The influence of water exercise methodology on the individual physiology responses

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ABSTRACT: The purpose of this study is to determine whether or not the methodology of water exercise classes can change the physiology parameters (heart-rate, oxygen consumption, minute ventilation) of people who practice this kind of activity. The subject will be carried on gymnastic clubs with water exercise classes. It will be divided into three groups: (GA) Aquatic Gymnastic; (HI) Aquatic Interval Training; and (HA) Hidroaerobic. To be part of the subject, the water exercise classes should be given in: 60 min; 1.20 to 1.50 deep swimming pool and water temperature between 27 to 29ºC. With an ergospirometric system Teen 100 and a Polar Vantage NV with Interface Plus, will be measured the heart-rate, the oxygen consumption and the minute ventilation. In order to determine any significant differences, one way ANOVA analysis of variance and Scheffe test will be used to evaluate and identify possible differences between classes. As a result, the methodology of water exercise classes can change the physiology parameters (heart-rate, oxygen consumption, minute ventilation).

Keywords: water exercise heart-rate, oxygen consumption, minute ventilation

Correspondence to:
RESUMO

A influência dos diversos tipos de estratégia, utilizados nas aulas de hidrogimnástica nos parâmetros fisiológicos do praticante

O presente estudo tem como objetivo geral verificar a influência da estratégia utilizada na aula de hidrogimnástica sobre os parâmetros fisiológicos (frequência cardíaca, ventilação-minuto e consumo de oxigênio) do praticante. A amostra foi compreendida por academias de ginástica que apresentaram aulas de hidrogimnástica, e foi dividida em três grupos, como se segue: (GA) Ginástica Aquática; (HI) Hidrogimnástica Intervalada e, finalmente, (HA) Hidrogimnástica Aeróbica. Os fatores de inclusão foram: academias de ginástica que possuíam a modalidade hidrogimnástica, sendo estas realizadas em piscina coberta, com profundidade entre 1,20 e 1,50 m, e aquecida com temperatura entre 28 e 30°C, sugerida pela AEA (Aquatics Exercise Association). Deverão apresentar em seu planejamento, um ou mais grupos da metodologia já citada anteriormente. Todas as aulas tinham a duração de 45 min. Os fatores de exclusão foram: o pH da água inadequado para a prática da atividade, a heterogeneidade da turma em exercício, não podendo conter na mesma gestante, idosos e atletas. As medidas aferidas foram: frequência cardíaca, ventilação-minuto e consumo de oxigênio, utilizando um ergoespirômetro da marca Teen 100 e um Polar da marca Vantage NV e Interface Plus. Quanto ao tratamento estatístico, utilizou-se fundamentalmente, os métodos da estatística descritiva e da estatística de inferência, análise de variância factorial “Anova one way”, combinada ao teste de Schefe, para comparação inter-grupos das médias observadas nas variáveis analisadas. Como resultado, observou-se que as estratégias influenciaram nos parâmetros fisiológicos estudados de forma significativa.

Palavras-chave: frequência cardíaca de exercício aquático, consumo de oxigênio, volume-minuto respiratório

INTRODUCTION

The good physical form has been taking thousands of people in Brazil to the gymnastic clubs, in search of an oriented physical activity. However, the objectives of who seeks the gymnastic clubs are the most varied as possible.

According to Novaes (1991), the objectives of these people are altering along the decades. Analyzing the board 1, we can conclude that the aesthetic objective was predominant in the decades of 60/70. Starting from the decade of 80, the obtaining and the maintenance of the health, through the improvement of the cardio-pulmonary system, started to have importance in the physical activity and it is in the decade of 90, finally, that a great concern is observed, on the part of the teachers and apprentices, in improving the life quality and mainly the corporal aesthetic.

Geraldes (1993) accomplished in Rio de Janeiro and in other brazilian states a research whose objective, among others, was of establishing the main desires and needs of the students for, through them, to elaborate a more appropriate class planning for the objectives. In the research, it is ascertained that two main objectives represent the interest of most of the students (90%) and more frequently appear: the aesthetics and the health, following for some others of smaller expression (around 10%) as, for instance, the motive rehabilitation, the sociability, the fashion and other.

In the gymnastic clubs of Rio de Janeiro it can be observed that one of the most observed physical activities by people that exercise themselves is the water exercises, defined for corporal movements, synthetic and/or analytical, accomplished in the liquid environment, with the semi-submerged body in vertical position, however, maintaining the face out of the water.

For some time the water exercises keeps every time increasing its number of followers, because it presents a program that is capable to propitiate the improvement of the life quality in any age and for any situation, and for allowing the people to feel more comfortable and safe. Many seeks the water exercises for medical indication, being confused with the hydrotherapy that, according to Beat and Hanson (1998), is defined by “An inclusive therapeutic approaching that uses the aquatic exercises to help in the rehabilitation of several pathologies”, for another, for simple curiosity.

Box 1 - Objectives from the gymnastics in academy

<table>
<thead>
<tr>
<th>Decade</th>
<th>Objective from gymnastics</th>
</tr>
</thead>
<tbody>
<tr>
<td>60</td>
<td>Aesthetics</td>
</tr>
<tr>
<td>70</td>
<td>Mental hygiene</td>
</tr>
<tr>
<td>80</td>
<td>Physical and mental health</td>
</tr>
<tr>
<td>90</td>
<td>Health – achievement and maintenance</td>
</tr>
<tr>
<td></td>
<td>Improvement in quality of life</td>
</tr>
<tr>
<td></td>
<td>Body aesthetics</td>
</tr>
</tbody>
</table>

Today, the regular customers of the water exercises consists of children, youngsters, adults, seniors, pregnant, deficient, athletes etc... Do not care if the apprentice is young or student of the third age, athlete or sedentary; what really interests is the knowledge of the true objective of those that seek the water exercises as form of regulate physical activity.

Convict that the water exercises has for a long time left of being restricted activity to a special group of individuals, and feeling the need of scientific background and correct and effective orientation of the activity, I present the present article, whose objective is to demonstrate the influence of the strategy: Aquatic Interval Training, Hydroaerobic and Aquatic Gymnastics used in the water exercises class, on the apprentice’s physiological parameters (heart rate, ventilation-minute and oxygen consumption).

**METHODOLOGY**

The universe of the present study was constituted of the class strategies of the water exercises supplied at the gymnastic clubs, located in Barra da Tijuca, in the Rio de Janeiro city. It was searched in seven academies the most characteristic strategies.

The inclusion factors were: gymnastic clubs with the water exercises modality, the classes being accomplished in covered swimming pools, with depth between 1.20 and 1.50m and heated up with temperature between 27 and 30°C, suggested by AEA (Aquatics Exercise Association). Should present in it planning, one or more of the following strategy groups: Aquatic gymnastics (AG); Intervaled Water aerobics (AI); and Hydroaerobics (HA). All of the classes lasting for 45 min, average time stipulated by AEA.

The exclusion factors were: inadequate pH of the water for the practice of the activity, group in exercise, formed by pregnant women, senior and athletes. After the investment of these criteria, remained only three academies that made possible the study of nine different class strategies, three in each academy.

For each AG, HA and AI strategy were raffled seven gymnastic clubs, being two of these just as security threshold. It was chosen gymnastic clubs that presented in the class program all of the three strategy types, as it was previously quoted. After this choice, were raffled the academies that participated in the study, being only three academies. As basic criterion, the classes should be supplied by different professionals, being able to these, to work at the same academy.

**EXPERIMENTAL PROCEDURE**

Clinical and functional evaluation of the standard subject: the standard subject was submitted to a general clinic examination, being guaranteed that possessed normal life habits, following anamnesis, physical and laboratorial examinations suggested by ACSM (2000), corresponding to the conditions of being healthy and non-athlete. Being like this, the standard subject is a healthy individual, non-athlete and with sleep, feeding and activity in normality. Belongs to the feminine sex, in the age group of young adult age (15 - 30 years) according to the classification of the (WHO) quoted by Weineck (1991, p. 329). She has 59 kg, 170 cm of height, percentage of fat 12.8; VO\textsubscript{2\text{max}} 34.82 ml.kg\textsuperscript{-1}.min\textsuperscript{-1}, classified as acceptable in according with Jogging, quoted by Dantas (1995, p.140).

Anthropometric Evaluation: were measured the total corporal mass, the stature and the fat percentage, according to the demands of the protocol of Pollock, quoted by Marins and Gian-nichi (1996, p. 45), being used a CESCORF (Brazil) cutaneous fold compass, and a Filizola (Brazil) scale.

**Evaluation of the cardiorespiratory component:** it was accomplished through the protocol of BRUCE.

- The heart rate was determined with the use of Vantage NV and Interface Plus (Finland) frequencymeter, and the registered data at each 40 s, following the mensuration standard of the other physiological variables (ventilation-minute and oxygen consumption). This measure instrument was fixed in the standard subject and the data were obtained in real time.
- The ventilation-minute and the oxygen consumption were accomplished through the Teen 100 Metabolic Analyser (USA) portable ergoespirometer that allows the cardiorespiratory monitoring of the standard subject, during the accomplishing of the physical activity and in real time. The measures were registered at each 40 s due to restrictions of the Teen 100 ergoespirometer.

Gathering of the universe sample and sample selection: in this stage were verified the inclusion and exclusion criteria of the sample, being certified that the sample is framed in the desired category. For this, the appraiser possessed an evaluation sheet that contends the prerequisites for the classification of the class, and for the strategy that will be tested. Were raffled the academies that were framed inside of the appropriate methodological standard, being able to these to have one or more groups (AG, AI, HA), however, with different professionals supplying each class.

Verification of the variation of the physiological levels provoked by each class: always in the same schedule, the standard subject, that possesses feeding, activity and sleep normality, was monitored with an ergoespirometer and submitted to the nine water exercises classes for the collection of the following data: heart rate, ventilation-minute and oxygen consumption. The observations were made inside of three batteries series (AG, AI, HA), intervalled and registered inside of the maximum period, defined in the methodology, that do not allow the physical conditioning of the standard subject and consequent interference in the results.

**Chart 2 – Example of batteries to be held**

<table>
<thead>
<tr>
<th></th>
<th>Series 1</th>
<th>Series 2</th>
<th>Series 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aquatic gymnastics</td>
<td>1st day of test</td>
<td>4th day of test</td>
<td>7th day of test</td>
</tr>
<tr>
<td>Intervaled Water Gymnastics</td>
<td>2nd day of test</td>
<td>5th day of test</td>
<td>8th day of test</td>
</tr>
<tr>
<td>Aerobic Water Gymnastics</td>
<td>3rd day of test</td>
<td>6th day of test</td>
<td>9th day of test</td>
</tr>
</tbody>
</table>
The series of batteries, in other words, the investment of the chosen strategies, for beginning will be independent, even if relative to the same training, in other words, to a same strategy. The batteries came in the following way: first battery: series 1 of the training 1; series 1 of the training 2; series 1 of the training 3; second battery: series 2 of the training 1; series 2 of the training 2, series 2 of the training 3; third battery: series 3 of the training 1; series 3 of the training 2; series 3 of the training 3, as are displayed in the chart 2.

Because the analysis subject is a female individual, that presents a menstrual cycle of 28 days, the training was accomplished in the post-menstrual (6th - 12th day) period and in the post-ovulatory period (16th - 24th day), guaranteeing like this, and the reliability of the collected data (Dantas, 1985, p. 80).

For treating of a study in which the observed element is the own instrument of analysis of the treatments (training), through which was made the comparative process, was fundamental for the reliability of the data and its analyses, the continuous and systematic control of the intervening variables, that could influence the observed results. Therefore, the room temperature and air humidity were controlled, as well as the physiological variables that define the internal environment of the standard subject.

Once the analysis instrument is an person, the same is susceptible to assimilate the methodological process and to advance expectations that could fundamentally influence in her psychological aspect, interfering in the results. Trying avoiding such noises, the series of the trainings obeyed an order, second to previous draw, what implicated in the break of the expectations of the analyzed and with this, minimized the interference of psychological standards in the data collection process.

**Verification of the methodology that was used in the class:** the class was recorded with a compact VHS camcorder, JVC (Japan - GR-AX700 /AX400 model), and the video was submitted to a jury composed of five specialists, all doctors and masters / master students, with at least ten years of professional background in the area, that judge if the class filled out the requirements of the proposed strategy.

**Statistical Treatment**

About the statistical treatment that will be in charge, was used, fundamentally, the descriptive statistics methods to characterizing the universe of the samples, under the distribution aspects, when were discreet and average data, standard deviation, variances and other pertinent statistics, and when were continuous data.

To compare the average values, was made calculations according to the classes supplied for the same class type, the investment of the “ANOVA One Way” analysis variance test was observed for the significance of (p < 0.05). As complementary post-hoc test, the test of Scheffé was used, which identifies, of combinatory and comparative method, where are the possible differences manifested by the test of ANOVA.

**FEATURING AND DISCUSSION OF THE RESULTS**

**Characteristic and Homogeneity of the Different Types of Class**

To characterize the homogeneity of the different applied strategies in the water exercises class, arises the table 1, whose results denote that there is significant differences in the VO$_2$ variable (p = 0.0000 < 0.05) between its averages values, following the class type. When analyzing the class strategies before the discussed variable, it is noticed that, while the aquatic interval training and the hydroaerobics has the same value, the aquatic gymnastics presents superior values in relation to the oxygen consumption. For the VE variable (ventilation-minute), for a calculated significance (p = 0.0016 < 0.05), also exists significant difference, being the averages of the respective variable for the types of Aquatic Gymnastic (GA) class and Aquatic Interval Training (AI), significantly even and minor, when compared with the average of this variable determined in the HydroAerobics (HA) class type. The HR (heart rate) experimental variable and the significant differences (p = 0.00001 < 0.05), show in the combination of all the averages, being the smallest average calculated for the AG class type, and the higher average for the IW class type.

**Table 1 – Comparison of the physiological parameters from the different types of class (GA, HA and HI)**

<table>
<thead>
<tr>
<th>Variable</th>
<th>G.I. (intra)</th>
<th>G.I.(inter)</th>
<th>F</th>
<th>Sig. P</th>
<th>Scheffe</th>
</tr>
</thead>
<tbody>
<tr>
<td>VO$_2$</td>
<td>2</td>
<td>603</td>
<td>10.991</td>
<td>0.0000</td>
<td>GA&lt;HA=HI</td>
</tr>
<tr>
<td>VE</td>
<td>2</td>
<td>609</td>
<td>6.529</td>
<td>0.0016</td>
<td>GA=HI&lt;HA</td>
</tr>
<tr>
<td>FC</td>
<td>2</td>
<td>609</td>
<td>95.400</td>
<td>0.0000</td>
<td>GA=HA&lt;HI</td>
</tr>
</tbody>
</table>

**Table 2 - Average and standard deviation from the Aerobic Water Gymnastics strategy**

<table>
<thead>
<tr>
<th>$VO_2$</th>
<th>Phase</th>
<th>$VO_2$</th>
<th>VE</th>
<th>FC</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>General</td>
<td>1.22 (0.32)</td>
<td>38.89 (13.54)</td>
<td>146.26 (15.81)</td>
</tr>
<tr>
<td></td>
<td>00-05min</td>
<td>0.73 (0.36)</td>
<td>21.02 (9.26)</td>
<td>128.13 (16.97)</td>
</tr>
<tr>
<td></td>
<td>05-10min</td>
<td>1.21 (0.18)</td>
<td>39.46 (9.21)</td>
<td>149.93 (11.47)</td>
</tr>
<tr>
<td></td>
<td>10-15min</td>
<td>1.29 (0.25)</td>
<td>43.83 (10.32)</td>
<td>154.67 (12.44)</td>
</tr>
<tr>
<td></td>
<td>15-20min</td>
<td>1.36 (0.29)</td>
<td>46.64 (12.00)</td>
<td>153.73 (15.59)</td>
</tr>
<tr>
<td></td>
<td>20-25min</td>
<td>1.29 (1.32)</td>
<td>44.82 (15.49)</td>
<td>148.40 (14.02)</td>
</tr>
<tr>
<td></td>
<td>25-30min</td>
<td>1.37 (0.19)</td>
<td>41.00 (11.27)</td>
<td>148.73 (13.30)</td>
</tr>
<tr>
<td></td>
<td>30-35min</td>
<td>1.23 (0.20)</td>
<td>39.09 (11.12)</td>
<td>146.67 (13.79)</td>
</tr>
<tr>
<td></td>
<td>35-40min</td>
<td>1.28 (0.27)</td>
<td>38.58 (12.72)</td>
<td>146.80 (17.29)</td>
</tr>
<tr>
<td></td>
<td>40-45min</td>
<td>1.11 (0.31)</td>
<td>34.74 (13.62)</td>
<td>139.27 (12.14)</td>
</tr>
</tbody>
</table>
In synthesis, these results indicate that the used strategy type in the class significantly infers in the average values of the experimental variables. \( \text{VO}_2 \) and HR were lineally related during the HA and AI strategies.

**Featuring of the Data of the Research**

Constituted the first part of the statistical results, the data relative to the descriptive statistics, in which are presented the averages values and its respective standard deviation values (SD). It should be taken into account that the temporal sub-extracts were taken at each time interval of five minutes until the observation end.

**Characteristic of the Hydro Aerobics (HA) strategy**

To characterizing in a concise way the strategies used in the water exercises classes, it was observed in the table 2 that: \( \text{VO}_2 \), as well as HR of the referring class strategy, increase and decrease in a lineal way with the movement speed executed during the class, reinforcing the acknowledgement done by Gleim and col. (1989), that \( \text{VO}_2 \) and HR are lineally related during the dynamic exercise. VE increases in the first 20 min of the class and it is stabilized until the end of the same.

**Characteristic of the Aquatic Interval Training (AI) strategy**

When analyzing the IW strategy through the table 3, it was verified that, for the \( \text{VO}_2 \) and CR variables, the values still lineal. As the interveled training is characterized as periods of exercises and recovery intervals, the values increase and decrease in agreement with the strong stimulus of the class. VE maintains itself in constant way in the main part of the class, because the recommended recovery interval allows the interval of the subsequent exercise begin before the complete recovering. That assures that the aerobium circulatory and metabolic stress reaches almost maximum levels, in spite of the intervals of exercises were relatively short.

**FEATURING AND DISCUSSION OF THE RESPONSES TO THE QUERIES TO INVESTIGATE**

Which does the influence that the used strategy in the water exercises class cart in the heart rate, in the ventilation-minute and in the oxygen consumption of the apprentices during the accomplishing of the activity?

For the HR variable, the significant differences between the calculated average values, according to the class type, show in three of the eleven temporal extracts, c (10 - 15 min.), A (00-05 min.)

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**Table 3 – Average and standard deviation from the Intervaled Water Gymnastics strategy**

<table>
<thead>
<tr>
<th>( \text{V}_2 ) Phase</th>
<th>( \text{VO}_2 )</th>
<th>VE</th>
<th>FC</th>
</tr>
</thead>
<tbody>
<tr>
<td>General</td>
<td>1.24 (0.76)</td>
<td>52.64 (17.63)</td>
<td>150.49 (15.92)</td>
</tr>
<tr>
<td>A 00-05min</td>
<td>0.62 (0.55)</td>
<td>34.14 (11.18)</td>
<td>136.67 (14.81)</td>
</tr>
<tr>
<td>B 05-10min</td>
<td>1.14 (0.53)</td>
<td>53.52 (15.27)</td>
<td>159.53 (16.96)</td>
</tr>
<tr>
<td>C 10-15min</td>
<td>1.27 (0.17)</td>
<td>64.12 (17.41)</td>
<td>159.87 (12.63)</td>
</tr>
<tr>
<td>D 15-20min</td>
<td>1.35 (0.23)</td>
<td>58.40 (16.00)</td>
<td>155.40 (15.63)</td>
</tr>
<tr>
<td>E 20-25min</td>
<td>1.35 (0.30)</td>
<td>56.39 (15.45)</td>
<td>148.07 (13.02)</td>
</tr>
<tr>
<td>F 25-30min</td>
<td>1.26 (0.15)</td>
<td>54.65 (19.19)</td>
<td>153.20 (13.73)</td>
</tr>
<tr>
<td>G 30-35min</td>
<td>1.31 (0.18)</td>
<td>56.99 (15.54)</td>
<td>152.87 (14.31)</td>
</tr>
<tr>
<td>H 35-40min</td>
<td>1.34 (0.39)</td>
<td>55.20 (17.53)</td>
<td>149.07 (16.36)</td>
</tr>
<tr>
<td>I 40-45min</td>
<td>1.12 (0.18)</td>
<td>40.50 (11.21)</td>
<td>139.73 (11.29)</td>
</tr>
</tbody>
</table>

**Table 4 – Average and standard deviation from the Aquatic Gymnastics strategy**

<table>
<thead>
<tr>
<th>( \text{V}_2 ) Phase</th>
<th>( \text{VO}_2 )</th>
<th>VE</th>
<th>FC</th>
</tr>
</thead>
<tbody>
<tr>
<td>General</td>
<td>1.02 (0.41)</td>
<td>32.78 (13.03)</td>
<td>138.71 (12.44)</td>
</tr>
<tr>
<td>A 00-05min</td>
<td>0.84 (0.61)</td>
<td>29.65 (9.75)</td>
<td>128.40 (14.77)</td>
</tr>
<tr>
<td>B 05-10min</td>
<td>1.20 (0.39)</td>
<td>41.61 (7.34)</td>
<td>139.27 (12.27)</td>
</tr>
<tr>
<td>C 10-15min</td>
<td>1.30 (0.19)</td>
<td>37.20 (15.45)</td>
<td>143.27 (10.89)</td>
</tr>
<tr>
<td>D 15-20min</td>
<td>1.22 (0.16)</td>
<td>35.11 (14.39)</td>
<td>149.80 (7.95)</td>
</tr>
<tr>
<td>E 20-25min</td>
<td>1.08 (0.37)</td>
<td>37.71 (9.80)</td>
<td>145.27 (8.79)</td>
</tr>
<tr>
<td>F 25-30min</td>
<td>0.89 (0.35)</td>
<td>29.77 (13.89)</td>
<td>141.73 (12.11)</td>
</tr>
<tr>
<td>G 30-35min</td>
<td>1.14 (0.30)</td>
<td>35.92 (9.53)</td>
<td>136.33 (6.45)</td>
</tr>
<tr>
<td>H 35-40min</td>
<td>0.77 (0.31)</td>
<td>24.88 (10.13)</td>
<td>134.47 (8.95)</td>
</tr>
<tr>
<td>I 40-45min</td>
<td>0.74 (0.42)</td>
<td>24.28 (13.92)</td>
<td>129.87 (12.35)</td>
</tr>
</tbody>
</table>
and H (35 - 40 min.), and in the three, the calculated average for the AG class type, it presents the smallest value, and in the AI class type presents the largest value, all with significance p < 0.05.

In the VE experimental variable, the significant differences (p < 0.05) appear in all of the temporal extracts, denoting high sensibility front to the inferences of the intervening variable, standing out that the AI class type presents, in most of the comparisons between the respective averages, the highest value.

When analyzing the other strategies it is observed that, for the temporal extracts D (15 - 20 min), F (25 - 30 min) and H (35 - 40 min), that is the space that understands the main part of the class, the AG strategy presented smaller average values than the HA strategy.

Separating the VO₂ variable and accomplishing comparisons between the average values for each temporal extract of observation and according each class type, we got the demonstration of the differences in the extracts F (25 - 30 min / p=0.0102 < 0.05), H (35 - 40 min / p = 0.0000 < 0.05) and I (40. 45 min / p = 0.0001 < 00.5), and the averages observed in the classes HA and AI are equal and higher than the AG class. In the other temporal extracts were not observed significant differences.

**FEATURING AND DISCUSSION OF THE SPECIFIC OBJECTIVES**

**Heart Rate**

When verifying the influence of the strategy used in the water exercises class, in the apprentice’s heart rate during the class, it was observed that, for the HA and AI types, each strategy presents comparative combinations and distributions, characteristic of each stimulus. For the AG type, the average behaviour of the HR experimental variable appears constant and lineal.

When analyzing the graph 1, it can be observed that, if we disregard the warming and the cooling of the class, whose data correspond to values of adaptation to the liquid environment and the recovery of the stimulus, respectively, we find, for the AI strategy, HR of higher value in relation to HA and to AG.

This way it is possible to affirm that HR is more intensively worked when used the AI strategy and less intense in the AG strategy.

**Ventilation-minute**

Again, the results below corroborate to the previous results that evidence the high sensibility of the VE experimental variable front to the inferences of the class type. It still emphasized the observed combinatory similarity when accomplishing comparative process of the average values, in that the smallest calculated averages show, independently of the class type, in the temporal extracts A (00 - 05 min) and I (40 - 45 min), in other words, the warming and the calming down of the respective classes.

For the HA class type, the average behaviour of the HR experimental variable appears constant and lineal.

With the graph 2, it can be verified that the VE averages, also disregarding the initial and final parts of the class, establish a direct relationship with the applied strategy. Being AI composed of strong and weak stimuli during the class, the variable, for its time, shows high in relation to HA, that possesses continuous stimulus, and to
AG, that possesses intense stimuli and differentiated movements during the class.

**Oxygen Consumption**

For the VO2 variable, in the classes of the type HA and AI, the average values of the temporal extracts, manifested with similarity. However, for the AG class type, is observed, unlike the other two, significant differences, where the temporal extracts obey the stimulus applied for the mentioned strategy, presenting the smallest average values in the warming and in the relaxation of the class, and the highest values in the aerobic exercises part.

With the graph 3 presented is possible to affirm that the average values of the Al and HA strategies continue respecting similar values, while AG comes with inferior values, once again as consequence of the own characteristic of the class. If we transform these average values in percentage, we can verify that, in relation to VO2max reached by the standard subject, AI and HA strategies work exactly 38% of VO2max, while AG works at 31% of the same.

**Featuring and Discussion of the General Objective**

The present research looked to verify the influence of the strategy used in the water exercises class on the apprentice’s physiological parameters (heart rate, ventilation-minute and oxygen consumption).

With the presented and previously discussed results, it can be affirmed that the class strategy influences, in necessary way, the tested physiological parameters. When analyzing the graph 4 it is observed that:

- in the strategies AI, AG and HA, being disrespected the warming and the relaxation of the class, and changing the values of the averages in % of worked VO2, we got the average percentages values of 38% of VO2max and 32% of VO2max, respectively.
- Swain and Franklin (2002) quote that the minimum of intensity to be worked to obtain improvement in the cardiorespiratory aptitude is from 45% of VO2max in trained people, and of 30% of VO2max for people with low aptitude level.

Being like this, it is evident that the three previously mentioned strategies efficiently contribute for the improvement of the body ability using oxygen, resulting in better cardiorespiratory resistance in the non-athlete people.

In the opposite, for the improvement of the cardiorespiratory system in trained people, the strategies used in the study are disappointing, because these activities are just used as performance maintenance.

When analyzing VE, it is fundamental to remind that the individual, when trains in the vertical position and in liquid environment, it suffers a multidirectional pressure in his thorax, called hydrostatic pressure. This, for its time, compresses the lungs, reducing the individual’s vital capacity. With the analysis of the studied class strategies, we have for order of larger stimulus AI, HA and AG, that should be chosen in an appropriate way, by the individual’s previous pulmonary evaluation that seeks the water exercises as form of regular physical activity. Turning, like this, evident, that it is not advisable this activity for people that bears any pulmonary dysfunction.

**CONCLUSIONS AND RECOMMENDATIONS**

The ventilation-minute is a variable that increases during the activity in stable rhythm to maintain the appropriate concentrations of the alveolar gases, in order to allow that there are a larger swap of oxygen and carbon dioxide (McArdle, 1992).

According to Jeffrey and col. (1990), the hydrostatic pressure also contributed to an increase in the sanguine central volume, altering the intrathoracic pressure, which allows affirming that the existence of a multidirectional pressure that directly influences in the individual’s breathing that trains inside of the water, in the vertical.

With the results of the present research it can be affirmed that, when exercising in the water, the water exercises apprentice presents increased ventilation-minute, from the warming to the relaxation of the class, provided so much by the oxygen consumption, as for the liquid environment and for the strategy to be applied in the activity.

However, according to McArdle (1992), if the individual capacity to breathe during the exercises is inadequate, in this case, the line that relates pulmonary ventilation to the oxygen consumption would lean in an opposite direction and the equivalent breathing would decrease. It is what suggests the activity exercised in liquid environment, because, according to Withers and col. (1989), there is a decline of 3 to 9% of the vital capacity with the immersion of the body in the water, reinforcing, like this, the apprentice’s difficulty of breathing inside of the liquid environment when he assumes a vertical position.

Analyzing the used strategies, it can stand out AI as being the stimulus of larger significance for the activity, which is used the training method to find the class strategy.

According to Weineck (1991), the training comprises a process that, through the exercises, seeks to reach a higher level in the area of the foreseen objective.

The aquatic interval training follows the same standards and beginnings of the training of a common activity. According to McArdle (1992), the interval training is a method that consists of the intensity increase of training fractioned in times of resting, in one or several sessions, that seeks to have a correct spacing of the exercises and resting periods, accomplishing a quantity of work that, usually, could not be completed in a session in that the exercises was continually accomplished. The repeated series of exercises can vary since few seconds to several minutes or more, in agreement with the objective, could be modified in intensity terms and duration of the intervals of exercises, of the duration and type of recovery interval, of the number of work intervals (repetitions) and of the number of repetitions blocks (series) for session.

The interval training can be adapted to the water exercises, through periods of exercises and recovery intervals, could be so much active (work-recovery), as liabilities (resting-recovery), obeying the rules above. The recommended recovery interval allows to the subsequent interval of exercises to begin before the end of the recovery. That assures that the circulatory and metabolic aerobic
stress reaches almost maximum levels, in spite of the completion of exercises are relatively short. With longer periods of intermittent exercises, exists enough time for the metabolic and circulatory adjustments; in these conditions, the duration of the resting interval is not so crucial.

Krasevec (1986), defines the hydroaerobics as an activity of great aerobic phase, with located part, using the border as support and water in the height of the chest. Still SEE (1995), quotes that the aerobic segment combines cardiorespiratory conditioning and muscular resistance, minimizing the need of isolated and specific series for the work of strength and located muscular resistance, and providing larger benefit to the student of the class.

The above mentioned class strategy can be perfectly adapted to any level of the student’s conditioning. The professional can increase or to reduce the intensity of the exercises according to the need of the group.

The most found strategy in the water exercises is the aquatic gymnastics that, according to Paulo (1994), it is defined by a program of exercises, divided in releasing, warming, aerobic exercises, located, and of flexibility and relaxation. It is a class with duration of 45 min and depth between the umbilical scar and the xiphoid process.

Comparing the above strategies, according to the VE variable, for a calculated significance (p = 0.0016 < 0.005), it is denoted significant differences, being the averages of the respective variable for the AG and AI class types, significantly equal and smaller than the average of this variable, captured in the HA class type.

Resuming, with the results of this research it was possible to detect that people that has any pulmonary dysfunction should not choose the water exercises as form of physical activity.

**Behaviour of the Heart Rate Variable (HR)**

In relation to the behaviour of the heart rate in the liquid environment, the literature presents opposite positions because, while several authors - Magel and Faulknner (1967); Craig and Dvorak (1969); Avellini and cols. (1983); Risch and cols. (1978); Town and Bradley (1991); Sheldahl and cols. (1984); Svedenhag and col. (1992); and Kruel (1994) - affirm that a there is bradycardia during the immersion, other - Denison and cols. (1972); Gleim and cols. (1989); Johnson and cols. (1977); Whitley and Schoene (1987) - affirm that happens tachycardia, and still exist the ones that tell that do not happen alterations in the heart rate: Arborelius and col. (1972); Begin and cols. (1976); Blomqvist and Stone (1983); Ritchie and Hopkins (1991); Yamaji and cols. (1990).

By the results reached in the present searches, it is quite evident the relationship between the heart rate and the strategy type developed in the class. When analysed the three strategy types, AG, HA and AI, found comparative combinations that present peculiar distributions of each class type, however, all of the strategies display comparative similarity between the averages in the captures of the heart rate in rest, so much in the soli and in the water.

**Behavior of the Oxygen Consumption Variable (VO₂)**

Arborelius and cols. (1972); McArdle and cols. (1976); and Blomqvist and Stone (1983), quote that the cardiovascular res-
benefits, advantages and disadvantages that the activity in query offers. It will only like this turn possible to guide and to exercise in a correct way.

Therefore, it is waited of the professional of physical education the integrity of his performance. An effective combination, in the satisfaction of the necessities that take thousands of people to seek the water exercises as form of regular physical activity and of the scientific knowledge up to now presented.

With this, we concluded that this study is valuable for the professionals that work with the water exercises, because it represents a step, not only to cure the necessities of who trains, but also to munitions to professional of the liquid environment, of scientific knowledge that make possible the execution of a program of objective, reliable and trustworthy exercises.

It is necessary that the professional of physical education quit with old models and archaic repute: a new paradigm should be established. The professional has to worry in assisting the student’s objectives that seeks it in an appropriate way, however, that is only possible if there is theoretical background to base the accomplishing of the practice, because “The practice without the theory is blind, and theory without the practice is sterile.” G. Dimitrov.

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