International Journal of Sports and Physical Education (IJSPE)
Volume 4, Issue 4, 2018, PP 9-14
ISSN 2454-6380
http://dx.doi.org/10.20431/2454-6380.0404002
www.arcjournals.org

Investigating Flexibility Effects on Vertical Jump of the Adolescent Athletes

Fatih Özgül*

Assist. Prof. Dr., Cumhuriyet University, Department of Physical Education and Sports, Sivas, Turkey

Corresponding Author:** ***Fatih Özgül, *Assist. Prof. Dr., Cumhuriyet University, Department of Physical Education and Sports, Sivas, Turkey*

Abstract: *The aim of this study is to investigate the relationship between the 3 different stretching exercises and the vertical jump in the adolescent basketball and volleyball players. In the study, 48 male basketball and volleyball players with a mean age of 15.5 ± 1.2 years, a mean body mass index of 20.92 ± 2.71 kg / cm2 and a mean age of 4 ± 2.3 years from Erzincan Youth Services and Sports Club participated voluntarily. The groups were performed homogeneously by considering the level of flexibility. The control group was also established to test the level of development. Before the study, flexibility and vertical jump pre-test measurements were performed. In addition to the training days, 3 days a week and for 6 weeks specific flexibility studies were applied to the groups. At the end of 6 weeks, flexibility and vertical jump post-tests were performed to the groups. The data obtained from the study were analyzed by using the SPSS 22.0 program. Since parametric test assumptions were fulfilled (kolmogorov - smirnov), the variance analysis, the chi-square, the t test were used and the significance level was determined as .05. In the Dynamic, Static and PNF flexibility groups, flexibility and vertical jump development were found statistically significant ($p<0.05$). The greatest development in terms of flexibility was observed in the PNF group, however, the greatest improvement in the jump was observed in the Dynamic group. As a result, it can be said that static, dynamic and pnf flexibility exercises have an effect on vertical jump performance. The effect of dynamic flexibility on the vertical jump was larger than the other flexibility groups.*

Keywords: *Basketball, Dynamic, PNF, Static, Stretching, Vertical Jump, Volleyball.*

1. INTRODUCTION

The importance of the range of motion is well known in the success of sportive activities. The exercises to improve flexibility are that require the least amount of energy and that cover the shortest period of thetraining period. Maximum flexibility is reached at the age of 15,16 years (Pense, 2002). Stretching movements are applied in different varieties. The position of the athletes in a stretching position for a certain period is defined as static stretching (Costa et al., 2009). The flexibility method in which contraction and flexion movements are used is defined as the method of PNF (Bradley et al., 2007). It is defined as the dynamic stretching method consisting of dynamic movements performed in a slow tempo like ballistic stretching which includes rhythmic springings after a short stretch (Woolstenhulmeet al., 2006; Yamaguchi et al., 2007). Stretching is expected to increase the flexibility of the athlete, to become ready for activity and to increase the sportive performance of the athletes. The internal temperature of the muscle increases in flexibility exercises. It has been reported that warming increases the physiological muscle heat and muscle blood flow, enhances the biomechanical ability to control muscle stiffness and increases neurological functions (coordination and proprioceptive sensitivity) (Magnusson et al., 2000; Tiidus& Shoemaker, 1995; Shelloek, 1985).Despite the widespread use and acceptance of stretching exercises that are very important before the activities, the claimed benefits on performance and prevention of injuries have been controversial in many studies. The relationship between stretching and performance is often discussed in research. While stress-free warming reduces the effect of force (Manoel et al., 2008), there is a considerable increase in the effect of static flexion on the performance of the force (Kistleret al., 2010). It was stated that before exercises static stretching movements improved posture, reduced risk of injury and improved performance (Duncan, 2006). Therefore, it is stated that static stretching movements are a generally accepted form of warming for both children and adults (Young&Behm, 2002). In the literature, it has been reported that dynamic stretching-containing heating programs have

a positive effect on performance (Amiri-Khorasani et al., 2011). Therefore, the application of dynamic warm-up exercises has been a matter of interest by many researchers, trainers and sports experts (Faigenbaumet al., 2006). However, dynamic exercises do not contribute to the development of flexibility (Shrier&Gossal, 2000). Proprioceptive Neuromuscular Facilitation (PNF) is a stretching technique frequently applied by athletes who need flexibility in their performance (Franco et al., 2008). Nowadays, the PNF method is the fastest and most active way to increase static-passive flexibility. The increase in joint stability, strength and force balance is another potential benefit of PNF. Flexibilitywithoutforce can result in jointinjuries .Theuse of unique PNF techniques can developbothstrengthandflexibilitytogetherso can preventtheathleticinjuries (Appleton, 1998). PNF techniques are as follows: 1) Recurrent Contractions, 2) Rhythmic Initiation, 3) Slow Opposite, 4) Slow Opposite Hold, 5) Rhythmic Stabilization, 6) Pulse-Relax, 7) Hold-Relax, 8) Slow Opposite Hold Relax, 9) Opposite of Antagonist (Alter, 2004). In this study as PNF method; Pulse-Relax and Hold-Relax techniques were preferred.

In the study it was aimed that, to investigate the relationship between three different stretching exercises and the vertical jump in the adolescent basketball and volleyball players.

2. METHOD

In this study, pre-test post-test experimental model with control group which is one of quantitative research model was used. Simple random sampling method was used in the formation of groups. Athletes in the groups were identified as randomization (Büyüköztürket al., 2018; Karasar, 2016).

2.1. Research Group

Research group was consisted of 48 male athletes which are from Erzincan province and Erzincan Youth Services and Sports Club basketball and volleyball players. Theiraverageagewas15.5 ± 1.2 years, body mass index average was 20.92 ± 2.71 kg / cm^2 and the mean age of training was 4 ± 2.3 years. The groups are performed as Static Flexibility Group (SEG), Dynamic Flexibility Group (DFG), PNF Flexibility Group and Control Group (CG).

2.2. Measurement Tests

2.2.1. Flexibility

To measure the flexibility, a Sit-Reach test bench with a length of 35 cm, width of 45 cm and height of 32 cm was used. The test was repeated 3 times, and the best result was accepted as the value of flexibility (Raven et al., 1976). After the athletes leaned their bare soles to the test stand, they were forced to lean forward on their trunks (waist and hips) without bending their knees, and then waited 1-2 seconds at that point, leading to the maximum distance from which they could reach the hand finger tips on the test stand (Heyward, 2002).

2.2.2. Vertical Jump

A measuring stand or wall-marked measuring system is required for the vertical jump test. The test is the measurement of the distance between the most extreme point that the subject can reach by extending the arm (the soles are completely on the floor) (Kamar, 2008).

2.3. Test Procedure

Before the determination of the groups, the athletes were placed to sit and reach tests and the upper and lower limits of the flexibility levels were determined. According to the randomsamplingmethod, 4 groups were created as bad, medium, good and very good. For the distribution of the athletes equal to the groups, it was provided to choose their own group from the bag where the groups were written.

The pretests were applied to the research group that consisted of 48 athletes. Before the research, athletes and their families were informed about the purpose of the study and the permissions were taken from their families. The studies of 3 groups determined according to their flexibility levels were formed as exercises for 6 weeks, 3 days a week and 60 minutes stretching exercises per day. Trainings were performed on the same day and hours of the week in order to provide circadian rhythm. After 6 weeks, the flexibility of the groups was determined by the post-test of each athlete who had completed the flexibility studies. Each group was given a 5 min rest period. After the rest, each group was performed according to the vertical jump post-test procedure.

2.4. Analysis of Data

The data obtained from the study were analyzed by using the SPSS 22.0 program. Since parametric test assumptions were fulfilled (kolmogorov - smirnov), the variance analysis, the chi-square, the t test were used and the significance level was determined as .05.

3. FINDINGS

Table1. *Comparison of the players' flexibility, vertical jump and other specialities*

Specialities	Flexibility	N	Mean	Std. Dev.	Min.	Max.	Result
BMI	Dynamic	11	19.83	2.38	17.15	25.23	F=1,34 P=0,273
	Static	12	20.86	3.14	17.51	29.19	
	PNF	11	20.74	2.74	18.41	27.36	
	Control	14	21.97	2.44	19.14	28.33	
Sports Age	Dynamic	11	4.36	2.69	2.00	10.00	KW=2,54 P=0,403
	Static	12	3.50	1.44	2.00	6.00	
	PNF	11	5.50	3.15	2.00	11.00	
	Control	14	4.28	1.63	2.00	7.00	
Sleeve Length	Dynamic	11	227.72	14.88	210.00	255.00	F=1,88 P=0,146
	Static	12	220.66	13.66	199.00	245.00	
	PNF	11	231.81	13.60	215.00	258.00	
	Control	14	232.00	12.05	209.00	257.00	
FlexibilityPre-test	Dynamic	11	23.31	7.13	10.00	35.00	F=0,14 P=0,634
	Static	12	24.83	7.90	10.50	40.00	
	PNF	11	23.45	6.86	13.00	38.00	
	Control	14	24.64	6.91	10.00	34.00	
Flexibility Post-test	Dynamic	11	24.95	6.96	12.00	36.00	F=0,02 P=0,995
	Static	12	25.54	7.81	11.50	40.50	
	PNF	11	24.86	6.95	14.00	39.00	
	Control	14	24.89	7.01	10.00	34.50	
VerticalJumpPre-test	Dynamic	11	270.81	19.96	237.00	295.00	F=1,01 P=0,384
	Static	12	261.00	18.87	228.00	283.00	
	PNF	11	272.63	17.57	239.00	297.00	
	Control	14	265.78	13.84	237.00	292.00	
VerticalJump Post-test	Dynamic	11	272.90	19.73	240.00	297.00	F=1,62 P=0,197
	Static	12	259.75	18.72	226.00	282.00	
	PNF	11	273.63	17.32	240.00	298.00	
	Control	14	266.42	13.79	239.00	294.00	

When Table 1 is examined; The difference between the BMI, Sports Age, Sleeve Length, flexibility and vertical jump pre-post test groups was found to be insignificant (p> 0.05).

Table2. *Impact of Age on Flexibility*

Flexibility		Age Groups				Total	X^2	p
		14	15	16	17			
DynamicFlexibility	f	4	3	0	4	11	8,24	0,524
	%	36.4%	27.3%	.0%	36.4%	100.0%		
StaticFlexibility	f	4	2	3	3	12		
	%	33.3%	16.7%	25.0%	25.0%	100.0%		
PNF Flexibility	f	2	0	4	5	11		
	%	18.2%	.0%	36.4%	45.5%	100.0%		
Control Group	f	3	3	4	4	14		
	%	21.4%	21.4%	28.6%	28.6%	100.0%		
Total	f	13	8	11	16	48		
		27.1%	16.7%	22.9%	33.3%	100.0%		

When Table 2 examined; The difference between the mean scores of the athletes participating in the study was found to be insignificant when compared to their ages (p> 0.05).

Table3. *Impact of Flexibility Types on Vertical Jump*

Groups	Measurement	Mean	Std. Dev.	Result
Dynamic	FlexibilityPre-test	23.31	7.13	t=6,46
	Flexibility Post-test	24.95	6.96	p=0,001*
	VerticalJumpPre-test	270.81	19.96	t=9,89
	VerticalJump Post-test	272.90	19.73	p=0,001*
Static	FlexibilityPre-test	24.83	7.90	t=7,34
	Flexibility Post-test	25.54	7.81	p=0,001*
	VerticalJumpPre-test	261.00	18.87	t=4,48
	VerticalJump Post-test	259.75	18.72	p=0,001*
PNF	FlexibilityPre-test	23.45	6.86	t=7,45
	Flexibility Post-test	24.86	6.95	p=0,001*
	VerticalJumpPre-test	272.63	17.57	t=3,02
	VerticalJump Post-test	273.63	17.32	p=0,033*
Control	FlexibilityPre-test	24.64	6.91	t=1,98
	Flexibility Post-test	24.89	7.01	p=0,068
	VerticalJumpPre-test	265.78	13.84	t=2,83
	VerticalJump Post-test	266.42	13.79	p=0,013*

**p<0.05 significant*

When Table 3 is examined; when the flexibility pre-post testmean scores and the vertical jump pre-post test mean scores were compared the difference was found to be significant ($p < 0.05$). When the pre-post testmean scores and vertical jump pre-post test mean scores of the individuals in the static flexibility group were compared the difference was found to be significant ($p < 0.05$). When the pre-post testmean scores and vertical jump pre-post test mean scores of the individuals in the PNF flexibility group were compared the difference was found to be significant ($p < 0.05$). While the difference was found to be insignificant when the flexibility of the subjects in the control group compared to the pre-post test scores ($p > 0.05$), and the difference was found to be significant when the vertical jump pre-post test mean scores were encountered ($p < 0.05$).

4. Discussion and Conclusion

Static stretching in heating is used to improve maximum range of motion by improving joint range of motion and to reduce injury (Perrier, 2011). Many researchers believe that in the warm-up routine, dynamic stretching methods will be more rational to rule out the negative effects of static stretching on acute muscle strength and benefit from the positive effects of dynamic stretching (Manoel, 2008). Different dynamic warming exercises, including continuous and rhythmic movements, have been proven to improve the vertical jump performance (Young &Behm, 2002) and increase leg extension strength (Yamaguchi & Ishii, 2005).Faigenbaum et al. (2006) examined the acute effects of different warming protocols on anaerobic performances in adolescents. Dynamic warming and combined static stretching and dynamic warming applications have positively affected speed, health ball throw and vertical jump performance.Thompsen et al. (2007), stated that the use of dynamic exercises in heating is more applicable because of their positive effect than bikes and static stretching applications for jump performance in athletes.Faigenbaum et al. (2005), reported that dynamic warming practices, which are increasingly dense than normal, activate the power performance as a result of their research, in which they evaluate the acute effects of different warming protocols on health performance. Faigenbaum et al. (2006) reported that dynamic warm-up exercises in high school women athletes increased their vertical jump and long jump performances. These results support this study in the same direction. In contrast to these results; In a study conducted to determine if the depth splash performance was affected by static stretching, it was found that 3 active stretching exercises with a duration of 30 sec led to a significant decrease in depth jump performance (Sands & McNeal, 2003). Evans et al. (2006), in their study, 30 seconds 2 repetitive 5- static stretching movements consisting of a negative impact on the vertical jump was stated. In a study that examined the effect of three different stretching methods on splash performance, it was found that the static and PNF stretching results were as high as 5% and ballistic stretching was reduced by 2.7% and these three results were statistically significant (Bradley et al., 2007). McNeal and Sands (2001) performed static stretching exercises for lower extremity muscle groups in gymnasts and measured their effects with a vertical jump test. As a result of their research, they reported a 8.2% reduction in jump height after static stretching exercises. Young and Eliot (2001), evaluated the jump performances by performing four

different stretching procedures in which 14 male athletes were subjected to static stretching. The results showed that the static stretching procedure had more negative impact on vertical jump performance than other stretching procedures.

As a result of the research, when the effects of types of flexibility on vertical jump are examined; It can be stated that static, dynamic and PNF flexibility exercises are more effective than control group on vertical jump.When the flexibility exercises were compared among themselves, significant differences were found between them. Especially, the development of the PNF flexibility group was found to be higher than the other flexibility groups, whereas the effect on the vertical jump was lower than the other groups. While dynamic flexibility exercises show less improvement than other flexibility working groups, the effects on vertical jump of the athletes have improved more than the other groups. As the same in the static flexibility group, the development of flexibility and its effects on vertical jump were observed. The greatest effect seen in the vertical jump direction was observed in the dynamic flexibility group. According to this research, it can be said that age difference has no effect on vertical jump. In sports branches which vertical jump is important, the necessity of dynamic flexibility exercises should be recommended according to these results.

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Citation: *Fatih Özgül. " Investigating Flexibility Effects on Vertical Jump of the Adolescent Athletes " International Journal of Sports and Physical Education (IJSPE), vol 4, no.4, 2018, pp. 9-14. doi: http://dx.doi.org/10.20431/2454-6380.0404002.*