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Effect of periodized water exercise training program on functional autonomy in elderly women

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Abstract

Background: Scientific evidence have been related negative functional autonomy to sedentary lifestyle in elderly women by other hand physical exercise is highly recommended to prevent deterioration of neuromuscular functions and proposed during the rehabilitation of physical disability and fall accidents.

Aim: To determine the effect of periodized water exercise training on functional autonomy in elderly women.

Methods: Twenty-six subjects were randomly assigned in two, water exercise intervention group (n=16) and control group (n=10); The intervention group followed 12-week of periodized water exercise training program five times a week, 30 minutes of water exercise with work heart rate reserve of 40-50% (1-6th week) increasing the load to 50-60% (7-12th week); The protocol of the Group of Latin-American Development for Maturity (GDLAM) was used to evaluate functional autonomy; As statistical analyses mixed 2 x 2 ANOVA was used, also percentage changes (%) were calculated.

Results: The results showed significant improvement (p<0.05) comparing the interaction intergroup and the measurements in 10 meters walk test (10mW) (p=0.001) and general GDLAM index (GI) (p=0.012), percentage changes (%) showed positive improvements in the five components of (GDLAM) and (GI).

Conclusion: Periodized water exercise training program was able to enhance (10 mW) and (GI) however, will be appropriated in the future more studies to better clarify the possibilities of improvements between water exercise and functional autonomy.

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Key words: Elderly. Physical Exercise. Functional Autonomy.

EFFECTO DE UN PROGRAMA DE ENTRENAMIENTO PERIODIZADO DE EJERCICIO ACUÁTICO SOBRE LA AUTONOMÍA FUNCIONAL EN ADULTAS MAYORES

Resumen

Antecedentes: Evidencia científica relaciona autonomía funcional negativa y sedentarismo en adultas mayores, por otra parte el ejercicio físico se ha recomendado para evitar el deterioro de funciones neuromusculares y durante la rehabilitación de la discapacidad física y caídas.

Objetivo: Determinar el efecto de un programa de entrenamiento periodizado de ejercicio acuático sobre la autonomía funcional de adultas mayores.

Métodos: Veintiséis sujetos fueron asignados al azar en grupo de ejercicio acuático de intervención (n = 16) y un grupo control (n = 10); El grupo de intervención participó en 12 semanas de ejercicio acuático periodizado cinco veces por semana, 30 minutos con una frecuencia cardíaca de reserva de 40 a 50% (1-6 semana) y un aumento de la carga de 50 a 60% (7-12 semana); Se utilizó el protocolo del Grupo de Desarrollo Latinoamericano de Madurez (GDLAM) para evaluar la autonomía funcional; el análisis estadístico fue por ANOVA 2 x 2, también se calcularon los porcentajes de cambio (%).

Resultados: Se mostró mejoría significativa (p<0,05) al comparar la interacción intergrupo y las mediciones en el test de caminar 10 metros (10mW) (p=0,001) y general GDLAM index (GI) (p=0,012), los cambios porcentuales (%) mostraron mejoras en los cinco componentes de (GDLAM) y (GI).

Conclusion: El entrenamiento periodizado de ejercicio acuático fue capaz de mejorar (10 mW) y (GI) en adultas mayores, aun sin embargo, se requieren futuros estudios para aclarar las posibilidades de mejora en el ejercicio acuático y autonomía funcional.

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Introduction

The aging process is characterized by decrease progressively the neuromuscular functions loss of muscle mass than reduce strength and joint mobility\(^1\) there is scientific evidence pointing than individuals above 60 years old coincides with loss of independence\(^12\) and decrease in functional autonomy in completing activities of daily living such as walking, climbing stairs, or rising from a chair without the help of a person or device\(^2\) which affect the elderly social development and decreasing their quality of life. According with the National Health and Nutrition 2012, 26.9% of Mexican elderly had some degree of disability (26.9% in women and 23.8% in man) moreover these prevalence increases with age, by other hand, the survey showed than 34.9% of elderly suffered a fall in the last 12 months, being more frequently in woman than in man\(^2\), moreover, the occurrence of falls as accident lead the burden of health-care costs for medical care in elderly\(^6\).

The Group of Latin-American Development for Maturity (GDLAM) defines functional autonomy covering three aspects: autonomy of action that relates to the notion of physical independence; autonomy refers to the possibility of self-determination and autonomy than allows the person to judge any situation\(^1\). Evidence from cross-sectional analytical study clearly show than negative functional autonomy have been related to sedentary lifestyle in elderly women\(^8\). Also results of controlled trials focused on exercise in elderly women have been improve functional autonomy\(^10,13\). Hence physical exercise in elderly has been proposed to prevent falls in elderly and during the rehabilitation to minimize health problems related with this problem\(^14,16\).

This research considered the water exercise than carried out through realizing rhythmic-gymnastic activities in an aquatic environment\(^17\), this modality of exercise is especially recommended among people who have limitations with do exercise on dry land due to impact\(^20\) and which in the last ten years, has taken popularity and preference among elderly by taking advantage of water properties in order to provide fluidity and a wider range in movements while diminishing the risk of injuries\(^8,19\). It was found than water exercise in elderly women provides functional autonomy\(^10\). In this context, in exercise training periodization increasing the load heart rate reserve has been produce greater adaptations\(^20\), the present study involves a periodized water exercise training program with different frequency, work load intensity and time than other references\(^10\). Thus, the aim of this study was to determine the effect of periodized water exercise training program on functional autonomy in elderly women. The initial hypothesis was that water exercise training would improve functional autonomy in elderly women.

Materials and Methods

Subjects

Twenty-six elderly women volunteered to partake in the water exercise program in the aquatic complex of the Faculty of Sports at the Autonomous University of Baja California were recruited, before starting the periodized water exercise training the subjects completed a medical examination in order to identify the inclusion and exclusion criteria; the inclusion criteria were ambulation capacity, not have performed a systematical routine of exercise in the previous six months and exclusion criteria were to possess any sort of acute or chronic complication that would hinder water exercise, such as heart problems, diabetes mellitus, hypertension or asthma; physical complications that could affect the ability to accomplish exercise such as osteoarthritis, joint injuries or recent bone fractures, psychological and neurological problems.

The present study followed the ethical principles regarding human experimentation proposed by the Helsinki declaration; all the subjects provided a written consent in order to participate in the study\(^21\), that was approved by the research program of the Faculty of Sports of the Autonomous University of Baja California. Protocol # 149/2/C/13/16.

Study design and testing procedures

Participants were randomly assigned in two, water exercise intervention group (n=16, age of 67.5±4.7 years) and non-exercising control group (n=10, age of 67.4±5.4 years) who advised not to join in systemized exercise but to continue with their usual daily physical activities: In order to determine functional autonomy was performed according with the guidelines of the Group of Latin-American Development for Maturity (GDLAM) protocol than is composed by the following five tests: \(^7\) 10 m walk (10 mW), getting up from a seated position (GSP) getting up from the prone position (GPP), getting up from a chair and movement around the house (GCMH), and putting on and taking off a shirt (PTS). All tests were individually conducted and repeated two different times with a minimum of 5 min intervals, the lowest time of the two trials was recorded; These tests make it possible establishing the Functional Autonomy and General GDLAM index (GI) calculated as follows:\(^7\)

\[
GI = [10 \text{ mW} + \text{GPP} + \text{GSP} + \text{PTS}]^2 + \text{GCMH}/4
\]

Measurements were performed at the baseline pretest and immediately upon posttest of the 12-week of water-exercise, only those completing 95% of training adherence were included in the statistical analysis.

Periodized water exercise training

The water exercise was conducted and supervised by master in sport science specialist also in accordan-
ce with physical exercise prescription for older adults established by the American College of Sports Medicine\textsuperscript{2} and the American Heart Association\textsuperscript{3}.

The participants completed three-month of periodized water exercise training program five times a week, with 50 minutes per session which was comprised by 10 minutes of warm-up, 30 minutes of water exercise training component with intensity monitored by telemetry using a heart rate monitor Polar FT7\textsuperscript{®} (Finland), the work heart rate reserve of 40-50\% (1-6th week) increasing the load to 50-60\% heart rate reserve (7-12th week) the work heart rate reserve was estimated with the equation Max HR= 208-0.7x age\textsuperscript{4} followed by 10 minute of cool down.

Statistical analysis

Descriptive statistical procedures are presented as mean ± standard deviation; Shapiro-Wilk Test was used in order to determine the normality of the groups and the homogeneity of the sample. Differences inter and intragroup pretest-posttest were determined using mixed 2 x 2 ANOVA (groups x measurements), the significance level were performed of p<0.05, 95\% probability of accuracy of the results or negative event with a probability of 5\% per case. Also percentage changes (\%) were calculated for each study group [(Media post – Media pre)/ Media pre] x 100. Statistical analyses were performed using the statistical software (SPSS for Windows version 20 (IBM Corporation, New York, USA).

Results

Descriptive statistical (M ± DE) of the five tests to determine the functional autonomy and General GDLAM index (GI) are presented in Table I, the values showed lower means in experimental group than in control group at the baseline pretest than posttest of the 12-week of water-exercise.

Table II. provides the data of the mixed 2 x 2 ANOVA (groups x measurements) analysis showed significant values (p<0.05) comparing the interaction intergroup and the measurements (p=0.001), of 10 mW (s), also General GDLAM index (GI) showed significant values (p<0.05) comparing the interaction intergroup and the measurements (p=0.012), No significance differences were observed between the exercising and control group for the variables of GSP, GPP, PTS and GCMH.

As sown in figure I the percentage changes (%) of exercise group attained lower values after treatment.

Discussion

The main findings of the present research were that twelve weeks of periodized water exercise training program improve significant reductions in the (10 mW) of the battery tests of functional autonomy and in the (GI) in the elderly women who took part in the experimental group.

The (10 mW) test was validated in elderly justifying the distance at which an elderly can cross the street in an urban perimeter the test also reflects in elderly the security to walk without aid or assistance from people or equipment\textsuperscript{5}, these findings are corroborated elderly women who participate in a 4 months walking program\textsuperscript{6}, other findings showed significant changes whit less time in 10 m walk test of functional autonomy in elderly women practitioners of ballroom dance\textsuperscript{11}, this suggest than elderly women who engage systematic physical exercise may have more velocity to walk 10 mater distance.

Regarding the assessment of physical fitness in the elderly population several batteries have been used to determine the incidence of physical exercise\textsuperscript{5,16}: In the present study the (GDLAM) protocol assessment of functional autonomy was chosen for inexpensive, validated, easy to apply, replicable and the tests simulate activities of daily living calculating the time done

<table>
<thead>
<tr>
<th>Variables</th>
<th>Experimental (n=16)</th>
<th>Control (n=10)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pre</td>
<td>Post</td>
</tr>
<tr>
<td>10mW(s)</td>
<td>7.60±1.47</td>
<td>6.70±1.23</td>
</tr>
<tr>
<td>GSP(s)</td>
<td>11.36±2.40</td>
<td>10.04±2.22</td>
</tr>
<tr>
<td>GPP(s)</td>
<td>5.66±1.88</td>
<td>4.69±2.38</td>
</tr>
<tr>
<td>PTS(s)</td>
<td>11.50±3.68</td>
<td>11.20±3.52</td>
</tr>
<tr>
<td>GCMH(s)</td>
<td>33.03±4.97</td>
<td>31.84±8.48</td>
</tr>
<tr>
<td>GI</td>
<td>26.33±4.40</td>
<td>24.78±3.94</td>
</tr>
</tbody>
</table>

10 mW: 10 m walk\textsuperscript{8}; GSP: getting up from a seated position\textsuperscript{7}; GPP: getting up from the prone position\textsuperscript{7}; PTS: putting on and taking off a shirt\textsuperscript{7}; GCMH: getting up from a chair and movement around the house\textsuperscript{7}; GI: General GDLAM index\textsuperscript{7}.

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in general index of functional autonomy than provides information of certain freedom of action.

The results of (GI) on this study was consistent with other controlled trials in elderly women has been considered exercise modalities as aquatic exercise, dance, yoga, or walking. In the present study, the results on the tests getting up from a seated position (GSP), getting up from a chair and movement around the house (GCMH), and putting on and taking off a shirt (PTS) it was found percentage changes (%). improvements but no significant changes in relation to the mean of experimental and control groups, these results partial contradict those than found significant improvements in as aquatic exercise, dance, yoga, or walking. In spite of the water exercise training program in these research was designed five times a week with periodization in order to produce greater adaptations increasing the load heart rate reserve of 40-50% (1-6th week) increasing the load to 50-60% heart rate reserve (7-12th week) these discrepancies may be owing to the time than were carried through 4 to 8 months but with lower frequency (3 times a week) and work load intensity by other hand some of these programs where attendance in strength modalities than may have influence the improvements in functional autonomy tests and in the (GI).

In gerontology and geriatrics area physical exercise has been proposed during the rehabilitation of physical disability and fall accidents in elderly, due preventing deterioration of neuromuscular functions should be monitored functional autonomy to avoid the occurrence of accidental falls in these population.

### Table II

<table>
<thead>
<tr>
<th>Variable</th>
<th>Intergroup (A)</th>
<th>Measurements (B)</th>
<th>Interaction (AxB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>a10 mW (s)</td>
<td>.409</td>
<td>.119</td>
<td>.001</td>
</tr>
<tr>
<td>bGSP (s)</td>
<td>.024</td>
<td>.929</td>
<td>.340</td>
</tr>
<tr>
<td>cGPP(s)</td>
<td>.501</td>
<td>.301</td>
<td>.106</td>
</tr>
<tr>
<td>dPTS (s)</td>
<td>.154</td>
<td>.853</td>
<td>.288</td>
</tr>
<tr>
<td>eGCMH(s)</td>
<td>.276</td>
<td>.987</td>
<td>.114</td>
</tr>
<tr>
<td>fGI</td>
<td>.054</td>
<td>.417</td>
<td>.012</td>
</tr>
</tbody>
</table>

10 mW: 10 m walk; GSP: getting up from a seated position; GPP: getting up from the prone position; PTS: putting on and taking off a shirt; GCMH: getting up from a chair and movement around the house; GI: General GDLAM index.

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In gerontology and geriatrics area physical exercise has been proposed during the rehabilitation of physical disability and fall accidents in elderly, due preventing deterioration of neuromuscular functions should be monitored functional autonomy to avoid the occurrence of accidental falls in these population.

Fig. 1.—The percentage changes (%) of exercise group attained lower values after treatment.
In conclusion, periodized water exercise training program is able to enhance the percentage changes (%) of functional autonomy in elderly women, also the results showed positive improvements in (10 mW) of functional autonomy and in the General (GI) however, in will be appropriated in the future more studies to better clarify and investigate the possibilities of improvements between water exercise and functional autonomy, due to this modality of exercise has taken popularity among elderly provide them advantage of move with greater amplitude in water environment.

Acknowledgements

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Conflict Of Interest

The authors declare no conflicts of interest.

Authors’ contributions section

All authors read and approve the final manuscript. Paulina Yesica Ochoa Martínez and Javier Arturo Hall López, carried out the design of the study, Javier Arturo Hall López and Estelio Henrique Martin Dantas performed the statistical analysis, Paulina Yesica Ochoa Martínez and Javier Arturo Hall López interpreted the data, drafted or revised the manuscript, Estelio Henrique Martin Dantas and Paulina Yesica Ochoa Martínez, designed the study, Paulina Yesica Ochoa Martínez and Alberto Paredones Hernández were involved in the data collection and checked the manuscript, Paulina Yesica Ochoa Martínez, Javier Arturo Hall López and Alberto Paredones Hernández participated in the concept and checked the manuscript Paulina Yesica Ochoa Martínez was a general coordinator and designed the study.

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