

Comparison between unimodal and multimodal Physical Therapy interventions in frailty: a systematic review

Comparação entre intervenções fisioterapêuticas unimodais e multimodais na Síndrome da Fragilidade: revisão sistemática

Maria do Socorro Moraes Pereira Simões¹

Patrícia Albuquerque de Moura¹

Renata dos Ramos Varanda¹

Marina Minardi Nascimento¹

José Eduardo Pompeu¹

ABSTRACT

Frailty can be defined as a biologic syndrome that results from decline in multiple systems leading to vulnerability, with poorer capacity of the organism to maintain homeostasis facing stressing events. Physical symptoms of frailty involve unintentional weight loss, decreased physical activity level, exhaustion, muscle weakness, impaired balance and gait. Together, these symptoms can compromise independence in activities of daily living. Physical Therapy can improve muscle strength, balance, gait and cardiorespiratory aptitude of frail elderly, but remains unclear what is the best intervention strategy: unimodal or multimodal interventions, with combined exercises. This systematic review aimed: (1) to compare the efficacy of unimodal and multimodal Physical Therapy interventions; (2) to analyze its effects on clinical outcomes and (3) to elucidate what is the best modality of exercise and its combination in order to improve physical symptoms and independence in frail elderly. Searches were conducted in PubMed, Medline, PEDro, Lilacs and Scielo databases. We obtained 2,579 studies and 17 were included in analysis. Studies analyzed the following clinical outcomes: mobility, muscle strength, balance, falls and fear of falling, quality of life and functional capacity. We conclude that both unimodal and multimodal interventions have potential to promote beneficial effects, but the analyzed studies have important methodological issues that negatively affect their quality. Although the beneficial effects of both interventions, the quality of studies analyzed does not allow us to generalize these effects. We suggest that new clinical trials should be conducted with a stronger methodology and according to current guidelines for randomized clinical trials.

KEYWORDS

Elderly; Frail Elderly; Gerontology; Physical Therapy Modalities; Rehabilitation.

RESUMO

A fragilidade pode ser definida como uma síndrome biológica que resulta da diminuição da função de diversos sistemas, conduzindo à vulnerabilidade e pior capacidade do organismo para manter a homeostase frente a eventos estressores. As características físicas da fragilidade envolvem perda involuntária de peso, diminuição do nível de atividade física, cansaço, fraqueza muscular, diminuição do equilíbrio e marcha. Esses sintomas podem comprometer a independência nas atividades de vida diária. A fisioterapia pode melhorar a força muscular, equilíbrio, marcha e aptidão cardiorrespiratória de idosos frágeis, mas não está claro qual é a melhor estratégia: intervenções unimodais ou multimodais, com exercícios combinados. Sendo assim, esta revisão sistemática objetivou: (1) comparar a eficácia de intervenções unimodais e multimodais; (2) analisar os efeitos sobre os resultados clínicos e (3) elucidar qual a melhor modalidade de exercício e suas combinações na melhora dos sintomas físicos e independência em idosos frágeis. Foram realizadas buscas nas bases de dados PubMed, Medline, Pedro, Lilacs e Scielo. Obtivemos 2.579 estudos e 17 foram incluídos na análise. Os estudos incluídos analisaram os desfechos mobilidade, força muscular, equilíbrio, quedas e medo de cair, qualidade de vida e capacidade funcional. Concluímos que as intervenções unimodais e multimodais têm potencial para promover efeitos benéficos, mas os estudos analisados apresentaram falhas metodológicas que afetam a qualidade dos mesmos. Apesar dos benefícios de ambas as intervenções, a qualidade dos estudos não nos permite generalizar esses efeitos. Sugerimos que novos ensaios clínicos devam ser conduzidos, com metodologia de acordo com as recomendações para ensaios clínicos randomizados.

PALAVRAS-CHAVE

Idoso; Idoso frágil; Gerontologia; Modalidades de fisioterapia; Reabilitação.

INTRODUCTION

Frailty can be defined as a biologic syndrome that results from decline in multiple systems leading to vulnerability, with poorer capacity of the organism to maintain homeostasis facing stressing events^{1,2}. Its prevalence increases with age and is associated with negative health outcomes such as falls, disabilities and death^{1,2}.

Due to difficulty in identifying frail older adults, Fried et al.¹ proposed a standardized definition of frailty through five characteristics: unintentional weight loss, exhaustion, slowness, weakness and low physical activity level. Together, these symptoms can compromise independence in activities of daily living².

Giné-Garriga et al.³, in a recent systematic review and meta-analysis, showed that exercise interventions promote positive effects in physical functions of frail elderly, although modality and characteristics of exercise vary widely on literature.

Many researchers have analyzed the effects of unimodal interventions, which are based on only one type of exercise, while others have studied association of exercise modalities³. The most common Physical Therapy interventions are based on resistance training^{4,5}, aerobic exercises⁵ and balance exercises^{4,5}.

Remains unclear if unimodal or multimodal interventions show better effects in frailty, neither which is the best combination of exercises. This systematic review aimed: (1) to compare the efficacy of unimodal and multimodal Physical Therapy interventions, (2) to analyze its effects on clinical outcomes and (3) to elucidate what is the best modality of exercise and its combination in order to improve physical symptoms and independence in frail elderly. Our hypothesis is that both, unimodal and multimodal exercises, in different combinations, can promote positive effects on clinical outcomes of frail elderly, but due to multifactorial characteristic of frailty, combined exercises can be more effective than unimodal exercises.

METHODS

Searches were conducted in PubMed, Medline, PEDro, Lilacs and Scielo databases. The descriptors and Boolean operators were: [frail elderly OR idoso frágil] AND [rehabilitation OR reabilitação], [exercise OR exercício] [physical therapy OR fisioterapia], [resistance training OR treinamento de resistência].

Only randomized controlled trials were selected, published in the period from 2009 to 2014, in English or Portuguese languages and that analyzed the effects of unimodal or multimodal interventions in treatment of frailty.

Studies were firstly selected by title by two researchers. Abstracts of selected studies were read by the same two researchers and, in case of disagreements concerning inclusion, a third researcher participated in decision. After selection by abstracts, studies were fully read.

Quality of selected studies was analyzed using PEDro scale, which evaluates randomized clinical trials through eleven dichotomized questions (yes/no) those score from zero to ten. Every answer “yes” is scored, from question two to eleven. Scores on PEDro scale were not considered as exclusion criteria and were used only to classify and describe the selected studies⁶.

RESULTS

We obtained 2,579 studies, but after filtering according with its design, just 197 were randomized clinical trials. After reading the titles, we excluded 138 studies that did not assessed the effects of unimodal or multimodal interventions in treatment of frailty, resulting in 59 studies. After exclusion of duplicated studies, 17 were included in analysis, as shown in Figure 1.

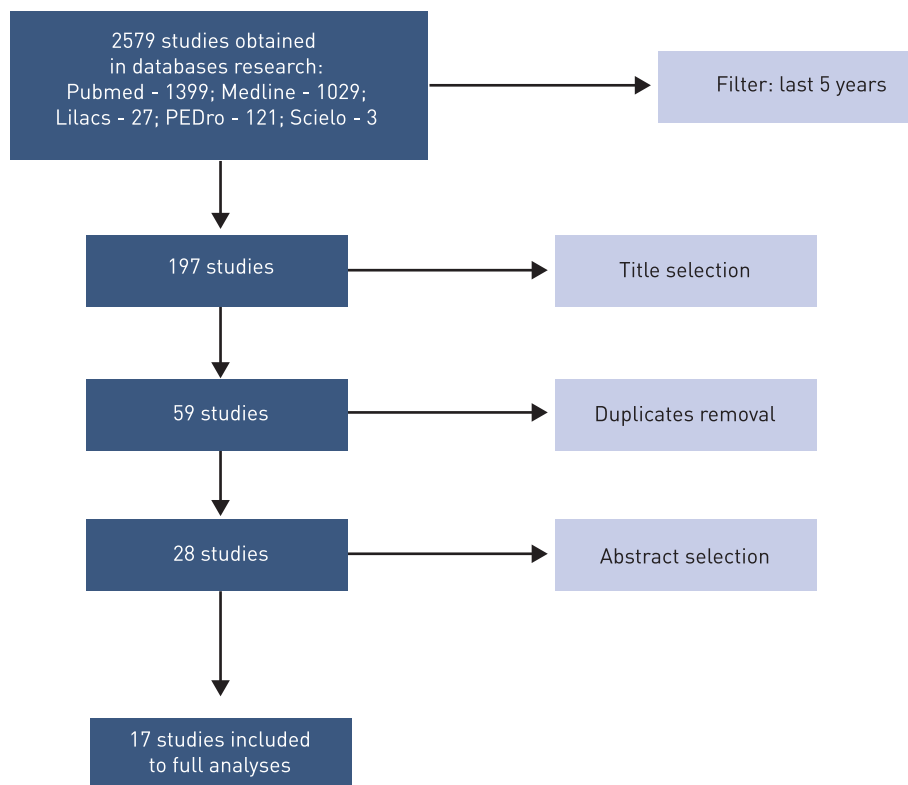


FIGURE 1 – Flow of research and selection of studies.

Selected studies analyzed the following clinical outcomes: mobility, muscle strength, balance, falls and fear of falling, quality of life and functional capacity.

Eleven studies⁷⁻¹⁶ analyzed mobility through the Timed Up & Go test (TUG), walking speed test, Performance-Oriented Mobility Assessment (POMA), five meters walking test, ten meters walking test and six minute walking test.

Muscle strength was analyzed in ten studies^{7-14,17,18} through isokinetic dynamometer, manual dynamometer, grip strength, sit-to-stand five times, sit-to-stand 30 seconds and sit-to-stand transfer muscle power.

Nine studies^{8,10,13-16,18-20} evaluated balance through Frailty and Injuries Cooperative Studies of Intervention Techniques (FICSIT-4), Short Physical Performance Battery (SPPB), Berg Balance Scale (BBS), baropodometry, tandem, semitandem and unipedal stance.

Falls were assessed in only one study¹⁴ through falls incidence inventory, while fear of falling was assessed in four^{21,23,24,28}, using Falls Efficacy Scale – International (FES-I) and Activities-specific Balance Confidence scale (ABC).

Quality of life was analyzed in four studies^{8,15,19,21} through Medical Outcomes Studies 12-item Short Form (SF-12) and EuroQol-5D (EQ-5D).

Five studies^{10,13,17,19,22} analyzed functional capacity through Barthel index and Functional Independence Measure.

Table 1 shows the results of PEDro scale analysis concerning methodological quality of selected studies and table 2 shows the description of studies regarding interventions, sample size, outcomes and results.

TABLE 1 – PEDro scale scores.

Authors/Year	1	2	3	4	5	6	7	8	9	10	11	TOTAL
Cadore et al. ¹⁴	Y	Y	Y	Y	N	N	N	N	Y	Y	Y	6
Cameron et al. ¹⁹	Y	N	N	Y	N	N	N	Y	Y	Y	Y	5
Coelho et al. ⁹	Y	Y	N	Y	N	N	N	Y	Y	Y	Y	6
Fairhall et al. ²⁴	Y	Y	Y	Y	N	N	Y	Y	Y	Y	Y	8
Giné-Garriga et al. ¹⁰	Y	Y	Y	Y	N	N	Y	N	Y	Y	Y	7
Giné-Garriga et al. ²¹	Y	Y	Y	Y	N	N	Y	N	Y	Y	Y	7
Gronstedt et al. ¹³	Y	Y	Y	Y	N	Y	Y	N	Y	Y	Y	8
Hagedorn et al. ¹⁶	Y	Y	Y	Y	N	N	N	N	Y	Y	Y	6
Langlois et al. ¹²	Y	Y	N	Y	N	N	N	N	Y	Y	Y	5
Lustosa et al. ⁷	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	N	8
Molino-Lova et al. ²⁰	Y	Y	Y	N	N	N	N	Y	Y	Y	Y	6
Pollock et al. ¹⁵	Y	Y	Y	Y	N	N	Y	N	Y	Y	Y	7
Rydwick et al. ²²	Y	N	N	Y	N	Y	N	N	Y	Y	Y	5
Sato et al. ¹⁷	Y	Y	Y	Y	Y	N	N	Y	Y	Y	N	7
Zak et al. ¹¹	Y	Y	Y	Y	N	N	Y	Y	Y	Y	Y	8
Zech et al. ¹⁸	Y	Y	Y	Y	N	N	N	Y	Y	Y	Y	7
Zhang et al. ⁸	Y	Y	Y	Y	Y	N	N	Y	Y	Y	Y	8

Abbreviations: Y: yes; N: no.

TABLE 2 – Description of selected studies.

Author	Intervention group	Control group	N	Outcomes	Results
Cadore et al. ¹⁴	12 wks, 2x/wk, 40 min/day; upper and lower body resistance training, balance and gait exercises, functional exercises	12 wks, 4x/wk, 30 min/day; mobility exercises	32	Gait ability, dual-task performance, balance, LLMS, ULMS, incidence of falls, functional status, muscle cross-sectional area and quality	IG: increased gait speed, decreased TUG, increased times raised from a chair, improved balance, lower deterioration on Barthel Index, decreased incidence of falls, better performance on dual task, increased ULMS/LLMS, increased muscle cross-sectional area
Cameron et al. ¹⁹	12 months; multifactorial and interdisciplinary program targeted to each individual's frailty criteria, additional interventions based on comprehensive geriatric evaluation	Usual care	241	Frailty, mobility, hospitalizations/admissions to nursing care facilities, disability, health-related QoL, psychological status, death	Reduced frailty, improved mobility, decreased mobility-related disabilities. Benefits not evidenced at follow-up
Coelho et al. ⁹	10 wks, 3x/wk; progressive dynamics resistance training (pre-frails)	10 wks, 3x/wk; progressive dynamic resistance training (non-frails)	48	Neurotrophic factors productions, cognitive performance, depression, frailty phenotype, muscle strength, muscle performance, functional mobility	Increased muscle strength, plasma levels of BDNF increased in both groups but more in non-frails, functional improvement

Author	Intervention group	Control group	N	Outcomes	Results
Fairhall et al. ²⁴	12 months; multifactorial program targeted to frailty, 10 sessions of PT targeted to mobility, increase physical activity and falls prevention	Usual care	241	Mobility-related disability, participation, mobility performance, mobility-related participation, self-report measure of activity, adverse events	Increased participation and mobility, mobility-related participation and gait speed
Giné-Garriga et al. ¹⁰	12 wks, 2x/wk; functional circuit training (functional balance and strength exercises)	12 wks, once a week; usual care + social meetings	51	Physical frailty component, balance, gait, physical function, muscle strength	Improves on physical performance measures, reduced physical frailty components
Giné-Garriga et al. ²¹	12 wks, 2x/wk; functional circuit training (functional balance and strength exercises)	12 wks, once a week; usual care + social meetings	51	Fear of falling, QoL	Reduced fear of falling, increased QoL
Gronstedt et al. ¹³	12 wks; goal-oriented training including transfers, walking, balance, muscle strength and endurance, outdoor walking, gymnastics, personal care, social activities	Usual care	322	ADL, functional balance, physical activity level, mobility, grip strength, falls-related self-efficacy	Increased physical activity level, balance, transfers, walking speed, leg muscle strength
Hagedorn et al. ¹⁶	12 wks, 2x/wk; muscle strength training, physical fitness training, home exercises, computer feedback balance training	12 wks, 2x/wk; muscle strength training, physical fitness training, home exercises, traditional balance training	27	LLMS, ULMS, lower-body strength, mobility, aerobic endurance, balance, gait, fear of falling	Both groups: increased muscle strength, decreased fear of falling; CG: increased lower-body muscle strength, increased balance; IG: increased endurance
Langlois et al. ¹²	12 wks, 3x/wk; stretching and balance exercises, aerobic exercises, strength training	Usual care	83	Physical capacity, cognition, QoL	IG improved in functional capacity, physical endurance, cognition and QoL
Lustosa et al. ⁷	10 wks, 3x/wk; lower limbs strength training with 75% of 1 RM, 3 series of 8 repetitions	Usual care	32	Functional performance, knee extensors muscle strength	Training provided increased muscle power and functional performance, with no differences in muscle strength
Molino-Lova et al. ²⁰	12 months; aerobic exercises + home-based 3x/wk exercises for muscle strengthening, flexibility, balance and coordination	Aerobic exercises	140	Functional capacity	IG presented greater improvements in functional capacity
Pollock et al. ¹⁵	8 wks, 3x/wk; whole-body vibration + exercises targeting muscle strengthening, balance and functional mobility	Exercises targeting muscle strengthening, balance and functional mobility	77	Functional mobility, sarcopenia, functional balance, fear of falling, health-related QoL	IG presented greater improvements in functional mobility
Rydwik et al. ²²	2x/wk, 12 wks; I: specific physical training + general diet advice; II: specific physical training + specific diet counseling + group-session training; III: specific diet counseling + group-session training + general physical training advice	General physical training advice + general diet advice	96	Physical activity level and ADL	Groups I and II increased physical activity levels; no differences in any group for ADL
Sato, Kaneda, Nonura ¹⁷	2 yrs - 2x/wk; hydrotherapy with ADL training + stretching + muscle strength training + relaxation	2 yrs - 1x/wk; hydrotherapy with ADL training + stretching + muscle strength training + relaxation	22	ADL abilities and LLMS	Both groups improved in ADL abilities; twice weekly group improved LLMS
Zak et al. ¹¹	5x/wk, 7 wks; I: progressive resistance exercises + nutritional supplementation; III: standard exercises + nutritional supplementation	II: progressive resistance exercises + placebo nutritional supplementation; IV: standard exercises + placebo nutritional supplementation	91	Functional performance capability, muscle strength, nutritional aspects	Groups I and II improved muscle strength, group III improved mobility and body weight

Author	Intervention group	Control group	N	Outcomes	Results
Zech et al. ¹⁸	2x/wk, 12 wks; one group performed muscle strength training and one group performed muscle power training	Maintained usual physical activity level	69	Physical performance, muscular power of LL, self-reported function of LL and upper extremities	Both intervention groups increased in physical function, but gains were not maintained after detraining period
Zhang et al. ⁸	8 wks - 3-5x/wk; Whole-body vibration	8 wks; usual care + PT + routine exercises	44	Mobility, LLMS, balance, balance confidence, postural control, general health status, subjective experience and training preference	Both groups showed improvements of all measures at 04 and 08 wks; more pronounced improvements in intervention group regarding mobility, LL, balance confidence and general health status

Abbreviations: wks: weeks; wk: week; min: minutes; LLMS: lower limbs muscle strength; ULMS: upper limbs muscle strength; IG: intervention group; CG: control group; QoL: quality of life; BDNF: Brain-derived neurotrophic factor; PT: Physical Therapy; ADL: activities of daily living; RM: repetition maximum; yr: year; LL: lower limbs.

DISCUSSION

Regarding quality of studies assessed through PEDro scale, most studies were scored as 7 or 8 (10 of 17 studies) and the other studies were scored between 5 and 6 (7 of 10 studies), which doesn't allow us to infer good methodological quality. However, 2 studies did not describe the method of randomization, 4 studies did not perform a blind distribution of participants between groups, 1 study did not have homogenous samples at the beginning of the study, 14 studies had problems concerning blinding in treatments, both to participants and therapists, 9 studies had more than 25% of drop out and 2 studies did not have measures of precision or variability of the results. These issues decrease the quality of the studies and can compromise the confidence in their results. Specifically about blindness of interventions, it is difficult that participants and therapists do not know what interventions they are participant but, it is possible and recommended the blindness of the assessor. Drop out higher than 25% can cause problems with statistical analysis and, at the same time, can indicate that the interventions of the studies had problems of adherence of participants.

Despite diversity among modalities of exercises observed in multimodal interventions, around 80% of studies included muscle strength training, balance training and functional activities in their protocols. Diversity was also observed regarding duration and frequency of exercises, but most protocols presented from 10 to 12 weeks of duration, 2 times per week and from 30 minutes to one hour. Apart the variation among exercise modalities, protocols varied regarding other interventions, like nutritional support^{11,22}, social activities and personal care^{10,13,21}. The high diversity among the variables of the studies makes impossible the comparison among them and we cannot affirm what is the better combination of exercises.

Incidence of falls was assessed only by one study¹⁴, which showed that multimodal interventions were more effective in reducing the incidence of falls when compared to unimodal intervention. Therefore, more studies should be done in order to elucidate what is the better combination of exercises to improve balance. About fear of falling, none of studies compared unimodal with

multimodal interventions but both modalities showed beneficial effects. Only two studies^{13,16} did not find these effects on fear of falling. Considering the multifactorial characteristics of falls, multimodal interventions that treat many risk factors as possible, would be more effective than unimodal interventions. However, it is necessary a study that aims to compare unimodal with multimodal interventions regarding fear for fall in order to confirm our speculation.

Regarding quality of life, protocols and comparison between groups were quite different among studies^{8,15,19,21}. Except for one study¹⁹, both unimodal and multimodal interventions showed positive effects on quality of life. We speculate that these positive effects are related to the fact that quality of life can be affected by many variables, such as mental and physical status, the main outcome of most studies. Based on the multifactorial characteristic of quality of life, probably, interventions that are more comprehensive can produce higher effects. However, this speculation needs to be evaluated with a study specifically designed for this aim.

When analyzing functional capacity results vary among studies^{10,13,17,19,22}, being difficult to establish the possible effects of interventions. We observed differences not only among interventions protocols, but also among assessments tools. Therefore, the effects of unimodal and multimodal exercises should be investigated.

Muscle strength seems to ameliorate through both unimodal and multimodal interventions^{7-14,17,18}. Only one study did not show positive effects in muscle strength¹². Improves in muscle strength are often obtained through exercise programs specifically aimed to that²³ and, in frailty, this physical component is related to gains in functional abilities².

Regarding balance, all studies^{7-15,17-22,24} except for one¹⁶, showed positive effects through both unimodal and multimodal interventions. Even considering the variety of interventions across studies, balance improvement was observed and may not only positively affect frail elderly people, but also prevent falls in this population. However, new longitudinal studies are necessary in order to assess the effects of balance exercises in the incidence of falls in frail elderly.

Mobility was improved through both unimodal and multimodal interventions^{7-12,15,16,24} and this finding are of most importance to clinical practice, since muscle strengthening, balance and mobility training are widely used in treatment of frailty and fall prevention.

According to the physical therapy interventions analyzed in this review, we conclude that both unimodal and multimodal interventions have potential to promote beneficial effects, but the analyzed studies have important methodological issues that negatively affect the quality of the studies. The results of the included studies suggest that unimodal interventions can promote changes in specific therapeutic goals, while multimodal interventions can produce most comprehensive effects, possibly optimizing rehabilitation period to more goals achievements in reduced time. However, due the methodological issues of the studies, the evidences of this affirmation should be better investigated. All clinical outcomes analyzed by studies showed improvements with unimodal and multimodal exercises. These results suggest that the best intervention program would be a combination of specific exercises according to the more pronounced deficiencies of frail elderly. Although we observed beneficial effects of both interventions, the quality of studies analyzed does

not allow us to generalize these effects. We suggest that new clinical trials should be conducted with a stronger methodology and according to current guidelines for randomized clinical trials.

Acknowledgments

No financial support.

Disclosure statement

No potential conflicts of interest were disclosed.

Authors' contributions

Simões, M.S.M.P.: contributed to conception and design, interpretation of data, writing and revising the text and final approval.

Moura, P.A., Varanda, R., Nascimento, M.M.: contributed to conception and design, acquisition, analysis and interpretation of data, revising the text and final approval.

Pompeu, J.E.: contributed to conception and design, interpretation of data, revising the text and final approval.

REFERENCES

1. Fried LP, Tangen CM, Walston J, Newman AB, Hirsch C, Gottdiener J, et al. Frailty in older adults: evidence for a phenotype. *J Gerontol A Biol Sci Med Sci*. 2001;56(3):M146-56.
2. Clegg A, Young J, Iliffe S, Rikkert MO, Rockwood K. Frailty in elderly people. *Lancet*. 2013;381(9868):752-62.
3. Giné-Garriga M, Roqué-Fíguls M, Coll-Planas L, Sitjà-Rabert M, Salvà A. Physical exercise interventions for improving performance-based measures of physical function in community-dwelling, frail older adults: a systematic review and meta-analysis. *Arch Phys Med Rehabil*. 2014;95(4):753-69.e3.
4. Macedo C, Gazzola JM, Najas M. Síndrome da fragilidade no idoso: importância da fisioterapia. *Arq Bras Ciê Saúde*. 2008;33(3):8.
5. Arantes P, Alencar M, Dias R, Dias J, Pereira L. Physical therapy treatment on frailty syndrome: systematic review. *Rev Bras Fisioter*. 2009;13(5):365-75.
6. Costa CML. Tradução e adaptação da PEDro Scale para a cultura portuguesa: um instrumento de avaliação de ensaios clínicos em Fisioterapia. Lisboa: Universidade Técnica de Lisboa; 2011.
7. Lustosa LP, Silva JP, Coelho FM, Pereira DS, Parentoni AN, Pereira LS. Impact of resistance exercise program on functional capacity and muscular strength of knee extensor in pre-frail community-dwelling older women: a randomized crossover trial. *Rev Bras Fisioter*. 2011;15(4):318-24.
8. Zhang L, Weng C, Liu M, Wang Q, Liu L, He Y. Effect of whole-body vibration exercise on mobility, balance ability and general health status in frail elderly patients: a pilot randomized controlled trial. *Clin Rehabil*. 2014;28(1):59-68.
9. Coelho FM, Pereira DS, Lustosa LP, Silva JP, Dias JM, Dias RC, et al. Physical therapy intervention (PTI) increases plasma brain-derived neurotrophic factor (BDNF) levels in non-frail and pre-frail elderly women. *Arch Gerontol Geriatr*. 2012;54(3):415-20.
10. Giné-Garriga M, Guerra M, Pagès E, Manini TM, Jiménez R, Unnithan VB. The effect of functional circuit training on physical frailty in frail older adults: a randomized controlled trial. *J Aging Phys Act*. 2010;18(4):401-24.
11. Zak M, Swine C, Grodzicki T. Combined effects of functionally-oriented exercise regimens and nutritional supplementation on both the institutionalised and free-living frail elderly (double-blind, randomised clinical trial). *BMC Public Health*. 2009;9:39.
12. Langlois F, Vu TT, Chassé K, Dupuis G, Kergoat MJ, Bherer L. Benefits of physical exercise training on cognition and quality of life in frail older adults. *J Gerontol B Psychol Sci Soc Sci*. 2013;68(3):400-4.

13. Grönstedt H, Frändin K, Bergland A, Helbostad JL, Granbo R, Puggaard L, et al. Effects of individually tailored physical and daily activities in nursing home residents on activities of daily living, physical performance and physical activity level: a randomized controlled trial. *Gerontology*. 2013;59(3):220-9.
14. Cadore EL, Casas-Herrero A, Zambom-Ferraresi F, Idoate F, Millor N, Gómez M, et al. Multicomponent exercises including muscle power training enhance muscle mass, power output, and functional outcomes in institutionalized frail nonagenarians. *Age (Dordr)*. 2014;36(2):773-85.
15. Pollock RD, Martin FC, Newham DJ. Whole-body vibration in addition to strength and balance exercise for falls-related functional mobility of frail older adults: a single-blind randomized controlled trial. *Clin Rehabil*. 2012;26(10):915-23.
16. Hagedorn DK, Holm E. Effects of traditional physical training and visual computer feedback training in frail elderly patients. A randomized intervention study. *Eur J Phys Rehabil Med*. 2010;46(2):159-68.
17. Sato D, Kaneda K, Wakabayashi H, Nomura T. Comparison of 2-year effects of once and twice weekly water exercise on activities of daily living ability of community dwelling frail elderly. *Arch Gerontol Geriatr*. 2009;49(1):123-8.
18. Zech A, Drey M, Freiburger E, Hentschke C, Bauer JM, Sieber CC, et al. Residual effects of muscle strength and muscle power training and detraining on physical function in community-dwelling prefrail older adults: a randomized controlled trial. *BMC Geriatr*. 2012;12:68.
19. Cameron ID, Fairhall N, Langron C, Lockwood K, Monaghan N, Aggar C, et al. A multifactorial interdisciplinary intervention reduces frailty in older people: randomized trial. *BMC Med*. 2013;11:65.
20. Molino-Lova R, Pasquini G, Vannetti F, Paperini A, Forconi T, Polcaro P, et al. Effects of a structured physical activity intervention on measures of physical performance in frail elderly patients after cardiac rehabilitation: a pilot study with 1-year follow-up. *Intern Emerg Med*. 2013;8(7):581-9.
21. Giné-Garriga M, Guerra M, Unnithan VB. The effect of functional circuit training on self-reported fear of falling and health status in a group of physically frail older individuals: a randomized controlled trial. *Aging Clin Exp Res*. 2013;25(3):329-36.
22. Rydwick E, Frändin K, Akner G. Effects of a physical training and nutritional intervention program in frail elderly people regarding habitual physical activity level and activities of daily living--a randomized controlled pilot study. *Arch Gerontol Geriatr*. 2010;51(3):283-9.
23. Ciolac EG, Garcez-Leme LE, Greve JM. Resistance exercise intensity progression in older men. *Int J Sports Med*. 2010;31(6):433-8.
24. Fairhall N, Sherrington C, Kurrle SE, Lord SR, Lockwood K, Cameron ID. Effect of a multifactorial interdisciplinary intervention on mobility-related disability in frail older people: randomised controlled trial. *BMC Med*. 2012;10:120.

**ENDEREÇO PARA
CORRESPONDÊNCIA**
JOSÉ EDUARDO POMPEU
51 Cipotanea street, Cidade
Universitária, Sao Paulo/SP, Brazil.
Zip code: 05.360-160.
Tel: (5511) 3091-8424.
E-mail: j.e.pompeu@usp.br

RECEBIDO 20/12/2014
REVISADO 15/10/2015
APROVADO 02/11/2015
