Journal of Clinical Gerontology & Geriatrics
www.e-jcgg.com

Original Article

Functional fitness and quality of life in elderly individuals trained in aquatic and land environments: Is it the environment and/or the training structuring?

Rodrigo Sudatti Delevatti[1,2,3], *Thais Reichert[1], Ana Carolina Kanitz[1,4], Bruna Machado Barroso[1], Diego Regert[2], Fernando Sakuraba[2], Cláudia Gomes Bracht[1], Luiz Fernando Kruel[1]

[1]University Federal of Rio Grande of Sul, Porto Alegre, RS, Brazil
[2]Sogipa School of Physical Education, Porto Alegre, RS, Brazil
[3]University Federal of Santa Catarina, Florianópolis, SC, Brazil
[4]University Federal of Uberlândia, Uberlândia, MG, Brazil

ABSTRACT

Background/Objective: Aging causes a loss of functional fitness, which reduces the ability of the elderly to accomplish their daily life activities, affecting their quality of life. To overcome this scenario, exercise is indicated. It is important to know which training environment promotes greater quality of life and functional fitness. The aim of the present study was to compare the quality of life and functional fitness of elderly practitioners of water-based (WB) and land-based (LB) physical training.

Methods: This study is characterized as observational of comparative cross-sectional design. Sample consisted of 14 individuals practitioners of LB (69.24±6.61 years) and 14 practitioners of WB (67.28±6.03 years). LB had weekly frequency from three to four sessions, in which aerobic and resistance training were performed, without clear structuring (control and progression of volume and intensity) of training. WB had two weekly sessions of deep water running aerobic training, with clear structuring of training.

Results: Quality of life was similar between the groups, except in environment domain, in which WB showed greater values (LB: 66.07±7.34, WB: 75.67±12.98). WB presented better performance in the dynamic balance test (LB: 6.83±1.03s; WB: 5.74±0.78s), as well as greater upper limb strength (LB: 19±5 repetitions; WB: 28±8 repetitions), lower limb strength (LB: 13±4 repetitions; WB: 21±4 repetitions) and flexibility levels (LB: -10.21±12.85 repetitions; WB: 1.71±9.74 repetitions).

Conclusion: Elderly practitioners of a periodized water-based training have the same quality of life, however, greater strength, dynamic balance and flexibility in comparison to practitioners of a non-periodized training on land environment.

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***Correspondence**
Prof. Thaís Reichert
University Federal of Rio Grande of Sul, Porto Alegre, RS, Brazil
E-mail:
thais_reichert@hotmail.com

Received 25 February 2018
Accepted 6 July 2018

Keywords
aquatic exercise
aerobic training
resistance training
aging

INTRODUCTION

Aging process is characterized by a loss of functional fitness, which reduces the ability of the elderly to accomplish their daily life activities.[1,2,3] Functional restriction makes this population more vulnerable and frequently dependent of other people to execute basic tasks like walking, climbing stairs and stand up from a chair, which decrease their physical activity level and quality of life.

Faced with this scenario, the practice of a combined training associating resistance and aerobic exercises has been recommended in order to optimize the functional fitness of the elderly public.[4] In this sense, resistance training combined to aerobic training on the treadmill or cycle ergometer have been widely investigated and the results indicate a beneficial effect of this practice on the physical fitness of the elderly.[5-10] In addition to traditional land-based training, aquatic environment has been suggested as an alternative for training. Among the modalities performed in this environment, deep water running (DWR) is highlighted. DWR is carried out with the aid of a float vest which keeps the individual in the orthostatic position at the water level, without supporting the feet on the bottom of the pool, thus eliminating joint impact on the lower limbs and spine.[11,12] Moreover, in the aquatic environment there is a reduction of the heart rate and blood pressure values.[13] These characteristics are beneficial for the elderly population, who presents a high prevalence of osteoarticular and cardiovascular disorders. Due to the aquatic environment characteristics described above, this environment could be considered as a safer alternative for physical exercise practice, possibly reducing the number of injuries.

Studies showed that DWR promotes important benefits for the elderly population, such as an increase in lower limb strength and cardiorespiratory fitness,[12] as well as improvements in functional capacity.[14] These benefits were also found with a combined training performed on land.[15-18] However, few studies have confronted training models in different environments (land-based versus water-based training) in order to compare their effects.[19-21] The results of these studies demonstrated that, in general, it seems that both training models promote similar benefits, except in some variables that aquatic training seems to be more efficient. However, these studies compared hydrogymnastics with walking on land or with strength training using elastic bands, therefore, it is not yet known if DWR practitioners have the same level of functional fitness as those practicing a land-based combined training. Besides, these results are generally derived from interventional studies, in which there is a very well controlled environment, and thus do not reflect the real world, in that elderly people perform exercise training without a good control of intervenient factors.

Thus, there is a gap in the literature about how these health outcomes, especially neuromuscular ones, would be shown in elderly individuals trained in different environments (aquatic and dry-land). Only in this way, we will be able to have a better understanding about the role that the environment and training structuring assume in the exercise indications for the elderly health.

Therefore, the aim of this cross-sectional study was to compare functional fitness and quality of life of elderly individuals practitioners of land-based training without clear periodization with elderly practitioners of water-based periodized training.

METHODS

Design

This study is characterized as observational of comparative cross-sectional design.

Participants

The sample was composed by 28 elderly individuals between 65 and 75 years old. As inclusion criteria, individuals should not present any history of neuromuscular, metabolic, hormonal or cardiovascular diseases, except hypertension. Eutrophic, overweight and obese individuals were included. Individuals with osteoarticular limitation that could impair the evaluations were excluded from the study. All participants lived in the city of Porto Alegre or in the metropolitan area. The participants trained on land environment (LB; six men and eight women, n=14) were selected at a gym from the city of Porto Alegre/RS and should be training for at least six months. On the other hand, participants trained in the aquatic environment (WB; six men and eight women, n=14) were selected in a deep water running program from the School of Physical Education, Physiotherapy and Dance (ESEFID) from the Universidade Federal do Rio Grande do Sul (UFRGS) and were training for 28 weeks. All individuals received instructions about the study procedures and signed a consent form, which was previously approved by the UFRGS' Ethics Committee in Research (n° 675.861). The study was conducted according to the Declaration of Helsinki.

Features of land-based training

All individuals practitioners of land-based training were training both resistance and aerobic exercises, characterizing a combined training. The weekly frequency was from three to four sessions with duration of approximately 90 minutes, prescribed according to the specific purpose and conditioning level of each participant, without specific criteria for load progression.

Training sessions were composed by warm-up, main part and cool down. The warm-up was performed on the treadmill or cycle ergometer for about 10 minutes, at light intensity. The main part was divided by aerobic and resistance components. The aerobic component was generally performed through the interval method, with running stimuli interspersed by walking, totaling 20 to 30 minutes. In the resistance component, around two resistance exercises were performed for each muscle group. Resistance training was generally separated into A and B, according to the muscle groups to be trained. Around three series of 12 maximal repetitions were performed for each exercise, totaling around 40 minutes. Cool down was composed by stretching exercises.

Features of water-based training

All individuals practitioners of water-based training were training DWR modality, which is predominantly aerobic. Weekly frequency was comprised of two sessions with 45 minutes of duration each, prescribed according to the purpose of a health conditioning program, with specific criteria for load progression.

Training sessions were constituted by warm-up, main part and stretching. Warm-up consisted of deep water walking at an intensity corresponding to index 11 (light) of the Borg's Scale of Perceived Exertion. The main part was composed by DWR which intensity was periodized through the Borg's Scale and performed in a continuous or interval way. Continuous training intensity progressed from the index 13 to 17 of the Borg's Scale of Perceived Exertion (6-20). On the other hand, interval training progressed from 10 blocks of three minutes (2 minutes at index 15 and 1 minute at index 11) to six blocks of three minutes (2 minutes at index 18 and 1 minute at index 11). The completed periodization can be visualized in Table 1. Both training models progressed from 30 to 36 minutes. Concomitantly to deep water running, upper limbs exercises were also performed for the main muscle groups (elbow flexion and extension, shoulder horizontal flexion and extension and shoulder abduction and adduction). Stretching was standardized, emphasizing the muscles worked in the main part of the session.

Experimental procedures

The elderly trained on dry-land environment underwent the assessments at the gym where they trained, whereas the elderly trained in aquatic environment were evaluated at ESEFID-UFRGS. Firstly, quality of life was assessed through WHOQOL-BREF questionnaire. This questionnaire is constituted by 26 questions, in which two of them refer to general quality of life and the remaining are divided by four domains: social relationships, environment, psychological and physical health. Subjects were oriented about the correct manner to complete the questionnaire by previously instructed evaluators. After that, the individuals performed the functional fitness tests battery of Rikli and Jones,[22] except the 6-minute walk test. The battery is comprised by five tests, aiming to assess agility/dynamic balance (8-foot up-and-go), lower and upper limbs strength (elbow flexion and sit-up test, respectively) and upper and lower limbs flexibility (back scratch and sit-and-reach test, respectively). Tests were performed in this order with one-minute interval between them. Before each test, the evaluator demonstrated the exercise and the participant executed one attempt for familiarization. The result of the second attempt was used for analysis.

Statistical analysis

The sample size was determined by calculation based on a previous study (Souza et al.[23]), which was chosen because of the similarity with the evaluations and sample of the present study. The calculation was performed in the GPower software version 3.1, in which a significance level of 0.05 and a power of 95% were adopted for all variables. For the sample size, the highest value among the variables was adopted: 24 subjects (12 for each group). However, in order to manage a possible data loss, a percentage of 15% was added to the estimated value. Thus, 28 individuals (14 for each group) were recruited. Descriptive analysis was used and the values were presented as mean and standard deviation. Shapiro-Wilk and Levene tests were used to test normality and homogeneity of the data, respectively. Independent t test was carried out for the comparison of the variables between the groups. Significance index adopted was $\alpha=0.05$. SPSS version 20.0 was used for analysis.

RESULTS

Regarding participants' age, WB participants were 67.28±6.03 years, whereas LB ones were 69.24±6.61 years.

Table 2 presents quality of life results. It is perceived that the practitioners of land-based combined training and water-based aerobic training have similar quality of life in physical health, psychological and social relationships domains, as well as in general quality of life. However, water-based training group presented greater quality of life in the environment domain.

Functional fitness results can be observed in Table 3. Practitioners of water-based training showed greater performance in the 8-foot up-and-go test, evidencing greater dynamic balance and agility. In addition, this group also accomplished a greater number of repetitions in elbow flexion and sit-up tests, evidencing greater resistance strength in both upper and lower limbs. WB also obtained greater flexibility values in the upper limbs. Lastly, similar values of lower limbs flexibility were verified between groups.

Table 1. Deep water running training periodization

Mesocycles	Weeks	Continuous Group		Interval Group	
		Intensity	Duration	Intensity	Duration
1	1-4	13	30 min	10x (2 min 15+1 min 11)	30 min
2	5-8	15	30 min	6x (4 min 17+1 min 11)	30 min
3	9-12	16	31 min	7x (4 min 17+30 s 11)	31 min 30 s
4	13-16	13	30 min	10x (2 min 15+1 min 11)	30 min
5	17-20	15	30 min	6x (4 min 17+1 min 11)	30 min
6	21-24	16	31 min	7x (4 min 17+30 s 11)	31 min 30 s
7	25-28	17	36 min	12x (2 min 18+1 min 15)	36 min

Min=minutes; s=seconds.

Table 2. General quality of life and in physical, psychological, social relationships and environment domains for land-based (LB) and water-based (WB) groups

	LB	WB	p
QoL, physical domain	76.53±6.96	75.26±10.04	0.699
QoL, psychological domain	72.92±9.90	75.89±9.83	0.432
QoL, social relationships domain	71.43±9.64	72.02±19.22	0.918
QoL, environment domain	66.07±7.34	75.67±12.98	0.023*
QoL, general	79.46±10.52	81.25±12.73	0.689

QoL=quality of life. * Indicates statistically significant difference between groups.

Table 3. Functional fitness in land-based (LB) and water-based (WB) groups

	LB	WB	p
8 foot up and go (s)	6.83±1.03	5.74±0.78	0.006*
Flex, UL (cm)	-10.21±12.85	1.71±9.74	0.010*
Flex, LL (cm)	-7.50±13.03	-3.07±9.79	0.319
Strength, UL (rep)	19±5	28±8	0.003*
Strength, LL (rep)	13±4	21±4	<0.001*

Flex=flexibility; UL=upper limbs; LL=lower limbs; s=seconds; cm=centimeters; rep=repetitions. *Indicates statistically significant difference between groups.

DISCUSSION

The main finding of the present study was that the elderly practitioners of a water-based periodized training showed similar quality of life, nevertheless, greater dynamic balance, resistance strength and flexibility in comparison to practitioners of a land-based training without clear periodization.

Quality of life is defined as "the individual's perception of their position in life, in the context of culture and values system in which they live and in comparison to their goals, expectations, standards and concerns".[24] For its assessment, in the present study we applied a questionnaire which divides it into four domains: physical, social relationships, psychological and environment. Physical domain includes issues on which physical exercise directly acts: pain, energy and fatigue, sleeping, mobility, daily life activities and ability to work. Our findings demonstrate that practitioners of water-based and land-based exercise present similar quality of life in these parameters. On the other hand, social relationships domain is composed by issues regarding personal relationships and social support. When physical exercise is performed in groups, as in the case of deep water running, or at the same space, like land-based combined training, it may influence on these factors. In the same way as physical domain, it was demonstrated that the practitioners of both types of training evaluated have similar quality of life in this domain. Environment domain is related to physical security, financial resources, transport and physical environment, whereas psychological domain is related to spirituality, ability to concentrate, body image and appearance. Physical exercise has little or no influence on these items, therefore the results observed in the present study must be associated to reasons other than the investigated training.

The findings of our cross-sectional study corroborates other studies with longitudinal design, which found that after participating in a training performed on land environment or in aquatic environment, individuals presented similar quality of life.[25-27] In these investigations, Delevatti et al.[25] applied the same quality of life instrument of assessment as the present study. The authors observed that the individuals participating in the DWR program (physical domain: 68.6±13.6, psychological domain: 72.0±13.2, social domain 65.4±16.0, environment domain 64.9±10.1, general 69.6±14.4) and land-based running program (physical domain: 63.2±16.6, psychological domain: 67.8±14.4, social domain: 64.2±21.4, environment domain: 65.8±14.8, general: 65.1±17.8) showed similar quality of life after training. It is important to highlight that the values found in all domains by Delevatti et al.[25] are lower than those observed in the present study. This may be explained because this study only evaluated individuals with type 2 diabetes, a condition associated to lower quality of life.[28] Yet, Delevatti et al.[25] evaluated quality of life after 12 weeks of training, while in our study all individuals were training for at least 6 months, which also helps explaining the higher values showed in our study.

Regarding functional fitness results, the periodized water-based training practitioners showed better dynamic balance. This result can be explained by the instability created by aquatic environment, mainly in DWR modality, in which the subjects have no contact with the bottom of the pool.[29,30] This instability generates stimuli for balance development,[31] which is not observed in the dry-land environment. Water-based training practitioners also showed greater levels of resistance strength in comparison to the practitioners of combined training on land environment, which can be considered a surprising result. DWR is performed cyclically with horizontal displacement and with big knee and hip amplitude, thus generating a big resistance during its execution, which can promote stimuli for the strength increment in lower limbs.[12] Yet, DWR intervention progressed to a high training intensity, corresponding to anaerobic threshold,[32] which requires a great speed of execution of the practitioners, and may have generated recruitment of type II fibers, responsible for force production. Upper limbs exercises concomitantly performed with running may have been enough to improve resistance strength of these muscles. Besides that, water-based training practitioners showed greater flexibility values in the lower limbs, which can be attributed to the incentive to perform upper limbs exercises at maximum amplitude during the DWR performance.

It is highlighted that, in the present study, the better results showed by the practitioners of aquatic environment exercise were demonstrated with a shorter practice time (28 weeks vs. minimum of 6 months), weekly frequency (2 vs. 3 or 4 sessions) and duration of session (45 vs. ~90 minutes). It is believed that such expressive result is explained because only the practitioners of the water-based training had training periodization (progression from low to high training intensities and intensity control during the sessions). On the other hand, the land-based training practitioners only had a readjustment of the load, thus there was no undulation of the different physiological stimuli of volume and intensity. Faced with that, practitioners of the water-based training had training overload, which generated stimuli for physical fitness improvement, whereas practitioners of land training may have generated similar physiological stimuli over time, without a progressive structuring of load able to impact homeostasis and to generate adaptive responses along time.

The results of the present study are in disagreement with the findings of Souza et al.,[23] who observed greater strength and balance levels in land-based resistance training practitioners in comparison to hydrogymnastics practitioners. However, although this study had transversal design, without a complete knowledge about the interventions, the water-based practitioners trained hydrogymnastics, a different modality from that adopted in the present study, without intensity control and without exploring the speed of execution of the movements, a variable associated to strength gain.[33] On the other hand, the elderly trained on dry-land environment performed weight training, a modality that even without proper periodization, usually has overload adjustments and associates good strength levels to its practice. Linking the findings of de Souza et al.[23] to our findings, it seems fundamental to the achievement of a good functional fitness in elderly people, especially for the development of muscle strength and dynamic balance, the conduction of a training periodization and not the environment in which it is performed (water-based or land-based). However, more studies with greater methodological power, like randomized clinical studies, are required for more information about the importance of the environment (water-based or land-based) and training progression in the functional fitness and quality of life of the elderly.

Caution must be taken in interpreting the results of the present study. Due to the study design, the differences between groups cannot be attributed only to the training programs previously performed by the subjects. Anthropometric, sociodemographic and socioeconomic characteristics, health status, nutritional status, physical activity performed during the entire life, among other confounding factors, may have influenced our results.

This study has some limitations, like the cross-sectional design, which requires caution in the interpretation of the cause (training) – consequence (outcomes) relationship of the present study. In addition, the sample characterization is only based on the age of participants and other important variables related to anthropometry, sociodemographic and socioeconomic characteristics were not assessed. Nevertheless, there are also important strengths, like the fact that the elderly individuals were evaluated in a "real life" situation, without laboratory methods of load control, and the relevant discussion raised about the importance of the environment and training structuring in the functional fitness of the elderly people, which are very important for the quality of this population's daily life activities.

CONCLUSION

Practitioners of a periodized training of deep water running have the same quality of life, however, greater resistance strength, dynamic balance and upper limbs flexibility in comparison to practiotioners of a non-periodized land-based combined training.

CONFLICTS OF INTEREST STATEMENT

No potential conflicts of interest were disclosed.

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