Çalışmanın ikinci kısmına katılmaya hak kazanmanız hâlinde, sizinle iletişime geçebilmemizi sağlayacak bir elektronik posta adresine nöropsikolojik testleri tamamlayacağınız internet sitesinin linki gönderilecektir. Çalışmanın ikinci kısmını tamamlandığınızda size araştırma ile ilgili bilgi verilecek, ardından varsa sorularınız cevaplanacaktır. Son olarak, emeğinizin karşılığı olarak markette veya sanal alışverişte kullanabileceğiniz 30 TL tutarında Migros çeki hediye edilecektir.

Bu çalışmaya katıldığınız için şimdiden teşekkür ederiz. Çalışma ile ilgili daha fazla bilgi almak isterseniz bizimle elektronik posta yolu ile iletişime geçebilirsiniz:

Dr. Öğr. Üyesi Hande Kaynak
Çankaya Üniversitesi Psikoloji Bölümü
E-mail: handek@cankaya.edu.tr

Psk. Fatma Öykü Çobanoğlu
Çankaya Üniversitesi Bilişsel Psikoloji Programı
E-mail: foykucobanoglu@gmail.com

Yukarıda yer alan ve araştırmadan önce katılımcıya verilmesi gereken bilgileri okudum ve katılmam istenen çalışmanın kapsamını ve amacını, gönüllü olarak üzerime düşen sorumlulukları tamamen anladım. Bu çalışmaya tamamen gönüllü olarak katılıyorum ve çalışmayı istediğim zaman bırakabileceğimi biliyorum. Bu koşullarda söz konusu araştırmaya kendi isteğimle katılmayı ve sağladığım bilgilerin bilimsel çalışmada kullanılmasını kabul ediyorum.

☐ Kabul Ediyorum.

Devam Et

APPENDIX C: THE CLARIFICATION TEXT ON PERSONAL DATA PROCESSING AND PROTECTION LAW

Yasal Şartlar

mythesislab.com sitesinde yer alan tüm bilgiler, tablolar, formlar, ölçekler, testler ve buradan verilen tüm linkler, proje yürütücüsü Dr. Öğr. Üyesi Hande Kaynak ve proje araştırmacısı Psk. Fatma Öykü Çobanoğlu tarafından yürütülen ve Çankaya Üniversitesi Bilimsel Araştırma Projeleri (BAP) tarafından fonlanan "Sürekli Tıkınırcasına Yeme Eğilimi Olan Obez Bireylerde Bilgi İşleme Hızı, Seçici Dikkat, Çalışma Belleği ve Set Değiştirme Süreçleri Arasındaki İlişkilerin İncelenmesi: Bir Transkraniyal Doğru Akım Uyarım Çalışması" adlı bilimsel araştırma projesi için sunulmuştur. Bu sitede yer alan bilgiler önceden haber vermeksizin her zaman değiştirilebilir, düzeltilebilir ve çıkarılabilir. Proje yürütücüsü ve araştırmacısı, bu ve benzeri değişikliklerin doğrudan ve/veya dolaylı sonuçlarından, sitedeki bilgilerin farklı anlaşılmasından, kasıt dışında doğru olmamasından, sitede bulunan bilgiler ya da bu bilgilere dayanılarak yapılan işlemlerden veya siteye ulaşılamamasından doğan ve doğacak zarar ve/veya kayıplardan, bu siteden bağlantı yapılarak ulaşılan herhangi bir web sitesine girilmesi veya bunların kullanımından doğabilecek doğrudan ve/veya dolaylı kayıp ve/veya zararlardan hiçbir şekilde sorumluluk kabul etmemektedir.

Sitede mevcut olan bilgiler, proje yürütücüsünün önceden yazılı izni alınmaksızın kısmen veya tamamen kopya edilemez, dağıtılamaz, kiralanamaz, çoğaltılamaz, alt lisansla kullandırılamaz, değiştirilemez, ileride kullanılmak üzere saklanamaz, hiçbir şekilde ticari amaçla kullanılamaz veya kullandırılamaz.

Bu sitede yer alan herhangi bir bilgiyi yasalara veya burada belirtilen kurallara aykırı kullanmak, herhangi bir şekilde tahrif etmek cezai ve hukuki yollara başvurulmasına neden olacaktır.

Bu sitede bulunan bilgi veya ifadelerin (tasarımlar, resimler vb.) telif hakkı projeye aittir; proje yürütücüsünün yazılı izni olmaksızın kullanılamaz. Site ve içeriğindeki bilgilerin kullanımından doğabilecek ihtilaflarda, Türkçe yasal uyarı metni esastır. Siteyi ziyaret eden kullanıcılar aşağıdaki koşulları, yazılanlarla sınırlı olmamak şartıyla tüm maksat ve halin icabı ile kabul etmiş sayılacaktır.

Gizlilik İlkesi

mythesislab.com web sitesini ziyaretiniz dolayısı ile bazı hallerde proje yürütücüsü ve araştırmacısına vereceğiniz kişisel bilgilerinizin toplanma ve kullanma prensipleri aşağıda belirtilmektedir. Toplanan tüm veriler mythesislab.com veritabanında korunmaktadır. Çalışmaya katılım tamamen gönüllülük esasına dayanmaktadır ve hiçbir kimlik bilginiz istenmemektedir. Web sitesini ziyaretiniz hâlinde, size sunulacak olan beş nöropsikolojik testi tamamlamanız beklenmektedir. Kişisel veriler, tarafınızca verilerin paylaşılmasından önce tarafınızdan alınan verilerin işlenmesi, saklanması ve aktarılmasına ilişkin açık onay kapsamında işlenmekte olup sağlayacağınız bilgiler tamamen gizli tutulacak ve sadece araştırmacılar tarafından değerlendirilecektir. Elde edilecek veriler sadece bilimsel amaçlar için kullanılacaktır. Kişisel verileriniz hakemli akademik dergilerde ve proje araştırmacısının yüksek lisans tezinde verileri işleyerek aynı amaç kapsamında aktarılabilir. Bu veriler ancak tarafınızca değiştirilebilir nitelikte olup hiçbir üçüncü kişinin verilere ulaşması ve değiştirmesi teknik anlamda mümkün değildir. Proje yürütücüsü ve araştırmacısı kişisel bilgilerinizin yukarıdaki şartlar çerçevesinde kullanılması sonucu meydana gelebilecek zararlardan dolayı sorumluluk kabul etmez. Siteyi ziyaret eden kullanıcılar bütün bu şartları okumuş ve kabul etmiş sayılırlar. Proje yürütücüsü ve araştırmacısı yukarıda yer alan açıklamaları önceden haber vermeksizin değiştirme hakkını saklı tutar.

Proje ile ilgili daha fazla bilgi almak ve/veya 6698 sayılı Kişisel Verilerin Korunması Kanunu’na (KVKK) göre sahip olduğunuz haklarınızın etkili bir şekilde kullanılması için dilerseniz proje yürütücüsü Dr. Öğr. Üyesi Hande Kaynak (handek@cankaya.edu.tr) ya da proje araştırmacısı Psk. Fatma Öykü Çobanoğlu (foykucobanoglu@gmail.com) ile elektronik posta yolu ile iletişime geçebilirsiniz.

APPENDIX D: DEMOGRAPHIC INFORMATION FORM

Katılımcı No: …………..   **Tarih:** …. / …. / …..

Cinsiyetiniz: Kadın ( ) Erkek ( )

Yaşınız:

Medeni durumunuz: Evli ( ) Bekar ( )

İlişkisi var/Nişanlı ( ) Dul/Boşanmış ( )

Eğitim düzeyiniz: İlkokul ( ) Ortaokul ( ) Lise ( )

Üniversite ( ) Yüksek lisans ( ) Doktora ( )

Mesleğiniz: ……………….

Boyunuz: ………… m   Kilonuz: ………….. kg

Kronik bir hastalığınız var mı?

Evet ( ) Varsa belirtiniz: ………… Diyabet hastasıyım (HbA1C: % …...)

Hayır ( )

Düzenli olarak kullandığınız bir ilacınız var mı?

Evet ( ) : Adı / Tedavi nedeni: …………….. Kullandığınız süre: …………

Hayır ( )

Son 6 ay içerisinde psikiyatrik/nörolojik tedavi gördünüz mü?

Evet ( ) Hayır ( )

Renkleri birbirinden ayırt etmekte güçlük yaşıyor musunuz?

Evet ( ) Hayır ( )

Tanı konmuş bir görme bozukluğunuz var mı?

Evet ( ) Tanınız: ……………

Bozukluğunuz düzeltildi mi? (gözlük, lens, lazer ile vs.):

Hayır ( )

Tanı konmuş bir işitme bozukluğunuz var mı? Evet ( ) Hayır ( )

Düzenli besin takviyesi alıyor musunuz (örn: vitamin, balık yağı, protein tozu vb.)?

Evet ( ) Hayır ( )

APPENDIX E: EATING DISORDER EXAMINATION QUESTIONNAIRE – BINGE EATING SUBSCALE

Lütfen sağdaki boşluğa sizin için uygun olan sayıyı yazınız. Soruların yalnızca son dört haftaya yönelik (28 gün) olduklarını unutmayınız.

	Son dört hafta içinde (28 gün)…	
1.	Son 28 gün içinde, kaç kere başka insanların alışılmadık miktarda fazla (şartlara göre) olarak tanımlayacakları biçimde yemek yediniz?	………..
2.	Bu süre içinde kaç kere yemek yediğiniz sırada kontrolü kaybettiğiniz hissine kapıldınız?	………..
3.	Son 28 günün kaç **<u>GÜNÜNDE</u>** aşırı yemek yeme nöbetleri ortaya çıktı? (örn: Alışılmadık miktarda fazla yemek yediğiniz esnada kontrolünüzü kaybettiğinizi hissettiniz.)	………..
4.	Son 28 gün içinde, bedeninizin şekli ya da kilonuzu kontrol amacıyla kaç <u>kere</u> kendinizi kusturdunuz?	………..
5.	Son 28 gün içinde, bedeninizin şekli ya da kilonuzu kontrol amacıyla kaç <u>kere</u> müshil (bağırsak çalıştırıcı) kullandınız?	……….
6.	Son 28 gün içinde, kilonuzu, bedeninizin şeklini ya da yağ miktarınızı kontrol etmek, kalorileri yakmak amacıyla, kaç kere "kendinizi kaybedercesine" ya da "saplantılı" biçimde egzersiz yaptınız?	……….

APPENDIX F: REZZY/SCOFF EATING DISORDER SCALE

1. Rahatsız edici şekilde tok hissettiğiniz için kendinizi kusturuyor musunuz?

Evet (   )   Hayır (   )

2. Ne kadar yediğiniz konusunda kontrolü kaybettiğiniz için endişeleniyor musunuz?

Evet (   )   Hayır (   )

3. Son zamanlarda 3 ayda 6 kg'dan fazla zayıfladınız mı?

Evet (   )   Hayır (   )

4. Başkaları çok zayıf olduğunuzu söylediği halde şişman olduğunuza inanıyor musunuz?

Evet (   )   Hayır (   )

5. Yemeğin hayatınıza hükmettiğini düşünüyor musunuz?

Evet (   )   Hayır (   )

APPENDIX G: THREE-FACTOR EATING QUESTIONNAIRE REVISED 21-ITEM (TFEQ-R21)

Lütfen kendinize en uygun bulduğunuz cevabı işaretleyiniz.

1. Kilomu kontrol etmek için bilerek küçük porsiyonlarda yemek yemeyi tercih ederim.
(1): Kesinlikle yanlış
(2): Çoğunlukla yanlış
(3): Çoğunlukla doğru
(4): Kesinlikle doğru

2. Endişeli hissettiğimde yemek yemeye başlarım.
(1): Kesinlikle yanlış
(2): Çoğunlukla yanlış
(3): Çoğunlukla doğru
(4): Kesinlikle doğru

3. Bazen yemeğe başladığımda kendimi durduramayacak gibi olurum.
(1): Kesinlikle yanlış
(2): Çoğunlukla yanlış
(3): Çoğunlukla doğru
(4): Kesinlikle doğru

4. Kendimi üzgün hissettiğimde çoğu zaman gereğinden fazla yerim.
(1): Kesinlikle yanlış
(2): Çoğunlukla yanlış
(3): Çoğunlukla doğru
(4): Kesinlikle doğru

5. Bazı yiyecekleri beni şişmanlattığı için yemiyorum.
(1): Kesinlikle yanlış
(2): Çoğunlukla yanlış
(3): Çoğunlukla doğru
(4): Kesinlikle doğru

6. Yemek yiyen birisi ile birlikteyken genelde benim de yeme isteğim uyanır.
(1): Kesinlikle yanlış
(2): Çoğunlukla yanlış
(3): Çoğunlukla doğru
(4): Kesinlikle doğru

7. Stresli veya gergin olduğumda, çoğu zaman yeme ihtiyacı hissederim.
(1): Kesinlikle yanlış
(2): Çoğunlukla yanlış
(3): Çoğunlukla doğru
(4): Kesinlikle doğru

8. Çoğu zaman öylesine acıkırım ki midemi dipsiz bir kuyu gibi hissederim.
(1): Kesinlikle yanlış
(2): Çoğunlukla yanlış
(3): Çoğunlukla doğru
(4): Kesinlikle doğru

9. **Her zaman öyle aç olurum ki tabağımdaki yemeği bitirmeden durmak benim için çok zor olur.**
(1): Kesinlikle yanlış
(2): Çoğunlukla yanlış
(3): Çoğunlukla doğru
(4): Kesinlikle doğru
10. **Kendimi yalnız hissettiğimde, kendimi yemek yiyerek teselli ediyorum**.
(1): Kesinlikle yanlış
(2): Çoğunlukla yanlış
(3): Çoğunlukla doğru
(4): Kesinlikle doğru
11. **Kilo almaktan kaçınmak için öğünlerde yediğim yemek miktarını bilinçli olarak kısıtlıyorum.**
(1): Kesinlikle yanlış
(2): Çoğunlukla yanlış
(3): Çoğunlukla doğru
(4): Kesinlikle doğru
12. **İştah açıcı bir yiyecek kokusu aldığımda veya lezzetli bir yemek gördüğümde, yemeğimi henüz bitirmiş olsam bile kendimi yememek için zor tutuyorum.**
(1): Kesinlikle yanlış
(2): Çoğunlukla yanlış
(3): Çoğunlukla doğru
(4): Kesinlikle doğru
13. **Sürekli her an yemek yiyebilecek kadar aç olurum.**
(1): Kesinlikle yanlış
(2): Çoğunlukla yanlış
(3): Çoğunlukla doğru
(4): Kesinlikle doğru
14. **Eğer kendimi gergin hissedersem, yemek yiyerek sakinleşmeye çalışırım.**
(1): Kesinlikle yanlış
(2): Çoğunlukla yanlış
(3): Çoğunlukla doğru
(4): Kesinlikle doğru
15. **Çok lezzetli olduğunu düşündüğüm bir yiyecek gördüğümde, çoğu zaman o kadar acıkırım ki hemen o an yemek zorunda kalırım.**
(1): Kesinlikle yanlış
(2): Çoğunlukla yanlış
(3): Çoğunlukla doğru
(4): Kesinlikle doğru
16. **Moralim bozuk olduğunda yemek isterim.**
(1): Kesinlikle yanlış
(2): Çoğunlukla yanlış
(3): Çoğunlukla doğru
(4): Kesinlikle doğru

17. Her zaman çekici yemekleri/besinleri fazla satın alarak evde bulundurmaktan kaçınırım.
(1): Kesinlikle yanlış
(2): Çoğunlukla yanlış
(3): Çoğunlukla doğru
(4): Kesinlikle doğru
18. İstediğimden daha azını yemek için çaba sarf etmeye yatkınım.
(1): Kesinlikle yanlış
(2): Çoğunlukla yanlış
(3): Çoğunlukla doğru
(4): Kesinlikle doğru
19. Aç olmamama rağmen yemek yemeye devam ederim.
(1): Kesinlikle yanlış
(2): Çoğunlukla yanlış
(3): Çoğunlukla doğru
(4): Kesinlikle doğru
20. Akşam geç saatlerde veya çok acıkınca kendimi tutamayıp yemek yerim.
(1): Kesinlikle yanlış
(2): Çoğunlukla yanlış
(3): Çoğunlukla doğru
(4): Kesinlikle doğru
21. Yemek yerken kendimi her zaman kısıtlarım.
(1): Kesinlikle yanlış
(2): Çoğunlukla yanlış
(3): Çoğunlukla doğru
(4): Kesinlikle doğru

APPENDIX H: SHORT FORM OF BARRATT'S IMPULSIVENESS SCALE, VERSION 11 (BIS-11-SF)

İnsanlar farklı durumlarda gösterdiği düşünce ve davranışları ile birbirinden ayrılırlar. Bu test bazı durumlarda nasıl düşündüğünüzü ve davrandığınızı ölçen bir testtir. Lütfen her cümleyi okuyunuz ve bu sayfanın sağındaki, size en uygun kutucuğun içerisine X koyunuz.

Cevaplamak için çok zaman ayırmayınız. Hızlı ve dürüstçe cevap veriniz.

	Nadiren	**Bazen**	**Sıklıkla**	**Her zaman**
1. İşlerimi dikkatle planlarım.				
2. Dikkatli düşünen birisiyim.				
3. İş güvenliğine dikkat ederim.				
4. Düşünerek hareket ederim.				
5. Geleceğini düşünen birisiyim.				
6. Uçuşan düşüncelerim var.				
7. Aklıma estiği gibi hareket ederim.				
8. Düşünmeden alışveriş yaparım.				
9. Hobilerimi değiştiririm.				
10. Kazandığımdan daha fazla harcarım.				
11. Düşünmeden iş yaparım.				
12. Dikkat etmem.				
13. Düşünmeden bir şeyler söylerim.				
14. Düşünmeden hareket ederim.				
15. Zor problemler çözmem gerektiğinde kolayca sıkılırım.				

APPENDIX I: PASAT RECORD FORM A

Tarih ________

Saat ________

Adı-Soyadı ______________________________ Cinsiyeti __________

Doğum tarihi (GG/AA/YYYY) __________ Mesleği __________

PASAT - FORM A

Deneme	9+1 10__	3 4 __	5 8 __	2 7 __	6 8 __	4 10__	9 13__	7 16__	1 8 __	4 5 __
Deneme	9+1 10__	3 4 __	5 8 __	2 7 __	6 8 __	4 10__	9 13__	7 16__	1 8 __	4 5 __
Deneme	9+1 10__	3 4 __	5 8 __	2 7 __	6 8 __	4 10__	9 13__	7 16__	1 8 __	4 5 __

Test

1+4 5 __	8 12__	1 9 __	5 6 __	1 6 __	3 4 __	7 10__	2 9 __	6 8 __	9 15__
4 13__	7 11__	3 10__	5 8 __	3 8 __	6 9 __	8 14__	2 10__	5 7 __	1 6 __
5 6 __	4 9 __	6 10__	3 9 __	8 11__	1 9 __	7 8 __	4 11__	9 13__	3 12__
7 10__	2 9 __	6 8 __	9 15__	5 14__	2 7 __	4 6 __	8 12__	3 11__	1 4 __
8 9 __	5 13__	7 12__	1 8 __	8 9 __	2 10__	4 6 __	9 13__	7 16__	9 16__
3 12__	1 4 __	5 6 __	7 12__	4 11__	8 12__	1 9 __	3 4 __	8 11__	2 10__

Toplam Doğru Sayısı = ______ Doğru Yüzdesi = ______

9-HPT

Dominant el ☐ sağ ☐ sol

sağ sol Deneme 1 ______ sn Deneme 2 ______ sn ☐ Tamamlanamadı

sağ sol Deneme 1 ______ sn Deneme 2 ______ sn ☐ Tamamlanamadı

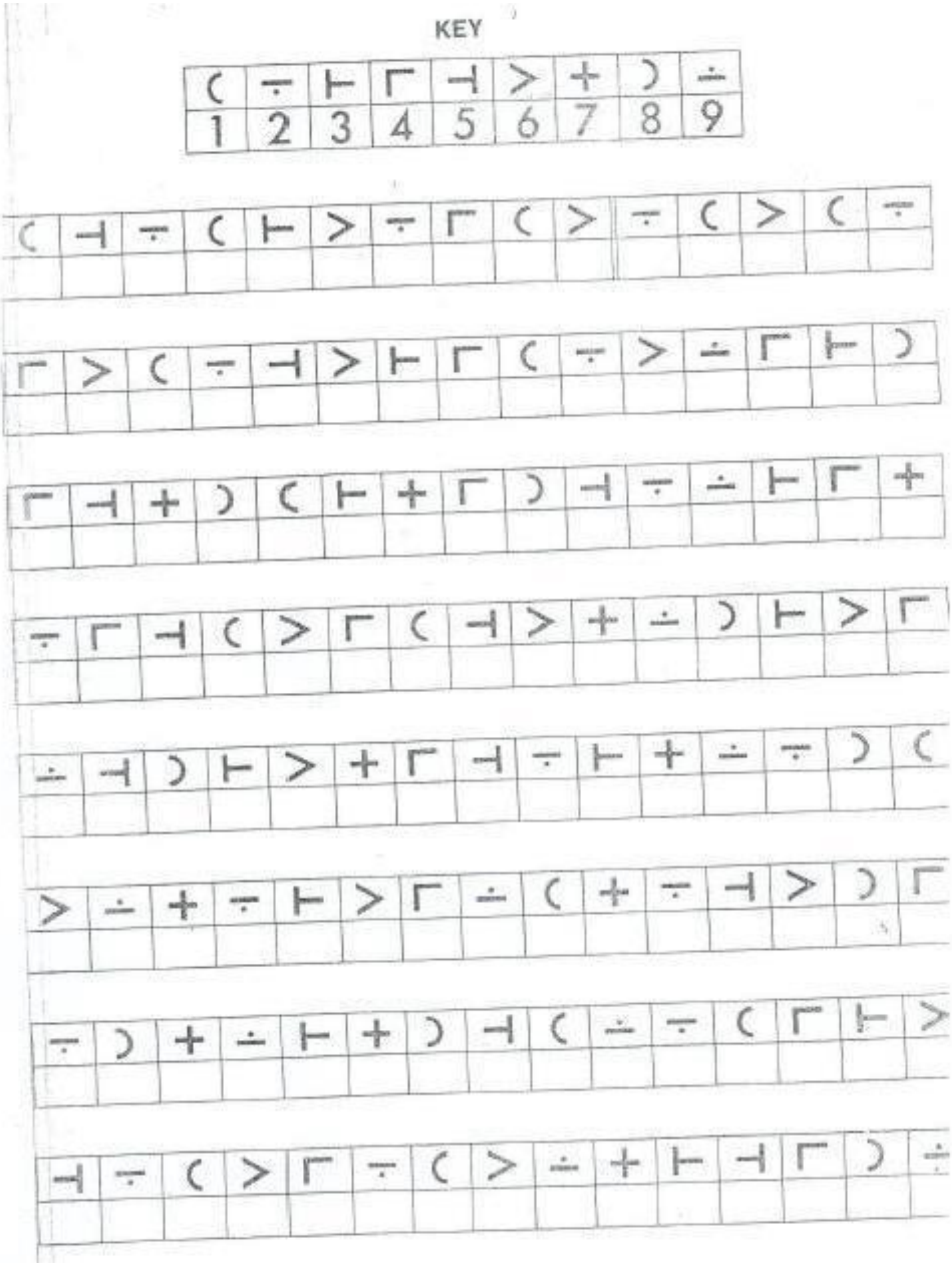
8M YÜRÜME TESTİ

Deneme 1 ________ sn Deneme 2 ________ sn ☐ Tamamlanamadı

☐ Desteksiz

☐ Destekle..........................
(Kullanılan desteği belirtiniz)

APPENDIX J: SYMBOL DIGIT MODALITIES TEST



APPENDIX K: STROOP TEST TBAG FORM - MANUAL

STROOP TESTİ TBAG FORMU

KAYIT FORMU

Adı soyadı: **Doğum Tarihi:**
Yaşı:

Cinsiyeti: **Eğitim düzeyi:**
Uygulama Tarihi:

Bölüm 1: Siyah basılmış renk ismi okuma

M S K Y
Y M S K
Y K M S
K Y S M
S K Y M
K M S Y

Bölüm 2: Renkli basılmış renk ismi okuma

M S K Y
Y M S K
Y K M S
K Y S M
S K Y M
K M S Y

Bölüm 3: Şekil rengi söyleme

Y M S K
S K Y M
M Y S K
M S K Y
K Y M S
S Y M K

Bölüm 4: Renk ismi olmayan Kelime rengi söyleme

Y M S K
S K Y M
M Y S K
M S K Y
K Y M S
S Y M K

Bölüm 1: Renk ismi olan kelime rengi söyleme

Y M S K
S K Y M
M Y S K
M S K Y
K Y M S
S Y M K

	Toplam süre	Hata sayısı	Düzeltme sayısı
Bölüm 1			
Bölüm2			
Bölüm3			
Bölüm4			
Bölüm5			

APPENDIX L: WECHSLER MEMORY SCALE – REVISED

GENEL BİLGİ VE YÖNELİM SORULARI Bütün maddeleri aynen verildiği gibi uygulayın.	
Sorular Cevaplar	Puan (1 veya 0)
1. Kaç yaşındasınız ?	
2. Doğum tarihiniz nedir (Gün-Ay-Yıl)?	
3. Doğum yeriniz neresidir?	
4. Annenizin adı nedir?	
5. Şu anki Cumhurbaşkanımız kimdir?	
6. Ondan önceki Cumhurbaşkanımız kimdi?	
7. Hangi yıldayız?	
8. Hangi aydayız?	
9. Bugün ayın kaçı?	
10. Şu anda neredesiniz?	
11. Hangi şehirdesiniz?	
12. Bugün günlerden ne ?	
13. Saate bakmadan şu anda saatin kaç olduğunu söyler misiniz?	
14. Sağ elinizi mi yoksa sol elinizi mi kullanıyorsunuz?	X
15. Herhangi bir işitme bozukluğunuz var mı?	X
16. Herhangi bir görme bozukluğunuz var mı?	X
17. Renk körlüğünüz var mı?	X
En Yüksek Puan = 13 Aldığı Toplam Puan =	

SAYI UZAMI Denek, bir maddenin her iki denemesinde başarısız olduğunda altteste son verin. I. Denemede başarılı olsa da olmasa da, deneğe II. Denemenin ilgili maddesini uygulayın.					
DÜZ SAYI UZAMI					
Madde	I. Deneme	Puan (1veya 0)	II. Deneme	Puan (1veya 0)	Puan (2,1 veya 0)
1.	6 - 2 9		3 - 7 -5		
2.	5 - 4 - 1 - 7		8 - 3 - 9 - 6		
3.	3 - 6 - 9 - 2- 5		6 - 9 - 4 - 7 - 1		
4.	9 - 1 - 8 - 4 - 2 - 7		6 - 3 - 5 - 4 - 8 - 2		
5.	1 - 2 - 8 - 5 - 3 - 4 - 6		2 - 8 - 1 - 4 - 9 - 7 - 5		
6.	3 - 8 - 2 - 9 - 5 - 1 - 7 - 4		5 - 9 - 1 - 8 - 2 - 6 - 4 - 7		
En Yüksek Puan = 12					
TERS SAYI UZAMI Denek Düz Sayı Dizileri Uzamından 0 puan almış olsa da Ters Sayı Dizileri Uzamını uygulayın.					
Madde	I. Deneme	Puan (1veya 0)	I I. Deneme	Puan (1veya 0)	Puan (2,1 veya 0)
1.	5 – 1		3 - 8		
2.	4 - 9 – 3		5 - 2 - 6		
3.	3 - 8 - 1 – 4		1 - 7 - 9 - 5		
4.	6 - 2 - 9 - 7 – 2		4 - 8 - 5 - 2 - 7		
5.	7 - 1 - 5 - 2 - 8 - 6		8 - 3 - 1 - 9 - 6 - 4		
6.	4 - 7 - 3 - 9 - 1 - 2 - 8		8 - 1 - 2 - 9 - 3 - 6 - 5		
En Yüksek Puan = 12					
Düz ve Ters Sayı Uzamı En Yüksek Puan = 24 ToplamPuan=					

GÖRSEL BELLEK UZAMI Denek, bir maddenin her iki denemesinde başarısız olduğunda altteste son verin. I. Denemede başarılı olsa da olmasa da, deneğe II. Denemenin ilgili maddesini uygulayın.					
DÜZ GÖRSEL BELLEK UZAMI					
Madde	I. Deneme	Puan (1veya 0)	II. Deneme	Puan (1veya 0)	Puan (2, 1 veya 0)
1.	2 - 6		8 - 4		
2.	2 - 7 - 5		8 - 1 - 6		
3.	3 - 2 - 8 - 4		2 - 6 - 1 - 5		
4.	5 - 3 - 4 - 6 - 1		3 - 5 - 1 - 7 - 2		
5.	1 - 7 - 2 - 8 - 5 - 4		7 - 3 - 6 - 1 - 4 - 8		
6.	8 - 2 - 5 - 3 - 4 - 1 - 6		4 - 2 - 6 - 8 - 3 - 7 - 5		
7.	7 - 5 - 6 - 3 - 8 - 7 - 4 - 2		1 - 6 - 7 - 4 - 2 - 8 - 5 - 3		
En Yüksek Puan = 14					

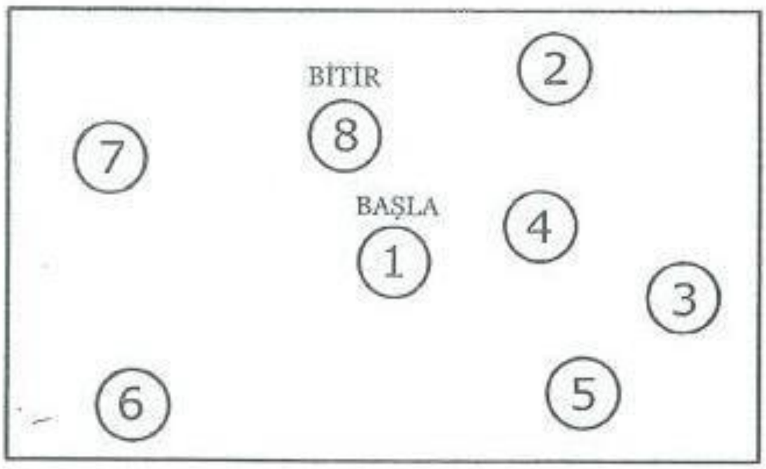
				Toplam	
TERS GÖRSEL BELLEK UZAMI Denek Düzden Dokunmadan 0 puan almış olsa da Tersten Dokunmayı uygulayın .					
Madde	**I. Deneme**	**Puan (1veya 0)**	**II. Deneme**	**Puan (1veya 0)**	**Puan (2, 1 veya 0)**
1.	3 - 6		7 - 4		
2.	6 - 8 - 5		3 - 1 - 8		
3	8 - 4 - 1 - 6		5 - 2 - 4 - 1		
4.	4 - 6 - 8 - 5 -2		8 - 1 - 6 - 3 - 7		
5.	7 - 1 - 8 - 3 - 6 - 2		3 - 8 - 1 - 7 - 5 - 4		
6.	1 - 5 - 2 - 7 - 4 - 3 - 8		6 - 7 - 4 - 3 - 1 - 5 - 2		
				En Yüksek Puan = 12	
				Düz ve Ters Görsel Bellek Uzamı En Yüksek Puan= 26 Toplam=	

APPENDIX M: TRAIL MAKING TEST

İZ SÜRME TESTİ

A FORMU

ALIŞTIRMA

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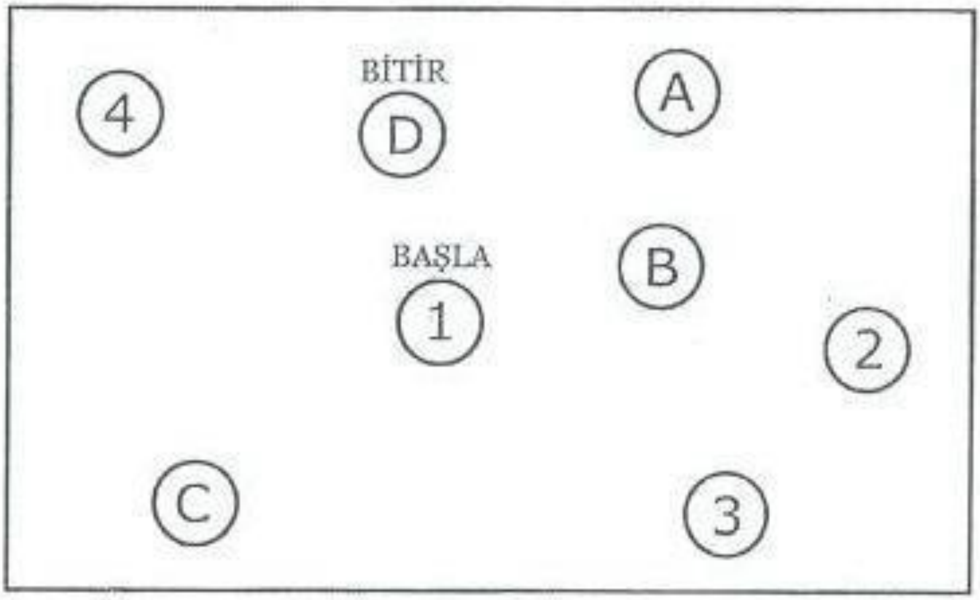
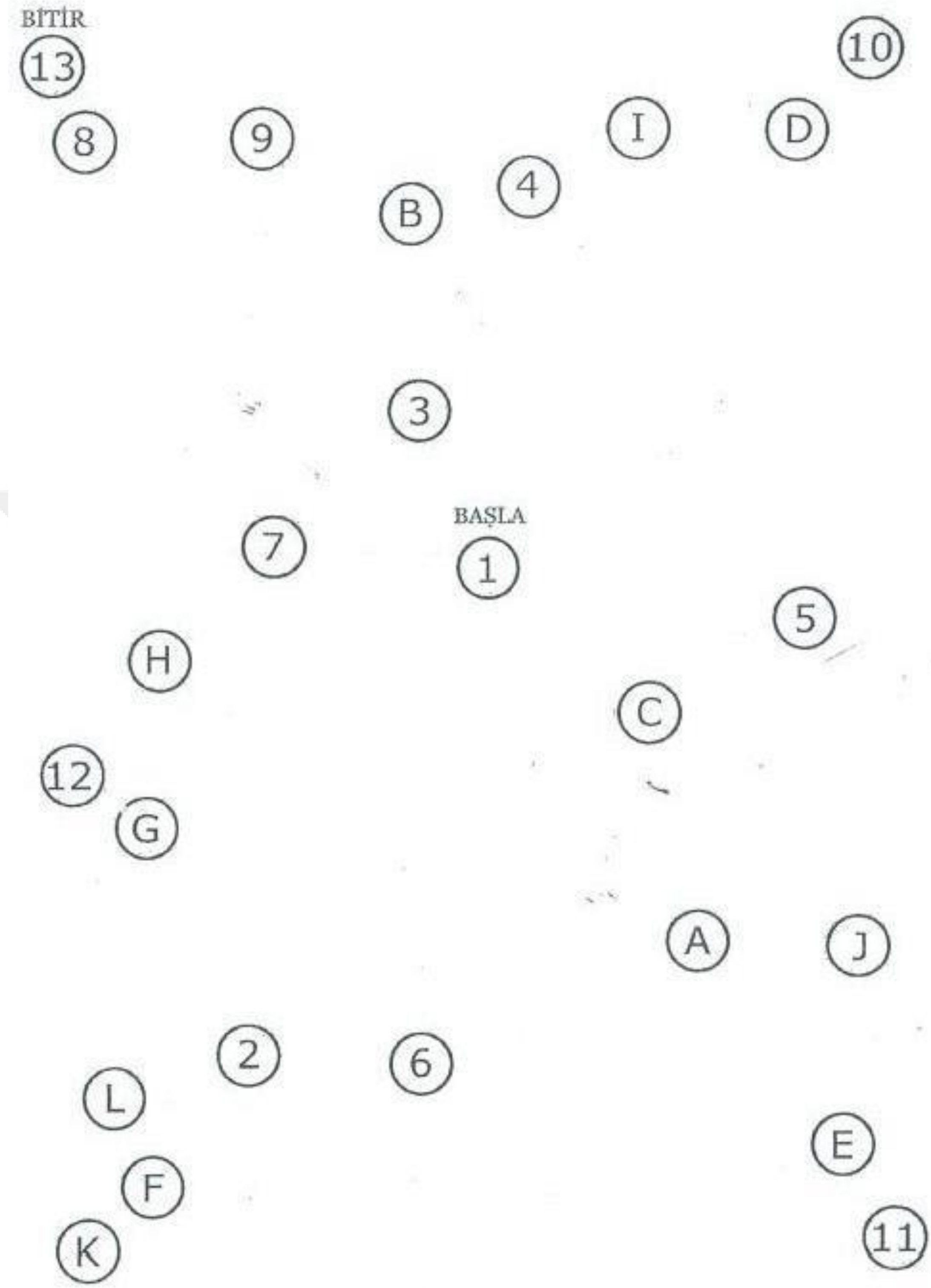
17
21
20
19
16
18
4
22
5
13
6
BAŞLA
24
1
7
14
2
10
8
3
BİTİR
9
11
25
12
23

İZ SÜRME TESTİ

B FORMU

ALIŞTIRMA




BİTİR
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