

## A training program based on some muscle contractions method's using the “Foam Roller” tool to improve some physical variables for volleyball team, Helwan university

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### **Abstract**

*The aim of this study was to identify the effect of a training program based on some muscle contractions method's through proprioceptive/PNF using 1- Relaxation Technique RT (Contract-Relax CR, Hold Relax HR, Contact-Hold-Relax CHR), 2- Reversal Of Antagonists RA (Slow Reversal SR, Slow Revesal–Hold SRH, Slow Revesal. Hold-Relax SR.HR), supported by Foam Roller and knowing effect of training program on developing some physical abilities (front flexibility, back and thigh flexibility, back flexibility "spine flexibility", flexibility of the arms/shoulders horizontally, accuracy of arm guidance/steering, reaction speed) to volleyball team, Helwan university. The researcher used the experimental method using the experimental design of two experimental groups, a sample of (12) in 2022/2023. The results indicated that the training program based on some muscle contractions method's through proprioceptive/PNF using methods under research and supported by Foam Roller have an effects positive in developing some physical abilities under research to volleyball team, Helwan university.*

**Keywords:** Muscle contractions, Proprioceptive, Physical abilities, Foam Roller, Volleyball.

### **Introduction:**

Various methods have emerged for developing certain physical capabilities through diverse approaches. Recently, new training exercises have surfaced to enhance these capabilities, relying on specific methods of muscle contractions facilitated by proprioceptive. These exercises have gained widespread popularity and garnered the approval of sports scientists globally, as well as trainers across various athletic activities. These training methods are based on employing consecutive isometric contractions combined with muscle relaxation. These contractions aid in inhibiting the activity of proprioceptive nerves connected to muscles that resist excessive stretching, thereby leading to an increased range of motion for the muscle during movements performed with full joint extension. [3: 23] [38: 24][39: 172.173]

Flexibility, accuracy, and reaction speed are integral components of comprehensive physical fitness for volleyball players that they should strive to develop. These physical attributes play a crucial role in achieving favorable outcomes in matches. [40: 181]

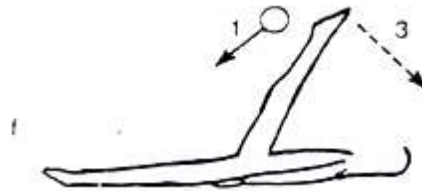
**Flexibility** is considered one of the essential components of physical fitness necessary for enhancing other physical attributes. Its deficiency can significantly impact other physical elements [20: 31], **Accuracy** refers to the important concept of achieving accurate and effective performance in sports skills and activities [18: 27], **Reaction speed** is the interval between perceiving a stimulus and initiating a response. This ability involves detecting the stimulus, processing the information [37: 142] [42: 85].

Training methods involving muscle contractions through proprioceptive rely on a variety of techniques and procedures. While the nature of these approaches may closely resemble each other in terms of the types of exercises used, they differ in the ways these contractions are executed using receptors during muscle work. Regardless of the variations in methods, the key lies in the effectiveness of the muscular contractions employed during the training. These exercises are based on a continuous interchange between static and dynamic contractions in the primary motor muscles as well as the antagonist muscles involved in the targeted movement.

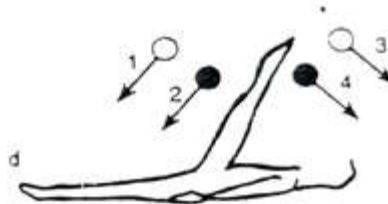
[2: 265] [17: 6] [39: 266]

Consequently, the importance of relying on methods involving muscle contractions through proprioceptive becomes evident in harnessing the benefits of reflexive reactions stemming from stretching and eliciting reflex interactions by influencing the muscle spindles that respond to changes in muscle length and the rate of these changes. [20: 25]

One of the systems used in proprioceptive muscle contraction techniques is the Relaxation Technique (RT) system (as shown in Figure 1 and Annex 5), and the Reversal Of Antagonists (RA) system (as shown in Figure 2 and Annex 5). [1: 18,19]



**Figure 1:** From the Relaxation Technique (RT) system: Contraction by shortening the antagonistic muscles in a specific position of the range of motion



**Figure 2:** From the Reversal Of Antagonists (RA) system: Alternating contraction by shortening between both the primary motor muscles and the antagonistic muscles

These Systems (RT, RA) aim to develop certain physical capacities under research and lower the threshold of stimulation in the active muscles by facilitating the flow of nerve impulses through the nervous system. Additionally, they aim to enhance the strength of opposing muscles, noting that the use of resistance should be carried out during the positive range of motion of the specific limb. [33: 186] [40: 26]

Training programs are implemented using the muscle contraction system through proprioceptive, whether through collaboration with peers or trainers, or even through individual application. Additionally, other mechanical tools or devices can be used to enhance the effect of these exercises or training, which work to increase muscle activity and improve certain investigated physical capacities [22: 32]. In support of this, the researcher utilized a "Foam Roller" tool in the proposed training program based on the Relaxation Technique (RT) and the Reversal of Antagonists (RA) muscle exchange system, as outlined in the training program steps and Appendix 4.

Previous studies conducted by Akram Gabr (2016)[5], Navarro et al. (2018)[34], Butttagat (2019)[12], Noha Abdallah (2020)[35], Lativn (2021)[20], Martin Rose et al. (2022)[24], and the study by Mario Sporis and Fredi Fiorentini (2023)[23] have demonstrated that training programs utilizing muscle contraction techniques through proprioceptive receptors contribute to the development and improvement of various physical capacities in athletes. These programs have been shown to enhance range of motion, muscular endurance, maximal strength, reaction speed, accuracy, and flexibility among players. [5,34,12,35,20,24,23]

Through the researcher work at the faculty of physical education and her assistance in training the volleyball players of Helwan University's team, the researcher noticed that those involved in the training process commonly used conventional and well-known exercises. This resulted in players feeling bored due to the repetition of these exercises, alongside the limited impact on certain physical capacities associated with volleyball.

Also, the researcher found that the trainers do not allocate sufficient time for performing light flexibility exercises during the warm-up period, before strength training, or after completing the training session. Additionally, there is a lack of utilization and understanding of the techniques and methods of employing some muscle contraction techniques through proprioceptive neuromuscular facilitation (PNF), including how to use them, the techniques involved, and the various rhythms of this approach. These aspects could potentially be effective in enhancing certain physical abilities of the players representing the Helwan University volleyball team.

Consequently, the researcher designed a training program based on the proprioceptive muscle contractions system (Appendices 2, 3, 4, 5) and investigated its impact on enhancing certain physical abilities among the players of Helwan University's volleyball team.

#### **Research Objective:**

The research aims to investigate the impact of a training program based on a system utilizing certain methods of muscle contractions through proprioceptive neuromuscular facilitation (PNF). The program includes the following approaches:

1. Relaxation Technique (RT) System, utilizing three methods:
  - a. Contract-Relax (CR).
  - b. Hold Relax (HR).
  - c. Contract-Hold-Relax (CHR) (Appendix 2/A and Appendix 5).
2. Reversal Of Antagonists (RA) System, employing three methods:
  - a. Slow Reversal (SR).
  - b. Slow Reversal-Hold (SRH).
  - c. Slow Reversal-Hold-Relax (SR.HR) (Appendix 2/B and Appendix 5).

The aim is to investigate the effects of these methods on developing various physical variables (anterior trunk and thigh flexibility, back and thigh flexibility, spinal column flexibility, horizontal arm/shoulder flexibility, arm aiming accuracy, reaction speed) among players of the Helwan University volleyball team.

#### **Research Hypotheses:**

1. There are statistically significant differences between the mean pre, post measurements for the first experimental group in terms of certain physical capabilities under research among players of the volleyball team, with a favor towards the post measurements.
2. There are statistically significant differences between the mean pre, post measurements for the second experimental group in terms of certain physical capabilities under research among players of the volleyball team, with a favor towards the posterior measurements.
3. There are no statistically significant differences in the post measurements between the two experimental groups regarding certain physical capabilities under research among players of the volleyball team.

#### **Research Procedures (Methodology)**

##### **Method:**

An experimental approach was employed using an experimental design involving two experimental groups. Pre-test and post-test measurements were taken for each group.

**Community, research sample (Research Population and Sample):**

The research population consisted of 12 female volleyball players from the Helwan University volleyball team during the academic year 2022/2023. The actual sample for the experimental study was purposively selected from the total of 12 players representing the Helwan University volleyball team in university championships. The sample was then randomly divided into two experimental groups as follows:

1. The first experimental group: This group followed a training program based on the Relaxation Technique (RT) to improve certain physical abilities under research. This group consisted of 6 players.
2. The second experimental group: This group followed a training program based on the Reversal Of Antagonists (RA) to improve certain physical abilities under research. This group also consisted of 6 players.

Additionally, a survey was conducted on a sample of 16 female students from the fourth year of the Faculty of Physical Education. This was done to calculate the scientific parameters of the tests used in the research.

**Tools:**

A. Measurement Tools and Devices:

- Stadiometer for measuring height and weight (in cm and kg).
- Stopwatch with a precision of 1/10th of a second.
- Measuring tape.
- Calibrated scale.
- Ruler with measurements of 30 cm and 100 cm.
- Foam Roller (Appendix 4).

B. Physical Tests for the Studied Variables: (Appendix 1)

A total of 6 physical tests were selected for the variables under research (accuracy, flexibility, reaction speed), based on references : (Kinda, 2006)[18], (Ahmed, 2013)[4], (Zaki, 2012)[43], (Farid et al., 2012)[15], (Mohamed & Hamdy, 2005)[31], (Mohamed A., 2013)[25], (Ayman A., 2006)[10], (Tarek & Ayman, 2006)[41], (Mohamed & Ayman, 2005)[28], (Ayat A., 2016)[9], (Rehab et al., 2013)[36], (Laila, 2010)[19], (Maher & Amira, 2019)[21], (Mohamed, 2005)[26], (Mohamed H. & Mohamed N., 2012)[27], (Mohamed S., 2017)[30], (Mohamed L. & Wajdi M., 2008)[29]. (Appendix 1).

The following table indicates that the experts' agreement (Appendix 6) on the tests reached a 100% agreement rate. Thus, these tests are deemed suitable for measuring the variables under research, as shown in Table (1) and Appendix (1).

**Table (1):** Expert Agreement Percentage on the Tests under research

		N. (Number of Experts)= 5
N.	The variables (physical tests related to the research variables)	The agreement rate
1	Front Flexibility "Flexibility of the Trunk and Thighs in Forward Bending Movements" (Forward Bend Test from Standing)	100% agreement.
2	Back and thigh flexibility in horizontal bending movements (Forward bending test from long sitting position).	100% agreement.
3	Back flexibility "spinal flexibility" (Backward bending/raising test from supine position).	100% agreement.
4	Horizontal arm/shoulder flexibility (Backward arm lifting test from standing position).	100% agreement.
5	Arm aiming accuracy (Intersecting rectangles aiming test).	100% agreement.
6	Reaction speed (Motor response test).	100% agreement.

The data from Table (1) indicates a 100% agreement among the experts on the suitability of the tests for the variables under research.

**Validity:**

**Table (2):** Significance of Differences between Specialized and Non-Specialized Groups in the Research Tests,

N=10

Variables	Measurement Unit	Specialized Group N1=5		Non-Specialized Group N2=5		Mean Difference	Value "t" Calculated
		Mean	Standard Deviation	Mean	Standard Deviation		
Anterior/Frontal Flexibility	Centimeters	7.19	1.03	5.90	0.98	1.29	3.45 *
Back and Thigh Flexibility	Centimeters	6.74	1.02	5.67	1.00	1.07	3.29 *
Posterior Flexibility "Spinal Flexibility"	Centimeters	36.89	2.23	32.55	2.09	4.34	7.71 *
Arm/Shoulder Horizontal Flexibility	Centimeters	45.30	3.88	41.91	3.06	3.39	6.39 *
Arm Aiming Accuracy	Degree	12.59	1.05	9.06	2.48	3.53	6.93 *
Reaction speed	Second	8.96	0.39	10.50	0.49	1.54	3.52 *

The tabulated "t" value at (8, 0.05) = 2.30 (two-tailed)

It is evident from Table (2) that the calculated "t" value is greater than the tabulated "t" value for all the tests, indicating that the calculated "t" value is statistically significant. This suggests the presence of significant differences between the distinguished and non-distinguished groups in favor of the distinguished group. Therefore, the aforementioned tests under study are capable of distinguishing between individuals, confirming their validity for the intended purpose.

**Reliability:**

**Table (3):** Reliability Correlation Coefficient between the First and Second Administration of the Tests under Study

N=5

Variables	First Application		Second Application		The calculated correlation coefficient "r"
	Mean	Standard Deviation	Mean	Standard Deviation	
Anterior/Frontal Flexibility	5.90	0.98	5.93	0.99	0.952*
Back and Thigh Flexibility	5.67	1.00	5.65	0.98	0.956*
Posterior Flexibility "Spinal Flexibility"	32.55	2.09	32.57	2.11	0.954*
Arm/Shoulder Horizontal Flexibility	41.91	3.06	41.86	2.99	0.937*
Arm Aiming Accuracy	9.06	2.48	9.04	2.47	0.953*
Reaction speed	10.50	0.49	10.53	0.51	0.951*

"R" value at the significance level (3, 0.05) = 0.878 (two-tailed)

It is evident from Table (3) that the calculated correlation coefficient "r" is larger than the tabulated correlation coefficient "r" in all the previous tests, indicating that the value of "R" is statistically significant. This suggests the presence of a correlation between the first and second applications and thus the stability of the previous tests.

### **The Proposed Training Program:**

#### **1. Basic Principles of Proprioceptive Neuromuscular Facilitation (PNF) Training:**

The researcher indicates that the basic principles of the PNF training program involve the following points, based on the insights provided by Alter, M., Michael, J. in 2022 [7]. These points must be considered when developing and implementing training programs using muscle contractions through proprioceptive, As shown in Annex (5).

#### **2. Program Objective:**

The aim of the training program is to enhance certain physical capabilities through the investigation of (Relaxation Technique RT) using methods (CR, HR, CHR), as well as the (Reversal Of Antagonists RA) system using methods (SR, SRH, SR.HR). This program aims to develop these physical capabilities for the volleyball players representing Helwan University in university championships.

#### **3. Determining the Level of Investigated Variables:**

The level of certain physical capabilities under research has been determined through the utilized tests, as illustrated in Table (7) and Appendix (1).

#### **4. Program Content:**

The training program includes:

- General warm-up exercises to prepare various muscles of the body and activate blood circulation.
- Developing reaction speed to different stimuli during matches.
- Enhancing flexibility of the body's joints while elongating muscles.
- Improving precision in performance and aiming during matches.
- Identifying specific exercises for reaction speed, precision, and flexibility and distributing them within the training units. (Appendices 2, 3, 4)

#### **5. Program Regulation:**

- Perform program-specific exercises 4 days a week with a 24-hour rest period between sessions.
- Maintain consistency in the exercises for both groups and keep the rest intervals and intensities consistent.
- Training Systems and Methods Used:
  - a. Relaxation Technique RT System, employing three methods: Contract-Relax (CR), Hold Relax (HR), Contact-Hold-Relax (CHR), as illustrated in Appendix 5.
  - b. Reversal Of Antagonists RA System, using three methods: Slow Reversal (SR), Slow Reversal-Hold (SRH), Slow Reversal-Hold-Relax (SR.HR), as outlined in Appendix 5.

#### **6. Foam Roller Tool: (Appendix 4)**

The researcher employed the "Foam Roller" tool [16] (Figure 3), The expert opinions were collected (Appendix 6) regarding the exercises used in the program, and the experts' approval of these exercises was 100% as indicated in Appendix (4), which includes some images of exercises using the Foam Roller tool and its various types (shapes) that can be used during the training sessions.



Examples of Arm and Shoulder Exercises



Examples of Leg Exercises



Examples of trunk Exercises

**Figure (3):** shows examples of some program exercises using the Foam Roller tool

(Attachment 4)

### 7. Execution Method, Conditions, and Mechanics of Muscle Contraction Exercises through Proprioceptive PNF:

Attachment (5) illustrates the following aspects:

- The execution method of the program using the researched techniques.
- Conditions for applying muscle contraction exercises through proprioceptive PNF.
- Mechanics of performance during the exercises.

This is in accordance with the information provided by "Alter, M., Michael, J. 2022"[7] along with an explanation of the features of the program based on muscle contraction techniques through proprioceptive PNF.

### 8. Determining Load Intensity:

The load intensity was determined according to the following guidelines:

- Light Load: Represents approximately 35% to less than 50% of the maximum capacity.
- Moderate Load: Represents approximately 50% to less than 75% of the maximum capacity.
- Submaximal Load: Represents more than 75% of the maximum capacity.

The researcher used the pulse rate as an indicator to regulate the load, where: Maximum Pulse Rate = 220 - Chronological Ag. [13: 23]

**9. Timing Distribution of the Training Program Content within Daily Training Units:**

**Table (4):** Temporal Distribution of the Daily Training Unit

Training Unit Components	Time Distribution	Relaxation Technique (RT) Program Group	Reversal of Antagonists (RA) Program Group
Warm-up	15 minutes	Exercises to Warm Up All Body Parts	Exercises to Warm Up All Body Parts
Main Part	35, 55, 65 minutes	Exercises for Developing Flexibility, Precision, and Reaction Speed Using CR, HR, CHR Techniques	Exercises for Developing Flexibility, Precision, and Reaction Speed Using SR, SRH, SR.HR Techniques
Cool Down	10 minutes	Cool Down and Relaxation Exercises	Cool Down and Relaxation Exercises
Total Unit Time	60 /80 /90 minutes (as shown in Table 5 and Appendix 2)		

It is evident from Table (4) that the total duration of the session is 60/80/90 minutes, comprising (15 minutes for the warm-up phase, 35/55/65 minutes for the main phase, and 10 minutes for the cooldown phase).

**10. Expert Opinion Survey:**

Expert opinions were gathered (Appendix 6) regarding the research-specific assessments of certain physical fitness components as previously outlined in Table 1 and Appendix 1. Additionally, expert opinions were sought concerning the program's time distribution, training units, and exercises utilizing/ using the Foam Roller, as demonstrated/ illustrated in Tables 4, 5 and Appendices 2, 3, 4.

**11. Pilot Testing of the Training Program (Pilot Study):**

One unit of the training program was piloted on the survey study sample on, October 5, 2022. The following aspects were ensured:

- Suitability of the Training Location.
- Suitability of Tools and Equipment Used in Measurement Processes
- Adjusting Training Loads to Match the Skill Level of Specialized Players in Terms of Repetitions and Time Intervals (Inter-Set Rest Periods) and Considering Individual Differences Among Trainees (Regulating Training Load for Muscle Contraction Program Through Proprioceptive) in Terms of Intensity, Volume, and Rest).

**Duration of the Training Program:**

The program was implemented on the primary study sample consisting of (12) players, as shown in the following table:

**Table (5):** Timeline of the Training Program for the Two Research Groups

N	Content	Timeline Distribution
1	Duration of Application	12 weeks
2	Number of Units per Week	4 units per week
3	Total Number of Program Units	48 training units
4	Training Unit Time	Weeks 1-4: 60 minutes Weeks 5-8: 80 minutes Weeks 9-12: 90 minutes
5	Total Training Program Time	# 60 minutes X 16 units = 960 minutes # 80 minutes X 16 units = 1280 minutes # 90 minutes X 16 units = 1440 minutes # total = 3680 minutes, which is equivalent to 61 hour and 33 minutes



It's evident from Table (5) that the duration of the program application is 12 weeks, with a frequency of 4 units per week, totaling 48 training units for each research group.

The following table illustrates a unit from the research group program:

**Research Measurements:**

**1. Moderation of sample distribution (Homogeneity):**

**Table (6):** Descriptive Distribution for the Research Sample

N=22

N	Variables	Measurement Unit	Statistical Analysis			
			Mean	Standard Deviation	Median	Skewness Coefficient
1	Age	Years	21.09	1.74	21.00	0.16
2	Height	Centimeters	167.35	3.47	167.00	0.30
3	Weight	Kilograms	70.10	5.48	70.00	0.05
4	Anterior Flexibility	Centimeters	5.91	0.97	6.00	-0.28
5	Back and Thigh Flexibility	Centimeters	5.67	0.98	5.70	-0.09
6	Posterior Flexibility "Spinal Flexibility"	Centimeters	32.55	2.10	32.50	0.07
7	Arm/Shoulder Horizontal Flexibility	Centimeters	41.94	3.07	42.00	-0.06
8	Arm Aiming Accuracy	Degree	9.89	2.52	9.90	-0.01
9	Reaction Speed	Second	10.66	0.91	10.70	-0.13

It is evident from Table (6) that the previous variables range between (-3, +3), indicating the homogeneity of the distribution in the research sample for these variables.

**2. Equivalence (Pre-measurements):**

**Table (7):** Equivalence of the Research Groups Sample

N= 12

N	Variables	The first experimental group N1=6		The second experimental group N2=6		difference between means	calculated t value
		Mean	Standard Deviation	Mean	Standard Deviation		
1	Age	21.08	1.73	21.10	1.75	0.02	0.98
2	Height	167.34	3.46	167.36	3.50	0.02	0.97
3	Weight	70.09	5.47	70.11	5.51	0.02	0.98
4	Anterior Flexibility	5.89	0.96	5.93	0.97	0.04	1.04
5	Back and Thigh Flexibility	5.68	0.99	5.66	0.98	0.02	0.98
6	Posterior Flexibility "Spinal Flexibility"	32.54	2.09	32.56	2.10	0.02	0.97
7	Arm/Shoulder Horizontal Flexibility	41.92	3.06	41.95	3.07	0.03	1.01
8	Arm Aiming Accuracy	9.90	2.51	9.91	2.52	0.01	0.81
9	Reaction Speed	10.68	0.93	10.69	0.94	0.01	0.82

*The tabulated t value at (10, 0.05) = 2.23 (two-tailed)*

It is evident from Table (7) that all values of the aforementioned variables are not statistically significant, indicating Equivalence between the two research groups.

**3. The post-measurement:**

The post-measurement were conducted for both the experimental and control groups in the same order and under the same conditions as the pre-measurements. (Appendix 1)

**Results**

**Table (8):** Significance of Differences between Pretest and Posttest Means for the First Experimental Group in the Studied Variables.

Variables	The first experimental group (Relaxation technique RT system) N1=6				difference between means	calculated t value
	pre		post			
	Mean	Standard Deviation	Mean	Standard Deviation		
Front Flexibility	5.89	0.96	7.16	1.03	1.27	3.43 *
Flexibility of the back and thighs	5.68	0.99	6.70	1.05	1.02	3.22 *
Back flexibility (Spinal flexibility)	32.54	2.09	36.83	2.24	4.29	7.61 *
Arm/shoulder horizontal flexibility	41.92	3.06	45.26	3.87	3.34	6.29 *
Arm aiming accuracy	9.90	2.51	12.04	2.53	2.14	5.12 *
Reaction speed	10.68	0.93	9.02	0.92	1.66	3.97 *

"T" value at the significance level (5, 0.05)= 2.02 (one-tailed)

It is evident from Table (8) that there are statistically significant differences between the pre-test and post-test measurements for the first experimental group at a significance level of 0.05.

**Table (9):** Significance of Differences between Pretest and Posttest Means for the second Experimental Group in the Studied Variables.

Variables	The second experimental group (Reversal of antagonists RA system) N1=6				difference between means	calculated t value
	pre		post			
	Mean	Standard Deviation	Mean	Standard Deviation		
Front Flexibility	5.93	0.97	7.19	1.04	1.26	3.41 *
Flexibility of the back and thighs	5.66	0.98	6.71	1.06	1.05	3.33 *
Back flexibility (Spinal flexibility)	32.56	2.10	36.92	2.27	4.36	7.97 *
Arm/shoulder horizontal flexibility	41.95	3.07	45.32	3.90	3.37	6.35 *
Arm aiming accuracy	9.91	2.52	12.06	2.55	2.15	5.02 *
Reaction speed	10.69	0.94	9.03	0.91	1.66	3.93 *

"T" value at the significance level (5, 0.05)= 2.02 (one-tailed)

It is evident from Table (9) that there are statistically significant differences between the pre-test and post-test measurements for the second experimental group at a significance level of 0.05.

**Table (10):** displays the significance of differences between the means of post-test measurements for the two experimental groups in the variables under research.

Variables	The post-measurement N=12				difference between means	calculated t value
	The first experimental group N1=6		The second experimental group N2=6			
	Mean	Standard Deviation	Mean	Standard Deviation		
Front Flexibility	7.16	1.03	7.19	1.04	0.03	0.97
Flexibility of the back and thighs	6.70	1.05	6.71	1.06	0.01	0.91
Back flexibility (Spinal flexibility)	36.83	2.24	36.92	2.27	0.09	1.24
Arm/shoulder horizontal flexibility	45.26	3.87	45.32	3.90	0.06	1.11
Arm aiming accuracy	12.04	2.53	12.06	2.55	0.02	1.01
Reaction speed	9.02	0.92	9.03	0.91	0.01	0.89

"T" value at the significance level (10, 0.05)= 2.23 (two-tailed)

It is evident from Table (10) that there are no significant differences in the post-test

measurements between the two experimental groups at the 0.05 significance level.

## Discussion

### 1. Discussion of Results for Hypothesis 1 (RC Contraction Group):

The results from Table (8) indicate that there are significant improvements in the investigated variables (frontal flexibility of trunk and thigh, back and thigh flexibility, spinal column flexibility, horizontal arm/shoulder flexibility, arm aiming accuracy, reaction speed) for the first experimental group after the implementation of the training program using the Relaxation Technique (RT). This improvement is evident through the tests such as forward trunk bending, long sitting trunk bending, backward trunk bending, raising arms backward from standing position, arm aiming accuracy, and reaction speed tests.

These results indicate a significant improvement in these variables between the pre-test and post-test measurements for the benefit of the post-test measurements. The researcher attributes this improvement to the effect of the training program implemented through the Relaxation Technique (RT) using:

- The Contract-Relax (CR) method. The CR method involves performing maximal contraction and shortening of antagonist muscles against resistance at a specific range of motion, followed by moments of relaxation. This is then followed by a shortening movement of the moving limb to reach the maximum possible negative range. This process is repeated several times.
- Additionally, the Hold Relax (HR) method involves maintaining a constant contraction of antagonist muscles, followed by a relaxation period during which the player moves the limb against resistance within the achievable range of motion, attempting to reach a wider range.
- Finally, the Contact-Hold-Relax (CHR) method combines muscle contraction with holding the contraction for a specific period, followed by relaxation.

Thus, utilizing this training approach through these three methods led to the improvement of physical capabilities for volleyball players.

This is consistent with the results of studies conducted by "Alaa A. 2004"[20] and "Lativn 2021"[20], where their findings showed that training programs targeting physical capabilities and utilizing various techniques of neuromuscular effects through the Relaxation Technique (RT) had a positive impact on physical variables. [6: 117] [20: 128]

Therefore, the application of the training program using this multi-method approach has contributed to the improvement of physical capabilities for the first experimental group. This highlights the importance and effectiveness of these methods in enhancing the physical abilities and performance of the volleyball players.

And this aligns with what was mentioned by "Talha H. 2021"[38], "Appleton 2021"[8], and "Brian, Councilman 2019"[11], indicating that muscle contraction training methods have a significant impact on physical performance. It is also evident that strong and flexible muscles and joints contribute to reducing the risk of injuries and increasing the range of motion. [38: 142] [8: 73] [11: 45]

### 2. Discussion of Results for Hypothesis 2 (RA Reversal of antagonists group):

The results from Table (9) indicate a significant improvement in the variables (tests) associated with physical performance for the second experimental group. This improvement was observed after implementing the muscle contraction program using the Reversal of Antagonists (RA) muscle antagonist system. This suggests the positive impact of the training program executed using the RA system, employing the following techniques:

- Slow Reversal (SR): This method involves dynamic contraction of antagonist muscles, followed by dynamic contraction of the target muscle. It relies on alternating dynamic contractions between the primary mover muscles and the antagonist muscles.
- Slow Reversal–Hold (SRH): In this technique, dynamic contraction of antagonist muscles is followed by isometric contraction of the same muscle group. Subsequently, dynamic contraction of the working muscles is performed, followed by isometric contraction of the same group.
- Slow Reversal–Hold-Relax (SR.HR): This approach includes dynamic shortening contraction of the antagonist muscles, followed by isometric contraction of the same muscles. Then, a rest period is followed by dynamic shortening contraction of the primary mover muscles.

Therefore, utilizing this system through these three techniques has played a significant role in stimulating the neuromuscular system and enhancing physical performance. As a result, it led to improvements in the physical capabilities of the volleyball players.

This indicates that the program implemented using the Reversal Of Antagonists (RA) system has contributed to achieving advancements and improvements in the capabilities of trunk flexion from standing and from long sitting, trunk flexion/extension from supine, raising arms/shoulders backward from standing, aiming accuracy, and reaction speed. These outcomes were the result of the training exercises integrated into this system, which enhanced the relevant muscles' development and increased their efficiency and performance capabilities.

The aforementioned findings align with the studies conducted by "Noha A. 2020"[35] and "Mario Sporis, Fredi Fiorentini 2023"[23], where their results indicated that the use of reciprocal contraction methods (the Reversal Of Antagonists approach) leads to increased efficiency, performance enhancement, and improved physical capabilities such as speed, coordination, balance, back and leg muscle strength, as well as flexibility in shoulder joint, spinal column, and hip joint. [35,23]

Thus, the second hypothesis, which suggests the presence of statistically significant differences between the pre-test and post-test means for the second experimental group (utilizing the Reversal Of Antagonists RA system) in terms of the level of physical abilities under research, is confirmed in favor of the post-test measurements.

### 3. Discussion of Results for Hypothesis 3 (RA, RT):

Whereas from Table (10), it becomes evident that the null hypothesis is accepted as there were no statistically significant differences between the post-test measurements of the first experimental group and the second experimental group in the variables under research. The researcher attributes this result to a change in physical performance for both groups, which is related to the training systems used, represented by the Relaxation Technique (RT) and the Reversal Of Antagonists (RA) system, along with the Contract-Relax (CR), Hold Relax (HR), Contact-Hold-Relax (CHR), Slow Reversal (SR), Slow Reversal–Hold (SRH), and Slow Reversal. Hold-Relax (SR.HR) methods. Therefore, the positive impact of these methods on enhancing the physical capabilities of the players is evident.

Whereby both "Ernest W. MacLiehico 2021"[14] emphasize the importance of muscle contraction programs that impact physical capabilities. The inability to achieve sufficient joint flexibility can restrict the range of motion and affect strength, speed, and coordination in volleyball. This can diminish overall player performance. Additionally, lack of flexibility can lead to excessive stress on joints and ligaments, increasing the likelihood of injuries. [14: 646] [32: 235]

Based on this, as both “Adrian 2022” [3] and “Ernest W. MacIehico 2021”[14] have indicated, improving physical capabilities through appropriate training programs can contribute to enhancing players' performance and increasing their ability to effectively and correctly implement training methods. This is in line with the results that suggest incorrect movements, often occurring due to inadequate physical abilities, can negatively impact overall volleyball performance. [3: 23] [14: 227]

Thus, the third hypothesis is confirmed, which indicates the absence of statistically significant differences in the post-intervention measurements between the two experimental groups in terms of physical fitness levels among the volleyball players. Therefore, it has been concluded that both the Relaxation Technique (RT) and the Reversal Of Antagonists (RA) training systems, using the mentioned methods (CR, HR, CHR, SR, SRH, SR.HR), are effective approaches in improving the physical fitness levels under research for the volleyball players. This supports the first and second hypotheses that have been discussed.

### Conclusions

- The training program utilizing muscle contractions through sensory receptors using the Relaxation Technique (RT) system and employing methods such as Contract-Relax (CR), Hold Relax (HR), and Contact-Hold-Relax (CHR), demonstrated a positive impact on developing physical capabilities (frontal flexibility, back and thigh flexibility, spinal flexibility, horizontal arm/shoulder flexibility, arm targeting accuracy, reaction speed) for volleyball national team players.
- The training program employing muscle contractions through sensory receptors using the Reversal Of Antagonists (RA) system and applying methods such as Slow Reversal (SR), Slow Reversal-Hold (SRH), and Slow Reversal-Hold-Relax (SR.HR), also showed a positive influence on enhancing physical capabilities (frontal flexibility, back and thigh flexibility, spinal flexibility, horizontal arm/shoulder flexibility, arm targeting accuracy, reaction speed) for volleyball national team players.

### Recommendations

**Based on the research findings, the following recommendations are suggested:**

- Implement training exercises utilizing muscle contractions through sensory receptors using methods such as CR, HR, CHR, SR, SRH, and SR.HR, to enhance the physical capabilities of volleyball national team players.
- Emphasize the integration of specific exercises to develop the targeted physical capabilities while making effective use of available tools and equipment.
- Utilize tools like the Foam Roller in specialized training programs designed to enhance the physical capabilities of volleyball national team players.

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