

T.C.
YEDİTEPE UNIVERSITY
INSTITUTE OF HEALTH SCIENCES
DEPARTMENT OF NUTRITION AND DIETETICS

**INVESTIGATION OF THE EFFECTS OF
DIFFERENT ONLINE NUTRITION COUNSELING
INTERVENTIONS ON WEIGHT CONTROL**

MASTER'S THESIS

EZGİ MISIRLI

İstanbul, 2021

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SUPERVISOR

Assist. Prof. Dr. İrem KAYA CEBİOĞLU

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	Title, Name-Surname (Institution)
Chair of the Jury:	Dr. Binnur Okan Bakır (Yeditepe University)
Supervisor:	Asst.Prof.Dr. İrem Kaya Cebioğlu (Yeditepe University)
Member/Examiner:	Assoc. Prof. Dr. Jale Çatak (İstanbul Zaim University)

APPROVAL

This thesis has been deemed by the jury in accordance with the relevant articles of Yeditepe University Graduate Education and Examinations Regulation and has been approved by Administrative Board of Institute with decision dated and numbered

Prof. Dr. Bayram YILMAZ
Director of Institute of Health Sciences

DECLARATION

This thesis is my own work, I did not have unethical behavior at any stage from planning to writing, I obtained all the information in the thesis within academic and ethical rules, I refer to all the information and comments that were not obtained through the thesis study and that I included these sources in the list of references, during the thesis study and writing. and I declare that I am not violating copyright.

History

20.08.2021

Name and surname

EZGİ MISIRLI

TABLE of CONTENTS

APPROVAL	ii
DECLARATION	iii
TABLE of CONTENTS	iv
LIST OF TABLES	vi
LIST OF SYMBOLS and ABBREVIATIONS	vii
ABSTRACT	viii
ABSTRACT (Turkish)	ix
1. INTRODUCTION and PURPOSE	1
2. LITERATURE REVIEW	4
2.1. Obesity	4
2.1.1. Definition and Types of Obesity	4
2.1.2. Obesity Epidemiology and Etiology	6
2.1.3. Clinical Features and Diagnosis of Obesity	13
2.1.4. Complications of Obesity	19
2.2. Obesity Treatment	27
2.2.1. Prevention of Obesity	27
2.2.2. Medical Nutrition (Diet) Therapy	30
2.2.2.1. Macro Nutrient Requirements	33
2.2.2.2. Eating habits	37
2.2.3. Physical Activity	38
2.2.4. Pharmacological Treatment	40
2.2.5. Surgical treatment	40
2.2.6. Cognitive (Behavioral Change) Treatment	41
2.2.7 Lifestyle Interventions	41
2.3. Online Nutrition Consultancy	42

2.3.1. Telehealth Services	42
2.3.2. Telenutrition in Nutrition Monitoring	45
3. MATERIALS and METHODS	48
4. RESULTS	51
5. DISCUSSION AND CONCLUSION	59
6. REFEEFERCES	67



LIST OF TABLES

Table 2. 1 International Classification in which nutrition status is evaluated according to body mass index prepared by the World Health Organization	16
Table 2.2 Body Fat Percentage Values In Adults (%).	17
Table 2.3 Strategies Identified By The CDC To Increase Physical Activity In The Community Preventive Services Guide.....	29
Table 4.1 Demographic Characteristics.....	51
Table 4.2. Medical History of Participants.....	51
Table 4.3. Eating Habits.....	52
Table 4.4. Weekly Average Weight Values of The Participants.....	54
Table 4.5. Weekly Average BMI Values of The Participants.....	55
Table 4.6. The Weight Differences Between Three Groups.....	56
Table 4.7. The BMI Differences Between Three Groups.....	57
Table 4.8. The BMI Percentage Differences Between Three Groups.....	57
Table 4.9. The Weight (kg) Differences Between Three Groups.....	58

LIST OF SYMBOLS AND ABBREVIATIONS

AI	Artificial Intelligence
BMI	Body Mass Index
FTO	Obesity-Associated Gene
HNANES	National Health and Nutrition Examination Survey
IoT	Internet of Things
LDL	Low-Density Lipoprotein
NAFLD	Non Alcoholic Fatty Liver Disease
NAHS	Non-Acholic Hepatosteatoz
POUNDS	Prevention Study Using New Dietary Strategies
USDA	American Department of Agriculture
WHO	World Health Organization

ABSTRACT

Mısırlı, E. (2021). Investigation of the Effects of Different Online Nutrition Counseling Interventions on Weight Control. Yeditepe University, Institute of Health Science, Department of Nutrition, MSc thesis, İstanbul.

This thesis study aimed to investigate the differences in the effectiveness of different methods of online nutritional therapy by utilizing three different methods used in the online consulting system of individuals. It included only female adults over 18 years old and older as participants. Intervention groups were formed according to the follow-up system preferred by individuals among the volunteers. Three different intervention methods were examined in the study: Motivation Group (in contact with each other via WhatsApp), Monitoring Group, and Mail Group. While individuals in all intervention groups were followed for 8 weeks, weekly meetings were held with the dietitian in the Motivation Group and the Monitoring Group. The calorie and nutrient content of the diets of all participants will be Dietary Approaches to Stop Hypertension (DASH) for the standardization of nutrition programs. Physical activity for 165 minutes per week is added to their program. Total 102 female patients participated in this study. When the weekly weight follow-ups were examined for each group within themselves, significant weight loss was detected every week as well as BMI change. The highest weight loss was observed in the motivation group with 9.49 kg. Then the monitor group comes in with 8.02 kg and the mail group with 3.7 kg. These differences are statistically significant. Body Mass Index differences are higher at Motivational Group than other groups and this difference is statistically significant ($p<0.05$). Conclusion: Participant's weekly dietitian-led interactive Web-based meeting participation, communication with each other were important predictors of weight loss in an 8-week intervention.

Keywords: Online Nutrition Therapy, Tele Nutrition, Motivational Nutrition Therapy

ÖZET

Mısırlı, E. (2021). Farklı Online Beslenme Danışmanlığı Müdahalelerinin Kilo Kontrolü Üzerindeki Etkisinin Araştırılması. Yeditepe Üniversitesi Sağlık Bilimleri Enstitüsü, Beslenme ve Diyetetik ABD., Yüksek Lisans Tezi. İstanbul.

Bu çalışmada, bireylerin online danışmanlık sisteminde kullanılan 3 farklı yöntemin, online beslenme tedavisi ile farklı yöntemlerin etkinliğindeki farklılıkların belirlenmesi amaçlandı. Gereç ve Yöntem: Çalışmaya 18 yaş üstü kadın bireyler dahil edilirken, gönüllüler arasından bireylerin tercih ettiği takip sistemine göre müdahale grupları oluşturuldu. Çalışmada üç farklı müdahale yöntemi incelendi: Motivasyon Grubu (whatsapp üzerinden birbirleriyle iletişim halinde), İzleme Grubu ve Mail Grubu. Tüm müdahale gruplarındaki bireyler 8 hafta boyunca izlenirken Motivasyon Grubu ve İzleme Grubunda diyetisyen ile haftalık görüşmeler gerçekleştirildi. Tüm katılımcıların diyetlerinin kalori ve besin içeriği, beslenme programlarının standardizasyonu için Hipertansiyonu Durdurmak için Diyet Yaklaşımları (DASH) oldu. Haftada 165 dakika fiziksel aktivite programlarına eklendi. Bulgular: Çalışmamıza toplam 102 kadın hasta katıldı. Her grup kendi içinde haftalık kilo takipleri incelendiğinde, her hafta önemli kilo kaybı ve BKİ değişimi tespit edildi. En fazla kilo kaybı 9.49 kg ile motivasyon grubunda gözlemlendi. Ardından 8,02 kg ile monitör grubu ve 3,7 kg ile mail grubu gelmektedir. Bu farklar istatistiksel olarak anlamlıdır. Motivasyon Grubunda Beden Kitle İndeksi farklılıkları diğer gruplara göre daha yüksektir ve bu fark istatistiksel olarak anlamlıdır ($p<0,05$). Sonuç: Katılımcının haftalık diyetisyen liderliğindeki etkileşimli Web tabanlı toplantı katılımı, birbirleriyle iletişimleri, 8 haftalık bir müdahalede kilo kaybının önemli yardımcılarıydı.

Anahtar Kelimeler: Online Beslenme Danışmanlığı, Tele Beslenme, Motivasyonel Beslenme Danışmanlığı

1.INTRODUCTION and PURPOSE

Recent reports published by WHO (World Health Organization) defined it as excessive accumulation of fat in the body that poses a health risk. In determining obesity, a measurement calculation system, Body Mass Index (BMI), is typically utilized. The WHO shared that there has been an obesity pandemic existence in recent years and an increasing trend in terms of obesity prevalence across the world. In addition, in a 2016 statement, the WHO stated that obesity has been causing a higher risk of death than infectious viruses and malnourishment (1).

According to the Prevalence of Endocrinologic Diseases Study in Turkey II (TURDEP- II study), the prevalence of obesity in our country is 36%. Between the TURDEP-I and TURDEP-II surveys, the average body mass index in Turkey increased from 26.6 to 28.6 kg/m² and the average waist from 87.2 to 94.5 cm in 12 years. The rate of increase in abdominal obesity was found to be 35% (2).

Excess weight and obesity are strongly associated with many pathologies, including atherosclerotic cardiac disease, diabetes mellitus, various kinds of cancer. Two important mechanisms that cause the development of cardiovascular disease in obese people, a metabolic disorder, systemic inflammation, and metabolic syndrome and its complications contribute to the development of low-grade chronic inflammation. Metabolic syndrome occurs as an indicator of metabolic disorder associated with obesity (3). The WHO explains that 41 million people in the world have died due to these diseases (1).

Obesity treatment consists of different methods such as nutritional changes, increasing physical activity, behavioral changes, medical and surgical treatment (4). Considering present dietary methods and ideas, the energy intake and output of the body should be balanced in order to lose weight. The calories in foods play significant roles for the energy balance and are significant for the weight loss efforts, foods are not only composed of calories. When determining an appropriate weight loss diet, it is essential to choose the preferred foods as well as replace low-calorie but healthy nutrients that could promote a healthy life with the quality of a diet. The composition of macronutrients aside, the decrease

of the energy intake is nevertheless a fundamental constituent of a diet effectivity (5). Simultaneous video communication, also known as Video conferencing or telehealth, is considered an important and available approach and implementations offered via video cameras connected to devices (e.g. smartphone, PC, tablet) over the internet technology (6). It has the chance of simultaneous video communication for about 4 billion individuals worldwide with internet access, a video camera, and a device (7). Video communication applications e.g. Zoom could be easily and freely downloaded from the Internet and is extensively used every day for professional, group, and personal communication. Another advantage of Online video counseling is that it provides individual counseling mode, which allows advisers to respond to the advisor's verbal and non-verbal cues, as opposed to phone assistance, voice-only support, and written resources. There is an opportunity for immediate clarification of doubts, or to identify reluctance or enthusiasm in both voice and body language, minimizing the possibility of misunderstanding as a result (8). Real-time video counseling is also associated with travel time and face-to-face eliminates the costs of interventions, visits to the clinic to avoid the stigma associated with preferred video-calling potential increases convenience and discretion that can be done in a private place and has access to a wide. Real-time video counseling is known as useful software for large-scale purposes to identify any health risks related to nutrition, alcohol consumption, smoking, obesity, and physical activity (6, 9).

Telehealth is the larger scope of the online health care system, while telemedicine is specifically used for only remote clinical services (10). With changing technology, most dietitians have started telemedicine practices without any previous experiences in consultation. The use of telemedicine has potential benefits such as decreasing costs of healthcare, promoting access to healthcare, helping patient compliance and outcomes. Similarly, telemedicine can also remove any barriers in geographic issues as well as assist global access to patients worldwide. In addition, telemedicine could provide opportunities for the collection of further information about the patients by online platforms. For example, some dietitian experts might need information about a patient's foods, kitchen, and serving utilities, and may conduct drug and supplement reviews (11).

In this study, 3 different methods were used in the online consulting system of individuals it is aimed to determine the differences in effectiveness created in nutritional therapy processes.



2. LITERATURE REVIEW

2.1. Obesity

Obesity, which has been expressed by the WHO in recent years with the analogy of the pandemic; is a complicated multifunctional chronic disease caused by the interaction of genetic and environmental factors, which can be explained by any rise in body fat mass compared to the lean body mass because the energy provided by the body intake is more than the energy consumed (12, 13).

2.1.1. Definition and Types of Obesity

When viewed historically, more weight gain and associated health outcomes, population-based anthropometric measurements (a society where the norms of gender-specific body weight and height) are defined using. However, these data are based only on individual measurements of people without taking into account adiposity and are calculated by using a formula $\text{weight (kg)} / \text{height (m}^2\text{)}$, commonly called BMI (14).

The National Health Institute (NHI) and the World Health Organization (WHO) have identified Body Mass Index (BMI) as a standard for describing the obesity of individuals (1,15). This new method substituted older systems that required fat estimates as well as specific weight-height tables gender-wise. BMI system depends on the ratio of the body weight to the square of the body height within normal adult body features. The BMI calculation results in less than 18.5 and higher than 40 kg/ m². BMI index for a normal person should be between 18.5 40 kg/ m² and 24.9 40 kg/ m². A person with a BMI of between 25.0 and 29.9 kg/m² is considered overweight. Obese people have a BMI index higher than 30 kg/m². United States Center for the Disease Control and Prevention (CDC) recommends that a decision should be made by looking at age-based BMI charts for children and adolescents, reducing obesity to 95 percent of the standard weight. defines it as a BMI above percentile (16).

BMI ranges between 25 kg/m² and 29.9 kg/m² is typically categorized as the overweight definition for children by age BMI charts; standard weight 90 is defined as a BMI in or above the percentile slice. Studies have been conducted that show that being overweight as a child is a marker of being overweight or obese in adulthood (17). Preventing and eliminating excess weight demands a more tolerant and more reasonable way to combat obesity, without taking into account individual differences. Being overweight is, up to a point, a “welfare disease,” as countries recover from extreme poverty, the excess weight among women will increase. However, as countries continue to prosper, there is a decrease in overweight. At the same time, in low-income countries, higher socioeconomic status (SES) is likely to be overweight women with a low socioeconomic status more than those of middle-income countries, more weight load, women of low socioeconomic status are more likely (18).

Obesity treatments are as old as Hippocrates, which recommends certain changes in the lifestyles of obese individuals. William Banting becomes the first person with the popular books on a diet 2000 years later (14).

Obesity is caused by cellular differences in adipose tissue and is divided into two types: android and gynoid. The Android type has larger fat (hypertrophy) cells, while the gynoid type has increased fat cell count (hyperplasia) (19).

In male (android) type obesity, adipose tissue has a predominant visceral and upper thoracic distribution, while in the feminine (gynoid) type adipose tissue is predominantly found in the lower part of the body (buttocks and thighs). Android obesity is more related to a cardiovascular risk factor than gynoid obesity. Although environmental factors play a role in its development, the presence of this pathology in families contributes significantly to its emergence. Android obesity is associated with metabolic abnormalities that also characterize X syndromes, such as insulin resistance, arterial hypertension, and dyslipidemia. The tendency of individuals with Android obesity to become diabetic is partly due to genetic and partly due to environmental factors. Hyperinsulinemia and high free fatty acid flow, two determining factors for Type 2 diabetes mellitus (T2DM), act at the level of the liver and

endocrine pancreas to increase insulin resistance and reduce insulin secretion. Other functional anomalies have also been included to explain Android obesity, such as the irregularity of adrenocortical and sexual steroids or a global irregularity in stress mechanisms. However, no significant evidence seems to support one of these hypotheses (19).

Gynoid fat is composed of long-chain polyunsaturated fatty acids. Because of these fatty acids in breast milk, it has been indicated that breastfed babies tend to have enhanced and higher levels of cognitive abilities, as it has been suggested that it aids early brain progress in fetuses and newborns. Docosahexaenoic acid and Arachidonic acid (14,19) are two important fatty acids found in human breast milk, which have a critical role in the formation of a healthy body and the function of the neurons.

Gynoid fat contributes to the female body shape that girls begin to develop in adolescence; it is stored on the breasts, buttocks, thighs, and bottom parts of the body. Such a process is modulated with the estrogen, female hormones, causing her to store much more fat tissues than the males, mainly affected by the male testosterone (17).

2.1.2. Epidemiology and Etiology of Obesity

The WHO shares that there has been an obesity pandemic in recent years and the prevalence of obesity across the world has been increasing. In addition, in a 2016 statement, the WHO stated that obesity has a higher risk of death from infectious diseases and starvation (1). The prevalence of obesity in the United States (US) has increased dramatically since 1990, and according to current data, more than a third of adults (more than 72 million people) and 17% of children and adolescents are classified as obese (20). A study conducted in European countries found that the prevalence of obesity in women was between 6.2-36.5% in different countries and 4-28, 3% in men (21).

Overweight and obesity are problems worldwide, affecting more than one hundred million citizens in the US, which comprises more than one of third of the population. The US National Health and Nutrition Review Survey reported that obesity affected about 35%

of men and 40.4% of women in the US from 2013 to 2014. The prevalence of obesity for the group of children between the ages of 2 and 19, was 17.0% between 2011 and 2014. The severe obesity category, BMI being higher than 40 kg/m², showed the fastest increase and is considered as the most challenging treatment group (22).

In our country, the prevalence of obesity is also increasing. In terms of the TURDEP-II study conducted by Satman and his colleagues, the prevalence of obesity in our country is 36%. Between TURDEP-I and TURDEP-II surveys, the average body mass index in Turkey increased from 26.6 kg/m² to 28.6 kg/m² in 12 years and the average waist increased from 87.2 to 94.5 cm. The rate of increase in Abdominal obesity was found to be 35% (2).

Obesity is caused by a positive energy balance that is sustained for a long period of time. There are several complex mechanisms in this positive energy balance beyond one's control. Because the causes of obesity can partially overlap, it is a multifactorial condition. Multifactorial obesity is common, as it may be due to a specific etiological factor identified. Multifactorial obesity refers to the complication of such a disease caused by any genetic and environmental risk factors. Obesity, which can be attributed to a certain etiological issue, is required for the individuals involved to have a BMI level higher than the age-appropriate limit value, should be clinically significant. The multifactorial etiology of obesity makes it difficult to find long-term solutions (23)

2.1.2.1.Genetic

The genetic etiology of obesity can be divided into two categories. First, Mendelian (or monogenic) obesity identifies individuals carrying a rare gene variant that has a dramatic effect on adiposity. These variants are associated with a lifetime high risk of disease and exhibit an almost one-to-one relationship between the genotype and phenotype. Monogenic obesity can be classified as syndromic or non-syndromic. Syndromic obesity refers to Mendelian obesity, which occurs along with different clinical phenotypes, such as mental retardation, dysmorphic features, and organ-specific developmental abnormalities. Pathogenic mutations and structural variations in genes in the leptin-melanocortin pathway generally cause non-syndromic forms, which are primarily characterized by hyperphagic

obesity. Homozygous - compound heterozygous carriers of pathogenic mutations in genes through the Leptin - melanocortin pathway are found extremely rare, leading to a completely penetrating form for early extreme obesity. Conversely, heterozygous incomplete penetrating mutations along a similar pathway explain a larger proportion of oligogenic obesity cases. Heterozygous loss of function mutation carriers in MC4R exhibit mildly obese phenotypes that can be mitigated by environmental factors that increase the risk of obesity (24,25).

Monogenic obesity and single forms of syndrome obesity are depicted. Related studies have provided us with valuable information about important central pathways for regulating body weight. In total, these forms of obesity account for 2-4% of all obesity patients, and among them carriers of functionally related melanocortin-4 receptor gene mutations have a large proportion. This autosomal dominant form of obesity has been shown to increase adult body weight by about 15 and 30 kg in men and women, respectively (26). Leptin deficiency, which passes through autosomal recessive inheritance, is the only form of monogenic obesity that can be treated causally through leptin replacement therapy (27).

Secondly, various obesity cases could be credited to the harmonious presence of DNA variation in various genes, with each of that of a relatively small effect, identified as polygenic obesity. With regard to body weight regulation, contemporary simulations estimate many variants with slight to moderate effects that could explain the genetic makeup of composite traits such as obesity (25). The heritability of obesity and BMI was estimated at about 0.6 to 0.8 per twin studies and was found to be similar from pre-adolescence to late adulthood (28).

In a genome-related meta-analysis, 97 BMI loci have been identified, demonstrating the broad significance of the genome. Some related alleles might vary in body weight by approximately 200 g and are sufficient to explain about 3% of the total BMI variation in a population. The mechanisms related to the effect or ineffectiveness of the two alleles on each other have not yet been clarified at the molecular level. Gene-gene or gene-environment interactions are just beginning to be investigated (29).

2.1.2.2. Feeding Habits

Eating habits are one of the factors that significantly lead to the fast spread of obesity. Notwithstanding growing interest in healthy eating, the increased energy awareness and fat content of foods, and a variety of lean availability, lean, and sugar-free foods and beverages, obesity continues to be widespread. In modern society, an abundance of cheap and intense energy foods, numerous conveniently located food businesses that encourage eating away from home, various foods at mealtime, and excessive portion size facilitate excessive consumption. Food manufacturing companies try to improve the appearance and flavor of their foods as well as encourage overeating via successful advertising and marketing. The effects are dramatic as they have negative health effects and cause messages about healthy eating to be misrepresented (30).

In the Western world, the emergence of food biotechnology allows the consumption of all types of food throughout the year. This, combined with virtually unlimited food access by a large portion of the population, leads to several changes in the usual diets of individuals. Thus, there was an increase in the consumption of animal food and carbonated beverages, which provide 20-30% of the total daily energy intake. Some research suggests that excessive juice intake (more than 350 mL/day) may support the development of obesity in preschoolers and even limit their growth. It should be noted that excessive nutrition of children and adolescents with these products is a central element. this explains the accumulation of excess body fat. Total calories are taken, nutrient composition, flavor, and variety, and the size and number of daily meals are also closely related factors to obesity (31).

Other factors consist of some current lifestyles, where working hours of parents often make it difficult to prepare food daily, and in many cases lead them to resort to pre-cooked food, and carbohydrate-rich drinks such as artificial juices instead of water. Therefore, almost no dietary control could exist (32)

Constantly eating out also leads to a progressive increase in adipose tissue since meals (fast foods) outside the home are often richer in fat and have higher calories. It is also

known that many children eat the main meals of the day (e.g. lunch) at school canteens, and many of them do not pay attention to serving healthy foods (33).

2.1.2.3. Physical Activity

In addition to the change in eating habits, a more inactive lifestyle and reduction in physical activity often appear at certain lifetimes, Especially during the transition to adulthood from adolescence. The data obtained from the US National Health Interview Survey, strong participation in aerobic activities and strengthening a gradual decrease between the ages of 12-21, the highest decline in the physical activity of the ages between 15 and 18, and a constant deterioration has been usual in the early period (34).

Despite increased awareness of fitness and healthy eating, it may seem contradictory that physical inactivity is a common problem for many citizens in society. Recently, the number of health clubs, walking, and jogging paths, and cycling trails are increasing. Also, the use of such resources seems to be getting popular for people of all ages. On the other hand, the amount of energy spent on these physical activities and exercise is generally insufficient to counter the inactive nature of our lifestyle and the impact of unnecessary calorie consumption. According to a report in America, only 22% of adults regularly engage in physical activity, and most of the adult population live an almost entirely sedentary lifestyle (35).

The study with adolescents found they used public transport instead of walking for more than 15 minutes. According to technical data, this decreased by 37% in the number of journeys made on foot and by 20% in the number of miles walked (36). A study conducted in Spain showed that only 32.2% of boys aged 6-9 and 17.8% of girls exercise more than two days a week in their free time (37).

2.1.2.4. Environmental Factors

The formation of eating habits in old age and the way the baby is fed begins in the mother's womb. In contrast to the protective effect of breast milk nutrition against obesity,

improper nutrition during dairy childhood increases the risk of developing obesity. The frequency and layout of meals learned at an early age also affect the child's body weight at a later age. Obesity is less common in people who consume regular meals and do not skip meals than in people who consume one or two meals a day (38).

It is accepted that the desire to overeat and the large portion habit seen in obese people are acquired in the family at an early age. In Modern societies, children who spend more time at home have a lack of physical movement due to reasons such as excessive television watching and excessive interest in computers. Reasons such as watching TV while eating in family life or lack of regular tableware habits lead to a growth in the obesity risk (14).

The socioeconomic level of the family is also important in the development of obesity. In families with high socioeconomic levels, overeating children can lead to obesity, while children with low socioeconomic levels and crowded families have irregular and unbalanced nutrition. If a balanced eating habit is not acquired in the family, children tend to consume foods high in fat, such as fast-ready meals, or excessive sugary liquid drinks when they reach school age (31).

2.1.2.5. Drugs and smoking

Smoking is one of the leading causes of preventable morbidity and mortality. Several studies have shown that smoking behavior is closely related to body weight and obesity and that the body weight of smokers in the past is heavier than that of non-smokers at all (39-41). Mechanisms underlying the effect of smoking on weight include varying energy intake, physical activity, metabolic rate, and inflammatory status due to smoking status (41).

The relationship between obesity and smoking is complex: smoking has been associated with both low and high BMI, as well as negative fat distribution. In most cross-sectional studies, adult smokers were found to be weaker than non-smokers, but with a larger waist circumference or a smaller waist-to-hip ratio (42,43). Also, among smokers, a higher number of smokers per day had a higher BMI and waist circumference. A large study of

women in Australia found that smokers were more likely to gain weight during follow-up than women who had never smoked (44).

Drug-induced weight gain is a serious side effect of many commonly used drugs, leading to incompatibility with treatment and exacerbation of comorbid conditions associated with obesity. Improved glycemic control provided by insulin, insulin secretagogues, or thiazolidinedione therapy is often accompanied by weight gain. Weight gain is also common in psychotropic therapy. Atypical antipsychotic drugs (clozapine, amoxicillin, risperidone, and quetiapine) are known to cause significant weight gain. Antidepressants such as amitriptyline, mirtazapine, and some serotonin reuptake inhibitors (SSRIs) can also promote significant weight gain, which cannot be explained solely by improvement in depressive symptoms. The same phenomenon is observed in mood regulators such as lithium, valproic acid, and carbamazepine. Antiepileptic drugs that promote weight gain include valproate, carbamazepine and gabapentin. Lamotrigine is a weight-neutral antiepileptic, while topiramate and zonisamide can cause weight loss (45).

2.1.2.6. Psychological Factors

Studies of individuals with obesity in the context of delicious food together with the expected inadequate impulse control fat and sugar-rich foods (delicious food) against a stronger sensitivity (notice a trend), and this motivational incentives to foods (request) show that people have. The negative mood has been shown to be implicated in obesity, resulting in the compensatory (excessive) intake of delicious food. It should be noted that negative mood has a two-way relationship with obesity; obesity has also been shown to result in a negative mood. Adding to that, of course, is the fact that obesity is associated with stigma, discrimination, bullying, and stereotypical media portrayals. Importantly, it should be emphasized that obesity and addiction significantly overlap, both in terms of phenomenology and the brain mechanism that drives incompatible behavior. As a matter of fact, it has been suggested that obesity should be characterized as a mental disorder (46).

2.1.3. Clinical features and diagnosis of obesity

The most obvious symptom of obesity is weight gain in which an increase may lead to other symptoms. Weight gain is measured by BMI which is not always an accurate measurement of body fat content. For example, some athletes are very muscular, and their weight reflects high levels of novelization. Such a condition can incorrectly put them in the category of obesity, despite the fact that body fat is very low. For this reason, it is necessary to examine other symptoms, such as waist circumference. Waist circumference in men greater than 102 cm and in women greater than 88 cm is associated with obesity (47).

Obesity is associated with sleep apnea, which causes daytime drowsiness and insufficient restful sleep. Various sleep problems are observed in obese patients. Joint and bone pain due to weight gain can be accompanied. Back and lower back pain due to loading in the spine are also common problems. Excessive sweating, heat intolerance, infections in the folds of the skin can be seen. Sleep problems and weight gain can lead to a decrease in energy, chronic fatigue develops. Depression. shortness of breath or dyspnea, dark skin in some parts of the body (acanthosis nigricans), cracks, swelling of the lower extremities, and varicose veins are common clinical signs in patients with obesity (47).

Anthropometric measurements are used primarily to diagnose obesity. Anthropometry is the scientific evaluation of physical characteristics such as measurements and proportions of the human body. According to WHO reports, it is a universal, non-invasive and inexpensive technique that reflects human health and nutritional status, as well as provides information about performance and survival. Anthropometry allows people to be compared with each other (48).

Anthropometry is used at all ages from childhood to old age. But it differs according to gender, race, social level. For this reason, each community and community should have its average values, and reviews should be made according to these values, since measurements can vary according to the person applying them, there are rules to be considered. Measurements should be made from the right side of the body and twice. There is a suitable position for each measurement, the patient should be in this position and relaxed.

Attention should be paid to factors that may affect measurements such as atrophy, hypertrophy, edema. Appropriate and calibrated devices must be used for measurements (48).

For height measurements, the shoes should be out, the arms on both sides and loose, the heels should be flush, leaning back, and the head should be in the appropriate position. Measurement is performed after a deep breath (49).

Body weight is the sum of the weight of all compartments of the human body (e.g. fat and lean masses). Any changes in weight is the change in muscle, fat, water, or combinations, it does not provide us with the information that can make the distinction. However, it is the most commonly used measurement in patient follow-up in the clinic. In a standard measure, things that make weight, such as shoes, jackets or coats, jewelry, are removed, should be light clothing on it. The person to be measured should stand right in the middle of the weight, the arms should stand on both sides and loose, the person should look forward, not down. Measurements are influenced by daily urine output, excessive fluid consumption, bowel movements, and menstrual period in women (48). In pathological cases affecting fluid balance, the change in measurements is greater, and sometimes some clinically important differences can be masked (49).

For waist circumference measurement, the person should be standing, arms on both sides and loose, legs adjacent. The narrowest area between the Costas and the Krista iliaca should be selected and measured. It cannot be applied in people with standing conditions, pregnant, or those with colostomy, ileostomy, and acid. It does not provide useful information to very weak people. For hip circumference measurement, circumference measurement is performed from the highest point (48,50).

Skin crimp thickness measurement is done with a tool called caliper. Because adipose tissue in the abdominal area cannot be measured, subcutaneous adipose tissue measurement gives an estimated value for body fat. It works better in weak people with low-fat stores than in obese people. Although it is a fast and simple method, measurements may differ depending on the type of caliper. Measurements are usually made from four regions: triceps, biceps,

subscapular and suprailiac. In patients who cannot stand, it also measures in horizontal position and there is no change in results (48,51).

Measuring the circumference of the upper-middle arm is useful in distinguishing chronic energy deficiencies and predicting mortality in acute hospital admissions. It is also used to calculate body mass index if the patient's height or weight is unknown. For example, if the circumference of the upper-middle arm is 25 cm, the body mass index is approximately 20 (48,50).

The most commonly used method for determining the amount of adipose tissue is body weight. But the definition of obesity or weakness differs depending on social variables and personal characteristics, such as height. For this reason, many methods have been developed that measure the relationship between height and weight. Currently, the most accepted BMI system is used. BMI is estimated by the ratio of the person's weight in kilograms to the height squared in meters (48).

Since the length of height in adulthood is usually constant, comments are made on fixed BMI values, while percentile curves specific to societies are used because there is a constant lengthening of height in children (52).

BMI and protein-energy malnutrition (PEM) are evaluated as well as the degree of obesity is determined. BMI describes the relationship between body weight and height and is an easy-to-use test that correlates well with total body fat (48). An association was found between increased values and increased risk of cardiovascular diseases, mortality, and certain cancers (53,54).

The WHO has prepared a broad-framed classification from advanced malnutrition to obesity according to BMI values (52). Table 2.1 shows the WHO classification in which nutrition status is evaluated according to BMI in adults.

Table 2. 1 International Classification in which nutrition status is evaluated according to body mass index prepared by the World Health Organization

Source : (52)

Classification	Body Mass Index
Low Weight	<18.50
Severe	<16.00
Moderate	16,00–16,99
Mild	17,00- 18,49
Normal	18,50- 24,99
Overweight	≥25.00
Preobese	25.00–29.99
Obese	≥30.00
1.Degree	30.00–34.99
2. Degree	35.00–39.99
3. Degree	≥40.00

An important restriction when evaluating BMI is the differentiation of muscle and adipose tissue. A person with a high BMI cannot answer the question of whether muscle mass or fat mass is too much. This restriction is especially important for very tall or overly muscular athletic people (48). For many health problems, especially heart diseases, the area of lubrication is also important. Lubrication around organs in the Abdomen is riskier than peripheral lubrication. Body mass index results do not deliver enough information about the distribution of the fat mass within the body (53).

2.1.3.1 Body composition measurements

Body composition measurements are used to determine the proportions of fatty and lean body tissues. The main goal in body composition measurements is to estimate or calculate body fat percentage by determining body density (55).

The imbalance between the body's needs and nutrient intake leads to changes in body composition (55). In the case of a decrease in nutrient intake, weakness occurs, while in excess nutrition, the transition to obesity, where fat mass increases, appears. Body fat percentage values in adults were shared in Table 2.2 (51).

Table 2.2 Body Fat Percentage Values In Adults (%)

Classification	Men	Women
Weak	< 8	< 15
Healty	8-15	15-22
Light fat	16-20	23-26
Fat	21-24	27-32
Too fat	>25	>32

Source: (51)

The thickness of the skin fold measured from various parts of the body can be calculated first by the body density and then by the fat ratio. Just as different formulas specific to men and women are used, there are self-developed body fat ratio calculations in their societies (56).

The waist/hip ratio is indicative of the distribution of fat in the upper and lower regions of the body. Fat accumulation in the upper part of the body, also called Android-type lubrication, is usually seen in men. Fat accumulation in the lower half of the body is more common in women. An increased waist/hip ratio indicates an increased risk of cardiac and metabolic diseases. In men, the upper limit of waist/hip ratio is 1, while in women it is 0.85 (51,56).

In order to determine the fat area of the upper-middle arm, information about the circumference of the upper-middle arm and the thickness of the triceps skin fold is needed (51). The upper-middle arm muscle circumference is used to assess lean mass. The elbow is bent 90 degrees and the circumference of the upper-middle arm is measured, and the muscle circumference of the upper-middle arm is calculated by combining the result found and the

skin crimp thickness result nov. Figure 2 shows the formula for the circumference of the upper-middle arm novices (51,56).

Bioelectric impedance analysis (BIA) or bioelectric resistance is calculated by measuring the response of body tissues to electric current. Electric current passes faster through body tissues where there is a lot of water, such as blood, urine. Bioelectric impedance analysis technique by measuring the electric current in the electric permeable areas of the Body, Body Composition is estimated. Body fat mass is calculated by comparing the results with information such as height, weight, gender. BIA is a safe, not too invasive, relatively cheap, and reliable method, and since some devices are portable, head-of-bed evaluation can be performed (56,57).

Bias can be seen depending on the arm and leg length used when calculating fat measurement, so that there may be differences between societies and ethnic groups in body limbs. In addition, deviations can be seen since BIA does not directly calculate fat mass and gives an estimated result (55).

Hydrodensitometer (underwater weight measurement; UWM) estimates body density by using the buoyancy of water. Bone and muscle tissue are denser than water. For this reason, muscle and bone-rich body parts become heavier in water. Measurements are made in and out of water and body density is calculated. By removing air from the lung and gastrointestinal tract, the margin of error is minimized. The restrictive aspects of underwater network measurement are that it is expensive, difficult to implement, and a technique that causes discomfort to the patient. Air displacement plethysmography (air displacement plethysmography) is a method of calculating body density with a similar principle as UWM (56,57).

Bone densitometer (Dual-energy X-ray absorptiometry, DXA) is a system that distinguishes between fatty and lean(novelized) lean soft tissue and bone mineral components based on the loss of X-rays in the body tissues. With DXA, body composition can be distinguished regionally. Although it is a gold standard method for measuring bone

density, it is also used to calculate fat. Although it is a safe technique, it is expensive and requires qualified personnel trained in radiology (57)

Computed tomography (CT) captures high-resolution three-dimensional images by Projecting X-ray rays from various angles to the body. Soft tissue and adipose tissue are separated from these two tissues by the difference in the reduction of X-rays. Direct volume measurements of organs are also performed. 2-dimensional analysis of axial sections is used to calculate body composition with CT (56).

Images of soft tissue in the body can be produced by magnetic resonance imaging (MRI), which uses different magnetic properties of element nuclei in the cell this technique is performed using different magnetic resonance frequencies of protons in fat and water, the signals are divided into water and oil images. Because it does not use radiation in the MRI technique, it is used for three-dimensional volumetric imaging even in newborns and infants (56, 57).

2.1.4. Complications of Obesity

For many obesity-related diseases, there is an increase in risk in direct proportion to weight. The Global Burden of Disease Project report examined 239 research investigations involving a total of ten million individuals with a mean period of follow-up for 13.7 years to determine any correlation between any origin of death and the levels of BMI. About 4 million people who survived five years of follow-up survived chronic diseases. A correlation was found between the BMI values of 385,879 people who died and the mortality rate due to all causes. The individuals with the BMI values between 20 kg/m^2 and 25 kg/m^2 showed the lowest mortality rate. All of the cause death is 7% (HR; 1.07) in persons having a BMI of between 25.0 kg/m^2 and 27.5 kg/m^2 , and 20% (HR, 1.20) a level of BMI between 27.5 kg/m^2 and 30.0 kg/m^2 . 1. degrees obesity ($30.0 \text{ kg/m}^2 < \text{BMI} < 35.0 \text{ kg/m}^2$), the mortality of reasons of 45% (HR, 1.45), 2. degrees amplified with 94% (HR; 1.94) for obesity ($35 < \text{BMI level} < 40$). 3. for the individuals with obesity levels ($40 < \text{BMI} < 60$), the all-cause levels of the mortality rate were found to have increased by 176% (HR, 2.76) (58,59).

Any above weight gain could increase death risk, on the contrary, any weight loss could decrease any potential death risk in overweight individuals. The findings in a study conducted in Sweden showed that a high decrease (29%) was observed in terms of total mortality following 60 years old (in ten year period) in comparison with a long-term investigation. Similar results were obtained after a follow-up period of 10.2 years in the Look AHEAD Report, which examined long-term follow-up of patients diagnosed with T2DM. The patients included in the study with a 10% weight loss of their total body weight in the first year period of an investigation were observed much lower risk (21% less) for potential heart diseases such as CVD and a 24% reduction for secondary CVD risk (61).

Several main pathways appear to mediate the impacts of obesity on the human body. Many forms of adipose tissue dysfunction are known as an important element in the emergence of various types of obesity-related health diseases. Those dysfunctions involve disturbances in the storage of adipocytes and the fatty acid release, overproduction or underproduction of the cytokines and the adipokines, hormone transformation, as well as any negative mechanical outcomes of larger tissues (62).

Well-known toxic impacts of any excessive fatty acids in the adipose tissue play an important role could generate metabolic disease as well as any types of abnormalities on the function of hormonal changes. The most abundant type of peptide produced by the adipose tissue is known as adiponectin (63). The adiponectin is best known for promoting the vascular role and the sensitivity of insulin. The concentration of adiponectin is conversely proportional to the size of the adipocyte and the visceral fat mass. On the other hand, there exists an increase in the size of the fat cell. In addition to most adipokines, which are concealed in big quantities. Although a large number of adipokines were discovered during research, their particular role is mostly not known in any type of disease. Angiotensinogen formed by the adipose tissue generates a precursor to the angiotensin that may stimulate any hypertension risk. In addition, levels of the enzyme aromatase in fat tissues, sterols (androstenedione) can convert to estrogen, this also in women with obesity, especially estrogen derived from oil is the basic source of estrogen after menopause may explain why women possess a higher risk of endometrial and breast cancer (64).

2.1.4.1 Medical Complications

There is very strong evidence that body mass index, central lubrication, and increase in body weight increase the risk of T2DM (65). Some studies conducted as the meta-analysis showed the increase of the upper body and any emerging risk related to the metabolic syndrome as well as T2DM (66). The length of being obese for young people as opposed to elder citizens was found as a great risk of T2DM. Any levels of additional and extra weight gain enhance developing T2DM risk for especially adults at the ages of between 25 and 40. Any level of increase in body weight is also correlated to the TDM risk factors (67).

It has clearly been found that losing weight is helpful in decreasing the risk of developing diabetes. Knowler and colleagues (68) found that in the Diabetes Prevention Program, a 5.5% weight loss average over a 3-year period reduced the chance for transitioning from pre-diabetic status to the diabetic by around 60%. Correspondingly, bariatric surgery restored blood glucose levels to normal glucose tolerance in patients with diabetes (69).

Some types of cancer are significantly very high in especially overweight people (70,71). Men face neoplasms of the rectum, colon, and prostate cancers at higher risk. Cancers within the reproductive system, such as breast (72), endometrium (73), and gallbladder, are more common in women. Studies have shown that women who gain 25 kg or more following the age of 18 have a greater risk of having breast cancer. Women with 10 kg weight gain after the menopause period often have a higher risk of getting breast cancer than women with stable weight conditions (70).

Breast cancer is not only just about body fat in total, but it also is related to visceral body fat. Such an association with body fat may also help explain why the risk of breast cancer at age 75 is high in women with the highest BMI compared to the low-end quartile. Circulating, unconjugated estradiol may cause an association between breast cancer and the increased body fat, in addition to an association between the risk of getting endometrial cancer and an increased amount of body fat (74).

Some studies indicated that as BMI rises, heart disease and heart failure risk gradually increase (75). Data from a study conducted by nurses that examined how excess weight increased the risk of CVD showed that the risk of developing coronary artery disease increased 3.3-fold in those with a BMI of $> 29 \text{ kg/m}^2$ compared to women with a BMI of $<21 \text{ kg/m}^2$ (76). The weight gain positively disturbs such risk in the levels of preliminary BMI. Namely, a gradual growth against heart disease risk was found with increased waist circumference at all initial BMI levels. Similarly, the risk of heart disease rise was also found alongside an increased body mass index within the categories of waist circumference (75). In a study that evaluated 6452 men in the UK, the risk of major CVD increased by 6% (per 1.11 kg/m^2 increase) in body mass index (77).

Central lubrication reflected around the waist is also a solid indicator of the risk of CVD. The risk is even higher when improved principal lubrication is additional to the other constituents of metabolic condition. US National Health and inspection survey data (Jensen and colleagues (78)) revealed which any risk of having the syndrome of the metabolic for men could be predicted by a BMI measurement. Nevertheless, considering the waist circumference as a constant variable for BMI, the circumference of the waistline was found to be primarily responsible for all risks for metabolic syndrome. In another review study, abdominal obesity indices (e.g. the waist circumference, waist/hip ratio) were better than seen as an indicator of cardiovascular risk, including hypertension, dyslipidemia, and body mass index for risky T2DM (79).

Atrial fibrillation and congestive heart failure carry a greater risk in addition to coronary diseases in overweight people (75,80). While the risk of heart failure is triggered by obesity, recent investigations showed that high BMI could improve survival rates in people with already being diagnosed as serious heart failure, which is a phenomenon, named as "obesity paradox" (81). Obesity often contradicts any association between body weight and BMI (82, 83). One possible explanation for this situation is "selection bias". Such a process exists because researchers generally include the participants with much higher risks, these individuals are identified after the development of the disease, not prior to the disease. A typical technique to remove such a bias is to combine the onset of exposure and the onset

of follow-up. The same approach is true for the impacts of obesity on the death risk (33). In the other perspective, the capacity for an obese individual to prevent any cardiovascular risks could be explained by the obesity paradox. The obesity paradox could also be explained that BMI does not consist of any distribution of fat tissues underneath. Padwal and colleagues (84) recently showed that body fat and BMI show distinctive values in terms of cardiovascular risk. It is stated that if fat is the problem or not, the body mass index measurement can lead to flawed results (85).

Studies showed hypertension as being one of the biggest public health problems across the globe. Steven and his friends in a study of a successful weight-loss intervention after lowering their blood pressure level among hypertensive individuals, weight loss maintainers also lower blood pressure levels are maintained and re-weight areas, they are back to initial blood pressure levels (86). Neter and others (87) in a meta-analysis of 25 analyses, found out an average weight loss of 5.1 kg following the diet and exercise programs reduced blood pressure by 4.4 per 3.5 mm Hg (the systolic blood pressure/diastolic blood pressure). The researchers with the weight loss of 5-kg showed greater reductions in blood pressure than individuals with less weight loss (86, 87).

Excess weight or being overweight has impacts on the respiratory system. For example, it could create the obstructive, serious, and sometimes fatal Sleep Apnea problem (88). High snoring index and max nighttime sound intensity for this problem are normal. Nocturnal oxygen saturation could be extensively diminished at especially at night times (89). A recent study conducted on diabetic obese patients with the use of polysomnography revealed 30.5% of participants having a sufficient Sleep Apnea problem and 22.6% with a severe Sleep Apnea problem. BMI and waist boundary were drastically associated with the presence of Sleep Apnea problems. Independent of obesity, it is related to the features of metabolic syndromes, involving hypertension, T2DM, high cardiovascular risk facilitated by hypoxia.

Excessive daytime tiredness could result in significant outcomes and may pose a chance for driving vehicles and other daily routines involving any alertness (88).

There are other types of health risks associated with obesity such as gallbladder disease. Aune and colleagues (75), in a recent analysis, discussed whether any relationship exists between obesity and gallbladder disease, and findings revealed that normal BMI ranges could even cause any increase in experiencing gallbladder disease. Specifically, their results also showed that the risk for gallbladder disease could be increased by 63 % for every 5 units rise in body mass index; 46% relative risk increase for every 10 cm increase in the waistline.

There is another disease, known as the non-alcoholic fatty liver disease of NAFLD, which is generally related to obesity (90 Inflammation/damage without hepatocellular liver oil, and in that case, the non-alcoholic hepatosteatosis (NAHS) can progress to cirrhosis and eventually. A NAFLD diagnosis could be made by any presence of excessive liver fat with the lack of secondary causes. If any types of hepatocellular damage exist in fatty liver in NASH and since fibrosis, cirrhosis, and liver failure being linked to the risk of hepatocellular carcinoma, then it could turn into a serious medical situation. Studies showed that subjective to specific populations and types of diagnostic approach, the prevalence of NASH could range between 3% and 5% as that of NAFLD could be found between 6 and 30% (91).

Some researchers describe the non-alcoholic fatty liver disease as a hepatic symptom of metabolic syndrome (92). It is common (84% to 96% prevalence) for a patient undertaking bariatric surgery. For example, obesity could be independently predicted by the amount and prevalence of fatty liver as its prevalence increased between 1988 and 2008 in the USA (93). Li and colleagues (94), in a 21 study (13 were prospective) metaanalysis investigation showed that obesity increased the risk of developing NAFLD by 3.5 times. Furthermore, every one unit growth in the BMI causes NAFLD risk by 1.2 times and NAYKH risk by 1.25 (95).

Aune et al. (96) reported an association of BMI with gout risk in 10 prospective studies in the 10.5-year follow-up case, including 27,944 cases of gout among 215,739 people.

An overweight person has likely to experience another disease such as osteoarthritis, as recent studies have shown. Osteoarthritis generally occurs in the ankle and knee in a human body and is linked to excessive body weight or being overweight. On the other hand, there have been some studies that showed that in the absence of weight-bearing, extra weight could change bone structure and cartilage by the osteoarthritis in non-weight-bearing joints. In conclusion, any enhanced rates of osteoarthritis are the main indicator for excess weight as well as the accompanying disease (osteoarthritis) (97). In a recent study (Okoro and colleagues (98)) patients older than 45 years suffering from arthritis have Class-3 obesity with BMI being higher than 40 kg/m².

2.1.4.2 Psychological Complications

Obesity together with other diseases could provoke critical psychosocial functioning areas in a body including psychosocial issues. Thus, the psychosocial functioning assessment for the obese patient is an important part of the treatment schedule, especially for bariatric surgery. Weight loss is promoted psychosocial functioning for many patients, but few of them practice undesirable psychological symptoms after weight loss (99).

Various studies revealed that people with obesity (between 20% and 60%), especially severe obesity, experience some types of psychiatric illnesses. The percentages are even higher than the individuals in the general public (100,101). Researches showed an association between depression and being overweight. For example, people with high obesity are more likely (five times) to experience major depressive episodes within a year than the ones with an average weight, which is especially in higher correlation because of the status of women as society emphasizes the thin body as a feature of female beauty (102).

It is known that irregular nutrition is common in obese patients. Many patients that undergo a sort of weight loss treatment indicated restarting to eat junk foods for their emotional anxieties; others have difficulty controlling eating frequency, portion sizes, or bad eating habits in response to modern society's bombardment of food cues. While this may be surprising to some, only a small minority have officially recognized eating disorders. The most common eating disorder in obese patients is binge eating disorder. Binge eating

disorder is characterized by consuming large amounts of food in a short time (< 2 hours) when an individual loses control. In conclusion, the person eats much faster than normal and usually alone, uncontrollably, until he is full when there is no hunger. In addition, the individual usually reports disgust after eating (103,104). Mitchell and colleagues (101) suggested that eating disorder occurs between 5% and 15% of obesity patients. Some obesity patients have bulimia nervosa, where overeating is accompanied by other compensatory behaviors such as self-vomiting or excessive exercise. About 5% of obesity patients suffer from Night Eating Syndrome, a mood disorder defined as a delay in the circadian model of food intake caused by eating, sleeping, and waking up to eat at night (105).

The presence of overeating can negatively affect weight loss efforts. Overeating conditions are related to insufficient weight loss or early weight gain as well as bariatric surgery. Overeating is not considered an opposing sign for bariatric surgery and any other weight loss treatments. However, without any pharmacotherapies particularly designed to solve the bad eating behavior and the lifestyle modification strategies it is considered as the prognostic indicator that the outcome of weight loss therapy will be poor (106).

Patients who apply for bariatric surgery commonly suffer from any type of anxiety disorder; this condition is less settled among those who apply for non-surgical treatment. The most common (about 9% of the patients) observed kind of anxiety disorder in patients for the bariatric surgery was found to have a mainly social anxiety disorder (99). It is not surprising to find people with obesity suffering from any form of anxiety especially considering western society's emphasis on subtlety as an indicator of physical beauty (105).

A few of the patients who suffer from obesity actively use substances. An example of a contraindication for the treatment of weight loss includes active substance use or abuse. About 10% of bariatric surgery candidates reported a history of illegal drug usage or alcoholism, a higher percentage than is seen in society. Surprisingly, the studies showed that patients with a history of excessive obesity and any substance abuse suffer from more weight loss than patients with no history of substance use (107). It is also considered that these individuals probably established any impulse control and various self-regulation strategies.

The health-related quality of life is also another outcome of obesity. Several researches revealed a negative correlation between the quality of life and being overweight. Individuals who are overweight frequently stated that they experience substantial struggles in their occupational and physical functionality. These types of problems and issues generally make many patients look for weight-loss treatments (99).

One of the most important features of the quality of life for many people is the image of the body. Any dissatisfaction with a body image for a person is as common in overweight people as it is for average overweight girls and women. The degree of dissatisfaction with body image is considered to be related to the amount of excess weight of a person, but some people criticize their certain characteristics or whole body. Studies showed that dissatisfaction with the body image even plays an important role in the search for weight-loss treatment even in the presence of significant weight-related health problem cases (99).

2.2. Obesity Treatment

2.2.1. Prevention of Obesity

Many chronic diseases, e.g. heart and lung disease, cancer, kidney failure, and diabetes are major risks attributed to being obese. Obesity also negatively affects any treatments for chronic problems and is one of the important factors that cause them. Quality-adjusted life expectancy was found to be reduced by obesity in studies (108).

According to WHO, obesity is a key priority to reduce the impact of non-communicable diseases. Assisting overweight persons to reach normal weight loss and stopping further weight gain could ultimately lead to a decline in total obesity percentages as well as in the rates of chronic disease, and thus reduction of the related medical and other costs (1). The preventive care could be provided by the international guidelines through the entire medical system, incorporated with "curative" or disease management-focused consultations, independent of any health issues or age factors (109).

Population-based messages that target the public in relation to increasing food and movement require an individual commitment for effectiveness. When many people follow the advice in messages, such a strategy would be enough to tackle the obesity problem. Nevertheless, any positive eating message is generally less noticeable compared to alternative messages that encourage the consumption of less healthy foods, and environmental conditions are often an obstacle to healthy exercise behaviors (108).

One study proposed redesigning the existing environmentally friendly conditions to eliminate the motor vehicle and promoting more physical and active transportation opportunities including cycling and walking as well as increasing accessibility and the number of options for healthy food products. In a review study, Papas and others (101) investigated 20+ studies examining any relationship between being overweight (obesity), physical activity, and the number of food outlets. Most of the studies were designed as cross-sectional. Out of 20 studies, they mostly suggested a statistically significant relationship between environmental conditions including physical activity food outlets, and risk of obesity. They also reported that there existed a statistically significant relationship between the prevalence of being overweight and the number of recreational capacities, especially for adolescents. Yet, very few studies studied the effect of any changes in environment or settings with variations within the prevalence of obesity. In another study, Ludwig et al (111) reported that there is a strong relationship between residing in a neighborhood with high poverty than a lower-poverty neighborhood in terms of the prevalence of obesity.

It was suggested that the food access and access to certain non-healthy foods are manipulated and restricted, then purchases and consumption of such foods and eventually result in weight loss. On the other hand, in the food production industry, obesity supports the assumption that it is caused by the decrease of the level of physical activity and exercise as an approach to assist people to solve more space issues and proposes a powerful way to provide alternatives to more healthy food (112). Nevertheless, the cost of healthy foods and very limited access to them present significant challenges in many low-income communities. The Healthy Food funding initiative offer access to healthy foods for the supermarkets for the underserved communities in society, but healthy food consumption did not increase

(113). Ideally, there should be additional factors involved such as improved access, proportion, pricing strategies to spread the consumption of healthier products.

Some studies suggested some strategies to promote and provide the opportunities for healthy food such as promoting farmers and farmer markets, supporting financially availability of fresh vegetables and fruits for the school children, and increasing the price of unhealthy foods with high sugar or fat contents at workplaces and schools while reducing the cost of fruits and vegetables. Though such strategies could possibly result in an upsurge in fruit and vegetable consumption, it should be noted that only focusing on the consumption of fruit and vegetable could not be adequate, since there is no straight and close relationship proved between obesity prevention and any impacts of fruit and vegetable. On the other hand, any enhanced consumption of fruits and vegetables provides significant health benefits (14).

Physical activity levels were significantly reduced in both children and adults. They learn from people exercise at the places including residence, working, playing, praying, shopping, and were including how to help has become an important approach to overturn such a trend. CDC suggested 10 critical strategies that could promote any physical activity in the Guide for the Community Preventive Services in the below table (16).

Table 2.3 Strategies Identified By The CDC To Increase Physical Activity In The Community Preventive Services Guide

Evidence-Based Recommendations To Increase Physical Activity In Communities
Community-wide campaigns to promote physical activity
Making decisions for the use of stairs
Individually tailored health behavior change programs
Establishing or enhanced access to physical activity places with informative outreach activities
Urban design and land use policies at street scale
Community-scale urban design and land-use policies
Active transport to school
Transport and travel policies
Improved school-based physical education
Social support practices in community settings

Source: (16)

2.2.2. Medical Nutrition Therapy

Obesity treatment consists of different methods such as nutritional changes, increasing physical activity, behavioral changes, medical and surgical treatment (14).

Considering all of the approaches of dietary to lose any excess weight, the energy taken into the body should be less than the amount of energy used by the body. Therefore energy balance should be negative. Food calories are considered a fundamental element of energy balance in the body and they are critical for weight loss. However, foods not only contain calories but also have other characteristics. It's very substantial to choose the enjoyed foods and prefer foods with low-calorie when deciding on a diet to lose weight. Such diets could also improve the quality of the diet. In addition to the structure of macronutrients, the intake for energy reduction is nevertheless a fundamental feature of diet efficiency. It is emphasized that calorie reduction is the most important determinant of weight loss according to the Diabetes Prevention Programs (DPP). Reduced fat consumption is the second determinant, and physical activity is a key determinant only when caloric intake does not change (5).

A daily caloric insufficiency (of 500 kcal) could create a weekly shortage (of 3500 kcal), which equates to the amount of energy within about half a pound of adipose tissue. Such a calculation predicts a linear continuous weight loss; it is not linear but curvilinear. When individuals start a weight loss program, they initially lose weight fast at first. Later, the weight loss slows down till reaching a plateau. That's is because the initial decrease of any calorie intakes causes certain levels of food intake and then this eventually lowers weight loss (114).

There are many elements that result in special response patterns when losing weight. Initially, the first factor is the initial weight loss speed. Individuals with diabetes in a multi-center clinical trial, which is included in the AHEAD study, those with the highest initial weight loss first 2 months, the first 2 months compared to those who had the lowest weight

loss in between 4 and 8 years period has had almost twice as much weight loss. Such a result could be justified that following and obeying certain diet programs are very significant for effective weight loss for a person (115).

Another factor, genetic variation, has impacts on weight loss due to its biological reactions to various types of diets (116). A new dietary strategies, known as POUNDS, has been implemented in overweight prevention studies and diabetes prevention programs (116, 117), greater weight loss was observed when individuals with fat mass genotype A and the obesity-associated (FTO) gene were given a high-protein diet. Another study with eight clinical trials in overweight or obese people stated that the related genotype (FTO) did not alter any type of reaction for a diet (118). The use of genetic profiles may therefore be valuable for generating regimens for any personalized dietary to manage obesity in the future, only clinical trials and investigations require further evidence.

If a diet has an energy intake level of between 200 kcal and 800 kcal per day, then it is called a very low-calorie-based diet. In a recent study, Tsai and Wadden (119) very low-calorie diet is significantly (9.7%) more effective than short-term weight loss (16.1%), but long-term weight loss is similar to that revealed that both the type of diet. In another study, Nordmann and colleagues (120) revealed that overweight people lost more weight higher at 6-month low carb diet but less than 12-month low carb diet. A 6-month low-carb diet usually allows a carbohydrate intake of 60 grams per day.

Tobias and others (121), in a longitudinal study of trials of a meta-analysis, suggested that low carb diets caused a significantly higher weight loss compared to its alternatives with a similar intensity. Such a result (121) was aligned with another meta-analysis investigation conducted by Bueno and others (122). They concluded that an individual with a low carb diet could lose as much as 0.91 kg more than the ones with very low carb ketogenic diet programs. Though there existed a statistically significant difference above studies, the final change in the weight loss was found to be negligible and very small. For years, the amount of any fat intake has been suggested to be reduced according to many dietary references for weight loss, because fat consists of higher energy content of 9 kcal per gram than

carbohydrates of 4 kcal per gram. A study that critically investigated and discussed six types of research concluded that there existed no statistical significance between low-fat diets and other weight-loss dietary programs. Low-fat diets usually contain between 20 and 30 grams per day (20 % of the total energy from fat intake) (123).

Recent research (121) discussed meta-analysis studies in a review that aimed to compare impacts of the low-fat interventions in a longitudinal investigation with more than 1 year period. The low-fat intervention was defined as a total fat less than <30% of daily intake. They recorded the weight variations of other dietary interventions. They concluded that the groups who were treated with higher fat daily intake experienced higher weight loss and better comforting sleep, while differences in weight loss were minimal (121). As an important message, it has been emphasized that "commitment" was found as more critical and important than a specific diet for weight loss success.

Consuming higher water content in daily diet is another strategy that not also reduces any fat intake through diet but also helps to consume foods. In a study, it was compared with a lower-fat dietary program with a lower energy density diet that included additional fruit and vegetable. This study found out that more fruit and vegetable in the daily diet was more helpful to lose more weight than a reduction of fat alone (124).

The glycemic index could be typically calculated by the amount of increase in blood sugar corresponding to the test foods given (125). Thomas and others (126) stated that a significant however small change for the individuals who preferred low glycemic index diets with a meta-analysis. In addition, individuals with diets of a low glycemic index helped more to reduce the low-density lipoprotein (LDL) total and cholesterol. However, it is necessary to further investigate the impacts of low glycemic index diets in the long term. Any fasting glucose can deliver a cue to diet choice. Hjort and colleagues (127) showed that the prediabetic patients with high fasting glucose could be better satisfied by a lower index of glycemic diet that contains whole grain and extra fiber.

A study (128) studied protein diets of 12% and 25% for a part of 30% fat diet in a 2-year study. The findings revealed that the amount of weight loss was much greater for a

higher protein diet in the first 24 weeks and also for 104 weeks, but there was no significant difference for the 56-week diet (128).

Mediterranean diets are best known for high consumptions of whole grains, olive oil, fruits, nuts, whole grain, and vegetables. They were used to get higher weight loss than a low-fat diet in a 4-year study for diabetic individuals (129). Another study (130) showed that it is a low-fat diet that reduces body weight. Prevencion Con dieta mediterránea in Spain compared to 2.2 kg study, for the duration of 5-year follow-up study in the high-fat Mediterranean diet (from fat 41.8% calories) consumed higher and significant weight loss (0.43 kg) ($p < 0.05$) and causes decrease from 0.55 cm around the waist has revealed that (131).

Diets containing various macronutrient compounds could also cause weight loss in short-term periods. But following the first 3 to 6 months, the weight loss reaches a plateau. Later, the lost weight is regained and the average weight goes back to the initial level within a 1-2 year period. Maintaining weight loss for the long term is mostly determined by the capacity to follow the diet schedule strictly. It could also be achieved by behavioral support. There exist differences between individuals in reaction to any diet, which are greater than any average difference for the weight loss between the other diets compared. Personalized dietary regimens are important concepts that might increase the effectiveness of weight loss in the long-term periods. For that reason, clinicians should consider genetic differences in the diet's response to weight loss (14).

2.2.2.1. Macronutrient Requirements

"Macro" is known as a Greek word meaning "large" and related to the size of the nutrient in the context of nutrition and its significance in the balance of energy. Such a balance could be basically described as "energy input" (intake calories into the body with foods and drinks) vs. "energy output" (calories consumer within the body for daily needs). Energy or calories is the essence of health and nutrition. Basis of energy is received through 3 macro foods including fat, protein, and carbohydrates (14).

Studies have been conducted to investigate the idea that diets with single foodstuffs can promote weight loss, and fat, protein, or carbohydrates taken in different proportions, called Weight Loss Diets (14). The percentage of proportions and combinations of fat, protein, and carbohydrates are the main factors in a macro-based diet in a person's diet, different from the total amount of the calorie in the body alone. They are conventionally accepted as a percentage of total calories and USDA (US Department of Agriculture) reported guidelines are as follows (133): carbohydrates: 45–65%, Protein: 10–35%, fat: 20–35%. These recommendations provide a very wide range for each of the macronutrients, but it is necessary to determine which ratio or decemember is correct for the specific needs and goals of an individual (14).

Carbohydrate

Carbohydrates are high-density foods. During exercise and provides fuel for the brain. It is a backup of protein to maintain novelization during exercise. 1 gram of carbohydrates contains 4 calories of Energy (1). Carbohydrates come in three forms including sugar, fiber, and starch. They are very important for dietary plans and are used for various purposes in the body. There should be more carbohydrates (between 50%-65%) for a healthy diet including more fiber and starch and less sugar. Sugar is immediately absorbed through blood and is the main source of energy. Candy is the main name for sugar and has many kinds. It could be found in many foods such as honey, milk, fruit, and sap of some trees. Sugarcane and beet are also used to produce table sugar and similar sweeteners as added to the foods. Providing any calories for needed energy in the body, sugar is also used in the taste, texture, and appearance of foods, food preservation (as in jam) (14).

Fruits contain sugar, while they also provide water, fiber, mineral, and vitamins, which increase their nutritional assistance. Although, for instance, honey contains some vitamins and minerals, it is not sufficient to provide any nutritional benefit; since the total consumed amount of honey is mostly in small portions. On the other hand, a person consumes great amounts of sugary foods can cause a decrease in the intake of other foods that contain significant (132).

Starch is another type of carbohydrate that breaks down and is absorbed in the body into small constituents of sugars. The foods with starch compared to sugary foods stay and remain in the body for a longer period of time, making you feel "full" for longer. Starch provides most of the calories we eat and is widely grown. It is the main source of energy in most diets. Most of the diets generally depend on starchy food and starch-containing plants. Increasing and refining the number of starchy foods could cause the loss and disappearance of significant nutrients. Therefore experts suggest unrefined such foods as much as possible. For example, whole grains in whole-wheat bread or similar foods are much more nutrient-rich than any other refined breads or foods such as refined white bread (14,132).

Fiber is the carbohydrate part of a plant that the body cannot do. It is not digested and absorbed, so it has the task of "cleaning" the intestines. As the digestive system functions through our body, fiber can captivate water to support the body dispose of any waste products. Fiber could also help the body to protect it from serious diseases including cancer, heart disease, and different types of diabetes. In addition, a person without a sufficient amount of fiber could suffer intestinal problems and constipation (133).

The modern style of the consumption of any carbohydrate products favors total carbohydrates, added sugar products, and fiber-rich foods. On the other hand, various types of carbohydrates are used as much as they are needed. Today's world has been experiencing a critical issue in the nutrition known as the added sugar. A simple macronutrient uses the values of sugar, fiber, and total carbohydrates to calculate the ratio of carbohydrates. A report based on data between 2007 and 2008 (also 2015 and 2016) published by NHANES showed that humans consumed carbohydrates and fiber with 8% and 7% of the necessary amount needed for the body. Also, this fiber is not healed at the time of intake. It showed that sugars are dominant in the American diet. It showed that between 2007 and 2016, men tried to reduce their carbohydrate intake, while women reduced their fiber consumption from 7g to 6g (132).

Protein

Protein is an important product used to create, repair, and protect body tissues. Protein plays an important role in body systems including hormones, transport, and metabolic. It is the most important combination of enzymes that control the body's metabolism. One gram of protein contains about four calories of energy (14). The USDA recommends that an adult take protein in the amount of 0.8 g/kg/day (133).

Protein is the main material for rich amino acids that is crucial in the fundamental body process. It is composed of small structures known as amino acids to create the basic structures of the body. Amino acids inside protein are generally described as a building block for body tissues. The most fundamental body and life functions seriously depend on protein. The cells of the body are continuously broken down and reformed in the body. Such a process needs a regular source of protein products. It is also used to rebuild and repair various human body tissues including bone, muscle, blood, organ, skin, as well as to repair damaged tissues due to disease or injury. Disease-fighting antibodies also have a protein structure to clot the blood and keep the immune system strong by developing (115).

Protein does also constitutes an important constituent of the transport system in the human body. It is the main stone of the transport system, which transports nutrients and oxygen to the cells of the body. An adequate amount of protein is necessary for maintaining the fluid regulations in the body. Extra proteins might be needed to maintain normal levels during important times of life including childhood, pregnancy, adolescence, infancy, and especially the circumstance needed for the extra tissue development. The body starts using the energy stored in the protein products if the energy levels in the body drop too low, but such a use of protein is not the main use for the protein. In addition, the protein disturbs every organ and tissue in the body to be used as energy for the body system, when the body lack energy for a long time (14).

Fats

Fats provide energy and perform various important functions. Fats taken with the diet provide the basic fatty acids necessary for nutrition. They help the absorption process of vitamins A, D, E, K, which are known as fat-soluble vitamins. They have an energy level of 9 calories per gram. It is necessary for the growth and maintenance of healthy life. Fats are also known as a critical constituent of the body tissues such as the central nervous system and brain. Such organs and tissue systems require enough levels of fats from the nutrients. The fats are generally used to produce important chemicals in the body such as a hormone. They also protect the body cells from surrounding organs and allow the body to store the necessary energy or calories when needed. They give a satiety feeling for the body by staying in the stomach (14).

The fats often used in diets (dietary fats) are stored in plant and animal products in nature. With the exception, every herbal or animal product consists of some amounts of fat products. There are two types of fatty acids: unsaturated (polyunsaturated, monounsaturated) and saturated. The human body cannot produce two of the needed polyunsaturated fatty acids (essential fatty acids), therefore they should be received from the foods. However, the body could produce saturated fats and monounsaturated fats. Unsaturated fats are found as liquid form and saturated fats are solid form at room temperature. The oils digested in the body contains varieties of different fatty acids that have different effects on the human body systems. Also, animal fats (excluding fish oil) consist of much higher saturation ratio than fats received from plants. However, fat acids found in plants have higher rates of unsaturated fat tissues than in animals. Unlike other fats, olive oil is unsaturated fat and has less effect on blood cholesterol than saturated fats. In addition, saturated fats become toxic in the bloodstream (135).

2.2.2.2. Eating Habits

Recent research findings have highlighted the important outcomes of the eating habit to maintain a healthy weight and improving metabolic abnormality, and conversely, the problems that can be caused by overeating habits and fast foods intake (136,137). It is

important to have regular breakfast, lunch, and dinner in the daily routine. For example, the findings of a 14-day diet of changing eating habits showed that a regular eating pattern was beneficial for higher insulin sensitivity, lower glucose response, and weight management. A cohort analysis by the US National Health and Development Study suggested a higher risk of cardiometabolic after 10 and 17 years based on foods with irregular energy intake, specifically for the breakfast and lunch times (137).

The studies showed that regular nutrition plays an important role in controlling body weight and maintaining a healthy metabolism. Yet, the effectiveness of eating habits sometimes cannot be measured in the intervention process because of confounding and influencing elements. Therefore, stability is needed in maintaining lifestyle changes (e.g. meal regularity, regular physical activity) over a long period of time to satisfy the goals for a healthy body and metabolic status (138).

2.2.3. Physical Activity

There is plenty of evidence to support the idea that any physical activities positively affect weight loss in individuals in short and long-term periods. Expenditures of energy consist of various mechanisms including physical activities, thermal impacts in the foods, and resting, listed as the order of their magnitudes. Physical activities include thermogenesis and non-exercise activity that stem from novelist muscles' volitional activities. The energy amount utilized in the food storing and processing in the human body is the main source for the food's thermal effects. Finally, daily energy needs for a body are described as rest energy spending (14).

Studies proved that the body weight and waistline of an individual are strongly correlated with any type of energy expenditure activities. On the other hand, the studies also showed that it is still uncertain for the fact that levels any decrease in the energy expenditure (e.g. from physical activity) is related to obesity problems, which grew over the last thirty-year periods. Various types of assessments of the are known difficult to use and not very

prices. For that reason, it could be said that there is missing reliable information. Some major investigations on the subject stated that any epidemics of the current obesity could be outcomes of a rise in energy intake not any decline of the energy expenditure (139,140).

Most of the studies on the impacts of physical activity investigated the types of aerobic physical activity, while there exists evidence that resistance exercise having some effects also on weight loss. Continuous exercise can affect the body weight with rising lean body mass, resulting in an increase in the rest metabolic rate. Resistance exercise also increases a person's strength, which can lead to more free life physical activity and therefore increased total daily energy consumption (141). However, the vast majority of data show that resistance exercise only leads to minimal reductions in body weight or body obesity (142).

A study of more than 4,500 adults from the United States National Health and Nutrition Review survey showed that more physical activity was associated with a lower BMI. This association was found to be present only with moderate to severe physical activity and was not found to be associated with low-intensity physical activity. These data show that there is a physical activity intensity threshold required to affect body weight and prevent excessive weight gain (143).

Notwithstanding the benefits of any physical activity in the weight loss process, they tend to fall during adolescence ages as studies have found that most adults are low (14). In a study of adolescent girls, activity levels decreased in both black and white girls each year during adolescence. By the age of Seventeen, black girls were found to be engaged in almost no impulsive physical activities, and caucasian girls were found to be engaged in only a very small amount of spontaneous physical activity (144).

There is great interest in the effect of sedentary behavior on a variety of health-related outcomes, including overweight and obesity. Professional activities in energy expenditure, per day in the United States since 1960 -140 kcal/day and decreased by this reduction in energy expenditure since 1960, the average U.S. are an important part of the increase in body weight for men and women (145).

Earlier literature in that field has mainly discussed the relationship between watching TV and obesity risk for a sedentary behavior variable. Watching television was suggested to be positively correlated with weight gain risk and obesity development (14).

2.2.4. Pharmacological Treatment

There are two types of weight-loss medicine or drugs approved by the FDA (US Food and Drug Administration) to manage weight loss and handle obesity. One of them was designed for long-term obesity treatments as agents. They are agents for the continuous release combinations such as lorcaserin, orlistat, phentermine, liraglutide, topiramate extended-release combination, and bupropion naltrexone (14).

Importantly, it should be noted that the studies that include real drugs and placebo consist of lifestyle changes and interventions (e.g. exercise, diet) essential for the continuous weight loss efforts. Pregnant women are susceptible to these drugs in terms of side effects since they enhance fertility. Therefore any pregnant women taking such drugs in weight loss programs should be aware of such effects and consult their OGYNs (14).

2.2.5. Surgical Treatment

Surgical methods and strategies (e.g. medical device usages) have recently emerged and developed over the past 50 years to achieve and maintain clinically significant weight loss. For example, more than 200 thousand bariatric operations and procedures were completed in the USA for the year 2015 alone (146).

Preoperative evaluation of the candidates for the possible bariatric surgery requires confirmation of the patient's understanding of fundamental suggested operations and successful treatment procedures. The dedication of the motivation of the patients for regular and continuous behavioral changes is also necessary for the suitable outcomes from the operations (146).

2.2.6. Cognitive (Behavioral) Therapy

Behavioral changes and/or lifestyle interventions have been an important part of weight loss programs for over half a century. Data from two large randomized controlled trials, Look AHEAD and the Diabetes Prevention Program, support the effectiveness of these approaches. These studies are notable for their frequency of contact, emphasis on individualizing therapy, and long-term emphasis on maintaining weight loss. In the Look AHEAD study, the best results for weight loss were achieved with frequent, face-to-face interventions, but it is difficult to include it in primary health care (78,147).

In a meta-analysis of behavioral weight loss programs, LeBlanc and colleagues (4) reported an average weight loss of 3.01 kg using methods that support behavioral strategy, but the average range of values was found to be quite large (-0.71 to -8.30 kg).

Lifestyle interventions can also be effective in preventing weight gain. Patients who participated in biweekly group sessions for 1 year after weight loss maintained 13 kg of 13.2 kg of post-treatment weight loss (148). The most successful patients frequently monitor their weight and have been identified as those who respond quickly to small weight increases (14).

2.2.7 Lifestyle Interventions

Self-monitoring

Self-monitoring involves recording the type and amount of food and beverages consumed, as well as calorie content and weight gain. Self-monitoring helps patients determine their eating habits (including time and places associated with consumption) and also helps patients choose goals to reduce their calorie intake (148).

Stimulus control

Stimulus control techniques teach patients to manage external cues, such as the sight or smell of food, as well as the time, place, and events associated with eating (148). By reducing exposure to problem foods, patients are prevented from overeating.

Goal setting

Goal setting helps patients make objective, measurable changes in eating, activity, and related behaviors (148). They are guided in setting specific goals for caloric intake, minutes of physical activity, and frequency of self-monitoring.

Problem-solving

Problem-solving teaches patients to analyze the difficulties they face in complying with their diet and activity prescriptions (148,149). Patients learn to identify a number of possible solutions to the problem, choose the most promising one, and then apply it. They learn to identify cognitive distortions (for example, "I'll never lose weight because I ate that dessert") and replace them with logical responses (ex. "A hundred and fifty calorie cake won't prevent my weight loss, especially if I walk after dinner"). It is important that patients remember that 150 calories should be "removed" in the future by exercise or by reducing the intake of other carbohydrates/fat-containing foods (14).

2.3. Online Nutrition Consulting

2.3.1. Online Health Services

Recent years have marked the simultaneous maturation of several important digital innovations, especially in information and Communication Technology, whose year 2020 is advancing at an unprecedented pace. Every sector and sector, including health, has been affected by digital transformation. Further consolidation of telehealth, digital innovations such as the development of next-generation wireless networks (5G), artificial intelligence (AI) approaches, and the Internet of Things (IoT) have created an extraordinary ecosystem

for new opportunities in healthcare and other industries. These developments could potentially address some of the most pressing challenges facing health care providers and politicians, including universal, egalitarian, sustainable health care coverage for a growing, aging population. They can fundamentally change the screening, diagnosis, and monitoring of diseases, more accurately profile the progression of the disease, and further improve and/or personalize treatments (150).

Telehealth refers to the broader scope of remote health care, while telemedicine specifically refers to only remote clinical services (10). The use of telemedicine has potential benefits such as reducing healthcare costs, improving access to healthcare, and improving patient compliance and outcomes. Similarly, telemedicine can eliminate geographic barriers and facilitate international access to patients worldwide. In addition, telemedicine performed when using online platforms can also open up unique opportunities to learn more about patients. For example, dietitians may ask to see the patient's kitchen, food items, or serving plates, and may conduct drug and supplement reviews (11).

In 2019, the WHO began to develop a framework for the adoption of digital innovations and technology in health care. WHO digital recommendations in health care interventions 'benefits, losses, acceptability, feasibility, resource utilization, and fairness considerations' and encourages you to evaluate on the basis of the tools, still on the journey to achieve universal health coverage - tools - organization. (151).

Several digital interventions have been prioritized for review by the WHO. Related to this discussion is client-to-provider telemedicine use to complete healthcare delivery; provider-to-provider telemedicine use; targeted customized health information transfer; healthcare worker decision-making support; digitized health information tracking; and training. In all these scenarios, the review highlights the need to monitor patient safety, privacy, traceability, accountability, and safety, along with plans to address any breach. With new technological entrances to the traditional sector, some issues should be taken into account during the development of services. There will also be ethical conundrums that have yet to be voiced and discussed. The clinician concerned should seek to be involved in the

development of these new advances to closely align all kinds of innovations to address unmet clinical needs. At the same time, clinicians should examine whether any innovation is in line with quality, ethics, and sustainable health care because legislation always lags behind such significant leaps in innovation (151).

Tele-home care, a type of Tele-health, is defined as a communication and clinical information system that allows patients to interact with audio, video, and health-related data using ordinary telephone lines from their homes to home health institutions (150). Patients telephone care on a daily basis through monitoring, early warning signs of home health care nurses to detect and prevent expensive emergency room visits by reducing the frequency of hospitalization, the patients themselves may enable you to to feel at home and improve their quality of life (152).

Tele-home care can train home-living patients with chronic diseases to make informed decisions about disease management. Such authorization could eliminate or at least delay their transition to high-cost care environments, as well as reduce the burden that their formal and informal caregivers are already experiencing. This is particularly important in the context of today's shortage of home healthcare providers (152). In addition, researchers reported that telephone care adopted by home health institutions for the delivery of care related to chronic disease was underutilized and its use was discontinued (153).

Telemedicine allows clinicians to evaluate their patients remotely. This is preferable for several reasons. First, telemedicine can facilitate more efficient and fair distribution of limited health care resources. This allows doctors and other professionals to provide care to remote areas, the lack of travel and reduces the carbon footprint associated with transportation services, special care, and Rare Diseases deals with the difficulties faced by patients and some patients connect to. Waiting times can be shortened through increased capacity and access to care for patients with both chronic and acute diseases. In acute conditions, patients can receive immediate expert opinion, even if it is not locally available (154).

Video consultations are available with an innovative service design that further limits patient journeys and clinical visits while maximizing the quality of telemedicine consultation. Effective tele-scanning programs require multiple components. First, it must be a reliable, cost-effective, and operator-friendly data collection system. A preferred goal is to ensure the longitudinal consistency of the data format to facilitate comparisons. The device itself should be simple with mechanisms to facilitate data transfer. Ideal designs should include networks in which multiple, simpler devices can communicate with a central station. System updates should include Central stations to provide streamlined logistics and cost efficiency, especially if they have broadly simpler devices on the network (155).

2.3.2. Telenutrition In Nutrition Monitoring

As in other areas of health, technology-based remote communication has become preferred for nutrition counseling. With changing technology, at least half of dietitians have started telemedicine practices that they have no previous experience with in consultation. In addition, telemedicine performed when using online platforms can also open up unique opportunities to learn more about patients. For example, dietitians may ask to see the patient's kitchen, food items, or serving plates, and may conduct drug and supplement reviews (11).

Appel et al., (156) reported that a group that received weekly phone coaching for 3 months, an internet program to record food intake and physical activity, and monthly coaching for an additional 18 months lost an average of 6.1 kg in 6 months. Weight loss was generally well maintained at 24 months (4.6 kg) and was not significantly different from what another group achieved using an intense face-to-face intervention (5.1 kg at 24 months).

Tate et al., (157) and also given a guide to internet resources for weight management via e-mail for 6 months 24-week field course (online food and activity records sent and received feedback from patients intrusive online) has shown that the only directory that is lost in patients compared to patients 4,1 kg. In a 1-year follow-up study, Tate et al. (157) showed that patients assigned to low-intensity Internet intervention with the addition of weekly behavioral counseling lost 4.4 kg, while those who received low-intensity Internet intervention alone lost 2.0 kg.

Harvey-Berino et al., (158) compared the same 24-session intervention provided on the internet or face-to-face. At 6 months, the face-to-face intervention resulted in a weight loss of 8.0 kg versus 5.5 kg for the Internet group alone.

There are 3 compilations that evaluate online video counseling presented individually to target obesity. Studies have targeted clinical populations such as diabetes, hypertension, and overweight or obesity. In a study conducted in Denmark, participants received nutritional counseling for diabetes via video conference from outpatient departments. 165 patients with an average age of 58 years had Hemoglobin A1c levels of 8. it was evaluated on the month and development was observed (159).

In another study, lifestyle changes were monitored via video conference, and development was recorded in terms of health status and patient satisfaction at the end of 3 months of wear (160). In the third study, video counseling intervention participants received health coaching training materials and weekly personalized video conferencing by a multidisciplinary team (registered dietitian, exercise physiologist, and medical doctor) based on data uploaded during the 12-week intervention. Positive changes in weight control and health-related parameters were noted (161).

Although they are popular, little is known about the effectiveness of smartphone apps for weight management. A new study comparing normal primary care with or without MyFitnessPal practice revealed essentially no weight loss difference between the two approaches for 6 months (162).

There are few studies on the effect of different types of interventions used in online nutrition counseling on weight loss. The effect of group therapies is also not known well. It has been shown that more frequent and intensive communication increases the efficiency of the consultancy. Sherwood et al. (155) showed that patients who received 20 intervention sessions over a 6-month period lost an average of 4.9 kg; Those who received 10 calls for intervention lost 3.2 kg, and those who managed themselves lost 2.3 kg. In the study of Duncan et al. (163), they were followed up more intensely for 9 months with communication technologies against printed materials, and the nutritional behavior changes and physical

activity increase rates of the group receiving intensive counseling were determined more. Although two observational studies published so far on the effect of group therapy as part of weight loss programs have shown more positive effects on weight loss, the effect of group therapy methods used in online nutrition counseling is unknown (164,165). Contrary to these studies Berk et al (166) found that a group-behavioral therapy program for long-term weight maintenance after an initial $\geq 5\%$ weight loss from dieting in obese individuals with type 2 diabetes was not superior to usual care alone. Another outcome of individual versus group therapy is the dropout rate of individual therapy was higher than that of group therapy (167).

3. MATERIALS AND METHODS

In previous studies, the differences between efficiencies of face-to-face consultancy and online consultancy systems have been examined. However, no study has been found in the literature examining the differences between the methods used in the online counseling system. With this study, the differences in the effectiveness of 3 different methods used in the online counseling system in the nutritional therapy processes of individuals were determined. In this way, it will be possible to scientifically determine the method that will provide the highest quality and highest efficiency of this application, which provides a practical solution to the lives of individuals to improve their health, and the online counseling system, which has become a subject of discussion today, will be made on a more standard and scientific basis. This study aimed to explore any differences in the effectiveness of 3 different methods used in the online consultancy system in the nutritional treatment processes of individuals.

The sample to be included in this study was selected from volunteer individuals who applied to the "Ezgi MISIRLI Nutrition and Diet Consultancy" company providing online service in Istanbul. While women individuals over the age of 18 were included in the study; during menopause, being pregnant and lactating were determined as exclusion criteria. Intervention groups were formed according to the follow-up system preferred by individuals among the volunteers. Three different intervention methods were examined in the study: Motivation Group, Monitoring Group, and Mail Group. Individuals in all intervention groups will be monitored for 8 weeks. It is aimed to reach a total of 90 participants, 30 in each group. Physical activity criteria for the participants were determined as 165 minutes per week (179).

Nutrition programs were sent to all individuals in the intervention groups via e-mail every week on the initial update day, and the weekly anthropometric measurements of all participants were recorded. Each participant conveyed the weekly weight result before eating in the morning as well as waist, hip, and chest circumference measurements on the day of the update. All of the participants were warned that they should measure after getting up in the morning, without taking any liquid or solid food, and after removing their clothes after

urination or defecation in the morning. The data collection form questioning the demographic information, disease status, and habits of the individuals and recording their anthropometric follow-up will be delivered to all participants at the beginning of the intervention and will be retrieved at the end of the study.

Three groups were formed according to the interventions planned in the study.

1. Motivation Group: Received the counseling service as a video call via the internet for 45 minutes, repeated once a week. Their diets will be updated once a week on the day of the initial update, and they have a separate program for each day. They were able to communicate with their dietitians during working hours without any restrictions. All participants were asked to photograph their consumption in main and snack meals in order to be able to follow the current meal at various times of the day. In addition, a reminder of water consumption was made during the day. This group has joined a motivational group where they can both communicate with their dietitians and interact with each other through the WhatsApp application.
2. Monitoring Group: He received the consultancy service as a video call over the internet for 45 minutes, repeated once a week. Their diets were updated once a week on the initial update day, and they had a separate schedule for each day. They were able to communicate with their dietitians during working hours without any restrictions. All participants were asked to photograph their consumption in main and snack meals in order to be able to follow the current meal at various times of the day. In addition, a reminder of water consumption was made during the day. In addition, they will be in one-to-one communication with their dietitians through the WhatsApp application, but they are not included in a motivation group where they can interact with each other.
3. Mail Group: Within the scope of the consultancy service, they received their weekly menus, which are updated every 7 days and include a separate diet plan

each day, via mail, but they did not contact the dietitian and did not make any reports by the dietitian during the day.

The calorie and nutrient content of the diets of all participants will be determined by the research dietitian, and planning was made in accordance with the principles of Dietary Approaches to Stop Hypertension (DASH) for the standardization of nutrition programs. DASH diet to protect cardiovascular health, balance blood pressure; It is a form of a diet aimed at portion size, consuming healthy foods, and getting the right amount of nutrients. (168,169).

A database was created in the SPSS 25.0 statistics program to evaluate the data obtained at the end of the 8-week interventions. . Numerical variables; mean, standard deviation (SD), median, lower and upper values, and categorical variables as numbers (S) and percentage (%). The confidence interval was determined as 95% in all analyzes, and the results were considered statistically significant for $p < 0.05$. Shapiro-Wilks tests were conducted to control the normality distribution of the quantitative variables. Kruskal-Wallis and Mann-Whitney U tests were used for the analysis of intergroup variables.

4.RESULTS

A total of 102 patients participated in our study. Table 4.1 represents the demographic characteristics of the study population. The mean value of the participant's age is 29, initial weight is 64 kg, height is 167 cm, BMI is 21 kg/m², waist circumference is 73.5 hip circumference is 102.5, chest circumference is 93 cm.

Table 4.1 Demographic Characteristics

	Mean	Standart Deviation	Minimum	Maximum
Age	29	2.83	25	34
Initial Weight (kg)	64	4.96	52.6	77.8
Height (cm)	167	5.18	158	178
BMI kg/m2	21	0.93	18.6	23.2
Waist Circumference (cm)	73.5	4.12	62	85
Hip Circumference (cm)	102.5	5.44	93	112
Chest Circumference (cm)	93	5.23	80	106

We found 22.5 % of the participants have diseases diagnosed., 22.5 % of them are still having some medicine, 63 % of them are smoking. You may find the frequency of the participant's medical history in Table 4.2.

Table 4.2. Medical History of Participants

		Frequency	Percentage
Diagnosed Disease	Yes	23	%22.5
	No	79	%77.5
Having medicine	Yes	23	%22.5

	No	79	%77.5
Smoking	Yes	62	%63
	No	40	%37

The mean value of the daily meal times of the participants is 6 meals a day, 54.9 % of them are making regular exercises. The mean value of the water they consume daily is 2.25 lt, The average value of coffee or tea they consume daily is 3 cups a day, alcoholic beverage is %74.5. You may find eating habits in Table 4.3.

Table 4.3. Eating Habits

	Mean	Standart Deviation
Meal Times Daily	6	0
Water (Lt)	2.25	0.59
Coffee or Tea (Cup)	3	1.71
	Frequency	Percentage
Have Snacks	102	%100
Fast Food Consuming	93	%91.1
Alcohol Consuming	76	%74.5
Tea-Coffee Consuming	98	%96
Regular Physical Activity	56	%54.9

The average weight values of the participants in the three groups according to the weeks are presented in Table 4.4.



Table 4.4. Weekly Average Weight Values of The Participants

		<i>Initial</i>	<i>1.Week</i>	<i>2.Week</i>	<i>3.Week</i>	<i>4.Week</i>	<i>5.Week</i>	<i>6.Week</i>	<i>7.Week</i>	<i>8.Week</i>	<i>p</i>
<i>Motivational Group</i>	<i>Mean± Ss</i>	66.88±6.9	65.71±7.	64.77±7.09	64.09±6.8	63.45±6.7	62.57±6.5	61.93±6.4	61.13±6.	60.51±6.2	<i>0,001**</i>
	<i>Min-Max</i>	8 55.6-77.8	14 54.4-77.1	53.9-76.7	4 54.2-75.4	53.5-75.9	2 53-74	7 52.6-73.1	31 51.7-72	3 51.1-71.5	
	<i>(Media n)</i>	(67.2)	(65.45)	(64.05)	(63.4)	(62.85)	(61.8)	(60.85)	(60.2)	(59.75)	
<i>Monitoring Group</i>	<i>Mean± Ss</i>	63.9±4.41	62.96±4.	62.37±4.4	61.79±4.4	61.07±4.4	60.56±4.6	60.01±4.7	59.38±4.	58.79±4.6	<i>0,001**</i>
	<i>Min-Max</i>	52.6-72.5	42 52-72	51.8-71.8	6 51-72.5	8 50,5-71.5	1 49.8-72.3	3 49.4-72	66 49-70.5	48.7-69.7	
	<i>(Media n)</i>	(63,3)	(62.5)	(61.7)	(61,3)	(60.45)	(59.9)	(59.05)	(58.5)	(58.1)	
<i>Email Group</i>	<i>Mean± Ss</i>	63.15±3.9	62.46±3.	62.19±3.98	62.07±4.0	61.66±4,0	61.21±3.9	60.91±3.8	60.73±4.	60.32±4.1	<i>0,001**</i>
	<i>Min-Max</i>	4 54.6-70.2	89 54.3-69.8	53.1-69.9	3 52.5-70.5	1 52-70	1 51.6-69.2	9 51-68.5	16 50.6-68.3	2 50.2-68.8	
	<i>(Media n)</i>	(62.8)	(62.1)	(62.15)	(61.95)	(61.6)	(60.95)	(60.8)	(60.7)	(60.15)	
<i>FriedmanTesti</i>		<i>**p<0,01</i>									

The average BMI values of the participants in the three groups according to the weeks are presented in Table 4.5.

Table 4.5. Weekly Average BMI Values of The Participants

		<i>Initial</i>	<i>8th Week</i>	<i>p</i>
Motivational Group	Mean±Ss	23.34±1.10 20.7-	21.12±1.02 18.7-	0,001**
	Min-Max (Median)	24.5 (23.7)	22.7 (21.3)	
Monitoring Group	Mean±Ss	23.04±0,92 21-	21.21±0.95 19.5-	0,001**
	Min-Max (Median)	24,4 (23,05)	23.2 (21.61)	
Email Group	Mean±Ss	22.83±0.75 21.2-	21.64±0.88 20.0-	0,001**
	Min-Max (Median)	24.3 (22.85)	23.0 (21.60)	

Wilcoxn Testi ** $p < 0,01$

The weight differences between the 3 groups according to the weeks are presented in Table 4.6. Weight differences are higher at Motivational Group than others every week and these differences are statistically significant.

Table 4.6. The Weight Differences Between Three Groups

		n	Min.	Max.	Mean	SD	p
Motivational Group	1 st Week	34	-,71	4,01	1,7956	1,02019	0,002
	2 nd Week	34	,80	5,91	3,2000	1,28113	0,000
	3 rd Week	34	2,26	7,32	4,1865	1,24345	0,000
	4 th Week	34	-,36	8,08	5,1200	1,60946	0,000
	5 th Week	34	1,08	9,09	6,4235	1,59983	0,000
	6 th Week	34	2,34	10,95	7,3847	1,76131	0,000
	7 th Week	34	3,60	12,13	8,5718	1,69160	0,000
	8 th Week	34	5,04	13,02	9,4938	1,68882	0,000
Monitoring Group	1 st Week	34	,30	3,00	1,4706	,68558	0,002
	2 nd Week	34	,60	4,00	2,3971	,76890	0,000
	3 rd Week	34	-,42	5,83	3,3035	1,15606	0,000
	4 th Week	34	,97	6,83	4,4353	1,34177	0,000
	5 th Week	34	-,14	7,75	5,2547	1,54004	0,000
	6 th Week	34	,28	9,79	6,1174	1,94081	0,000
	7 th Week	34	2,35	10,86	7,1100	1,82371	0,000
	8 th Week	34	3,60	11,90	8,0265	1,80996	0,000
Mail Group1	1 st Week	34	,17	2,45	1,0915	,47524	0,002
	2 nd Week	34	-1,58	2,89	1,5285	1,01697	0,000
	3 rd Week	34	-1,45	4,14	1,7253	1,41376	0,000
	4 th Week	34	-1,94	6,21	2,3597	1,65467	0,000
	5 th Week	34	-1,29	7,51	3,0782	1,63350	0,000
	6 th Week	34	,00	8,82	3,2968	1,99484	0,000
	7 th Week	34	,00	11,71	3,5479	2,65796	0,000

8 th Week	34	,00	11,71	3,7700	3,12498	0,000
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Kruskal Wallis Test

The BMI differences of the 3 groups according to the weeks are presented in Table 4.7. Body Mass Index differences are higher at Motivational Group than other groups and these differences are statistically significant.

Table 4.7. The BMI Differences Between Three Groups

	n	Min.	Max.	Mean	SD	p *
Motivatonal Group	34	1.20	3.20	2.2235	0.42000	0,000
Monitoring Group	34	0.90	2.90	1.8618	0.42356	
Mail Group	34	.00	2.90	0.9000	0.71985	

* *Kruskal Wallis Test*

Table 4.8. The BMI Percentage Differences Between Three Groups

	n	Min.	Max.	Mean	SD	p *
Motivatonal Group	34	5.45	13.22	9.5153	1.68828	0,000
Monitoring Group	34	3.73	11.93	8.0738	1.78731	
Mail Group	34	.00	12.13	3,9362	3.10941	

Table 4.9. The Weight (kg) Differences Between Three Groups

	n	Min.	Max.	Mean	SD	p *
Motivatonal Group	34	2.20	7.60	5.1971	1.29252	0,000
Monitoring Group	34	2.00	6.50	4.1647	1.02864	
Mail Groupl	34	.10	7.20	2.1824	1.54635	

5.DISCUSSION and CONCLUSION

We aimed to determine the differences in the effectiveness of 3 different nutritional therapy methods used in the online counseling system in obese patients. 102 patients enrolled in the study.

While women individuals over the age of 18 were included in the study, being men and menopausal, pregnant, or lactating women were determined as exclusion criteria. The effectiveness of diets differs between men and women in terms of weight loss. There are several characteristics that may contribute to the difference in weight loss success between men and women. Characteristics that support greater weight loss in men is that it contains a greater percentage of muscle mass compared to fat mass. This causes higher resting and total energy expenditure (170,171) and helps to increase the effectiveness of exercise on weight loss (172). When looking at a woman's physiology, women have higher concentrations of leptin, an appetite-regulating hormone (173). Since leptin reduces energy intake, it facilitates weight loss. Other contributors to weight loss variability between men and women include work-life differences and lifestyle interventions. In a review by Williams et al. (174) investigating the difference in weight loss between men and women, 49 studies were included. Women were found to lose weight during these interventions, although 80% of studies directly comparing weight loss (kg) between men and women indicated that men lost significantly more weight than women. In the study of Farnsworth et al. (175) and Evans et al. (176), significant differences in weight loss were reported between men and women. However, this difference was not significant when adjusted for initial weight. Studies reporting weight loss as a percentage of baseline weight, only two reported a significant gender difference, with men in greater percentage weight loss at 16-week follow-up and 30-month follow-up (177,178). Meta-analyses of differences in change in weight outcomes between men and women showed greater differences for men when absolute weight change was used. This is probably because the weight change takes into account the fundamental differences that exist in weight and height, where the absolute weight change is not. Therefore, evaluating by weight loss instead of BMI and rate of weight change may lead to an erroneous conclusion as to whether there is a significant gender difference (174).

Physical activity concurrent with the diet program was recommended to the patients participating in our study. It was determined as 165 minutes/week in the patient. Many different types of training can be applied for weight management. The effects of resistance training, aerobic exercises, or combinations of different types are still under investigation. There are 5 elements of exercise programs; exercise type, intensity, frequency, duration, and improvement. It takes a certain period of time for sedentary people to develop exercise adaptation. The frequency of exercise depends on the person's training history and level of physical fitness. In general, the frequency of starting exercise for inactive individuals is planned as 1-3 days a week. Then, it is suggested that the frequency of training can be increased to 3-5 days as the level of physical fitness increases. The exercise duration is started in a shorter time compared to the current situation of the people and increased to longer periods with adaptation (179).

In the literature, there are studies that determined that the weight loss achieved with diet and exercise is higher than the weight loss achieved with diet alone. In Dumankaya's study (179), dieting women lost an average of 6.78 kg and lost 1.97 kg from lean tissue. Those in the diet+exercise group lost 8.02 kg and lost 2.9 kg of lean tissue. In the diet+exercise group in women; body weight, BMI values lost more than the diet group. In studies with energy restriction and/or the addition of exercise for obesity treatment, body weight, fat ratio, and abdominal fat loss were observed effectively (180,181). Although exercise alone has positive effects on body composition in women; It has been concluded that its application with diet may provide optimal benefit in the prevention of obesity and obesity-related diseases (182,183).

American Collage of Sport Medicine (ACSM) recommends moderate exercise for general. 'High-intensity interval training' (HIIT) is recommended for young, healthy, asymptomatic individuals, can be made to access faster. In addition to aerobic exercise, ACSM requires strength-resistance exercise at least 2 days a week. The ACSM recommended exercise frequency is 3-5 days per week. If it cannot be done 3 days a week, the planned exercise time can be done in 2 days or even at once (184). Ministry of Heath Physical Activity Guideline-2018 recommends 150 minutes, moderate, or 75 minutes of

heavy-paced exercise per week (185). In the 2021 guideline of the Turkey Endocrine Metabolism Association (TEMMD) it is written that individuals should be encouraged to exercise other than daily physical activities. It recommends 150 minutes of moderate-intensity or 75 minutes of vigorous aerobic exercise per week or equally combined exercises should be targeted (186).

A uniform diet was recommended for all overweight or obese individuals participating in the study so that it would not make a difference in the results, and the DASH diet was chosen as the diet. The DASH diet model is a proven method to improve diet quality and lower cardiometabolic risk factors independent of weight loss or physical activity changes (187). The DASH diet emphasizes nutrients such as potassium, magnesium, fiber, and protein through fruits, vegetables, whole grains, beans, and low-fat dairy products, and limit total fat, saturated fat, and cholesterol (188). Numerous trials have demonstrated the blood-pressure-lowering effects of DASH in subgroups of men, women, racial/ethnic minorities, and whites, and in both hypertensive and non-hypertensive participants (189). The effects were greater when DASH and sodium reduction were combined (187). Similarly, trials demonstrated the positive effects of DASH on glycemic control (190) and weight control (191). The two most commonly used approaches in the balanced low-calorie diets group are the Mediterranean diet and the DASH diet. Both have scientifically proven health benefits. TEMMD recommends the DASH diet and Mediterranean diet for losing weight in a healthy way (186).

In our study, participants lost between 3.7 kg and 9.49 kg according to their group with DASH diet. There are also studies in the literature that have a significant relationship between the DASH diet and weight loss and improvements in diet quality (192-194). In the study of Steinberg et al. (195), a relationship was found between DASH compliance measured by the DASH nutrient index and weight loss. This situation has been interpreted in two ways; showed that those who lost weight consumed more of the nutrients supported in DASH, or that those who adopted DASH lost more weight. Other evidence supports this endpoint that a DASH-friendly diet with and without calorie restriction may be effective for weight loss (196).

Diabetes Mellitus or thyroid patients are not included in our study. These patients may have insulin resistance and it does affect weight loss. In addition, different program guides are given for DM and thyroid patients. For this reason, patients were not included in the study in order not to add to the results of the study. Several studies on weight loss have examined whether differences in glucose and insulin dynamics are a mediating factor for successful weight loss on low-fat and low-carb diets. (197-201). The majority of these studies observed that obese adults with higher insulin resistance lost more weight on Low-Carb diets compared to Low-Fat diets. Studies in middle-aged adults have suggested that subclinical hypothyroidism and higher TSH in the euthyroid range are associated with higher weight and BMI (197-201) or higher fat mass (202,203). This suggests the effect of metabolic rate changes caused by thyroid hormone.

In our study, the patients themselves chose the groups they would follow. From the findings of the study, it was seen that individuals with high weight applied to the patient groups followed by video conference, not the group followed by e-mail. While weight loss at motivational group and monitoring group is 9.4 kg and 8.0 kg at the end of 8 weeks, weight loss at mail group is determined as 3.7 kg. Choosing your own group may lead to bias in the results. In the study of Evans et al. (176), it was reported that patients with higher initial weight had significant differences in weight loss. However, when weight loss was set as a percentage of initial weight, this difference was not found to be significant. Mason et al.'s study (204), which reported weight loss as a percentage of starting weight, reported a significant gender difference among all groups, with a greater percentage of weight loss in the 30-month follow-up.

In our study, patients in the motivation and monitoring group had weekly online meetings while in contact with the dietitian, and they could reach their dietitians via WhatsApp whenever they wanted. On the other hand, patients at the mail group received weekly emails with a diet list. The mean scores of the weight loss were higher for the motivational group (around 9.5 kg) during 8 weeks. Sherwood et al. (155) found that patients who received 20 intervention sessions over a 6-month period lost an average of 4.9 kg; Those who received 10 calls for intervention lost about 3.3 kg. This result is similar to our study,

regular and weekly meetings help to lose weight. Weight management programs that offer follow-up with a coaching system to support participants were seen as more successful in the process of weight loss (205-207). While women who use weight loss programs with the follow-up of coaches have higher weight loss success, similar successes have not been achieved in men (208,209). However, both men and women benefit from a coaching system and regular follow-up to increase engagement and weight loss success (207-209).

In our study, we found that weekly meetings are more effective than sharing diet lists via email. Unlike our study, the literature email system was generally used for supporting personalized interventions and their results seem positive. In Leahey and Wing's study, weekly email and face-to-face coaching sessions from a trainer helped participants lose between 10% to 20% compared to their body weights (210). Alternatively, weekly email coaching and monthly personalized coaching phone calls have also been shown to improve adherence to health-related strategies, reduce health risk factors and improve weight loss (211-213). It has been shown that with weekly behavior change sessions and weekly personalized self-monitoring feedback, the probability of weight loss increased by 5% at 6 months and 10% at 12 months, and that weight loss is sustained over 2 years (211,213,214). Weekly to monthly follow-ups over a 6 to 12-months intervention were associated with 5% to 10% weight loss and better adherence to healthy lifestyle recommendations (210-212). Although it was determined that female participants attended more coaching sessions than male participants in the studies, no statistically significant difference for the weight loss was found. (208,209,211). Individualized feedback provided by an expert on self-monitoring was effective in both men and women (215). Personalization has been found to be more effective than automated emails that provide general health information or tips on nutrition and behavior in particular (216,217). In the study of Painter et al (218)., in a 6-month intervention, the participant's participation in a one-on-one expert coaching session, weekly expert-led interactive Web-based group participation, and weekly diet list sharing from the expert, the number of feedback days were found to be important determinants of weight loss.

In our study, 9.49 kg weight loss is determined for the group called the motivation group, which is in contact with each other, while weight loss at the monitoring group which

does not have contact with each other is 8.02 kg. There are similar results in the literature. Even we know that behavioral weight-loss interventions were effective in achieving clinically significant weight loss (219), group-based delivery of behavioral weight-loss interventions is more common and effective than individual-based delivery (220,221). In our study, the reason why the results in the motivation group were more successful may be that all participants were women. Studies have found that men's participation in group sessions in weight loss interventions is significantly lower than that of women (208, 209, 211). Participants in group-based behavioral weight loss programs often comment on the value of being a group member in improving their weight loss success (222). Anecdotally, interventionists often point out the importance of a weight loss group's commitment to results. Group cohesion is defined as “a dynamic process reflected in the tendency of a group to stay and stay together in pursuit of instrumental goals and/or meeting the emotional needs of members” (223). Group cohesion has been found to be associated with better outcomes in many group types, including group exercise programs and psychotherapy groups (224,225). In the study by Painter et al. (218), the percentage of weekly Web-based group sessions was found to be an important contributor to weight loss. 60% class attendance was associated with 5% clinical weight loss was associated with greater weight loss among.

Many theorists examine group commitment in two dimensions: task-oriented integration and social attraction to the group. Task-oriented integration means focusing on the group “task,” namely weight loss. The social attraction for the group is to focus on social relations within the group (223). A high level of task-oriented integration can promote greater accountability and increase learning opportunities by observing others in the group. If social attraction to the group is higher, it may increase social support and promote normalization difficulties associated with weight loss. It has been stated that individuals in groups get better results if there is a high level of cohesion within the group (222). Social attraction was associated with better participation, while group conflict was negatively associated with participation and weight loss.

In our study, we did not aim to search about factors that affect the weight loss at group interventions. There are studies in the literature in which evaluating the determinants

of the effect of group interventions on weight loss. As seen in the study of Nackers et al. (226), in the study of Taylor et al. (227) it is proved that positive group characteristics such as group cohesion, participation, and social support were not found to be associated with weight loss. While Taylor et al. study did not evaluate negative group interactions, the findings from Nackers' study indicated that only very negative interactions in groups could affect weight loss (226,227). However, these studies did not examine the relationships between group factors and outcomes. There are several possible alternative explanations for the lack of association between group cohesion and participation and weight loss. First, other individual-level constructs from health behavior models may be more important in predicting engagement and weight loss, such as self-efficacy, behavioral intentions, positive expectations about outcomes, and outcome expectations (228, 229).

Animal and epidemiological studies conducted to date have associated stress with disordered eating, weight gain, impaired glucose metabolism, abdominal adiposity, and lipid abnormalities (230). Individuals may tend to overeat in response to adverse environmental factors and the rewarding value of food. In addition, stress can exacerbate homeostatic hunger and satiety signal (231). Despite this recognition, most weight-loss interventions do not include solutions that support stress management and increased response to homeostatic signals that regulate food intake. Mindfulness-based approaches can be effective in reducing psychological stress (232). Mindfulness meditation, which enhances awareness of current experience with a non-judgmental attitude, can prevent maintaining long-term eating habits, especially in the face of stress (233). Studies showed that mindfulness-based interventions improve eating behaviors, weight management, and metabolic health (234- 238). In one analysis of mindfulness, after 6 and 12 months of follow-up periods, study participants in the mindfulness arm continued to have reduced sweet food intake compared to that in the other group (control arm). It was concluded that the greater the weight loss was, the more meditation and mindful eating practices the participants had during the intervention, and the lower triglyceride (HDL ratio) and lower fasting glucose levels were at 6 months (239).

The previous studies investigated the effectiveness differences between face-to-face counseling and online counseling systems. However, no study has been found in the literature

examining the differences between the methods used in the online system, this is the strength of our study. Larger studies evaluating online nutritional counseling with common follow-ups and group interventions are needed in the future.

The highest level of weight loss was calculated as 9.49 kg for the motivation group. Then the monitor group comes in with 8.02 kg and the mail group with 3.7 kg. Participant's weekly dietitian-led web-based meeting participation, communication with each other were important predictors of weight loss in an 8-week intervention.

There is a need for more studies with a large population on online weight-loss interventions in which patients are in contact with each other in the future. Identifying and implementing effective online interview techniques is also an important contribution in terms of cost.

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