

EFFECT OF DIFFERENT WARM-UP METHODS ON FLEXIBILITY JUMPING AND BALANCE³

ABSTRACT

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The aim of this study is to investigate the effect of three different warm-up methods on flexibility, jumping and balance. 28 male students (age 22.00±2.00 years) from Faculty of Yasar Dogu Sport Sciences were enrolled in the study. Three different warm-up methods including static, dynamic and jogging were applied to the subjects at 24 hours intervals. Study group was subjected to flexibility, jumping and static and dynamic balance tests 4 minutes after each warm-up application. Data analysis showed that flexibility values measured after static warm-up were higher than those obtained after dynamic warm-up and jogging (p<0.01). Jumping values after static warm-up were found to be significantly higher than those obtained after jogging (p<0.05). In dynamic balance measurement, "average balance error after jogging" was found worse than dynamic warm-up (p<0.05). Static balance results showed that values after static and dynamic warm-up were better than those obtained after jogging (p<0.05). In conclusion flexibility values after static warm-up were found to be higher than those obtained after dynamic and jogging warm-up. Static warm-up was found to cause greater increase in jumping performance in comparison with jogging. Balance values after jogging were worse than those obtained after static and dynamic warm-up.

Keywords: Static warm-up; dynamic warm-up; flexibility; jumping; balance.

FARKLI ISINMA YÖNTEMLERİNİN ESNEKLİĞE, SIÇRAMAYA VE DENGEEYE ETKİSİ

ÖZET

Bu çalışmanın amacı üç farklı ısınma yönteminin sıçrama, esneklik ve dengeye etkisini araştırmaktır. Bu çalışmaya Ondokuz Mayıs Üniversitesi Yaşar Doğu Spor Bilimleri Fakültesinde okuyan (yaş 22,00±2,00 yıl), 28 erkek öğrenci denek olarak katılmıştır. Deneklere 24 saat arayla üç farklı ısınma yöntemi olan statik ısınma, dinamik ısınma ve sadece ısınma koşusu uygulanmıştır. Araştırma grubu her ısınma uygulamasından 4dk sonra sıçrama, esneklik, statik ve dinamik denge testine tabi tutulmuştur. Verilerin analizi sonucunda, statik ısınma sonrası ölçülen esneklik değerlerinin, dinamik ısınma ve jogging ısınmaya göre daha yüksek olduğu tespit edilmiştir (p<0,01). Sıçrama değerleri incelendiğinde, statik ısınma sonrası değerlerin jogging ısınma sonrası değerlerden istatistiksel olarak daha yüksek olduğu tespit edilmiştir (p<0,05). Dinamik denge ölçümünde jogging ısınma sonrası "ortalama denge hatası" dinamik ısınmadan daha kötü bulunmuştur. (p<0.05). Statik denge sonuçlarında ise statik ve dinamik ısınma sonrası değerlerin jogging ısınma sonrası değerlere göre daha iyi olduğu görülmüştür (p<0,05). Sonuç olarak statik ısınma sonrasında esneklik değerlerinin dinamik ve jogging ısınmaya göre daha yüksek olduğu görülmüştür. Sıçrama performansını ise statik ısınmanın jogging ısınmaya göre daha fazla artırdığı tespit edilmiştir. Jogging ısınma sonrası denge değerlerinin statik ve dinamik ısınmaya göre daha kötü çıktığı görülmüştür.

Anahtar Kelimeler: Statik ısınma; dinamik ısınma; esneklik; sıçrama; denge

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INTRODUCTION

Nowadays, whether in a sportive activity for health or in a performance sport or training for that sport, the first activity we see in a competition or training period is warming-up (Kuter and Ozturk, 1997). Warm-up exercises are done to get a better performance from the athlete, to prevent possible injuries, to prepare the athlete for the loadings in the best physiological and psychological way and to help them adapt (Stamford,1985; Muratli and Sevim, 1993). In addition, warm-up causes the blood circulation to be regulated by increasing the frequency and deepness of respiratory, heart rate, energy and oxygen consumption as well as causing an increase in the extent of motions by decreasing muscle viscosity and removal of toxic substances (Bompa, 1980 ; Shellock and Prentice, 1985; Taskin, 2002).

In all kinds of sportive activity, warm-up and therefore static stretching and dynamic exercises are used extensively and the real performance starts after these exercises both in training and in competitions. That is, in training, the next part of the training is started after warm-up and consequently static stretching and dynamic exercises are completed while in competitions, the competition starts after warm-up, static

stretching and dynamic exercises (Unlu, 2008). Static stretching activities before exercise are reported to develop the posture, decrease the risk of injury and help a good performance development (Duncan and Woodfield, 2006). Thus, it has been stated that static stretching activities are generally accepted ways of warm-up both for adults and for children (Young and Behm, 2002). However, findings of some scientific studies show that acute static stretching exercises cause negative effects in types of performances in which success depends on maximal strength development (Cornwell et al., 2001; Young and Behm, 2002; Young and Behm, 2003; Nelson et al.,2005). On the other hand, despite the concerns of some authors about the effects of dynamic exercises on flexibility development (Shrier and Gossal, 2000), it has been put forward that dynamic warm-up exercises from low intensity to medium intensity can be an alternative to static stretching exercises in both adults and children (Shrier and Gossal, 2000; Herbert and Gabriel, 2002; Faigenbaum et al., 2005). The purpose of this study is to examine the effects of three different warm-up methods on flexibility, jump and balance performance and thus to contribute to literature.

METHODS

Subjects: 28 male students with a mean age of 22.00 ± 2.00 years, mean weight of 75.14 ± 9.98 kg, and mean height of 178.14 ± 8.08 cm who were studying at Ondokuz Mayıs University Faculty of Yasar Dogu Sport Sciences participated in this study voluntarily. The contents of the study were first of all explained in detail to each student who accepted to participate in the study. This research was carried out under the verdict of Ondokuz Mayıs University ethical committee. Before the measurements, all the participants were

warned about not doing intense exercises or not drinking alcohol the day before the measurements. The three different warm-up methods were applied randomly and 24 hour interval. After each warm-up method, flexibility, jumping, static balance and dynamic balance measurements were made.

Warm-Up Methods

Static Stretching; Following a 5 minute-long warm-up jogging and 1 minute-long walking, 5 stretching exercises were made on lower extremities for 10 minutes. Each

stretching was performed 3 times for each leg as 15 seconds of stretching and 5 seconds of relaxing for a minute and for two minutes in total for both legs. After four minutes of rest, measurements were made. The stretching exercises performed were modified bar stretching, stretching hip rotators, touching the tips of toes when bent to the front, quadriceps stretching and calf stretching, respectively.

Dynamic Stretching; Following a 5 minute-long warm-up jogging and 1 minute-long walking, 7 dynamic type warm-up exercises were made. The subjects made each dynamic type warm-up exercise for 15 meters and they repeated the same exercise until the starting point after a 10 second rest. Measurements were taken after a 4 minute-long rest. The dynamic warm-up exercises performed were high knee walk, high knee pull, highknees, buttkicks, lungewalks, backward lunge, and straight leg kick, respectively.

5 minute-long warm-up jogging; consisted of only 5 minute-long jogging and 1 minute-long walking. After this jogging, no stretching or dynamic warm-up exercises were performed and after a 4 minute-long rest, measurements were taken.

Students were subjected to the following tests;

Flexibility Measurements: Trunk Flexion Meter was used for sit and reach test. For this test, visually impaired students were asked to sit down on the floor barefoot and to rest their soles of feet to the test tripod and to push the digital display on the tripod forward without bending their legs. The subject was kept for 1-2 seconds on the maximum point and indicator values were recorded. This procedure was repeated three times, the best value was evaluated.

Static Jump: While athletes were standing on the mat on both feet with

their knees at 90 ° squat stance and their arms akimbo, they jumped as high as they can. Athletes jumped three times. Best score of each was taken into evaluation.

Static and Dynamic Balance Measures

CSMI make Prokin Tecno Body isokinetic balance measurement device was used for static and dynamic balance measurements.

Dynamic balance test was realized in both feet standing position. The standing position was the same as the static balance test. The test was completed by making five rounds clockwise in the platform in 60 seconds following the circular route on the screen. For the subjects who could not complete the test within the specified time, the subject's performance up to that point was recorded as the test result. As the balance score increased, the subject's dynamic balance was considered to be bad and as the score decreased, it was considered to be good.

Static balance test was made on a field platform, on both feet standing position with eyes open and closed. In both legs test, the standing position was determined with feet open as wide as the shoulder and the standing position of the feet equal to the originating point by taking the lines on the x and y axis of the platform as references. The subject was asked to look at a fixed point in front of him and the test was started after the balance was found. During the test which lasted 30 seconds, the subject was asked to keep his position and the subject followed the position from the screen. The test was started by pressing the start button on the computer keyboard and at the end of the test; it was ended automatically by the computer. As the balance score increased, the subject's static balance was considered to be bad and as the score decreased, the balance static balance was considered to be good.

Data Analysis

The data obtained from the research were analyzed in SPSS version 19.0 package program. Continuous variables exhibit a normal distribution after a Kolmogorov Smirnov test. To find out whether different warm-up methods

were effective on the measured parameters, repetitive analysis test and Bonferroni correction paired comparison test were used. Statistical significance was $p < 0.05$ and $p < 0.01$. Data were given as “mean” and “Standart Deviation (SD)”.

RESULTS

Table 1: Flexibility values after different warm-ups

Variables	Warm-up Method	Mean	SD	F	P	Anova
Flexibility (cm)	Jogging (1)	9,87	7,27	101,45	,000	2>1,3** 3>1**
	Static (2)	14,60	7,12			
	Dinamic (3)	13,41	7,32			

** $p < 0,01$

In Table 1, when the subjects' flexibility values after different warm-ups are analyzed, it can be seen that it was 9.87 ± 7.27 cm for jogging warm-up, 13.41 ± 7.32 cm for dynamic warm-up and 14.60 ± 7.12 for static warm-up. The values of static warm-up were found to

be statistically higher than the values of dynamic and jogging warm-up values ($p < 0.01$). Flexibility values measured after dynamic warm-up were found to be statistically higher than the values measured after jogging ($p < 0.01$).

Table 2: Jumping values after different warm-ups

Variables	Warm-up Method	Mean	SD	F	P	Anova
Jumping time (ms)	Jogging(1)	536,03	57,13	3,330	,044	2>1*
	Static (2)	569,35	64,65			
	Dinamic(3)	554,78	60,32			
Jumping height (cm)	Jogging (1)	35,60	7,20	3,629	,037	2>1*
	Static (2)	40,23	8,85			
	Dinamic (3)	38,15	8,07			
Jumping power	Jogging (1)	3531,42	609,53	1,993	,040	2>1*
	Static (2)	3808,75	704,75			
	Dinamic (3)	3744,28	748,89			

* $p < 0,05$

Jumping time, jumping height and jumping power values found after static warm-up were found to be statistically

higher than those of jogging warm-up values ($p < 0.05$) (Table 2).

Table 3:Dynamic balance values after different warm-ups

Variables	Warm-up Methods	Mean	SD	F	P	Anova
Average Balance Error (%)	Jogging (1)	29,46	16,11	6,425	,004	1>3*
	Static (2)	25,96	19,87			
	Dinamic (3)	21,78	12,80			
Average Strength Variance (kg)	Jogging (1)	3,11	2,84	,809	--	
	Static (2)	3,03	2,50			
	Dinamic (3)	2,38	1,01			
Stability Indicator	Jogging (1)	1,17	1,31	1,624	--	
	Static (2)	2,08	2,60			
	Dinamic (3)	1,37	2,19			
Delay Time (%)	Jogging (1)	1,25	1,91	,066		
	Static (2)	1,42	2,25			
	Dinamic (3)	1,32	1,02			
Total Standard Deviation of the Body	Jogging (1)	31,58	4,62	1,20	--	
	Static (2)	29,43	5,73			
	Dinamic (3)	30,64	3,58			
Forward-Backward Standard Deviation of the Body	Jogging (1)	7,11	9,53	1,96	--	
	Static (2)	3,30	4,38			
	Dinamic (3)	5,07	6,86			
Standard Deviation of the Body to the Center and Sides	Jogging (1)	29,58	2,18	,286	--	
	Static (2)	28,93	5,63			
	Dinamic (3)	29,59	2,13			

*p<0,05

Table 3 gives the subjects' dynamic balance values after different warm-ups. Average balance error values after jogging warm-up were found to be statistically higher than those after dynamic warm-up

(p<0.05). Other dynamic balance values were not found to be statistically different in terms of three different warm-up methods (p>0.05).

Table 4: Static balance values after different warm-ups

Variables	Warm-up Methods	Eyes Open				Eyes Closed			
		Mean	SD	F	P Anova	Mean	SD	F	P
X Axis Pressure to the Central Point (mm)	Jogging (1)	-,0714	1,18	1,24	--	-,82	3,54	1,94	--
	Static (2)	,0357	,88			,07	3,34		
	Dinamic(3)	,2500	,75			-1,67	4,36		
Y Axis Pressure to the Central Point (mm)	Jogging (1)	-1,96	1,50	4,04	,024	-2,67	5,10	,73	--
	Static (2)	-1,00	1,46			-1,14	7,92		
	Dinamic(3)	-1,10	1,37			-2,75	9,21		
the area used (mm ²)	Jogging (1)	402,60	208,36	4,38	,005	684,96	552,04	,34	--
	Static (2)	302,57	182,11			682,17	388,26		
	Dinamic(3)	315,25	191,91			625,75	469,19		
the environment used (mm)	Jogging (1)	474,00	130,59	,68	--	552,04	167,86	1,17	--
	Static (2)	452,32	131,77			388,26	173,12		
	Dinamic(3)	470,03	145,65			469,19	202,68		
Average Speed to the Right and Left	Jogging (1)	7,39	2,29	2,82	--	9,25	2,41	1,28	--
	Static (2)	7,42	2,44			10,39	3,89		
	Dinamic(3)	8,28	2,77			13,46	17,32		
Average Speed to the Front and Back	Jogging (1)	7,64	2,97	5,33	,002	14,67	5,51	1,96	--
	Static (2)	5,82	3,04			14,50	4,47		
	Dinamic(3)	5,42	3,46			13,50	4,84		
Standard Deviation to the Right and Left	Jogging (1)	3,07	1,08	2,40	--	4,64	1,59	,44	--
	Static (2)	2,89	1,25			5,07	2,49		
	Dinamic(3)	3,39	1,19			4,82	1,77		
Standard Deviation to the Front and Back	Jogging (1)	12,28	3,79	1,60	--	8,25	5,39	2,65	--
	Static (2)	11,28	3,95			7,53	3,46		
	Dinamic(3)	11,35	4,14			6,92	3,34		

*p<0,05

Table 4 gives the static balance test measurements which were performed with two feet in terms of different warm-up (jogging, static, dynamic) methods. The values of “Y Axis Pressure to the Central Point”, “the area used” and “Average Speed to the Front and Back” measured after jogging were found to be

statistically higher than the values measured after dynamic and static warm-up with eyes open ($p < 0.05$).

It was found that the balance levels of the subjects did not differ statistically significantly in terms of different warm-up methods (jogging, static, dynamic) with both feet and eyes closed ($p > 0.05$).

DISCUSSION AND CONCLUSION

This study was conducted to analyze the effects of different warm-up methods on flexibility, jumping and measurements. Three different warm-up methods were performed on different days (24 hours apart) and flexibility, jumping and static and dynamic balance measurements were taken.

This study examined whether three different warm-up methods differed in terms of flexibility values. Flexibility values measured after static warm-up were found to be higher when compared with the flexibility values measured after both jogging and dynamic warm-up value. Flexibility values measured after dynamic warm-up were found to be statistically significantly higher when compared with the flexibility values measured after jogging. In a study by Unlu (2008) conducted with a total of 102 5th graders- 50 boys and 52 girls- measurements were made. Different warm-ups consisting of 15 second-long static stretching, 15 minutes-long dynamic exercise, combined static stretching and dynamic exercise and only low intensity aerobic exercise (with no stretching or dynamic exercise) following a low intensity jogging were performed on the subjects. As a result of the study, it was reported that the best flexibility value was measured after static stretching both in boys and in girls and the flexibility value measured after dynamic warm-up was found to be higher than the one measured after general warm-up. The results of Unlu's study support the results of our study. In their study they examined the effects of

different stretching times on the performance of 11 artistic gymnasts, Coknaz et al. (2008) found that 15 second-long stretching exercises with 10 repetitions caused statistically significant increases in flexibility values when compared with 30 second-long stretching exercises with 5 repetitions or with no stretching exercises. 15 second-long stretching time in our study may be the reason for the high flexibility values after static warm-up.

In a study by Ozkaptan (2006), it was found that after a general warm-up followed by 20 second-long static stretching, flexibility values were found to be better when compared with other methods. Flexibility values after dynamic warm-up of 10 repetitions and dynamic warm-up of 20 repetitions were found to be higher than the values after general warm-up. The results of Ozkaptan's study, is in parallel with our study. Unick et al (2005) performed sit and reach test which is a flexibility assessment by applying three different test procedures. The first test procedure contained only general warm-up, the second one contained 15-second-long three repetition static stretching exercises of quadriceps femoris, hamstring and gastrocnemius muscle groups while the third contained 30-second-long ballistic stretching exercises of the same muscle groups. The results of the study showed that ballistic and static stretching exercises did not influence the flexibility values. Faigenbaum et al. (2006) reported that none of the sit and reach test values after general warm-up, static warm-up and dynamic warm-up

measurements had an influence on the flexibility values. The reason why the results of the mentioned two studies and our study are not similar may be the differences in warm-up methods.

In this study the differences between jumping values were analyzed after three different warm-up methods; the values of jumping time, jumping height and jumping power after static warm-up were found to be significantly higher than the values after jogging warm-up. Jumping values showed no significant difference between static warm-up and dynamic warm-up. In their study, Atak and Hazir (2013) measured the jumping values of 14 female volleyball players playing in the volleyball clubs of the first and second leagues following static and dynamic warm-up methods. After the measurements, they reported that there was no statistical difference between static warm-up and dynamic warm-up and that the negative effect of warm-up methods that included static stretching on jumping performance was not very clear. The results of Atak and Hazir's study and the results of our study are in parallel with each other. In a study by Demirci (2013), it was reported that there was no statistically significant difference between static stretching and dynamic stretching warm-up methods in terms of their effect on jumping performance. The results of Demirci's study and the results of our study are in parallel with each other. The findings of Gelen's (2008) study showed that static stretching exercises followed by low intensity aerobic conditions affected vertical jumping height negatively while dynamic warm-up exercises affected vertical jumping height positively. The results of Unlu's (2008) study showed that vertical jumping values after static stretching were lower when compared with general warm-up while vertical jumping values after dynamic warm-up and combined warm-up were higher when compared with general warm-up. The results of

these two studies are not in parallel with our study. When the studies in literature on this subject are reviewed, it can be seen that there are studies which report that static stretching decreases performance (Gelen, 2008; Unlu, 2008) while there are also studies which report that static stretching has no effect on performance (Atak and Hazir, 2013; Demirci, 2013). These results show that there is no consensus on this subject. The results of this study are in parallel with some of the studies in literature. The reasons for these differences may be the different numbers and times of stretching in static and dynamic stretching exercises, the use of different warm-up methods, the use of different ways of jumping to find out the jumping performance, not having a full warm-up of the muscles for high performance, climactic reasons or other factors.

In balance test, the parameters measured in the dynamic balance test were compared between the three different warm-up methods. It was found that the "average balance error" values after jogging warm-up were higher than those of dynamic warm-up measurement values. That is, the "average balance error" measured after dynamic warm-up was found to be better than measured after jogging warm-up since a balance value close to zero shows that balance is better. As for other parameters, values of "average strength variance", "stability indicator", "delay time", "total standard deviation of the body", "forward-backward standard deviation of the body" and "standard deviation of the body to the center and sides" were not found to have statistical differences. Denerel (2011) analyzed the acute effect of dynamic stretching exercises on dynamic balance. The study included 67 volunteering recreational athletes from three sport branches and the average age of the participants was 20,5. In the study, after the three different warm-up methods were applied, dynamic balance

measurements were made and as a result, it was found that warm-up, static stretching and dynamic stretching methods all affected dynamic balance performance positively and that there was no statistical difference between the three methods. Bugnet (2011) examined the effect of static stretching on dynamic balance with the participation of 18 healthy subject with an average age of 72 and 30 adults with an average age of 25,8. It was reported that regardless of age, short term stretching exercise had very little or no effect on dynamic balance. In another study by Celebi (2001), four protocols were determined which were static stretching, warm-up consisting of 10 minute-long cycling with the 70% of the maximal heart rate, warm-up+stretching and control. After each subject completed the warm-up protocol, dynamic balance measurements were taken and combined balance losses and swinging values were calculated. As a result of the study, in dynamic balance measurements, combined balance losses were found to be lower in stretching and warm-up+stretching exercises when compared with the control. No significant difference was found between four tests in terms of swinging values while lower swinging values were found in stretching and warm-up+stretching exercises. As a result, it was reported that stretching and warm-up+stretching exercises affected dynamic balance better.

In eyes open, both feet static balance measurements, in “Y Axis Pressure to

the Central Point”, “the area used”, “Average Speed to the Front and Back” measurements, the values after jogging warm-up were found to be statistically higher than the values after static and dynamic warm-up. This result shows that balance values after static or dynamic warm-up are better than the values after jogging warm-up. In addition, although there was no statistically significant difference between static and dynamic warm-up, it was found that static warm-up affected static balance better when compared with dynamic warm-up.

Behm et al.(2004) reported that static stretching exercises affected both feet static performance negatively and that only warm-up exercise affected both feet static performance positively. The differences between the results of Behm et al.’s study and our study is thought to be resulting from the length of the stretching exercises applied by Behm et al.(2004). Costa et al. (2009) reported that, 15 seconds-long static stretching exercises had a positive effect on balance performance while 45 seconds-long static stretching exercises had no effect on balance performance.

In conclusion flexibility values after static warm-up were found to be higher than those obtained after dynamic and jogging warm-up. Static warm-up was found to cause greater increase in jumping performance in comparison with jogging. Balance values after jogging were worse than those obtained after static and dynamic warm-up.

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