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Research Article

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Mathematical statistics analysis-based meditation teaching method affects swimming ability improvement result difference test

Jing Jin[1] and Bo Dang[2]

[1]Department of Physical Education, Xianyang Normal University, Xianyang, Shaanxi, China
[2]Department of Physical Education, Xi'an Siyuan University, Xi'an, Shaanxi, China

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ABSTRACT

Swimmers are prone to generating sense of fatigue in swimming training and competition process, proper fatigue is helpful for swimmers swimming ability improvement, while excessive fatigue is harmful for human body, therefore sports fatigue generation and fatigue recovery researches play crucial roles in swimmers' training and performance improvement. By mathematical statistics analysis, is analyzes sports fatigue causes and fatigue recovery methods, in the hope of making contributions for swimming fatigue recovery. Through researching, it indicates that meditation training method teaching has significant effects on fatigue recovery, finally gets that experimental group has obvious advantages in heart rate, mood state and fatigue extent these three total indicators by comparing with control group.

Key words: Sports fatigue, significant difference, meditation training, teaching experiment

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INTRODUCTION

National sports institutions textbook "Sports Physiology" defines fatigue concept as "The phenomenon of working ability and body function temporary reduce because of movement", Till 1982 the fifth international sports biochemistry meeting made a new definition of fatigue as "body physiological process cannot continue its function go ahead in specified levels or cannot maintain predetermined sports intensity". This paper takes swimming as carrier, explores meditation training effects on the sport fatigue recovery, in the hope of providing scientific analysis method and theoretical basis for sports fatigue recovery and sports ability improvement [1-3].

For sports fatigue and fatigue recovery researches, lots of people has made efforts, by which athletes sports ability are continuously improving, keeping breaking sports events records once and again, from which Wu Shao-Ming etc.(2001) state fatigue and recovery relationships as well as its effects on improving training performance[1]; Zhang Hai-Feng etc.(2002)introduce some adaptive teenagers recover fatigue methods[2]; Wang Yun-Min(2009) adopts intergroup experiment design method to make difference analysis of swimming fatigue recovery teaching method, and get that psychological method has remarkable effects on sports fatigue recovery[3-5].

On the basis of previous studies, research on swimming fatigue recovery teaching experiment, apply teaching experiment collected swimmers' fixed fatigue indicators and flexible fatigue indicators in swimming recovery process, explore psychological recovery advantages which are better than traditional sports recovery methods so as to explore meditation training method effects on swimming training fatigue recovery through research provided indicator data features that reflect fatigue recovery extent, provide analysis methods for sports teaching and scientific path for athletes sports ability improving.

SWIMMING FATIGUE PROBLEMS PUT FORWARD AND ANALYSIS

Through modern sports practices, it can get a conclusion as "No load no fatigue, no recovery no improvement". It is well known that after human body carries out one moment movements, it will have sense of fatigue; By practice

proved conclusions, it is clear that athletes only can generate fatigue through sports exercise, then let body function get over recovery so that achieve sports performance improving efficiency [6-8].

Swimming is a kind of endurance physique dominant sport event, in athletes training process, its ways is relative single by comparing with other events; due to the sport features, it let training process prone to cause sense of fatigue. In one sports fatigue test, it gets that high-level swimmers in fatigue and normal such two states swim 200m with their 1/2 strength, the two performance have 20s gap. Through the test result, it is known athletes how to recover their body and mentality after high intensity training is very important [9].

Fatigue is work itself function reducing phenomenon, fatigue occurrence inner essence can be divided into mental fatigue and physical fatigue, from which physical fatigue can also be divided into central fatigue and peripheral fatigue, if classify according to body parts, it can be divided into skeletal muscle fatigue, cardiovascular system fatigue and respiratory system fatigue, if classify according to fatigue extent it can be divided into mild fatigue, acute fatigue, excessive nervous, excessive training and excessive fatigue. Swimming training possesses large loading, long time, large quantity, intense and high density as well as other features, these features bring athlete great burdens both in physiology and psychology, make athlete often in excessive fatigue states; we know that proper fatigue is helpful for sports ability improvement, but excessive fatigue will be harmful for athletes. Apply gradually reducing intensity body relaxing training is helpful for athletes body each function recovery to before training levels, but the method can only relieve athletes muscle tension sense, it is difficult to reduce athletes' psychological anxiety and oppression. Therefore, in order to recover athletes' fatigue, it should carry out from body relaxation and psychological relaxation such two aspects, athletes under circumstance of peaceful heart, will propel body relaxation, on the contrary body relaxation will also propel psychological stress relief; in athletes training fatigue recovery process, if it can make reasonable relaxation from psychology and body such two aspects, it will let athletes fatigue recovery get more done in less time [10].

In order to have a clear grasp on sports fatigue, it can make judgment monitoring on athletes individual performance flexible fatigue and fixed fatigue two aspects, from which fixed fatigue means human body physiological fatigue generated after sports training, it mainly reflects on muscle soreness, dizzy, weakness, poor sense of water, technical motion rigid, loss of appetite, sleep quality drop and other aspects, while flexible fatigue means athletes psychological fatigue generated after sports training, it mainly reflects on tired of water, afraid of water, decline in memory, emotional irritability, lack of confidence and slow in reacting as well as other aspects.

Through above analysis, it can get acknowledge of swimming fatigue generation causes and principles, the purpose is getting rid of sports fatigue and improving athletes' sport ability through reasonable method, main methods to eliminate fatigue are training recovery, warm-up, medicine recovery and psychology recovery as well as other aspects; this paper is just designing psychology recovery methods meditation training teaching experiment, the training method including body relaxation, regulate breath and attentional focus these three phases, with specified hints and audible signal as stimulus, function on central nervous system, let it in proper excited state, it is helpful for eliminating nervous tension and improving mood state, strengthen blood circulation in the brain, improve central nervous system function state, and it is also helpful for muscle tissues rest and technology recovery.

RESEARCH HYPOTHESIS AND EXPERIMENT DESIGN

Research hypothesis

- Assume that meditation training is helpful for short-term recovery after every time training course, use heart rate value to reflect;
- Assume that meditation training is helpful for one phase training long term recovery, use heart rate value when wakes up in the morning to reflect;
- Assume that experiment group's athletes have higher sense of achievement, more energy and less sports negative evaluations by comparing with control group.

Assume that meditation training, body organize training's athletes mood state improvement would be better by comparing with simple rest in recovery term after training.

Research objects

31 swimmers, from which men swimmers are 11, women swimmers are 20, including 7 national master sportsmen, 13 state first-class athletes and 11 state second-class athletes, average age is 21.1 years old, average training years is 7 year, above research objects all haven't experienced meditation training and other relaxation training.

Research indicator

Select three can comprehensive reflect athletes flexible fatigue and fixed fatigue that are respectively heart rate, mood state and fatigue extent three indicators, below make respectively explaining on these three indicators values

significance and collect ways.

Heart rate indicator: In sports practice, it normally can reflect sports intensity and physiologic loading, is a very sensitive physiologic indicator reflects body metabolism status, in progressively increasing sport till secondary maximum loading sport, with loading intensity gradually enlarging, its energy metabolism request will be higher and higher, oxygen uptake will be higher and higher, heart rate will be higher and higher; in swimming training, heart rate is a indicator that can reflect training stress, in training starting phase, heart rate will continue some minutes rising, after a while, heart rate keeps constant, it can define training criterion according to constant value, then it can define sport loading according to total time the heart rate value maintains.

According to athlete age, it can deduce its maximum heart rate, as formula (1) shows:

$$N_{\max} = 220 - A \tag{1}$$

In formula (1), $N_{\max}$ represents athlete maximum heart rate value its unit is time/min, A represents athlete age. According to resting state heart rate, deduce athlete heart rate threshold value range as formula (2) shows:

$$[(220 - A) \times 70\% + N_0] \le N \le [(220 - A) \times 80\% + N_0] \tag{2}$$

In formula (2), N_0 represents resting heart rate, N represents heart rate threshold value.

Before and after athlete training, adopt radial pulse self-testing method to carry out heart rate measurement, all subjects go through wrists correctly located pulse measurement training, 2to 3 fingers beyond thumb are used for feeling pulse, when starting signals transmit, in the meanwhile the felt pulse not taken into calculation, when count pulse, it requires to keep quiet, morning pulse, before training and after experiment heart rate collecting time all are 30 seconds, then let the heart rate times 2, during training and after training, heart rate collecting time are 6 seconds, then let the heart rate times 10, finally record these data.

Mood state： Mood state is a psychological indicator that reflects athletes sports performance whether be success or failure, Apply domestic scholar Zhu Bei-Li revision on American D.M.McNair and others compiled mood quantization table and establish Chinese norm, the quantization table is composed of 40 adjectives, including nervous, anger, fatigue, depressed, energy, panic and self-esteem correlated emotional seven subscales, all adopt five levels scale to answer the questions, their score status accordingly is from 0 to 4 score, each subscale highest score are respectively 24, 28, 20, 24, 24, 20, 20, the lowest score is 0, then according to original scores, calculate each group subjects negative emotion total estimated score, the total estimated score TMD as formula (3) shows, it works out:

$$TMD = (Ner + Ang + Fati + Dep + Pan) - (Ene + SE) + 100 \tag{3}$$

In formula (3), Ner represents nervous component, Ang represents angle component; $Fati$ represents fatigue component; Dep represents depressed component; Pan represents panic component; Ene represents energy component; SE represents self-esteem component. Mood quantization table subscale inner consistency reliability is between 0.85 and 0.87, retest reliability is between 0.65 to 0.74; according to mood quantization table, it can monitor athlete loading, and provide basis for reasonable measurements adopting.

Fatigue extent: Design athlete fatigue questionnaire, the questionnaire scale is composed of emotion/energy exhausted, sense of achievement reduction and athletes' sports negative evaluation three subscales, there are respectively including 7, 7, 5, 2 entries total 21 questions, their reliability average is $\alpha = 0.85$.

Fatigue extent measurement is carrying out with weeks as intervals, implement measurement after final training experiment ending every week.

Experiment design

Experiment process divides into preparation test and formal test, time for preparation test is from Oct.13th to Oct.17th, while time for formal test is from Oct.20th to Nov.21st total 5 weeks, divide swimmers by stratified random into two groups, from which experimental group has 16 people, control group has 15 people.

Week 1: No carrying out experiment, all testee athletes receive pre-test so as to get mood state and fatigue level basic value.

From week 2 to week 5: All testee athletes take same training contents, coaches training plan is that 4 days take training every week, 1.5 hours every day, from which 3 days scheduled on 10:00 to 11:30 in the morning, one day scheduled on 16:00 to 17:30 in the afternoon, training content including warm-up, training parts and relaxing organization such three parts.

Heart rate measurement is measuring in 3 days after finishing experiment every week, 5 times measuring per day, measuring time is respectively wake-up in the morning, the moment after maximum intense training ending, one minute after training ending and after experiment handling total 5 time phases.

Mood state and fatigue extent are measured in the week 1 weekends as pre-test, in the rest 4 weeks, experimental group testee take 20 minutes breath meditation training experimental handling after training finished and body organization activities fulfilled every day, while control group testee are arranged to take a quiet rest for 20 minutes in the room, then carry out successive mood state and fatigue extent measurement on two groups' testee athletes at the end of every week, control every time measuring program keeping consistency.

Implement statistics and data handling with dependent variables' heart rate, fatigue extent and mood state, their intergroup comparison experiment design is as following Figure 1 shows:

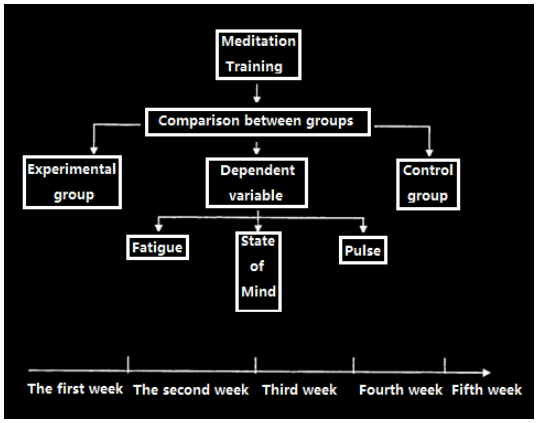

Figure 1: Intergroup comparison experiment design block diagram

RESEARCH RESULT MATHEMATICAL STATISTICS ANALYSIS

Heart rate testing result mathematical statistics analysis

Heart rate is required to measure 3 times per week, this paper takes 3 times measurement values average value as one week measurement results, then makes statistics analysis on them, control group and experimental group heart rate values statistics status in four weeks as Table 1 shows, Table 1 displays 5 time phases' heart rate values and independent sample T test value and significance P value.

Table 1: Formal training process four weeks heart rate statistics

Measurement time phase	Week 1				Week 2			
	Experimental group	Control group	T value	P value	Experimental group	Control group	T value	P value
Morning pulse	61.2±3.4	63.5±3.6	-1.557	0.435	60.7±2.6	63.5±3.5	-2.108	0.047
Before training	79.5±5.3	80.0±4.1	-0.252	0.804	79.1±4.9	79.7±3.9	0.226	0.732
During training	165.8±9.6	166.2±9.5	-0.088	0.931	166.1±9.1	167.0±8.9	-0.244	0.809
After training	140.0±11.7	141.8±5.3	-0.339	0.738	141.3±10.7	142.3±13.3	-0.204	0.840
After experiment	88.0±6.1	92.8±5.3	-2.023	0.056	87.8±5.1	92.5±4.9	-2.242	0.036
Measurement time phase	Week 3				Week 4			
	Experimental group	Control group	T value	P value	Experimental group	Control group	T value	P value
Morning pulse	61.5±2.4	64.3±3.3	-2.327	0.030	60.9±2.5	63.4±3.4	-2.296	0.032
Before training	80.3±4.8	80.8±3.7	-0.313	0.757	79.7±4.5	80.3±3.4	-0.358	0.724
During training	168.8±8.5	169.9±8.9	-0.317	0.754	166.8±9.2	168.5±9.4	-0.419	0.680
After training	141.8±10.6	143.7±12.7	0.389	0.701	141.7±10.3	144.1±11.6	-0.531	0.601
After experiment	87.7±4.7	93.3±4.7	-3.364	0.013	87.0±4.8	92.9±4.5	-3.533	0.012
Note: Heart rate value unit is time/minute								

From Table 1 four weeks heart rate data, it is clear that before, during and after training experimental group and

control group have no significant difference, morning pulse heart rate value experimental group is 2 to 3 times lower than that of control group by comparing, it has significant difference, while after experiment heart rate, control group is 5 to 7 times higher than that of experimental group by comparing, it also has significant difference.
Apply Table 1 data, it can get intergroup heart rate four weeks change tendency as Figure 2 shows.

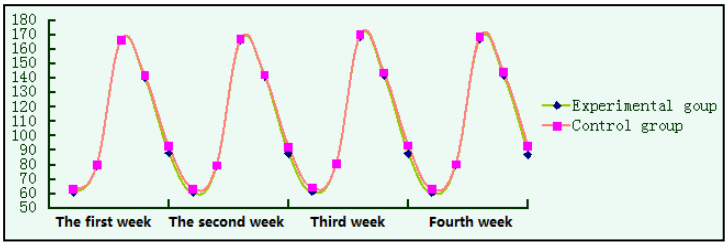

Figure 2: Four weeks five different moments intergroup heart rate values changes

From Figure 2, it is clear that experimental group and control group during four weeks teaching training process, their heart rate average values have no bigger fluctuation, experimental group has little decreasing tendency by comparing with control group.

Mood state measurement result mathematical statistics analysis

Mood state totally goes through 5 times measurement, as Table 2 shows mood state total score, nervous component score, anger component score, fatigue component score, depression component score, panic component score, energy component score and self-esteem component score status, meanwhile displays control group and experimental group independent sample test T value and significance P value.

Table 2: Mood state total score and each component score

Mood state indicators	Before experiment test results			
	Experimental group	Control group	T value	P value
Total score	112.92±11.94	115.91±12.14	-0.596	0.558
Nervous	8.50±3.06	9.18±3.25	-0.518	0.610
Anger	8.33±2.57	8.36±3.23	-0.025	0.980
Fatigue	8.67±2.02	9.27±3.29	-0.538	0.596
Depressed	7.67±1.61	8.09±2.51	-0.478	0.632
Panic	7.50±1.83	7.00±1.84	0.651	0.522
Energy	16.00±2.59	15.00±2.90	0.873	0.392
Self-esteem	11.75±3.55	11.00±2.49	0.582	0.567

Mood state indicators	Week 1				Week 2			
	Experimental group	Control group	T value	P value	Experimental group	Control group	T value	P value
Total score	100.0±8.55	115.8±10.5	-3.993	0.001	96.25±8.24	115.4±8.87	-5.385	0.000
Nervous	6.33±1.92	9.09±2.98	-2.659	0.015	6.00±1.54	9.00±2.41	-3.593	0.002
Anger	7.17±1.53	8.64±2.38	-1.779	0.090	5.83±1.75	8.63±2.37	-3.240	0.004
Fatigue	6.75±1.76	9.45±3.08	-2.614	0.016	6.08±1.51	9.73±2.76	-3.979	0.001
Depressed	6.75±1.42	7.91±2.30	-1.468	0.157	6.42±1.24	7.64±1.91	-1.831	0.081
Panic	5.42±1.38	6.73±1.85	-1.938	0.066	5.17±1.27	6.64±1.80	-2.277	0.033
Energy	18.50±2.61	14.82±2.71	3.315	0.003	18.83±2.52	14.91±2.59	3.686	0.001
Self-esteem	13.92±3.55	11.09±2.39	2.217	0.038	14.42±3.15	11.27±2.37	2.686	0.014
Mood state indicators	Week 3				Week 4			
	Experimental group	Control group	T value	P value	Experimental group	Control group	T value	P value
Total score	97.33±8.36	115.9±8.56	-5.263	0.000	95.92±7.88	115.5±7.78	-6.005	0.000
Nervous	6.17±1.53	9.09±2.21	-3.717	0.001	6.00±1.54	9.00±2.10	-3.936	0.001
Anger	6.00±1.54	8.64±2.38	-3.186	0.004	5.67±1.23	8.55±2.16	-3.969	0.001
Fatigue	6.25±1.36	9.82±2.60	-4.178	0.000	6.01±1.71	9.73±2.45	-4.262	0.000
Depressed	6.58±1.38	7.82±1.99	-1.742	0.096	6.42±1.44	7.73±1.90	-1.872	0.075
Panic	5.42±1.08	6.73±1.85	-2.097	0.048	5.25±1.22	7.00±1.79	-2.766	0.012
Energy	18.67±2.53	15.09±2.43	3.449	0.002	18.92±2.54	15.18±2.40	3.616	0.002
Self-esteem	14.25±3.19	11.09±2.47	2.636	0.015	14.50±3.00	11.27±2.37	2.844	0.010

From Table 2 data, it is known that during experiment preparation, pre-test experimental group and control group

testee athletes' mood maladjustment scores differences are not remarkable, there are no significant differences existing in seven components; In four weeks testing after formal training, experimental group testee athletes' mood maladjustment scores is lower than that of control group by comparing, and scores have significant differences.

As Figure 3 shows five weeks two groups mood maladjustment total score comparison status

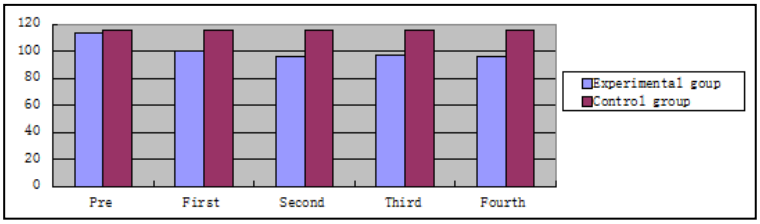

Figure 3: Two groups' five week experiment training mood maladjustment total score bar chart

From Figure 3, it is clear that pre-test mood state maladjustment total scores has little differences, while other four weeks total score differences are great, experimental group is lower than control group, mood state seven components has no big differences when in pre-testing, in other 4 weeks, intergroup scores comparison conditions can be clearly known from Figure 4, for nervous, anger, fatigue, depressed and panic scores, control group is higher than experimental group; while fro energy and self-esteem, experimental group is higher than control group.

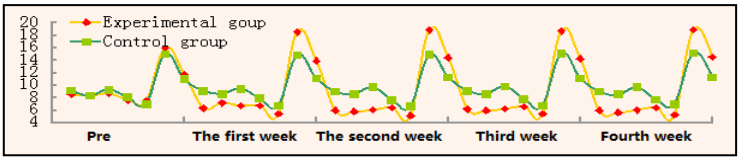

Figure 4: Five weeks' two groups' mood state seven components scores comparison figure

Fatigue extent measurement result mathematical statistics analysis

For fatigue extent measurement, this paper adopts pre-testing, week 1, week 2, week 3 and week 4 five times measurement, and do independent sample T value test on fatigue extent total value and each component value, their results as Table 3 shows.

Table 3: Two groups fatigue extent measurement result comparison table

Fatigue extent indicator	Before experiment test result			
	Experimental group	Control group	T value	P value
ABQ	25.42±9.54	24.36±8.61	0.277	0.784
A	1.58±3.37	2.00±2.45	-0.336	0.740
B	11.83±3.93	10.45±3.24	0.914	0.371
Q	12.00±4.00	11.91±3.78	0.056	0.956

Fatigue extent indicator	Week 1				Week 2			
	Experimental group	Control group	T value	P value	Experimental group	Control group	T value	P value
ABQ	14.92±6.30	23.36±8.08	-2.809	0.011	13.25±5.59	22.82±7.45	-3.502	0.002
A	-0.67±1.83	1.64±2.20	-2.739	0.012	-1.08±1.73	1.45±2.02	-3.247	0.004
B	7.42±2.54	10.09±3.11	-2.266	0.034	6.92±2.54	9.91±2.98	-2.599	0.017
Q	8.17±2.95	11.64±3.59	-2.544	0.019	7.42±2.54	11.45±3.39	-3.253	0.004
Fatigue extent indicator	Week 3				Week 4			
	Experimental group	Control group	T value	P value	Experimental group	Control group	T value	P value
ABQ	14.58±5.60	24.00±7.00	-3.578	0.002	13.42±4.85	23.12±6.05	-4.569	0.000
A	-0.67±1.83	1.82±1.99	-3.123	0.005	-1.17±1.53	1.64±1.69	-4.179	0.000
B	7.42±2.54	10.36±2.77	-2.664	0.015	7.08±2.31	10.26±2.42	-3.323	0.003
Q	7.83±2.17	11.82±3.22	-3.510	0.002	7.50±2.15	11.82±6.05	-3.888	0.001

Note: ABQ represents fatigue extent total score; A represents lower sense of achievement; B represents emotion and energy exhausted; Q represents negative evaluation on sports.

From Table 3 data, it can get five time phases intergroup fatigue total value visual map, as Figure 5 shows.

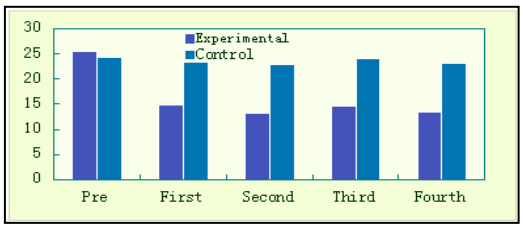

Figure 5: Intergroup fatigue extent total value comparison bar chart

From Figure 5, it is clear that pre-test fatigue extent has no big difference, for week 1 to week 4 fatigue extent total value, experimental group is lower than control group, similarly, from Table 3 data, it can get fatigue extent 3 components five time phases' values comparison status, as Figure 6 shows.

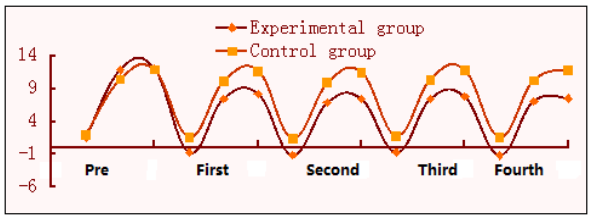

Figure 6: Fatigue extent each component five time phases' values comparison

From Figure 6 five time phases' three components' values comparison status, it is clear from beginning on First to ending on Fourth, the control group curve always is above that in experimental group, that is to say except for two groups have no great differences at pre-testing, other each time phase measurement result, experimental group fatigue extent all lower than that of control group.

CONCLUSION

By heart rate test result, it is clear that before training, control group and experimental group athletes' heart rate average value is 80 time/min, indicates that experimental group and control group athletes have same physical quality, which provides reliable basis for meditation training fatigue recovery experiment teaching; Week 1 test indicates that experimental group and control group are in remarkable difference, while until week 2, week 3 and week 4, the differences are constantly increasing. From this, it can prove that meditation training has remarkable effects on athletes' heart rate short term recovery and long term recovery. By mood state test results, it is clear that before training two groups have no differences, while week 1 to week 4 experimental athletes' mood maladjustment reduce from112.93 before experiment to 95.92, their moods have obvious improvement, while control group has no remarkable changes from beginning to ending, it accordingly can know that meditation training method is of great help in athlete mood adjustment, it is helpful for propelling athletes mood improvements. By fatigue extent test results, it is known that before training two groups' have no differences in values, from week 1 to week 4, experimental group athletes fatigue extent are gradually decreasing, it decreases from 25.42 before experiment to 13.42, total decreases 12.00, while control group fatigue extent total value basically has no great changes, it can know from this that meditation training has great effect on swimmers' fatigue recovery, it functions as relieving fatigue for central nervous system, it has a better effect on calming, easing pains and enhancing memory.

For sports fatigue generation causes and elimination methods, it carried out analysis, extracted heart rate, mood state and fatigue extent indicators that reflected swimmers' fatigue sense; designed a kind of meditation training method applying into swimming training teaching experiment, and through 5 weeks' experiment process, extracted each testee athletes' fatigue and recovery indicator data; By indicators data reflection states comparing in time and space, analyzed before and after experiment two groups differences in heart rate, mood state and fatigue extent, and got that meditation training method has remarkable effects on swimming fatigue recovery.

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