ISSN: 0974-8369

**Biology and Medicine**

International, Open Access

**Biology and Medicine**

Tyutyukov *et al.*, Biol Med (Aligarh) 2015, 7:3
http://www.biolmedonline.com

**Research Article** **Open Access**

# Special Respiratory Training for Preparing Cold-Water Swimmers

**Vyacheslav Grigorievich Tyutyukov*, Galina Vladimirovna Safonova, Olga Viktorovna Shakirova**

*Far-Eastern Federal University, 8, Suhanova Street, Vladivostok 690091, Russia*

## Abstract

This article deals with the information about special respiratory training supplementing the main means and methods of preparing cold-water swimmers. This training provides the effect of cold, hypoxia, and hypercapnia, which contributes to the gains in performance of swimmers of this category due to the improvement in indices of the body's functional systems. The target of the research is the instruction and training process for cold-water swimmers. The subject of the research was determined as procedures of training of cold-water swimmers combining the means and methods of preparation which are traditional for such sport and the respiratory training based on the effect of cold, hypoxia, and hypercapnia. The research is aimed at proving the efficiency of additional inclusion of respiratory training providing the effect of cold, hypoxia, and hypercapnia to the general training of cold-water swimmers. This article will be of interest to representatives of sport science and sportsmen who are mainly engaged in sports requiring breath holding and demonstration of endurance.

## Keywords

Respiratory training; Diving response; Effect of cold, hypoxia, and hypercapnia; Cold-water swimming; Functional status indicators; Sport results

## Introduction

### The problem

Productivity in most types of human motor activity, including sports, in large part depends on the functional capabilities of vital systems. In order to increase productivity, it is necessary to change qualitatively the state of body (increase its adaptability) in general or with regard to some specific systems of body, which will result in optimization of readiness for necessary physical action [1].

One of the measures for increasing functional readiness of sportsmen to demonstrate highly effective competitive activity is the use of special-purpose exercises on certain functional systems of body [2,3]. A measure in respect of sportsmen's respiratory system is the use of various complex respiratory exercises (trainings) providing normalization of the state of body and maintenance of physical performance level. The main function of respiratory system is the maintenance of proper level of oxygen and carbon dioxide homeostasis in compliance with tissue metabolic rate [4]. High functional activity of this system is especially important for cyclic kinds of sport, which includes cold-water swimming.

## Exploration of the importance of the problem

The training providing the effect of cold, hypoxia, and hypercapnia (ECHH) may be referred to the above-mentioned respiratory training. The main point of this respiratory training is that as the result of immersing face in water with certain temperature (temperature gradient between water and air should be above 8°C) and subsequent holding of breath in such position for a while causes a rudimentary phenomenon of "diving response" (vagal bradycardia and peripheral vasoconstriction) in human to show up; the intensity and nature of this phenomenon depend on synergetic ECHH.

## Description of relevant scholarship

Reports stating that such response in human can be incurred only by immersing face in water were already published by Song *et al.* and Gooden [5,6]. Later Galantsev *et al.* and Baranova proved that adaptation of human to ECHH activates body reserves and promotes optimization of physical state due to increase of nonspecific resistance to adaptogenic factors causing the body to shift to a more effective way of metabolism [7,8].

This type of respiratory training was successfully applied in rowing, track-and-field athletics, synchronized swimming, and the preparation of young swimmers [3,9,10]. It makes the study of efficiency of using this respiratory training in preparation of cold-water swimmers possible, interesting, and significant. Cold-water swimming is becoming increasingly popular both in the Russian Federation and across the world. It entails a strong physical load; meanwhile it can accelerate rehabilitation after muscle injuries and induces nonpathological changes of hematological homeostasis increasing body reserves [11]. But it should be remembered that cold-water immersions cause cold shock in humans, which in some cases may become the reason of drowning [12,13].

At the same time, the ninth Winter Swimming World Championship, which took place in February 2014, in Rovaniemi (Finland), gathered together 1,200 swimmers from 36 countries. Students of the Far Eastern State University got interested in this type of swimming; twenty of them had already started a cold-water swimmers' club.

## The hypothesis and its correspondence to research design

The experiment conducted as a part of this research was performed in the swimming pool of Blagoveshchensk city (Amur region) and offshore in Zeya River where the training center of Amur Regional Federation "Aquaice Sport" was located. Twelve cold-water swimmers were enrolled in this experiment; participants were divided (by

---

***Corresponding author:** Tyutyukov VG, Far-Eastern Federal University, 8, Suhanova Street, Vladivostok 690091, Russia

**Received:** June 30, 2015; **Accepted:** July 20, 2015; **Published:** Aug 17, 2015

**Citation:** Tyutyukov VG, Safonova GV, Shakirova OV (2015) Special Respiratory Training for Preparing Cold-Water Swimmers. Biol Med (Aligarh) 7(3): BM-114-15, 5 pages.

alphabetical order) into two equal groups (experimental group [EG] and control group [CG]). Sportsmen's qualification level corresponded with II category at the common swimming distances. The coach of both groups was the president of Amur's regional nongovernmental organization "Federation of Aquaice Sport," A.V. Brylin. Persons enrolled in the experiment were 19-20 years of age, all of whom had 4-5 years' experience in swimming and over 2 years' experience in cold-water swimming. Average anthropometric data of swimmers were as follows: body length—178.1 ± 4.2 cm; body weight—78.4 ± 3.2 kg.

According to the logical evidence structure, the experiment was conducted simultaneously for the two equal groups. Upon choosing such design for the experiment, we supposed that all spontaneous factors beyond our control would more or less equally affect participants in both EG and CG. Differences in net result, if any, would be the consequence of experimental factor only. As criteria for confirmation of the suggested hypothesis, we chose the criteria in accordance to which the hypothesis would be regarded as confirmed only in case if increment of pedagogical (training) result obtained in the consequence of influence of experimental factor would be bigger than in the consequence of influence of control factor. Effectiveness of influence of studied factors in CG and EG was determined after performing a series of trainings.

## Methods

### Identify subsections

To evaluate the influence of respiratory exercises with achievement of ECHH on the performance of swimmers during the experiment, special-control tests were performed, which included 1,500 m freestyle swimming in a swimming pool and 450 m breaststroke in open water with a temperature of 6°C at the beginning of the experiment and 4°C in the end. Test results let us evaluate the influence of respiratory exercises with achievement of ECHH, as additional means of training, on cold-water swimmers' sport performance. Total duration of pedagogical experiment, which was performed from December, 2013, to January, 2014, was 8 weeks (microcycles). Statistical analysis of digital data obtained during the experiment was performed with Mann–Whitney criterion, which is used to compare differences between two small samples.

### Sampling procedures

The main training process for participants from both groups followed one program. The only difference between groups in the list of preparation measures used at this stage was that participants of the EG additionally performed (after finishing the main training program) the recommended respiratory exercise providing ECHH.

### Measures and covariates

Such methods as pulsometry and tonometry were used to evaluate trends in functional indicators of the swimmers' body in cold water. Indicators of blood pressure and pulse were registered with blood pressure monitor "Ri-champion®." Obtained data were used as follows:

- To calculate Ruffier index (RI), which is a criterion for cardiovascular reserve capacity [14]. This index was calculated according to the formula $RI = (HR \times BPs)/100$, where HR is heart rate and BPs—systolic blood pressure. Rating scale for this index: 80 and below—high reserve; 81-90—average; 91 and above—low;
- To calculate adaptive potential (AP) of circulatory system according to the formula $AP = 0.11 \times HR + 0.014 \times BPd + 0.014 \times A - 0.27 + 0.009 \times W - 0.009 \times L$, where BPd is diastolic blood pressure; A—age, years; W—body weight, kg; and L—body length, cm. Indicator values were evaluated in accordance with the following scale: AP = 2.1 and below corresponds with rate "satisfactory adaptation"; 2.11-3.20—"tension of adaptation mechanism"; 3.21-4.30—"unsatisfactory adaptation"; 4.31 and above—"failure of adaptation mechanism" [15]. AP value enables to evaluate the state of compensative and adaptive mechanism, which is the basis for cardiac stroke volume;
- To estimate cardiac stroke volume (SV) by Starr, the following formula was applied: $SV = 90.97 + 0.54 \times PP - 0.57 \times BPd - 0.61 \times A$, where PP is pulse pressure; BPd—diastolic pressure; and A – age, years.

Estimation of cardiac SV makes it possible to monitor indicators of central hemodynamics, and in particular to describe pump function of heart which ensures delivery of oxygen to tissues [16].

Harvard step test was applied to evaluate the physical performance of persons enrolled in the experiment; the test involves a person stepping up and down on a platform that is 50 cm high for 5 min at a certain rate (30 cycles per min) [17]. Each cycle consisted of four steps. The rate was maintained by a metronome set for 120 bpm. After completion of the test, the subject sat down, and heartbeat was counted during the first 30 s on the second, third, and fourth minute of recovery. The swimmers' physical performance was estimated pursuant to Harvard step test index (HSTI), which was calculated according to the formula $HSTI = t \times 100/(f1 + f2 + f3) \times 2$, where $t$ is step-up time, s and $f1, f2, f3$—heartrate during 30 s on the second, third, and fourth minute of recovery, respectively. Results of Harvard step test were evaluated as follows: 90 units and above—excellent value, 80-89.9—good value, 65-79.9—average value, 55-64.9—value below average, below 55—bad value.

Trends in some indicators of mental state of cold-water swimmers when subjected to respiratory exercises providing ECHH were observed according to the data of Spielberg–Hanin test [18]. This test (self-assessment scale) is a reliable source of information about current anxiety level assessed by the person himself (state anxiety) and trait anxiety reflecting sufficiently the steady state of certain components of mental status. Trait anxiety defines steady inclination to perceive big range of situations as threatening in the form of anxiety state. State anxiety is described as tension, worry, and some nervousness. Very high state anxiety causes impaired concentration and may affect fine coordination. High trait anxiety directly correlates with the presence of neurotic conflict and emotional and neurotic breakdowns. Primarily anxiety is not a negative trait; certain level of anxiety is a natural and mandatory attribute of active personality. At the same time, there is appropriate individual level of "beneficial" anxiety. We interpreted the results of self-assessment scale assuming that a score below 30 indicates low anxiety, from 31 to 45—moderate anxiety, and above 46—high anxiety.

## Research design

During the experimental period, all participants exercised three times a week; two trainings were performed in swimming pool and one training was in open water. For cold-water swimming, participants used neoprene shorts and caps. In the EG, in the end of each training, respiratory exercises providing ECHH were performed. Sportsmen achieved this effect by repeatedly immersing face into a basin containing water at a temperature 10-12°C lower than ambient temperature. Water and air temperature were measured using thermometer. Ice chips were

**Citation:** Tyutyukov VG, Safonova GV, Shakirova OV (2015) Special Respiratory Training for Preparing Cold-Water Swimmers. Biol Med (Aligarh) 7(3): BM-114-15, 5 pages.

put in the basin to reach necessary temperature of water. Three persons simultaneously performed the procedure providing ECHH. Cold-water basins with diameter 40 cm and capacity 10 l were placed on a stand in such way to ensure comfortable posture without bending upper abdomen and to minimize tension in back and neck muscles when bending head and body for immersion. Subjects were asked to immerse face in water four times at the time of unforced expiration, without preliminary hyperventilation. Upon that:

- first and fourth immersions were performed with breath holding until sense of discomfort (until first urge to inhale);
- second and third immersions were performed with breath holding to maximum by volitional effort.

HR and PB were measured at rest before the procedure and during and after immersion of face in water (during restoration after breath holding). Also, in the cause of the procedure, we registered the duration of breath holding. Rest between immersions lasted until HR reached its initial value. During the 8 weeks, 24 procedures were performed; each procedure consisted of four immersions of face in water. Consequently, each swimmer from the EG performed 96 special respiratory exercises.

Methods of conducting the training described above suggest consideration of some peculiarities:

- If the time of second respiratory exercise significantly exceeded the time of first one, meanwhile pulse became higher than initial, then the third respiratory exercise was stopped upon appearance of first symptoms of discomfort.
- If after the performance of second respiratory exercise the pulse slowed down in comparison with initial value, then the next respiratory exercise was performed with breath holding to maximum by volitional effort.

In any case, time of breath holding should not exceed 2 min.

## Participant (subject) characteristics

Subject groups underwent similar preparation before beginning of the experiment during the preparatory period (June-September, 2013), and then on baseline (October-November, 2013) of the main training period. The major purpose of the trainings at that time included increase of capacity of cardiovascular and respiratory systems, strength, capacity, and efficiency of aerobic support of motor activity. During the period of preparation, swimmers used means of both general and special physical training. During the same period, sportsmen mainly swam with high-intensity training load, which aimed at adaptive alteration of cardiovascular system. Main methods of the swimmer's training were distance and interval method; swimming tasks were performed in both steady and alternate way. We provided both separate series of trainings and continuous interval trainings, but the preference was given to distance steady method with HR increasing to 110-120 bpm, and repeated method at 400-800 m distance, which was covered by sportsmen with HR 120-140 bpm. Swimmers exercised both in swimming pool and in open water with a temperature common for the climatic zone of Amur region and season (7-8°C in November and beginning of December, 1°C in January).

## Experimental manipulations or interventions

All sportsmen swam part of the distance in swimming pool wearing specially designed cold vest, which had pockets for ice cylinders. The external side of the vest is made of thermal insulating cover, and the thick internal side has a cell structure that enables cylinders to get contact with the water surrounding the chest surface and cool water. But the cylinders do not contact the swimmer's body directly. It made possible to train adaptation mechanism of thermal regulation activating at the most under conditions of cold-water swimming even in swimming pool with a water temperature of 26-27°C. Long distances were mainly covered by front crawl stroke or breast stroke. Both in swimming pool and in open water with relatively high water temperature, the series of trainings provided was as follows: 400 m + 200 m + 100 m with rest intervals 30-60 s, swimming 400 m using only legs with HR 132-138 bpm, 1-3 distances of 400 m each with rest intervals 30-60 s, 4-6 distances of 200 m each with HR 144 bpm and rest intervals 30-60 s.

In the pre-experimental period and during the experiment itself, training programs aimed at development of basic and special endurance were mainly used. In pool, sportsmen swam medium and long distances (200, 400, 800, 1,500 m) and short distances (50-100 m). In this period, swimmers swam the distances with varying speed. Mainly, the interval method of training was applied with intensity 80-85% when HR reached 170-180 bpm. At rest time, HR decreased to 120-130 bpm. During the experiment, after the river had frozen up, sportsmen swam in special ice hole 12.5 m long with a cover system preventing freezing. Once a week, sportsmen swam sprinter distances one time from 200 to 450 m according to the following algorithm: first week—200 m, second week—250 m, third week—300 m, fourth week—350 m, fifth week—400 m, sixth-eighth weeks—450 m. Cold-water trainings involved gradual immersion into water and preliminary psychological adaptation [19,20]. Total period of stay in cold water during one training varied from 4 to 11 min. Controlled competitive swimming was performed in ice holes with standard length within 1 week after completion of 8 weeks of experimental cycle. From 2010, at all big championships, standard length of ice hole is 25 m. For 6 weeks of experimental trainings, swimmers of both groups swam approximately 21,000 m; they stayed in cold river water for about 50 min, during which they covered about 3,000 m.

## Results

### Statistics and data analysis

Analysis of cold-water swimmers' examination results after 8 weeks of pedagogical experiment demonstrated the presence of certain trends in control values (Table 1). Participants of the EG after training supplemented with a special program of respiratory exercise demonstrated more clearly significant increase of performance—HSTI for the period of 8 weeks increased by 9.2% ($p < 0.05$). In the CG, no significant changes of this indicator were observed. The value of HR at rest for the period of observation in both groups in general had undesirable but significantly confirmed growing tendency. From the point of view of Polonetsky and Button *et al.,* increase of this indicator can be explained by acceleration of metabolism and growth of energy consumption in cold-water swimmers [21,22].

The value of Ruffier index in CG demonstrated no significant changes for the research period, but in EG significant decrease of this index was observed, which is regarded as a rather positive factor. Decrease of Ruffier index to 80 units and below indicates high reserve possibilities of cardiovascular system. In EG, the value of Ruffier index after special respiratory training decreased by 6.5% ($p < 0.05$)—from 87.9 to 82.2 units. Adaptive capacity of circulatory system in subjects from EG significantly improved by 13.6% toward the end of the study,

| | **Control group (CG) (*n* = 6)** | | | | **Experimental group (EG) (*n* = 6)** | | | | **Final differences between groups ($\bar{X}_2$-$\bar{X}_4$)** | |
|---|---|---|---|---|---|---|---|---|---|---|
| | **Beginning** | **End** | **Difference in % and statistical difference** | | **Beginning** | **End** | **Difference in % and statistical difference** | | | |
| **Indicators** | $\bar{X}_1 \pm m$ | $\bar{X}_2 \pm m$ | **%** | ***p*** | $\bar{X}_3 \pm m$ | $\bar{X}_4 \pm m$ | **%** | ***p*** | **%** | ***p*** |
| Performance (HSTI), nominal unit | 89.6 ± 24.5 | 91.2 ± 18.8 | 1.8 | >0.05 | 88.4 ± 21.3 | 99.6 ± 16.5 | 12.7 | <0.05 | 9.2 | <0.05 |
| HR at rest, bpm | 74.4 ± 12.37 | 77.2 ± 13.05 | 3.8 | <0.05 | 72.8 ± 12.53 | 74.4 ± 13.12 | 2.2 | <0.05 | 3.6 | >0.05 |
| Ruffier Index, nominal unit | 88.0 ± 9.4 | 88.4 ± 10.6 | 0.45 | >0.05 | 87.9 ± 10.8 | 82.2 ± 9.8 | –6.5 | <0.05 | 7.0 | <0.05 |
| Adaptive capacity, nominal unit | 2.1 ± 0.08 | 2.3 ± 0.14 | 9.5 | <0.05 | 2.2 ± 0.10 | 1.9 ± 0.12 | −13.6 | <0.05 | 17.4 | <0.05 |
| Stroke volume, ml | 68.4 ± 13.6 | 72.1 ± 10.6 | 5.4 | <0.05 | 71.6 ± 10.4 | 73.4 ± 10.4 | 2.5 | <0.05 | 1.8 | >0.05 |
| Breath holding time, s | 38.2 ± 16.8 | 42.4 ± 15.2 | 10.7 | <0.05 | 39.6 ± 16.0 | 50.6 ± 12.5 | 27.8 | <0.05 | 19.6 | <0.05 |
| Trait anxiety, score | 39.6 ± 3.5 | 44.6 ± 7.4 | 12.6 | <0.05 | 38.8 ± 3.6 | 39.4 ± 7.3 | 1.5 | >0.05 | 11.6 | <0.05 |
| State anxiety, score | 22.0 ± 4.5 | 21.8 ± 6.3 | –0.9 | >0.05 | 20.8 ± 6.7 | 17.2 ± 7.3 | −17.3 | <0.05 | 21.1 | <0.05 |
| 1,500 m swimming, s (min.s.) | 1282.6 ± 48.6 (21.22.6) | 1254.8 ± 52.1 (20.54.8) | −2.18 | <0.05 | 1288.4 ± 43.2 (21.28.4) | 1186.6 ± 46.6 (19.46.6) | −7.9 | <0.05 | 5.43 | <0.05 |
| 450 m cold water swimming, s (min.s.) | 472.4 ± 18.2 (7.52.4) | 462.2 ± 16.3 (7.42.2) | −2.16 | <0.05 | 468.5 ± 17.6 (7.48.5) | 446.1 ± 13.6 (7.26.1) | −4.78 | <0.05 | 3.48 | <0.05 |

**Table 1:** Trend in indicators of functional state and special preparedness of cold water swimmers during the experiment

and was assessed as "satisfactory adaptation." Prior to the beginning of the experiment, adaptive capacity in EG corresponded with "tension of adaptation mechanism." In CG, adaptive capacity of circulatory system during the 8 weeks continued to be in the state of tension.

The value of SV in both groups had significantly confirmed growing tendency; that's why in the end of the study, no differences between groups were observed.

Analysis of "breath holding time" indicator showed that after using experimental program of respiratory training, the value of this indicator in EG increased by 27.8% ($p < 0.05$), which was two times higher than similar data of subjects in CG: in CG, breath holding time increased only by 10.7% ($p < 0.05$). Participants of the EG for the time of research demonstrated decrease of state anxiety and no signs of growing trait anxiety; meanwhile, in CG, this indicator increased by 12.6% ($p < 0.05$). Apparently, such correlation of considered types of anxiety in EG should be regarded as more reasonable and related to the values corresponding to the level of "beneficial anxiety" (according to the data of deeper analysis). Moreover, it may be confirmed by the results of 1,500 m swimming, which in EG (by the end of the experiment) improved by 5.43% ($p < 0.05$) in comparison with CG. Undoubtedly, it should not be denied that such swimming performance in "warm" water could be as well the result of qualitative alteration in the functional state of cardiorespiratory system.

## Ancillary analyses

Participants of both groups for the period of research demonstrated tendency toward growth of body weight. We assume that it is a quite normal effect. According to certain data, it may be the defensive reaction protecting the body from overcooling [23].

The most significant effect of proposed respiratory training should be deemed to be the improvement of results in 450 m cold-water swimming. Results of this swimming test in EG improved from 468.5 to 446.1 s (4.78%; $p < 0.05$). In CG the trend was less significant—2.16% ($p < 0.05$). Consequently, final difference between groups reached 3.48% and was significant.

## Discussion

It shall be noted that while planning this experimental research, authors of this article relied on data of preliminary approbation of this respiratory training performed by some cold-water swimmers when they prepared for participation in an open competition between Russian cities (with international participation), which took place in Tyumen city (Lipovoe lake) on December 15-16, 2012. In this competition of marathon-distance swimming, swimmer A.V. Brylin, who had performed the described respiratory training during preparation, demonstrated the result of his training in the 2,200 m race, and his time of staying in water with temperature 1.2°C during this race was 1 h and 5 s. This result is a personal record of the sportsman. His previous result with the same temperature of water was in a 1,700 m race (time of swimming 48.25.00). In this case, the result was improved by 29.4%, not without the help of the experimental method of respiratory training. Besides, swimming speed in the record swimming race, in spite of 500 m longer distance, increased by 5.1% (from 0.58 to 0.61 m/s).

This type of respiratory training was also used in the preparation of Far-Eastern swimmers for swimming across the Bering Strait "Chukotka—Alaska 2013," and in the preparation for IX World Winter Swimming Championship in 2014. At this championship, representatives of the Far-Eastern Federal Region won 8 gold, 10 silver, and 8 bronze medals, thereby making a strong contribution in the common victory of the Russian team. Represented data confirm appropriateness of use of respiratory exercises providing ECHH for increasing sport effectiveness of cold-water swimmers. This type of respiratory training enables to get significant improvement in general performance and growth of adaptive capacity of the cardiovascular system. Besides, this training helps to decrease state and trait anxiety providing achievement of a state of psychological well-being and preparedness for planned physical loads.

### References

1. Tyutyukov VG (2013) Respiratory training with achievement of the effect of cold, hypoxia and hypercapnia in preparation of cold water swimmers. In the Proceedings of the 2013 Russian National Conference, pp. 301-305.

2. Afonyakin IV (2003) Use of Interval Hypoxic Training for Increasing Anaerobic Performance of Swimmers, M. S. Thesis, Russian State Academy of Physical Culture, Moscow.
3. Ruban AV (2004) Application of Respiratory Exercises with Elements of Cold, Hypoxic and Hypercapniac Influence in Training of Swimmers, M. S. Thesis, State Academy of Physical Education named after P.F. Lesgaft, St-Petersburg.
4. Kolchinskay AZ (1993) Mechanism of interval hypoxic trailing effects. Hypoxia Medical Journal 1: 5-7.
5. Song SH, Kong DH, Kang BS, Hong SK (1963) Lung volumes and ventilator responses to high CO$_2$ and low O$_2$. Journal Applied Physiology 18: 466-470.
6. Gooden BA (1994) Mechanism of the human diving response. Integrative Physiological and Behavioral Science 29(1): 6-16.
7. Galantsev VP, Baranova TI, Yanvareva IN (2001) Drug-free method of rehabilitation, preventive measures and increase of functional reserve of human body. Invention Patent 2161476. Research Institute of Physiology named after A.A. Ukhtomsky, Moscow.
8. Baranova TI (2008) Mechanism of Adaptation to Diving Hypoxia, M. S. Thesis, Research Institute of Physiology named after A.A. Ukhtomsky, St-Petersburg University, St-Petersburg.
9. Galantsev VP, Baranova TI, Vaschuk OV (1995) The question of evaluation of effectiveness of adaptive reactions on cyclical physical loads with increasing strength. Issues of Students Physical Education 24: 93-100.
10. Baranova TI, Berlov DN, Sviridenko MV, Yakovleva IN (1999) Influence of cold and hypoxia as the way to increase functional reserves of sportsmen’s body. In the Proceedings of the 1999 International Science Conference, p. 17.
11. Lombardi G, Ricci C, Band G (2011) Effect of winter swimming on hematological parameters. Biochemical Medica 21(1): 71-78.
12. Datta A, Tipton M (2006) Repiratory responses to cold water immersion: nerval pathways, interactions, and clinical consequences awake and asleep. Journal of Applied Physiology 100(6): 2057-2064.
13. Golden FS, Tipton MJ, Scott RC (1997) Immersion, near-drowning and drowning. British Journal of Anaesthesia 79 (2): 214-225.
14. Smagulov NK, Mukhametzhanov AM, Karimov NZ (2013) Physiological evaluation of tension of cardiovascular system in military men during compulsory military service. Fundamental Research 9: 143-147.
15. Baevsky RM, Berseneva AP (1997) Evaluation of Adaptive Capacity of Body and Risk of Diseases. Moscow Medicine Press, pp. 28-36.
16. Zabolotskikh IB, Stanchenko IA, Skopets AA (2002) The way of measuring stroke volume. Invention patent #2186520. Russian Center of Functional Surgery and Gastroenterology.
17. Aulik IV. Determination of Physical Performance in Clinic and in Sport. Moscow Medicine Press, pp. 48-50.
18. Kudryashov AF (1992) The Best Psychological Tests for Vocational Selection and Vocational Guidance. Petrozavodsk Petrocom Press, p. 318.
19. Hayward JS, French CD (1989) Hyperventilation response to cold water immersion: reduction by staged entry. Aviation, Space, and Environmental Medicine 60(12): 1163-1165.
20. Barwood MJ, Dalzell J, Datta AK (2006) Breath-hold performance during cold water immersion: effects of psychological skills training. Aviation, Space, and Environmental Medicine 77(11): 1136-1142.
21. Polonetsky LZ (2007) Significance of heart rate in clinical practice. New possibilities of antianginal therapy. Medical News 5: 5-7.
22. Button C, Croft JL, Cotter JD (2015) Integrative physiological and behavioral responses to sudden cold water immersion are similar in skilled and less-skilled swimmers. Physiology & Behavior 138: 254-259.
23. Brannigan D, Rogers IR, Jacobs J (2009) Hypothermia is a significant medical risk of mass participation long distance open water swimming. Wilderness and Environmental Medicine 20(1): 14-18.

**Citation:** Tyutyukov VG, Safonova GV, Shakirova OV (2015) Special Respiratory Training for Preparing Cold-Water Swimmers. Biol Med (Aligarh) 7(3): BM-114-15, 5 pages.