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Original Article

The Effect of A Land-Based Training Program on Certain Biomechanical Variables of Arm Movements And The Personal Record of The 50m Breaststroke

Prof.Dr.Ahmed Mahmoud Abdel Hakim[1], Prof.Dr.Walaa Mohamed Kamel El-Abd[2], PhD Candidate. Jihan Bakr Abdel Sadek Ali [3]

[1,2,3] Department of Theories and Applications of Combat and Water Sports, Faculty of Sports Science, University of Sadat City, Egypt

E-mail address: gihan.bakry.x12345@icloud.com

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Abstract

The research aims to identify the effect of a land-based training program on certain biomechanical variables of arm movements and the Personal Record in the 50m breaststroke. The researchers used the experimental method with an experimental design for two groups, one experimental and the other control. The research community represents swimmers registered with the Egyptian Swimming Federation. The research sample consisted of (10) swimmers who were divided into two groups, (5) swimmers for the experimental group, and (5) swimmers for the control group, in addition to (5) swimmers for the exploratory group from the same research community but outside the main group. The most important results were that the training program proved its effectiveness in developing arm movements for breaststroke swimming, which led to a noticeable improvement in the digital level. The researchers also recommended paying attention to land-based training due to its great importance in developing swimmers' performance.

Keywords: ***Biomechanics, land based, Breaststroke***

Introduction

Swimming is an activity characterized by many biomechanical variables that differ from other sports because the aquatic environment differs from the solid land we are accustomed to, which makes it a fertile environment for study and investigation in many aspects and requirements. (Abu Al-Ala,1994)

The main biomechanical goal of swimming as a competitive short-distance sport is to break records. Therefore, the training process in swimming must be developed to achieve the best numerical achievement in local, international and Olympic championships. (Abu Al-Ala,200) (Antonio,1985)

Therefore, the swimmer must pay attention to time, whether it is the time to cover the distance, or the time taken by each part of the body when pulling with the arms, kicking with the legs, breathing movements, coordination, or rotations. (22:28)

Abdul Aziz Al-Nimr and Nariman Al-Khatib (2000) believe that swimming requires muscular strength in the upper part of the body, the strength of the chest muscles, shoulder muscles, and the back and arm muscles all have a significant impact on the swimmer's performance, and strength training characterized by speed leads to improving the swimmer's performance and improving his numerical level, in addition to playing an important role in preventing injuries. (Abdul Aziz,2000)

Megan and Nissan (2008) explain that land training outside of water training improves basic swimming skills, and muscle strength training helps build both strength and flexibility. Swimmers need to perform land strength training after water training, as training in water does not affect fatigue and stress during land training. (Megan and Nissan,2008)

The use of tools and devices aimed at developing physical abilities in a comprehensive manner is the basic feature of training programs designed to achieve the best results and sporting achievements in general. Swimming is one of the most important sporting activities for which modern tools and devices have become one of the most important factors that help in achieving the best results through standardized training doses directed at achieving the set goals in a manner that is consistent with the age groups of swimmers, so as to develop the level of sporting achievement while maintaining the possibility of swimmers reaching the best achievement without affecting the swimmer's growth or condition. The sport of swimming has witnessed great progress in recording records and great achievements, as a result of continuous training, field practice, and reliance on the latest scientific techniques and applied sciences, including biomechanics (Mohamed,2016)

Through the presence of researchers in the field of training and their observation of swimmers, they noticed a decrease in their digital level, which depends on biomechanical variables, as well as a lack of interest in ground training that helps in developing the skill performance of swimmers as well as improving their physical level, and the greater interest is in favor of water training, so they turned to innovating and designing devices that play a role in improving skill performance as well as biomechanical variables, which in turn leads to improving the digital level of swimmers.

The aim of the research is to identify The effect of a land-based training program on certain biomechanical variables of arm movements and the Personal Record in the 50m breaststroke.

Study Hypotheses

According to the research objectives, the following hypotheses were formulated There are statistically significant differences between the pre- and post-measurements of the experimental and control groups in the biomechanical variables of the breaststroke, in favor of the post-measurement of the experimental group

1. There are statistically significant differences between the pre- and post-measurements of the experimental and control groups in the personal record of breaststroke swimming, in favor of the post-measurement of the experimental group.
2. There are differences in the improvement rates between the two post-measurements of the experimental and control groups in the biomechanical variables and the digital level, in favor of the post-measurement of the experimental group.

Materials and Method

The authors used the experimental method with an experimental design for the experimental and control groups using pre- and post-measurement, in order to suit the nature of the research.

Participants

The research sample was chosen intentionally from the breaststroke swimmers at the Olympic swimming pool in Shebin El-Kom, numbering (15) swimmers, with an average age of less than (14) years. They were divided into (5) swimmers for the control group, (5) swimmers for the experimental group, in addition to (5) swimmers for the Pilot study.

Homogeneity of the participants groups

Table (1) shows the value of the skewness which was between (±3) ranged between (0.44: 2.05), which indicates that the research samples fall under the normal distribution curve, and that the sample individuals were distributed in a normal and homogeneous manner, growth rates and training age.

Table 1. The normality of the distribution of the research community in rates Growth and training age (n = 15)

Variables	Units	Average	The median	St.Dv	Skweness
Age	Year	12.33	12.00	0.49	2.05
height	Cm	152.20	150.00	5.75	1.15
the weight	kg	42.53	42.00	3.62	0.44
Training experience	Year	2.20	2.00	0.68	0.89

Equivalence of the participants Groups

It is evident from Table (2) that there are no statistically significant differences between the growth rates and training age of the experimental and control groups, as the calculated "Z" values ranged from (0.317 to 0.655), which are lower than the tabular "Z" value, indicating that both groups are comparable in terms of growth rates and training experience**.**

Table 2. Significance of differences Mann-Whitney test among the research groups (Experimental and control) in growth rates and the training experience (N1 = n2 = 5)

Variables	Units	Groups	Nr	Mean	St.Dv	Average Rank	Total ranks	Z Value
Age	Year	Control	5	12.20	0.45	5	25	0.655
		Experimental	5	12.40	0.55	6	30	
height	Cm	Control	5	153.20	4.66	5,900	30	0.424
		Experimental	5	151.60	6.80	5.100	26	
the weight	Kg	Control	5	41.80	2.86	5,200	26	0.317
		Experimental	5	42.60	3.97	5,800	29	
Training experience	Year	Control	5	1.80	0.84	5.100	26	0.454
		Experimental	5	2.00	0.71	5,900	30	

Forms used for data registration

1. Anthropometric measurements registration form.
2. Digital level registration form.
3. Biomechanical variables registration form.

Pilot Studies

The Pilot study was conducted on a sample from the same research community, but outside the main sample, and their number was (5) swimmers, and tests were conducted on them (physical tests, skills, personal record test, biomechanical variables).

Validity of the tests

It is clear from Table (3) The presence of significant differences in physical test scores averages for both groups featured and unfeatured, where the value ranged from calculated z (2.611:2.785) and it is greater Of value Z" The table indicates that The validity of these tests in what they were designed for.

Stability of physical tests

It is clear from Table (4) There is a statistically significant correlation between the test and re-test of the studied physical tests as the correlation coefficient ranged between (0.87: 0.99) which indicates the stability of this Tests.

Table 3. Significance of differences Mann-Whitney test between Featured and non-featured group in Physical tests (n1 = n2 = 5)

Test	Groups	Nr	mean	St.Dv.	Average Rank	Total ranks	Z value
Right hand grip strength (kg)	non-distinguished	5	41.60	0.89	3	15	2.660*
	Distinguished	5	49.20	0.84	8	40	
Left hand grip strength (kg)	non-distinguished	5	38.60	0.89	3	15	2.730*
	Distinguished	5	45.20	0.45	8	40	
back muscle strength (kg)	non-distinguished	5	12.80	1.10	3	15	2.677*
	Distinguished	5	17.00	0.71	8	40	
Medicine ball throw (3) kg (meter)	non-distinguished	5	3.60	0.89	3	15	2.685*
	Distinguished	5	6.40	0.55	8	40	
Fitness (Second)	non-distinguished	5	7.66	0.18	8	40	2.611*
	Distinguished	5	6.01	0.34	3	15	
shoulder flexibility (centimeter)	non-distinguished	5	20.60	0.55	3	15	2.668*
	Distinguished	5	27.20	0.84	8	40	
trunk flexibility (centimeter)	non-distinguished	5	7.40	0.55	3	15	2.685*
	Distinguished	5	11.00	0.71	8	40	
Numbered circles (Second)	non-distinguished	5	6.99	0.41	8	40	2.611*
	Distinguished	5	5.40	0.33	3	15	
Pull up on the bar (repetition)	non-distinguished	5	8.60	0.55	3	15	2.694*
	Distinguished	5	13.80	1.64	8	40	
Finger and forearm weightlifting test (kg)	non-distinguished	5	1.80	0.45	3	15	2.785*
	Distinguished	5	4.80	0.45	8	40	

* Tabular value of "Z" at (0.05) = 1.96

Table 4. Correlation coefficient between test and re-test for tests physical (n= 5)

Variables	Unit	Test		Re-Test		The difference	"r"
		Mean	St.Dv	mean	St.Dv		
Right hand grip strength	kg	41.60	0.89	41.40	0.55	0.20	0.92*
Left hand grip strength	kg	38.60	0.89	38.80	1.10	0.20	0.92*
back muscle strength	kg	12.80	1.10	12.60	1.52	0.20	0.99*
Muscular power	m	3.60	0.89	3.80	0.84	0.20	0.87*
Fitness	Sec	7.66	0.18	7.68	0.21	0.02	0.98*
shoulder flexibility	Cm	20.60	0.55	20.40	0.89	0.20	0.92*
trunk flexibility	Cm	7.40	0.55	7.20	0.84	0.20	0.87*
Compatibility	Sec	6.99	0.41	6.92	0.46	0.07	0.94*
Pull up on the bar	Rep	8.60	0.55	8.80	0.84	0.20	0.87*
Finger and forearm weightlifting test	kg	1.80	0.45	1.40	0.89	0.40	0.88*

Homogeneity of the research groups in all variables

It is clear from the results of table (4) the median of the research sample individuals (experimental - control - Pilot study) in Physical tests, biomechanical variables, skill performance and digital level where the value of the torsion coefficient was limited to (±3) fit ranged between (-0.70:2.22), which indicates that the research samples fall under the normal distribution curve, and that the sample individuals were distributed in a normal and homogeneous manner.Those variables.

Table 5. Normality of the distribution of the research population in physical tests and biomechanical variables Skill performance and personal record (n=15)

Variables		Average	Median	St.Dv	Skweness
Physical	Right hand grip strength (kg)	41.80	42.00	0.86	-0.70
	Left hand grip strength (kg)	38.80	38.00	1.08	2.22
	back muscle strength (kg)	12.87	13.00	0.83	-0.48
	Muscular power (m)	3.80	4.00	0.86	-0.70
	Fitness (Sec)	7.46	7.49	0.44	-0.23
	shoulder flexibility (Cm)	20.80	21.00	0.86	-0.70
	trunk flexibility (Cm)	7.60	7.00	0.91	1.98
	Compatibility (Sec)	6.79	6.76	0.49	0.15
	Pull up on the bar (Rep)	8.80	9.00	0.86	-0.70
	Finger and forearm weightlifting test (kg)	1.87	2.00	0.52	-0.77
Biomechanical	Number of strokes (arm cycle)	41.20	41.00	1.32	0.45
	stroke length (50)m/Nr of hits	1.21	1.22	0.04	-0.37
	Strike time Swimmer's time/Nr of strokes	0.99	0.98	0.04	0.53
	Speed rate (50)m/ swimmer's time	1.23	1.22	0.02	1.32
	Beat rate Nr of strokes / swimmer's time	1.01	1.02	0.04	-0.42
Skill performance level		10.60	10.00	0.83	2.17
Personal level		40.80	41.12	0.75	-1.30

Equivalence of the two groups (expermintal and control)

Table (5.) reviled that there is no significant differences in the averages of physical test scores, biomechanical variables, skill performance and digital level for both the experimental and control groups, the value of "Z" were (0.106 to 0.522) and it is less than tabular Z value , which indicates the equivalence of the two groups in those variables.

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Table 6. Significance of differences mann-Whitney testAmong the research groups (Experimental and control) in physical tests, biomechanical variables, skill performance and personal record (n1 = n2 = 5)

	Variables	Groups	Mean	St.Dv.	Average Rank	Total ranks	Z value
Physical characteristics	**Right hand grip strength (kg)**	Control	42.00	1.00	5,800	29	0.332
		Experimental	41.80	0.84	5,200	26	
	Left hand grip strength (kg)	Control	39.00	1.41	5,700	29	0.239
		Experimental	38.80	1.10	5,300	27	
	back muscle strength (kg)	Control	12.80	0.84	5.100	26	0.454
		Experimental	13.00	0.71	5,900	30	
	Medicine ball throw (3) kg (m)	Control	4.00	1.00	5,800	29	0.332
		Experimental	3.80	0.84	5,200	26	
	Fitness (Sec)	Control	7.26	0.65	5,200	26	0.315
		Experimental	7.46	0.34	5,800	29	
	shoulder flexibility (Cm)	Control	21.00	1.22	5,600	28	0.111
		Experimental	20.80	0.84	5,400	27	
	trunk flexibility (Cm)	Control	7.80	1.30	5,600	28	0.118
		Experimental	7.60	0.89	5,400	27	
	Numbered circles (Sec)	Control	6.59	0.67	5,400	27	0.106
		Experimental	6.79	0.33	5,600	28	
	Pull up on the bar (Rep)	Control	9.00	1.22	5,600	28	0.111
		Experimental	8.80	0.84	5,400	27	
	Finger and forearm weightlifting test (kg)	Control	2.00	0.71	5,900	30	0.516
		Experimental	1.80	0.45	5.100	26	
Biomechanical	**Number of strokes (arm cycle)**	Control	42.00	1.00	5,800	29	0.332
		Experimental	41.80	0.84	5,200	26	
	Stroke length (50)m/Nr of hits	Control	39.00	1.41	5,700	29	0.239
		Experimental	38.80	1.10	5,300	27	
	Strike time (Swimmer's time /Nr of strokes)	Control	12.80	0.84	5.100	26	0.454
		Experimental	13.00	0.71	5,900	30	
	Speed rate (50)m/ swimmer's time	Control	4.00	1.00	5,800	29	0.332
		Experimental	3.80	0.84	5,200	26	
	Beat rate (Nr of strokes/swimmer's time)	Control	7.26	0.65	5,200	26	0.315
		Experimental	7.46	0.34	5,800	29	
Personal record (Sec)		Control	42.00	1.00	5,800	29	0.332
		Experimental	41.80	0.84	5,200	26	
Skill performance level (Deg)		Control	10.80	1.10	5,700	29	0.239
		Experimental	10.60	0.89	5,300	27	

Main Study

1. Land – based exercises.

The researchers designed a land – based training programe using specific exercises on land – based equipment that simulate actual performance , theraby enhancing the technical performance of arm movements in breast strock

2. Motion analysis

The researchers analyzed the biomechanical variables of the sample -such as strock length, strock frequency, and speed rate – whose improvement leads to an increase in the swimmer,s digital performance level.

Table 7. Performance time line movements arms with exemplary performance of breaststroke

Standard deviation	*Framework	Performance Phases	Average / Th
0.042	0:6	Musk stage	0.266
0.043	7:24	Pulling phase	0.643
0.115	25: 51	Push and slide phase	0.957
Average total time		1.867	

It is clear from the table (7) The overall percentage of conformity of the kinematic paths of the performance sample on the proposed device reached 92.70% with the range of motion in research and references for performing arm movements, which proves that the proposed device follows the correct kinematic paths for performance at a high rate. The percentage of similarity between the movement paths of the performance sample on the device and the typical range of motion.

Table 8. Correspondence ratios between the kinematic trajectories of the performance sample on the device with the free-range with exemplary performance

Tracking point	Matching ratio	
	X axis	Y axis
Fingertips	98.03%	82.352%
Wrist	96.07%	94.11%
Elbow	90.19%	90.19%
Shoulder	100%	98.03%
Thigh	78.43%	98.03%
Total percentage	92.54%	

Training Program

The researchers prepared exercises similar to the motor path for the skill performance of arm movements in the context of the unit through the name of the stage, distributing the exercise group over the skill performance stages, which are as follows (holding - pulling - pushing - total arm performance), and the following was settled upon:

Table 9. training program outlines

Nr	Variables	Content
1	Application period	End of general preparation period and beginning of special preparation period
2	Number of weeks	10 weeks
3	General preparation period	3 weeks
4	Special preparation period	7 weeks
5	training program sessions	30 units
6	Number of units per month	12 units
7	Number of units per week	3 units
8	Training unit time	90 minutes
9	Warm up	10 minutes
10	Main part	70 minutes
11	The final part (calming down)	10 minutes

Table 10. Time distribution of the training program sessions

Nr	Phases	Duration	Objectives
1	**Catch**	2 weeks	-Perform the grip point outside the shoulder level. -Fingers are joined and extended forward, palm facing down.
2	**Pull**	3 weeks	The arms move sideways, downwards and in the direction of the longitudinal axis of the body. - The arms reach below shoulder level with a slight bend in the elbow.
3	**Push**	3 weeks	- Start from the point where the hands reach below shoulder level. The hands move towards the chest with the palms facing the chest in a quick, backwards, pushing motion
4	**Overall arm performance**	2 weeks	-Coordination between the arms, head and trunk is achieved

The program was applied using the designed device on the experimental group, which included (30) training sessions, (10) weeks, at the end of the general preparation period, which lasted (2 weeks) and the beginning of the special preparation period, which lasted (8) weeks, at a rate of (3) sessions per week. The training days were (Sunday, Tuesday and Thursday) of each week in the period from Tuesday (6/4/2024) until Thursday (8/6/2024). The researcher prepared special warm-up exercises for (10 minutes), which included exercises**,** She prepared special exercises for cooling down, and their duration was (10 minutes)

Post measurements

After completing the training program, the researcher conducted post-measurements on the experimental and control groups on Tuesday 8/13/2024.

Tools and devices

1. Capture devices, tools and biomechanical analysis software:

- Camera SoCoo/ C30 S High Speed Camera - (set at 60 frames/second, 1920*1080 pixels).
- Tripod with water level.
  - Laptop HP Pavilion G6.
  - Motion analysis programTracker analysis 6.0.
  - 1m x 1m 4-point calibration cube
  - Statistical analysis programs (programv. 20 SPSS, Microsoft Excel 2016)

2. Training devices and tools
  - Medical scale, standards for measuring weight to the nearest kilogram.
  - Measuring tape.
  - Rustmer for measuring total length to the nearest cm.
  - Sit and Reach Box.
  - Hand Grip dynamometer.
  - Dynamometer.

Statistical Analysis

The researchers used a program "spss” they used the following treatments because they are appropriate to the nature of the research: - Arithmetic mean - Median - Standard deviation.

Results and Discussion

Based on the research objectives and hypotheses, the researchers presented and discussed their findings as follows:

-There are statistically significant differences between the pre- and post-measurements of the total figempiricism And the officer At level Biomechanical variables and digital level For breaststroke and dimensional measurement For the experimental group For sample "under investigation""

there are significant differences between the mean pre-test and post-test scores in the physical tests, biomechanical variables, skill performance, and numerical level for the control group, favoring the post-test scores. The calculated "z" values ranged from (2.00 to 2.07), which are greater than the tabular "z" value, indicating the superiority of the post-test measurements over the pre-test in these variables for the control group participants. However, there were no statistically significant differences between the mean pre-test and post-test scores in strike time and strike frequency rate for the control group, with calculated "z" values of (0.13, 0.40), which are lower than the tabular "z" value.

Table 11. Significance of the differences between the average ranks of the pre- and post-measurement of the control group using the Wilcoxon test inBiomechanical variables and digital level (n=5)

Variables		Pre-measurement		Post measurement		Average Rank		Total ranks		"z" value	improvement rates
		Mean	St.Dv	Mean	St.Dv	Negative	Positive	Negative	Positive		
Biomechanical variables	Number of strokes (arm cycle)	41.00	1.41	38.60	0.55	3.00	0.00	15.0	0.00	2.03*	5.85%
	Stroke length (50)m/Nr of hits	1.22	0.04	1.30	0.02	0.00	3.00	0.00	15.00	2.03*	6.14%
	Strike time (Swimmer's time /Nr of strokes)	0.99	0.04	0.98	0.01	4.50	2.00	9.00	6.00	0.40	1.17%
	Speed rate Total distance (50) m / swimmer's time	1.23	0.04	1.32	0.02	0.00	3.00	0.00	15.00	2.02*	7.33%
	Beat rate Number of strokes / swimmer's time	1.01	0.04	1.02	0.01	2.33	4.00	7.00	8.00	0.13	1.03%
Personal record (Sec)		40.61	1.17	37.82	0.58	3.00	0.00	15.0	0.00	2.02*	6.87%

Researchers attribute this to the fact that attention to ground training In training Simulates the technical performance of swimming Leads to Improving biomechanical variables, which affects the personal record For breaststroke.

These results are consistent with the findings of a study. Both Hamoudi Ismail (2010), the study of Muhammad Al-Saeed (2016), the study of Kazem Ahmed (2023), the study of Adham Askar (2019), the study of Abdel Moneim (2014), the study of Morco and others (2012), and the study of Nady Hisham, others (2023)

Zakaria Anwar Abdul-Ghani and Masouma Khalil Al-Kazemi (2017) mention that several modern trends have emerged in sports training, and among these modern trends is qualitative training, this type of training that reaches the highest levels of specialization in developing skill and physical performance in terms of quantity, quality, and timing of performance, according to the momentary readiness of the muscles or muscle groups within the skill and physical performance to practice the type of specialized sports activity.

Both Muhammad Hussein Ali, Muhammad Al-Bahrawi, and Ahmed Eid Adly (2018) believe that the main goal of specific exercises is to improve the technical aspects of performance, and this is done through basic training by presenting the correct movement forms and trying to divide them, and increasing the resistance or burden on the player while performing specific training, in order to increase the sense of performance and motor and temporal paths, and it is also used to correct incorrect performance and motor paths that are not suitable for ideal performance.

Ahmed Mohamed Ibrahim (2021) adds that swimming coaches often encounter many errors related to technical performance methods, and through the processes of kinetic analysis of the swimmer's performance, it is possible to identify the strengths or weaknesses in the performance and then seek to identify the errors and ways to treat them, which enables us to understand the nature of the kinetic performance of swimmers during swimming different distances according to the specific performance methods and swimming skills.

The results of the second hypothesis which states: *"There are statistically significant differences between the pre- and post-measurements of the experimental and control groups in Digital level For breaststroke, and in favor of the dimensional measurement of the experimental group* "

It is evident that there are significant differences between the mean pre-test and post-test scores in the physical tests, biomechanical variables, skill performance, and numerical level for the experimental group, favoring the post-test scores. The calculated "z" values ranged from (2.02 to 2.07), which are greater than the tabular "z" value, indicating the superiority of the post-test measurements over the pre-test in these variables for the experimental group participants. However, there were no statistically significant differences between the mean pre-test and post-test scores in strike time and strike frequency rate for the control group, with the calculated "z" value of (0.40), which is lower than the tabular "z" value.

Researchers attribute this to the fact that the focus on biomechanical analysis in training programs has a positive effect on the digital level of swimming.

These results are consistent with the findings of the study of Adham Ahmed Gad El-Rab El-Sayed (2019), the study of Asmaa Sami Ahmed (2016) , the study of Baha Tawfiq Al-

Daqqa (2007), the study of Muhammad Ali Al-Qat (2004), and the study of Abu Al-Ala Abdel Fattah (1994).

Table 12. Significance of the differences between the average ranks of the pre- and post-measurement of the groupempiricismWilcoxon testBiomechanical variables and digital level (n = 5)

Variables		Pre-measurement		Post measurement		Average Rank		Total ranks		Z Value	improvement rates
		Mean	St.Dv	Mean	St.Dv	Negative	Positive	Negative	Positive		
Biomechanical variables	**Number of strokes (arm cycle)**	40.80	1.64	35.00	1.22	3.00	0.00	15.0	0.00	2.06*	14.22%
	Stroke length ((50)m/Nr of hits)	1.23	0.05	1.43	0.05	0.00	3.00	0.00	15.00	2.03*	16.54%
	Strike time (Swimmer's time /Nr of strokes)	1.01	0.05	1.04	0.03	2.00	4.50	6.00	9.00	0.40	3.25%
	Speed rate (Total distance (50) m/ swimmer's time)	1.22	0.01	1.38	0.01	0.00	3.00	0.00	15.00	2.02*	12.83%
	Beat rate (Nr of strokes / swimmer's time)	0.99	0.05	0.96	0.03	4.50	2.00	9.00	6.00	0.40	3.24%
Personal Record		41.02	0.46	36.35	0.21	3.00	0.00	15.0	0.00	2.02*	11.38%

Samira Arabi and Tamer Jarar (2013) mention that the kinetic analysis of the human body is an important factor influencing the teaching and training of motor skills, as it adds a healthy background to the trainer that helps him to present the motor skill appropriately and to know the points on which attention should be focused in the training process.

Imad Abdel Haq (1999) adds that the analysis of skill performance is the basis for teaching sports skills.

Adham Ahmed Gad El-Rab El-Sayed (2019) believes that the kinetic analysis of swimming shows the correct kinetic structure of the skill to reach breaking the records of local swimmers to reach the world level, as linking mechanical and physical factors produces for us the most important factors that the coach must focus on while training swimmers to raise their digital level.

Researchers attribute this to the fact that Using training programs Based on OR according to biomechanical analysis It leads to the development of biomechanical variables and thus improves the personal record of swimmers.

This result confirms the validity of the second hypothesis, which states: There are statistically significant differences between the pre- and post-measurements of the experimental and control groups in personal record for breaststroke, in favor of the dimensional measurement of the experimental group.

Presentation of the results related to the third hypothesis of the research, which states: ‘’*There are statistically significant differences between the two post-measurements of the experimental and control groups in the biomechanical variables and the digital level, in favor of the post-measurement of the experimental group*”

Table 13. Significance of differences Mann-Whitney test between Dimensional measurements of the two groups (Experimental and control) in biomechanical variables and digital level (n1 = n2 = 5)

Variables		Groups	Nr	Mean	St.Dv	Average Rank	Total ranks	Z value	improvement rates
Biomechanical variables	Number of strokes (arm cycle)	Control	5	38.60	0.55	8	40	2.668*	9.33%
		Experimental	5	35.00	1.22	3	15		
	Stroke length ((50)m/Nr of hits)	Control	5	1.30	0.02	3	15	2.668*	10.38%
		Experimental	5	1.43	0.05	8	40		
	Strike time (Swimmer's time/Nr of strokes)	Control	5	0.98	0.01	3	15	2.611*	6.10%
		Experimental	5	1.04	0.03	8	40		
	Speed rate (Total distance (50) m/ swimmer's time)	Control	5	1.32	0.02	3	15	2.611*	4.02%
		Experimental	5	1.38	0.01	8	40		
	Beat rate (Nr of strokes / swimmer's time)	Control	5	1.02	0.01	8	40	2.611*	5.68%
		Experimental	5	0.96	0.03	3	15		
Personal record		Control	5	37.82	0.58	8	40	2.611*	3.88%
		Experimental	5	36.35	0.21	3	15		

Differences between average measurements Dimensionality -Dimensionality of the group fig empiricism And the officer in Biomechanical variables and digital level

e-mail. jtapess@phed.usc.edu.eg

It is clear from Table No. (13) There is a significant difference between the averages of the measurement scores.at Dimensionality between the experimental and control groups In physical tests, biomechanical variables, skill performance and digital level In favor of the average post-measurement scores In favor of the average post-measurement scoresFor the experimental group, where the value ranged " calculated (1.972:2.668) which is greater than the value of "z" table indicating the superiority of measurement Post-test for the experimental group On the measure Post-test for control group In physical tests, biomechanical variables, skill performance and personal record.

Researchers attribute this to the interest in biomechanical analysis .And development of biomechanical variables In training programs, it positively affects the digital level of swimming.

These results are consistent with the findings of the study of both Adham Ahmed Gad El Rabb (2019) (5) and the study of Mustafa Samir Salama(2023),And the study of Amr Mohamed Ibrahim (1994) .

Jamal Alaa El-Din (1980) states that biomechanical analysis constitutes the initial assumptions and premises related to establishing the scientific basis for rationalizing the essence of the process of training and teaching sports skills.

Antonio G.s each stage of competitive swimming competitions has a goal Its own, Through this goal, the general goal in competitive swimming can be achieved, which is to complete the race distance in the shortest possible time.

Susan Abdel Moneim and others (1997) add that biomechanical information constitutes the best means to achieve the goal of movement, as it helps us discover errors in motor performance, and is also considered a means to find ways to improve performance.

Conclusion

Based on the research objective and hypothesis, and according to the methodology followed and the results reached, processed, presented and discussed, and within the limits of the research sample, the researcher reached the following conclusions:

The land- based training showed a positive effect in improving the biomechanical variables of breaststroke.

By comparing the improvement rates between the experimental and control groups in the dimensional measurements, we find that the improvement rates achieved by the experimental group were much greater than the improvement rates achieved by the control group in the biomechanical variables and the personal record, which indicates that the training program using land - based had an effective impact in raising the personal record as well as the biomechanical variables of breaststroke in the research sample.

Recommendations

According to the results of the statistical treatments and the conclusions reached, the following recommendations could be presented:

1. The necessity of benefiting from the proposed training program using land – based training to improve the biomechanical variables and personal record of swimmers.
2. The necessity of benefiting from the proposed training program using the land based training to improve the biomechanical variables (stroke length - stroke frequency rate) for swimmers.
3. The necessity of using land – based exercises in swimmer,s training programs.

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