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The Effect of a training program to develop muscular endurance and power of upper body in advanced karate players

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Abstract

Study purpose. The importance of motor abilities lies in enabling player to perform frequent and rapid combat movements efficiently and effectively without a decrease in performance or exposure to rapid stress, which is necessary especially during fights that require constant effort and high rhythm. Proceeding from this importance, the research aimed to prepare a training program to develop muscular endurance and arm strength among advanced karate players, and to identify impact of this program in developing those abilities.

Materials and methods. The researchers used the experimental approach to design the two equivalent groups (experimental and control), and the sample number was (18) advanced karate players who were deliberately selected, and then randomly divided into two groups of (9) players for each group. The pilot group underwent the training program developed, while the control group continued its traditional training. The implementation of the training program lasted for two months, from 7/1/2025 to 6/3/2025. Before and after tests were conducted on, the two groups to measure the level of endurance of muscular strength and characteristic strength with speed, and the results were analyzed using appropriate statistical methods.

Results. The results showed a clear superiority of the experimental group over the control group, which indicates the effectiveness of the training program in developing the targeted capabilities. Adopting this program within the training plans prepared for advanced karate players because of its clear positive impact on improving physical performance. indicated that the development of strength endurance is achieved when working at 60-70% of the maximum strength with high repetitions and short rest, which is the method used in the current program.

Conclusion. The training program showed clear effectiveness in improving muscular endurance and upper body speed characteristic strength in advanced karate players, compared to the control group. This improvement was attributed to the integration of resistance and biometric exercises with combat movements, resulting in effective neuromuscular adaptation and improved skill performance.

Keywords: Isotonic Eccentric, Muscular Endurance, Running Performance, Middle Distance Running.
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Introduction

The field of sports training has witnessed a remarkable development during the last decades, as the training process has become based on accurate scientific foundations, including physical, physiological, psychological, and skill aspects, in order to reach optimal performance (Wilk et al., 2024). This development has emerged clearly in combat sports, including karate, which is a comprehensive martial art, combining strength, speed, flexibility, and endurance, and requires a balanced preparation that includes all aspects of physical and psychological performance (Borges et al., 2022).

Since karate has been accepted into official international competitions, the need to develop training programs commensurate with the requirements of the game at its advanced levels has increased. Competition in this sport is no longer limited to skill aspects only, but has become integrally dependent on high physical abilities, especially those related to strength and endurance (Núñez-Barriopedro et al., 2021).

Among the important physical abilities in Karate, the endurance of muscular strength and the characteristic strength of speed stand out as crucial elements, particularly in the muscles of the arms, which are constantly used in basic movements such as punches (tsuki) and bumps (auki) (Ghazi et al., 2024). The importance of these abilities lies in enabling the player to perform repeated and rapid combat movements with the same strength and efficiency for long periods, whether in training or competition, without a decrease in performance or an early feeling of fatigue (Christiani et al., 2021).

Poor muscular endurance reduces the player's ability to execute combat skills efficiently, which negatively affects his competitive level, especially in fights that require constant effort and escalating rhythm (Cao et al., 2021). Developing these abilities is a prerequisite for achieving perfect performance in karate, especially for players at advanced levels. In this context, recent studies have confirmed that the use of specialized training methods such as variable resistance, elastic cord exercises, and extreme repetitions under time intensity, effectively contribute to the development of strength tolerance in players (P. Piepiora & Witkowski, 2023).

The importance of the current research stems from the fact that it addresses a specialized aspect that many trainers and researchers have not paid enough attention to, which is the impact of special exercises on the muscular strength of the arms of advanced karate players. The research aims to fill a scientific and applied gap in the field of specialized physical preparation, by designing a training program based on scientific foundations, and measuring its impact using accurate tools such as dynamic endurance tests and electro muscular registration (EMG).

The importance of this work also lies in providing a training model that is applicable and developed in training circles, which enhances the quality of performance and contributes to the preparation of players with high physical ability in line with the requirements of karate in its modern era.

Karate is a combat sport that requires a careful integration of elements of fitness and special motor skills, especially at advanced levels characterized by intense competition and multiple rounds (P. A. Piepiora et al., 2024). Muscular strength in the arms stands out among the physical abilities that affect competitive

performance, as it plays a role in maintaining the effectiveness of motor performance during repeated punches, bumps, and defensive and offensive attacks throughout the fight (Guo, 2022).

However, the reality on the ground indicates that there is a weakness in this ability among many players, which is reflected in the decline in performance during critical moments, and is often linked to the non-inclusion of specialized exercises in traditional training programs, which often focus on general strength or technical skills without direct targeting of strength tolerance (Wirth et al., 2022) Hence, the problem of the current research is determined by the need to test the effectiveness of a specialized training program to develop the muscular strength of the arms, as a scientific input to improve the competitive performance of advanced karate players (Chaabene et al., 2012).

Research Aims to preparing a training program in the development of muscular strength tolerance and strength distinguished by the speed of the arms among advanced karate players. Identify the impact of the training program on the muscular strength of the arms of advanced karate players. Identify the impact of the training program on the rapid strength of the arms of advanced karate players.

Researchers assume There are statistically significant differences between the pre and post-tests of the experimental and control groups in favor of the post-test. There are statistically significant differences between the pre, post-tests of the experimental, and control groups and in favor of the experimental group.

Materials and methods

Study participants

The researchers used the experimental approach, as it is appropriate to the nature of the research issue. The research sample was deliberately selected from among the advanced karate players of Al-Basra club for martial art, and their number was (18) players, The sample members were randomly assigned to two equal groups, where the experimental group underwent a training program specifically designed to develop the muscular strength of the arms, while the control group continued its usual training according to the traditional methods followed by the trainer. For the purpose of ensuring the homogeneity of the sample members in terms of physical characteristics (height, weight, age), the torsion coefficient was calculated to determine the homogeneity of the statistical distribution of those variables, as shown in Table 1. In addition, the statistical equivalence test was conducted between the two groups in the main variables that may affect the results of the research, in order to ensure the stability of the initial conditions, and that no initial differences affect the expected results later, and as shown in Table 2.

Table 1. Shows homogeneity each group

Variables	Measurement Unit	Mean	Standard deviation	Median	Modulus of torsion
Height	Cm.	170.1	1.43	170	0.45
Weight	Kg.	70	1.78	69	0.91
Age	Year	24	1.41	24	0.71

Table 2. Shows equivalence between control and experimental groups sample.

Source of variance	Experimental group		Control group		Calculated t value	Sig.
	M.	St.d	M.	St.d		
Pulling the handle to the point of exhaustion	8	1.13	8	1.16	1.23	Random
Power characteristic of the speed of the arms	10.77	1.10	10.66	1.11	1.19	Random

Study organization

The researcher used experimental method with an equivalent control and experimental group design. To achieve the research objectives and address the problem.

Defining Research Variables

After reviewing sources, references, and previous research, the researcher found the variables under study to be important in addressing the research problem, including pulling the handle to the point of exhaustion, and power characteristic of the speed of the arms.

Tests Used

Researchers have determined the pull-up, flexion and extension of the arms test based on scientific sources and because it is one of the best tests for measuring force tolerance and speed-characterized force of the upper extremity muscles. First: Measuring the muscular strength tolerance of the arms (Zemková, 2022) Test Name: Pull Up from Attachment. Purpose of the test: Measure the strength elongation of the muscles of the arms, back, and shoulders. Tools: The handle used in the conjunctiva device. Testing procedures: The attachment must be done with the body relaxed and the arms fully supported, with the hands placed on the iron crossbar towards up, the athlete pulls up until the chin exceeds the upper crossbar , then returns to the attachment position with the arms extended and repeats the process until the disability. Recording: The player records the number of repetitions of pulling and stretching to the point of fatigue.

Second: Measuring the strength distinguished by the speed of the arms (Syahruddin et al., 2022). Test Name: Forward Leaning (Bending and Extending Arms) Continuously for (10) Seconds. Purpose of the test: Measure the strength characteristic of the speed of the muscles of the arms. Tools: playground, electronic stopwatch, whistle to give start and end signal.

Test Specifications: From the forward leaning position, bend and extend the arms as much as possible in (10) seconds.

Conditions. The player takes a forward resting position on the ground so that the object is upright at the start signal and the laboratory extends the arms completely, continuing to repeat the performance as many times as possible without stopping for ten seconds correctly. Take into account the chest's contact with the ground while performing the bending of the arms and then extend them completely. Recording: The laboratory records the number of repetitions of bending and stretching performance within (10) seconds.

Exploratory Experiment

The researchers conducted a mini reconnaissance experiment that included all the components and procedures to be applied in the research, in terms of setting the place, organizing the tools, distributing the tasks, and the mechanism of conducting the tests. This

experiment was carried out on a sample of (4) players from outside the original research sample, in order to ensure neutrality and avoid influencing the results of the core sample. The experiment was conducted on Sunday 5/1/2025.

Pre-tests

The researchers carried out pre-tests on the research sample consisting of the two groups: experimental and control, with the aim of measuring the variables for the level of muscular strength tolerance of the arms, which is the main indicator of this research. These tests were carried out in standardized conditions in terms of time and space, and under the direct supervision of the researchers and the auxiliary team to ensure the accuracy of the results and the stability of the measurement. The pre-test procedures were carried out on Monday (6/1/2025), during which the researchers took into account the application of all instructions for carrying out the tests in accordance with the predetermined scientific conditions and standards, in order to ensure fairness of measurement between the members of the two groups. Pre- test results also showed that the sample level is very similar in performance, which enhances the validity of the sample and gives reliability to the research results.

Training Program

A rehabilitation training program was implemented for (8) weeks, aimed at developing the muscular strength tolerance and the speed characteristic strength of the upper body in line with the motor performance requirements of advanced karate players, especially in punches, bumps and explosive movements. The program has designed according to the principles of modern training, grading from low to medium load, incorporating rapid resistance exercises, biometric, and circular training, with an emphasis on quality and speed of performance. It took 60 minutes for each module, and included a dynamic warm-up (10 minutes), a main part (40 minutes) divided into: exercises for enduring strength using light weights and high repetitions, and exercises for rapid strength with low repetitions and high speed, then concluded with calming and muscle elongation (10 minutes). The phases of the program were divided into three periods: the general adaptation phase (week 1–2) with mild intensity, then qualitative stimulation (week 3–5) with a gradual increase in intensity, finally with the stage of specialization and explosion (week 6–8) with a focus on rapid performance and limited comfort to stimulate the anaerobic system.

Post-tests

Post-tests were conducted on (6/3/2025) for both groups under the same conditions of pre-tests in terms of time, place, tools and procedures, to ensure the accuracy of the comparison. All tests were carried out in a stable physical condition for the participants and under the supervision of the researchers to ensure objectivity.

Statistical analysis

SPSS and Excel are used to analyze the data, adopting a significance level ($\alpha \leq 0.05$) to determine the significance of the differences between the measurements.

Results

Presentation, analysis, and discussion of tests of muscular strength endurance and speed characteristic strength of the pre and post arms of the experimental and control groups.

Table 3. Shows value of mean and standard deviations and the value of (t) calculated and tabular for variables bearing the muscular force and the characteristic force at the pre and post velocity of the experimental and control groups

Variables	Group	Pre-test		Post-test		PRS	Calculated T	Tabular (T) Value	Sig. level
		M.	St.d	M.	St.d				
Pulling the handle to the point of exhaustion	Experimental group	8	0.86	11	1.11	3	6.36	2.30	Sig.
	Control group	8	0.86	9.88	0.92	1.88	4.85		Sig.
Bending and extending the arms from the prone position test 10 seconds	Experimental group	10.77	0.83	13.88	0.78	3.11	28		Sig.
	Control group	10.66	1	12.55	1.13	1.89	17		Sig.

value of the tabular T at a degree of freedom of 8 is equal to 2.30

The table 3 results of pulling until fatigue test showed that there were statistically significant differences in favor of the post-test in both the experimental and control group. Where the average frequencies of the experimental group were (11) repetitions compared to (8) in the pre-metering, with a calculated value of (T) of (6.36). Which indicates the impact of the training program in improving muscular strength tolerance. This improvement is attributed to the adoption of strength tolerance exercises within medium intensity and high repetitions, which is consistent with what (Muwaffaq Asaad Al-Hiti ,2011) indicated that the development of strength endurance is achieved when working at 60-70% of the maximum strength with high repetitions and short rest, which is the method used in the current program.

The integration of competitive and technical exercises (such as combat scenarios, kata and punch exercises) with physical exercises also contributed to the creation of a training environment similar to reality, which increased the motivation of players and the accuracy of their motor response. Which was confirmed by the study of Nawzad Hussein Darwish et al, 2015), where they explained that competitive exercises raise the level of motivation and improve the specialized physical ability associated with combat situations. The physiological explanation for this improvement is consistent with (Khamraeva et al., 2024) where we showed that the use of resistance and weights leads to an adaptation in the nervous and muscular system, which raises the efficiency of the motor response, especially in sports that rely on rapid and explosive performance such as karate. In addition to the above, (Khazaal, 2025) pointed out that the nature of force tolerance varies according to the type of sports activity, stressing that combat sports such as karate need training programs that combine intensity, muscle explosion and continuity, which was applied in this program through push, pull, combat rope exercises, and quick strikes under time pressure.

Thus, it is clear that the remarkable improvement in the performance of the experimental group was not the result of chance or random training but rather came because of a training program designed according to precise scientific principles. Which relied on the systematic integration of physical and skill abilities, with the selection of exercises that are commensurate with the nature of combat performance in karate (Przybylski et al., 2021). This integration of design contributed to effective physical and functional adaptation, and reflected positively on strength and endurance indicators. Finally, the scientific literature confirms that the power characteristic of speed is achieved only by combining the two components of power and speed in complex exercises that simulate realistic situations. (Abdulgani Taha & Younus, 2021) This concept has been embodied in the current program by combining resistance exercises, quick starts, and strikes carried out at full speed under time pressure and competition, which led to a noticeable improvement in this ability, and made its development a natural result of this training overlap. Based on this analysis, it can be said that the training program was not only effective,

but also based on scientific and applied principles that correspond to the performance requirements in the sport of karate, which explains the remarkable progress in the target physical variables in the experimental group members. *Presentation, analysis and discussion of the post-tests of muscular strength endurance and speed-specific strength of the arms for the experimental and control groups.*

Table 4. shows values of means, standard deviations, and calculated and tabulated value of (t) for variables of muscle strength endurance and strength characterized by post-post speed for experimental and control groups.

Variables	**Experimental group**		**Control group**		**Calculated T**	**Tabular (T) Value**	**Sig. level**
	M.	**St.d**	**M.**	**St.d**			
Pulling the handle to the point of exhaustion	11	1.11	9.88	0.92	2.33		Sig.
Bending and extending the arms from the prone position test 10 seconds	13.88	0.78	12.55	1.13	2.91	2.12	Sig.

value of the tabular T at a degree of freedom of 16 is equal to 2.119905

The table 4 in order to verify the significance of the differences between the pre and post measurements of the research variables, At a significance level of (0.05) and a degree of freedom of (16), the researchers compared the calculated value of the (T) test with the tabular value. The results indicated that there were statistically significant differences when the calculated value exceeded its tabular counterpart, indicating the positive impact of the applied training program. When comparing the results of the post-test between the experimental group and the control group, it was found that there were clear differences in favor of the experimental group, reflecting the effectiveness of the specialized training program in improving both muscular strength tolerance and strength characteristic of speed. Although there was improvement in physical indicators in both groups, the extent of improvement was deeper and more significant in the experimental group.

This variation is attributed to the quality and composition of the training program, as the program applied to the experimental group was characterized by its integration and comprehensiveness, combining general physical exercises (such as endurance and strength training) with special exercises associated with karate, including skill exercises and competitive scenarios. This integration has contributed to the creation of a simulated training environment, resulting in deeper functional and physical adaptations. On the other hand, the exercises of the control group were limited to general and routine training programs that do not contain targeted specialized components, which made the rate of improvement limited despite the existence of statistically significant differences in some variables.

Discussion

This approach is consistent with what (Bompa & Buzzichelli ,2019) pointed out in their book Periodization: Theory and Methodology of Training. They explained that the effectiveness of training programs depends not only on the size of the training load, but also on the extent to which the content of the program is related to the actual performance requirements of the target sport (Borges et al., 2022). They also emphasized that specialized training leads to deeper and more sustainable adaptations compared to general training (Kabacinski et al., 2022). Accordingly, it can be said that the differences in the results of the post measurements between the two groups clearly reflect the impact of the quality of training and not only its quantity

(Umamaheswari, 2024) and the player who is trained in an environment similar to the requirements of the competition and develops specialized performance, shows higher physical and skill responses, as happened to the members of the experimental group (Wulandari et al., 2021).

This variation is attributed to the quality and composition of the training program, as the program applied to the experimental group was characterized by its integration and comprehensiveness, combining general physical exercises (such as endurance and strength training) with special exercises associated with karate, including skill exercises and competitive scenarios.(Bhattacharya et al., 2022) This integration has contributed to the creation of a simulated training environment, resulting in deeper functional and physical adaptations (Lygouras & Tsinakos, 2024). On the other hand, the exercises of the control group were limited to general and routine training programs that do not contain targeted specialized components, which made the rate of improvement limited despite the existence of statistically significant differences in some variables (Gaweł et al., 2025).

Conclusions

The training program showed clear effectiveness in improving muscular endurance and upper body speed characteristic strength in advanced karate players, compared to the control group. This improvement was attributed to the integration of resistance and biometric exercises with combat movements, resulting in effective neuromuscular adaptation and improved skill performance. The results of the study confirm the importance of integration between physical abilities and skill in training, and the role of functional adaptation in the development of combat performance in karate players.

Researchers recommend training program be used as a reference in the preparation of training plans for karate players, given its effectiveness in developing physical abilities associated with combat performance. Emphasize the integration of specialized exercises (such as quick punches and upper part exercises) into training programs to ensure complementarity between strength and skill. Encouraging future studies on the impact of similar programs on other physical elements (such as speed, agility, balance), and training supervisors to design programs based on scientific evidence.

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Conflict of interest

There is none

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