# DÜZENLİ SPOR YAPAN VE YAPMAYAN 12-14 YAŞ GRUBU KIZ ÇOCUKLARDA STATİK VE DİNAMİK DENGE PERFORMANSININ İNCELENMESİ

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## ÖZ

Bu çalışma ile 12-14 yaş grubu, voleybol oynayan ve herhangi bir branşla ilgilenmeyen kız çocuklarda dinamik ve statik denge yeteneğinin incelenmesi amaçlandı. Çalışma gruplarını, en az 2 yıl voleybol geçmişine sahip, haftada 4 gün voleybol antrenmanı yapan ve okul takımında yer alan (n=12) ve herhangi bir spor branşı ile ilgilenmeyen gönüllü kız öğrenciler (n=12) oluşturdu. Katılımcıların yaş, boy, kilo ölçümleri ile dinamik ve statik denge performansları ölçüldü. Dinamik denge performansı, anterior (ANT), posterolateral (PL) ve posteromedial (PM) olmak üzere 3 yönde modifiye Yıldız Gezi Denge Testi (YGDT) ile statik denge performansı ise, Tek Bacak Üstünde Durma Denge Testi ile değerlendirildi. Tüm katılımcıların yaş, boy, vücut ağırlık değerleri, ANT, PL ve PM ve 3 değerin ortalaması alınarak hesaplanan karma puan (COMP) değerleri ve statik denge değerlerinin ortalamaları ve standart sapma değerleri hesaplanarak yorumlandı. Gruplar arası ANT, PL, PM, COMP ve statik denge skorları arasındaki farklılıkların karşılaştırılmasında Mann-Whitney U testi kullanıldı. Çalışma sonunda voleybol oynayan grupta her iki bacak PL ve COMP dinamik denge performansı skorları ve baskın olmayan bacak statik denge performans skoru herhangi bir sporla ilgilenmeyen sedanter gruba göre daha yüksek bulundu. Sonuç olarak, çocukluk döneminde yapılan düzenli egzersizlerin çocukların dinamik ve statik denge gelişimine olumlu etkileri olduğu söylenebilir.

**Anahtar Kelimeler:** Voleybol, motor beceri, Yıldız Gezi Denge Testi, Tek Bacak Üstünde Durma Denge Testi

# INVESTIGATION OF STATIC AND DYNAMIC BALANCE PERFORMANCES OF FEMALE STUDENT-ATHLETES AND NON-ATHLETES BETWEEN 12 AND 14 YEARS OF AGE

## ABSTRACT

The aim of this study is to evaluate the static and dynamic balance performance of female students aged between 12-14 years who regularly play volleyball and who do not play any sports. Total of 24 female students voluntarily participated in this study. Twelve subjects have been practicing regularly for at least 2 years (four days a week), while the others have never participated in any physical activities. The height and weight of the subjects were measured and static and dynamic balances were determined bilaterally by Single Leg Stance Balance Test and Star Excursion Balance Tests (SEBT), respectively. SEBT scores were obtained for anterior (ANT), posterolateral (PL), and posteromedial (PM) directions, and for an overall composite (COMP) score. Right limb, left limb, both limbs static balance and dynamic balance limb average scores were compared between groups using Mann-Whitney U. According to the findings, right leg, left leg, both legs PL and COMP scores and left leg static balance score were found to be higher in the group that have been playing volleyball on a regular basis. Consequently, it can be said that exercising on a regular basis has positive effects on the static and dynamic balance of young female children.

**Key words:** Star Excursion Balance Test, Single Leg Stance Balance Test, volleyball, motor ability, physical activity

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## INTRODUCTION

It is suggested that physical activities are one of the key factors in physical and mental development of children[8,15,21,29]. Physical activity capacity can also be defined as physical fitness or motor fitness. Motor fitness, which is also called motor skills, is also known as the individual's performance skills, which are influenced by factors, such as speed, agility, balance, coordination, and strength[6]. While participation of children and adolescents to recreational and extramural physical activities is suggested to help them with regards to reducing risks of sports-related injuries and increasing their physical performances, it is also suggested that these activities will also help trainers and healthcare professionals in this respect[20]. It is also stated that children and adolescents are not young adults, and that their bodies and minds work in different ways, and therefore, they should not only be regarded as little children, but also as different individuals. It is also emphasized that they are exposed to non-linear periods, such as rapid development in their personality traits and their learning abilities especially in motor skills[25].

In recent years, development of proprioception and balance in order to improve the quality of life, prevent potential injuries, and to increase performance in physical activities and in various age groups, and the exercises required for this development have been discussed in various studies. It is believed that dynamic balance is a significant skill in all age groups and it is required for regular daily activities, such as walking, running, or other physical activities that require control of dynamic movements[6]. In addition, the studies show that the motor health that includes balance and coordination is a component related to physical well-being in childhood and adulthood.

It is stated that motor skills exercises are fundamental methods of training for balance and coordination from ten years of age and the importance of balance and coordination-based exercises in this period is emphasized[34]. Balance is indicated as one of the fundamental movement skills for physical developments, their functional participation in activities and to gain motor skills[28,35]. Postural control or balance is commonly grouped under two categories as static balance, which is the ability of keeping the body balance in a certain place or location, and dynamic balance, which occurs when the external forces are neutralized by the soft tissues around the muscles and joints[36]. These two functions of postural control are based on different components, such as the position of the center of gravity and guidance of body parts[17].

It is reported that sports activities develop postural adaptations based on the sports branch[22]. Some studies suggest that the advanced levels of balance in highly-experienced athletes may result from repetitive exercises that influence motor responses, or these advanced skills of the athletes may be related to proprioceptive and visual movement. Although they have not yet developed a common ground, the experts suggest that the alterations in both sensual and motor systems influence balance performance[2]. Although there are numerous studies about the evaluation of static and dynamic balance in young athletes[2,14,18,31,24], more research is required for the effects of static and dynamic balance in children, who are engaged in different physical activities[25]. If we consider the injury rates of children increase due to their developing neuromuscular systems and in relation to

their participation in physical activities[3], since derivation of particularly the dynamic balance measurements and provision of helpful information about determination of injury risks are limited to high-cost systems, our study will put forth reliable and more affordable tests. The purpose of this study is to analyze static and dynamic balance performances of children, who play volleyball on a regular basis and sedentary children, who are not engaged in any sports activities.

## METHOD

Total of 24 female students from Demirci 75. Yıl Alime Paşa Middle School, who have been playing volleyball for at least 2 years, and practice 4 days a week as junior varsity team (n=12) (mean age, 12.75±0.45 years; body height, 153.08±3.6 cm, body mass, 46.83±6.77 kg, training age, 2.25±0.45 years), and sedentary female students, who have never been engaged in any sports activities, (n=12) (mean age, 12.58±0.51 years, body height, 151.75±6.61 cm, body mass, 41.67±4.94 kg), volunteered for this study.

The participants were informed about all measurement methods to be used for data collection, and their parents signed Volunteer Consent Forms approved by the Ministry of Education, and the ethical committee approval no: 2016-36 in 09.06.2016 was obtained to carry out this study from the Ethical Committee of Uşak University, Institute of Medicinal Sciences. All tests were performed by one researcher and standardized tests were used for all tests. For credibility of this study, all students were required not to practice or exercise 24 hours before the tests. Al tests were performed in the same period of each day, in an upright position. The students with no knee imbalances, who had never gone through any surgical operations on their legs, and who did not have any cardiovascular, vestibular, or neurological diseases, were selected for this study.

### Balance Tests

Balance performance measurements include static and dynamic balance tests and these tests were performed in upright position standing on dominant leg (preferred leg) and on non-dominant leg.

*Dynamic Balance Test:*

Modified Star Excursion Balance Test (SEBT) was used for dynamic balance measurements of the participants. The SEBT originally designed as a lower-extremity reach test on 8 designated lines on the ground[10]. The test later simplified as to include only 3 directions as anterior (ANT), posterolateral (PL), and posteromedial (PM)[11]. Internal consistency reliability of this scale is (ICC: 0.86–0.92)[12]. Leg lengths of each participant were measured bilaterally in centimeters at supine position from anterior superior iliac point to the distal part of medial malleolar. Bilateral reach distance was measured by using a tape measure fixed on the ground, and the reached point was marked on the tape measure for each direction of SEBT. The tape measures were positioned in connection with each other with 135° angle opposite to the anterior points of posterior medial and posterior lateral areas. The measurements were taken randomly for dominant and non-dominant legs. The leg used for kicking the ball was determined as the dominant leg. ANT reach was measured from the toe tip at the center, PL and PM were measured as the distance between the heel and the remotest point reached. The test requires the participants to be shoeless in order to

reach maximum distance with their free leg when their other leg is on the point of intersection of the star pattern on the floor. During the test process, the participants were required to keep their hands on iliac and keep their heels on the ground and to touch the remotest point with their toe tip. An experienced researcher made brief demonstration about the test before the measurement process, and the participants were asked to try to reach each direction at least 4 times[26]. When the participants put their body weights on their reaching legs during measurements, when they disconnected their stance heels from the ground, or ceased to touch their hips, the process was repeated after the participant was verbally warned. All reach-out distances were recorded in centimeters. Dynamic balance tests were carried out at the gym by the study team. After the data were collected, the average of reach-out scores for each direction was taken and normalized in accordance with the leg length values[13]. Normalized scores are shown as a percentage of stance leg length (LL%). Normalized ANT, PL, and PM scores were averaged and combined score (COMP) was found, and 4 normalized measurements (ANTR, PLR, PMR, and COMPR) from right leg, and 4 normalized measurements (ANTL, PLL, PML, and COMPL) from left leg were utilized to be used in statistical analysis.

*Static balance test:*

Single Leg Stance Balance Test was used for evaluating static balance performance. This test was calculated as participants' the stance time on a single leg as much as they could, while they were blindfolded, their arms were crossed over their chests, and their free legs were bent in the air. When the participants stood in this position for over 180 seconds, the test was ended[1]. Two measurements were taken for each leg and the best measurements were used for statistical assessment.

**Statistical Analysis**

SPSS 23 statistical software was utilized for data analysis. Age, height, body weight values and averages of ANT, PL, and PM values of all participants were interpreted by calculating standard deviation values. Skewness and kurtosis values were used to decide whether the data were suitable for normal distribution. Among non-parametric tests, Mann-Whitney U test was used to compare the differences between ANT, PL, PM, and COMP scores of both groups. All levels of significance were determined as (p) 0.05.

## RESULTS

Total of 24 female students have participated in this study as the volleyball group (n=12) with mean age of 12.8±0.45 years, body height of 153.1±3.6 cm, body mass of 46.8±6.77 kg, and 2.25±0.45 years of practice, the control group (n=12) with mean age of 12.6±0.51 years, body height of 151.8±6.61 cm, and body mass of 41.7±4.94 kg. It is observed that all dynamic and static balance performance averages were higher in volleyball group when compared to the control group, and that the higher difference was observed in left leg static balance average (Figure 1).

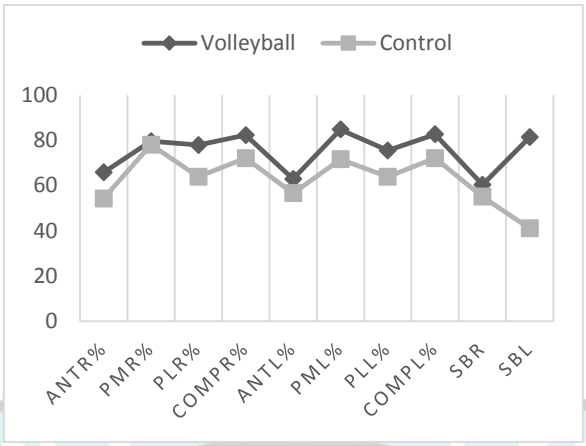


**Figure 1.** Mean SEBT scores and static balance scores for volleyball and control group. ANTR%: Right limb anterior, PMR%: Right limb posteromedial, PLR%: Right limb posterolateral, COMPR%: Right limb composite, ANTL%: Left limb anterior, PML%: Left limb posteromedial, PLL%: Left limb posterolateral, COMPL%: Left limb composite, SBR: Right limb static balance, SBL: Left limb static balance.

**Table 1. Mean SEBT scores and SDs for volleyball and control groups.**

| Score | Volleyball Group | Control Group |
|---|---|---|
| Right Limb | | |
| ANT (%) | 69.8±3.42 | 67.3±6.2 |
| PM (%) | 95.6±6.36 | 91.4±7.5 |
| PL (%)* | 86.1±5.96 | 77.5±8.03 |
| COMP (%)* | 84.8±4.19 | 85.4±6.2 |
| Left Limb | | |
| ANT (%) | 68.2±3.2 | 66.6±5.22 |
| PM (%) | 95±6 | 87.1±10.3 |
| PL (%)* | 84.8±5.07 | 77.8±8.04 |
| COMP (%)* | 89.3±3.73 | 83.8±6.37 |

* Statistically significant difference between groups (p<0.05).

Mean SEBT balance performance scores between groups are shown in Table 1. A statistically significant difference was observed in PL and COMP values of both left and right legs in volleyball group (p<0.05). No statistically significant differences were observed in ANT and PM values of both left and right legs (p>0.05).

**Table 2. Mean Static Balance scores and SDs for volleyball and control groups.**

| Score | Volleyball Group | Control Group |
|---|---|---|
| Right limb (sec) | 60.4±24 | 55.1±44.2 |
| Left limb (sec)* | 81.5±55.3 | 41±36.7 |

* Statistically significant difference between groups (p<0.05).

When the differences between the mean of static balance performances of participating groups were analyzed, a statistically significant difference was observed between groups in left legs (p>0.05), although no statistically significant differences were observed in right leg measurements (p<0.05) (Table 2).

## DISCUSSION

The static and dynamic balance skills of children, who play volleyball and who are not engaged in any sports activities, were analyzed in this study. For this purpose, the static and dynamic balance performances of female students aged between 12-14 years, who have regularly been playing volleyball for 2 years and who do not play any sports, were evaluated. In this study, a significant difference was found between PL and COMP balance performances of both legs in volleyball group and static balance performance of left leg in control group. When the mean ranks were considered, it was observed that the averages of legs and static balance score of right leg were higher in study group, but this difference was not sufficient for a statistically significant difference. It is believed that these differences may result from repetitive learned behaviors that influence motor responses, and may be related to proprioceptive and visual movement. It is known that static and dynamic postural controls are important and necessary motor skills[35] and advanced muscular strength is necessary for postural balance[7]. Violan et al. (1997) evaluated static balance performances of children aged between 8 and 13, who participated in beginner level karate classes, and aged between 8 and 12, who were engaged in this activity for recreational purposes, after 6 months of karate practices and found significant differences in the first group[32]. In their study conducted on 13-year-old male football players, Stepinski et al. (2003) observed no significant differences in statistic balance performances when compared to other individuals in the same age group, who were not engaged in any sports activities[28]. In another study conducted on children between the ages of 9 and 12, a positive relationship was found between dynamic force and balance, and gender and body weight were found to be factors that influence static balance[33]. Sheehan et al. (2013) evaluated postural balance before and after the implementation of 6-week exergames program on 4$^{th}$ graders, and the postural balance performances of the students, who participated in this exercise program on a regular basis, were found to be higher than the regular physical activity group. It is also stated that female students made more progress than male students[27]. In their study conducted on young male volleyball players, Szczepanik and Szopa (1993), found that static balance performances of these athletes were more advanced than the control group. In another study, significant increase was observed in anterior-posterior balance performances of both legs of all participants, female basketball, football, and volleyball players aged between 13 and 17, after a 6-week neuromuscular training program, but no statistically significant outcomes were observed in their medial-lateral balance performances[30]. It was also observed that overall postural balance performances scores for right side were higher than the left side[23]. In this study, left leg static balance performance score of volleyball group was found to be higher than the control group. Physical activity is known to develop coordination, acceleration, reaction time, and balance, along with speed, skills, abilities, and agility. It is also known that dynamic balance requires constant change of movement and proper adaptation to this change[4]. In this study, PL and COMP balance performance scores for both legs in volleyball group were found to be higher than the scores of the control group.

In a study by Meng and Fook (2014) found that the dynamic balance (SEBT score) performances of the study group, which

consisted of boys with 8.8 years of age average that went through a 4-week skills program, increased when compared to the control group consisted of children, who were not engaged in any sports activities[19]. In their study conducted on young female football players, Filipa et al. (2010) found that the dynamic balance score (COMP score) of the study group was higher than the control group after the Star Excursion Balance Test (SEBT) measurements performed after an 8-week neuromuscular exercise program[5]. In their study conducted on male and female skiers aged between 9 and 15, Mahieu et al. (2006) performed a whole-body vibration training on the study group and performed an equivalent resistance training on the control group[16]. Following the measurements taken after 6 weeks, both exercise programs were found to have positive effects on postural control. In his study conducted on young college students, who played any sports or who were not engaged in any kind of physical activities, Golshae (2013) found significant differences between dynamic balance scores and static balance scores of dominant and non-dominant legs of student athletes[9].

The data obtained at the end of this study found that regular exercise programs that start at early ages had an influence on developing balance skills, and might be a protective method in preventing potential injuries, particularly lower extremity injuries.

## CONCLUSION

Consistent development of motor skills in early ages for healthy young individuals is one of the most significant matters that should be emphasized. Stabilization in various postural activities in kids is not only related to age-related neural maturation development, it is also related to environmental constraints. There are only a few studies in literature that focus on development of static and dynamic balances of children, and the effects of different sports activities on postural control. Future studies must focus on this opinion and exercise programs for improving balance performances of children are required.

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