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ORIGINAL ARTICLE

Effects of aquatic physiotherapy versus conventional physical therapy on the risk of fall in the elderly: a randomized clinical trial

Efeitos da fisioterapia aquática versus fisioterapia convencional no risco de queda em idosos: ensaio clínico

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Abstract

Objective: To identify whether physiotherapy treatment in water is more effective than the treatment in land environment, aiming at improving the process of physical limitation or functional inability (gait speed, balance, motor abilities) caused by lack of balance in elderly with risk of fall. *Methods*: Randomized clinical trial, experimental study. The sample was composed of 35 senior individuals of both sexes, with average age of 65. Nineteen people composed the control Group /Conventional Physiotherapy, while the rest composed the experimental Group/Aquatic Physical therapy. Both groups were submitted to twenty sessions of physical therapy, twice a week, for 50 minutes in individual treatment. Aerobic activities were conducted for both groups separately. Exercises using water specific therapy, such as Halliwick rotation control and Bad Ragaz ring method, were used in the aquatic group and in the conventional group, physiotherapeutic techniques were applied, approaching the concepts of proprioceptive neuromuscular facilitation (PNF) and decubitus change training. The following tests were used to measure the risk of fall/balance: Timed Up and Go Test, Sit-to-Stand in 30 seconds and Functional Reach. *Results*: Both physiotherapeutic interventions, aquatic and conventional, showed to be greatly efficient however aquatic physiotherapy showed certain advantages compared to conventional physical therapy, promoting more beneficial effects in the gait speed, balance, motor abilities and, mainly, in the reduction of the risk of fall.

Keywords: elderly, Halliwick, Bad Ragaz, Physical therapy, aquatic, risk of fall.

Resumo

Objetivo: Identificar se a Fisioterapia aquática é mais eficaz que a fisioterapia convencional, visando a melhora do processo de limitação física ou incapacidade funcional (Velocidade da marcha, equilíbrio, habilidades motoras) causada por desequilíbrio em pacientes idosos com risco de queda. *Métodos*: Ensaio clínico randomizado, estudo experimental. A amostra foi composta por 35 idosos de ambos os sexos, com uma média de idade de 65 anos. Dezenove pessoas compuseram o Grupo Controle/Fisioterapia Convencional, enquanto o restante constituiu o Grupo Experimental / Fisioterapia Aquática. Ambos os grupos foram submetidos a vinte sessões de fisioterapia, duas vezes por semana, durante 50 minutos em tratamento individual. As atividades aeróbicas foram realizadas para ambos os grupos separadamente. Exercícios utilizando terapia específica da água, como o controle de rotação de Halliwick e o método do anel de Bad Ragaz, foram utilizados no grupo aquático e, no grupo convencional, foram aplicadas técnicas fisioterapêuticas, abordando os conceitos de facilitação proprioceptiva e treinamento de mudança de decúbito. Os seguintes testes foram usados para medir o risco de queda/equilíbrio: Timed Up and Go Teste, Teste de sentar e levantar em 30 segundos e Teste de Alcance Funcional. *Resultados*: Ambas as intervenções fisioterapêuticas, aquáticas e convencionais se mostraram bastante eficientes, entretanto a fisioterapia aquática apresentou certas vantagens em relação à fisioterapia convencional, promovendo efeitos mais benéficos na velocidade da marcha, equilíbrio, habilidades motoras e, principalmente, na redução do risco de queda.

Palavras-chave: idosos, Halliwick, Bad Ragaz, Fisioterapia, ambiente aquático, risco de queda.

Introduction

When becoming older, our body goes through changes that, even when not related to any pathological process, result in the progressive degradation of the organism, thus generating a decrease in the individual capacity of executing certain daily life tasks. Such systemic change is reflected in an increase in the fall predisposition in older individuals [1]. According to the IT department of the Brazilian Health System (DATASUS), falling was the highest cause of hospitalization among the senior population, especially in individuals in the age of 70 or older, reaching 57.53 for every 10,000 Brazilian residents.

In individuals between the age of 20 and 45, the tendency to fall is 18.5%, going up to 21% in middle-aged people, and increasing even more up to 35% in people over 65. Within the young population, such phenomenon occurs, in most times, during physical activity practice, especially in the case of running, while in elderly persons, such incident occurs during basic daily activities, such as walking [2]. Fall represents a great risk for the health of the elderly, resulting in morbidity or mortality, due to their greater vulnerability to loss of balance [3].

It is possible to relate different sensory-motor areas, which guarantee the integrity of balance while walking [4]. Through neuroimages, Ferraye [5] showed the activation of many different parts of the motor and sensory systems for balance regulation, highlighting fronto-parietal regions, basal nuclei, cerebellum and supplementary motor area.

In addition, Bakker [6] related cerebral areas to the precision of walking, detecting both the need for efferent information to execute the motor act and the need for sensory information to identify some kind of instability and provoke appropriate stabilizing responses, through programmed feeding reactions or through continuous and updated feedback corrections, thus activating the necessary muscles for movement orientation of the body within space [7].

On the other hand, the insufficiency of such sensory, neural and/or musculoskeletal systems causes the slowdown reaction response to the mass center movement, which is triggered by sudden external disruption, to be reduced and not efficiently executed [8]. The degeneration of such systems due to aging is associated to lower functional performance and to higher risk of falling, thus possibly making these individuals dependent on others. However, many different treatments have been used; among them, conventional physical therapy can be highlighted, featuring many intervention techniques to reduce the aging effects, such as the combination of balance and strength training [9], gait training [10] and others, thus helping these people to return to their daily life activities with better quality.

With regards to the other techniques, aquatic physical therapy is able to generate greater instability in the individual, when compared to the land therapy (conventional physical therapy), increasing the neuron inputs to the central nervous system, which will regulate the musculoskeletal system to balance postural instability [11]. Despite some studies demonstrating improvement in mobility of individuals submitted to the aquatic physical therapy, these are still limited [12]. Therefore, there is a need for more researches comparing the treatment in water versus the land environment, aiming at improving the process of physical limitation or functional inability, including decreased gait speed and motor abilities caused by lack of balance that may also increase the risk of falling which is the purpose of this work.

Methods

This work consists of an experimental study – a randomized clinical trial. It has been submitted to the Brazil Platform with the title “Comparison between an aquatic physiotherapy protocol versus conventional physiotherapy in the risk of fall in the elderly” and it has been approved by the Ethics Committee of Research at Veiga de Almeida University, nº 2.904.741 CAAE: 80453417.8.0000.5291. All intervention and data collection have been conducted at the Veiga de Almeida Health Center (CSVA in the Brazilian acronym), an institution linked to Veiga de Almeida University.

Sample

The sample initially was composed of 38 senior individuals of both sexes, with average age of 65 but just 35 individuals concluded the study and received the full intervention. Table I presents the description of characteristics for each group. The reasons for non-compliance was hospitalization for anemia, cancer treatment and one death (figure 1).

The inclusion criteria demanded that all seniors were over the age of 60 and had reported fall incidents in the last 6 months, while the exclusion criteria involved individuals who were conducting other types of treatment that could interfere in the sample, such as: osteopathic manipulative techniques, conventional physiotherapeutic treatments, recent fractures, neurological diseases, fecal and/or urinary incontinence, arthritis in the hips or limiting knees, and severe aphasia, identified by individual reports or by medical opinion.

The sample calculation was obtained through the GPower program, version 3.1, through F-test, a priori, considering assessment time as intra-individual factor and group as among-individuals factor. In the calculation, we consider the type I error in 5% (α=0.05) and power of 90%. The effect size has been delimited through collection of data on the number of elderly people attending the Veiga de Almeida Health Center. So, considering two groups and three variables, the statistical program suggested a sample with eighteen individuals in each group.

Table I - *Baseline characteristics.*

Characteristics	**Aquatic Physical therapy**	**Conventional Physical therapy**
Age (y), mean (SD)	65.8 (2.7)	64.3 (1.8)
Female, n (%)	12 (80)	15 (78)
Functional Reach, mean (SD)	22.23±1.85	20.83±1,80
Sit-to-Stand, mean (SD)	9.12±4.58	8.06±2.01
Timed up and go test, mean (SD)	15.50±1.37	12.62±1.33

A randomization was conducted by a third appraiser who was no involved in recruitment. The sequence was obtained through the Random Integer Generator app for Android, where the participants were numbered from 1 to 38. Group allocation was concealed from the investigator through sealed, opaque envelopes.

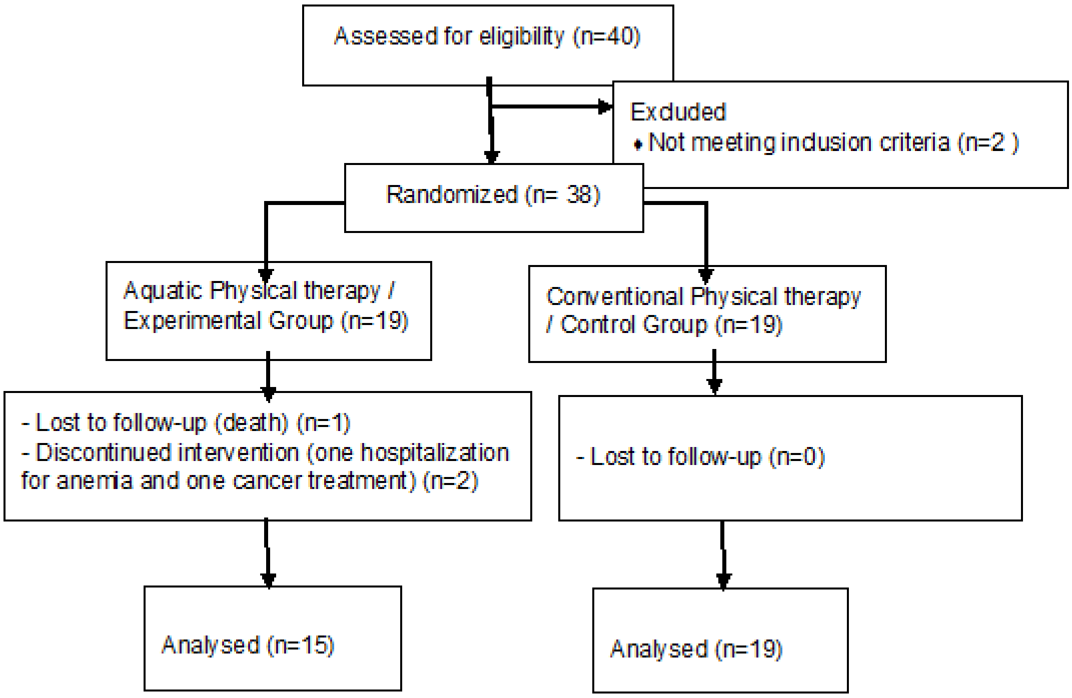


Figure 1 - *Flow diagram for randomization: A randomized clinical trial.*

The patients agreed on participating voluntarily in the study by signing the Free and Clarified Consent Term submitted to the following address: Veiga de Almeida Health Center, Praça da Bandeira, 149 - Praça da Bandeira, Zip Code 20270-150. The study was conducted between December 2016 and November 2018, after completing all necessary assessments.

Experimental design

Both interventions were provided by physical therapists who received training from experts in Orthopedic Trauma and aquatic therapy (Bad Ragaz Ring Method and Hallick). This training included a 3-week and the same experts organized regular meetings during the trial to monitor delivery of interventions. No changes in the protocol were observed.

The groups showed very similar conducts (table II). Both groups were submitted to twenty sessions of physical therapy, twice a week, for 50 minutes in individual treatment. Both interventions were provided by physical therapists who received training from experts in orthopedic trauma and aquatic therapy (Bad Ragaz Ring Method and Hallick). This training included a 3-week and the same experts organized regular meetings during the trial to monitor delivery of interventions. No changes in the protocol were observed.

All participants were submitted to the following kinetic-functional tests that were used to measure the risk of fall/balance: Timed Up and Go Test (TUGT) used to measure mobility, balance, walking ability and fall risk in elderly [13,14]. Sit-to-Stand in 30 seconds (S30) is a tool that assesses functional lower extremity strength in elderly [15] and Functional Reach (FRT) used to assess an elderly stability and balance, with the goal of obtaining the initial parameters for fall predisposition and of comparing them at a later moment [14]. These functional tests evaluate important parameters for balance and describe the patient's functional profile in your daily tasks.

Conduct of the experimental and control group

During the first fifteen minutes, aerobic activities were conducted for both groups differentiating only the environment, including gait exercises with and without obstacles, direction changes and double tasking. After thirty-five minutes, exercises using water specific therapy in experimental group, such as Halliwick rotation control and Bad Ragaz ring method and pool with the temperature between 31° and 34° degrees Celsius. In the CG, physiotherapeutic techniques were applied, approaching the concepts of proprioceptive neuromuscular facilitation (PNF), decubitus change training and balance training aiming at bringing closer the conducts of the experimental and control groups, considering that the Bad Ragaz method utilizes the PNF principles, and the Halliwick rotation control simulates the decubitus changes. In the experimental group balance training was not applied.

Table II - *Conducts executed within the aquatic physical therapy and conventional physical therapy groups.*

Conduct of the experimental group/Aquatic Physical therapy	**Conduct of the control group/Conventional Physical therapy**
- Walking (Front and lateral gait) - Gait with direction changes - Gait with obstacles - Double tasking	- Walking (Front and lateral gait) - Gait with direction changes - Gait with obstacles - Double tasking
- Transfer training through Halliwick rotation controls (transversal, sagittal, longitudinal and combined)	- Transfer training (Sit-to-Stand training, decubitus changes and reaching the object to the front)
- Strength training through the Bad Ragaz ring method (Trunk, upper and lower limb patterns)	- Strength training through the proprioceptive neuromuscular facilitation technique (Trunk, upper and lower limb patterns)
***	- Balance training

***In the aquatic physical therapy group, balance training was not applied.

Outcomes

In the beginning of treatment all participants received a booklet containing the main information about the elderly falls prevention. The primary outcomes were risk of falling (measured with TUG, FRT and S30) and effectiveness of both physical therapy treatment (measured with the three kinetic-functional tests). Secondary outcomes were gait speed (measured with TUG), balance (measured TUG and FRT) and motor abilities (TUG and S30) [13-15]. The assessments were carried out at three moments. First assessment was carried out before the start of interventions. The second assessment was carried out in the end of the 10th session and the third assessment, at the end of the 20th session. Approximate interval of assessments lasted for at least one month except for the first. A total of 3 months of treatment. The nature of the interventions precluded blinding of the subjects and therapists.

Statistical analysis

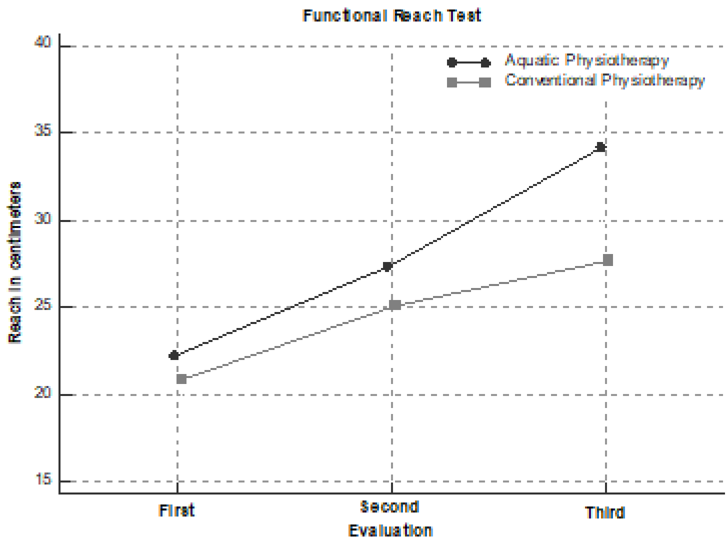
The data analysis was obtained through the Stata program, version 25.0, through a Mixed Variance Analysis (ANOVA) with two factors and repeated measures, considering time (first, second and third assessment) as intra-individual factor and group as among-individuals factor. The data distribution was analyzed by the Shapiro-Wilk test ($p<0.05$), considering the normality standard. This study aims at showing the interaction between the groups, through the following fall-predicting tests: TUGT, FRT and S30 with a time interval of 10 sessions.

Results

Out of the initial sample, 35 individuals concluded the study and receive the full intervention. The average age was of 65.

In the FRT, time proved to have an effect for the Aquatic Physical therapy group (EG), with an increase between the first and second assessment [DF = 5.053; p = 0.0001], between the first and third assessment [DF = 11.941; p = 0.0000000004] and between the second and third assessment [DF = 6.888; p =0.00002]; for the Conventional Physical therapy group (CG), an increase occurred between the first and second assessment [DF = 4.278; p = 0.001] and between the first and third assessment [DF = 6.833; p = 0.00001], while no significant difference was found between the second and third assessment [DF = 2.556; p = 0.146].

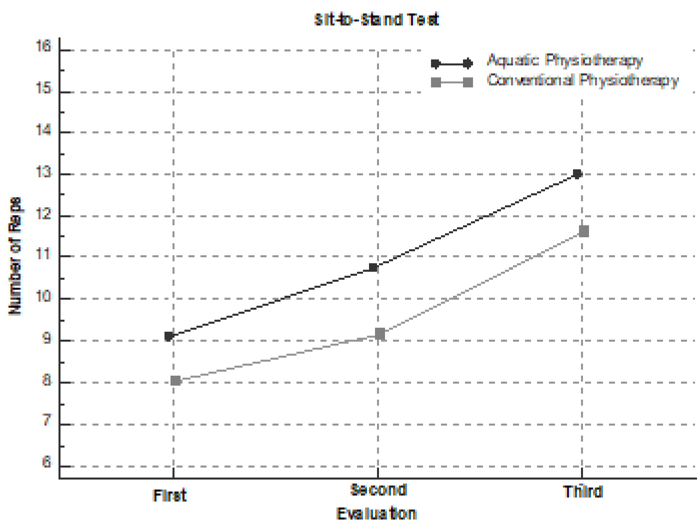
Therefore, when comparing the two groups, it is possible to observe greater average and difference for the aquatic physical therapy group (Figure 2).



* Significance value < 0.05.
Figure 2 - *Average and comparison of the assessments of the Functional Reach Test between the aquatic physical therapy (EG) and the conventional physical therapy groups (CG).*

For the S30, time showed an effect for the EG with an increase between the first and second assessment [DF = 1.647; p = 0.001], between the first and third assessment [DF = 3.882; p = 0.00008] and between the second and third assessment [DF = 2.235; p =0.008] and for the CG, an increase occurred between the first and second assessment [DF = 1.111; p = 0.025], between the first and third assessment [DF = 3.556; p = 0.0001] and between the second and third assessment [DF= 2.444; p =0 .003].

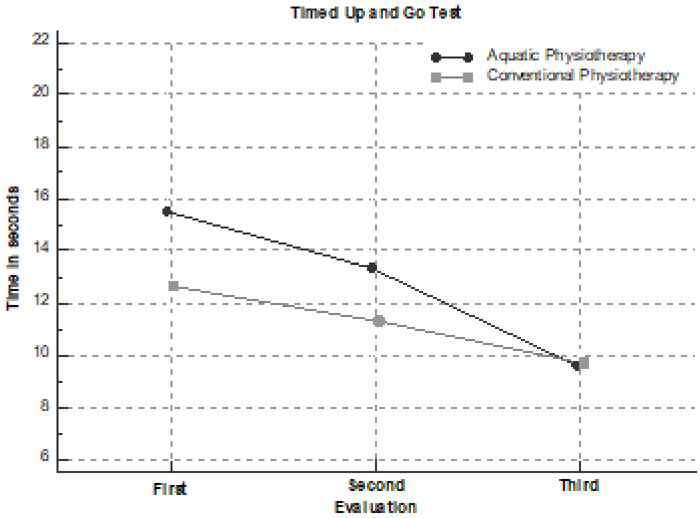
This way, when comparing the two groups, it is possible to observe greater average and difference for the aquatic physical therapy group (Figure 3).



*Significance value 0.05.
Figure 3 - *Average and comparison of the assessments of the Sit-to Stand in 30 seconds between the aquatic physical therapy (EG) and the conventional physical therapy groups (CG).*

With regards to the effect of time on the dynamic balance TUGT, difference was found for the EG, with a reduction in the average between the first and second assessment, [DF = -2.182; p = 0.05], between the first and third assessment [DF = -5.915; p = 0.0002] and between the second and third assessment [DF = -3.734; p = 0.00001]. No significant difference was found among the values in the CG (Figure 4).

Assessment average of the Timed Up and Go Test



*Significance value < 0.05

Figure 4 - *Average and comparison of the assessments of the Timed Up and Go Test between the aquatic physiotherapy (EG) and the conventional physical therapy groups (CG).*

The two-way mixed ANOVA showed that time has an effect on the TUGT [F (1.253, 41.363) = 20.752; p <0.05], Sit-to-Stand [F(1.408, 1.408) = 34.117; p <0.05] and FRT [F(2, 2) = 60.461; p <0.05]. No effect was found for the group, but interaction between time and group was observed for the functional reach test [F (2, 2) = 5.199; p <0.05]; a difference of 6.5 cm was found in the third assessment [F(7.156); DF = 6.510; p = 0.012] between the Aquatic Physical therapy (34.176±1.745 mean ± sd) and the Conventional Physical therapy (27.667 ± 1.696 mean ± sd) groups (Table III). Our trial blinding of all assessor who measured outcome.

Table III - *Intra-group analysis of the Time effect. *value < 0.05, Bonferroni Post Hoc Analysis.*

	Aquatic Physical therapy	**Conventional Physical therapy**		
Functional Reach	*mean±sd*	*mean±sd*	*Dif.*	*P*
First assessment	22.23±1.85	20.83±1,80	1.40	0.571
Second assessment	27.28±1.85*	25.11±1,80*	2.17	0.450
Third assessment	34.17±1.85*	27.66±1,80	6.51	0.012*
Sit-to-Stand			*Dif.*	*P*
First assessment	9.12±4.58	8.06±2.01	1.06	0.376
Second assessment	10.76±3.88*	9.17±2.06*	1.59	0.135
Third assessment	13.00±4.25*	11.61±2.33*	1.38	0.236
Timed up and go test			*Dif.*	*P*
First assessment	15.50±1.37	12.62±1.33	2.88	0.238
Second assessment	13.32±1.37*	11.32±1.33	2.00	0.296
Third assessment	9.59±1.37*	9.69±1.33*	0.10	0.935

Table IV - *Intra-group analysis of confidence interval.*

	95% CI Aquatic group	**95% CI Conventional group**
Functional Reach		
First	18,5580 to 25,9126	17,2596 to 24,4071
Second	23,6109 to 30,9656	21,5374 to 28,6848
Third	30,4991 to 37,8538	24,0929 to 31,2404
Sit-to-Stand		
First	7,5131 to 10,7222	6,4962 to 9,6149
Second	9,1602 to 12,3692	7,6073 to 10,7260
Third	11,3955 to 14,6045	10,0518 to 13,1704
Timed up and go test		
First	12,7862 to 18,2267	9,9814 to 15,2686

Second	10,6044 to 16,0450	8,6814 to 13,9686
Third	6,8709 to 12,3115	7,0536 to 12,3409

	95% CI Aquatic group	95% CI Conventional group
Functional Reach		
First	18,5580 to 25,9126	17,2596 to 24,4071
Second	23,6109 to 30,9656	21,5374 to 28,6848
Third	30,4991 to 37,8538	24,0929 to 31,2404
Sit-to-Stand		
First	7,5131 to 10,7222	6,4962 to 9,6149
Second	9,1602 to 12,3692	7,6073 to 10,7260
Third	11,3955 to 14,6045	10,0518 to 13,1704
Timed up and go test		
First	12,7862 to 18,2267	9,9814 to 15,2686
Second	10,6044 to 16,0450	8,6814 to 13,9686
Third	6,8709 to 12,3115	7,0536 to 12,3409

Discussion

Many authors argue in favor of certain functional tests to be fall predictors in elderly individuals, especially the TUGT, FRT and S30 [16,17]. In the present study, such tests classified the participating elderly people to be at risk of fall at the moment previous to the experiment; however, at the end of the intervention period, values were found that put them out of the fall risk, defined through the prediction for the elderly [18].

A few factors seem to be related to the results and the difference between physiotherapeutic conducts in different environments. For aquatic physical therapy, it is possible to highlight instability triggered by the junction of hydrodynamic and physiological immersion properties [19]. The influence of the aquatic environment can be initially described as adaptation and response to the instability offered by the surroundings. However, the better performance of the elderly in the functional tests that demanded balance and mobility indicates the activities executed to have influenced the participants and to have decreased the risk of fall.

Likewise, it is possible to observe participants in the conventional physical therapy improve, thus supporting some of the results found in a systematic analysis conducted by MAT [20], which showed strength exercises, balance training and aerobic exercises to optimize balance and improve gait performance. On the other hand, for the aquatic physical therapy method, no balance training was used with the participants of this group; however, the results were satisfactory, which could be related to the aquatic environment [21].

According to Marinho-Buzelli [22], water physical characteristics can provoke greater instability to the immersed body, submitting it to constant challenges for balance maintenance. Therefore, the results obtained in the present study, specifically for the functional reach test, showed better capacity of the participants to shift their gravity center front to back, and to remain inside the support basis, mainly in the aquatic environment. Possibly, such environment was able to offer the individual a greater participation of the central nervous system to regulate the joints, mainly of the trunk and lower limb muscles, to compensate the oscillations caused by water, trying to maintain the individuals stable within the offered circumstances [23].

Additionally, a study conducted by KIM [24], compared the influence of PNF in the aquatic and land environments, quantifying them through some functional tests also utilized in this study, such as the TUGT and FRT. The results showed both groups to improve after the intervention; however, when comparing one group to the other, the aquatic one performed better. This reinforces even more the good results found in the present study, indicating that the Bad Ragaz, which is based on PNF, effectively promoted improved muscular activity, through its diagonals, maybe because it recruited a greater quantity of muscular fibers, due to the conditions offered by the aquatic environment. This possibly maximized the proprioceptive stimulation and the offered resistance, thus fostering improved muscular strength, flexibility and balance [25].

In general, aquatic physical therapy takes advantage of such three-dimensional environment to potentialize the motor learning process. The Halliwick method allowed the individuals to progress with their independence in water through mental adaptation and through rotation control that can reproduce basic daily life activities, such as decubitus change for example. Therefore, improvement in muscular strength, joint mobility and movement amplitude reinforce the positive findings of the tests applied. We believe that, possibly, aquatic physical therapy may have also positively influenced the results, by reducing the fear of falling after perceiving that they were able to execute tasks they previously thought to not be possible outside of such environment, even though the present study did not use any tools to measure this aspect [26,27].

Menant [28], in his systematic review, observed some essential factors for fall prediction in the elderly, mainly highlighting the gait speed, considering that the fall usually occurs due to the limitations these individuals have when walking. In a complementary way, it is necessary to highlight the importance of the positive results this study obtained for the TUGT, where the individuals were able to cover the same distance in a shorter time and with better quality. Such gain, for the group that executed the task in the aquatic environment, can be justified by the easiness that the thrust offered, thus allowing the human body to float, reducing the body overweight and facilitating certain movements, for example some key movements in the gait, such as dorsiflexion and the hip joint flexion, thus contributing to better walking [24,25]. On the other hand, no significant improvement in decreasing the time occurred for the TUGT test in the control group.

The gradual improvement in the kinetic-functional tests used inspires the relevance of intervention programs in the balance increase through the activities executed. Among the methods, neuroplasticity stimulation through learning new abilities can be highlighted, done by reorganizing the neural network in response to the stimulus, generating memory consolidation thanks to experimentation. Among the groups, with certain advantage for the aquatic group, the research observed that postural changes offered by the aquatic environment, together with the slowdown of movements due to viscosity, allowed the immersed individuals to have more time to plan the balance reaction. Such property possibly allowed for the subjects to experiment attempts of trial and error, thus stimulating better motor planning [12,29].

The results of the present study can be justified by the occurrence of the learning factor after a period of repetition, once the pool allowed for the slowdown of movements, facilitating repetition and, as a result, the acquisition of new information through working memory and the information already stored in the long-term memory and, according to the stimuli recurrence, such information became stronger and stronger until getting fixed [30]. In addition, physical exercise stimulates angiogenesis, sinaptogenesis and cellular proliferation by liberating the Insulin-like growth factor 1 (IGF-1), the Brain-derived Neurotrophic Factor (BDNF) and the Vascular Endothelial Growth Factor (VEGF). Such factors that are optimized within the aquatic environment can promote brain plasticity, thus increasing cortical activity and causing better learning and motor memory [31,32].

Among the limitations of the study, a suggestion is to use electromyography in future researches to compare and measure muscular electric activity; an accelerometer to determine more detailed gait parameters (pace, length, speed); neuroimage resources to analyze the activation of cortical and sub-cortical areas in the aquatic environment and measure of the psychological aspects. It is worth highlighting that, considering the positive results, the methodology of the present study allowed to reach the main objectives, collaborating for the knowledge about strategies to reduce the risk of fall and the facilitation of aquatic physical therapy in this process. Current evidence highlights that sedentarism, which is a very common factor in the elderly population, results in an aggravation of the health of such individuals, triggering greater fragility and dependence, thus showing that regular physical activity decreases the risk of fall, cardiovascular diseases, cognitive alterations, muscular weakness and others [33].

Conclusion

Both physiotherapeutic interventions, aquatic and conventional, showed to be greatly efficient, promoting beneficial effects in the gait speed, balance, motor abilities and, mainly in the reduction of the risk of fall, which may have possibly influenced the elderly participants of this study to reintegrate again their activities. Aquatic physical therapy involved aerobic exercise and water-specific exercises, approaching the concepts of Halliwick and the Bad Ragaz Ring Method, and showed certain advantages compared to conventional physical therapy. We suggest this improvement to be related to the physical properties of the aquatic environment. This essay can also demonstrate the patient’s gradual evolution process, showing us the importance and relevance of each assistance technique.

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Anexo

Outcome Measures

Test	Measure	Description
Timed Up and Go Test (TUGT)	Mobility, balance, walking ability and fall risk in elderly [13,14].	Start the stopwatch, they are instructed that, on the word “go” they are to get up and walk 3 meters, turn, return to the chair and sit down again. Interpretation: <10 seconds = normal <20 seconds = good mobility, can go out alone, mobile without a gait aid <30 seconds = problems, cannot go outside alone, requires a gait aid [34].
Sit-to-Stand in 30 seconds (S30)	Functional lower extremity strength in elderly [15].	Sit in the middle of the chair, each hand on the opposite shoulder crossed at the wrists. Place your feet flat on the floor, keep your back straight and keep your arms against your chest. On “Go”, rise to a full standing position and then sit back down again. Repeat this for 30 seconds [35].
Functional Reach *(*FRT)	Stability and balance [14].	Using a yardstick on the wall, parallel to the floor. At the height of the acromion of the subject's dominant arm. It's the maximal distance one can reach forward beyond arm's length, while maintaining a fixed base of support in the standing position. Taking note of the starting position by determining what number the metacarpophalangeal (MCP) joints line up with on the yardstick. Scores less than 18,5 cm indicate limited functional balance [36].