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OPTIMIZATION OF VO2MAX FOR MEDICAL STUDENTS PLAYING HANDBALL

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Abstract

It is known that the handball game requires an aerobic capacity at maximum values with direct implication on the handball game, especially on the endurance and the frequent rhythm changes. Handball is a dynamic game and requires from the players an intense physical effort, nowadays witnessing an impetuous increase in sports performance due to the knowledge from different fields of science that have penetrated the science of training. Purpose: The influence of physical training with the help of swimming on the indicators of aerobic exercise capacity and VO2-max. Methods: This study was conducted on 20 students, members of the handball team of the University of Medicine and Pharmacy "Carol Davila" in Bucharest, with a height (178,10±6,27cm), weight (70,5±11,32 kg) and age (21,8±1,98 years), divided into two groups, experiment and control, (10) players for each group. In conducting this research, the Garmin Fenix 5 smartwatch device was used. The research was applied to the two groups through initial testing, intermediate after the preparatory period and final testing after the competition period. Results: At the final testing, after the competition period, for the experiment group, which benefited from swimming sessions in the training program, a clear evolution with a total difference of 341 mil / min from the control group is observed.

Keywords: Handball players, maximal oxygen uptake, swimming

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1. Introduction

Handball is a dynamic game and requires from the players an intense physical effort, nowadays witnessing an impetuous increase in sports performance due to the knowledge from different fields of science that have penetrated the science of training. The handball game requires an aerobic capacity at maximum values with direct implication, especially on the endurance in speed regime and the frequent changes of pace. A few scientific articles available on team handball described the game as a high-impact intermittent exercise mode, which is characterized by a great number of sideward movements, jumps, and throws (Delamarche et al., 1987, pp. 55-59). Athletes are forced to face the ever-increased demands imposed by the evolution of sports technique and tactics in high performance handball (Buse, Georgescu et al., 2021, p. 333). For handball players, successful match performance requires several physical attributes such as speed, power, strength and agility, plus the ability to maintain performance during repeated sprints (Michalsik et al., 2013, pp. 590-99). According to the literature, strength and power training programs have been demonstrated to be effective in improving athletics capabilitie in team-sport player (Bauer et al., 2019, p. 851; Chaabene et al., 2018, p. 1779; de Hoyo et al., 2016, p. 377; Fathi et al., 2019, p. 2117; Freitas et al., 2017; Kobal et al., 2017, p. 1476). During the training period, handball training focuses on the development of physical fitness, as it is aimed at the pre-competitive period where the ability of repeated sprinting, aerobic and anaerobic capacity is improved to move on to improving tactical and technical skills (Mazurek et al., 2018, p. 137). VO2 max is the maximum aerobic capacity, i.e., the highest level of oxygen consumption achieved in maximum effort regime being in a relationship of direct proportionality with the performance of athletes, especially for endurance ones that improve when VO2 max increase (Marangoz & Var, 2018, pp. 216-219). Typically, the VO2 max limit is reached within a range of 8 to 18 months and can be maintained even if the swimming training volume is reduced by 60% for a period of 15-21 days (Wilmore & Costill, 2004, p. 298). Crucially, once a plateau in VO2 max has been reached further improvements in performance are still seen with training, this phenomenon being because the athlete is able to perform at a higher percentage of VO2 max for prolonged periods, the reasons being the improvement of the anaerobic threshold and the energy saving (Katch et al., 2011, p. 267). Swimming regularly interspersed among other activities, provides a number of benefits such as: it works the whole body (through the styles of swimming, bras, crawl, back and butterfly), also addresses the internal organs (cardiovascular system, lungs and helps to lower blood pressure) (Marcin, 2017). According to the study conducted by Ribeiro et al. (1990, p. 200) 79% of the variability of swimming performance on 400 meters is associated with a swimming speed corresponding to 85% percent of VO2 max. Differentiated training aims at the relationship of collaboration and organization of forms of training (Buse, Pitigoi et al., 2021, p. 338).

2. Problem Statement

The extent to which VO2 max can change as a result of training also depends on the value at which it starts. There is also an upper genetic boundary beyond which, additional increases in either intensity or volume have no effect on aerobic power. In general, it is considered the best indicator of cardiorespiratory resistance and aerobic fitness, being the ability of the body to use the available oxygen.

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Our approach was oriented in the direction of supporting medical students who due to the very busy curricular curriculum cannot participate throughout the year in specific trainings in handball and must cope with the numerous intense efforts and qualification matches on the regional university center. In this study we have investigated VO2 max at the beginning of the training periods, after the training period and at the end of the competitive period.

3. Research Questions

The current study has focused on exploring and identifying how swimming is actuated as a complementary support in the training of handball medical students players on VO2 max. The basic question of this study is whether swimming as a complementary sport can help increase VO2 max values for medical students knowing that they have limited training time. Thus, we have hypothesized that handball medical students players who participate in swimming sessions interspersed in the training program, can achieve a substantial increase in VO2 max.

4. Purpose of the Study

Increase VO2 max values for medical students practicing handball with the help of a swimming session interspersed in the training program..

5. Research Methods

5.1. Participants

The research was conducted on a number of 20students, members of the handball, male and female, of "Carol Davila" University of University of Bucharest, aged between 19-25 years, where goalkeepers are excluded. The players were divided into two groups of 10 (5 boys and 5 girls). Physiological characteristics of the subjects are presented in table 1. Before the study began, all the experimental procedures, benefits and risks of the study were explained to the participants, and they each provided written informed consent.

Table 1. (Mean ±SD) values of the subjects characteristics

Variables	Group 1 (experimental)	Group 2 (control)
Age (years)	21.7±2.05	21.9±2.02
Height (m)	177.8±6.73	178.4±6.13
Body mass (kg)	67.8±9.49	71.6±12.52

5.2. Materials

For the examination we used the Garmin Fenix 5 smartwatch since it allows the measurement of the maximum VO2 value. This device is worn by the student during the Yo-yo test for intermittent IR1 recovery level 1. The test is not conditioned by any laboratory equipment; therefore, it can be conducted in the field, in the given interior or exterior arrangements. It can store the information and being transferred later to the computer through a USB connection.

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5.3. Procedure

The research was conducted on two groups of 10 participants, evaluated simultaneously, in a similar order, at approximately the same time of day, with a difference of one two minutes. Throughout the entire research process, the compliance of ethical guidelines was ensured: athletes participated voluntarily, without any constraints; all were informed that, at any moment, they could decide to withdraw from the study; the participants remain anonymous, and data has been treated confidentially. An initial test was applied to both groups, after which a normal training program of 4 months followed with 2-3 workouts per week depending on the study program, in addition, throughout this period, the experiment group entered the swimming pool 1 to 2 times a week, on days without training. After this period, the intermediate testing was performed, followed by a pre-competitive and competitive period of 6 weeks, totaling 4 to 5 activities per week depending on the the competitive calendar; also during this period, the experimental group continued with swimming sessions at least 3 times a week. At the end of this period, the final test was performed, 18-20 hours after the last training, the objective of the test is to measure the maximum values of VO2 at that time for those two groups.

6. Findings

Regarding the results obtained by student, according to the two groups, the statistics highlight some significant differences.

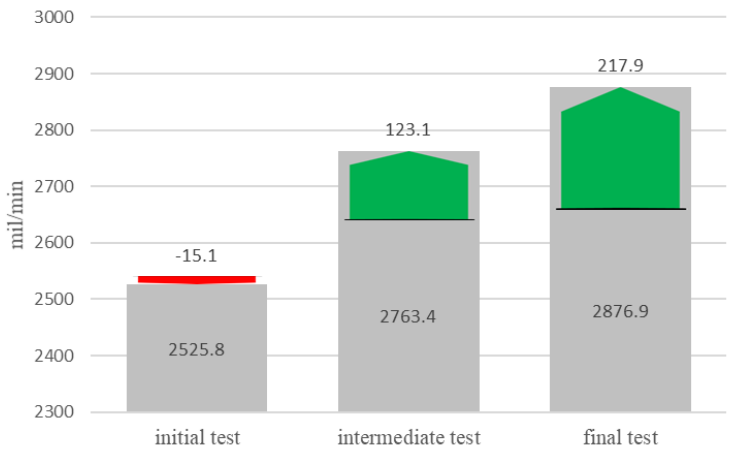

Figure 1. Difference in average VO2max values in the three tests for both groups

As shown in Figure 1 in initial testing, the average maximum oxygen volume for the experiment group is 15 mil/min lower than the experiment group. At the end of the preparatory period, although it was lower, the average VALUE of VO2 max increased for the experiment group by 123.1 mil/min above the average value of the control group. At the end of the competitive period, these average values are clearly higher for the experiment group, having an exponential increase of 217.9 mil/min, compared to the control group, which recorded an increase of only 18.7 mil/min compared to intermediate testing.

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7. Conclusions

This study explored the hypothesis that handball medical students' players participating in swimming sessions interspersed in the training program can achieve a substantial increase in VO2 max. Thus, swimming practiced in a complementary way, in the training of medical student's handball players, can increase VO2 max by 10% compared to the normal increase due to specific training. At the final testing, after the competition period, for the experiment group, which benefited from swimming sessions in the training program, a clear evolution with a total difference of 341 mil / min from the control group is observed. For the training of medical students, handball players, who benefit from a limited-term training and related to the specific medical curriculum, we consider a substantial contribution in their preparation especially in the pre-competitive and competitive period where for the experiment group there is an increase of VO2 max by 4% compared to the control group where the increase is insignificant being only 0.7%.

References

Bauer, P., Uebellacker, F., Mitter, B., Aigner, A., Hasenoehrl, T., Risrl, R., Tschan, H., & Seitz, L. (2019). Combining higher-load and lower-load resistance training exercises: A systematic review and meta-analysis of findings from complex training studies. *Journal of Science Medicine in Sport, 22*, 838–851. https://doi.org/10.1016/j.jsams.2019.01.006

Buse, P., Georgescu, L., Pitigoi, G., Paunescu, C., Petrescu, S., Pricop, A., & Petrescu, O. (2021). Findings regarding the introduction of post effort recovery on handball player. In Rusu, Oravitan, Cosma & Korkmaz (Ed.), *New Trends of Fundamental Research in Sport Science From research to performance*, Conference Proceedings Book, march 2022, Craiova, (pp. 330-333). Universitaria.

Buse, P., Pitigoi, G., Paunescu, C., Petrescu, S., Pricop, A., Petrescu, O., & Georgescu, L. (2021). The importance of using swimming as a complementary sport for handball players, (2022). Findings regarding the introduction of post effort recovery on handball player. In Rusu, Oravitan, Cosma & Korkmaz (Ed.), *New Trends of Fundamental Research in Sport Science From research to performance*, Conference Proceedings Book, march 2022, Craiova (pp. 334-339). Universitaria.

Chaabene, H., Prieske, O., & Negra, Y. (2018). Change of Direction Speed: Toward a Strength Training Approach with Accentuated Eccentric Muscle Actions. *Sports Medicine, 48*, 1773–1779. https://doi.org/10.1007/s40279-018-0907-3

de Hoyo, M., Gonzalo-Skok, O., Sañudo, B., Carrascal, C., Plaza-Armas, J., Camacho-Candil, F., & Otero-Esquina, C. (2016). Comparative Effects of In-Season Full-Back Squat, Resisted Sprint Training, and Plyometric Training on Explosive Performance in U-19 Elite Soccer Players. *Journal of Strength and Conditioning Research, 30*(2), 368-377. https://doi.org/10.1519/JSC.0000000000001094

Delamarche, P., Gratas, A., Beillot, J., Dassonville, J., Rochcongar, P., & Lessard, Y. (1987). Extent of lactic anaerobic metabolism in handballers. *International Journal of Sports Medicine, 8*, 55-59. https://pubmed.ncbi.nlm.nih.gov/3557785/

Fathi, A., Hammami, R., Moran, J., Borji, R., Sahli, S., & Rebai, H. (2019). Effect of a 16 week combined strength and plyometric training program followed by a detraining period on athletic performance in pubertal volleyball players. *Journal of Strength and Conditioning Research, 33*, 2117–2127. https://doi.org/10.1519/jsc.0000000000002461

Freitas, T. T., Martinez-Rodriguez, A., Calleja-González, J., & Alcaraz, P. E. (2017). Short-term adaptations following Complex Training in team-sports: A meta-analysis. *PLOS ONE, 12*(6), e0180223. https://doi.org/10.1371/journal.pone.0180223

Katch, V. L., McArdle, W. D., & Katch, F. I. (2011). *Essentials of Exercise Physiology, Fourth Edition*. Printer: C&C Offset Printing Co. Ltd., Lippincott Williams & Wilkins, a Wolters Kluwer business.

Kobal, R., Loturco, I., Barroso, R., Gil, S., Cuniyochi, R., Ugrinowitsch, C., Roschel, H., & Tricoli, V. (2017). Effects of different combinations of strength, power, and plyometric training on the physical performance of elite young soccer players. *Journal of Strength and Conditioning Research, 31*, 1468–1476. https://doi.org/10.1519/JSC.0000000000001609

Marangoz, I., & Var, S. M. (2018). The Relationship among Somatotype Structures, Body Compositions and Estimated Oxygen Capacities of Elite Male Handball Players. *Asian Journal of Education and Training, 4*(3), 216-219. https://eric.ed.gov/?id=EJ1182100

Marcin, A. (2017). What Are the Top 12 Benefits of Swimming?. Retrieved on January 11, 2020, from

Mazurek, K., Zmijewski, P., Makaruk, H., Mróz, A., Czajkowska, A., Witek, K., & Lipińska, P. (2018). Effects of short-term plyometric training on physical performance in male handball players. *Journal of Human Kinetics, 63*, 137. https://doi.org/10.2478/hukin-2018-0014

Michalsik, L. B., Aagaard, P., & Madsen, K. (2013). Locomotion characteristics and match-induced impairments in physical performance in male elite team handball players. *International Journal of Sports Medicine*, *2013*, *34*(7), 590–599. https://doi.org/10.1055/s-0032-1329989

Ribeiro, J. P., Cadavid, E., Baena, J., Monsalvete, E., & De Rose, E. H. (1990). Metabolic predictors of middle-distance swimming performance. *British Journal of Sports Medicine, 24*(3), 196-200. https://bjsm.bmj.com/content/24/3/196

Wilmore, J. H., & Costill, D. L. (2004). *Physiology of Sport and Exercise: 3rd Edition*. Champaign, III: Human Kinetics.