EFFECTS OF FLEXIBILITY EXERCISES IN FEMALE VOLLEYBALL PLAYERS ON VERTICALJUMP PERFORMANCE

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ABSTRACT

11 females athletes, who play volleyball in 3rd league, whose average ages are (18.36 ± 0.67) years, average heights are (171.45 ± 7,76) cm, and body masses are (58,18± 4,58) were provided to voluntarily participate in the study. After determining body compositions of volunteers, [in the context of] 5 types of dynamic exercise movement specific to volleyball branch, static stretching exercise of 8 x 2 s were applied to 4 different groups of muscle. After this application, participants performed the dynamic and static exercises in the separate days and full squat, half squat, and counter movement jump tests were applied. Dynamic half squat jump, dynamic full squat jump, dynamic counter movement jump, static half squat jump, static full squat jump, and static counter movement jump were measured as (31.86 ± 2.05) cm, (31.71±1.30) cm, (37.20±1.49) cm, (32.86±1.86) cm; (34.25±1,67) cm; and (37.91±1.50) cm, respectively. When the mean measures of dynamic (30.46 ± 1.27) and static (32.94±1.63) full squat jumps are assessed, it was identified that there was a significant difference between the mean values of dynamic and static full squat jump measurements (p=0.002<0.05). It was identified that there was a statically significant difference between the mean values of dynamic and static full squat 1st jump measurements (p=0.015<0.05) Again, it was found that there was a statistically significant difference between the mean values of dynamic and static full squat 3rd jump measurements in the quality supporting mean values of our measurements (p=0.007<0.05). It was identified that there was no significant difference between the values of dynamic and static half squat jump It was also identified that there was no significant difference between the values of dynamic and static counter movement jump. The values of counter movement jump showed statistically significant difference compared to the other jump values. The findings of the study show that in volleyball players, static stretching increased performance and that high jumping data were reached, when compared to dynamic stretching exercise. In the branches like volleyball, where jumping is important, when short tine static stretching exercise was added to pre-performance exercises, it can be said that positive results may be obtained.

Key Words: Exercise; static stretching; dynamic stretching

BAYAN VOLEYBOLCULARDA ESNEKLİK EGZERSİZLERİNİN DİKEY SIÇRAMA PERFORMANSI ÜZERİNE ETKİLERİ

ÖZ

Araştırmaya 3.Lig de voleybol oynayan yaş ortalamaları (18.36±0,67) yıl boy ortalaması (171,45±7,76) cm vücut ağırlığı (58,18±4,58) kg olan 11 bayan sporcunun gönüllü olarak katılımları sağlanmıştır. Gönüllülerin vücut kompozisyonu belirlendikten sonra voleybol branşına özgü 5 tip dinamik egzersiz hareketi, bacağın 4 farklı kas gurubuna 8x2 sn statik germe egzersiz testi uygulandı. Bu uygulamadan sonra dinamik ve statik egzersizler ayrı günlerde yaptırılıp, yarım squat, tam squat ve yaylanarak sıçrama testleri uygulandı. Dinamik yarım squat sıçrama (31,86±2,05) cm dinamik tam squat sıçrama (31,71±1,30) cm dinamik yaylanarak sıçrama (37,20±1,49) cm statik yarım squat sıçrama (32,86±1,86) statik tam squat sıçrama 34,25±1,67 cm statik yaylanarak sıçrama (37,91±1,50) cm olarak ölçülmüş. Dinamik ve statik tam squat sıçrama ölçüm ortalamaları değerlendirildiğinde dinamik (30,46±1,27) cm vestatik (32,94±1,63) cm tam squat sıçrama ölçüm değerlerinin ortalamaları arasında istatistiksel olarak anlamlı bir farkın olduğu tespit edilmiştir. (p=0,002<0,05). Dinamik ve statik tam aquat 1. sıçrama ölçümleri ortalamaları arasında istatistiksel olarak anlamlı bir farkın olduğu tespit edilmiştir (p=0,015<0,05). Yine ölçüm ortalamalarımızı destekler nitelikte dinamik ve statik tam squat 3. sıçrama ölçümleri ortalamaları arasında istatistiksel olarak anlamlı bir farkın olduğu tespit edilmiştir. (p=0,007<0,05) Dinamik ve statik yarım squat sıçrama sıçrama değerleri arasında anlamlı bir fark olmadığı tespit edilmiştir. Dinamik ve statik yaylanarak sıçrama değerleri arasında da istatistiksel olarak anlamlı bir farkın olmadığı tespit edilmiştir. Yaylanarak sıçrama değerleri diğer sıçrama değerlerine göre istatistiksel olarak önemli farklılıklar gösterdi. Araştırmanın bulguları voleybolcularda kısa süreli statik germenin performansı artırdığı ve dinamik germe egzersiziyle karşılaştırıldığında daha yüksek sıçrama verilerine ulaşıldığını göstermektedir. Özellikle sıçramanın önemli olduğu voleybol gibi branşlarda performan söncesi egzersizlere kısa süreli statik germe egzersizi eklendiğinde olumlu sonuçlar elde edilebileceği söylenebilir.

Anahtar Kelimeler: Egzersiz; static germe; dinamik germe

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INTRODUCTION

In volleyball, in block and smutch movements toward jumping, since jumping up very high forms the basis of this sports branch, it keeps important place in the success. In volleyball, that players jump average 150 times during match reveals that success depends on ability as well as the increase in leg force and jumping height. When jumping movement is considered, the strong flexors of upper leg is hamstring muscle group. The strong extensors of knee movements is quadriceps muscle group, which is 2.5 times bigger compared to hamstrings that have knee make the strongest extension movement. Therefore, while training programs are prepared, identification of lower extremity force is important in terms of its improving performance[36].

Athletes and coaches guiding them target on increasing flexibility in many branches, and therefore, many stretching exercises are applied. Common view is that a good warm up requires a stretching to be present in the muscle, which forms a pain in muscle The rhetoric that if the pain is not existent, there is no gain as well is reminded to athletes during stretching. While the state is so in the application, in the light of scientific criteria, stretching has been examined from many aspects (sort, intensity, application place, time, and frequency) for many years, and some advices are given to those in field. ROM increase in acute stretching actualizes with the increase of the length and flexibility. In chronic ncreases in ROM, beside the increase of compliance in muscle, the increase of tolerance to stretching is also effective[24].

If flexibility is wanted to be increased, the questions " When, how much time, and in which branches especially must be stretching exercises performed?", and "Which performance criterion and how do they affect? "include the subject of a number of study. Following light aerobic warming applications, stretch exercise routine has been accepted as a part of warming. It is stated that stretch application includes mechanisms, which increase range of joint movement (ROM)[2,33,14], reduce muscle pains[16] and sportive injuring risk[31], and protect against these risks[34] However, a number study that gradually increases express that stretch applications can negatively affect performance. Especially, the studies that has been carried out for the last 20 years express that laboratory performance measurements (e.g. maximal force, vertical jumping, sprint, running economy, etc.), immediately performed after stretch exercises, were repressed[4,5,6,11,28,30].

The aim ofthis study is to examine the effects of acutely applied static stretching exercise on the force and power.

MATERIAL AND METHOD

11 females athletes, whose mean ages are 18.36 ± 0.67 years; mean heights, 171.45 ± 7.76 cm, and body weights, 58.18±4.58, and who play in female volleyball team of Diyarbakır BüyükşehirBelediyesi, were provided to participate in this study. The study was carried out under physician control. Before the study, all athletes were informed and the approval of ethical committee of Faculty of Sport Sciences, Selcuk University, was received. From the athletes participating in the study, after acquiring consent form regarding that they were informed about the study, the study was started.

Athletes made dynamic stretching training and statics tretching training with volleyball -specific technical connection in the different days. After work programs were applied, measurement values of vertical jump were determined. Measurement of these values were started in 15 seconds following training.

Exercise Tests Applied in the Study

After dynamic and static stretching training (within 15 seconds), performance measurement was started and trainings were performed in training hours in evenings and in the different times. Dynamic and static stretching training consisting of 4 exercise was applied with the duration of 2x8 seconds.

Between 3 repetitive measurement, a break of 10 seconds were given and 30 seconds,after 3 repetitive measurements. In the study, in rest between sets, this point as taken into consideration, and assessments were individually done. The subjects were enabled to adapt to the conditions.

Test of Dynamic Stretching Exercise Test

(The movements were performed in volleyball fields as going and coming), Rest in the rate of ½.

General warm up of 10 minutes

a. Forward running on bended knee frontward :2 x 8 sec.

b. Forward running with stretched knees and legs swung frontward-upward: 2x8 sec.

c. running with right knee pulled forward and lateral: 2x8 sec.

d. Forward running with legs touching hits in the back: 2x8 sec.

Static Stretching Exercise Test

It was applied to muscular group of lower extremity

a. Hamstring muscle:stretching out toe of stretched leg insitting position-2x8 seconds

b. Quadriceps muscle: stretching with toes touched hips -2x 8 seconds

c. In sitting position with stretched legs, plantar flexion movement of ankle -2x 8sn

d. In sitting position with stretched legs, dorsiflexion movement of ankle -2x8 seconds

Measurement Tests Applied in the Study

Measurement of Height and Body Weight

The heights and body weights of subjects were measured by means of bascule in the type of pharmacy, on which both body weight and height of the subjects were measured with barefoot and worn swimsuit[29].

Measurement of Vertical Jump: Vertical Jump (Wall)Test

This test measures leg force or jumping ability. For performing this, one first stands with the legs in side by side and natural position near the wall. With arms close to the wall, the upper point is marked. Then, by jumping, the top point reached is identified. The difference between the first point and the top point reached is identified. In other words, vertical jumping test is to measure, in meter, the difference between the height the person can reach by standing and the height he/she can reach by jumping[17].

Half SquatJump

The subjects are asked to jump as high as possible with a maximum force through their knees, while their hands are on waists in such a way that their knees will form an angle of 90 degree without making any scatting movement[36].

Full Squat Jump

The subjects are asked to have as full squat position in such a way that their hands are on waists and jump as high as possible with a maximum force through their kneeswithout making any scatting movement[36].

Counter Movement Jump

The subjects are asked to jump up with a maximum force after making a quick squat movement downward knees in normal upright position, while their hands are on waist[36].

Analysis of Data

According to the values measured after the study, the performances of the athletes and effects of training were evaluated. The data obtained in the study were assessed on SPSS 15.0 statistical package program. The differences between measurements were analyzed by using DependentnSample t-test and Multi Variable Wilks'Lambda test. Significance level of findings was identified as $p<0.05$.

FINDINGS

Table 1. Physical Characteristics of Study Group

Physical Characteristics	N	$\bar{X} \pm S_{\bar{X}}$
Age (year)	11	18,36±0,67
Body Weight (kg)	11	58,18±4,58
Height (cm)	11	171,45±7,76

Table 2. Definitive statistics regarding to comparison of the mean measurement values of dynamic and static jumps and results of dependent sample t-test

	N	$\bar{X} \pm S_{\bar{X}}$	Dependent Sample t-test
Dynamic half squat jump	11	30,46±1,93	p =0,413>0,05
Static half squat jump	11	31,37±1,75	
Dynamic full squat jump	11	30,46±1,27	p =0,002<0,05
Static full squat jump	11	32,94±1,63	
Dynamic counter movement jump	11	36,41±1,50	p =0,461>0,05
Static counter movement jump	11	36,74±1,50	

It was identified that there was a statistically significant difference between the mean values of dynamic full squat jump measurements and the mean values of static full squat jump measurements ($p=0,002 < 0,05$).

Table 3. The results of dependent sample t-test, in which the difference between the mean measurement values of the highest dynamic jump and the highest static jump was examined.

	N	$\bar{X} \pm S_{\bar{X}}$	Dependent sample t -test
Dynamic half squat jump	11	31,86±2,05	p =0,391>0,05
Static half squat jump	11	32,86±1,86	
Dynamic full squat jump	11	31,71±1,30	p =0,005<0,05
Static full squat jump	11	34,25±1,67	
Dynamic counter movement jump	11	37,20±1,49	p =0,084>0,05
Static counter movement jump	11	37,91±1,50	

It was identified that there was a statistically significant difference between the highest dynamic jump measurements and the highest static jump measurements (p=0,005 < 0.05).

Table 4:The definitive statistics, in which the differences between the mean values of 1st, 2nd, and 3rd dynamic and static measurements were examined for all measurements, and the results of dependent sample t-test

Comparison of all jump values	N	$\bar{X} \pm S_{\bar{X}}$	Dependent sample t-test
1.Dynamic half squat jump	11	28,68±1,81	p =0,317>0,05
1.Static half squat jump	11	29,89±1,68	
2. Dynamic half squat jump	11	31,21±2,08	p =0,463>0,05
2.Static half squat jump	11	32,10±1,73	
3. Dynamic half squat jump	11	31,49±1,97	p =0,620>0,05
3.Static half squat jump	11	32,11±1,95	
1. Dynamic full squat jump	11	30,51±1,39	p =0,015<0,05
1.Static full squat jump	11	32,54±1,63	
2. Dynamic full squat jump	11	30,30±1,37	p =0,052>0,05
2.Static full squat jump	11	32,80±1,61	
3. Dynamic full squat jump	11	30,57±1,24	p =0,007<0,05
3.Static full squat jump	11	33,48±1,78	
1.Dynamic counter movement jump	11	36,45±1,64	p =0,378>0,05
1.Static counter movement jump	11	35,85±1,47	
2.Dynamic counter movement jump	11	36,31±1,48	p =0,006<0,05
2.Static counter movement jump	11	37,69±1,51	
3.Dynamic counter movement jump	11	36,48±1,44	p =0,079>0,05
3.Static counter movement jump	11	36,69±1,64	

It was identified that there was a statistically significant difference between the mean values of the 1st dynamic full squat measurements and the 1st static full squat measurements. (p=0.015<0.05). It was identified that there was a statistically significant difference between the mean values of the 3rd dynamic full squat measurements and the 3rd static full squat measurements (p=0.007 < 0.05). It was identified that there was a statistically significant difference between the mean values of the 2nd dynamic full squat measurements and the 2nd static full squat measurements (p=0.006< 0.05).

DISCUSSION

In the literature, the different experimental conditions were formed related to static and dynamic stretch, and the different findings were obtained. Especially on static stretch, it was more identified in the different conditions. While some part of the findings suggested that acute static stretch application did not have any effect on the performance, there were also studies finding that it reduced or increased performance.These differences, as we previously mentioned about, the differences of experimental conditions of applications belonging to them resulted from the differentiations of the participant.

The effects of stretch on muscle vary, depending on the sort, time, duration of stretch and the time between screech and measurement. Many researchers studied the acute effect of static stretch application on passive elements of muscle- tendon unit. Acute effects are lees seen in short stretching times and low repetitions. In the variations in viscoelastic components, rather than how many seta stretch is applied or how may weeks training time are, it is stated that the duration of stretch in a single application is more effective[20].

In our study, the values of dynamic half squat jump for 3rd league female volleyball players were measured as 31.86±2.05 cm; dynamic full squat jump, 31.71±1.30 cm; dynamic counter movement jump, 37.20± 1.49 cm; static half squat jump, 32.86±1.86 cm; static full squat jump, 34.25±1.67 cm; and static counter movement jump, 37.91±1.50 cm. The values of jump height in our study turned out similar to the values of different jump measurement in the literature. It was identified that flexibility made a positive contribution to vertical jump performance. When jumping movement is dealt with, it was seen that flexor and extensor muscles were effective in lower extremity. Between static and dynamic full squat measurement values, in the highest data **(**p=,005<0.05), in mean values (p=0.002<0.05), a statistically significant difference was identified in favor of static exercise.It was identified that there was statistically significant difference betwee n the means of dynamic and static full squat1st ((p=0.015<0.05)) and 3rd (p=0.007<0.05) jumping measurement s in favor of static exercise.In exercise program we carry out, jump heights similar to that in literature were obtained. Şimşek et al.(2007), in the study they carried out on female volleyball players, while three values of jump measurement of 1st league players was found as 30.22 ± 5.7 cm for full squat jump value; 30.06 ± 5.7 cm, for half squat jump value; and 38.14 ±5.0 active jump value, full squat jump value of 2nd league players was found 29.38±3.2 cm; half squat jump value, 28.17±2.7; and active jump value, 35±3.6 cm. In both 1st league and 2nd league volleyball players, it was identified that extensor muscles introduced data of higher value compared to flexor muscles. (Çon et al 2012), in their study they carried out on 20 male and 20 female volleyball players, whose mean ages are 21.08±1.5, after warm up and stretching of 15 minutes, while static jump height of females was identified as 24.8±5.7 cm and counter movement jump height, 26.9±8.5 cm; the same jump values were identified for males as 33.6 ± 10.6 cm and 36.1±12.3, respectively. Barnes et al (2007), in the studies carried out on the female volleyball players, whose mean ages, 19.2±0.9, they found the counter jump movement values of these players as 36.4±2.5 cm for 1st league players; 31.8±4.6 cm for 2nd league

players, and 30.2±7.2 cm for 3rd league players. Hakkinen et al ark (1993), in the study they carried out on the volleyball players, identified static jump value of 1st team as 28.5±2.5 cm and counter jump movement value of this team as 31.1±1.3 cm and these values were found as 29.6±2.5 cm for 1st team and 31.3±4.6 for the second team, respectively.

In static stretch, although the intensity of stretch was introduced by EMG activity, in dynamic stretch, such a study was not met. This state makes think of that the movement was performed so intense in dynamic stretchis subjectively evaluated. The studies in the number of gradually increasing exercise states that stretching exercise should be performed in cooling phase rather than warm up[23]. The studies applying dynamic stretch focused on the effects of strength, sprit performance, and jumping performance. Hough et al (2009) suggested that dynamic stretch application of 7 minutes increased jumping performance and EMG activity.

Applications of dynamic stretch, following aerobic warm- up, is carried out by the movements in compliance with the branch dealt with. McMillian et al (2006) stated that applications of dynamic stretch carried out together with aerobic warm- up over 10 minutes increased expiration process of shuttle run and jumping time. Samuel et al. (2008) stated that 2 sets of application of dynamic stretching taking 30 seconds did not have any effect on jumping performance and isokinetic force. In the applications of dynamic stretch, since intensity cannot be standardized, the studies result in the different findings. Many studies have attempted to standardize intensity as the number of repetition in unit time. The difference between performing movement faster and slower have not been revealed yet. It was suggestedthat application of dynamic stretching, in which 100 movement are performed, increased more vertical and forward jumping performance[10]. McMillian et al, (2006) compared to that made 50 repetitions in minute Fletcher and Colombo (2010). McMillian et al. (2006), together with warn-op of 10 minutes, stated that dynamic exercises increased stretching distance, while Samuel et al (2008) stated that dynamic training taking 30 seconds did not have any effect on stretching performance. In other study toward measuring the value of vertical jump, static stretching of 10 x 15 and 5 x 30 second were applied to the muscles of hamstring and gastrocnemius and it was identified that there was no significant difference between two different times in terms of times of vertical jumping[7].

In the study we carried out, when the highest half squat jump values of static stretching exercise, applied to 4 different muscular group (8x2 sec.), and dynamic exercises consisting of 4 movements are compared to each other, dynamic half squat jump value was measured as 31.86±2.05 and static half squat jump value as 3.,86±1.86 cm. Although it was identified that there was a significant difference between jump values (p=0,391 > 0,05), it was identified that it was higher in favor of static jump.Dynamic counter movement jump was measured as 37.20±1.49 cm and static counter movement jump as 37.91±1.50 cm (p=0,084>0,05), and it was identified that there was no statistically difference. When we evaluate the studies in the literature, it was seen than a stretch longer than 15 sec. did not cause more flexibility and strength losses and that similar results were obtained from the stretch of this duration am more. Here, we identified that in the study, in which we had static and

dynamic stretch exercise with similar duration performed, the results of static stretching exercise turned out higher in all measurements compared to dynamic stretching exercise. It was found that counter movement jump values were higher compared to the other jump values. We cans say that the cause of its being high was the stored energy released by muscles, while counter cross movement jump was performed.

When regarded to chronic applications, in stretch application, performed with the duration of 45 sec, 4 times of repetition, and resting time of 45 sec. over 3 weeks, any variation was not observed in the mechanic and viscoelastic characteristics of muscle[24.]. On the females and males in the range of ages 18-24, static stretch of 3x30 seconds was applied to gastrocnemius, muscles and it was recorded that stretch reduced vertical jump performance in the rate of 5.6%[39]. Stretching of 30 kg was applied to quadriceps, hamstring and plantar flexors for three times, and forward jumping height was negatively affected[6]. In another study, static stretching of 3 sets, long for 15 sec. and long 45 sec. were applied to quadriceps and hamstring muscles and, after static stretching, a decrease of 5.5% in forward stretching height occurred[37]. In another studies, 5 static and 12 dynamic stretching exercise of 2x15 sec. were done and, after low –intensity warm-ups, it was measured that dynamic-type exercises increased jumping performance, while static stretching exercises decreased jumping performance in the rates of 9.2 -10.1[12]. The studies in the literature are in direction of that single dynamic trainings increased vertical stretching and force values. In general, trainings of single dynamic and static exercise were performed. In this exercises, stretching exercise toward single group of muscle were done and, in dynamic stretching exercises, it was seen that there were differences in the number and types. It was seen that exercise programs, in which the effect of dynamic and static exercises on vertical stretching performances was compared, were not applied. The magnitude of pressure on the performance was closely related to the duration of stress. Young et al (2006), in their study, in which they examined the effect of different duration of stress on performance, demonstrated that decrease in jumping performance was less in stretch applied for 1 minutes than that applied for 2 and 4 minutes. After static stretch application lasting 5 -10 minutes, it was shown on ultrasonic device that tendon elasticity decreased[20,21]After stretching exercise done for 30–120 sec., there are some resources stating that there is no change in force[3,9,25]. When we review literature, we see that elongation of stretching negatively affects performance. This difference in findings is likely affected from many factors such as selection of subjects, gender, sportive fitness state, sports branch, sort of stress applied, resting intervals, and the numbers of set. Although many studies include efforts focusing on how performance changes by static stretch, the findings of studies differentiate. While mostly stated that static stretch decreases performance, [in some studies], it was also reported that it did not vary or increased. In our study, 4 types of dynamic exercises and static stretching exercise (8x2 secs) were done in 4 different muscle groups and when the highest measurements are evaluated, while a significant difference was not found between the values of dynamic and static half squat jump and dynamic and static counter movement jump, the value

of dynamic full squat jump was measured as 31.71±1.30 cm and that of static full squat jump as 34.25±1.67 cm, and it was identified that there was a significant difference in favor of static full squat jump p=0,005<0,05). When we evaluate these results, it can be said that we identify that the duration of stretching has effects on the different forms of vertical jump. When we also compare full squat jump performance, carried out after static exercise, with the performance carried out in dynamic exercise, [the values] were found high in such a way that it will include significant difference. In volleyball players, since stretching exercise is generally used before including in the play, it can be said that assessing these results will be positive. Static stretch, as a result of acute adaptation of the increasing load along myotendinous articular to elastic components of muscle, reducing stress release, affect viscoelastic features[40]. When a muscle or muscle group is elongated by one of stretch methods, a stress occurs in the active and passive elements. The magnitude of the stress that forms varies in related to the intensity and duration of the stretch applied. In muscular tendons and ligaments, during a slowly stretching, a stress occurs in the same length but less passive than a faster stretch[22]. In long lasting multiple repetitions, mechanical effectivity of ligaments reduces and juncture stability begin to release, decreasing[35]. In long duration stretching exercises,some decreases occur in tendon elasticity (stiffness) and muscular moment[19]. That stretching exercises raises stimulation threshold of golgi tendon organ and that there is no decrease in EMG frequency signal demonstrates that performance is affected from by muscle[27,18]. In the studies in the literature are generally in direction of that performance decreases in stretch result from the muscles. According to our considerations, short duration stretching exercises, reduce negative effect on muscle and increase stimulation threshold of golgi tendon, and thus, high jumping values are reached. It can be said that that static stretching exercise in our study turns out higher in three different vertical jumping performance compared to the dynamic performance arises from that exercise is short duration and the number of repetition is short. Since short duration exercises do not make negative effect on muscle–based mechanisms, it can be said that it positively affects vertical jumping performance.

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