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Effects of Functional Training on Strength, Power, Agility, Anaerobic Capacity, Punch Speed, and Punch Power for Amateur Boxer

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Abstract

Background and Aim: Developing athletes for excellence is necessary to manage training systematically. Functional training in athletes is a training that affects strength, power, and balance, this allows athletes to perform and control their skills to the fullest and it is a training method that is suitable for training to prepare athletes in the training stage to train well. Therefore, the researcher is interested in studying functional training with amateur boxing athletes. The objectives of this study were: 1) to investigate the effects of a functional training program on amateur boxers' strength, power, agility, anaerobic capacity, punch speed, and punch power; and 2) to compare between control and experimental group specific on strength power, agility, anaerobic capacity, punch speed and punch power for an amateur teen male boxer.

Materials and Methods: In this research, types of research are quasi experimental-designs that control-group interrupted time-series design. The sample for this study is 30 male boxers aged 15-18 from the Bengbu boxing team in Anhui Province. They are divided into an experimental group and a control group, with 15 participants in each group. They were examined for strength, power, agility, anaerobic capacity, punch speed, and punch power on the pretest, after week 4, and post-test, respectively. Then, the 8-week functional training program was administered to the experimental group three times per week. The control group adopts traditional strength training. Data analysis techniques included mean and standard deviation, independent t-test, and one-way ANOVA repeated measures. A Post hoc analysis using Bonferroni was conducted to establish significant differences within the groups ($p<.05$).

Results: The results show that both groups with pre-test, after week 4th and post-test such as Strength (kg): control group was 77.88±11.09, 79.24±11.01and 80.96±10.82 and the experimental group was 80.08±11.01, 82.14±10.73, and 84.65±10.68. Power (cm); control group was 57.13±3.62, 58.6±3.22 and 59.66±2.94 and experimental group was 57.26±5.67, 59.06±4.83, and 61.00±4.30. Agility (sec): control group was 13.68±0.73, 13.42±0.69 and 13.25±0.66, and experimental group was 13.67±0.93, 13.24±0.84 and12.64±0.61. Anaerobic capacity (watt): control group was 514.24±103.46, 525.39±105.32 and 536.56±105.51 and the experimental group was 496.03±112.15, 512.14±105.92 and 543.47±103.29. Punch speed (m/sec): control group was 4.01±0.35, 4.14±0.36 and 4.26±0.34, and experimental group was 3.91±0.51, 4.18±0.46 and 4.70±0.38. Punch power (watts): control group was 1097.60±146.71, 1106.08±146.72 and 1122.14±144.71, and the experimental group was 1098.25±167.89, 1123.41±167.22 and 1261.18±163.26, respectively. There was a significant difference between the group on agility, speed punch, and power punch (*$p<.05$), but strength, power, and anaerobic capacity were not a significant difference. However, there were significant differences within the experimental group on strength, power, agility, anaerobic capacity, speed punch, and power punch with pre-test, after week 4^{th,} and post-test, respectively (*$p<.05$).

Conclusion: (1) Functional training can develop the strength, explosive force, agility, anaerobic ability, punching speed, and punching strength of amateur boxers, and 2) functional training is more effective than traditional strength training in developing the explosive force, punching speed and punching strength of amateur boxers.

Keywords: Functional Training; Punch Speed; Punch Power; Amateur Boxer

Introduction

Developing Athletes for Excellence is necessary to manage training systematically. This includes considering various elements such as gender, age, age, physical and mental development at different ages, etc., which can be written as a long-term athlete development plan as follows: Step 1 - Basics, it is a step that focuses on fun, development of basic fitness and general motor skills. The training period is from the 1st year to the 3rd year, and from 6 to 13 years old. Step 2 - Learn to practice, it is a stage that focuses on learning how to practice and develop general skills. The training period is from the 3rd year to the 5th year, and from 10 to 15 years old. Step 3 - Training for Training, is a class that focuses on specific training for sports. The training period is from the 5th to the 7th year, and from the age of 13 to

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17 years old. Step 4 - Competitive training, is a step that focuses on correcting weaknesses and developing athletic abilities. The training period is from the 7th to the 9th year, and from the age of 15 to 19 years old. Step 5 - Training for victory, this step focuses on optimization and peak performance of athletes. The training period is from the 10th year, and the age over 18 years old (Mackenzie, B., 2006).

For the amateur boxing team in Bengbu, Anhui Province, there are athletes in the range of 13 to 18 years old, who are in the third stage of training to train, this stage is suitable for boys aged 12 to 16 and girls aged 11 to 15 years old. The main objectives should be to develop athletes' physical abilities (with emphasis on aerobic conditioning) and basic motor skills. The key point of this step is developing speed and sport-specific skills, developing basic aerobics after the onset of PHV (onset of Peak Height Velocity), learn training techniques to develop the correct muscles, including having proper nutritional status and maintaining water balance in the body (hydration), preparing the mind training near peak performance and training at peak performance. So, what kind of training methods will support and harmonize the training of athletes during this period that will help develop athletes to be excellent?

In terms of basic movement skills Develop speed and sport-specific skills. Most sports training is mostly specific training, but training that combines physical fitness with performance skills, such as muscle training, and power system training Various forms of athletic performance training were found in the study, for example, Turna, B., & Alp, M., (2020:169). Leading soccer players Hao, T., & Yuxi, L., (2020:11) stated that functional training is training from sub-divisions and integrating them into overall abilities in a gradual manner to develop important sports fundamentals for athletes to further their excellence. Elbadry, N.A. (2014:298-299) found that 8 weeks of functional training results in good balance, and core muscles are strong, which affects the throwing ability of a hammer thrower. This was consistent with Tai, H., & Tai, D., (2021:60) who found that wrestlers had better balance performance, and Hung, M.-H. et al. (2021:9) found that climbing athletes could balance also better.

Functional training is muscle training joints and perception, the response of athletes to work together smoothly, and can show effectively control sports performance skills by training the work of the hips, hips (Squat), bending forward, lunging, pushing, and pulling. Its purpose is to allow athletes to manage force. and self-weight in all planes of motion. Michael& Boyle. (2016:18-19).

Functional training in athletes is training that affects strength, power, and balance. This allows athletes to perform and control their skills to the fullest and it is a training method that is suitable for training to prepare athletes in the training stage to train well. For this study, the researchers were uncertain whether functional training would be as effective as training in hammer throwers or wrestling. and what should be the proper form of training? Therefore, the researcher is interested in studying functional training with amateur boxing athletes.

Objectives

1. To study the effects of the Functional Training Program on strength, power, agility, anaerobic capacity, punch speed, and punch power for amateur teen male boxers.

2. To compare between control and experimental group specific on strength power, agility, anaerobic capacity, punch speed, and punch power for amateur teen male boxers.

Literature Review

1. Functional Training

The concept of functional training was first put forward by scholar Gary Cook in 1997 Cook, G.(1997:14-19), that human body movement can be regarded as a dynamic chain, and the weak links can be found through the analysis of different human movements, to carry out targeted training and avoid excessive development of single muscle or single linkability. Functional training is a series of exercises involving balance and proprioception, supported by feet and without the help of instruments. Boyle, M., (2003). Therefore, we believe that functional training should be a multi-joint and multi-muscle movement training mode to promote the overall coordinated development of the body. These exercises are multi-plane exercises carried out under stable control and weight bearing. Therefore, we can understand that the focus of functional strength training needs to maintain and control the stability of the body, to better stimulate the body's response in this state. The founder of "IHP" functional training in the United States, Santana believes that functional fitness training is conducted in a way consistent with the function of the body and the specificity of target sports. Santana J. C.(2015). Steven Plisk believes that the sports involved in functional training are specific, which is the exercise for people to maintain activities of daily life and is related to mechanics, coordination, and energy metabolism. But Liang Mengxia believes that functional training is a training system that aims to improve the weak link

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of human movement and improve the functional status of various tissues and organ systems in the process of exercise by using a variety of methods and means in line with the laws of human growth and development. Functional training is not a specific and single training method, but a system of multiple training systems. Dong Delong and Wang Weixing (2010:105-109) believe that functional training can be divided into functional strength training, functional speed training, functional endurance training, etc. The basic principles of functional training: the principle of lightweight and multiple times, the principle of instability, and the principle of combining stability and instability. (Xia, X., 2022). The principle of functional strength training should follow the physiological function of the body, pay attention to the training of body instability, and highlight the importance of the core and deep parts of the body. Ma Jinning and Li Rong (2020) believe that functional strength training is a process in which the human body makes fine adjustments to joints, muscle groups, tissues, and other body parts through the neuromuscular system in an unstable state to complete multi-joint, multi-muscle groups, and multi-dimensional coordination. Focus on the training of deep muscle groups and small muscle groups and focus on the control and stability of competitive movements. Li, X. (2019) pointed out that functional strength training can improve the coordination, ability to change direction, and ability to change the movement of boxers in the study of the development of functional strength training on the sensitive quality of boxers. Therefore, functional strength training should be scientific and reasonable, consistent with training principles, and not fixed. It is a training method formulated for different sports based on the particularity of each sports item.

2. Factors in Muscle Strength Development

Muscle strength is the basic quality of human movement, which is related to the shape of the muscle, and more importantly, depends on the size of the cross-sectional area of the muscle. Zhang, H., (2003:43-46). For the same target, the larger the cross-sectional area of the muscle, the greater the muscle strength. (Kumar, S. 2004). Of course, this also has a certain relationship with each person's body shape. Strength is an essential prerequisite for any exercise, and the generation of strength depends on muscle movement, which is the biological basis of strength development. Wang, X., (2012:55-57). Only through certain exercises can the growth of muscles be stimulated, thereby improving muscle strength. However, the growth of muscles is affected by many factors, such as certain resistance training, adequate rest, reasonable dietary intake, and so on. (Enoka, R. M. 1988:146-148).

Lamon, S, Morabito, A, et al. (2021:1). Studies have shown that sufficient sleep can ensure the synthesis rate of muscle protein, and insufficient sleep will affect the synthesis efficiency of muscle. This also shows that if you want faster and better muscle growth and synthesis, you need to ensure adequate sleep after training to create conditions for muscle synthesis. Moore, D. R., Phillips, S. M. et al. (2009:161-168). Pointed out that reasonable intake of protein is also an important factor for rapid muscle growth and synthesis, and sufficient protein intake can ensure the efficiency of muscle synthesis after resistance training. However, the protein intake after training needs to be controlled within a reasonable range, and it should not be too much. Excessive protein intake will also have an impact on the rate of muscle synthesis. As Witard pointed out in the study, after resistance training, 20 grams of protein intake can maximize the rate of muscle fiber protein synthesis. Witard, O. C., Tipton, K. D., et al. (2014:86-95)

3. Training Principles for Boxers

Ten Training Principles of Boxing: the principle of personal response, the principle of adaptability, the principle of overload, the principle of gradual progress, the principle of special training, the principle of changing training, the principle of combining preparatory activities with relaxation activities, the principle of long-term training, the principle of using and discarding, and the principle of moderation. It is also pointed out that different training principles need to be used for different athletes, which cannot be generalized to better consider each athlete. Modern boxing training is more suitable for complex training plans, and a single training plan can no longer meet the needs of modern boxing events. The performance of boxing technology lies in the strength and speed of athletes. Strength is the foundation and speed is the key. Without the guarantee of strength, there will be no fast speed. Matthews, M., & Comfort, P. (2008:12-15). The essence is to add some biomechanically similar light strength exercises after the traditional strength training. This method can well improve the muscle strength that boxers need to develop, and can stimulate deeper muscles, so it can be more efficient. Different training demand perspectives require different training principles. The principle of appropriate load plays a vital role in boxing training. The amount of load and load stimulation that the body can bear is limited. Therefore, in a systematic training program, the increase in exercise load must be based on the recovery of individual tolerance. based on force. In terms of the technical and tactical training principles of boxing, Lisheng, T., put forward nine training principles, including scientific training

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principles, physical training principles, stable training principles, fast training principles, accuracy training principles, counterattack training principles, defense and counterattack training principles, tactical training principles, and ruthless character training principles, from the objective law of boxing development. The competition rules and the individual differences of athletes have expounded the technical and tactical training of boxing. (Lisheng, T., 1999:4)

Conceptual Framework

The conceptual framework for the research is as follows:

-The independent variable is the functional training program

-The dependent variables were strength muscle, power muscle, agility, anaerobic capacity, punch speed, and punch power of amateur teen male boxers.

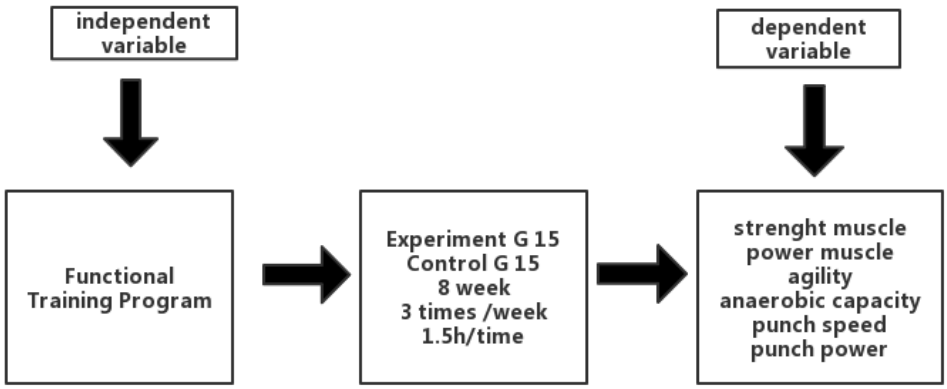

Figure 1 Conceptual Framework

Methodology

In this research, types of research are quasi experimental-designs that control-group interrupted time-series design. The sample for this study is 30 male boxers aged 15-18 from the Bengbu boxing team in Anhui Province. They are divided into an experimental group and a control group, with 15 participants in each group. The research tool is a functional training plan developed by researchers based on expert opinions, lasting for 8 weeks, 3 times a week, and lasting 1.5 hours each time, and passed the Item-Objective Congruence (IOC) index from 5 experts. And adaptability training was conducted on the subjects. All participants were tested for strength (1-RM bench press test), power (vertical jump test), agility (hexagon test), anaerobic capacity (running-based anaerobic sprint test), punch speed (right-hand straight punch single punch speed test), and punch power (Right-hand straight punch power test). before the experiment began, after 4 weeks, and after the experiment ended. Afterward, we prepared data for statistical analysis and summarize the analysis results. The data analysis used Statistical Product and Service Solutions software. Mean and stand Deviation is used to examine, T-test independent conducts to mean compared between groups, One ANOVA repeated measurement conducts to mean compared within the experimental group, and the significant difference level is 0.05.

Results

The effect of functional training on strength, power, agility, anaerobic capacity, punch speed, and punch power in amateur boxers.

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Table 1: The comparison within the experiment group on strength between the pre-test, after week 4th and the pos-test by ANOVA Repeated measurement

Source of variant	Type III SS	df	MS	F	p-Value
Week	156.937	2	78.469	279.674	.00*
Error	7.856	28	0.281		
total	164.793	30	78.75		

*P>0.05

Table 4 shows that less than one comparison had a significant difference at .05

Table 2: The comparison within the experiment group on power between the pre-test, after week 4th and the pos-test by ANOVA Repeated measurement

Source of variant	Type III SS	df	MS	F	p-Value
Week	104.578	2	52.289	57.591	.00*
Error	25.422	28	0.908		
total	130	30	53.197		

*P>0.05

Table 5 shows a significant difference in the power test at .05

Table 3: The comparison within the experiment group on agility between the pre-test, after week 4th, and the pos-test by ANOVA Repeated measurement

Source of variant	Type III SS	df	MS	F	p-Value
Week	7.969	2	3.985	94.232	.00*
Error	1.184	28	0.042		
total	8.153	30	4.027		

*P>0.05

Table 6 shows that less than one comparison had a significant difference at .05

Table 4: The comparison within the experiment group on anaerobic capacity between the pre-test, after week 4th and the pos-test by ANOVA Repeated measurement

Source of variant	Type III SS	df	MS	F	p-Value
Week	17457.766	2	8728.883	30.436	.00*
Error	8030.214	28	286.793		
total	25487.98	30	9015.676		

*P>0.05

Table 7 shows that less than one comparison had a significant difference at .05

Table 5: The comparison within the experiment group on punch speed between the pre-test, after week 4th, and post-test by ANOVA Repeated measurement

Source of variant	Type III SS	df	MS	F	p-Value
Week	4.845	2	2.42	253.497	.00*
Error	0.268	28	0.01		
total	5.113	30	2.43		

*P>0.05

Table 8 shows that the punch speed test showed a significant difference at a considerable level even after only one comparison.

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Table 6: The within-experiment group comparison on punch power between pre-test, after week 4th, and post-test by One-Way ANOVA Repeated Measures

Source of variant	Type III SS	df	MS	F	p-Value
Week	230816.45	2	115408.22	2085.63	.00*
Error	1549.39	28	55.335		
total	232365.82	30	115463.56		

*P>0.05

From the table, it was found that less than one comparison had a significant difference at .05.

Table 7 Analysis results of various tests within the experimental group

Variables	Type III SS	df	MS	F	p-Value
Strength	156.937	2	78.469	279.674	.00*
Power	104.578	2	52.289	57.591	.00*
Agility	7.969	2	3.985	94.232	.00*
Anaerobic capacity	17457.766	2	8728.883	30.436	.00*
Punch speed	4.845	2	2.42	253.497	.00*
Punch power	230816.45	2	115408.22	2085.63	.00*

The result shows that functional training can develop the strength, power, agility, anaerobic capacity, punch speed, and punch power of amateur boxers.

Table 8: Comparative results of various tests between the experimental group and the control group

Variables	Group	X+SD	t	P
Strength (Kg)	Control	80.96+10.82	.94	.35
	Experimental	84.65+10.69		
Power (cm)	Control	59.66+2.94	.99	.33
	Experimental	61.00+4.31		
Agility (sec)	Control	13.25+0.66	2.59	.02*
	Experimental	12.65+0.62		
Anaerobic capacity (Watt)	Control	536.56+105.51	0.18	.85
	Experimental	543.47+103.29		
Punch speed (m/s)	Control	4.26 +0.34	3.31	.00*
	Experimental	4.70 + 0.38		
Punch power (watts)	Control	1122.14+ 144.72	2.46	.02*
	Experimental	1261.18+ 163.26		

*P>0.05

Table 7 shows that agility, punch speed, and punch power were the significant difference at .05, on strength, power, and anaerobic capacity was no significant difference at .05. The result showed that functional training is more effective than traditional strength training in developing power, punch speed and punch power.

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Discussion

The test scores of boxers in the experimental group increased in different ranges before and after the experiment in strength, power, agility, and anaerobic capacity, there is a significant difference in test scores between post-experiment and pre-experiment. which is consistent with the functional

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training pointed out by Yuri, F., et al Consistent with the theory that physical fitness can be developed, the results suggest that functional training can develop physical fitness in amateur boxers. Silva-Grigoletto, M. E., et al. (2019:4) also conducted a 6-month functional training on samples to study the impact of functional training on human health and fitness, The findings suggest that functional training can improve fitness and develop physical fitness. This is also consistent with the findings of this study.

At the same time, there was a significant difference ($p<0.05$) in the boxing speed and strength of boxers in the experimental group before and after the experiment, and the test scores significantly improved after 8 weeks of functional training. Indicating that functional training programs can improve the punching speed and punching strength of amateur male boxers. This finding is consistent with Shabeb, A., & Ali, A. S. . (2017:1), who think that functional training can improve the speed and strength of boxing beginners' straight punches.

After 8 weeks of the experiment, there were significant differences between the experimental group and the control group in the three test scores of explosive forces, punching speed, and punching strength ($p<0.05$), indicating that functional training was more effective than traditional strength training in developing the explosive force, punching speed and punching strength of amateur boxers. However, there was no significant difference in test scores between the two groups in the three items of strength, agility, and anaerobic exercise ability. This situation may be due to the inability to control the athletes' reasonable dietary intake and good sleep and rest during the experimental process, resulting in slower muscle development. As Enoka proposed, the growth of muscles is affected by many factors, such as central resistance training, This viewpoint can also confirm this phenomenon, which is equivalent to rest, rational binary intake, and so on. (Enoka, R. M. 1988:146-168)

Conclusion

It can be concluded that the functional training created by the researchers can develop the strength, explosive power, agility, anaerobic exercise ability, punching speed, and punching strength of boxers. The functional training created by the researchers is more effective than traditional strength training in developing boxing athletes' explosive power, punching speed, and punching strength.

Recommendations

1. Boxers who want to develop fitness can use a functional training program.
2. Boxers can use functional training to develop punching speed and punching power.

Further Research Recommendation

1. Other adversarial events can also attempt to use functional training to develop athletes' physical fitness and skill performance.
2. The design content of functional training should conform to the characteristics of each sport.

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