Nutrición Hospitalaria

Nutr Hosp. 2015;32(2):823-828
ISSN 0212-1611 • CODEN NUHOEQ
S.V.R. 318

Original / *Deporte y ejercicio*

Blood pressure in hypertensive women after aerobics and hydrogymnastics sessions

Adriana Loiola Souto[1], Luciana Moreira Lima[2], Eliane Aparecida Castro[1], Renato Peixoto Veras[3], Wellington Segheto[4], Thaís Camargos Zanatta[1] and Leonice Aparecida Doimo[1]

[1]Department of Physical Education and Sports, Federal University of Viçosa, Minas Gerais. [2]Department of Medicine and Nursing, Federal University of Vic¸ osa, Vic¸ osa, Minas Gerais. [3]Department of Epidemiology, State University of Rio de Janeiro, Rio de Janeiro. [4]Department of Nutrition and Health, Federal University of Viçosa, Viçosa, Minas Gerais (Brazil).

Abstract

Introduction: **regular exercise has been recommended as an important behavior in controlling blood pressure. In recent years it has been demonstrated that a single session of exercise can lower blood pressure levels compared to pre-exercise period, becoming an effective non-pharmacological therapy for the treatment of hypertension.**

Objective: **the purpose of this study was to analyze the levels of blood pressure in post-exercise period of controlled hypertension women after an aerobics session and a hydrogymnastics session.**

Methods: **twelve elderly (65±3.6 years) who practice regular physical activity for at least two months had their levels of blood pressure measured during 60 minutes after the end of each session. Blood pressure was measured every five minutes after the end of each session until the twentieth minute of recovery. Following, blood pressure was measured every ten minutes. T-student test was used to compare mean and the level of significance adopted was 5%.**

Results: **the mean values of hypotension found during the recovery period after the hydrogymnastics session were not significantly different when compared to blood pressure levels of the pre-exercise period (p=0.260). However, the result of the same comparison for the aerobics session was statistically significant (p<0.001). The lowest values of systolic blood pressure reached in the recovery period for hydrogymnastics (120 mmHg) and aerobics (106 mmHg) were significantly different (p<0.001).**

Conclusions: **the aerobics session showed to be more effective in reducing post-exercise blood pressure compared to the hydrogymnastics. After practice aerobics, the participants presented lower blood pressure levels and longer duration of the hypotensive effect.**

(*Nutr Hosp*. 2015;32:823-828)

DOI:10.3305/nh.2015.32.2.9228

Keywords: *Hypertension. Exercise. Aged.*

PRESIÓN ARTERIAL EN MUJERES HIPERTENSAS TRAS SESIONES DE GIMNASIA AERÓBICA Y ACUÁTICA

Resumen

Introducción: **la práctica regular de ejercicios ha sido recomendada como conducta importante en el control de la presión arterial. En los últimos años se ha demostrado que una sola sesión de ejercicio físico puede disminuir la presión arterial comparada a los niveles del periodo pre-ejercicio, convirtiéndose en una terapia no farmacológica efectiva para el tratamiento de la hipertensión.**

Objetivo: **analizar el comportamiento de la presión arterial post-ejercicio en mujeres hipertensas controladas tras la realización de una sesión de gimnasia acuática y una sesión de gimnasia aeróbica.**

Métodos: **participaron en el estudio 12 mujeres mayores con edad de 65±3.6 años y practicantes de actividad física por un periodo superior a dos meses. La presión arterial fue medida durante 60 minutos tras el final de cada clase. Este procedimiento fue realizado cada 5 minutos tras el esfuerzo hasta el vigésimo minuto de la recuperación, seguido de mediciones cada 10 minutos hasta el sexagésimo minuto. Fue utilizado el test T-Student para la comparación de los promedios y fue adoptado un nivel de significación del 5%.**

Resultados: **los promedios de hipotensión encontrados durante la recuperación tras la clase de gimnasia acuática no fueron significativamente diferentes comparados con los promedios obtenidos en el pre-ejercicio (p=0,260). Sin embargo, en la sesión de gimnasia aeróbica la diferencia entre esos valores fue estadísticamente significativa (p<0,001). Los menores valores de presión arterial sistólica alcanzados en la recuperación para gimnasia acuática (120 mmHg) y gimnasia aeróbica (106 mmHg) también fueron significativamente diferentes (p<0,001).**

Conclusión: **la gimnasia aeróbica se mostró más eficiente para la reducción de la presión arterial post-ejercicio con respecto a la gimnasia acuática, presentando menores valores y mayor duración del efecto hipotensor.**

(*Nutr Hosp*. 2015;32:823-828)

DOI:10.3305/nh.2015.32.2.9228

Palabras clave: *Hipertensión. Ejercicio. Mayores.*

Correspondence: Wellington Segheto.
Universidade Federal de Viçosa.
Departamento de Nutrição e Saúde.
Av. PH Rolfs, s/n.
CEP 36570-000, Viçosa, Minas Gerais (Brasil).
E-mail: wsegheto@gmail.com

Recibido: 15-V-2015.
Aceptado: 18-VI-2015.

Abbreviations

ACSM: American College of Sports Medicine
AEA: Aquatic Exercise Association
BMI: Body Mass Index
HR: heart rate

Introduction

The aging process has received great attention and many actions that are directed to elderly provide psychological, social and physical stimulations which appears to be one of the best ways to reduce the negative effects of this process, especially chronic degenerative diseases, allowing better living conditions.

Social programs that are destined to elderly offer conditioning programs, mainly aerobics and hydrogymnastics, which are often recommended as an important way to assuage and avoid health problems such as the level of blood pressure[1,2].

Recent studies found that not only chronic exercises but also a single session of exercises can cause a decrease in blood pressure levels when compared to blood pressure levels in the pre-exercise period[2-4], which can be considered an effective therapy non-pharmacological to treat high blood pressure.

Available studies show that the magnitude of post-exercise hypotension is variable[5]. Therefore, it is essential the identification of the influencing factors in blood pressure reduction in order to assist in exercise prescription[1,3,6]. The physical activities recommended for seniors are aerobic activities with low impact such as walking, swimming, cycling and hydrogymnastics, which their practices are associated with lower risk of injury. The hydrogymnastics presents some advantages over the exercises performed on ground, as the reduction in gravitational forces, decreased mechanical stress of the musculoskeletal system, ease of thermoregulation and reduction of the impact on the joints, reducing pain and allowing wider ranges of motion[7]. The use of these properties and benefits are important, especially for the elderly.

On the other hand, aerobics is a rhythmic exercise that uses large muscles groups to maintain an appropriate intensity for an extended period of time, which have as objectives improve the ability of the cardiovascular system, help to balance the arterial pressure[3], and reduce percentages of fat and the risk of cardiovascular diseases[8]. The maintenance of these conditions at a normal level is a determining factor to reduce chances of stroke or any disease related to inactivity[6].

A subjective comparison between aerobics and hydrogymnastics suggests that hydrogymnastics is more fun, enjoyable, effective, stimulating, comfortable and safe[9]. The exercises done in the ground also provide many benefits, but they might be followed by pain, overheating, sweating and feeling of exhaustion[8], and aquatic exercises have the advantage of eliminating such undesirable effects. However, comparison of the benefits of those exercises on blood pressure in hypertensive patients is not yet fully established in the literature. The purpose of this study was to analyze the levels of blood pressure in post-exercise period of controlled hypertension women after an aerobics session and a hydrogymnastics session.

Methods

A descriptive observational cross-sectional study was conducted. The study included twelve elderly women (65±3.6 years) with controlled hypertension and practitioners of regular physical activity for at least two months. All volunteers were participants of the Extension Project "De Bem com a Vida", which offers free guided physical activity every day of the week through exercise sessions, including aerobics and hydrogymnastics.

According to the exclusion criteria, seniors who had the following health problems were not allowed to participate in the research: endocrine, orthopedic or neurological, as well as users of ergogenic resources. Although all participants were using at least one medication to control hypertension, there was no homogeneity in the type of drug. The participants were instructed to maintain sleep patterns and antihypertensive medication intake as usual, refrain from the intake of caffeine and alcohol, and not exercising for 48 hours before each aerobics or hydrogymnastics session. The project was conducted according to guidelines of the Declaration of Helsinki and World Medical Association and approved by the Ethics Committee on Human Research (No. 119/2011).

Experimental procedures

The medical history of each volunteer was analyzed and the researcher instructed them about the appropriate procedures to be followed in the study such as the types of exercise would be done, intensity of the heart rate (HR) and how blood pressure would be measured and monitored, and other questions that emerged eventually. In addition, the values of weight, height, waist, and hip circumferences were recorded and Body Mass Index (BMI) was calculated. Thereafter, the volunteers remained seated in a quiet and comfortable place for 30 minutes in order to measure the heart rate and blood pressure at rest.. All participants had a recent medical certificate that attested they had appropriate conditions for the practice of physical activities.

To verify whether the volunteers would exercise in both sessions within the limits of the development of cardiorespiratory fitness and health recommended by the American College of Sports Medicine[10] (60-85% of maximum HR), the cardiac training frequencies were individually and previously calculated using the Karvonen's method as presented by McArdle et al. (2003)11: HR threshold=HR rest + % intensity (HR max - HR rest). The maximum heart rate was estimated using the formula described by Tanaka et al. (2001)[12], using the following equation: HR max=208 - 0.7 x (age).

The participants were asked to measure their resting heart rate (HR rest) for three consecutive days, immediately after they wake up and before they get up, for 15 seconds each measurement, in order to calculate their HRrest based in the average of the three measurements. To adjust the intensity of effort to the water as suggested by the Aquatic Exercise Association (AEA)[13], seventeen beats were reduced of maximum and minimum training heart rate of each participants. Heart rate was measured using a heart rate monitor Oregon Scientific HR102 model.

Hydrogymnastics and aerobics sessions

Participants performed a hydrogymnastics session with moderate intensity for 45 minutes, which emphasized the maintenance or development of aerobic conditioning, in addition to muscular endurance exercises. Warm up through stretching, walking, and movement of large muscle groups, was realized during ten minutes. For the next fifteen minutes, the intensity increased through greater speed and greater range of motion. After this time, the session was performed by using hand's floats in order to increase muscular resistance and strength, (upper and lower body, simultaneously), as well as abdominal exercises. The return to resting conditions had five minutes of duration with loosening and stretching exercises.

The indoors pool used has depth from of 130 cm and was heated in a temperature of 30°C. The volunteers were instructed to position themselves into the pool in a way that the water remained the mid-axillary line. During session, the researchers were concerned to maintain the level of effort relatively continuous, as well as the training heart rate of the participants.

After three days, the volunteers participated in an aerobics session for 40 minutes, based on the same effort level of the hydrogymnastics session, but without reducing[17] beats as suggested by AEA to work performed in the aquatic environment. The aerobics session was performed with a five minutes warm up that included stretching exercises and small displacements. During the following thirty minutes after the warm up, exercises that requested large muscle groups were choreographed using different rhythms. The intensity increased gradually during the session; however, it decreased by the end of the session. The cool down period involved stretching and loosening exercises that lasted five minutes.

The hydrogymnastics and aerobics sessions occurred at the same location and were gived by the same teacher.

Measurement of blood pressure

In both procedures, the participants arrived at the location twenty minutes before the session begins to organization and measuring blood pressure and heart rate prestressing. At the end of the session, the volunteers went to a comfortable place and remained sitting there for 60 minutes to the measurement of passive recovery blood pressure. This procedure was performed immediately after the effort and every five minutes until the twentieth minute of recovery, from then on blood pressure was measured every 10 minutes. The method used to evaluate blood pressure was the auscultatory, and in all cases the measurement was performed by the same examiner, who used the aneroid Dickinson Becton sphygmomanometer, and the stethoscope Becton Dickinson Duo-SoNic.

Statistical treatment

Descriptive analysis used mean, standard deviation, maximal and minimum values were performed for anthropometric variables. The Shapiro-Wilk test confirmed the normal distribution of the data. For comparisons of means between hydrogymnastics and aerobics sessions Student t-tests were used. SPSS version 20.0 for Windows and SigmaStat version 1.0 were used for statistical analyses (SPSS Inc., Chicago, Illinois, USA). The significance level was set at $\alpha=0.05$.

Results

Table I presents the data about the characteristics of the sample, including minimum and maximum values, means and standard deviations to age, weight, height, BMI and waist to hip ratio.

Table II shows the mean values of the desired training zone (60-85% calculated maximum HR) and the maximal HRspecific to each session, calculated from the resting HR and age.

Figure 1 and table III presents the average values of heart rate at specific times during the two sessions and recovery period. No differences were found between aerobics and hydrogymnastics sessions.

Figure 2 shows the behavior of the mean systolic blood pressure measured in the pre- and post-exercise,

Table I
Anthropometric Profile

Parameter	*Minimum values*	*Maximum values*	*Mean ± standard deviations*
Age (years)	60	69	65 ± 3.2
Weight (Kg)	50.4	87.8	66.4 ± 11.4
Height (cm)	141	163	155 ± 6.3
BMI	23.3	35.57	27.6 ± 3.7
Index waist/hip	0.75	0.97	0.87 ± 0.06

Table II
Average percentages of training and their values (bpm) estimated for each mode

Training Percentage	*60%*	*85%*	*Maximal HR Calculated*
Aerobics	124 ± 2.60	147 ± 2.37	160 ± 2.31
Hydrogymnastics	107 ± 2.54	130 ± 2.31	143 ± 2.28

Table III
Mean values of heart rate (bpm) and their training percentages in the four stages of the experimental sessions

Time of Measurement	*Aerobics*	*Training Percentage*	*Hydrogymnastics*	*Training Percentage*	*p*
Prestressing	74	Rest	72	Rest	0.53
End of warm up	97	29%	98	49%	0.72
Main Part	104	37%	100	51%	0.37
End of Relaxation	94	25%	94	45%	0.95

and during the recovery phase, which lasted 60 minutes in both sessions.

The mean values of hypotension found during recovery period of the hydrogymnastics session were not significantly different when compared to pressure levels of prestressing (p=0.260). However, in the aerobics session the difference between these values was statistically significant (p<0.001). The lowest systolic blood pressure achieved in the recovery of the hydrogymnastics session (120 mmHg) was also significantly higher than the lowest value of systolic blood pressure achieved in the aerobics session (106 mmHg. p<0.001).

Discussion

The identification of factors that can help in the treatment of hypertension constitutes an important strategy to prevent the emergence of comorbidities associated to this disease. This study presents an evaluation of blood pressure after holding two physical exercises that can aid in the treatment of hypertension and improve the quality of life of elderly. Several evidences in the literature show that regular aerobic exercises exert an antihypertensive effect[3,14,22,23] that when performed chronically can be able to prevent and treat systolic hypertension[4].

After observed the profile of the volunteers, it was noticed that the participants presented high levels of BMI and waist/hip index , which might have contributed to the reduction of the mobility and agility[15], and thus justify the percentage of effort below 60% of maximum heart rate found in this study (Table II). The behavior of the heart rate was consistent with literature[16], the heart rate of the participants rose gradually, and it kept in a specific training zone. The same expected response was observed in the recovery period, in which the heart rate values

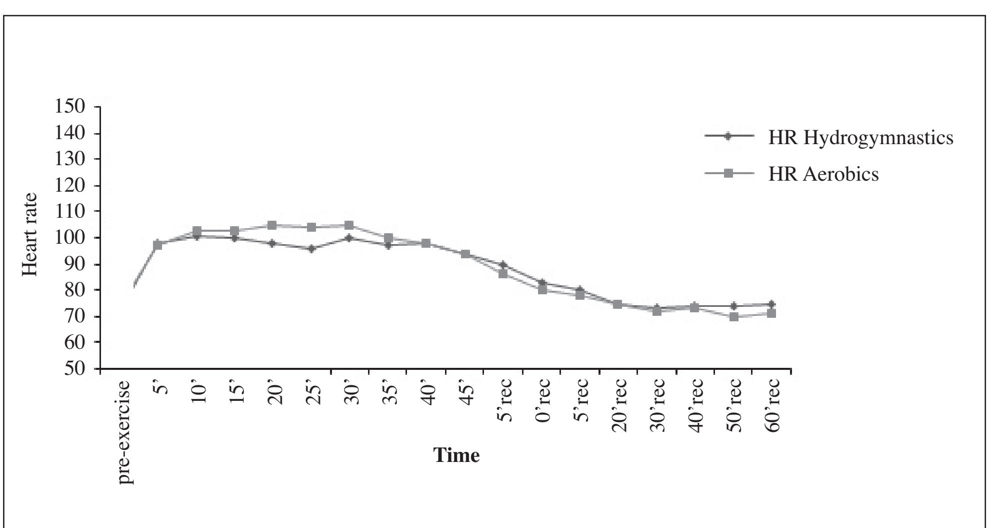

Fig. 1.—Behavior of average heart rate before, during, and after hydrogymnastics and aerobics sessions.

returned gradually to values earlier found. Regarding to blood pressure, similar values were observed in the pre-exercise period to hydrogymnastics and aerobics, since the group analyzed was the same for both, and all volunteers were being treated for hypertension. In both experimental sessions was observed that the average of the systolic blood pressure was highest immediately after the session and it rapidly declined in the recovery period. However, the behavior of diastolic blood pressure remained relatively constant at the end of the exercise and during the recovery period, in both sessions (data not shown).

It was observed that by the end of the hydrogymnastics session, participants presented a larger mean of systolic blood pressure (Figure 2), which can be explained by the physiological effects of immersion, such as water temperature and depth of the pool. Both hypotheses have similar mechanisms. The first hypothesis is based on the fact that when entering the pool, especially in waters with lower temperatures, there is a peripheral vasoconstriction, which increase blood volume in the central region, and arterial pressure[17-18]. Regarding to the depth of pool, the deeper the object is placed in the fluid, the more hydrostatic pressure it experiences. The hydrostatic pressure induces a greater shift of blood from peripheral and interstices vessels to the central circulation, increasing plasma volume that also contributes to the elevation of blood pressure[17,19]. This second hypothesis seems to be more related to blood pressure levels reached at the end of the hydrogymnastics session, since researchers used the pool with heated water. Furthermore, the intensity achieved in the hydrogymnastics session, according to the HR was higher compared to values found in the aerobics session; however, it did not present a significant difference. In addition, in the hydrogymnastics session the HR tended to concentrate on the lower end of the training target zone that is accompanied by average values of perception, which was also a smaller effort (11 and 12)[24]. Possible explanations for this occurrence would be the difficulty in maintaining an appropriate speed for performing exercises in water following the musical rhythm, and the difficulty of maintenance the training equipment below the waterline by participants. In the latter case, the low density of the equipment used in session might act more as a support for the upper body than an implement for increase of overhead.

The hypotensive effect during the 60 minutes of recovery was apparent in both sessions when compared to the arterial pressure value immediately after the effort. However, is more relevant to consider the hypotensive effect when compared to blood pressure levels at rest (pre-exercise), and not to those found at the end of the effort. This effect was greater in the aerobics session. After 60 minutes, the blood pressure levels of the participants after the hydrogymnastics session were similar to the pre-exercise levels ($p=0.301$), while 60 minutes after the aerobics session, the blood pressure values were significantly lower than those values observed in the pre-exercise ($p<0.01$). It is important to notice that the time of more significant hypotension occurred at the twentieth minute of recovery for hydrogymnastics session, and in the thirtieth minute of the aerobics session. Hypotension can facilitate the translocation of albumin from the extravascular space to the intravascular space, which is related to the recovery of plasma volume decreased by the effect of dehydration caused by exercise[21]. Hydrogymnastics can cause a marked diuresis, tending to hipovolemia[17]. The biggest loss of fluid due to the hydrostatic pressure and the sweating action in hydrogymnastics sessions, may have triggered most from the compensation mechanisms of hypovolemia, such as a higher systolic blood pressure, observed at the end of the hydrogymnastics session. In parallel, the fluid loss may have emphasized the translocation of albumin content, contributing to increased plasma volume and consequently showing higher post-exercise blood pressure values in relation to the aerobics session.

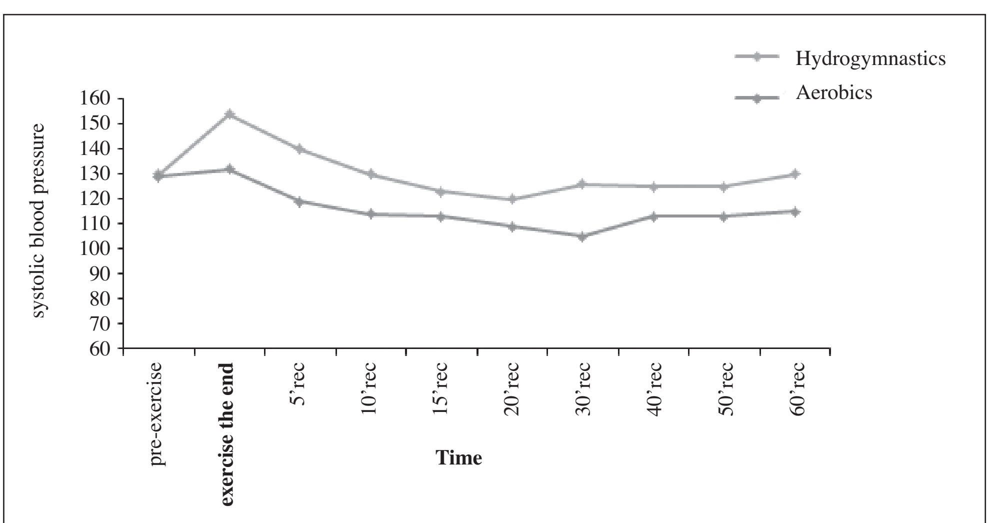

Fig. 2.—Comparison of the mean systolic blood pressure before session, after the effort and during recovery.

Regarding the hypotensive effect in the aerobics session, apart from presenting lower values of systolic blood pressure, it lasted longer period of time. By the end of the sixtieth minute of recovery, blood pressure levels were still lower than pre-exercise values, similar result to that reported by Terblanche e Millen[23]. Unlike hydrogymnastics session where the systolic blood pressure returned to values close to the pre-exercise around the thirty-minute recovery.

The training frequencies of both modalities were below the values recommended by the ACSM; therefore the two forms of exercises can promote health and improve the quality of life elderly.

Given the global aging, increase the social appeal for expansion and creation of new programs aimed to the elderly public, since the participation in social programs that involve physical activity may represent the only way to remain active in this life fase[25]. Those programs give the opportunity to seniors to practice a regular and targeted exercise, reducing the main negative symptoms, both biological and psychological, and improving the quality of life of its members.

Conclusion

Both modalities studied are widely indicated as adjunct treatment for hypertension. However, this study demonstred that aerobics is more efficient to reduce post-exercise blood pressure compared to hydrogymnastics in controlled hypertensive elderly, showing lower blood pressure levels and longer duration of the hypotensive effect.

References

1. V Brazilian Guidelines in Arterial Hypertension. *Arq Bras Cardiol* 2007;89:e24-79.
2. Aronow WS et al. ACCF/AHA 2011 expert consensus document on hypertension in the elderly: a report of the American College of Cardiology Foundation Task Force on Clinical Expert Consensus Documents developed in collaboration with the American Academy of Neurology, American Geriatrics Society, American Society for Preventive Cardiology, American Society of Hypertension, American Society of Nephrology, Association of Black Cardiologists, and European Society of Hypertension. *J Am Soc Hypertens* 2011;5:259-352.
3. Bond V et al. Aerobic exercise attenuates blood pressure reactivity to cold pressor test in normotensive, young adult African-American women. *Ethn Dis* 1999;9:104-110.
4. Laterza MC, Rondon MUPB, Negrão CE. Efeito anti-hipertensivo do exercício. *Rev Bras Hipertens* 2007;14:104-111.
5. Forjaz CL, Santaella DF, Rezende LO, Barretto AC, Negrao CE. Effect of exercise duration on the magnitude and duration of post-exercise hypotension. *Arq Bras Cardiol* 1998;70:99-104.
6. Artinian NT et al. Interventions to promote physical activity and dietary lifestyle changes for cardiovascular risk factor reduction in adults: a scientific statement from the American Heart Association. *Circulation* 2010;122:406-441.
7. Fomina OG. Active exercises in water for advanced age women as the way to improve their physical workability and to correct body composition. *Adv Gerontol* 2009;22:343-347.
8. Jemni M, Friemel F, Sands W, Mikesky A. Evolution of the physiological profile of gymnasts over the past 40 years. A review of the literature. *Can J Appl Physiol* 2001;26:442-456.
9. Graef FIK, Kruel LFM. Freqüência cardíaca e percepção subjetiva do esforço no meio aquático: diferenças em relação ao meio terrestre e aplicações na prescrição do exercício – uma revisão. *Rev Bras Med Esporte* 2006;12: 221-228..
10. ACSM. American College of Sports Medicine - Manual de Pesquisa das Diretrizes do ACSM para os testes de esforço e sua prescrição. 4a. ed. Rio de Janeiro: Guanabara Koogan; 2003.
11. McArdle WDK, F.I.; Katch, V.I. Fisiologia do exercício - Energia, Nutrição e Desempenho Humano. 5a. ed. Rio de Janeiro: Guanabara Koogan; 2003.
12. Tanaka H, Monahan KD, Seals DR. Age-predicted maximal heart rate revisited. *J Am Coll Cardiol* 2001;37:153-156.
13. AEA. Aquatic Exercise Association. Manual do profissional de fitness aquático. Rio de Janeiro: Shape; 2001.
14. Lizardo JHF, Modesto LK, Campbell CSG, Simões GG. Hipotensão pós-exercício: comparação entre diferentes intensidades de exercício em esteira ergométrica e cicloergômetro. Rev. bras. cineantropom. *Desempenho hum* 2007; 9:115-120.
15. Douda HT, Toubekis AG, Avloniti AA, Tokmakidis SP. Physiological and anthropometric determinants of rhythmic gymnastics performance. *Int J Sports Physiol Perform* 2008;3:41-54.
16. Borresen J, Lambert MI. Autonomic control of heart rate during and after exercise : measurements and implications for monitoring training status. *Sports Med* 2008;38:633-646.
17. Bufalino KD, Moore Af, Slongier EL, Johnson RL, Andres FF. Physiological and Perceptual Responses to Bench Stepping in Water and in Land. *Med Sci Sport Exerc* 1992;24: S183.
18. Craig ADM. Thermal Regulation of Man Exercising During Water Immersion. *J Apll Physiol* 1968;25:28-35.
19. Baum G. Aquarobics – The Training Manual. 1a. ed. London: W. B. London; 2000.
20. Brito AF, Alves NF, Araujo AS, Goncalves MC, Silva AS. Active Intervals Between Sets of Resistance Exercises Potentiate the Magnitude of Postexercise Hypotension in Elderly Hypertensive Women. *J Strength Cond Res* 2011; 25:3129-3136..
21. Hayes PM, Lucas JC, Shi X. Importance of post-exercise hypotension in plasma volume restoration. *Acta Physiol Scand* 2000; 169:115-124.
22. Arca EA, Martinelli B, Martin LC, Waisberg CB, Franco RJ. Aquatic exercise is as effective as dry land training to blood pressure reduction in postmenopausal hypertensive women. *Physiother Res Int* 2014;19:93-8.
23. Terblanche E, Millen AM. The magnitude and duration of post-exercise hypotension after land and water exercises. *Eur J Appl Physiol* 2012;112:4111-4118.
24. Neves ARM, Doimo LA. Avaliação da percepção subjetiva de esforço e da freqüência cardíaca em mulheres adultas durante aulas de hidroginástica. Rev. Bras.Cineantropom. *Desempenho Hum* 2007;9:385-391.
25. Ribeiro JAB, Cavali AS, Cavali MO, Pogorzelski LV, Prestes MR, Ricardo LIC. Adesão de idosos a programas de atividade física: motivação e significância. Rev. Bras. Ciênc. *Esporte* [online] 2012:34:969-984.