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Study on the influence of rapid stretching compound training on the physical fitness of police officers

Yun Chen[1]

Yun Chen

1.Chongqing Police College,Chongqing, China
84688195@qq.com ORCID:0009-0001-5905-5845

Abstract

The purpose of this study was to systematically evaluate the effects of Plyometric Training on the physical fitness of police officers, and to verify it using a rigorous randomized controlled experimental design. In this study, 40 police officers from a police college were randomly divided into experimental group and control group, 20 in each group. The experimental group received the rapid stretching compound training intervention, while the control group maintained the traditional training mode. The experiment period was 8 weeks, training 3 times a week, 60min each time. In this study, key physical indicators such as 50-meter running, grip strength, standing long jump, and 10-meter ×4 round trip running were used for intervention, and the training effects were evaluated before and after. The results showed that the

experimental group was significantly better than the control group in the improvement of speed, explosive power and sensitivity, with statistical significance ($P<0.05$), only the improvement of maximum grip strength did not reach a significant level. Rapid stretching compound training is of great value in improving the sports performance of police officers, especially in the police tasks requiring short time high intensity explosive power and sensitivity.

Key words: Rapid stretching compound training; Police personnel; Physical training; Explosive power; Athletic performance

Introduction

As the core maintainer of social security and public safety, police personnel's physical quality is directly related to the efficiency and safety of task execution. Police work usually involves high-intensity, unexpected and high-risk tasks, such as pursuing suspects, responding to emergencies and dealing with violent conflicts. These tasks require police officers to possess excellent physical fitness, especially in terms[1] of speed, explosive power and agility. Therefore, scientific and reasonable physical training methods are very important to improve police officers' actual combat ability. At present, police physical training mainly relies on traditional aerobic endurance training, strength training and police actual combat skills training. Although these training methods can improve the general physical fitness level, there are some limitations[2] in enhancing the special sports ability required for police work. For example, police operations often involve high-speed movements and quick reactions in a short period of time, while the traditional training mode lacks pertinence and is difficult to effectively improve the explosive power and agility of police officers in a short period of time. In addition, the training mode is single and boring, which may lead to the reduction of training compliance, thus affecting the training effect. Therefore, it is urgent to explore more

physical training methods that meet the needs of police, so as to optimize the training effect and enhance the professional competency of police officers.

Plyometric Training is a training method based on the principle of Stretch-Shortening Cycle (SSC), which has been widely[3] used in sports training and competitive sports in recent years. This training method improves the muscle's ability to store and release elastic potential energy through rapid alternating centrifugal and centripetal contractions, thereby enhancing strength output. The core mechanisms include enhancing the response efficiency of the neuromuscular system, improving motor coordination and maximum power generation. A large number of studies have shown that rapid telescopic compound training has remarkable[4, 5] effects on improving sprinters' starting speed and enhancing the explosive power and agility of basketball and football players. However, although a large number of studies have confirmed the effectiveness of this training method in the field of competitive sports, its application in the physical training of police officers is still relatively limited. Police work is highly practical and involves a variety of complex situations. Whether rapid expansion compound training can adapt to the special needs of this professional group, and how to optimize the training program to maximize its benefits, still need to be further studied.

In view of this, the purpose of this study is to systematically evaluate the impact of rapid stretching compound training on the physical quality of police officers, and to verify it through scientific experimental design. Through the method of randomized controlled experiment, the influence of this training mode on the speed, explosive power and sensitivity of police officers was comprehensively evaluated, and the traditional training mode was compared and analyzed. This study not only provides scientific basis for the optimization of police training system, but also provides reference for the physical training of other high-intensity occupational groups, so as to promote the development of police training system to a more scientific and refined direction.

1. Research object and method

1.1 Research objects

This study was carried out in Chongqing, and the subjects were college preparatory police personnel of a police college in Chongqing. A total of 40 subjects were included in the study. The included subjects were randomly divided into 2 groups for baseline data detection, and the difference between groups was tested by one-way analysis of variance. The test results

showed that there were no significant differences between the experimental group and the control group in terms of height, age, weight and body fat percentage, indicating that there was comparability among the subjects in each group.

1.2 Research Methods

A total of 40 college preparatory police officers in a police college were included in this study and randomly divided into 2 groups, namely the experimental group and the control group, with 20 people in each group. Among them, the experimental group underwent rapid telescopic compound training, and the control group underwent normal police training arrangements. The whole experiment lasted for 8 weeks, and the training was conducted 3 times a week (Monday, Wednesday and Friday, respectively), 60min each time. Before and after the experiment, the physical fitness indexes of the subjects in each group were detected, and the differences were compared, and the influence of rapid stretching compound training on the physical fitness of police officers was discussed. The specific implementation plan of each experimental group is shown in Table 1.

Table 1. Training contents of experimental groups

Groups	Training content	Number (times)	Number of sets (sets)	Interval time (s)
Experimental group	Ankle jump with both feet extended	8	4	60
	Double leg jump	8	4	60
	Straight straight obstacle jump	10	4	60
	Jump on the jump box with both legs	6	4	90
	Lateral continuous obstacle jump	8	4	60
	Jump Deep	8	4	60
	Throw a yoga ball against the wall	10	4	90
	Jump deep to the second	2	4	90

	jump box
Control Group	Normal police training arrangements were performed, and no other form of rapid telescopic compound training was performed during the experiment.

2 Data processing

All the measured data in this study were imported into the statistical software SPSS25.0 for statistical analysis. The basic data of the subjects in each group were described by mean and standard deviation; T test was used for difference analysis of physical fitness test data. The data were expressed by X±S, and the significance level was set as $\alpha=0.05$, that is, $P<0.05$ was significant difference, $P<0.01$ was extremely significant difference.

3 Results

3.1 Comparison of speed and strength quality between experimental group and control group

3.1.1 Comparison of speed and strength quality between experimental group and control group

In this study, the speed quality and strength quality of the subjects were reflected by testing their 50-meter running performance and maximum grip strength. Shapiro-Wilk analysis was conducted on the 50-meter running data and maximum grip strength data of the subjects in each group before and after the experiment, and the analysis result found that $P>0.05$, indicating that the measured data followed a normal distribution. Then, the changes in the 50-meter running and maximum grip strength of the subjects in each training group before and after the experiment were compared by means of paired sample T-test. The research results are shown in Table 3.1.1. As can be seen from the table, the experimental group improved significantly in 50m running after the experiment compared with before the experiment ($P<0.05$), but the improvement effect of maximum grip strength was not significant ($P>0.05$). In contrast, the 50-meter running performance and maximum grip strength performance of the control group after the experiment were not significant compared with those before the experiment, $P>0.05$. In conclusion, the rapid stretching compound training of 60min 3 times a week for 8 weeks can significantly improve the speed quality of police officers, but the effect on the improvement of grip strength is not good.

Table 3.1.1. Comparison of differences in speed and strength quality of subjects before and after the experiment (X±S)

Groups		50m (s)	Grip strength (kg)	T_1/P_1	T_2/P_2
Experimental group	Before the experiment	7.62±0.43	51.4±7.2	2.241/0.037 *	2.613/0.021 *
	After the experiment	7.10±0.17	54.2±5.5		
Control group	Before the experiment	7.67±0.25	50.1±5.2	1.612/0.475	1.827/0.108
	After the experiment	7.55±0.41	50.7±4.9		

Note: T_1 is the test statistic of 50 meter run paired sample, P_1 is the significance result of 50 meter run paired sample t test; T_2 is the test statistic of maximum grip strength paired samples, P_2 is the significance result of maximum grip strength paired samples T-test, * means $P<0.05$, ** means $P<0.01$.

3.1.2 Comparison of speed and strength quality between the experimental group and the control group

In order to further analyze the effect of rapid stretching compound training on improving the speed and strength quality of police officers, this study adopted the independent sample T test to compare the difference between the two groups after the experiment in 50m running performance and maximum grip strength, and the research results are shown in Table 3.1.2. After 8 weeks of rapid stretching compound training, the 50-meter performance of the experimental group was significantly improved than that of the control group, $P<0.05$, but there was no significant difference in grip strength between the two groups, $P>0.05$.

Table 3.1.2. Comparison of differences in speed and strength quality between groups before and after the experiment (X±S)

Groups	50m (s)	T_1/P_1	Grip strength (kg)	T_2/P_2
Experimental group	7.10±0.17	- 4.454/0.011 *	54.2±5.5	2.141/0.132
Control group	7.55±0.41		50.7±4.9	

Note: T_1 is the test statistic of 50m run independent sample, P_1 is the significance result of 50m run independent sample t test; T_2 is the test statistic of maximum grip strength independent sample, P_2 is the significance result of maximum grip strength independent sample t test, * means P<0.05, ** means P<0.01.

3.2 Comparison of explosive power and sensitivity quality between experimental group and control group

3.2.1 Comparison of explosive power and sensitivity between the experimental group and the control group

In this study, the explosive power and sensitivity of the subjects were reflected by testing their standing long jump performance and 10mx4 round trip running. Shapiro-Wilk analysis was conducted on the standing long jump data and 10mx4 data of the subjects in each group before and after the experiment, and the analysis result found that P>0.05, indicating that the measured data followed the normal distribution. Then paired sample T-test was used to compare the changes in the standing long jump and 10mx4 of the subjects in each training group before and after the experiment. The research results are shown in Table 3.2.1. As can be seen from the table, the standing long jump and 10mx4 time of the experimental group after the experiment were significantly improved compared with that before the experiment, P<0.05. In contrast, the time of standing long jump and 10mx4 in the control group after the experiment was not significant compared with that before the experiment, P>0.05. In conclusion, the rapid stretching compound training of 60min 3 times a week for 8 weeks can significantly improve the explosive power and sensitivity of police officers.

Table 3.2.1. Comparison of explosiveness and sensitivity of subjects before and after the experiment (X±S)

Groups		Standing Long Jump (m)	10m x 4 Round trip (s)	T_1/P_1	T_2/P_2
Experimental group	Before the experiment	2.21±0.25	10.83±0.62	2.531/0.041 *	2.714/0.024 *
	After the experiment	2.49±0.18	10.61±0.39		
Control group	Before the experiment	2.29±0.16	10.91±0.64	1.052/0.517	1.214/0.351
	After the experiment	2.37±0.08	10.85±0.68		

Note: T_1 is the standing long jump paired sample test statistic, P_1 is the significance result of standing long jump paired sample t test; T_2 is the test statistic of 10m×4 round trip paired samples, P_2 is the significance result of t test of 10m×4 round trip paired samples, * means P<0.05, ** means P<0.01.

3.2.2 Comparison of explosive power and sensitivity quality between the experimental group and the control group

In order to further analyze the effect of rapid expansion compound training on the improvement of explosive power and agility of police officers, this study adopted the independent sample T test to compare the standing long jump performance and 10mx4 time between the two groups after the experiment, and the research results are shown in Table 3.2.2. After 8 weeks of rapid stretching compound training, the standing long jump of the experimental group was significantly improved compared with the control group (P<0.05), and the 10mx4 time was also significantly improved compared with the control group (P<0.05).

Table 3.2.2. Comparison of differences in explosive power and sensitivity before and after the experiment between groups (X±S)

Groups	Standing Long Jump (m)	T_1/P_1	10m4 Round Trip Run (s)	T_2/P_2
Experimental group	2.49±0.18	2.518/0.001 *	10.61±0.39	-1.394/0.032
Control group	2.37±0.08		10.85±0.68	

Note: T_1 stands for standing long jump independent sample test statistic, P_1 stands for standing long jump independent sample t test significance result; T_2 is the test statistic of 10m×4 round trip independent sample, P_2 is the significance result of t test of 10m×4 round trip independent sample, * means P<0.05, ** means P<0.01.

4 Discussion

In this study, a randomized controlled experimental design was used to explore the influence of rapid stretching compound training on the physical fitness of police officers by scientific methods. The experimental design strictly controlled variables to ensure that there was no significant difference in physical fitness indexes between the two groups before intervention (P>0.05). The experimental intervention lasted for 8 weeks, with 60 minutes of training 3 times a week, and the effects of the intervention were evaluated through a systematic physical fitness test. The results showed that compared with traditional police training, rapid stretching compound training can significantly improve the speed, explosive power and agility of police officers, which further confirmed the applicability of this training mode in high-intensity occupational groups.

Our study found that the 50-meter running performance of the experimental group was significantly improved after training (P<0.05), indicating that the fast stretching compound training can effectively enhance the short-distance sprint ability. These results are consistent with the results of Finch et[6] al. (2021) study on long jumper athletes, which showed that rapid stretching compound training can optimize the muscle stretch-shortened cycle (SSC) mechanism and improve muscle power output and explosive power. In addition, Cao Xiaoxiang et[7] al. (2020) in China also confirmed that after 8 weeks of SSC training, the fast strength index of the subjects was significantly improved, which further supported the conclusions of this study. In terms of sensitivity, the 10-meter ×4 round trip performance of the experimental group was significantly optimized (P<0.05), indicating that rapid stretching compound training can improve the adaptability of police officers to body control ability and rapid direction changing ability. This is consistent with the results of Gao Yuan et[8] al. (2019), who found that rapid stretching compound training can improve the sharp turn, stop and coordination ability of adolescent male subjects. This study further verified the applicability of this training model to adult professional groups, especially for police officers' ability to cope with emergencies. In terms of speed quality, 8-week rapid stretching compound training significantly improved the sprint speed of police officers, while the traditional police training mode had no significant effect in this respect. Wang Chunhui et[9] al. (2021) also found in the study of young male subjects that although conventional training can improve aerobic endurance, the improvement of short-distance sprint ability is limited, while rapid stretching compound training can significantly shorten the 30-meter sprint performance (P<0.05). In addition, Yu Zhongyou et[10] al. (2020) pointed out that 8-week fast stretching compound training can effectively shorten the time of 5-meter sprint and 10-meter sprint, which indicates that this training mode can effectively enhance the explosive power of lower limbs and improve short-distance acceleration.

Why can rapid expansion compound training have a significant impact on short-distance sprint ability? Delecluse et[11] al. proposed that the core mechanism of this training mode is that it promotes the adaptation of the neuromuscular system through high-intensity bouncing exercises, making the conversion from centrifugal contraction to centrional contraction more efficient, and thus improving the explosive power of the lower extremities. Short-distance sprint ability largely depends on the ability to push off quickly, that is, the explosive power of lower limbs. Therefore, the rapid expansion compound training has a high pertinence in

improving the speed quality. However, in terms of upper body strength quality, this study did not find that fast stretching compound training had a significant effect on maximum grip strength ($P>0.05$). The possible reason is that the training program of this study mainly focused on the improvement of lower limb explosive power and sensitivity, while the proportion of upper limb training was relatively low. In addition, the relatively short duration of the study (8 weeks) may not have been sufficient to induce significant muscle adaptation. Delecluse et al. suggest that rapid expansion and contraction exercises may be more effective for upper body strength development when combined with more upper-limb training, such as band resistance exercises or explosive thrusts. Therefore, future studies can further optimize the training regimen and explore the long-term effects of rapid expansion complex training on upper body strength quality.

To sum up, this study verified the positive effect of rapid stretching compound training on the physical quality of police officers through strict experimental design, especially the improvement of speed, explosive power and sensitivity. The results of this study provide a scientific basis for the optimization of police training system, and can also provide reference for the physical development of other high-intensity occupational groups. However, there are still some limitations in this study, such as short experiment period and less upper limb training content. Future studies can further explore the effect of long-term training and optimize training programs to improve the overall physical quality of police officers in a more comprehensive way.

5 Conclusions

The results of this study show that the rapid stretching compound training can significantly improve the speed, explosive power and sensitivity of police officers. Compared with the traditional training mode, this training method can activate the neuromuscular system more effectively, optimize the exercise performance, and enhance the high-intensity exercise ability in a short time, especially in the short-distance sprint, sensitivity and other aspects of significant advantages. This study provides a scientific basis for the optimization of police personnel physical training, and also provides practical guidance for the physical development of related occupational groups. Future studies can further explore the adaptability of this training model in longer training cycles and individuals with different physical levels, so as to build a more comprehensive and accurate physical training system for police officers.

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