

**SHORT-TERM FOLLOW-UP OF INDICATORS OF OBESITY IN FRAIL ELDERLY OBESE:
EFFECTS OF INTERVENTION WITH HYDROGYMNASIC**

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ABSTRACT

The aim of this study was to investigate the effects of a short-term intervention with hydrogymnastic on indicators of obesity in frail elderly obese. We evaluated 18 obese women (BMI ≥ 30 kg/m²), aged between 60 and 75 years old, beginners in a program of hydrogymnastic. The training volume was three times per week and 45 minutes per day. This pattern was maintained for six months. There are trends for improvement with the intervention. The most important changes were observed during the 2nd stage for all variables (about twice higher than in the 1st stage). The correlations with major importance in terms of association and statistical significance were positive. Only hip and WHR presented negative correlation ($p < 0.01$). The intervention of short-term with aquatic exercise of hydrogymnastic tends to produce improvements in indicators of obesity and can be a viable alternative for the treatment in frail elderly.

Key words: Frail Elderly. Weight Loss. Obesity. Exercise Therapy; Water.

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RESUMO

Acompanhamento de curto prazo de indicadores de obesidade em idosas obesas frágeis: efeitos da intervenção com hidroginástica

O objetivo do estudo foi investigar os efeitos de uma intervenção de curto prazo com hidroginástica sobre indicadores de obesidade em idosas obesas frágeis. Foram avaliadas 18 mulheres obesas (IMC ≥ 30 kg/m²), com idade entre 60 e 75 anos que iniciaram um programa de hidroginástica. O volume de treinamento foi de três vezes por semana e 45 minutos por dia, sendo mantido nesse padrão por seis meses. Houve tendência a melhorias com a intervenção. As alterações mais importantes foram observadas ocorreram durante o 2º trimestre para todas as variáveis (cerca de duas vezes maiores que no 1º trimestre). As correlações com maior importância em termos de associação e significado estatístico foram positivas. Somente quadril e RCQ apresentaram correlação negativa, indicando significativamente ($p < 0,01$). As intervenções de curto prazo com o exercício aquático de hidroginástica tende a produzir melhorias em indicadores de obesidade e pode ser uma alternativa viável para o tratamento da obesidade de idosos frágeis.

Palavras-chave: Idosas frágeis. Emagrecimento. Obesidade; Exercício terapêutico. Água.

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INTRODUCTION

Demographic studies of the Brazilian population show narrowing at the base of the pyramid and enlargement of the top, which reflects the decline of fecundity rates and the aging of the country. Between 1940 and 1960 the age pyramids were in constant distribution.

Approximately 50% of the population was under 20 years of age and less than 3% was over 65 years of age. From this point on the pyramid, structure began to change. According to the census in 1970, 5.07% of the population was 60 years of age or more, rising to 6.07% in 1980, 7.30% in 1991 and 8.56% in 2000 (Carvalho and Garcia, 2003).

Future projections show that the elderly population, aged 65 years or older will increase at a rate of 2 to 4% per year, reaching almost 20% of the population in 2050 (Carvalho and Rodriguez-Wong, 2008).

The increasing rates of chronic noncommunicable diseases are associated with demographic transition and represent a major health challenge to global development in the coming decades. It threatens the life's quality of millions of people and has great economic impact for countries, particularly for countries with low and middle income. The highest rates of health problems worldwide are attributed to chronic noncommunicable diseases, being considered the disability-adjusted life-years (chronic noncommunicable diseases: 47%; communicable diseases: 41%; injuries: 12%), and number of deaths per year (chronic noncommunicable diseases: 59%; communicable diseases: 32%; injuries: 9%) (Anderson and Chu, 2007).

According to the International Statistical Classification of Diseases and Related Health Problems – ICD-10 (WHO, 2007) obesity is a disease among the chronic noncommunicable group, which is one of the most concern the framework for presenting pandemic threat around the world – in 2005, nearly two billion people with 15 years old or more, suffered with overweight (BMI \geq 25.0 kg/m²), and among these, there were more than 400 million clinically obese (BMI \geq 30.0 kg/m²); in 2015, are expected three billion people, with 15 years or more, with overweight, and among these, more than 700 million are clinically obese (WHO, 2006).

Moreover, obesity is multifactorial in its appearance and is a risk factor for several

other chronic noncommunicable diseases (Obesity, 2000).

In the context of prevention of diseases and control of risk factors to health, it appears that aquatic exercise is effective to cause post-exercise hypotension effect (Rodriguez et al., 2011), improving flexibility and aerobic fitness of elderly patients with osteoarthritis (Wang et al., 2007). Moreover, it was observed that obese women had fat reduction and weight loss when doing aerobic exercise in water (Gappmaier et al., 2006).

However, we did not find studies that aimed to investigate the control of obesity in the elderly with hydrogymnastic. Considering that obesity is a problem that must be controlled, the aim of this study was to investigate the effects of short-term intervention with aquatic training of hydrogymnastic on indicators of obesity in frail elderly obese.

MATERIALS AND METHODS

The sample consisted of 18 obese women (BMI \geq 30 kg/m²), aged between 60 and 75 years old, in the beginning of a hydrogymnastic program.

Exclusion criteria were: cognitive or motor impairment, acute or chronic, which could compromise the practice of aquatic exercise; lack of medical clearance to exercise; non-adherence.

As inclusion criteria, women should have 60 years or more, be sedentary, be frail elderly (Kim and Schulz, 2008) and have a BMI \geq 30.0 kg/m².

The training program followed current physical activity recommendation for elderly (Nelson et al., 2007) and consisted of three sessions per week with 45 minutes per day. The intensity of the training sessions was controlled to stay between 11 and 13 on the Borg's scale, which consists in moderate exercises (Carvalho et al., 2009).

All procedures followed the principles of the Declaration of Helsinki (<http://www.wma.net/en/30publications/10policies/b3/>). This research was approved by the ethics committee (14/10) by Methodist University of Piracicaba and all participants filled in Human Informed Consent Form.

The indicators of obesity were analyzed: weight; Body Mass Index (BMI); waist and hip circumferences, Waist to Hip

Ratio (WHR); Conicity Index (C index) and Waist to Height Ratio (WtHR).

Subsequently, the delta percentage alterations were calculated over the time by the delta. These indicators of obesity were collected in three stages: early in the first stage of intervention, early in the second stage of intervention and after six months of intervention.

To investigate whether the variables showed normal distribution, we used the Kolmogorov-Smirnov and to verify the homogeneity of variance was used Levene test.

After verification of normality and homogeneity, was conducted an analysis of variance (ANOVA) with repeated measures to test the hypothesis that changes in indicators of obesity for hydrogymnastic training and to compare the percentage deltas between

periods 1st and 2nd stages to verify major changes in a given period. When significant differences were found by ANOVA, post hoc Newman-Keuls was used to identify where the differences were located.

The Pearson correlation was used for analyzing associations between the deltas for the semester. The level of significance in all tests was $p \leq 0.05$.

RESULTS

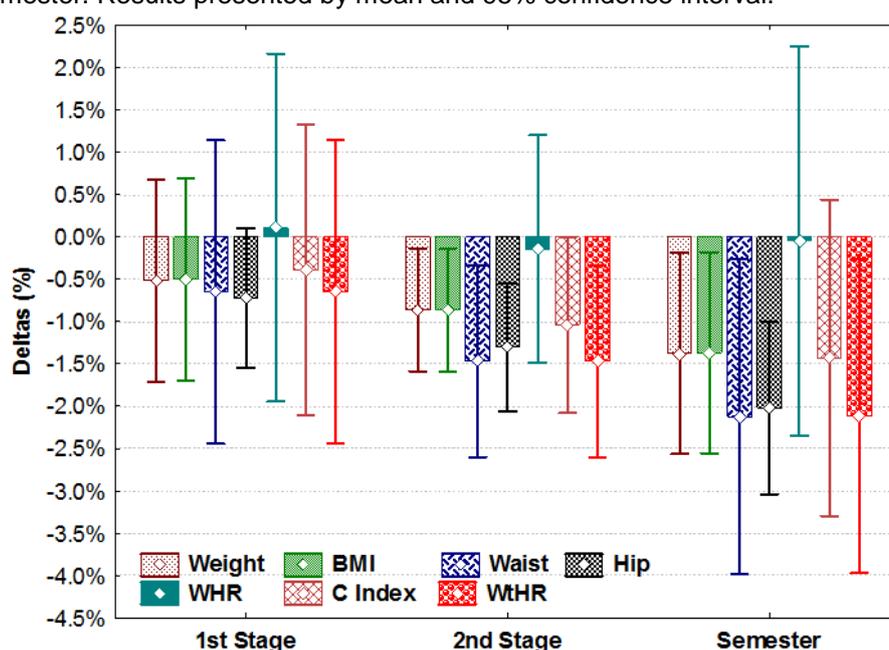
The changes over the six months of training with hydrogymnastic are presented in Table 1. It was observed trends in reduction almost all variables over time.

However, the observed changes were not statistically significant ($p > 0.05$). The only variable over time that showed no tendency towards reduction was WHR.

Table 1 - Changes in the indicators of obesity along six months of training of hydroginastic.

	Baseline	3 months	6 months
Weight (kg)	77.07 ± 10.27	76.66 ± 10.17	75.96 ± 9.81
BMI (kg/m²)	30.73 ± 3.86	30.55 ± 3.69	30.28 ± 3.64
Waist (cm)	97.22 ± 10.56	96.56 ± 10.80	95.11 ± 10.63
Hip (cm)	113.22 ± 7.54	112.39 ± 7.46	110.89 ± 6.99
WHR	0.86 ± 0.06	0.86 ± 0.06	0.86 ± 0.06
C Index	1.28 ± 0.09	1.27 ± 0.08	1.26 ± 0.09
WtHR	0.61 ± 0.07	0.61 ± 0.07	0.60 ± 0.07

Figure 1 - Comparison between the deltas of 1st and 2nd stage and effect of training of hydroginastic along the semester. Results presented by mean and 95% confidence interval.



Comparisons of changes are shown in Figure 1, (deltas percent) occurred in the indicators of obesity in the 1st stages and 2nd stages of hydrogymnastic training, as well as the changes over the six months of intervention. It was found that the greatest changes (statistically nonsignificant) in indicators of obesity occurred during the 2nd stages - 1.68 times higher for weight, 1.72 times higher for BMI, 1.80 times higher for hip, 2.25 times higher for waist, 2.27 times higher for WtHR and 2.66 times higher for index C. Only WHR did not change in any of the stages.

The deltas were very strong and significant correlations between weight and BMI (common variability of 99.99%), waist circumference and conicity index (common variability of 90.90%), waist circumference and waist to height ratio (common variability of 99.99%), waist to hip ratio and conicity index (common variability of 88.10%) and conicity

index and waist to height ratio (common variability of 89.97%).

The deltas showed strong and significant correlations between waist circumference and waist to hip ratio (common variability of 79.76%) and between waist to hip ratio and waist to height ratio (common variability of 79.72%).

The deltas were moderate and significant correlations between weight and hip (common variability of 36.73%), waist to hip ratio and hip (common variability of 36.96%) and waist to hip ratio (common variability of 35.52%).

Between waist to hip ratio and hip the observed correlation was negative, that is, the smaller the hip, the higher the waist to hip ratio. The remaining variables of the observed correlations were weak or very weak and not statistically significant (Table 2).

Table 2 - Association between changes (deltas) that occurred along the semester.

	Weight	BMI	Waist	Hip	WHR	C Index	WtHR
Weight	---	0.99*	0.17	0.61*	-0.14	-0.15	0.17
BMI	---	---	0.16	0.61*	-0.14	-0.16	0.17
Waist	---	---	---	-0.17	0.89*	0.95*	0.99*
Hip	---	---	---	---	-0.60*	-0.36	-0.17
WHR	---	---	---	---	---	0.94*	0.89*
C Index	---	---	---	---	---	---	0.95*
WtHR	---	---	---	---	---	---	---

*p<0,01.

DISCUSSION

The manifestation of the phenomenon of aging throughout life is variable among individuals of the same species and between individuals of different species through interaction, particularly, between genome and environment, thus resulting in higher or lower speed of process. This finding led to the development of numerous definitions of biological aging that, although differ in theoretical orientation underlying, they share the notion of progressive loss of function with age, with the consequent increase in the susceptibility and incidence of the disease, increasing the likelihood of death (Mota, Figueiredo and Duarte, 2004).

Among the factors modified with aging is the body fat. Epidemiological evidences shows, for example, that the prevalence of overweight may increase by 4.87 times, comparing young women (between 20 and 30

years) with older women (age \geq 60 years), 6.68 times for abdominal obesity and 1.31 times for the percentage of fat (Silva and Almeida, 2009).

In Brazil, according to the latest estimative (Brazil, 2008), 44.2% of the adult population, about 81 million people, are overweight or obese, generating direct costs of 4.3% of the budget in the health of the country, equivalent to US\$ 36 million (Sichieri, Nascimento and Coutinho, 2007).

The Obesity Society (Allison et al., 2008) conceptually defined obesity as the excessive accumulation of body fat, may be by total body fat, by a particular fat deposit, or even based on morphology or function of adipocytes. BMI \geq 30.0 kg/m² is an operational definition for obesity useful in many contexts, but should not be used as a conceptual definition. Obesity denotes excess body fat in a quantity large enough to cause a decrease in health and longevity. This reduction in health

status will not be noticeable in all cases according to the operational definition used to measure it.

According to the ICD-10 (WHO, 2007), obesity is a disease, classified under codes E65 to E68. However, this proposal does not include sedentarism, the causal factor of this disease, although it is considered by The Obesity Society (Allison et al., 2008).

The concept of excessive accumulation of fat as a disease has gained strength with the confirmation that the adipose cells are no longer regarded only as structures of protection and support, but as a real organ with intense endocrine activity, paracrine, autocrine and metabolic (Allison et al., 2008; Zahorska-Markiewicz, 2006).

Although this concept appears relatively new in 1980s researchers describe that the adipose tissue produced hormones (Siiteri, 1987).

Adipokines, factors secreted by adipose tissue, are the link between obesity, chronic noncommunicable diseases and premature death. Among them, distinguished the tumor necrosis factor-alpha (TNF- α - lipolytic, stimulates energy intake and reduced insulin sensitivity), interleukin-6 (IL-6 - pro-inflammatory, lipolytic, reduces insulin sensitivity), plasminogen activator inhibitor-1 (PAI-1 - inhibits the activation of plasminogen, blocks fibrinolysis), leptin (signaling the CNS about the body reserves of energy, regulation of immune systems, respiratory and reproductive), resistin (increases insulin resistance), estrogen (produced by the action of aromatase, the main source of estrogen in men and postmenopausal in women), among others (Allison et al., 2008; Siiteri, 1987).

The elderly women surveyed in this study began treatment with aquatic exercise of hydrogymnastic indicating numbers above the cutoff points proposed for Brazilians (BMI \geq 26 kg/m²; waist \geq 83 cm; WHR \geq 0.83; C index \geq 1.18; WtHR \geq 0.53) (Pitanga and Lessa, 2004; Pitanga and Lessa, 2006).

Later, it was shown from these cutoff points that coronary risk for the elderly would increase by 1.99 times for BMI, 2.50 times for waist, 3.36 times for WHR and 3.53 times for C index (Pitanga and Lessa, 2007).

In the second stage of training, weight, BMI, waist, hip and WtHR there were two times more reduction compared to the first stage. The C index was reduced three times in the

second stage when compared with the first. Although there were reductions in indicators of obesity in this study, they were not statistically significant during the semester. One possible reason is the adaptive effect to the intensity and volume of the exercise sessions.

Typically, aging is marked by declines in organic processes that may have important functional significance on skeletal muscle function, cardiovascular, pulmonary, physical capabilities, metabolic and body composition, with consequent increased susceptibility and incidence of diseases, increasing the likelihood of premature death (Mota et al., 2004;

American College of Sports Medicine et. al, 2009). Further, the trainability of the elderly is lower when compared to younger (American College of Sports Medicine et. al, 2009).

The clinical significance of this fact is that the response to training may be slower or lesser magnitude, but great importance to preserve or improve the health status of the elderly.

Important fact to be noted is that WHR is presented in other studies as the most sensitive and specific for discriminating coronary risk (Pitanga and Lessa, 2005), as well as being indicator of obesity that poses the greatest coronary risk (Pitanga and Lessa, 2007), it did not change along of the intervention with aquatic exercise of hydrogymnastic. Thereby, indicating an inability to identify changes in the state of obesity and consequently, in a manner contrary to that shown by the indicators of obesity analyzed, that the risk posed by obesity did not change along of the intervention.

This phenomenon can be explained by two factors shown in the results of this study: 1^o) circumference of waist and hip showed the same proportion of changes along of the study. WHR is product of the ratio of waist circumference by hip, this indicative of obesity was not capable to identify the changes occurred; 2^o) there was moderate correlation, negative and significant ($p = 0.009$) between the deltas of the hip and WHR, indicating that the elderly reduced hip circumference along the study, increased WHR, even there was strong correlation, positive and significant ($p < 0.001$) between the deltas of waist and WHR.

CONCLUSION

Although this intervention did not provide significant improvements in statistical terms, should be considered that the study participants were older, sedentary and obese, therefore, with probable organic considerable declines. Only WHR, seen in other studies as the best discriminator for coronary risk, showed no ability to identify the changes observed in all indicators of obesity analyzed. Faced with the evidence presented in this study, consider that the intervention of short-term with aquatic exercise of hydrogymnastic tends to produce improvements in indicators of obesity and could be a viable alternative for the treatment of obesity. These results can be enhanced in long-term interventions and especially if applied by multidisciplinary teams.

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