



# The speed of the Motor Response and its Relation to Performance Level of Receiving and Defense in Volleyball

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## Abstract

The aim of this research was to design a training program to develop the motor response speed and know its relationship to the performance level of the receiving and defense skills in volleyball. The researcher used the experimental method, Data was collected from 28 volleyball players in the Sport School in Hadayek al-Qubba, Cairo in 2021/2022. The results of the research revealed that the proposed training program has a positive effect in developing the speed of the motor response to the volleyball players, The proposed training program has a significant correlation between the speed of the motor response and the skills of receiving and defense in volleyball.

**Keywords:** Motor response speed, Receiving, Defense, Volleyball.

## Introduction

Volleyball, in the present time, has reached an increasing evolution in its training plans, making the modality to be a source of numerous studies that aim at potentializing the athletes' performance and where details found in the technical, tactical and physical scopes become differential in the final result reached by a team in a competition (Barcelos et al., 2009) (Silva, 2007) [4][19].

Volleyball is one of the fastest sports requiring athletes to perceive the ball and its trajectory within milliseconds to initiate a targeted motor response, and the short distance between players requires extremely fast visuomotor reactions (Thorben et al., 2019) [23].

Response time or reaction time refers to the amount of time that takes places between when we perceive something to when we respond to it. It is the ability to detect, process, and respond to a stimulus (Russ et al., 2022c) [18], so the information required to decide upon the correct motor response differs fundamentally across experimental studies, being based, for example, on the presence, spatial location, or identity of the target item (Thomas, 2021) [22].

Response time/reaction time depends on various factors (According to Ross et al. 2022c) [18]: 1) Perception: Seeing, hearing, or feeling a stimulus with certainty is essential to having good response time. When the starter





shoots the gun at the beginning of a athlete's ears (they perceive the stimulus). 2) Processing: In order to have good response time, it's necessary to be focused and understand the information well. Following the previous example, the runners, after hearing the gun, will be able to distinguish the sound from other background noise and know that it is time to start running (process the stimulus). 3) Response: Motor agility is necessary in order to be able to act and have good response time. When the runners perceived and correctly processes the signal, they started moving their legs (respond to the stimulus).

If any part of these processes is altered, response time will be affected as a consequence. In other words, if one of the athletes had poor response time, they would have a disadvantage against the other runners. Response time necessarily includes a motor component, unlike processing speed. This is why having good response time is associated with having good reflexes (Russ et al., 2022c) [18].

In this example, the processes (perceive, process, and respond), are done in a matter of milliseconds, but response time can vary depending on a variety of factors:

- Complexity of the stimulus-The more complex the stimulus, the

race, the sound is received by the more information that has to be processed, the longer this process will take.

- Familiarity, preparation, and expectations: If you have to respond to a known stimulus that you've responded to before, the response time will be lower. The less information that you have to process, the quicker the response time will be. If, as in the example with the runners, you are expecting the stimulus (waiting for the gun), response time will be even lower.

- State of the organism: Some factors that may negatively affect the detection of the stimulus are fatigue, attention (being sleepy), high temperature, old age, or even eating too much food or substances like alcohol or other drugs. All of these factors may negatively affect the detection of the stimulus, processing it, and responding to it.

- Stimulated sensory modality: Response time is shorter when the stimulus that triggers the response is auditory than if it is visual because auditory stimuli require less processing. Each sensory modality has a different response time (Russ et al., 2022c) [18].

Through the researcher's observation in the field of training , her presence and supervision of the training of volleyball academies in Hadayek El-Kobba in Cairo, she





noticed the failure of many players in the successful attempts of the skills of receiving and defending the stadium, as well as slowness in the motor response or a lack of good appreciation of the place of the ball during the skillful performance of some defensive skills under research (receiving, defense), and in light of this, the researcher considers an attempt to design a proposed training program to develop the speed of the motor response and know its relationship to the level of performance of the receiving and defense skills in volleyball, hence the importance of the research to study the speed of the motor response and its relationship to improving skill performance in volleyball.

This research aimed to design a training program to develop the motor response speed and know its relationship to the performance level of the receiving and defense skills in volleyball.

Research hypothesis:

- 1- There are statistically significant differences between pre,post-measurements of the research sample in the speed of the motor response in favor of post-measurements.
- 2- There is a correlation between the speed of the motor response and the skill performance under research in volleyball.

## Methods

The experimental approach was used for one group by pre,post-measurements.

### Sample:

The research society consisted of 28 volleyball players in the Sport School in Hadayek al-Qubba, Cairo in 2021/2022, The basic sample was randomly selected from the female players of the research society. The total number of the sample was 15 players. And 8 players outside the basic research sample as exploration sample to obtain scientific validity.

### Data collecting tools

- 1) Data recording forms: (Appendix 1)
  - 1) Forms for recording the measurements and data for the sample: name, age, height, weight, motor response, fitness tests scores, and the skillful tests score under research in volleyball.
- 2) Tools and devices: Restameter device for measuring height and weight, distance tape measure, Bearings, medical balls, tennis balls, volleyballs, volleyball court.
- 3) Fitness elements tests and motor response test: (App.2, 3) The fitness elements tests for the Receiving and Defense in volleyball were identified through the following references:





(Kinda, 2006)[9], (Ahmed, 2013)[1], (Zaki, 2012)[26], (Farid et al., 2012)[6], (Mohamed & Hamdy, 2005)[14], (Mohamed, 2013)[12], (Ayman, 2006)[3], (Tarek & Ayman, 2006)[21], (Mohamed & Ayman, 2005)[13], (Ayat, 2016)[2], (Rehab et al., 2013)[16].

These references were used to identify the fitness elements needed to perform the skills under research (App.2), measurement tests for the fitness elements (physical tests). (Appendix 3), and Nelson's test (motor response test).(App.3)

The experts' opinion (App.6) was reviewed. The experts pointed out that the fitness elements and motor response test (Nelson's test - accuracy, strength, capacity, coordination, and flexibility) Shown in Table (1), Appendix (2,3).

The experts also pointed to the most appropriate tests for measuring these physical elements, which obtained an agreement rate higher than 75%. as follows:

- Nelson's test (Nelson's motor response test).
- Aiming at overlapping rectangles test. (accuracy)
- Multidimensional/Multi-distance running test (Measuring Fitness

using Shuttle Run test with various dimensions). (Agility)

- push a medical 3 kg ball a distance test. (Capacity)
- Through tennis ball on wall and receive it test. (Coordination)
- Trunk bending forward down (standing. folding) test. (Frontal Flexibility)
- Trunk bending up (inclined lying) test from Prone falling position. (Background flexibility). (App. 3)

4) Skillful tests (Receiving, Defense) (App.4): Through the following scientific studies and references: (Ayman, 2006)[3], (Tarek & Ayman 2006)[21], (Mohamed & Ayman 2005)[13], (Ayat, 2016)[2], (Rehab et al., 2013)[16], (Kinda, 2006)[9], (Mohamed & Hamdy, 2005)[14]. The skillful tests were determined to measure the level of performance of the Receiving and Defense. In addition, the expert opinion (App.6) was used to determine the tests to measure the skills, Experts agreed to the tests of (Test receiving serve and directing it to 1-2-3 zones, Defense skill measurement test from position 6, as shown in Table (1), (App.4).



Table (1) Percentage of experts' agreement on physical, skill tests under research and Nelson's motor response test (Experts =3)

Variables	Physical and skill tests and Nelson's motor response test	Agreement ratio
Accuracy	Aiming at overlapping rectangles test	100%
Agility	Multidimensional/Multi-distance running test (Measuring Fitness using Shuttle Run test with various dimensions)	100%
Capacity	Push a medical 3 kg ball a distance test	67%
Coordination	Through tennis ball on wall and receive it test	100%
Flexibility	Trunk bending forward down (standing. folding) test. (Frontal Flexibility)	100%
	Trunk bending up (inclined lying) test from Prone falling position. (Background flexibility)	100%
Speed of the motor response	Nelson's motor response test	100%
Receiving test	Test receiving serve and directing it to 1-2-3 zones	100%
Defense test	Defense skill measurement test from position 6	100%

It is clear from table (1) that experts agreement percentage on the skill tests under research was at (67%, 100%).

Table (2a) Validity and stability of tests under research ( N= 16 (test validity))

Variables	unit	Distinct N <sub>1</sub> =8		Non distinct N <sub>2</sub> =8		Mean difference s	T. value	
		M	±SD	M	±SD			
Nelson's motor response test	Second	9.15	0.34	10.53	0.46	1.38	3.09*	
Receiving	Degree	3.96	0.97	2.40	1.10	1.56	3.17*	
Defense	Degree	7.84	2.01	5.03	2.36	2.81	3.31*	
Accuracy	Degree	10.58	2.22	9.70	2.28	0.88	2.91*	
Agility	Second	15.48	0.94	16.05	0.99	0.57	2.52*	
Capacity	Meter	24.97	6.21	23.98	8.51	0.99	2.94*	
Coordination	Degree	10.59	1.62	9.09	1.78	1.50	3.14*	
Flexibility	Frontal	Cm	10.69	3.02	9.48	3.51	1.21	3.02*
	Background	Cm	8.67	1.38	7.01	1.49	1.66	3.20*

\*The value of t-table at (0.05) = 2.14 (two directions)



Table (2b) stability of tests under research ( N= 8 (test stability))

Variables	unit	1 <sup>st</sup>		2 <sup>n.d</sup>		CC	
		M	±SD	M	±SD		
<b>Nelson's motor response test</b>	Second	10.53	0.46	10.52	0.44	0.925*	
<b>Receiving</b>	Degree	2.40	1.10	2.42	1.12	0.921*	
<b>Defense</b>	Degree	5.03	2.36	5.04	2.37	0.922*	
<b>Accuracy</b>	Degree	9.70	2.28	9.69	2.26	0.924*	
<b>Agility</b>	Second	16.05	0.99	16.04	0.98	0.918*	
<b>Capacity</b>	Meter	23.98	8.51	24.04	8.56	0.895*	
<b>Coordination</b>	Degree	9.09	1.78	9.12	1.79	0.904*	
<b>Flexibility</b>	<b>Frontal</b>	Cm	9.48	3.51	9.55	3.52	0.896*
	<b>Background</b>	Cm	7.01	1.49	7.04	1.50	0.903*

\*T-value (cc) at (0.05) = 0.886 (two directions) Sperman

It is clear from Tables (2a,b) that there are statistically significant differences between the two distinct and non- distinct groups, indicating the validity of the tests. It is also evident that there is a correlation between the first and second applications indicating the stability of the tests.

**Program design:**

1. Time distribution of the program:  
The time distribution of the program is as shown in table (3). It is clear from Table (3) that the program application period is 12 weeks, and the unit time is 90 min..

Table (3) Program schedule

Content	time distribution
program application period	3 months
number of weeks	12 weeks
number of units per week	4 units per week
total number of program units	48 training units
training unit time	90 min. / 110 min. / 130 min.

2. Shaping the load during the program phases: The researcher used the undulating method (1-3), as shown in figure (1). The researcher used the undulating

method throughout the daily training units, where the formation of the load (1 - 1), over the course of (12) week.



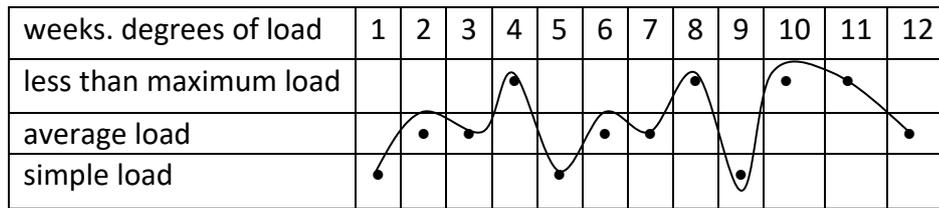


Figure (1) Formation of the periodic load scores for the training program

3. Determining degree of load: from the maximum capacity of the player, as shown in the figures(2,3,4).  
 Simple load: 35% - 50%,  
 medium load: 50% - 75%, less than maximum load: 75% - 90%

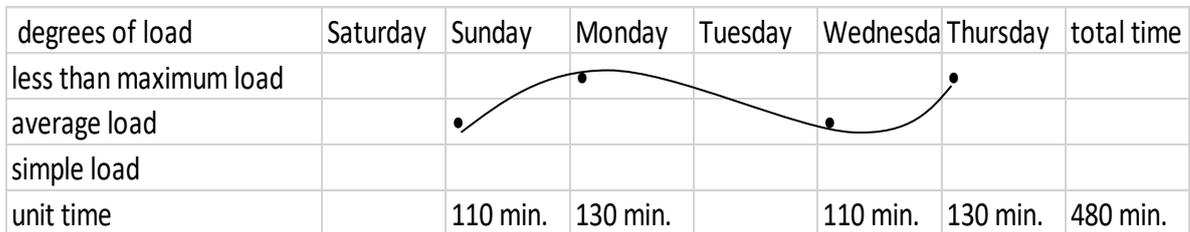


Figure (2) Formation/configuration of weekly load degrees for the week with simple load (35% - 50% of a player's maximum ability)

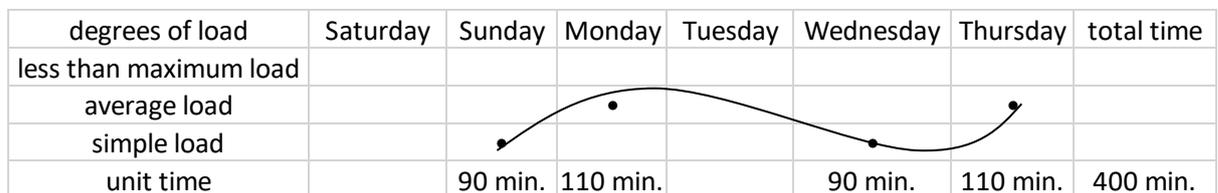


Figure (3) Formation/configuration of weekly load degrees for the week with average load (50% - 75% of a player's maximum ability)

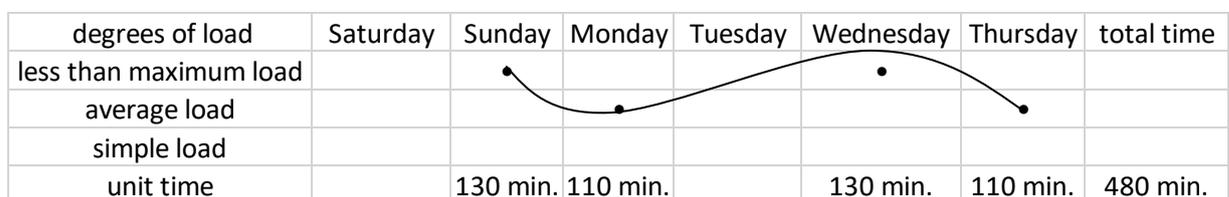


Figure (4) Formation/configuration of weekly load degrees for the week with less than maximum load (75% - 90% of a player's maximum ability)

4. Determining the weekly training volume: The researcher determined the weekly training volume as following:





- Total simple load time during the total preparation period = 400 min.  $(90+110+90+110) \times 3$  weeks = 1200 min..
  - The total average load time during the total preparation period = 480 min.  $(110+130+110+130) \times 5$  weeks = 2400 min.
  - Total less than maximum load during the total preparation period = 480 min.  $(130+110+130+110) \times 4$  weeks = 1920 min.
  - Total training time during the total preparation period = 1200 min. + 2400 min. + 1920 min. = 5520 min.(92 hours).
5. Time distribution of training program contents during the daily training units: It is clear from Table (4) that the parts of the training unit have been divided into three parts (preparatory, main, final).

Table (4) Work parts for each training unit

Parts of training unit	Time			content
	90 min.	110 min.	130 min.	
preparatory/primer part	20 min.	23 min.	25 min.	Exercises to prepare all parts of the body
main part	60 min.	75 min.	90 min.	Exercises to develop motor response speed
final part	10 min.	12 min.	15 min.	Relaxation and calming/pacification exercises

6. Experts' opinion: Where the experts' opinion was surveyed on the content of program, training method, time distribution of training program, general content of parts and distribution of the training unit, and organization of training program, and form of proposed training program was reached, which was clarified previously.
7. Implementation/Application of the proposed training program: The research experiment was carried out on the main study sample of (15) players, and the following was done for the main study sample:





- Conducting moderation of sample distribution/homogeneity, and pre-measurements before starting the implementation of the program in the variables of age, height, weight and the tests under research.
- Implementation of the proposed training program for (12) weeks.
- Post-measurements of the variables under research were carried out after the completion of program, and dimensional measurements were taken into account under the same

conditions in which the pre-measurements were carried out.

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

Skewness of the sample (23 players) in terms of: (Age, Height, Weight, Training age, Motor response test, Physical tests, Skill tests) has been limited to the ( $\pm 3$ ), where values ranged between (-0.65 to 0.09). That means there is harmony in the previous variables. Therefore, the sample is under the normal curve and the moderate distribution.

Table (5) Distribution moderation for basic and exploratory research sample N= 23

Parameters	Unit	Statistical analyses				
		Mean	Median	SD	SK	
Age	Year	15.74	16.00	2.61	-0.30	
Height	Cm	166.58	167.00	3.52	-0.36	
Wight	Kg	60.27	60.50	4.39	-0.14	
Training age	Year	2.97	3.00	0.98	-0.16	
<b>Physical Tests:</b>						
Motor response speed	Second	10.51	10.50	0.45	0.07	
Accuracy	Degree	9.71	10.00	2.29	-0.38	
Agility	Second	16.03	16.00	0.99	0.09	
Capacity	Meter	24.01	24.00	8.53	0.01	
Coordination	Degree	9.11	9.50	1.81	-0.65	
Flexibility	Frontal	Cm	9.5	10.00	3.53	-0.42
	Background	Cm	7.03	7.00	1.51	0.06
<b>Skillful Tests:</b>						
Receiving	Degree	2.42	2.50	1.11	-0.22	
Defense	Degree	5.05	5.00	2.38	0.06	

**Results:**

It is evident from Table (6) that there are statistically significant

differences between mean of pre, post-measurements in favor of post-measurement of the research





sample in variables under research, where calculated (T) values was

higher than tabular (T) value at the level of significance (0.05).

Table (6) Significance of differences between mean of pre,post-measurements in variables under research (n=15)

Variables	pre-measurement		post-measurement		T value
	Mean	SD.	Mean	SD.	
<b>Motor response speed</b>	10.52	0.45	9.10	0.38	2.59*
<b>Receiving</b>	2.39	1.09	3.93	0.95	2.66*
<b>Defense</b>	5.01	2.33	7.79	2.21	3.25*

\*T value at ( 0.05) = 1.77

Table (7) The relationship of motor response speed with the level of skill performance under research in volleyball (n=15)

Variables	Receiving accuracy	Defense accuracy
Motor response speed	0.821*	0.804*

\*"R" value at( 0.05) = 0.591

It is clear from Table (7) correlation coefficients of motor response speed with skills under research that are statistically significant at level of significance (0.05).

## Discussion

### *First research hypotheses:*

It is evident from Table (6) that there are statistically significant differences between pre,post-measurements in favor of post-measurement of the research sample in variables under research, where calculated (T) values was higher than tabular (T) value at the level of significance (0.05).

This indicates that the program contributed to improving

the speed of the motor response, which would make/ lead to an involuntary muscle contraction that stimulated other sensory organs and thus increased the number of motor units in the muscles working on these joints, which are necessary to increase muscle strength, as well as to match/consistency of plyometric exercises with movements performed in competition/match and thus the level of skill performance.

Thus, the measurement of time between the appearance of a stimulus and the initiation moment of a corresponding answer is, normally, defined by time of response or answer, and reflects the





relation of a neural orchestration between organic sensors, translators and central structures. According to Kandel et al. (Kandel et al., 2012) [8], these central structures codify the sensorial information in motor answers, by means of a series of retransmission. This happens along the parallel way of peripheral receivers until the primary sensorial cortex, one mode and multimode association cortex, where the sensorial information, representative of diverse modalities, converges in cortex areas that integrate the information in a polisensorial event, to have, this way, the motor action effectuation planned by the areas of frontal association. These ones represent, in other terms, mechanisms of processing stimulus and reply, traditionally studied in three stages of mental processing, called perception, election and answer programming (Da Silva et al., 2008) [5].

The motor response time is one of the more used measures of result for the motor/mental performance result in research, being able to influence the result or performance effects of a motor ability (Souza et al., 2008) [20], besides being decisive for the performance improvement and the success in combat sports such as the taekwondo, as well as in collective sports, in modalities such as soccer (Da Silva et al., 2008) [5] and

volleyball (Fontani et al., 2006)(Souza et al., 2008) [7][20]. Also in other sports, as well demonstrated by others authors (Da Silva et al., 2008)(Rodrigues S & Rodrigues M, 2018) [5][17], aiming at explaining the importance of the ability of processing, taught by Physical Education professionals in the practice of the objectives, contents and teaching strategies.

According to this result, the existence of an improvement of the cognitive functions associated to a longer time of practice in sports modalities. Therefore, according to Miyamoto & Meira Júnior (Miyamoto & Miyamoto, 2004) [11], this is obtained by the unique training step (elaboration time of answer) involved of the nervous system in a process of taking cognitive and perceptive decision during the preparation of the movement in tasks of complex reactions. So, Fontani et al. (Fontani et al., 2006) [7] identified, in experienced volleyball athletes, a high attention and stability in the scores of the tasks of complex reactions, in relation to the non-experienced athletes. This fact was also found by Ramos & Santos (Ramos, 2005) [15] after a study made with volleyball players, in which it was concluded that players with shorter time of practice in sports take more time to decide on a game situation, because the players'





exposition to problematic situations favor the development of a more elaborated strategic thought.

The above indicates that the proposed training program had an effective role in developing the speed of the motor response, Where the results of this study is in line with the study of Vikram (Vikram, 2008) [24], Mario, et al. (Mario et al., 2011) [10] that the training of the training programs contributes to an improvement in the time of acceleration, the muscular ability of the legs, agility and motor speed, and thus the positive effect on the level of skill performance under research.

#### ***Second research hypotheses:***

The results in Table (7) indicate that there is a correlation between the speed of the motor response and the skill performance under research, where the value of the correlation was 0.864 between the response speed and accuracy of the receiving serve, and between the response speed and defense accuracy was 0.82.

This indicates the presence of adaptation and rapid transformation of the research sample when performing the skills under research, as well as observing what the competitor is doing, and this depends on the speed of the player's movement.

The foregoing also indicates that the response speed is an

important element/component for the skills under research, in addition to efficiency of the research sample observation accuracy, good behavior (efficiency of behavior), self-confidence, and not being afraid of the attacking force of the opposing team and the efficiency of the receiving or defense skills, as the players who can succeed in the receiving or defense, it indicates the team's efficiency of a good response speed and therefore the success in the attack, as the good attack and scoring points and winning starts from the success of receiving or defense in a good way. Thus, obtaining many points for the team, which affects the team The attacker is distracted and distracts and leads to lack of focus and confusion

Receiving serve or defense is the first start against the opponent's attacks, and this requires attention, focus, and readiness to confront the opponent and monitor it throughout the playing period to perform the appropriate defensive position that leads to reducing the success rate of the opponent's attack.

The results of this study is in line with Welhan et al. (Welhan et al., 2015) in that the speed of the motor response leads to accuracy of defensive skills performance in volleyball, and there is a relationship between the speed of the motor response and the motor





skills under research in volleyball [25].

### Conclusion:

1. The proposed training program has a positive effect in developing the speed of the motor response to the volleyball players.
2. The proposed training program has a significant correlation between the speed of the motor response and the skills of receiving and defense in volleyball.

### Recommendations:

Due to the importance of the response time measurement and the nuances that involves it, for a satisfying volleyball performance, it is suggested that more studies with differentiated samples are accomplished. With this, we aim at the search for more consistent indicators that can help elucidating important aspects for the understanding of this variable, mainly in terms of qualitative inherent which may benefit the processing of information when in association with the ambivalence of the game itself.

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