ORIGINAL ARTICLE

Analysis of the muscle strength increase for recovery of ortostatism in elderlies with temporary immobility syndrome

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ABSTRACT

The immobility syndrome (IS), a comon issue among elderly people, occurs in patients who are bedridden for long periods, and causes loss of muscle strength and morbidity and mortality consequently. **Objective:** To analyze the necessary muscle strength increase for the recovery of orthostatism in the elderly with temporary IS. **Method:** Thirty elderly with IS were screened for inclusion/exclusion criteria, and 14 elderly were included. They had their quadriceps and gluteus muscle strength evaluated (in kilograms), and then performed strengthening sessions. At the end of the program, orthostatic attempts were made. Those who reacquired the posture were called G1; those who did not reacquire were called G2. The exercise load increase, number of sessions required, participant weight at baseline, age and immobility time were analyzed. **Results:** Ten participants of G1 (71.4%) reacquired orthostatism (G1), after a mean of 21.4 sessions, a mean quadriceps muscle strength increase of 6kg (177%), and a mean gluteus muscle strength increase of 2.2kg (102%), whereas in the G2, whose participants did not recover orthostatism, the mean quadriceps and gluteus muscle strength increase were 4.125kg (117%) and 1.625kg (39%) respectively. The p value of the group comparisons were 0.001 for the quadriceps strength increase and 0.0002 for the gluteus strength increase. There was a strong correlation between the participant's baseline weight and the quadriceps and gluteus muscle strength increase (-0.96 and -0.84 respectively) and moderate correlation between age of G1 and G2 and muscle strength increase (0.59 and 0.58 respectively) and between immobility time and muscle strength increase (0.53 for gluteus and 0.50 for quadriceps). **Conclusion:** Muscle strength increase was essential for recovering orthostatism, whereas weight, age and time of immobilism are significantly correlated with muscle strength increase.

Keywords: Frail Elderly, Resistance Training, Muscle Strength

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INTRODUCTION

The advance of health sciences, as well as treatment and diagnosis techniques, prevention and public policies has caused the life expectancy to increase. It is known that the aging of the world population is a widely spread phenomenon.

However, greater longevity means the older population. The aging process imposes changes in the locomotion system, limitations to the activities of daily life (ADL), which, combined with lack of physical activities, may increase dependence and jeopardize quality of life.[1]

The decrease of muscle strength, combined with the loss of muscle mass, is a relevant sign of mobility and functional ability loss of the aging person.[2]

These functional capacity losses are often associated with immobility syndrome (IS). It is considered a set of alterations that occurs in the bedridden for an extended period, such as reduction of the functional capacity of the connective tissue, joint tissue osteomuscular system, respiratory system, metabolic system and genitourinary system. There is a loss of 5% to 6% of muscle mass per day, and in about four weeks, nearly 50% of the initial force may be compromised.[3]

The IS is divided into: a) temporary: in which the immobilization can result from medical advice, or restraint due to external causes (e.g. femur fracture, orthostatic hypotension);[3] and b) chronic (resulting from chronic incapacitating disease, mental illness, falls, urinary incontinence, malnutrition, pressure ulcers and socioeconomic problems).[4]

The elderly population is susceptible to IS because of aging characteristic itself, to which several factors may be associated, such as psychological issues (depression, dementia and fear of falls), social issues (social isolation, physical restraints and lack of stimuli), and physical limitations (osteoporosis and muscle weakness). In addition, hormonal, nutritional, metabolic and immunological changes play important roles.[5]

This susceptibility increases even more among institutionalized elderlies. In a survey on the prevalence of locomotion difficulty in institutionalized elderlies, we observed locomotion difficulties in 50.3% of the cases, wheelchair in 41.7%, bedridden in 24%, walker in 16.7%, walking cane in 14.6%, and crutches in 3.1%.[6]

To stop or delay the loss of muscle mass and consequently loss of muscle strength, a strengthening program with load can be applied for large muscle groups. For patients who are bedridden for a long period, the purpose is to strengthen the gluteus and quadriceps muscles in order to recover the orthostatic posture.[7]

The increase of gluteus muscle strength is counterbalanced by the increase of quadriceps muscle strength, which tends to prevent the knee from flexing as a consequence of the center of gravity torque in the anterior direction when the foot touches the ground. With regard to the counterbalance of the gluteus muscle with the quadriceps muscle, the maintenance of upright posture demands that an anterior muscle counterbalances a posterior one, both acting in a way to dynamically stabilize the position.[8]

The orthostatic position is of extreme importance, and it can be either active or passive. This position stimulates mobility, improves gas exchange and alertness.[9] In addition, it improves the autonomic control of the cardiovascular system, stimulates the vestibular apparatus and facilitates the antigravity postural response.[10]

Hence, this study analyzed the reactivation of orthostatism of institutionalized bedridden elderlies for a period of 50 days up to 06 months (approximately 180 days), through strengthening quadriceps and gluteus medius.

Currently, there is lack of studies regarding this issue. Therefore, the importance of this topic is considerable, since IS can lead to morbidity and mortality from direct and indirect causes. In addition, with the results of this study it will be possible to offer tools for health professionals to deal more efficiently in the treatment of muscle strength loss and functional capacity.

OBJECTIVE

The primary objective of this study is to analyze the necessary increase in the muscle strength for the recovery of orthostatism of institutionalized bedridden elderlies.

The secondary objective of is study is to correlate the immobilism time, age and number of sessions with the reacquisition of orthostatism in institutionalized elderly with temporary IS.

METHODS

This study initiated after the proper approval by the Ethics Review Board of the *Universidade Mogi das Cruzes* (UMC) under registration number 13263 and approval number CAAE 01245512.9.0000.5497. The data collection was carried out at the *Viva Bem* nursing home in the city of São Paulo – SP.

This study began with 30 elderly people of both sexes, without distinction of social class and ethnicity, who read, accepted and signed the Informed Consent Form. The participants were clarified regarding the purpose of the study, assessments, procedures and risks to which they would be submitted and that they should meet the following criteria:

Inclusion criteria: both sexes, age between 60 and 80 years, living in the *Viva Bem* nursing home, being bedridden between 50 days and 06 months (to characterize long stay and temporary IS).

Exclusion criteria: inability to perform resisted exercises with the initial load stipulated in this study, presence of pressure ulcer, presence of balance related diseases that would jeopardize orthostatism without auxiliary devices, such as severe visual alteration, vestibular disorder (vertigo and dizziness), presence of severe pain, neurological disorder, osteoporosis, orthopedic injuries (fractures, dislocations, osteoarthroses, arthroplasties), hemodynamically unstable subjects or those with any medical restrictions, or subjects with no prognosis of gait due to diagnosis of fatal disease and/or life restricted expectancy, and finally patients under 20 points in the Mini Mental State Examination (MMSE) score.

For the strengthening program, we used shin weights from 0.5kg to 5kg, cushion for positioning during strengthening, and a weight to measure body weight and muscle strength (kg).

Initial explanations were given to the participant about the study, objectives, possible risks and expected benefits. After reading in full and accepting to participate in the study, the participant signed the Free and Informed Consent Form, which includes participant data and researcher data, as well as clarification about the study with procedure and objectives.

Participants completed two questionnaires: 1) personal identification questionnaire to collect epidemiological data, including name, age, sex, educational level, occupation, schooling, weight and height; and 2) a questionnaire on the condition of physical health, with questions about the possible presence of any alteration that would obstruct the accomplishment of strengthening or the independent orthostatism. Subsequently, the Mini Mental State Examination (MMSE) was applied to evaluate cognitive status. Due to the low schooling of the sample, a minimum score of 20 points was established.

The muscles (mm) strengthened in this program were femoral quadriceps and gluteus medius muscles, which are responsible for the acquisition and maintenance of orthostatism. The load for both muscles was a shin guard positioned at the ankles. As for the position of the participants were placed in dorsal decubitus, and a cushion was positioned in the popliteal fossa region providing flexion of the knee joint in order to allow extension movements. For the strengthening of the gluteus muscles, the participants should be placed in lateral decubitus, with slight flexion of the hip and knee bilaterally, and the participants should perform a hip abduction.

The participants should remain in the position described above, and perform 3 sets of 10 bilateral repetitions (3x10) of both muscles described above. To avoid muscle fatigue due to several attempts, the initial loading was suggested as 5% of the participant's body weight for quadriceps muscles and 3% for gluteus medius muscles, for example, for a participant with 70kg, 3kg would be set for quadriceps and 2kg for gluteus medius muscle. A pause in-between the series were added, according to the condition of the participants. If participants could manage, there should be a resistance increase of 0.5 kg until the maximum load supported by the participants, and if there was difficulty in completing the task, that load should be reduced in the same way. The participants should perform the knee extension and hip abduction movements 3x10 in full range of motion (ROM). The maximum load supported by a participant was recorded, and considered the initial load.

The strengthening program occurred 2 times week, for up to 16 weeks, a total of 32 sessions. For each session, the participants should perform 3x10 repetitions, bilaterally, with the load mentioned above, and with a pause of one minute in-between the series. If it was possible, the therapist would increase the resistance by 0.5kg. The duration of each session was approximately 30 minutes, including strengthening and attempted re-acquisition of orthostatism.

After the 10th strengthening session, subsequent attempts towards orthostatism were made. The participants should adopt and try to remain in the orthostatic position for at least 1 minute without auxiliary devices, using up to three attempts in each strengthening session. Participants who succeeded in completing their strengthening program would be re-evaluated. On the other hand, participants who could not stay in the orthostatic position within the stipulated time frame should be reevaluated after a maximum period of 16 weeks (32 sessions). For the purpose of classification, participants were divided into G1 (group of elderly who regained orthostatism) and G2 (group of elderly individuals who did not regain orthostatism).

If the participant was able to regain orthostatism, the number of sessions that were necessary and the values of the loads of the last strengthening session would be considered to calculate the muscle strength increase. We emphasize that blind assessments and treatments do not apply to this research, since the participants were divided according to their success or failure to reach and maintain after ortostatism, and were therefore not subject to external influences.

To characterize the sample, Excel® (Microsoft 2016) spreadsheets and charts were used to calculate means and standard deviations (age, weight, MMSE) and percentages for orthostatic acquisition of the two muscle groups. Correlation coefficient (Excel® 2016) was used to establish relationship between orthostatic acquisition and age, immobilization time, and number of strengthening sessions.

RESULTS

Of the 30 elderly people who started the study, six were excluded due to neurological dysfunction, eight because they did not present the minimum MMSE score, and two because of an orthopedic issues. Therefore, 14 elderly patients with mean MMSE score of 24.5 points (± 2.0), mean age of 68.6 years (± 5.4), immobilization time on average 117.5 days (± 38, 52), and weight on average 69.48 kg (± 9.13) were included in the study. Table 1 presents the general data of the sample.

For comparison purposes, after the strengthening program participants were divided into G1 - group that reacquired orthostatic posture; and G2 - group that did not regain orthostatic posture in the pre-determined time.

Table 2 shows the characteristics of G1 and G2 participants: gender, age, weight, and immobilism time. Of the G1, five were male and five were female, with mean age of 68 years (± 5.1), mean weight of 69.53 kg (± 10.6) and mean immobilism time of 101.4 days. The number of strengthening sessions required to achieve independent orthostatism was an average of 21.4 sessions. Of the G2, three were male and one was female, with mean age of 68.7 years of age (± 7.0) mean weight of 69.3 (± 4.4) and mean immobilism time of 157.75 days. The number of sessions performed was 32 the maximum number of sessions.

The table 3 represents both groups regarding muscle strength gain after the strengthening program, in which the evaluation and reevaluation were compared. Among G1 participants, the quadriceps femoris muscle supported the initial load of 3.55 kg (± 0.64) at baseline, whereas the final evaluation evidenced a mean load of 9.55 kg (± 1.26). Therefore, the increase in quadriceps muscle strength was 177%. As for the mean gluteus medius, at baseline the initial load was 1.35 kg (± 0.34) and the final evaluation recorded the mean load at 4.175 kg (± 0.55). The increase of gluteal muscle strength was 102%.

Table 1. Sample characterization

N	Initials	Sex	Age (years)	MMSE (score)	Immobilization time (days)	Weight (kg)
1	A.C.O	F	64	23	83	77
2	C.C	F	64	21	92	60
3	C.L.A	M	76	23	77	75.3
4	D.P.D	M	61	29	170	75.3
5	F.R.L	M	61	27	111	75.1
6	J.L.S	M	65	25	132	78.1
7	J.S.A	M	69	23	50	86.1
8	J.S.S	M	67	25	163	65
9	M.R.S	F	78	26	139	70
10	M.S.F	F	70	24	123	59.5
11	N.B.S	F	75	25	132	52
12	R.P.S	M	69	24	159	67.1
13	S.B	F	68	23	149	62
14	W.C.O	M	74	25	65	70.2
		Mean	68.6428571	24.5	117.5	69.4785714
		SD	5.47170544	1.990361	38.52022446	9.13111153

Sex M, male and F, fmale;.MMSE, Mini Mental State Examination; SD, standard deviation.

Table 2. General data of G1 and G2 after the strengthening sessions

Group	Initials	Sex	Age (years)	Immobilism time (days)	Weight (kg)	Number of sessions
G1	C.C	F	64	92	60	20
	A.C.O	F	64	83	77	22
	M.S.F	F	70	123	59.5	27
	S.B	F	68	149	62	23
	N.B.S	F	75	132	52	23
	F.R.L	M	61	111	75.1	18
	J.L.S	M	65	132	78.1	25
	J.S.A	M	69	50	86.1	17
	W.C.O	M	74	65	70.2	18
	C.L.A	M	76	77	75.3	21
		Mean	68.6	101.4	69.53	21.4
		SD	5.168279318	32.80650342	10.66667	3.238655414
G2	J.S.S	M	67	163	65	32
	R.P.S	M	69	159	67.1	32
	D.P.D	M	61	170	75.3	32
	M.R.S	F	78	139	70	32
		Mean	68.75	157.75	69.35	32
		SD	7.041543391	13.30100247	4.465049	0

Sex: M male and F female; SD, standard deviation; 32 is the maximum number of sessions.

The G2 started its strengthening program with the same principles as the G1, but at the end of the 16 weeks / 32 sessions, the orthostatic posture was not recovered.

Among the G2 participants, regarding the gain of muscle strength after the strengthening program, by comparing the baseline with the final evaluation, we observed that the quadriceps femoris muscle strength had an increased of 117% (3.375 kg ± 0.48 at baseline and 7.5 kg ± 0.20 at final evaluation). As for the gluteus medius, we observed an increase of 39% (1.25 kg ± 0.29 at baseline and 2.875kg ± 0.32 at the final evaluation).

The table 4 shows the mean muscle strength increase of the quadriceps muscle in kg, by comparing G1 with G2, after the muscle strengthening program. It is observed that in G1, the quadriceps femoris muscle had mean strength increase of 6 kg (± 1.01). However, the G2 presented mean strength increase of 4.125kg (± 0.37). The mean difference between the groups was statistically significant, with p=0.00113.

Table 3. Quadriceps femoris and gluteus medius muscles strengthening program analysis of groups G1 and G2 at baseline and final evaluation

			Quadriceps femoris strength (kg)				Gluteus medius strength (kg)			
Group	Initials	Body weight (kg)	Initial load at baseline (5% of body weight - kg)	Load at final evaluation (kg)	Difference (Final evaluation x baseline)	Increase (%)	Initial load at baseline (3% of body weight - kg)	Load at final evaluation (kg)	Diference (Final evaluation x baseline)	Increase (%)
G1	C.C	60	3	8	5	167%	1.8	4	3	122%
	A.C.O	77	3.85	9	5.15	134%	2.31	4	1.69	73%
	M.S.F	59.5	2.975	9	6.025	203%	1.785	3.5	1.715	96%
	S.B	62	3.1	9	5.9	190%	1.86	3.75	1.89	102%
	N.B.S	52	2.6	8	5.4	208%	1.56	3.75	2.19	140%
	F.R.L	75.1	3.755	10	6.245	166%	2.253	5	2.747	122%
	J.L.S	78.1	3.905	11	7.095	182%	2.343	4.75	2.407	103%
	J.S.A	86.1	4.305	9.5	5.195	121%	2.583	4.25	1.667	65%
	W.C.O	70.2	3.51	10	6.49	185%	2.106	3.75	1.644	78%
	C.L.A	75.3	3.765	12	8.235	219%	2.259	5	2.741	121%
	Mean	69.53	3.55	9.55	6	177%	1.35	4.175	2.1691	102%
	SD	10.6666719	0.643341969	1.257201478	1.01003314		0.337474279	0.553398591	0.521742902	
G2	J.S.S	65	3.25	7.5	4.25	131%	1.95	3.25	1.3	67%
	R.P.S	67.1	3.355	7.5	4.145	124%	2.013	3	0.987	49%
	D.P.D	75.3	3.765	7.25	3.485	93%	2.259	2.75	0.491	22%
	M.R.S	70	3.5	7.75	4.25	121%	2.1	2.5	0.4	19%
	Mean	69.35	3.375	7.5	4.125	117%	1.25	2.875	1.625	39%
	SD	4.46504946	0.478713554	0.204124145	0.368340875		0.288675135	0.322748612	0.424393292	

G1: Participants who recovered orthostatism; G2: Participants who did not recover orthostatism; SD, standard deviation.

This table also shows the mean increase of muscle strength of the gluteus medius in kg, by comparing G1 with G2, after the muscle strengthening program. It can be observed that in G1 the gluteal muscles had a mean increase of muscle strength of 2.17 kg (± 0.52), whereas in G2 the patients had a mean increase of 1.62 kg (± 0.42). The mean difference between the groups was statistically significant, with p=0.00028.

The Figure 1 compares both groups regarding the mean increase of muscle strength of the quadriceps femoris and the gluteus medius, and their corresponding percentages.

In the statistical analysis by the correlation coefficient between the variables of muscle strength increase of G1 and G2, in G2 a very strong correlation was observed between the increase of quadriceps muscle strength increase and the patients baseline weight (-0.98), and a strong correlation between the increase of gluteus medius muscle strength and the patients baseline weight (-0.84), and between immobilization time and the number of strengthening sessions (0.72). For the other comparisons, moderate correlations were found (Table 5).

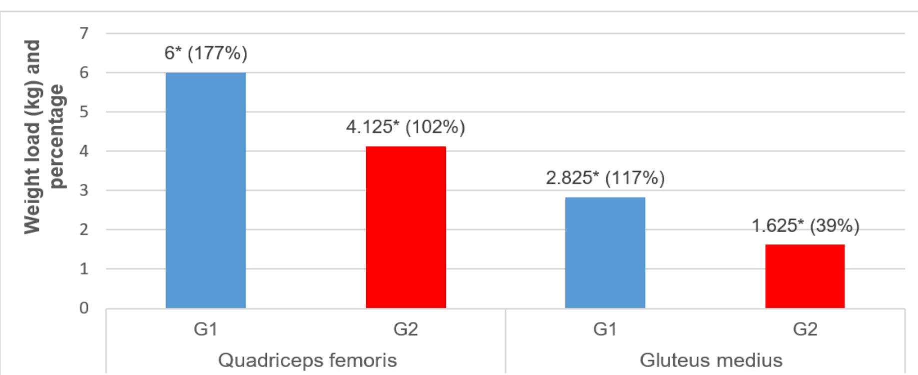
Hence, it is possible to suggest that the greater the age, baseline weight, and time of immobility the lesser chance of recovering orthostatism. We also observed that in G1 the mean immobility time was 101 days, whereas in G2 it was 157 days, which corresponds to a difference of 56% between both groups.

Table 4. Mean increase of muscle strength (kg) of the quadriceps and gluteus medius muscles of G1 and G2

Muscle	Analysis	Muscle strength increase (kg) G1	Muscle strength increase (kg) G2
Quadriceps femoris		5	4.25
		5.15	4.145
		6.025	3.485
		5.9	4.25
		5.4	
		6.245	
		7.095	
		5.195	
		6.49	
		8.235	
	Mean	6.0735	4.125
	SD	0.958201571	0.595119036
	(p value)	0.001135483	*
Gluteus medius		3	1.3
		1.69	0.987
		1.715	0.491
		1.89	0.4
		2.19	
		2.747	
		2.407	
		1.667	
		1.644	
		2.741	
	Mean	2.1691	1.625
	SD	0.521742902	0.595119036
	(p value)	0.000278038	*

* Statistically significant (p<0.001); G1, group 1; G2, group 2; SD, standard deviation

Figure 1. Mean increase of muscle strength of quadriceps femoris and gluteus medius, in the comparison of G1 and G2 (kg and %)



* p value for quadriceps femoris: 0.001135483 and gluteus medius: 0.000278038 – statistically significant (p<0.001)

Table 5. Correlation between the muscle strength increase variables of G1 after the strengthening program

Variable 1	Variable 2	Correlation coefficient
Increase FM G2 quadriceps femoris	weight	-0.963523292
Increase FM G1 gluteus medius	weight	-0.846058291
Increase FM G1 gluteus medius	weight	-0.60134472
Increase FM G1 gluteus medius	age	0.591954094
Increase FM G2 quadriceps femoris	age	0.584925713
Increase FM G1 gluteus medius	immobility time	0.5355121
Increase FM G1 quadriceps femoris	immobility time	0.501746627
Increase FM G2 quadriceps femoris	immobility time	-0.449711936

±0.9, very strong correlation; ±0.7 to ±0.9, strong correlation; ±0.5 to ±0.7, moderate correlation; ±0.3 to ±0.5 weak correlation; 0 to ±0.3, irrelevant correlation.

DISCUSSION

This research had the objective of analyzing the muscle strength increase of the quadriceps femoris and gluteus medius muscles after a strengthening program of institutionalized elderlies. The results showed that, after the end of the program, there was improvement of muscle strength and that this was essential for the recovery of orthostatic posture.

Sowers et al.[11] and Vans,[12] have shown that elderly men and women with lower physical activity have lower muscle mass and a higher prevalence of physical incapacity, what seems to be strongly related to the lower limbs strength.

In the literature, the loss of muscle mass and the decrease of muscle strength, common characteristics of people, are more evident in sedentary and bedridden elderlies with immobility syndrome. After the fifth decade of life, the rate of progression of strength reduction occurs around 8% to 15% per decade, and both men and women exhibit the same pattern of strength decrease.[13]

The reported prevalence of sarcopenia in this population is up to 33%, with a higher prevalence in intensive and long-term care facilities.[14]

In a survey carried out in a nursing home, 41 participants (40.2%) were diagnosed with sarcopenia, and 38 (95%) of them were categorized as severe, evidencing the high prevalence.[15]

It is known that the presence of sarcopenia increases the risks of functional disability and falls, with consequent functional dependence and costly healthcare. Many studies on frail elderly have emphasized the importance of physical exercise to maintain their autonomy.

The gain in muscle power and strength has been associated with a greater ability to perform functional activities, improvement of independence and quality of life of the elderly.[16-19] Probably, this can be explained by the decreased of types I and II fibers of elderlies and its underlying consequences.[20,21]

According to a literature review of 2009, the aging process leads to modifications in muscle architecture such as reduction of the pennation angle, fascicular length, muscle thickness and, consequently, anatomic and physiological cross-sectional area. Many of these modifications can be partially reversed with resistance training.[22]

A study carried out in Malaysia with 51 institutionalized elderlies, with mean age of 70.7 years analyzed the strength of the lower limbs muscles after a strengthening program.

The authors concluded that the muscle strength increase was statistically significant, as well as effective, simple and cheap. The methods of this study were similar to the present study (2x / week, in 3x8 to 10 replicates), but with a duration of 12 weeks. In addition, the load was delivered by an elastic band, not a shin weight, as in the present study.[23]

Exercise interventions seem to play an important role in increasing muscle strength and improving physical performance, although they do not seem to consistently increase muscle mass in the fragile and sedentary elderly individuals of the study group.[14]

Based on the studies conducted by Faria et al.,[24] muscle strengthening was effective in improving muscle strength, functional mobility, and balance of elderly individuals. The implemented exercise programs (resistance and balance training) of these studies favored older, frail individuals who obtained more significant improvements in function when compared to the less fragile ones.

Regarding the average age of G1 in the current sample, it is possible to suggest that the age factor moderately influenced independent orthostatism. However, Hassan et al.[25] studied the impact of progressive resistance training on institutionalized elderly patients with sarcopenia (85.9 ± 7.5 years). The program occurred 2x / week, for 6 months through pneumatic equipment, and involved muscles of upper limbs, lower limbs and trunk. At the end of the study, positive results in the reduction of disability due to sarcopenia were achieved, despite the advanced age.

Although it is clear in the literature that exercise is one of the most important components to prevent and treat frailty, the effect of the different types of resistance training on the frail elderly is uncertain. Therefore, Lopez et al.[26] carried out a systematic review with 16 studies and concluded that resistance training alone or combined with multimodal exercises increased the maximum strength by 37% and functional capacity by 58.1%. He also concluded that that the frequency of 1-6 times a week, 1 to 3 sets of 6 to 15 repetitions and intensity of 30 to 70% of the one-repetition maximum resistance 1-RM promotes significant improvement of strength, muscle power and functional capacity.

In another study with similar objectives, Binder et al.[27] analyzed 115 elderly individuals with fragility syndrome, and divided them into 2 groups: experimental group, which undertook intensive training of flexibility, strength with progressive load, and balance; and control group, who performed flexibility exercises alone. They concluded that intensive training improved physical function and preclinical disabilities in the elderly with physical performance and oxygen absorption deficit, and that the intensive program was better than the low intensity home exercise program.

As a matter of comparison, since the present study involved progressive increase of load, we highlight the study by Liu et al.[28] that analyzed Progressive Resistance Strength Training (PRT) in the elderly in a systematic review. 121 studies with 6700 participants were included. Most of the studies reported applying high intensity PRT for 2 to 3 times week. The results showed a significant but moderate improvement in physical ability, functional limitation, gait, and in the standing up movement. As for muscle strength, they found significant improvements when compared to the previously mentioned parameters.

The current literature presents relevant discussion regarding the muscular strengthening programs proposed for the elderly, indicating different types, intensity and duration of the proposed muscular strengthening training.[29]

In the study conducted by Sullivan et al.,[30] low and high load isotonic exercises yielded muscle strength increase of upper and lower limbs of frail older adults, what was even higher in the group that received high resistance training when compared to the benefits of low resistance exercise. Chandler et al.[31] found a 10 to 16% strength increase after a low to moderate intensity exercise program.

Another issue under debate in the literature is the use of loads, the number of exercises proposed, the number of repetitions and recovery intervals between sets and exercises specifically designed for the elderly.[29]

Strengthening should be performed for at least two times week, with a minimum of 48 hours in-between sessions, for proper muscle recovery. It is recommended that patients perform eight to ten exercises with eight to twelve repetitions for each set and the large muscle groups should be addressed, without exceeding 60 minutes in duration. It is recommended that patients inhale before lifting the load and exhale during contraction, avoiding the Valsalva maneuver.[32,33]

However, these studies should be compared with the present study with caution, since they were performed in the elderly, but without the characterization of immobility syndrome. In the literature there is scarce studies related to strengthening for the elderly with immobility syndrome.

CONCLUSION

The increase in muscular strength was essential for reactivation of orthostatism in the elderly with immobility syndrome, since most of the participants recovered orthostatism after the muscle strengthening program. Very strong correlation between the participants baseline weight and muscle strength increase and strong correlation between immobilization time and muscle strength increase were found. The other correlations regarding age of the participant and number of sessions were considered moderate. Therefore, elderlies with younger age, with shorter immobility time, and those who undertook greater number of strengthening sessions, had greater chances of recovering their orthostatic posture, given the strictly met the eligibility criteria.

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