International Journal of Sport Culture and Science
March 2025 : 13(1)
ISSN : 2148-1148
Doi : 10.14486/IntJSCS.2025.737

Investigation Of The Effects Of Lower Extremity Massage Performed Before Oraining On Flexibility In Volleyball Players

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Type: Research Article (Received: 29.08.2024 – Accepted: 20.12.2024)

Abstract

Investigation of the Effects of Lower Extremity Massage Performed Before Training on Flexibility in Volleyball Players.This study aimed to investigate the effects of lower extremity massage performed before training on flexibility in volleyball players. The participants were 12 athletes from the Gümüşsu Gümüşhanespor volleyball team, divided into two groups: an experimental group (6 athletes) receiving massage and a control group (6 athletes) without massage. Pre-test and post-test flexibility measurements were taken using a Digital Flexion Meter device over a 4-week period. Statistical analysis was conducted using SPSS, with significance set at $p<0.05$.The results showed that the experimental group had higher flexibility post-test scores compared to the control group. In the 3rd and 4th flexibility measurements, significant differences were found between the two groups. Within the experimental group, flexibility improved significantly from pre-test to post-test, as shown by the Wilcoxon Signed-Rank Test and Dependent Samples t-test results.Overall, the study concluded that lower extremity massage before training significantly improves flexibility in volleyball players. The post-test flexibility scores of the experimental group were higher than their pre-test scores, and their flexibility was superior to the control group's results. These findings are valuable for coaches, athletes, and sports scientists, contributing to performance criteria in volleyball.

Keywords: Volleyball, Massage, Flexibility, Lower Extremity

Introduction

Volleyball is a sport in which aerobic and anaerobic energy systems are used together, requiring the use of both aerobic and anaerobic systems as needed during the match (Thissen-Milder & Mayhew,1991). Additionally, several motor skills are used in connection with these energy systems. To mention the general structure and rules of volleyball, volleyball is a game played by two teams of six players each on a court 9 meters wide and 18 meters long, with a net in the middle of the court. The primary objective in volleyball is to score points by making the ball touch the ground on the opponent's side of the court. The secondary objective is to win the set, and ultimately, the match (Çelenk, 2013).

Massage, deriving its meaning from the Greek "massein" and the Hebrew "mashesh," is generally interpreted as touching, stroking, and kneading. Massage is a science that provides physical and psychological relaxation by stimulating muscles with mechanical movements (Gürkan, Dalbudak, Bakır, Bakır, Dinç, 2018). Sports massage is a sub-discipline of general massage theories, specifically targeting the muscular structure of athletes to facilitate warm-up, prevent cooling, and accelerate recovery after matches and training sessions. Sports massage combines traditional massage techniques with knowledge of human anatomy and muscle structure to enhance athlete performance, facilitate warming up, accelerate recovery after matches and training, and prevent cooling (Gürkan et al., 2018).

In addition to the general definition of massage, massage manipulations are also important. These include Stroking, Kneading, Friction, Percussion, and Vibration manipulations. Stroking, also known as Effleurage, is the foundation of massage manipulations. It is known as the preparation application of massage and is applied as both the first and last technique of massage. Its purpose is to prepare and warm up the target muscle tissue and muscle groups. Kneading, also known as Petrissage, is squeezing in circular or S-shaped movements by taking the target muscle tissue into the palm. Friction manipulation is the oldest massage technique that increases blood flow in the skin and warms tissues superficially by increasing tissue heat. Friction manipulation is applied to heal fibrous tissue, commonly known as knots, and edema formed forms under the skin. Percussion, also known as Tapotement, is the technique of hitting or beating, called tapping and hammering in our language. Percussion manipulation is performed with appropriate intensity on target muscle tissue with the palm, outer side of the little finger, and different regions of the hand. Vibration manipulation is the last of the classic massage techniques and is called the vibration technique. It involves tremor movements that occur when the hand touches the body. When the vibration technique is performed with sufficient hardness and duration, it creates some reflex physiological effects (Yüksel, 2007).

Flexibility refers to the ability of joints and joint groups connected to these joints to operate at the widest possible angle during a movement. In other words, it is the capacity of the joints and joint groups required to move at the most appropriate angle during the performance of a movement (Bisanz & Gerisch,1993). In the classification of flexibility, two headings come to

the fore. The first is "Flexibility According to Force Use," and the second is "Flexibility According to Application Form" (Ölmez, 2023).

"Flexibility According to Force Use" is divided into two parts: "Active Flexibility" and "Passive Flexibility." Active Flexibility involves the efforts and efforts of the athlete himself to perform movements and exercises. For example, an athlete reaching reaches his toes without any external support. Passive Flexibility involves the athlete performing movements and exercises with the help of a partner or a tool. For example, a partner supporting supports the athlete's toes while reaching them (Ölmez, 2023).

"Flexibility According to Application Form" is also divided into two parts: Dynamic Flexibility and Static Flexibility. Dynamic Flexibility involves performing loading movements with a specific rhythm. Small rhythmic loading movements are made at the end of flexibility. For example, the athlete continuously reaches his toes in a rhythmic manner rhymatically reaches his toes and adjusts his body position, repeating these movements in series. Static Flexibility maintains joint openness for a certain period. The basic principle of flexibility exercises performed by the athlete is stability. For example, the athlete reaches his toes and holds the ankle for a while. In this case, the stability of the ankle joint is ensured. The flexibility of the lower extremities, which are the support system in human life and sports branches, plays a critical role in success and health. For this reason, exercises should be done for the flexibility of the lower extremities. For the flexibility of the lower extremities, exercises to be performed with the legs and ankles should be known. These exercises should be performed with equipment such as cones, bars, ropes, and stairs. An individual should stretch the lower extremities up to a certain period to reduce tension and warm them up. To use just to maintain balance, the massage should be used for the feet as well (Ölmez, 2023).

Material and method

Digital Flexion Meter elasticity measuring device

Fotoğraf 1. Digital Flexion Meter elasticity measuring device

The Measurement Chart

The 'Measurement Chart,' created by the researcher, was designed to gather information on the physical characteristics of athletes and their family structures within the scope of the research subject. It includes age, height, weight, age of starting sports, and measurement results.

Photograph

Measurements with participants were meticulously recorded. During measurements, participants were informed with their consent, and this process was documented with photographic records. Images created by the researcher and participants during flexibility measurement and massage application added visual richness to the study.

Research Group

The population of the study consists of all volleyball players, and the sample group (research group) consists of the players of the Gümüşsu Gümüşhanespor Volleyball A Team, which competes in the Turkish Volleyball 1st League. The research group consists of 12 athletes. The researchers voluntarily participated in the study. The athlete group was divided into two groups: an experimental group (6 athletes) and a control group (6 athletes), and both groups were maintained until the end of the process. The experimental group received a 5-minute general massage to the lower extremities (legs) after the pre-test before warm-up, and post-test measurements were taken after the massage. The control group did not receive any massage, and only pre-test and post-test measurements were taken.

Validity and Reliability of Data Collection Tool

Various studies demonstrate the reliability of the 'Digital Flexion Meter' device in flexibility measurement.

In this study, athletes' flexibility measurements were conducted using the 'Digital Flexion Meter' device with the Standard Reach Test method. This test protocol has high validity and reliability in assessing flexibility in the back and leg regions (Holtvd., 1999).

Studies have yielded results regarding the use of the 'Digital Flexion Meter' device (Holt, Pelham, Burke, 1999; Perret, Poiraudeau, Fermanian, Colau, Benhamou, Revel, 2001).

Data Collection Process

The data collection process consisted of a single stage spanning 4 weeks. Initial measurements were taken from athletes before warm-up, followed by a five-minute massage on the lower extremities for a group of six participants without warming up, and then second measurements were taken. The control group underwent pre-tests on each measurement day without any massage and was kept active (engaged in specific games such as volleyball with a ball) without cooling down, followed by final test measurements along with the experimental group's final tests. The process was planned for 4 weeks with measurements taken once a week. The measurement days were as follows: 31.01.2023, 07.02.2023, 14.02.2023, 21.02.2023. The total measurement period was planned over 4 weeks with measurements taken once a week.

Data Analysis

In this study, the effects of lower extremity massage before training on flexibility in volleyball players were investigated, and necessary parameters were measured. The obtained data were analyzed using the SPSS for Windows 22.0 software package.

In the first step, the experimental and control groups were evaluated as independent groups, and it was aimed to determine whether there were differences in pre-test and post-test flexibility scores between the experimental and control groups (independent groups). Therefore, to select the test, it was evaluated whether the variables exhibited normal distribution using the Kolmogorov-Smirnov and Shapiro-Wilk tests. According to the test results, it was observed that pre-test and post-test flexibility scores exhibited normal distribution in the experimental and control groups. Independent Samples t-test was applied for comparison of independent groups.

In the second step, pre-test and post-test flexibility scores were evaluated as dependent groups, and it was examined whether the difference between pre-test and post-test flexibility scores exhibited normal distribution, which is one of the assumptions of dependent group tests, using the Kolmogorov-Smirnov and Shapiro-Wilk tests. According to the test results, it was observed that 1st flexibility scores did not exhibit normal distribution in the experimental group. Therefore, the Wilcoxon Signed Rank Test was used to compare pre-test and post-test scores. 1st, 2nd, 3rd, and 4th flexibility pre-test and post-test scores exhibited normal distribution in the control group. Therefore, the Dependent Samples t-test was used to compare pre-test and post-test scores.

In all current tests, the error rate was set at $\alpha=0.05$, and differences between comparisons were considered statistically significant when $p<0.05$. Ms-Excel 2010 and IBM SPSS Statistics 22.0 software were preferred for statistical analysis and calculations.

Table 4. Normality Test for Pre-Test and Post-Test Scores of Flexibility in the Control and Experimental Groups (1st, 2nd, 3rd, and 4th Tests)

			Kolmogorov-Smirnov			Shapiro-Wilk		
Group	**Test**		**Statistic**	**sd**	**p**	**Statistic**	**sd**	**P**
Control	**Pre-test**	1. Flexibility	0,277	6	0,168	0,832	6	0,112
		2. Flexibility	0,217	6	0,200	0,868	6	0,218
		3. Flexibility	0,226	6	0,200	0,877	6	0,255
		4. Flexibility	0,279	6	0,160	0,807	6	0,068
	Post-test	1. Flexibility	0,246	6	0,200	0,844	6	0,142
		2. Flexibility	0,195	6	0,200	0,903	6	0,392

		3. Flexibility	0,232	6	0,200	0,856	6	0,175
		4. Flexibility	0,257	6	0,200	0,810	6	0,073
Experiment	**Pre-test**	1. Flexibility	0,200	6	0,200	0,939	6	0,651
		2. Flexibility	0,216	6	0,200	0,930	6	0,580
		3. Flexibility	0,240	6	0,200	0,870	6	0,227
		4. Flexibility	0,254	6	0,200	0,787	6	0,045
	Post-test	1. Flexibility	0,149	6	0,200	0,990	6	0,989
		2. Flexibility	0,255	6	0,200	0,913	6	0,453
		3. Flexibility	0,259	6	0,200	0,882	6	0,279
		4. Flexibility	0,288	6	0,131	0,807	6	0,068

In Table 4, it was examined whether the variables exhibit normal distribution, and it was determined that the pre-test and post-test scores of the control group showed a normal distribution ($p > 0.05$).

Similarly, it was found that the pre-test and post-test scores of the experimental group also exhibited normal distribution ($p > 0.05$).

Table 7. Normality Testing of the Differences Between Pre-Test and Post-Test Scores for Flexibility in Control and Experimental Groups for 1st, 2nd, 3rd, and 4th Measurements.

		Kolmogorov-Smirnov			**Shapiro-Wilk**		
Group		**Statistic**	**df**	**p**	**Statistic**	**df**	**P**
Control	1. Flexibility Pre-test-Post-test	0,147	6	0,200	0,984	6	0,971
	2. Flexibility Pre-test-Post-test	0,311	6	0,071	0,830	6	0,108
	3. Flexibility Pre-test-Post-test	0,252	6	0,200	0,916	6	0,480
	4. Flexibility Pre-test-Post-test	0,193	6	0,200	0,957	6	0,794
Experiment	1. Flexibility Pre-test-Post-test	0,438	6	0,001	0,568	6	<0,0001
	2. Flexibility Pre-test-Post-test	0,187	6	0,200	0,939	6	0,647
	3. Flexibility Pre-test-Post-test	0,231	6	0,200	0,902	6	0,387
	4. Flexibility Pre-test-Post-test	0,281	6	0,150	0,863	6	0,201

In Table 7, the normality of the variables was examined. It was found that the control group's pre-test and post-test scores for flexibility in the 1st, 2nd, 3rd, and 4th measurements displayed normal distribution ($p > 0.05$).

However, the experimental group's 1st measurement pre-test and post-test scores did not show normal distribution ($p < 0.05$). For the 2nd, 3rd, and 4th measurements, the experimental group's pre-test and post-test scores demonstrated normal distribution ($p > 0.05$).

Findings

Table 1. Descriptive Statistics of Participants' Demographic Characteristics

	Control		Experiment	
	Min. / Max.	**Avr.±SS**	**Min. / Max.**	**Avr.±SS**
Age	17,0 / 36,0	25,17±6,55	22,0 / 39,0	29,50±6,41
Age of starting sports	6,0 / 18,0	11,33±4,63	10,0 / 17,0	13,00±2,45
Height (cm)	179,0 / 197,0	191,00±6,48	184,0 / 202,0	193,67±6,35
Weight (kg)	78,0 / 90,0	83,17±5,15	80,0 / 103,0	88,67±8,73
BKİ (wg / hg^2)	20,51 / 27,15	22,88±2,36	20,8 / 30,4	23,76±3,48

In Table 1, the average age of the control group is 25.17±6.55 years, while the average age of the experimental group is 29.50±6.41 years.

The average age for starting sports in the control group is 11.33±4.63 years, and in the experimental group, it is 13.00±2.45 years.

The average height of the control group is 191.00±6.48 cm, and the average height of the experimental group is 193.67±6.35 cm.

The average weight of the control group is 83.17±5.15 kg, while the average weight of the experimental group is 88.67±8.73 kg.

The average BMI of the control group is 22.88±2.36 kg/m², and the average BMI of the experimental group is 23.76±3.48 kg/m².

Table 2. Frequency and Percentage Values of Participants' BMI and Massage Application

		Control	Experiment
BKİ	**Normal**	5 (%83,3)	5 (%83,3)
	Owerweight	1 (%16,7)	-
	Obesity class1	-	1 (%16,7)
	Total	6 (%100)	6 (%100)
Massage Aplication	**5 minutes**	-	6 (%100)

In Table 2, it is observed that in the control group, 83.3% of participants are in the normal weight category and 16.7% are overweight, while in the experimental group, 83.3% are in the normal weight category and 16.7% are classified as grade 1 obese.

In the experimental group, all participants received a massage application for 5 minutes (100%), while no massage application was performed in the control group.

Table 3. Descriptive Statistics of Pre-Test and Post-Test Scores for Flexibility in the Control and Experimental Groups (1st, 2nd, 3rd, and 4th Tests)

		Control		Experiment	
		Min./ Max.	**Avr.±SS**	**Min. / Max.**	**Avr.±SS**
Pre-test	1. Flexibility (cm)	-7,9 / 5,4	0,03±6,00	-5,4 / 20,6	4,90±9,56
	2. Flexibility (cm)	-5,6 / 6,6	1,53±5,34	-5,4 / 20,8	5,70±8,68
	3. Flexibility (cm)	-6,4 / 6,2	0,62±5,30	1,5 / 18,4	7,08±6,38
	4. Flexibility (cm)	-4,6 / 5,7	1,47±4,74	2,3 / 18,6	6,87±6,13
Post-test	1. Flexibility (cm)	-7,7 / 5,2	0,05±5,68	-4,1 / 22,9	9,02±9,44
	2. Flexibility (cm)	-4,7 / 7,2	1,78±4,95	-0,5 / 24,3	9,13±8,61
	3. Flexibility (cm)	-5,6 / 6,0	0,98±5,04	3,3 / 19,9	9,10±6,39
	4. Flexibility (cm)	-4,0 / 6,1	1,75±4,67	3,8 / 22,8	9,62±6,90

In Table 3, the average score for the 1st flexibility pre-test in the control group is 0.03±6.00 cm, while in the experimental group it is 4.9±9.56 cm.

For the 2nd flexibility pre-test, the average score in the control group is 1.53±5.34 cm, and in the experimental group, it is 5.7±8.68 cm.

The average score for the 3rd flexibility pre-test in the control group is 0.62±5.30 cm, while in the experimental group it is 7.08±6.38 cm.

For the 4th flexibility pre-test, the average score in the control group is 1.47±4.74 cm, and in the experimental group, it is 6.87±6.13 cm.

Overall, it was found that the participants in the experimental group had higher levels of flexibility in the 1st, 2nd, 3rd, and 4th tests during the pre-test.

In the post-test, the average score for the 1st flexibility test in the control group is 0.05±5.68 cm, while in the experimental group it is 9.02±9.44 cm.

For the 2nd flexibility post-test, the average score in the control group is 1.78±4.95 cm, and in the experimental group, it is 9.13±8.61 cm.

The average score for the 3rd flexibility post-test in the control group is 0.98±5.04 cm, while in the experimental group it is 9.10±6.39 cm.

For the 4th flexibility post-test, the average score in the control group is 1.75±4.67 cm, and in the experimental group, it is 9.62±6.90 cm.

Overall, it was found that the participants in the experimental group had higher levels of flexibility in the 1st, 2nd, 3rd, and 4th tests during the post-test.

Table 5. Comparison of Pre-Test and Post-Test Scores for Flexibility by Group (1st, 2nd, 3rd, and 4th Tests)

		Control (n=6)	Experiment (n=6)	Group Comparison
		Avr.±SS	Avr.±SS	
Pre-test	1. Flexibility (cm)	0,03±6,00	4,90±9,56	t=1,056; p=0,316
	2. Flexibility (cm)	1,53±5,34	5,70±8,68	t=1,002; p=0,340
	3. Flexibility (cm)	0,62±5,30	7,08±6,38	t=1,909; p=0,085
	4. Flexibility (cm)	1,47±4,74	6,87±6,13	t=1,707; p=0,119
Post-test	1. Flexibility (cm)	0,05±5,68	9,02±9,44	t=1,994; p=0,074
	2. Flexibility (cm)	1,78±4,95	9,13±8,61	t=1,813; p=0,100
	3. Flexibility (cm)	0,98±5,04	9,10±6,39	t=2,442; p=0,035
	4. Flexibility (cm)	1,75±4,67	9,62±6,90	t=2,314; p=0,043

In Table 5, an Independent Samples t-test was conducted to determine whether there were differences in pre-test and post-test flexibility levels between the groups. The results showed no significant differences in the 1st, 2nd, 3rd, and 4th flexibility pre-test levels between the experimental and control groups ($p > 0.05$).

It was found that the differences in the 1st and 2nd flexibility post-test levels between the experimental and control group scores were not significant ($p > 0.05$).

However, the differences in the 3rd and 4th flexibility post-test levels between the experimental and control group scores were significant ($p < 0.05$). In light of these findings, it can be stated with 95% confidence that the 3rd and 4th flexibility post-test scores of the experimental group are higher than those of the control group.

Table 6. Descriptive Statistics of the Differences Between Pre-Test and Post-Test Scores for Flexibility in Control and Experimental Groups for 1st, 2nd, 3rd, and 4th Measurements.

	Control		Experiment	
	Min./ Max.	Avr.±SS	Min. / Max.	Avr.±SS
1. Flexibility Pre-test-Post-test (cm)	-0,9 / 0,8	-0,02±0,58	-18,0 / -0,6	-4,12±6,82
2. Flexibility Pre-test-Post-test (cm)	-0,9 / 0,7	-0,25±0,67	-4,9 / -1,4	-3,43±1,31
3. Flexibility Pre-test-Post-test (cm)	-0,8 / 0,2	-0,37±0,33	-3,0 / -1,2	-2,02±0,73

4. Flexibility Pre-test-Post-test (cm)	-0,6 / 0,1	-0,28±0,25	-4,2 / -1,2	-2,75±1,20

In Table 6, the mean difference between pre-test and post-test scores for flexibility is -0.02±0.58 cm for the control group and -4.12±6.82 cm for the experimental group in the 1st measurement.

For the 2nd measurement, the mean difference is -0.25±0.67 cm for the control group and -3.43±1.31 cm for the experimental group.

In the 3rd measurement, the mean difference is -0.37±0.33 cm for the control group and -2.02±0.73 cm for the experimental group.

Finally, in the 4th measurement, the mean difference is -0.28±0.25 cm for the control group and -2.75±1.20 cm for the experimental group.

Table 8. Comparison of Pre-Test and Post-Test Scores for Flexibility in Control and Experimental Groups for the 1st Measurement.

	Pre-test	**Post-test**	**Difference**	**Group Comparison**
	Medyan (IQR)	**Medyan (IQR)**	**Medyan (IQR)**	
Control	2,00 (11,95)	2,05 (11,40)	0,00 (0,88)	Z=0,105; p=0,916
Experiment	3,55 (16,93)	8,55 (15,00)	1,30 (5,17)	Z=2,207; p=0,027

In Table 8, the Wilcoxon Signed-Rank Test was applied to determine the difference between pre-test and post-test flexibility levels in the control group. The results showed that there was no statistically significant difference between the 1st pre-test and post-test scores ($p > 0.05$).

In the experimental group, the Wilcoxon Signed-Rank Test was also used to assess the difference between pre-test and post-test flexibility levels, and it was found that the difference between the 1st pre-test and post-test scores was statistically significant ($p < 0.05$). These results indicate with 95% confidence that the massage application was effective for the 1st flexibility level among the participants in the experimental group.

Table 9. Comparison of Pre-Test and Post-Test Scores for Flexibility in the Control Group for 2nd, 3rd, and 4th Measurements.

Control	**Pre-test**	**Post-test**	**Difference**	**Group Comparison**
	Avr.±SS	**Avr.±SS**	**Avr.±SS**	

2. Flexibility	1,53±5,34	1,78±4,95	0,25±0,67	t=0,908; p=0,406
3. Flexibility	0,62±5,30	0,98±5,04	0,36±0,33	t=2,750; p=0,040
4. Flexibility	1,47±4,74	1,75±4,67	0,28±0,25	t=2,795; p=0,038

In Table 9, a Dependent Samples t-test was applied to determine the differences between pre-test and post-test flexibility levels for the 2nd, 3rd, and 4th measurements in the control group. It was found that the difference between the pre-test and post-test scores for the 2nd flexibility was not statistically significant ($p > 0.05$).

For the 3rd and 4th flexibility measurements, a Dependent Samples t-test was conducted, and it was determined that the difference between the pre-test and post-test scores was statistically significant ($p < 0.05$). Additionally, it was observed that the post-test scores for the 3rd and 4th flexibility were higher than the pre-test scores. These results suggest that the training and competitions conducted throughout the season had a positive impact on flexibility development.

Table 10. Comparison of Pre-Test and Post-Test Scores for Flexibility in the Experimental Group for 2nd, 3rd, and 4th Measurements.

Experiment	Pre-test	Post-test	Difference	Group Comparison
	Ort.±SS	Ort.±SS	Ort.±SS	
2. Flexibility	5,70±8,68	9,13±8,61	3,43±1,31	t=6,415; p=0,001
3. Flexibility	7,08±6,38	9,10±6,39	2,02±0,73	t=6,813; p=0,001
4. Flexibility	6,87±6,13	9,62±6,90	2,75±1,20	t=5,600; p=0,003

In Table 10, a Dependent Samples t-test was applied to determine whether there were differences between pre-test and post-test flexibility levels for the 2nd, 3rd, and 4th measurements in the experimental group. The results showed that the differences between the pre-test and post-test scores for the 2nd, 3rd, and 4th flexibility measurements were statistically significant ($p < 0.05$). It was also observed that the post-test scores for the 2nd, 3rd, and 4th flexibility were higher than the pre-test scores. This finding indicates with 95% confidence that the massage application was effective.

Discussion

As a result of the literature review, a limited number of studies have been found that investigate the effects of lower extremity massage applied to volleyball players on flexibility parameters. Based on this, our study is planned to examine the effects of massage on flexibility in volleyball players.

In this section, the findings obtained will be compared with the results of various studies in the existing literature. Subheadings include demographic characteristics and the results of statistical comparisons of flexibility measurement outcomes.

higher. This is likely due to the Gümüşsu Gümüşhanespor volleyball team athletes having a higher starting age, greater experience, and older average age within the player group.

Statistical Comparison of Flexibility Measurement Results

In this section, we will compare and evaluate the flexibility measurement results obtained from our research, focusing on both inter-group (between control and experimental groups) and intra-group (within the experimental or control group) comparisons.

Table 3 shows that, in the pre-test, participants in the experimental group had higher flexibility levels (1st, 2nd, 3rd, and 4th) compared to the control group. The mean score for the 1st flexibility level in the control group was 0.05±5.68 cm, while in the experimental group, it was 9.02±9.44 cm. In the post-tests, the flexibility levels of the experimental group participants remained higher for levels 1, 2, 3, and 4. These results indicate that the flexibility parameter showed positive and significant improvement in the experimental group compared to the control group, likely due to the independent variable identified, which is the massage application.

Table 5 presents the results of an Independent Samples t-test conducted to determine whether there were significant differences in flexibility levels (pre-test and post-test) between groups. The results indicated that there were no significant differences in the scores for levels 1, 2, 3, and 4 in the pre-test ($p>0.05$). Additionally, no significant differences were found for levels 1 and 2 in the post-test ($p>0.05$). However, significant differences were found for levels 3 and 4 in the post-test ($p<0.05$), suggesting that the experimental group's scores for these levels were higher than those of the control group. Therefore, the significant difference in scores for levels 3 and 4 indicates that the massage application positively affected flexibility.

In summary, while the massage did not lead to significant changes in the 1st and 2nd flexibility measurements, it proved to be more effective during the subsequent 3rd and 4th measurements when combined with previous applications.

Table 8 shows that the Wilcoxon Signed-Rank Test was applied to determine whether there is a difference between the pre-test and post-test flexibility levels in the control group, and it was found that the difference between the pre-test and post-test scores of the first flexibility test was not statistically significant ($p>0.05$). In the experimental group, the Wilcoxon Signed-Rank Test was applied to determine whether there is a difference between the pre-test and post-test flexibility levels of the first flexibility test, and it was found that the difference between the pre-test and post-test scores was statistically significant ($p<0.05$). The higher post-test scores compared to the pre-test scores in the experimental group suggest that the massage application was effective. According to the data obtained from Table 8, it was

determined that the massage applied after the first flexibility pre-test in the experimental group was effective based on the post-test data.

In Table 10, the paired t-test was applied to determine whether there is a difference between the pre-test and post-test flexibility levels in the experimental group for the second, third, and fourth flexibility tests, and it was found that the differences between the pre-test and post-test scores were statistically significant ($p<0.05$). The higher post-test scores compared to the pre-test scores in the experimental group for the second, third, and fourth flexibility tests suggest that the massage application was effective.

Koçak et al. (2005) conducted a study investigating the effect of massage on flexibility in 16-18-year-old football players, and according to the results obtained, they concluded that combining training with massage would be more effective than training alone. The findings from our study parallel the results of Koçak et al. (2005).

In another study, the values obtained from the sit-and-reach test with massage application were compared with the values obtained from the treatment without massage. After treatment without massage, no changes were observed in some subjects, while significant improvements in sitting and reaching abilities were observed in subjects after treatment with massage application (Crosman, Chateauvert, Weisberg, 1984). The findings from our study are in parallel with the study conducted by Crosman, Chateauvert, and Weisberg (1984).

In a study conducted on 10 patients with chronic active and passive movement disorders in the knee joint, it was reported that massage performed with friction manipulation applied three times a week provided improvements in the range of motion in the knee joint (Fehan, 1990). The findings from our study are in parallel with the study conducted by Fehan (1990).

In another study conducted on 20 female students from Ondokuz Mayıs University Yaşar Doğu Faculty of Sports Sciences, the participants' pre-tests were taken, followed by a 30-minute leg and back massage, after which their post-tests were taken. According to the results obtained, the flexibility data measured after the massage were higher than those measured before the massage. It was concluded that massage improves flexibility, meaning it has positive effects on the range of motion of the joints (Atan, 2020). The findings from our study are in parallel with those of Atan (2020).

In a study conducted by Abanoz, Beyleroğlu, Şahin, and Çelik (2018), the effects of local sports massage applied before warm-up on various performance values in football players were examined. According to the results of this study, it was stated that local sports massage performed before training or competition had a negative effect on vertical jumping but positive effects on flexibility. The findings of our study show similarities in a compatible way with the study by Abanoz et al. (2018).

In another study, well-trained female volleyball players were divided into control, 30-second foam roller, and 60-second foam roller exercise groups. The results of the research indicated that both foam roller exercises (30 seconds and 60 seconds) had positive and significant

effects on hip flexibility values (Ali, 2019). The findings from our study are in parallel with those of Ali (2019).

In the study by Işık et al. (2017), the effects of different modalities on the flexibility of the hamstring muscle group were investigated. In this study, one group was subjected to stretching exercises only, another group was subjected to both stretching and massage, and the last group was subjected to heat application and stretching exercises together. The massage was applied by a trained physiotherapist for an average of 9-12 minutes. According to the results obtained, it was stated that the massage caused small changes in static stretching performance and that these changes were not significant. The findings from our study do not parallel those of Işık et al. (2017). It is thought that the lack of parallelism between the two studies is due to the difference in the study groups. In our study, professional-level volleyball players constituted the research group, whereas in the study by Işık et al. (2017), the research group consisted of individuals with short hamstring muscles.

According to the findings obtained from our study, it was found that massage applications have significant and positive effects on flexibility, i.e., joint range of motion. When the findings of our study are compared with the studies examined in the literature, it is found that there are studies both parallel and not parallel to our study. In all the studies that parallel our study, it was concluded that massage has positive effects on flexibility, as in our study. In the study that did not parallel our study, it is thought that the lack of parallelism between the two studies is due to the difference in the study groups.

Results

As a result, when comparing our research with studies in the literature, it was concluded that the average age of the research group in our study (35 years) is higher than the research groups in the studies in the literature. During the evaluation and interpretation of the flexibility results, studies both parallel and not parallel to our study in the literature were encountered. It is believed that the studies that show parallelism with our research are similar due to factors such as the massage application, the athletes' ages, training levels, and the stages of their careers. The studies that do not show parallelism with our research are thought to differ due to the different research groups in the two studies.

**Presented as an oral presentation at the 10th International Conference on Science Culture and Sport, 26-30 May, Budva/Montenegro Congress./ Produced from Onur AKTÜRK's Master's Thesis.*

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