**DERLEME**
*REVIEW*

# Relationship Between Visceral Fat Tissue and Exercise

## Abstract

There are two types of apidose tissue in the human body. Brown adipose tissue is found in small amounts in the body and produces heat in the body through adaptive thermogenesis in cold conditions and diet. White adipose tissue stores fats as triglycerides to be transferred to the blood as free fatty acids when the excess energy is needed. White fat tissue can transform into brown fat tissue due to factors such as hormonal stimulation, chronic cold environment and exercise. UCP-1 protein, an important protein found in brown adipose tissue, regulates energy distribution. White adipose tissue is divided into two in the body: subcutaneous and visceral white adipose tissue. Visceral tissue surrounds the internal organs, while subcutaneous tissue is found in the thighs and buttocks. Visceral fat cells, which accumulate especially around the abdominal organs, may be closely related to type 2 diabetes, dyslipidemia, atherosclerosis development, fatty liver, cardiovascular diseases and other metabolic diseases, and the most important cause of visceral fat accumulation is due to lifestyle changes, lack of exercise and the application of diet programs. Popular types of exercise to reduce visceral fat tissue include aerobic exercise, combination exercises, resistance exercises, high-intensity interval training and sprint interval training. In particular, aerobic exercises are considered the most popular exercise method used for weight loss because they can be performed easily and cause high energy expenditure. Popular exercise models to reduce visceral fat tissue include aerobic exercise, resistance exercises, combined exercises, high-intensity interval training and sprint interval training. Among these training methods, it is aimed to determine exercise models that aim to reduce the visceral fat rate around the abdominal internal organs at a high rate, and even specifically to determine which exercise model will be most effective.

**Keywords:** Aerobic, resistance, subcutaneous fat, visceral fat

# Viseral Yağ Dokusu ve Egzersiz İlişkisi

## Özet

İnsan bedeninde iki tip apidoz doku bulunmaktadır. Kahverengi yağ dokusu vücutta az miktarda bulunmakta ortamın soğuk olduğu koşullarda ve diyet zamanda adaptif termojenezis ile vücutta ısı üretimi gerçekleştirir. Beyaz yağ dokusu alınan fazla enerjiyi ihtiyaç duyulduğunda serbest yağ asitleri olarak kana aktarılmak üzere yağları trigliserit olarak depo etmektedir. Beyaz yağ dokusu hormonal uyarılar, kronik soğuk ortam ve egzersiz gibi etkenlerle kahverengi yağ dokusuna dönüşüm sağlayabilir. Kahverengi yağ dokusunda bulunan önemli bir protein olan UCP-1 proteini enerji dağılımını düzenlemektedir. Beyaz yağ dokusu vücütta subkutan ve visseral beyaz yağ dokusu olarak ikiye ayrılır. Visseral doku iç organları çevrelerken subkutan doku uyluk ve kalçalarda bulunur. Özellikle karın organlarının etrafında biriken viseral yağ hücreleri tip 2 diyabet, dislipidemi, aterosklerozis gelişimi, karaciğer yağlanması, kardiyovasküler hastalıklar ve diğer metabolik hastalıklar ile yakından ilişkili olabileceği ve viseral yağ birikiminin en önemli nedeni, yaşam tarzı değişikliğine göre egzersiz eksikliği ve diyet programlarının uygulama biçimi ile ilişkili olabilmekte. Viseral yağ dokuyu azaltmaya yönelik popüler egzersiz türleri arasında aerobik egzersiz, kombine egzersizler, direnç egzersizleri, yüksek yoğunluklu aralıklı antrenman ve sprint interval antrenmanları yer almaktadır. Özelliklede aerobik egzersizler, rahatlıkla uygulanabildiği ve yüksek enerji harcamasına sebep olduğu için kilo kaybı amacı ile kullanılan en popüler egzersiz metodu olarak değerlendirilmektedir. Viseral yağ dokuyu azaltmaya yönelik popüler egzersiz modelleri arasında aerobik egzersiz, direnç egzersizleri, kombine egzersizler, yüksek yoğunluklu aralıklı antrenman ve sprint interval antrenmanları yer almaktadır. Bu antrenman metotları içerisinde karın iç organları etrafında bulunan viseral yağ oranını yüksek oranda azaltmaya yönelik egzersiz modellerinin belirlenmesi hatta sipesifik olarak hangi egzersiz modelinin en etkili olabileceği tespiti amaçlanmıştır.

**Anahtar Kelimeler:** Aerobik, direnç, subkutan yağ, viseral yağ

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## INTRODUCTION

Excessive accumulation of fat cells in any part of the body may cause health risks (Kwon et al., 2010). Two main shapes of fat cell distribution are reported in the literature: Apple shape (android), with greater fat accumulation and density in the abdomen, and pear-shaped peripheral (gynoid) region, where visceral or subcutaneous fat accumulation and density is lower in the extremities (hips, limbs and legs) are observed. There are fundamental differences between these two types of lubrication because most heart diseases and metabolic diseases are associated with vascular and visceral fat deposits (Marandi et al., 2013). Fat localization is the main determinant of the occurrence of metabolic disorders, especially in which abdominal fat tissue is involved. It is important to distinguish white adipose tissue in subcutaneous adipose tissue, which is characterized by high storage capacity, from visceral adipose tissue, which is more metabolically active. Greater lipolysis in visceral adipose tissue leads to higher free fatty acid secretion, resulting in ectopic accumulations or direct transport to the liver via the portal vein. Visceral adipose tissue also releases a variety of pro-inflammatory factors, including pro-inflammatory cytokines (tumor necrosis factor [TNF]-α, interleukin [IL]-6, IL-1β), hormones (leptin, resistin), and other molecules such as monocyte chemoattractant protein. 1 (MCP-1) plays a role in the formation of chronic inflammation associated with insulin resistance. Therefore, visceral adipose tissue is highly associated with cardiovascular risks (Maillard et al., 2018). Fat cells that accumulate especially around the abdominal organs may be closely related to diabetes, cardiovascular and other metabolic diseases, and the most important cause of visceral fat accumulation may be related to lack of exercise and the way that diet programs are applied regarding to lifestyle changes. Abdominal fat increases with age in men, and increases significantly after menopause in women (Kwon et al., 2010). Insufficient physical activity and careless nutrition in human life can lead to excessive weight gain, which is a serious health threat to the human body (Kılıç, 2020). Exercise or sports-based activities can offer an effective solution to both psychological health problems (Güven et al., 2021) and physical or physiological problems (Göncü and Balcı, 2023). Limiting exercise or creating anxiety in this direction may also negatively affect individuals' quality of life (Özavci and Gözaydın, 2022). As a matter of fact, it is possible that with the occurrence of emotional tension, that is, stress, the perception of health gained from leisure-based exercise may decrease (Özavci et al., 2023) and eating habits may be negatively affected. When the literature is examined, it is seen that the evidence is increasing. In addition to walking, which is the most preferred type of exercise (Şahin et al., 2014), aerobic and resistance exercises or a combination of both can show varying degrees of effectiveness when used to reduce body weight and increase physical fitness, and supports the use of higher intensities. Recent studies have suggested that high-intensity combined exercise (45 minutes of exercise approximately three days a week for a minimum of 12 weeks) may be the most effective exercise method for improving cardiorespiratory fitness and reducing body mass index (BMI). However, despite growing evidence, exercise methods based on general physical activity guidelines (150 min per week of moderate-intensity aerobic exercise) have been reported (Kim et al., 2019, Peirson et al., 2014, Davis et al., 2022). Although it is thought that individuals can achieve significant reductions in body weight by adopting a lifestyle that includes physical activity, it is understood that exercise has changed its shape in the digital age, which has accelerated with modernization. These types of exercises, which provide cognitive benefits (Kilci, 2019; Kilci and Yalçıner, 2020), can pave the way for body fatness since they are based on body inactivity. On the other hand, researches show that moderate-intensity exercises for 150 minutes a week can prevent major health problems and maintain body weight control. However, longer-term exercises are needed for long-term weight control. For this reason, more than 250 minutes of exercise per week is recommended for overweight and obese individuals for long-term weight loss or control. Aerobic exercises are considered the most popular exercise method used for weight loss because they can be performed easily and cause high energy expenditure. It is also generally the preferred exercise method because it improves cardiorespiratory function and causes a decrease in body weight (Petridou et al., 2019). It plays an important role in the process of converting body fat cells into energy by increasing energy expenditure during resistance exercise training (Looney and Raynor, 2013). Resistance exercises can also lead to an increase in the total amount of energy consumed during the day, based on a more independent exercise level, along with the improvement in muscle strength and volume (Bray et al., 2018).

### *Adipose Tissue*

Adipose tissue is the connective tissue structure where excess energy is stored in the organism as triglycerides. In addition to playing a role in energy homeostasis, it also plays a role in heat insulation and production, as well as mechanical protection of the organs around it, etc. It also includes functions among its features. Adipose tissue creates a dynamic function due to its capacity to synthesize many biologically active substances, which are known as energy storage properties and provide metabolic balance like an endocrine structure (Coelho et al., 2013).

Due to their structure, the main function of adipocytes is to store triglycerides. They consist of different cell types and the stromal vascular fraction. These cell types include stem cells, preadipocytes, macrophages, endothelial cells, and fibroblasts (Tchoukalova et al., 2004). This structure also contains blood vessels, collagen and elastic fibers (Lebona, 1993). Adipose tissue is the fat tissue that generally undergoes volumetric change throughout life, based on energy consumption in terms of cell number and cell size, as well as energy consumption. It grows and develops due to the formation of new adipocytes from precursor cells and an increase in adipocyte size (Gregoire et al., 1998). Adipogenesis is expressed as the transformation of preadipocytes into mature fat cells, and the development of adipose fat tissue varies according to age and gender (Coelho et al., 2013). As preadipocytes in adipose tissue can transform into mature adipocytes throughout life, expansion of adipose tissue occurs when the storage requirement increases and becomes necessary (Gray and Vidal-Puig, 2007). Adipose tissue has a very important place in the regulation of biological functions and especially energy metabolism with the enzymes, cytokines, growth factors and hormones it secretes (Demirci and Gün, 2019). Adipose tissue hypertrophy (visceral, intramuscular fat and subcutaneous), increases triglycerides, free fatty acids, disrupts glucose metabolism, increases hepatocyte damage, and increases infiltration of the liver of inflammatory molecules (Chang et al., 2021). Fat cells are endocrine glands that affect human physiology with the adipokines they secrete and also provide communication between organs. Adipokines can show harmful and beneficial factors together, for example; while leptins reduce body weight, they also threaten the immune system. This situation is summarized by the fact that many diseases such as hypertension, type II diabetes, metabolic syndrome and asthma occur due to the increasing fat mass in the body. It is thought that changes in the amount of adipokines secreted by adipose tissue play a serious role in the development of such diseases. Additionally, as an important feature, it has been observed that fat cells secrete various inflammatory mediators in response to stress factors such as excessive weight gain (Günöz, 2002). The increase in fat tissue causes changes in the levels of adipokines released into the circulation. Thus, a connection can be seen between circulating adipokine levels and various pathological conditions. In addition to the shape of fat distribution in the body, visceral fat tissue, in particular, differs from other fat tissues in function as various adipokines and cytokines that cause systemic and insulin resistance in liver damage, neutrophilic chemotaxis, apoptosis and activation of liver stellate cells are secreted from visceral fat tissue (Boden, 1997). Adipose tissue in mammals is divided into white adipose tissue, brown adipose tissue and beige adipose tissue according to their basic histological characteristics, the type of adipocytes they contain and their related functions (Lebona, 1993).

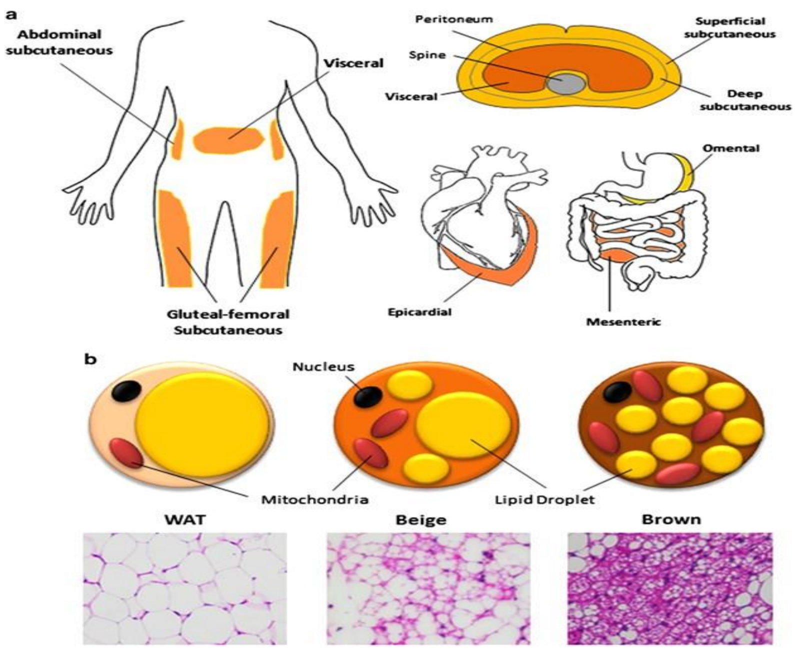


Figure 1. Fat Tissue Types

### *Types of Adipose Tissue*

Adipose tissues are subcategorized as white adipose tissue and brown adipose tissue according to their functions and morphology. Brown adipose tissue functions in thermogenesis, producing heat through the combustion of nutrients separated from ATP production by the (UCP1) uncoupling protein (Kaisanlahti and Glumoff, 2019). White fat stores excess energy, while brown and beige fat are thermogenic and dissipate energy as heat (Becher et al., 2021). Moreover, the main functions of energy storage white adipose tissue and heat production brown adipose tissue are considered endocrine tissues due to the secretion of adipokines that participate in the metabolic regulation of the body (Kaisanlahti and Glumoff, 2019). Adipose tissue is known as an endocrine organ and regulates various metabolic functions such as insulin sensitivity, energy metabolism, blood flow and even the inflammatory phase by producing adipokines. Adipose tissue is divided into two main subtypes: white adipose and brown adipose tissue, depending on the differences in their characteristics. White adipose tissue is responsible for storing the excess energy taken into the body through food as fatty acids. Brown adipose tissue is mostly specialized in thermogenesis. There is also a third type of adipocyte called “beige” adipocyte. It is a brown adipocyte that occurs in white fat depots and also has thermogenic capacity (Stanek et al., 2021). Beige adipose tissue has been found to be intermediate between brown adipose tissue and white adipose tissue. The tissue shares the ability for thermogenesis as well as morphological features. Beige adipose tissue derives from the precursors of white adipocytes and is found in clusters distributed across areas of white adipose tissue, as opposed to brown adipose tissue occurring in discrete depots (Kaisanlahti and Glumoff, 2019).

### *Brown adipose tissue*

The main task of brown adipose tissue is not to store fat, but to provide heat to the body by burning fat, that is, thermogenesis (Scheele and Nielsen, 2017). Adipocytes originate from the mesoderm in the formation of brown fat tissue, which is responsible for thermogenesis (Enerback, 2009). During fetal development, brown adipose tissue appears much earlier than white adipose tissue, which begins to develop in mid-gestation. Brown adipose tissue, which has a maximum size when compared to body weight at birth, decreases with age, while the proportion of white adipose tissue gradually increases throughout life (Gesta et al., 2007). This tissue is a specialized structure that is activated in anti-shivering or non-shivering thermogenesis due to lipid oxidation. The brown color of brown adipose tissue is expressed by its high density of mitochondria, which are important for lipid oxidation and heat generation (Choe et al., 2016). It is located mainly in the interscapular area in newborn individuals. Studies have been reported showing that brown adipose tissue exists in adults (Wang and Seale, 2016). In rodents, it is found primarily in the interscapular region, as well as in the cervical, mediastinal, pericardial and perirenal regions (Giordano et al., 2004). Although brown adipose tissue is seen in the interscapular region during the perinatal period of humans and rodents (DiSpirito and Mathis, 2015), as well as in both child and adult rodents, it is reported that it is limited in newborn individuals and is gradually replaced by white adipose tissue with advancing age. Tomography (positron emission/computed) studies have also suggested that brown adipose tissue is also present and has a function in adult humans (Virtanen et al., 2009; Cypess et al., 2009). In adults, brown adipocyte-like thermogenic cells are located in the supraclavicular and neck areas (DiSpirito and Mathis, 2015). For this reason, various adipose tissues are activated as the central regulator of energy homeostasis by storing excess energy and maintaining thermogenesis (Choe et al., 2016). Brown adipocytes, which constitute the basis of brown adipose tissue, are multilocular, unlike white adipocytes. Its structure contains large amounts of mitochondria and uncoupling protein 1 (UCP-1), which is a mitochondrial inner membrane protein. This protein is responsible for the heat released during aerobic respiration. In this way, brown adipose tissue functions to produce heat from stored energy and to spread heat around (Cannon and Nedergaard, 2004).

### *White adipose tissue*

White adipocytes, which are the main essence of white adipose tissue, have a large fat droplet covering a significant part of the tissue cytoplasm, indicating unilocular cells. In white adipocytes, the cell nucleus is not located in the center of the cell but is located at the edges. White adipocytes are among the largest cells in the body in terms of diameter, consistent with their fat storage function. White adipose tissue is divided into two according to its anatomical location in the body and, accordingly, its functions. The first of these is the visceral (omental, mesenteric, retroperitoneal, gonadal and pericardial) adipose tissue, which is located around metabolically active organs and whose main function is to provide energy to these organs (Cannon and Nedergaard, 2004). Subcutaneous adipose tissue, which is another type of white adipose tissue, is located especially in the abdominal, femoral and gluteal regions and undertakes the functions of thermal insulation and mechanical protection. Subcutaneous fat tissue is located just under the skin and is seen in prominent elastic focal areas in the abdomen and legs in the human body. Abdominal, mesenteric and omental foci constitute the main visceral adipose tissues in human body. The omental fat area constitutes a portion of the total amount of fat tissue in the body. The epididymal adipose focus, taken as a sample of visceral white adipose tissue in rodents, may function at a level equal to the omental region. Visceral adipose tissues activated in rodents are mesenteric and intraperitoneal (DiSpirito and Mathis, 2015). Between subcutaneous adipose tissue and visceral adipose tissue, there are differences in molecular, physiological, clinical and prognostic aspects along with anatomical region and cellular structure. Visceral adipose tissue located in the omentum and mesentery has a more vascular, cellular and neural innervation structure than the subcutaneous fat tissue. It has more inflammatory and immune cells, less preadipocyte differentiation capacity, and a higher proportion of large adipocytes. Glucocorticoid and androgen receptors are more abundant in visceral adipose tissue. Compared to subcutaneous fat tissue, visceral adipocytes are metabolically more active, highly sensitive to lipolysis, and more resistant to insulin. Additionally, visceral adipose tissue is more sensitive to adrenergic stimulation. It has the capacity to create more free fatty acids and take up glucose. Subcutaneous adipose tissue is more effective in removing free fatty acids and triglycerides from the circulation. Visceral adipose tissue is more decisive in the mortality rate than subcutaneous fat tissue (İbrahim, 2010). Adipose tissue mass increases towards middle age in the human body and decreases in old age. When fat tissue is evaluated as a mass, it changes over time from subcutaneous to intra-abdominal visceral foci in middle age and afterwards. Compared to young women and men, fat taken with food is stored less in the subcutaneous regions in older individuals, and the abdominal circumference in adult women increases by 4 cm every 9 years (Tchkonia et al., 2010). In adult humans, white adipose tissue constitutes the largest fat deposit that can be found in different deposits in the body. It contains large oil droplets and its main function is energy storage. This fat drop consists of triglyceride, which covers more than 90% of the cell volume. While there is a decrease in brown adipose tissue by age, an increase is observed in white adipose tissue (Saely et al., 2011). Mitochondria in white adipocytes are weaker and in variable quantity compared to brown adipocytes. For this reason, the oxygen need of brown adipose tissue is higher than white adipose tissue (Medina-Gómez, 2012). White adipose tissue is stored in 2 main regions in the body: visceral fat tissue and subcutaneous fat tissue (Mermer and Acar-Tek, 2017).

***Subcutaneous fat (subcutaneous) tissue***

Fat distribution varies among individuals. Subcutaneous fat is the area between the skin and the lamina profunda of the superficial fascia. Subcutaneous fat is located under the skin and found in the form of distinct elastic foci in the abdomen and legs. Subcutaneous adipose tissue is more effective in removing free fatty acids and triglycerides from the circulation (Arifoğlu 2017, Demirci and Gün, 2019).

***Visceral fat (omental) tissue***

Body fat is found primarily in subcutaneous adipose tissue (SCAT) under the skin or visceral adipose tissue (VAT) around internal organs, but can also be found in the bone marrow (yellow bone marrow), retro-orbital and periarticular. In these areas and within tissues such as muscle (intermuscular) and vital organs, this is often referred to as ectopic fat accumulation. Fat tissue accumulates predominantly in the subcutaneous fat tissue (80-90%), and the main depots of subcutaneous fat tissues are the abdominal, subscapular (upper back), gluteal and femoral (thigh) parts. The importance of this depot distinction is that subcutaneous fat tissue depots are located just under the skin and do not communicate with internal organs. Whole-body studies using imaging techniques have suggested that premenopausal women present with more subcutaneous fat tissue in the abdominal and gluteofemoral regions than men, particularly superficial subcutaneous fat tissue, which is the fat tissue closest to the skin. Alternatively, visceral fat tissue is located primarily within the intra-abdominal cavity in close proximity to major organs, including the liver and intestines. An important difference of this depot is that it discharges its components (non-fatty acids and adipokines) into the portal circulation. Visceral adipose tissue is thought to constitute 6-20% of total body fat, with higher amounts in men than women. There is also a small amount of visceral fatty tissue around the heart, known as epicardial fat (Frank et al., 2019).

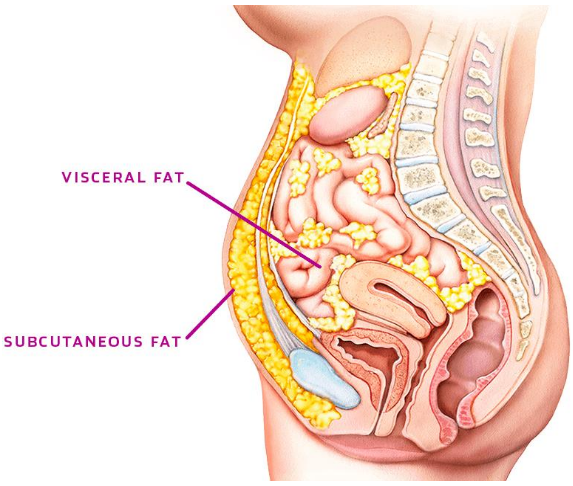


Figure 2. Visceral Fat Tissue

***The Relationship Between Visceral Fat Tissue and Exercise***

Exercise is a key component of energy expenditure and energy balance. Changes in energy balance change fat mass. Physical activity affects fat tissue both acutely and in the long term. During exercise, adipose tissue blood flow and fat mobilization are stimulated, possibly resulting in the delivery of fatty acids to skeletal muscles at a rate appropriate to metabolic requirements, except during vigorous exercise. Stimulants include adrenergic and other circulating factors. Through exercise, fat storage function decreases with exercise intensity, where fatty acids are directed from fat tissue to other tissues such as skeletal muscle (Thompson et al., 2012). Compared to dietary restrictions, which have superior effects in reducing body weight, recent research suggests that exercise programs are effective in reducing visceral fat tissue (Chang et al., 2021). Since excess body weight results from an imbalance between energy intake and energy expenditure, one way to maintain the correct body weight is by stimulating lipid catabolism through increased methods of physical activity. Properly designed physical activity provides lipolysis, that is, the hydrolysis of triacylglycerols stored in fat tissue; this causes the release of free fatty acids into the circulation and oxidation in muscles and other tissue structures (Mika et al., 2019). The release of fatty acids from adipocytes and their delivery to working muscles contributes to changes in the amount and composition of adipose tissue lipids. However, it has been reported that these effects depend on exercise intensity. Some studies have shown that low-intensity endurance training leads to maximum lipid oxidation, but current evidence on this subject is insufficient (Mika et al., 2019). A sedentary lifestyle may be a risk factor for adipose tissue function. Physical inactivity leads to the accumulation of fatty tissue. Visceral adipose tissue, which is harmful fat accumulation in the human body, contributes significantly to abdominal obesity, and has also been suggested to cause Type 2 diabetes, fatty liver, neurodegenerative diseases, osteoporosis and inflammatory bowel disease, cardiovascular diseases, metabolic syndromes, and, at a high rate, deaths (Chang et al., 2021;  Abedpoor et al., 2022).

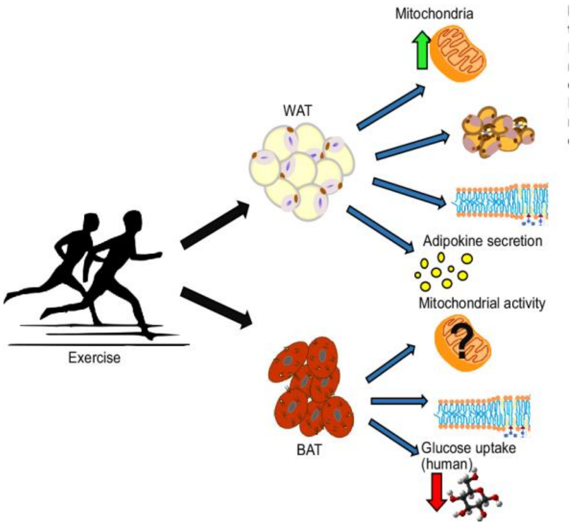


Figure 3. Exercise-induced adaptations to white adipose tissue (WAT) and brown adipose tissue (BAT)

It is understood that there are different methods in the literature for determining visceral fat. In this context, it can be said that various methodologies have been created for the evaluation of visceral fat tissue volume and distribution. Criterion methods that provide direct measurement of partial or total volumes include magnetic resonance imaging (MRI) and computed tomography (CT). More recently, dual-energy X-ray absorptiometry (DXA) has been identified as a reference method for the assessment of body composition. However, due to high cost and feasibility issues, indirect estimates of VAT are usually performed using anthropometric measurements, including waist circumference, sagittal diameter, and bioelectrical impedance analysis (Ross et al., 2020).

### *Visceral Fat Level Regarding Exercise Patterns*

Studies are still continuing as a research topic in determining exercise models to reduce visceral fat tissue, and even specifically which type of exercise may be most effective. Popular types of exercise to reduce visceral fat tissue include aerobic exercise, resistance exercise, high-intensity interval training and sprint interval training (Verheggen et al., 2016; Ismail et al., 2012). Recently, the dose-response effect of high-intensity exercise on reducing visceral fat was examined in overweight women by increasing repetitions of high-intensity exercise with each training session (Zhang et al., 2017). Increasing training volume did not, in turn, lead to greater visceral fat loss, meaning that training volume of high-intensity exercise repetitions may not be a relevant variable to alter abdominal visceral fat storage (Zhang et al., 2017). On the other hand, it has been reported that high-intensity exercise has facilitating effects on reducing abdominal visceral fat compared to low-intensity exercise in obese women participating in endurance exercise training, and high-intensity exercise has not been reported to have much effect on reducing visceral fat tissue, partly due to higher energy expenditure (Tong et al. ., 2018). Of these types of exercise, aerobic exercise has been proven by some studies to be the main type of exercise to reduce visceral fat tissue (Verheggen et al., 2016; Ismail et al., 2012), and it has been suggested that high-intensity interval training has similar effects to aerobic exercises (Andreato et al., 2019). It is emphasized that resistance exercises are associated with a decrease in body fat mass and a simultaneous increase in lean body mass. For this reason, results emerge indicating that there is little or no significant change in total body weight (Cavalcante et al., 2018). However, the effects of resistance exercises on visceral adipose tissue are thought to remain unclear (Ismail et al., 2012; Yan et al., 2019; Keating et al., 2017). Some studies have reported that aerobic exercises combined with resistance exercise reduce visceral fat tissue more than aerobic exercise alone (Park et al., 2003). Resistance exercises not only increase muscle size, strength, and lean body mass, but also change body composition by reducing visceral fat and total body fat (Zemková et al., 2017). It has been reported that resistance exercises reduce insulin resistance by increasing muscle mass and are especially effective in reducing visceral fat (Ibanez et al., 2005). When other studies are evaluated, it is thought that effective fat loss programs including diet programs and physical activity practices or both may be necessary for loss of abdominal fat and visceral fat. In the short and long term, programs based solely on nutritional recommendations are less effective than programs that also include physical activity. Current guidelines recommend moderate-intensity continuous training (MICT) because it can be sustained over a long period of time and promotes fat mobilization and oxidation. MICT may be thought to have positive cardiovascular and metabolic effects but often leads to little fat loss. Conversely, emerging evidence on high-intensity interval training (HIIT) has suggested that this method of exercise may lead to greater fat tissue loss than low/moderate continuous training, more effectively reducing abdominal and visceral fat mass, the most dangerous fat accumulation (Maillard et al., 2018; Wewege et al., 2017). There is strong evidence that high-volume, moderate-intensity sustained training, including exercise programs performed for 45 min.or more can reduce abdominal visceral fat tissue as well as improve body composition, cardiovascular fitness, and other health-related conditions. However, the superiority of interval training over continuous training in reducing abdominal fat, especially visceral fat, has not been fully investigated. Contrasting findings regarding training-induced abdominal visceral fat reduction in previous studies may be related to differences in training protocols, including volume and intensity, visceral fat measurement methods, overweight status, and gender (Zhang et al., 2017).

## CONCLUSION

Compared to dietary restrictions, which have superior effects on fat storage function and body weight reduction through exercise, with exercise intensity in which fatty acids are diverted from fat tissue to other tissues such as skeletal muscle, recent studies have reported that different patterns of exercise programs are suggested to be effective in reducing visceral fat tissue. Determining exercise models to reduce visceral fat tissue and specifically which exercise model would be most effective is still a matter of research. Popular types of exercise to reduce visceral fat tissue include aerobic exercise, resistance exercise, high-intensity interval training and sprint interval training. Body fat burning capacity may increase when aerobic exercise, resistance exercise, or a combination of both is used to reduce body weight and increase physical fitness, although recent studies have suggested that high-intensity combined exercise may be the most effective exercise method to improve cardiorespiratory fitness and reduce body mass index. It is thought that the fat accumulated especially in the abdominal organs may be closely related to type II diabetes, hypertension, asthma, cardiovascular diseases and other metabolic syndromes, and the most important cause of visceral fat accumulation may be related to the lack of exercise and the application of diet programs according to lifestyle changes. In the studies to be carried out to prevent the increase in visceral fat level and whole body fat level, aerobic exercise, resistance exercise, high-intensity interval training and sprint interval training and combined exercises, especially extending the duration, intensity and increasing the scope, will determine which exercise models will increase visceral fat and total body fat levels. It is thought that when they are all considered and performed together the effect on fat burning can give clear results..

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