

Examination of Changes Occurring in the Anatomic and Physiologic Structures of Women Participating in Power Plate Trainings

Sevki Kolukisa

*Giresun University, Education Faculty/Physical Education and Sports Department,
Giresun, Turkey*

Telephone: 0543 615 6625, E-mail: sevki.kolukisa@gmail.com, sevki.kolukisa@giresun.edu.tr

KEYWORDS Power Plate. Body Fat Percent. Physical Exercise. Obesity. Health Fitness

ABSTRACT The purpose of this study is to examine the effects of training carried out through Power Plate on physical, physiological and motor variables of women. Subjects were 20 women randomly selected between the ages of 25 and 45 (2.70 ± 6.62). After the pre-tests were carried out, subjects joined the Power Plate Training sessions of 24 weeks, and repeated the training sessions every three days of each week for 10 minute sessions. After the administration of post-tests, results were analyzed by SPSS 15.0 using descriptive statistics and Wilcoxon. Findings yielded a significant difference in all parameters of the differences between pre and post-tests with a significance level of $p < 0.01$. As a result of regularly applied exercises, individuals may reach physical appropriateness, or already existing physical appropriateness of individuals may be maintained on the highest level. Weight, BMI, fat, internal fat values was observed to decrease significantly, and there was an increase in muscle mass ($p < 0.01$). This study showed remarkable effects in the monitored parameters of middle-aged women, who participated in power plate trainings.

INTRODUCTION

Most medical, health, and exercise scientists agree that the capability to perform certain fitness movements and to reach results has positive effects on physical health. This effect can also be seen directly as the development of physiological function of several organs and systems as well as indirectly, as the development of emotional status resulting indirectly from physical activity (Stanford et al. 1993).

Nowadays, all world countries acknowledge how significant the role of sporting activities is in the building stones of a healthy society consisting of healthy individuals. Regular exercises help to develop body parts related to aspects of physical fitness. Health-related aspects of physical fitness can be defined as cardiovascular stability muscular strength, muscular resistance, body composition, flexibility as well as nervous and muscular relaxation (Heyward 1991).

There is a considerable amount of information available with regards to the benefits of regular exercise for middle-aged individuals and the society is aware of the fact that physical exercise conducted at an advanced age will have positive effects on the individuals' quality of life (Aydos and Kürkçü 1997).

After being digested, fats are absorbed and transported by the lymphatic system, subsequently they penetrate into blood circulation, and are either sent to the muscles in order to be burnt and consumed or are transmitted to fat cell at various places (especially under the skin) in order to be stored or accumulated if no exercise is conducted. After each meal, the amount of fatty acids contained in the blood reaches an increased level. Persons with an active life style hold these free fatty acids contained in the blood on a low level by virtue of their activity, as a result of which their rate of contracting cardiovascular diseases remain on a decreased level because such activities in the form of gentle exercise allows for the metabolization of fats and prevents fat-derived substances from accumulating in arterial peripheries and thereby causing arteriosclerosis. Being carried by the body as an additional load, the adipose tissue affects sportive performances negatively. The body fat index differs according to the age, sport branch, performance level, nutrition and population of individuals. The Body Fat Index (BFI) is a means, which can be used to determine the body fat composition. The Body Fat Index can be easily calculated by measuring various subcutaneous fat tissue thicknesses and using the resulting

values in the respective places of the formula (Bilgin 1995).

For the improvement of physical appropriateness, regular exercise has to fulfill certain standards. The American College of Sports Medicine (ACSM) indicates that an exercise program has to fulfill certain qualities and quantities in order to improve physical appropriateness, and accordingly makes the following suggestions: the frequency of exercise should be between 3-5 days a week, its intensity should be either between 60-90% of the maximum heart beat or between 60-70% of the heart beat reserve, its length should be between 20-60 minutes, and its type should be in the form of activities that use major muscle groups, possess rhythmic and aerobic structures, and can be executed continuously (Kin et al. 1996).

Power plate creates 30 to 50 contractions per second in our body. Activities conducted with vibration platforms stretch and contract muscles, whereby tonic vibration contractions are activated. These involuntary contractions created by Power Plate provide a healthier body and a well harmonized communication between the brain, nerves, and organs.

Power Plate employs 95-97% of muscle fibers all at the same time. The vibration created by power plate in our body does not only create tonic contractions, but every single muscle fiber of the trained region is employed by this strong vibration. Our muscles consist of numerous muscle fibers. Power Plate trains every single fiber of these muscles in a perfect manner. Moreover, even the muscle fibers located in deep locations get involved in this action.

Training with Power Plate is the same as with other strengthening programs. In general, it will be beneficial to begin the trainings with gentle exercises. At the first stage, the body should not be strained and the training periods should be kept short. At the beginning, a particular exercise should be preferably carried out for 30 seconds, which should be raised to 45 seconds and then to 60 seconds.

Thanks to its characteristics such as increasing metabolism, increasing muscular strength, cellulite-preventing benefits, decreasing pain, increasing elasticity, improving fitness, regulating and accelerating blood circulation, improving the harmony of the body, and increasing bone density, Power Plate has an extensive field of application consisting of various exercise packages, from which even individuals suffer-

ing from hypoglycemia, acute diseases, open wounds, serious migraine, thrombosis, individuals with artificial hips, pacemakers, platinum or metal connecting elements due to fractures, individuals who have undergone neurosurgery, pregnant and breastfeeding women, patients who have undergone by-pass, epilepsy (falling sickness), patients with transplants or tumors, and people suffering from other chronic diseases may benefit without problem.

MATERIAL AND METHODS

Participants

This study was carried out on 20 female test subjects between the ages of 25-45, who participated in Power Plate exercises at the Power Plate Club in Bursa in 2009. The test subjects' weight, height, body fat density, body muscle percentage, kcal value, BMI and body inner fat were measured, whereupon the exercise program began to be applied. Within the scope of the program, which was applied three-days-a-week for a period of six months, the exercises began with 30" and were gradually increased to 60". A Power Plate Training period of 30 minutes was applied per training session.

Instrument and Procedure

The exercise program consisted of squat, deep squat, wide stance squat, lunge, calves, pelvis bridge, latissimus dip, push up, triceps dip, biceps curl, bent over pull, shoulder press, front raise, lateral side, raise, abdominal crunch, lower abdominals, standing abdominals, and lateral abdominals movements, whereas stretching movements - hamstring stretch, quadriceps stretch, calf stretch, adductor stretch, shoulder stretch, and pectoral stretch movements were applied on the same training device. The massage movements covered calves massage, upper arm massage, quadriceps massage, adductor massage, abductor massage, and hamstring massage. Shoulder and neck relaxer, lower back relaxer, upper body relaxer, back relaxer, first step, and sitting pull were applied as relaxing movements.

Data Analysis

Data were analyzed using SPSS 15.0 Package Program. Along with descriptive statistic, Wilcoxon signed-rank test was used to analyze the data. Level of significance was determined to be 0.05

RESULTS

The following tables and explanations show the findings gathered under this study. As it can be seen in Table 1, the training program applied under this study delivered remarkable results with regards to the parameters included into the evaluation scope of the research group having the following values: age 32.70 ± 6.62 and height 165.30 ± 5.35 .

A decrease of 7.34 kg was achieved between the first and last weight values average of, while a statistically significant difference of 0.01 was observed between the values. A muscle increase of 6.92 was measured between the muscle values of the first and last test, while a statistically significant difference of 0.01 was observed between these measured values (Table 1).

A decrease of 2.81 was measured between the BMI values of the first and last test, while a statistically significant difference of 0.01 was observed between these measured values. A decrease of -6.61 was achieved between the body fat rate values of the first and last test, while a statistically significant difference of -0.01 was observed between these values.

A decrease of 182.10 calories was achieved between the calorie values of the first and last test, while a statistically significant difference of 0.01 was observed between the values. A decrease of 2.00 was measured between the inner fat values of the first and last test, while a statistically significant difference of 0.01 was observed between the values.

DISCUSSION

Metabolism is the amount of energy spent by the body in order to fulfill its basic functions. Our body continuously burns calories during eating, sleeping, cleaning, and other similar activities. The metabolism is affected by compounds of the body. These compounds reflect the rate between the body's muscle and fat tissues. In the body, muscles use more calories than fats. Individuals with a more muscular body have a faster metabolism since their bodies contain less fat (Ugur and Baysaling 2005).

Delecluse et al. (2003) discovered in their study a significant difference of 0.01 in the knee extension strength and whole body vibration (WBV). In addition, the contribution made to strength improvement of sedentary group was emphasized in the same study. Cormier et al. (2006) found in their study, a significant difference of 0.05 in the whole body vibration.

Accelerating metabolism and bringing the functions of the body to perfection by means of exercise is the most important health measure. Having a slow metabolism means that we resign ourselves to various diseases and disorders such as feeling cold, a dry skin, a slow pulse, low blood tension, etc. (Ugur and Baysaling 2005).

In a 24-weeks study, Roelants et al. detected a decrease of 2.2% in fat free cells. However, no statistically significant difference could be observed (Roelants et al. 2004). When training with Power Plate, muscles of the trained area work and develop with an efficiency of almost 100%.

Table 1: Defining statistical tests and Wilcoxon Signed-Rank test results on the research group's measured parameters

Parameters		N	ORT± SS		Z value	F calculation	Level of significance
Age		20	32.70±	6.62			
Height		20	165.30±	5.35			
Weight	First Test	20	74.20±	10.10	-3.920	0.0001	P0<0.01*
	Last Test	20	66.81±	9.30			
Muscle	First Test	20	23.36±	3.04	-3.920	0.0001	P0<0.01*
	Last Test	20	30.28±	4.15			
BMI	First Test	20	27.37±	4.06	-3.921	0.0001	P0<0.01*
	Last Test	20	24.56±	3.84			
Fat	First Test	20	40.23±	6.44	-3.921	0.0001	P0<0.01*
	Last Test	20	33.62±	5.56			
Calorie	First Test	20	1487.35±	109.02	-3.920	0.0001	P0<0.01*
	Last Test	20	1305.25±	102.65			
Inner Adipose	First Test	20	6.60±	1.84	-3.782	0.0001	P0<0.01*
	Last Test	20	4.60±	1.63			

The endurance and strength of our body increases effectively. Massage-featured exercises carried out with Power Plate help to decrease fatty tissues located under the skin, to decompose fat cells, and to have a tighter and healthier tissue. An in-depth effect begins with the decrease achieved in cellulites and the strengthening observed in the tissues.

In a clinical study carried out in Germany, Frank and Moos (2004) selected 60 women between the ages of 24-45, who suffered from cellulite. Power plate exercises were applied to this test group 2-3 times a week for a period of 24 weeks. While a decrease of 32% in the cellulites of the other group, to which cardio-training was applied in addition to Power plate subsequent to the trainings with Power Plate and which trained for 40 minutes, was observed, a decrease of 26% was observed in the group, which trained exclusively with Power Plate and only for 11 minutes a day. The results of this clinical study showed that Power Plate obviously is an effective method to decrease the severity level of cellulite without giving rise to any side effects.

Verschueren et al. carried out a 24-weeks research on 70 post-menopause women between the ages of 58-70 for the purpose of measuring the effects of Power Plate. Power Plate was included into the exercise program of the first group, whereas a normal exercise program was applied to the other group. The measurements carried out upon completion of the exercise programs showed an increase of 0.5% in the bone density of the "collum ossis femorum" area of women performing normal sports, while an increase of 0.9% was observed in the bone density of the group training with Power Plate (Verschueren et al. 2004). The following conclusion was reached at the end of this study: Power Plate is an effective means to improve the density of the hip bone, muscular strength, and balance (Verschueren et al. 2004).

Besides being healthy, Power plate is also effective in the prevention and treatment of chronic diseases. The habit of regular exercise is a magic key capable to open any door with respect to solving many health problems triggering disorders related to old age, various diseases, and rapid aging (Ersoy 2004).

Exercise decreases blood pressure as well as the risk to fall down and get injured due to loss of balance (hip or ankle fractures), slows down the body's loss of muscle and bone mass, in-

creases elasticity, improves balance and mobility, helps to maintain ideal weight, offers a regular sleep routine, relieves from strain and stress, and offers a healthy and long life (Günay 1999; Chapek 1994).

Physical activity and motion are basic functions that are necessary for the human organism to develop any movement. The importance of physical activity for middle-aged individuals is being studied systematically for the last 20 years (Akgün 1993).

It is assumed that the mechanical forces applied to the bones during physical activity increase the mineral density of bones and inhibits bone loss. Bone loss arises with advanced age. It has been detected, especially in women at the beginning phase of the menopause and in individuals at the age of approximately 30 suffering from endocrine insufficiency or a metabolic disease, that an average annual decrease between 0.75% 1%, and 2-3% is achieved with regard to bone loss, which may cause osteoporosis fractures (Kin et al. 1996).

Power Plate creates reflex contractions in our body. Our body functions involve natural reflexes such as the reflex movements of our eyes. Our body functions include touching and contracting reflexes similar to the involuntary twinkling of our eyes. For example, if a physician hits our knee with a hammer, our leg contract involuntarily. This is a sign showing that we are healthy. When training with Power Plate, a similar hammer effect is created in every single area of our body. Such contractions are called "Tonic Vibration Contractions".

In a research carried out at the University of Graz in Austria, the possibility to gain strength by means of Power Plate was measured within the scope of the rehabilitation of knee patients. Other sports activities besides Power Plate exercises were applied to one part of the group consisting of 12 patients with an average age of 35 selected for this research, while Power Plate exercises were applied to the other part. The exercise period covered 5 weeks. At the end of the period, a muscle increase of 78.1% was achieved in the group conducting other sports activities, the muscle increase observed in the group training with Power plate reached up to 126.7%. This research shows that Power plates prove itself in the treatment of rehabilitation conditions (Academy of Physiotherapy, Graz District Hospital, Austria 2003).

Exercise is one of the best means to achieve the desired level of healthiness, that is factors such as ideal body weight, avoidance of nicotine consumption, keeping stress level under control, having a healthy heart circulation, etc. that are accepted as general health rules (Zorba 2004).

To achieve this goal, physical exercise is required along with a balanced and well-organized diet, the calories of which have to be calculated properly. In adults, changes occurring in body weight depend primarily on changes of body fat, while the body fat rate indicates the excess amount of energy that enters the body (compared to the amount of energy that is consumed). Physiologically, the body weight of an adult is tried to be kept constant by means of certain homeostatic mechanisms. Hunger and satiety constitute the desire of our eating behavior, which plays a significant role in keeping the body weight on a constant level. Hunger and satiety are under the control of centers located in the hypothalamus. Nowadays, getting rid of surplus weight is an important problem not only for sportsmen/sportswomen, but also for many other people. The best way to regulate one's weight is to perform regular physical exercise combined with proper diet. One of the most important benefits achieved by performing exercise combined with a proper diet is that the body proteins are protected and fats are mobilized at a higher rate. Especially aerobic exercises are very effective in burning fats and protecting proteins (Akgün 1993).

Women are fatter than men. 3-5% of both the female and male body is made up of fat, which is necessary for the proper functioning of cell membranes and the nervous system. The female body contains additional 5-8% of gender-specific fat. The bone development of females ends in the first 20 years of aging. 18-21 are the ages, in which the body reaches its maximum height of development. It has been observed that the skeletal mineralization between the ages of 20's and 30's continues both in trabecular bone mass and bone mass. Peak bone mass is the bone density reached during human life. It has been seen that a high peak bone density prevents osteoporosis emerging at advanced age (Elmaci et al. 1993).

It is a scientific fact that it is possible to maintain health by means of exercise. Considering the amounts of money spent on medical methods, results achieved by such methods (drug therapy, surgery, and so on.) are far from being

satisfactory. On the other hand, it is possible to prevent a large scale of health expenses by means of everyday exercises of merely 10-15 minutes (Açıkada and Ergen 1990).

In many sports branches, a specific fat rate is defined for optimal performance. The relationship between excess total body fat and cardiovascular diseases has been known for long. In recent years, it has been detected that a relationship exists between excess total body fat and chronic diseases and high death rate (Bilgin 1995).

Along with helping to lose weight, exercise shows its effects by decreasing blood lipoprotein, influencing metabolism, increasing blood circulation performance and thereby decreasing the risk of cardiovascular diseases (Elmaci et al. 1993).

It has been proven that fat accumulations that emerge as a result of excess weight can be decreased by means of long-term and low-tempo exercises, which ultimately helps to prevent many health problems including cardiovascular diseases (Johnson et al. 1992).

The weight of water contained in our body represents 2/3 of our body weight. Within this context, deviations of one or two kilograms may be observed at the beginning or the end of the menstrual periods of women. Therefore, "slimming" and "losing weight" are two different things. Slimming is defined as the loss of excess weight, while needless drugs are consumed, which make the body lose water and may result in dangerous consequences (Montgnac 1997).

There are a lot of tables available in relation to normal values of body weight. Such tables comprise values such as age, gender, height, and body weight. However, it is not possible to always draw correct results from such tables. In many cases, such tables foresee a slight weight increase proportional to advanced age. But the decrease occurring in the number of metabolic active cells in the organisms as one's age advances is approximately 3% every ten years after the age of 25. Therefore, some authors indicate that such tables should not be trusted at all times; the body weight of a person may be high even if he/she is not that much fat or a person might be fat, that is adipose although his/her body weight is low. As it can be seen, it is very important to take into account the body fat rate in order to define adiposity (Akgün 1993).

One of the functional disorders seen in women, who are actively involved in sports, is the "premenstrual syndrome" emerging together

with physical and psychological syndromes. This syndrome, which might be seen at any age (but more frequently in women over 30), may show itself by one or more symptoms such as headache, depression, irritability, irregular perspiration, edema, and anxiety. The emergence of such conditions has negative influences on women (Kalyon 1994).

Physical appropriateness expresses the proper performance of particular movements and the body's existing condition status with regards to physical endurance. According to this definition, a person with the highest physical appropriateness is the person, who can move for the longest period of time without getting tired (Zorba and Ziyagil 1995).

As result of regularly applied exercises, individuals may reach physical appropriateness, or already existing physical appropriateness of individuals may be maintained on the highest level. The female muscle system (especially in the upper extremities) is less developed than the male muscle system with respect to muscle volume and length. The muscle mass of women has a rate that is 15-20% less than the muscle mass of men with the same size. Proportional to mass, muscle tendons are smaller and have a weaker structure. Depending on the aforementioned facts, the muscle tonus and muscle strength are less in women than the tonus and strength of men. The strength and speed development of women improves on a lower level due to this structure, while on the other hand, a higher elasticity and a higher motion angle of the joints can be observed. The weight caused by the low level of muscle mass in women is compensated by the high level of the body fat rate. However, no difference could be detected with respect to fibril composition. Depending on the aforementioned reasons, a lower improvement has been observed in characteristics such as strength, speed, and endurance as response to the trainings applied (Astrand 1964).

Generally speaking, the body composition is made up of the proportional combination of fat, bones, muscle cells, and other organic substances. Although there is a similarity between the body organs and members of various individuals, every single individual has a different physical composition (Zorba and Ziyagil 1995).

Yigit et al. (2013) concluded that to determine the physiological changes that occur in middle-aged individuals who do aerobics and fitness

for recreation purposes and also to determine the effects of sport-based recreation in terms of physiology and health. For this purpose, 42 (40.64 ± 5.33) middle-aged female subjects who were involved in sports-training activities at Istanbul-Akatlar Club Sporium in 2009-2010 participated in the study. The subject-group was subjected to an aerobic-based training program in parallel with their physical conditions three days a week for a period of 12 weeks. When pre and post-test results obtained were compared, a statistically significant decline was found in women in terms of parameters such as body-weight, body mass index, body fat content (%), basal metabolism, total daily energy requirement of the body, age and muscle strength; whereas an increase was observed with respect to Maximum Oxygen Intake (VO₂) parameter.

A study was conducted by Kolukisa et al. (2005) in Giresun in 2015. The subject-group was subjected to an aerobic-based training program in parallel with their physical conditions three days a week for a period of 12 weeks. When pre and post-test results obtained were compared, a statistically significant decline was found in women in terms of parameters such as body-weight, body mass index, body fat content (%), basal metabolism, total daily energy requirement of the body, age and muscle strength; whereas an increase was observed with respect to VO₂ max parameter.

CONCLUSION

It is known that Power Plate trainings are widely used for physiotherapy, sports, fitness, rehabilitation, medical, and cosmetic purposes. Literature related to studies, which have been carried out until today, shows that Power Plate is used in the aforementioned branches basically for purposes such as bringing elasticity, ensuring an in-depth training of all body muscles, minimizing the risk of joint injuries, increasing blood flow and oxygenation, ensuring a higher level of hormonal performance, increasing the body's bursting strength, increasing the flow rate of body fluids, decreasing the effects of osteoporosis, decreasing upper and lower back pains by strengthening these regions, decreasing and preventing the formation of celluloid, increasing bone density, increasing the production of collagen, and decreasing mental and physical stress.

RECOMMENDATIONS

As supported in related literature, the results of this study show that remarkable effects have been achieved in the monitored parameters of middle-aged women, who participated in Power Plate trainings.

REFERENCES

- Açıkada C, Ergen E 1990. "Kadin ve Spor", *Bilim ve Spor Büro*. Ankara: Tek Ofset Matbaacılık.
- Akgün N 1993. *Egzersiz Fizyolojisi*. İzmir: Ege Üniversitesi Basımevi.
- Astrand PO 1964. Human physical fitness with special reference to sex and age. In: E Jokl, Simon E Springfield (Eds.): *International Research in Sport and Physical Education*. Illinois: C. C. Thomas, pp. 341-346.
- Aydos L, Kürkçü R 1997. *13-18 Yas Grubu Spor Yapan ve Yapmayan Orta Öğrenim Gençliğinin Fiziksel ve Fizyolojik Özelliklerinin Karşılaştırılması*. Ankara: Beden Eğitimi ve Spor Bilimleri Dergisi. Volume 2, No. 3, pp. 31-38.
- Bilgin A 1995. *Kadında Fitnes Programının Vücut Kompozisyonu ve Aerobik Kapasiteye Etkisi Dokuz Eylül*. İzmir: Üniversitesi Yüksek Lisans Tezi.
- Chapek CL 1994. *Physical Fitness Programs*. Microform Publications Int'te for Sport and Human Performance Institute. Eugene: University of Oregon.
- Cormier Prue, Deane Russell S, Triplett N, Travis McBride, Jeffrey M 2006. Acute effects of whole-body vibration on muscle activity, strength, and power. *The Journal of Strength and Conditioning Research*, 20(2): 257-261.
- Delecluse C, Roelants M, Verschueren S 2003. Strength increase after whole-body vibration compared with resistance training. *Med Sci Sports Exerc*, 35(6): 1033-1041.
- Elmaci S, Gürpınar D, Erdinç T, Islegen Ç, Ertat A, Durusoy F 1993. Sedanter Sahislarda Egzersizle Kilo Kaybinin Bazı Kardiak Risk Faktörlerine Etkisi. İzmir: *IV. Milli Spor Hekimliği Kongresi Bildiri Kitabı* 17-19 Eylül.
- Ersoy G 2004. *Egzersiz ve Spor Yapanlar İçin Beslenme*. Ankara: Nobel Yayın Dağıtım.
- Frank H, Moos J 2004. *Effect of Vibration Training on Cellulite*. SANADERM Professional Clinic for Skin Illnesses and Allergies, Bad Mergentheim, Germany.
- Günay M 1999. *Egzersiz Fizyolojisi*. 2. Baskı. Ankara: Bağırhan Yayinevi.
- Heyward UH 1991. *Advanced Fitness Assessment Exercise Prescription*. Champaign Illinois. U.S.A.: Human Kinetics Books.
- Johnson RE, Mastropaola JA, Wharton MA 1992. Exercise dietary intake and body composition. *J Am Diet Assoc*, 60: 399.
- Kalyon AT 1994. *Spor Hekimliği Sporcu Sağlığı ve Spor Sakatlıkları*. 2 Baskı. Ankara: Gata Basımevi.
- Kin A, Kosar N, Tuncel F 1996. *8 Haftalık Step ve Aerobik Dansin Üniversiteli Bayanların Fiziksel Uygunluğuna Etkisinin Karşılaştırılması*. Ankara: Spor Bilimleri Dergisi, Volume 7, No. 3, pp. 21-30.
- Kolukisa S, Dönmez B, Dönmez K 2015. A Study on Physiological Changes in Women Who Do Sports for Recreative Purposes. *International Journal of Sport Studies*, 5: 19-23. From <http: www. ijssjournal .com. ISSN 2251-7502 © 2015; Science Research Publications>.
- Montignac M 1997. *Kadınlara Özel. Çev. Ümit Arar*. 1. Basım. İstanbul: Güncel İyincilik.
- Roelants M, Delecluse C, Goris M, Verschueren S 2004. Effects of 24 weeks of whole body vibration training on body composition and muscle strength in untrained females. *I J Sports Med*, 25: 1-5.
- Stanford D, Stanforth PR, ve Velasquez KS 1993. Aerobic requirement of bench stepping. *International Journal of Sports Medicine*, 14(3): 129-133.
- Ugur E, Baysaling Ö 2005. *Herkes İçin Spor, Vücut Gelistirme, Fitness ve Formda Kalma*. İstanbul: İpress Basım ve Yayın.
- Verschueren S, Roelants M, Delecluse C, Swinnen S, Vanderschuere D, ve Boonen S 2004. Effect of 6-month whole body vibration training on hip density, muscle strength and postural control in postmenopausal women: A randomized controlled pilot study. *Journal of Bone and Mineral Research*, 19: 9.
- Yigit O, Kolukisa S, Aydoğan A 2013. Rekreatif Amaçlı Spor Yapan Bayanların Fizyolojik Değişimlerinin Araştırılması. *Spor ve Performans Araştırmaları Dergisi*, 4(1): 17-20.
- Zorba E 2004. *Yaşam Boyu Spor*. Ankara: Nobel Yayıncılık.
- Zorba E, Ziyagil MA 1995. *Vücut Kompozisyonu ve Ölçüm Metotları*. 1. Baskı. Trabzon: Gen Matbaacılık.