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The effect of using a resistance vest on developing arm propulsion in the 200m freestyle for Baghdad club swimmers aged 13-14 years

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Abstract

The research aims to know the effect of using a resistance vest in strengthening the arm propulsion force as a tool to increase water resistance against the body's forward movement and the extent of its effect on the length and frequency of the arm pull and consequently on the level of achievement in the 200m freestyle swimming event. In order to achieve the research objective, the researcher randomly selected (10) swimmers aged (13-14) years, and divided them into two groups, the first experimental (5) swimmers as an experimental group, and the second (5) swimmers as a control group. Both groups implemented the sections of the training curriculum prepared by their coach in all its details, except that the experimental group used the swimming vest as a resistance tool within the strength and overload training within the daily training unit components, and the control group used the traditional training method according to the method prepared by the coach. The researcher conducted the test before and after the research period, which lasted for 12 weeks, with three training units per week. The results achieved were statistically analyzed for both groups. The researcher found that the 200m swimming time had improved for both groups, but the group that used the swimming vest in arm strength development training was better, in addition to the noticeable increase in the length of the pull for the control group. Therefore, the researcher recommends using the swimming vest in arm strengthening training because of its impact on achieving the level of achievement in the 200m freestyle swimming

Keywords: Yoga, pranayama, aged women, breath holding capacity, vital capacity

Introduction

Recently, studies and research on competitive swimming have increased, aiming to find and innovate training methods and techniques and to understand their impact on physical attributes. This is particularly important for participation in local, international, and Olympic championships, as these are among the games that can achieve the greatest number of medals ((Radhi, & Obaid, 2020: Saleh, *et al.*, 2021) ^[16, 17]

The movement of the arms and legs in all Olympic swimming events plays a significant role in performance speed, by applying the natural laws of motion to the body during movement and rest (Madloul, *et al.*, 2025) ^[11]. The speed of arm movements in freestyle swimming varies from one event to another. The 200m freestyle event is one of those events that requires improving the speed of arm movements by precisely and rhythmically regulating the frequency and length of strokes, appropriate to the nature of the race distance.

Accordingly, the importance of this research lies in identifying the effect of using a resistance vest in swimming as a training tool to develop the numerical level of swimmers from Baghdad clubs (aged 13-14) in the 200m freestyle event, and the extent of its impact on arm function, given its importance in speeding up the body's movement through the water.

Research problem

Swimming, like other sports and events, requires the utmost effort, depending on many intertwined factors, including appropriate training for the type of event, the swimmer's physical and functional ability, and the ability to perform properly (good technique), in addition to the use of training methods and means in training. The researcher noted a discrepancy in the level of swimmers' performance in the 200m freestyle swimming event,

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which the researcher believes that the problem in this discrepancy is attributed to the failure to use appropriate and special training methods to develop the work of the arms in a manner that is compatible with the level of digital development taking place in Olympic swimming events.

Research objective

- To identify the effect of training using a resistance vest on the length and frequency of the stroke in the 200m freestyle.
- To identify the effect of training using a resistance vest on the level of achievement in the 200m freestyle.

Research hypotheses

- There were statistically significant differences in the development of pull length and frequency in the post-tests, in favor of the experimental group in the 200m freestyle swimming.
- There was a positive effect of using a resistance vest on the level of achievement in the 200m freestyle swimming.

Research fields:

- **Human field:** A sample of swimmers from Baghdad Olympic Swimming Clubs, ages 13-14.
- **Time field:** (1/7/2025) to (30/9/2025)
- **Spatial field:** Al-Shaab Swimming Pool (50m), Baghdad.

Theoretical Studies

Freestyle Swimming

Freestyle swimming is one of the fastest competitive swimming styles (butterfly, backstroke, and breaststroke), based on the times achieved to cover the same competitive distance. Freestyle swimming is an alternating arm and leg movement that enables the swimmer to advance forward through the water by overcoming the resistance caused by the water molecules facing the swimmer. One arm enters the water at a point in front of the body between the head and shoulder, while the swimmer is in a floating position on his stomach, with a slight bend in the elbow joint. The index fingers enter first, with the palm slightly outward. The swimmer then extends the arm forward (stretch) under the surface of the water to prepare for the start of the catch process, then begins the pull process until the palms reach under the chest area, where the push process begins. When the swimmer's palm reaches near the thigh, the recovery process begins, which is the backward movement that aims to the arm should be in a completely relaxed position for the purpose of achieving rest and preparation for the next pull. As for the alternating strokes of the legs, their timing varies according to one cycle of the arms, as it is noted that there are three types of strokes, including (6) strokes, (4) strokes, and (2) strokes for the legs with each complete cycle of the arms. This coordination is not acquired as a result of training as much as it is a special nature of the swimmer. As for the breathing method, it is preferable to accustom the swimmer to implementing it on both sides during training to help him balance, and to train him to take a breath every three pulls of the arms during training, and to rotate the face to take a breath to both sides when the arm completes the final push of the water, in order not to break the movement rhythm during swimming, and the number of times of breathing varies according to the distance of the race.

Arm and Leg Movements

The researcher found that there is general agreement that arm movements provide approximately 70-85% of the propulsive forces that propel the body forward through the water in freestyle swimming. Research conducted by many swimming professionals has confirmed that in freestyle swimming, excellent swimmers obtain 70% of their movement through their arms and 30% through their legs. It was found that lower-level swimmers obtain 77% of their forward movement through their arms. (Miyashita, 1975) ^[14] Found that "there is a high positive correlation between the pulling force of the arms alone and the swimmer's speed."

The researcher concludes, through experiments in this field, that the legs are of great importance at speed, as they help raise the lower body, which begins to fall at high speeds due to the strong arm movement that raises the upper body. Therefore, their function is focused on helping maintain the body's streamlined position, not as a driving force to propel it forward. This does not mean that the swimmer must To reduce the number of strokes performed by the legs, the swimmer must balance the speed generated by the arm movements (i.e., the frequency and length of the stroke) and the legs with the specified race distance, so that the swimmer does not reach the point of fatigue before completing the race distance.

Swimming Stroke Timing

Timing is defined as "the number of arm strokes per minute." According to (Counsilmam), it is "the conventional way of expressing the ratio of arm strokes to leg strokes per arm stroke." Regardless of the number of leg strokes, there must be a downward stroke that corresponds to the final push of the arm to lift the hip upwards, to avoid resistance from the downward descent. At this stage, the importance of the legs becomes clearer as they play a more important role in maintaining the body's flow than as a driving force.

The researcher believes that a swimmer's success in choosing the number of arm strokes depends on their physical characteristics (the swimmer's height, arm length, foot size, and body weight). A longer arm will allow greater range of travel than a shorter arm, in addition to certain technical characteristics and the ability to perform movements smoothly, which come about through learning and repetition to adopt the appropriate style for the swimmer's physical makeup during actual training. In practical terms, when a swimmer increases his swimming speed, he must achieve the principle of increasing the number of strokes (frequency), especially in short-distance swimming events (50m and 100m) and medium-distance swimming (200m) freestyle, and maintain the length of the stroke, or increase the length of the stroke and maintain its frequency. That is, the average swimming speed is the product of the average number of strokes per minute and the distance covered with each full arm stroke in the water, which is measured in meters. (Kurt Wilke, 1986) ^[10] Indicates that the average speed equals the length of the stroke $\times$ its frequency, by counting the number of strokes for both arms for a certain distance. Since the distance is known, its length can be calculated by dividing the distance by the number of strokes completed. These variables depend on the athlete's physical and morphological specifications, in addition to being affected by appropriate training. This means that the higher the frequency, the higher the speed. However, there is a difference in the opinions of those working in the field of swimming regarding this variable, as (Abu al-Ala Ahmed *et al*, 1993) ^[11] indicates that

the essential factor in developing swimming speed is by increasing the length of the stroke.

The researcher concludes, through studies conducted in this field, that a swimmer's ability to perform the correct arm movement technique, in addition to some genetic and morphological characteristics such as the swimmer's height, arm length, body weight (on land), muscular strength, joint flexibility, gender, age, and the swimmer's ability to learn and adopt the correct technique, determine the most influential variable on their speed. This is dependent on training adaptation and the training methods and means used to develop the specific trait for the type of event. It is theoretically known that increasing limb speed results in a corresponding increase in propulsive forces and, consequently, an increase in the body's forward speed, which can be expressed as the distance covered in a given time. In general, the time a swimmer spends in the pull phase is determined by the distance and the average speed at which that distance is covered, which varies in frequency and length from one event to another. This means that there is a difference in the number of strokes and pull length between competitive distances. The researcher believes that the longer the race distance, the more important the variable of pull length is, as in the swimming event (200m and longer), meaning that swimmers of distances (50m-100m) have a higher frequency of arm pulls due to the shorter race distance, which is a training adaptation that requires a high frequency, compared to swimmers of long and medium distances.

Similar Studies

Study (Jan M. H. & *et al.* 1989) ^[8]

Study Title: "The Relationship between Stroke Frequency, Muscle Forces Used, and EMG Activity in Freestyle Swimming Against Resistance"

The researcher used rope pulling as resistance against the swimmer's forward movement as an alternative method to strength training methods on land-based equipment. This is because some land-based training equipment are not mechanically and their range of motion are not compatible with the swimmer's movements in the water in terms of time and frequency. The purpose of the study was to determine the effect of different stroke frequencies on the force used by the swimmer.

Methods and Instruments Used: (13) swimmers were selected to conduct the backstroke swimming test, and the effect of this test on the muscles involved. The muscles identified for this purpose were (the three heads of the brachii, the pectoralis major, the flexor and ulnar muscles, and the rectus femoris). An EMG device was used to determine the forces exerted by these muscles by connecting them to electrodes connected between the device and the muscles under study. The EMG device was also connected to a dynamometer to calculate stroke frequency via electrical channels prepared for this purpose.

Results Analysis and Discussion Strokes rates were calculated at (100%), (85%), and (75%) for arm and leg movement. The resistance data were recorded and analyzed on a dynamometer. The weights used were 2 kg, equivalent to an intensity of 100%. Using the equation: $(\text{forces} \times 20 \div 100)$, the following was obtained:

- The stroke frequency had a positive effect on the forces exerted. The higher the stroke frequency, the higher the average forces exerted (from 75-100%).
- A statistically significant increase in the

intensity/resistance ratio of the working muscles occurred with increasing stroke frequency. It was found that low stroke frequency (75%) was more efficient in producing force due to the longer time required to execute and complete the entire pull. However, the reality is that high stroke frequency overcomes high pulling forces (Erik Bollen, *et.al*, 1989) ^[7].

A study (Erik Bollen, *et al.*, 1989) ^[7]

Title: "The Relationship between Rope Pull and Freestyle Swimming."

The purpose of these studies was to determine the muscular work in regular freestyle swimming, how to develop it, and the effect of rope pull on the muscles involved. The device used in this study (EMG) focused on the specialization of some alternative training methods, as the main issue with land-based training was the uneven mechanics of work as found in water in regular swimming (Clarys, 1985) ^[4]. The activity of three external muscles was recorded by stimulating them with electrodes. These muscles are: the triceps brachii, the latissimus dorsi, and the pectoralis major. (13) Swimmers were selected and subjected to a 100m swimming test, with the arithmetic mean for the test being 56.9 seconds. To ensure a complete pull, a belt was placed around the swimmer's waist, connecting it to a pull device (reverse pull), and at the other end, connected to a dynamometer. A water resistance measuring device was placed on the swimmer's headgear, and stroke frequency was calculated to maintain a constant frequency. Three stroke frequencies were measured: 100%, determined by swimming at a high speed, and 85% and 70%, calculated from the frequency measured at 100%. At the start of the arm stroke (i.e., when the left arm strikes the surface of the water), the muscle force of the arm pull (100%) over a distance of 20 m at maximum speed was recorded. Stroke frequency (100%) was recorded by the average time for each arm stroke over five consecutive strokes. The same measurements were made at frequencies of 85% and 70%. The same tests were repeated by pulling the swimmer from behind by the rope, and at the same frequencies as those performed without pulling.

Analysis and Discussion of the Results:

- The results showed that as stroke frequency decreased, the force exerted also decreased.
- None of the muscles involved in the pull (except the back) were affected compared to regular freestyle swimming.
- When swimming with the pull, there was a clear decrease in stroke frequency.

The researcher concluded that swimming with the pull device is a specialized training method for increasing arm muscle strength at 100% frequency, and it is no different from regular swimming at the same frequency. When swimming at 85% frequency with the pull device, arm muscle activity is also specialized (but not similar) and more specialized than swimming at 100% frequency. At 70% frequency, there was no difference in arm muscle activity between rope pull and regular swimming. The final conclusion is that swimming with the pull device is similar to freestyle swimming. This is also true when testing the arm muscles.

Research methodology and field procedures:**Research Methodology****Methodology Used**

The researcher used the experimental method because it suited the nature of the problem.

Research Sample

The research sample was deliberately selected and included (10) swimmers representing Baghdad clubs in the 13-14 year old category, specializing in the 200m freestyle swimming.

Table 1: Value of the coefficient of variation and the results for the variables of height, age, and weight for the members of the research sample.

Variables	Measuring unit	Mean	Std. Deviations	coefficient of variation	Result
Height	Cm	165	1.247	0.755	Homogeneous
Mass	Kg	58.3	0.95	1.63	Homogeneous
Age	Year	13.07	0.184	1.40	Homogeneous

Research Devices and Tools

- Electronic Stopwatches.
- Work Team.
- Swimming Resistance Vest.

Field Research Procedures:**Field Test:**

The researcher conducted the field research test by adopting the times of swimmers from the research sample who participated in the Olympic Swimming Championship held by the Iraqi Central Swimming Federation on July 1, 2025, at the Al-Shaab Indoor Olympic Pool. The researcher used these times as a pre-test for the 200m freestyle event. All variables related to the research were recorded in a special log prepared for this purpose. After (12) weeks, the training period, the post-test was conducted for the two groups of the research sample on September 30, 2025. The times achieved were recorded, and the same procedures were implemented as for the pre-tests.

Experimental Tools Used

The researcher used a swimming resistance vest (a type of buoy with the foam layer removed and designed to fit the chest circumference of each swimmer). It was incorporated into the training curriculum as a means of increasing the water resistance encountered by the swimmer as he moves forward. The researcher relied on the opinions of experts and foreign sources to modify some sections of the training curriculum prepared by the research sample's trainer in terms of intensity and volume, in line with the nature of the sample, according to Appendix (1). The training curriculum included (12) weeks, with three training units per week, where the training volume ranged from (2700m) to (4500m) at the end of the eleventh week, where it began to decrease in preparation for the post-test of the research sample, where the training volume for arm work for both groups reached 14% of the total training volume. Both groups implemented the components of the training curriculum in all its details except for one paragraph, which is that the experimental group used the swimming breaststroke as a training tool implemented within the group of repetitions for arm training, consisting of (400m) in the form of a group of repetitions (2 x 8 x 25m) or (8 x

They represent (66.6%) of the original population, which numbered (15) swimmers. Based on the characteristics of the research sample, the researcher divided its members into two groups: the first an experimental group and the second a control group. This was based on the average times achieved and their standard deviations in the pre-test in the 200m freestyle swimming, using a random method. In selecting the research sample, the researcher ensured the homogeneity of the members of the two groups in the research test, as shown in Table (1).

50m) in the freestyle swimming method - arms only, and with an intensity close to or higher than what the swimmer does in competition, meaning that the swimming speed strategy during the (200m) freestyle swimming competitions changes between every 50m (pool), as some swimmers have a faster swimming speed in the first (50m) than in the other pools, and some have equal speed, and this Strategies also changed during the qualifying and final rounds, depending on the participating swimmers' physical and tactical abilities in each pool. Generally, the researcher recorded the time of each pool and then calculated the average, using it as a measure of the 50m speed as a training intensity. Therefore, the researcher asked the research sample to perform the same frequency recorded in the pre-test, emphasizing correct technique when performing strokes (arms and legs), and maintaining a straight, streamlined body position. This ensured greater impact when performing the exercise. The control group performed the same set of repetitions in terms of volume and intensity, but without using a swim vest, using the traditional method prepared by the coach, and emphasizing correct performance during training. All exercises were performed in the same pool, at the same speed, and by the same coach.

Statistical Methods

The researcher used the following statistical method to process the research test results.

- Arithmetic mean
- Standard deviation
- T-test: For paired samples.

Results and discussion

In order to achieve the research objectives and hypotheses in determining the extent of the impact of the training tool used (the swimming vest), it is necessary to shed light on the nature of the performance level of the research sample members in the 200m freestyle swimming. Furthermore, it is necessary to determine the extent of dispersion of their values from the average performance level in that test (which is the standard deviation, which helps the researcher detect, diagnose, and predict) (Mahmoud Al-Mashhadani, 1976) ^[13]. This is done through the following tables:

Table 2: shows the arithmetic means, standard deviations, and results for the pre- and post-tests, and for the experimental and control groups in the variable of pull frequency for the 200m freestyle swimming distance.

Groups	Pre-test		Post-test		Arithmetic mean of difference	standard error of the mean difference	T value		Type Sig
	Arithmetic mean	Standard deviation	Arithmetic mean	Standard deviation			calculated	Tableau	
Experimental		0.86	120.8	0.67	0.9	0.24	3.75	4.60	Non sig
Control		0,5	122.26	0.28	0,78	0,14	5.57		Sig

By observing Table (2) and after conducting statistical treatments, it becomes clear that there are statistically significant differences between the results of the pre- and post-tests of the two research groups in the variable of pull frequency for the 200m freestyle swimming distance. The calculated t-value for the experimental group, which was (3.75), was smaller than the tabular t-value, which was (4.60), with a degree of freedom of (4) and a significance level of

(0.05), indicating that the aforementioned variable did not develop in the post-test. Meanwhile, the calculated t-value for the control group was (5.57), which is greater than the tabular t-value, which was (4.60), with a degree of freedom of (4) and a significance level of (0.05). Therefore, the difference is significant in the post-test, in favor of the control group in this variable.

Table 3: Statistical results of the comparison between the experimental and control research groups in the variable of pull frequency in the post-test for the 200m freestyle swimming distance.

Groups	Arithmetic mean	Standard deviation	T value calculated	T-table value	Type Sig
Experimental	120.8	0.67	4.52	2.31	Sig
Control	122.26	0.28			
Under degree of freedom (8) and significance level 0.05					

Table (3) shows the statistical results for the experimental and control groups regarding the sprint frequency variable. The experimental group achieved an arithmetic mean of 120.8 with a standard deviation of 0.67, while the control group achieved an arithmetic mean of 122.26 with a standard deviation of 0.28. The calculated t-value between the two groups was 4.52, which is greater than the tabular t-value of

2.31, with a degree of freedom of 8 and a significance level of 0.05. This indicates a significant difference between the two groups regarding the sprint frequency variable, in favor of the control group. The researcher attributes this difference to the lack of effect of the use of a swimming vest by the experimental group.

Table 4: shows the arithmetic means, standard deviations, and results for the pre- and post-tests, and for the experimental and control groups regarding the sprint length variable for a 200m freestyle swimming distance.

Groups	Pre-test		Post-test		Arithmetic mean of difference	standard error of the mean difference	T value		Type Sig
	Arithmetic mean	Standard deviation	Arithmetic mean	Standard deviation			calculated	Tableau	
Experimental	1.47	0.008	1.49	0.007	0.02	0.003	6.66	4.60	Sig
Control	1.468	0.007	1.468	0.007	0.004	0.0024	1.66		Non Sig

By observing Table (4) and after conducting statistical treatments, it becomes clear that there are statistically significant differences between the results of the pre- and post-tests of the two research groups in the variable of pull length for the 200m freestyle swimming distance. The calculated t-value for the experimental group was (6.66), which is greater than the tabular t-value of (4.60) with a

degree of freedom of (4) and a significance level of (0.05), indicating that the aforementioned variable developed in the post-test. Meanwhile, the calculated t-value for the control group was (1.66), which is smaller than the tabular t-value of (4.60) with a degree of freedom of (4) and a significance level of (0.05). Therefore, the difference is significant in the post-test and in favor of the experimental group in this variable.

Table 5: shows the statistical results of the comparison between the experimental and control research groups in the variable of pull length in the post-test for the 200m freestyle swimming distance.

Groups	Arithmetic mean	Standard deviation	T value calculated	T-table value	Type Sig
Experimental	1.49	0.007	6.77	2.31	Sig
Control	1.468	0.007			
Under degree of freedom (8) and significance level 0.05					

Table (5) shows the statistical results for the experimental and control groups regarding the pull length variable. The experimental group achieved an arithmetic mean of 1.49 with a standard deviation of 0.007, while the control group achieved an arithmetic mean of 1.468 with a standard deviation of 0.007. The calculated t-value between the two groups was 6.77, which is greater than the tabular t-value of

2.31, with a degree of freedom of 8 and a significance level of 0.05. This indicates that there is a significant difference between the two groups regarding the pull length variable, in favor of the experimental group. The researcher attributes this difference to the effect of the use of the swimming vest worn by the experimental group.

Table 6: shows the arithmetic means, standard deviations, and results for the pre- and post-tests, and for the experimental and control groups, regarding the 200m freestyle swimming time variable.

Groups	Pre-test		Post-test		Arithmetic mean of difference	standard error of the mean difference	T value		Type Sig
	Arithmetic mean	Standard deviation	Arithmetic mean	Standard deviation			calculated	Tableau	
Experimental	152.8	1	143.8	0.836	9	0.41	21.95	4.60	Sig
Control	152.5	1.9	148.8	1.6	3.7	0.76	4.86		Sig

By observing Table (6) and after conducting statistical treatments, it becomes clear that there are statistically significant differences between the results of the pre- and post-tests of the two research groups regarding the variable of 200m freestyle swimming time. The calculated t-value for the experimental and control groups reached (21.95) and (4.86), respectively. These are both greater than the tabular t-value of

(4.60) with a degree of freedom of (4) and a significance level of (0.05). This indicates that the aforementioned variable developed in the post-test for both groups. There was also a significant difference in favor of the experimental group, indicating that there was a differential effect of the training methods used by the two groups of research sample members on this variable.

Table 7: shows the statistical results of the comparison between the experimental and control research groups regarding the variable of 200m freestyle swimming time.

Groups	Arithmetic mean	Standard deviation	T value calculated	T-table value	Type Sig
Experimental	143.8	0.836	6.26	2.31	Sig
Control	148.8	1.6			
Under degree of freedom (8) and significance level 0.05					

Table (7) shows the statistical results for the experimental and control groups regarding the 200m freestyle swimming time variable. The experimental group achieved an arithmetic mean of (143.8) with a standard deviation of (0.836), while the control group achieved an arithmetic mean of (148.8) with a standard deviation of (1.6). The calculated t-value between the two groups was (6.26), which is greater than the tabular t-value of (2.31) with a degree of freedom of (8) and a significance level of (0.05). This indicates that there is a significant difference between the two groups regarding the 200m freestyle swimming time variable, in favor of the experimental group. The researcher attributes this difference to the effect of the swimming vest used by the experimental group.

Discussion of the results of the 200m freestyle swimming test:

From our observation of Tables (2) and (3), it appears that there is a significant difference in the pull frequency variable in the pre- and post-tests, in favor of the control group. While there was no development in the experimental group, which the researcher attributes to the effect of the training method, which had a clear impact on developing swimming ability and thus its impact on the level of performance, and this is what he indicates.

(Maglischo, 2003) ^[12] that the exercises in which the training tools for developing ability are used must be characterized by similarity of movement and speed as in competition, and this is what was implemented by the two groups during the ability development exercises for arm work within the components of the training curriculum prepared for each of them, which created a different training effect and adaptation that caused an improvement in their performance time, as the training tool used (swimming vest) had an effect on the adaptation that occurred in the arm muscles, which subsequently led to an improvement in the performance time of the experimental group at the expense of the pull frequency, and despite the lack of improvement in the pull frequency, it was compensated for by increasing the pull length that occurred in the post-test, and as (Kurk Wilky, 1988) ^[9] indicates, swimming speed can be obtained by changing one of the

speed variables (frequency or pull length), meaning improving the pull length while maintaining its frequency, as is the case with middle and long distance swimmers, or increasing the pull frequency while maintaining its length, as in short competitions. Tables (4) and (5) also show a clear difference in the pull length variable for the pre- and post-tests of the two groups, which the researcher attributes to the fact that the training methods used for both groups had a clear impact on the pull length variable. This is consistent with what was found by (Pai & Wilson, 1984) ^[15], who indicated that speed is the product of the average pull length per minute to cover a certain distance. This is consistent with what (Cappaert, J. 1997) ^[3] concluded regarding the existence of a relationship between the pull length and the time required to cover a certain distance when using resistance-training methods, as the greater the resistance, the less frequent the pulls become and the longer they are. The researcher believes that the swimming breaststroke improved the muscular strength of the arms, thus increasing the ability of the muscles to produce a higher speed to cover a longer distance for each arm pull, as ability is the product of speed and muscular strength.

By observing Tables (6) and (7), there appeared a clear and statistically significant improvement in the results of the experimental and control groups for the pre- and post-tests in the variable of performance time, which showed a development in the level of achievement in the 200m freestyle swimming for both groups, as the calculated (t) value for both groups was greater than the tabular (T) value, indicating that there was a clear effect of the training methods used when implementing the training curriculum sections. However, the development in the performance level of the experimental group was more evident than it was in the control group. The researcher attributes this development to the effect of the training method used (swimming vest), which clearly affected the work of the arms and strengthened their muscles involved in work, as they are of great importance in producing the propulsive forces to advance the body forward during freestyle swimming. This is consistent with what was indicated by (Miyashita, 1975) ^[14] "that there is a high positive correlation between the pulling force of the arms only

and the swimming speed,” and with what was stated by (Conselman, 1980) ^[6] “that reaching the maximum propulsion efficiency in The water is created by pushing a large amount of water for the longest possible distance. This was achieved by increasing the length of the arm pull and the strength of the arm movements. The researcher finds that the increased loading achieved with the swimming vest has achieved the goal of its use. This is consistent with what was indicated by (Beltz, J.D., D.L. Costill. 1988) ^[2] that the increase in aerobic and anaerobic loading causes changes in the concentration of high-energy phosphates in the muscles performing the exercise. This explains the reason for the development of the level of arm performance as a result of the loading of the experimental group by increasing the resistance it faces with the swimming vest compared to what is the load in the control group.

Conclusion and Recommendations

Conclusion

Through the presentation, analysis, and discussion of the test results, the researcher reached the following conclusion:

- It was found that training using a resistance vest in swimming is an appropriate training method for increasing water resistance, which develops muscular endurance and, consequently, increases arm stroke length in 200m freestyle swimming events.
- There was no effect of using a swimming vest on the stroke frequency variable between the results of the experimental and control groups in the post-test.
- There was a clear discrepancy between the results of the experimental and control groups in the post-test regarding the 200m freestyle swimming time, in favor of the experimental group.

Recommendations

- Give importance to arm training when developing training programs due to its direct impact on raising achievement levels.
- Promote the use of the swimming vest as a training method to strengthen arm muscles, given its importance in improving achievement levels in the 200m freestyle swimming event.

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Appendix 1Three-unit training model for a training week, Swimmers Training Institute, ages 13-14 Sunday

Curriculum content and objective	Organization	Training method
Warm-up	300m freestyle + 100m pull + 4 x 50m (60 sec)	Continuous swimming: 10 minutes – Heart rate 120-150 bpm
Swimming Endurance	4 x 100m (25m right + 25m left) arm pull + 50m swimming	Interval: 2 minutes (work + rest) at 75% intensity*
Lactate Production Drills	6 x 50m + 50m rest between reps	Repetitions: 90 seconds (work + rest) at 90% intensity
Swimming Endurance: A Topical Foundation	4 x 100m legs only	Interval: 2.5 minutes (work + rest) at 75% intensity
Overload Drills	(8 x 50m) using swimmer's breaststroke	Maximum intensity: 90 seconds (rest + work) at maximal intensity
Recovery	400m downstroke	Continuous swimming: 6 minutes at light intensity
Volume	2800m	

Tuesday

Curriculum content and objective	Organization	Training method
Warm-up	800m (400m medley + 200m freestyle + 200m medley)	Continuous swimming time: 12 minutes, pulse up to 150
Swimming Endurance	8 x 50m (25m right + 25m left) arm pull	Interval - 90 seconds (work + rest) at 75% intensity
Lactate Production Drills	2 (8 x 25m) using a swim vest. Trial	Maximum intensity: 60 seconds (work + rest) at maximal intensity
Swimming Endurance: A Topical Foundation	4 x 100m legs only	2.5 minutes (work + rest) at 75% intensity
Overload Drills	6 x 100m	Replies: 90 seconds (work + rest) at submaximal intensity
Recovery	4 x 100m progressive (increasing time with each rep)	8 minutes at light intensity
Volume	3000m	

Thursday

Curriculum content and objective	Organization	Training method
Warm-up	600m (50m freestyle + 50m butterfly + 50m backstroke + 50m breaststroke x 3...)	Continuous swimming: 12 minutes, pulse up to 150
Swimming Endurance	8 x 100m (25m) arm stroke + 75m full length swim	Interval - 2 minutes (work + rest) at 75% intensity
Lactate Production Drills	3 (8 x 25m) specialty swim	90 seconds (work + rest) + 3 minutes at 90% intensity
Swimming Endurance: A Topical Foundation	4 x 100m men only	2.5 minutes (work + rest) at 75% intensity
Overload Drills	(8 x 50m) using swimmer's breaststroke. Experimental swim	90 seconds (rest + work) at maximum intensity
Recovery	400m gentle down stroke	Continuous swimming: 8 minutes
Volume	3200m	