CHANGES OF INSPIRATORY PARAMETERS AND SWIMMING PERFORMANCE BY INFLUENCE OF POWERBREATHE PLUS LEVEL 3

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Abstract

The aim of the study was to detect changes of inspiratory parameters and performance in underwater swimming by the use of the device POWERbreathePlus Level 3 (POWER®breathe, Southam, UK).The research specimens were comprised of probands (n = 5, height = 177.8±7.6 cm, weight = 66.0±6.6 kg)aged 17.5to23.1years. POWERbreathePlus Level 3 (POWER®breathe, Southam, UK) was integrated into the training process for 10 weeks. The experimental factor was given twice a day for 30 inspirations in the morning and evening. The impact of the experimental factor was monitored by an assay on the POWERbreathe K 5 (POWER®breathe, Southam, UK) breathing equipment. The assay was focused on finding out the intensity index (S – index), maximum speed of inhalation(flow) andvolume of inhaled air. The other test included underwater swimming on single breath. In parameter S – index was average levelin input testing 111.0±42.7 cm$H_2O$and the average level in output testing was 133.6±46.2 cmH_2O which means significant improvement (T = 0, n = 5, p < 0.05, ES = 0.90 – large effect). The improvement of the ensemble´s level was also detected in third inspiratory parameterwhere the volume was following: (T = 0, n = 5, p < 0.05, ES = 0.92 – large effect). The input level was 3.02±0.48and output level was 3.52±0.52 l. Significant increase of the average level of the ensemble (T = 0, n = 5, p < 0.05, ES = 0.91 – large effect) was detected also when the distance was increased which was swum under the water when the value of the ensemble during input testing was 38±6 m and during output testing was 43±6 m.

Key words: *functional breathing parameters, Powerbreathe, swimming performance*

Introduction

In the field of research on the efficiency of the given training load and its resources there are the possibilities of applyingan intra-individual approach from the perspective of temporal parameters characterized by the dominancy of the data's asynchronous configuration of dependent and independent variables (Broďáni, 2011). Theswimming performance is influenced by the amount of factors unquestionably belonging to the level of functional and physiological parameters. The ability to regulate breathing is substantially more important than in other "dry" sports because of the aquatic environment and the technique of the swimming strokes. The ability to correctly stabilise and steer the inspiration and expirationmuscles is an assumption to optimally maintain stroke efficiency. This creates conditions for good performance in a swimming pool. Jakovljevič& McConnell (2009) confirmed in their research the importance of observing and developing the functional parameters of breathing when swimming. Many authors, for instance, Wells et al. (2005), dealt with the possibility of increasing the functional parameters of breathing. Mickleborough et al. (2008) in their researches point to the size of the claim ofinspiration muscles and hold the view that the swimming training itself indicates the improvement of this muscle type. Authors like Edwards et al. (2008); Griffiths & McConnell (2007); Johnson et al. (2007); Tong et al. (2008); and others point to the fact that training the inspiration muscles improves performance both in untrained individuals, and endurance athletes and sprinters.The positive impact of training the inspiration muscles through the Powerbreatheequipment for endurance performance has been confirmed by several authors, for instance Griffiths & McConnell (2007); Johnson et al. (2007); Leddy et al. (2007) and others. On the other hand, authors like Downey et al. (2007); Johnson et al. (2007) have a different opinion and attribute the improvement of endurance performance to the perception of reduced strain.Kilding et al. (2010) have also tested Powerbreathe and have arrived to the findings that in the experimental specimen there was an improvement on the 100 m distance by 1.7 %($p < 0.01$) and on the 200 m distance by 1.5%($p < 0.01$).

Aim

The aim of the study was to detect changes of inspiratory parameters and performance in underwater swimming by the use of the device POWERbreathePlus Level 3 (POWER®breathe, Southam, UK).

Alternative hypotheses

H_{A1}: The effect ofPOWERbreathePlus Level 3 (POWER®breathe, Southam, UK) is rebounded in enhancement of inspiratory volume.

H_{A2}: On the base of inspiratory volume´s increase we expect significant increase of the values in distance which was under the water.

Methods

Characteristics of ensemble
The research specimen was comprised of an intentionally chosen 1 male proband and 4 female probands(height = 177.8±7.6 cm, weight = 66.0±6.6 kg) from the VŠC DuklaBanskáBystrica sports centre. The age of the specimen was from 17.5to23.1years.

Research´s organisation
The input measurements were carried out on 26 June 2013. Tests were taken through the POWERbreathe K5 (POWER®breathe, Southam, UK) breathing equipment. We are stating the best attempt from the three realised in the results. The experimental factor was taken from 01 July – 08 September 2013, i.e. for a period of 10 weeks. The input measurements were taken on 11 September 2013.All measurements were realized in standardised conditions in 50 m covered swimming pool "Štiavničky" in BanskáBystrica. The experimental factor was the inclusion of the POWERbreathePlus Level 3 (POWER®breathe, Southam, UK) equipment with individually adjustable resistance to the training process. The probands carried out the breathing with the equipment twice a day with 30 repetitions. The selected frequency and volume are suggested by the producer. Breathing through the devicePOWERbreathe Plus Level 3 (POWER®breathe, Southam, UK)was realized by swimmers every day in the morning at 6.30 AM before the training and every evening at 7.00 PM after the training. We detected the experimental factor´s influence on changes (input-output) in four indicators: 1) "S – index" – index intensity (strength), which measures the strength of muscles of respiration. The value was detected in cm cmH_2O.; 2) "Flow"- parameter of maximal speed by which the swimmers resized inspiration and expiration. The value was noticed in litres per second ($l.s^{-1}$); 3) The volume respectively amount of the air which gets to the lunges by inspiration. The value was noticed by litres (l). We have chosen in the evaluation the best experiment (from three experiments) in all inspiratory indicators. Input and output measurements of the indicators were realized in the beginning of the training, AND 4) The indicator was the test of maximal distance which was swum under the water on one inspiration (one breath). The test was realized after 500 m warm up swimming. The distance was evaluated in metres (m).

Statistical analysis
In presented study we have used within periphrastic characteristics of descriptive statistics arithmetic average (x) from position measures and standard deviation (SD) from variability measures. We used also minimal (min) and maximal (max) value of individual´s parameters. We used Wilcoxon Signed Ranks Test to detect the significance of changes between input and output measurements.The probability of type I error (alpha) was set at 0.05 in all statistical analyses.

The coefficient effect size wascomputedaccording the relation ES = |z|/√n (Corder& Foreman, 2009) and it was interpreted as: small effect = 0.10, medium effect = 0.30, and large effect = 0.50 (Cohen, 1988). Statistical analysis was realized with software IBM® SPSS® Statistics V19 (Statistical Package for the Social Sciences).

Results and discussion

The average level of ensemble S – index (table 1) was in input measurements 111.0±42.7 cmH_2O. The average value of ensemble increased after the application of 10 weeks- programme with the device POWERbreathePlus Level 3 (POWER®breathe, Southam, UK) on 133.6±46.2 cmH_2O what is significant improvement (T = 0, n = 5, $p < 0.05$, ES = 0.90 – large effect).

Table 1 Values of ensemble's S – index (cmH_2O)in input and output measurements

S - index	input	output
x	111.0	133.6*
SD	42.7	46.2
min	84.0	108.0
max	186.0	216.0

* significant difference (increase of S – index) $p < 0.05$

In speed of inhalation´s parameter – flow (table 2) was the average level of the ensemble in input measurements 6.18±2.07 $l.s^{-1}$. The average value of ensemble increased after the application of 10 weeks – programme with the device POWERbreathePlus Level 3 (POWER®breathe, Southam, UK) on 7.28±2.14 $l.s^{-1}$what is significant improvement (T = 0, n = 5, $p < 0.05$, ES = 0.90 – large effect).

Table 2 Speed of inhalation´s values ($l.s^{-1}$) of ensemble in input and output measurements

Speed of inhalation	input	output
x	6.18	7.28*
SD	2.07	2.14
min	5.00	6.00
max	10.00	11.00

* – significant difference (increase of speed of inhalation) $p < 0.05$

In volume of air´s parameter (table 3) was the average level of the ensemble in input measurements 3.02±0.48 l. The average value of ensemble increased after the application of 10 weeks – programme with the device POWERbreathePlus Level 3 (POWER®breathe, Southam, UK) on 3.52±0.52 l what is significant improvement (T = 0, n = 5, $p < 0.05$, ES = 0.92 – large effect).

We also compared the distance which was swum under the water (table 4). We assumed that the inspiratory parameters would increase after the application of 10 weeks – programme with the device POWERbreathePlus Level 3 (POWER®breathe, Southam, UK).

Table 3 Ensemble´s volume of air (l) in input and output measurements

Volume of air	input	output
x	3.02	3.52*
SD	0.48	0.52
min	2.00	4.00
max	3.00	4.00

* significant difference (increase volume of air) $p < 0.05$

Finally, it was confirmed in all indicators. We also assumed that the increase of inspiratory indicators would be also signified in enlarged distance which was swum under the water. The average value of distance swum in water was in input measurements 38±6 m and in output measurements 43±6 m, what is significant improvement of average performance ($T = 0$, $n = 5$, $p < 0.05$, $ES = 0.91$ – large effect).

Table 4 Enlarged distance swum under the water (m) by the ensemble in input and output measurements

Underwater swimming	input	output
x	38	43*
SD	6	6
min	31	35
max	46	51

* – significant difference (increase of enlarged distance swum under the water) $p <0.05$

Conclusion

The research's results confirmed that with the increase of the functional breathing parameters it is possible to improve swimming performance, which we monitored through an underwater swimming test. We tried to increase the inspiratory volume through of the POWERbreathePlus Level 3 (POWER®breathe, Southam, UK)breathing equipment. On the basis of the given aim – the improvement of the respiratory muscles – we determined the following hypotheses: In hypothesis H_{A1} we assumed that the efficiency of POWERbreathePlus Level 3 (POWER®breathe, Southam, UK)would significantly express itself statistically on the increase in inspiratory volume confirmed. The results of monitoring inspiratory volumes such as the S – index, the speed of inhalation and maximum volume of inhaled air showed us positive changes in the following values:

- In S – index parameter was the average level of the ensemble in input measurements 111.0±42.7 cmH_2O, and in output measurements 133.6±46.2 cmH_2O what is significant improvement ($T = 0$, $n = 5$, $p < 0.05$, $ES = 0.90$ – large effect).
- In flow parameter was the average level of the ensemble in input measurements 6.18±2.07 $l.s^{-1}$. 7.28±2.14 $l.s^{-1}$, what is improvement ($T = 0$, $n = 5$, $p < 0.05$, $ES = 0.90$ – large effect).
- In volume of air´s parameter was detected significant increase of the ensemble´s level ($T = 0$, $n = 5$, $p < 0.05$, $ES = 0.92$ – large effect), when the input level was 3.02±0.48 l and output level was 3.52±0.52 l.

In hypothesis H_{A2} we assumed that the increase in inspiratory volume would significantly express itself statistically in the maximum values of underwater swimming distance. The second hypothesis was also confirmed because the distance swum under the water was significantly enlarged.

Regarding the research results we can state that the duration of use (10 weeks), frequency (twice a day) and also the number of repetitions (30 inhalations) was sufficient to provoke the statistically significant changes ($p < 0.05$) in the monitored functional breathing parameters. We suggest, on the basis of the improvements regarding the level of functional breathing parameters:

- includingPOWERbreathe Plus Level 3 (POWER®breathe, Southam, UK) breathing equipment into the training process ,
- applyingPOWERbreathe Plus Level 3 (POWER®breathe, Southam, UK) twice a day for 30 repetitions for a minimum duration of 6 weeks,
- changing the level of difficulty according to the recommendations of the producer,

diagnosing and monitoring changes in the functional breathing parameters and their impact on swimming performance.

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PROMJENE PARAMETARA DISANJA I IZVEDBE PLIVANJA POD UTJECAJEM UREĐAJA POWERBREATHE PLUS RAZINE 3

Sažetak

Cilj istraživanja je bio otkriti promjene parametara disanja i izvedbe kod podvodnog plivanja korištenjem sredstva POWERbreathePlus Razine 3 (POWER®breathe, Southam, UK). UzorAK istraživanja sastojao se od ispitanikaa (n = 5, visina = 177,8 ± 7,6 cm, težina = 66,0 ± 6,6 kg) uzrasta 17.5 - 23.1 godine. POWERbreathePlus Razine 3 je integriran u trenažnom procesu za 10 tjedana. Eksperimentalni faktor je zadan dva puta dnevno u trajanju od 30 inspirija u jutarnjim i večernjim satima. Utjecaj eksperimentalnog faktora praćen je testom na POWERbreathe K 5 opreme za disanje. Test je usmjeren na pronalaženje indeksa intenziteta (S - index), maksimalne brzine udisanja (protoka) i volumena udahnutog zraka. Drugi Test uključuje podvodno plivanje na jedan dah. Parametar S-Indeks je prosjek razine ulaza u testiranje 111,0 ± 42,7 cmH2O i s prosječnom razinom u izlaznom testiranju od 133,6 ± 46,2 cmH2O što znači značajno poboljšanje (T = 0, n = 5, p <0,05, ES = 0.90 - veliki učinak). Poboljšanje na globalnoj razini također je otkriveno u trećem udisaju gdje je volumen bio sljedeći: (T = 0, n = 5, p <0,05, ES = 0,92 - veliki učinak). Ulazna razina bila je 3,02 ± 0.48 a izlazna razina 3,52 ± 0,52 l. Otkrivena je i kada je udaljenost povećana za one koji se mjereni pod vodom, kada je vrijednost globalnog trajanja bila na ulaznom testiranju 38 ± 6 m, a tijekom ispitivanja izlaz je bio 43 ± 6 m.

Ključne riječi: *funkcionalni parametric disanja, Powerbreathe, plivačka izvedba*

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