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The effects of resistance training types on clinical and functional indices in older individuals with Osteosarcopenia: A Systematic Review

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Abstract

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Purpose: In this study, we investigated the effects of resistance training types on clinical and functional indices in older individuals with Osteosarcopenia. **Method:** In this Systematic Review study, a systematic searching strategy was used in information databases such as Pub Med, Web of Science, Scopus, Google Scholar, Cochrane, and Ambace, all of the studies were extracted by using specific keywords such as Strength exercise, Exercise training, Resistance exercise, Resistance training, Strength training, Physical activity, Osteosarcopenia, Aging, Older adult, Elderly which were published on 7th August 2023. After all preliminary screening, surveying of complete text, and assessment of critical studies, scrutinized articles were related to inclusion criteria. Finally, 17 papers were selected for this study. **Results:** According to the present study, Resistance training for Osteosarcopenia older individuals has an effective result to improve Osteosarcopenia risk factors, and older patients' performance and clinical status. However, it has to be mentioned that it needs further study in the contexts of Resistance training and Osteosarcopenia syndrome in elderly adults. **Conclusion:** Resistance exercise training has markedly beneficial effects on elderly patients with Osteosarcopenia which improves Sarcopenia risk factors, and older patients' performance, clinical status and function of elderly patients.

Keywords: Aging, Exercise Training, Osteosarcopenia, Resistance training.

Introduction

Osteosarcopenia is a combination of Osteoporosis and Sarcopenia which causes a gradual reduction of muscle function and bone strength As the result of fractures risk factors and function reduction in elderly individuals (Hirschfeld, 2017, a; Sepúlveda-Loyola, 2020). The word Osteosarcopenia indicates to increment perception of bone-muscle interaction and also challenges risk factors that are related to fractures in Osteoporosis (Hirschfeld et al., 2017, b). Individuals with Osteosarcopenia characteristics are at hazard of function reduction, powerlessness, and life quality decrement in comparison with normal body composition (Curtis et al., 2015). So, results showed that females with Osteosarcopenia symptoms are at hazard of fractures and bone laxity (Lee et al., 2012). Sarcopenia or Osteosarcopenia contains equality risk factors like life quality decrement, disease prevalence, mortality spread, and bone mineral density reduction (Kemmler et al., 2013, a). Dynamic resistance training with diet supplement effectively may be a promising strategy for the improvement of Osteosarcopenia's important aspects which includes metabolism, the central nervous system, and cardiovascular endpoints in older individuals (Marcus et al., 2010). Resistance training is an efficient treatment to increase muscle power and reduction of bone fracture types in elderly individuals (Bauer et al., 2019). Many primary studies reported the useful effects of resistance training on muscle lipids (Fatima et al., 2019). Several studies concentrated on resistance training with high intensity to improve muscle balance and power, also muscle mass enhancement which was accomplished in females after menopause periods with fractures enhancement risk due to Osteosarcopenia (Shojaa et al., 2020,

a). Resistance training with the elastic bands on Osteosarcopenia patients causes improved body composition (body mass density), muscle quality, and physical function (Liao et al., 2018). Resistance training with the elastic band has positive effects on muscle strength and physical function in elderly individuals with a mobility disability (Hofmann et al., 2016). The exuberance of studies demonstrated the

effect of resistance training with a diet of opulent protein on Sarcopenia (Beckwée et al., 2019). Resistance training with a protein supplement may be the most engaged candidate to neutralize muscle mass reduction and Sarcopenia in older individuals (Hurley et al., 2011). Recently in a 16-week randomized controlled trial on sedentary older healthy males had been observed the same effects on muscle mass and time strength parameters were compared with a high volume of a resistance training program (Wittke, 2017; Hirschfeld, 2017, c). Exercise training is surveyed as a therapeutic safe strategy to support muscular skeletal health and keep from bone fractures. Also participating in exercise training with numerous impacts especially before puberty periods results to increase bone mineral density in all types of sexes (Fasihi et al., 2021). Powerful scientific documents exist to protect exercise training in childishness periods which induce bone mass superior function in older ages furthermore, regular exercise causes diminished bone fracture and laxity (Fasihi et al., 2020). Whereas accomplished studies in the context of the effects of resistance training on Sarcopenia are sporadic, so present study determines the effects of resistance training types on clinical and functional indices in older individuals with Osteosarcopenia components.

Methods

This Systematic Review was registered on the Prospero site on ID: CRD42023450433, so in this Systematic Review study, a systematic searching strategy was used in information databases such as Pub Med, Web of Science, Scopus, Google Scholar, Cochrane, and Ambace, all of the studies were extracted by using specific keywords such as Strength exercise, Exercise training, Resistance exercise, Resistance training, Strength training, Physical activity, Osteosarcopenia, Aging, Older adult, Elderly which were published on 7th August 2023. After All preliminary screening, surveying of complete text, and assessment of critical studies, scrutinized articles were related to inclusion criteria. Finally, 17 papers were selected for this study.

According to exclusion criteria, all of the review studies, case studies, conferences and lectures papers, unsportsmanlike articles or papers that have unrelated titles, non-English or Persian papers, papers that have no randomized control trials, the period time of strength training intervention were under two weeks, pharmacology or medical intervention, males and female's participants under 60 years were deleted. Other studies had met inclusion criteria such as, English or Persian original papers, papers with relative titles that have control group, or their Pedro site scales were above 5marks.

After surveying papers with perfect information which had met inclusion criteria such as study type, sample volume, and subject's characteristics (age, sex, health status), factors were extracted that were related to male and female human participants as, equal or over 60 years with various body mass indexes, different races, only strength training sports intervention with low, medium, and high intensity or the period of strength training more than 2 weeks, without any pharmacology or medicine interventions, and exercise program characteristics (type, intensity, time). Then this information based on study type, exercise training type, and subjects' characteristics were classified and all of them were reported in table or paper text format. Furthermore, the article's quality was evaluated by inquiry of the Pedro site. This site had assigned marks from 0 to 10 to all of the screened papers in terms of scientific quality proportional to the present study so, the used papers in this study had equal or above 5 marks. Therefore 17 papers met the inclusion criteria in this study and so the average of imported papers' Pedro site marks was 6.1±1.5. In addition to papers screening and data extraction were accomplished by two authors. In case of no agreement, the subject was discussed between two authors and then the ultimate opinion was expressed. All of the paper selection and data extraction steps were depicted in figure 1.

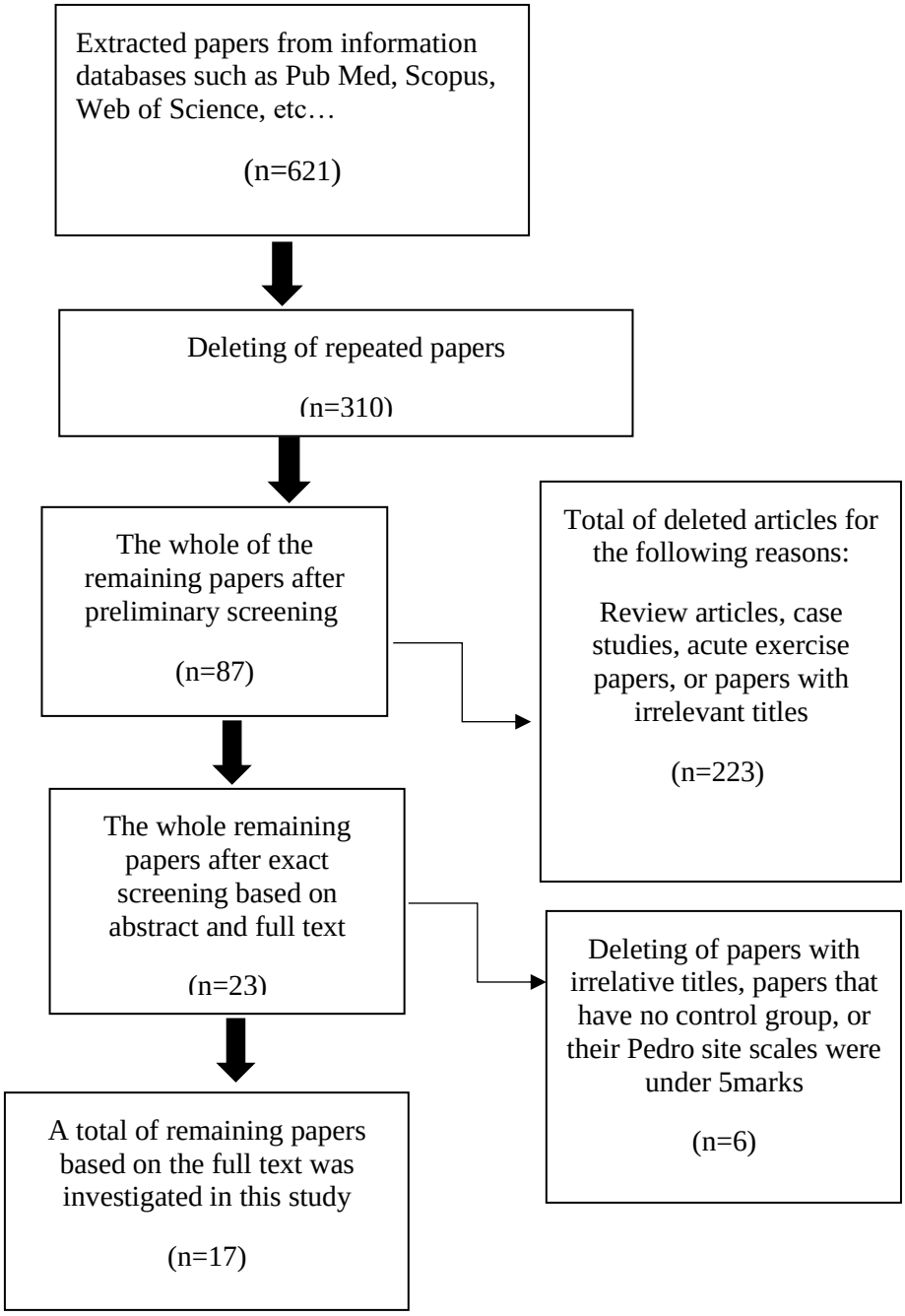

Figure1. Papers extraction steps to study inclusion criteria

Results

According to accomplished research in various information databases, 621 papers were detected. Early 310 repeated papers were eliminated and in numbers of 311 papers remained. Initial screening of papers was done and in numbers of 223 out of 311 papers because of not having inclusion criteria such as, review articles, case studies, acute exercise papers, or papers with irrelevant titles were pretermitted. After primary studying of papers' titles and abstracts and deleting of irrelevant papers, the number of 87 papers was evaluated. After the ultimate surveying of 23 full texts papers and deleting of 6 unrelated papers that have no control group, or their Pedro site scales were under 5marks finally, 17 papers had been met to study (Figure 1). After papers screening, the data from 17 selected papers were collected and extracted. This data includes the information of first author paper, provider country, publishing year, sample volume, participants' sex, exercise training type with intensity, time, frequency of that in week, and summary of data which were reported in Table1. So the results of 17 selected papers determines that resistance training makes to decrease fat mass and improves parameters of Sarcopenia risk factors in older adults.

Table 1. Table1.The characteristics of analyzed randomized controlled trials

Study	Country	Subject group +control group= sample size(base)	Sex	Participants' characteristics	Body mass index (kg/m^2)	Frequency (day/week)	Intervention time (weeks)	Exercise training intervention	Results
Banitalebi et al.,2020, b.	Iran	31+32= 63	Female	Elderly women with Osteosarcopenia	>30	3	12	Using EBRT protocol (using Theraband which was designated to exercise all of the big muscular group) and OMNI-RES (resistance training scale OMNI for controlling training intensity) with different training intensities.	Application of EBRT protocol for elderly women with Osteosarcopenia syndrome is useful.
Banitalebi et al.,2021.	Iran	31+32=63	Female	Elderly women with Osteosarcopenia	>30	3	12	The effect size of (resistance training with an elastic band) EBRT By using X-ray absorbing radiation with double energy rays was used to evaluatebone density	Osteoporosis biomarkers improved in older women with Osteosarcopenia.

Cunha et al.,2018, b.	Brazil	21+20+21 =62	Female	Elderly women with Osteosarcopenia	26.8±4.4	3	12 weeks of resistance training+4 weeks of measurement =16 weeks	Usage of resistance training with 1 set in 1 number subject group along with 10-15 1RM for each exercise and 3 sets of 10-15 1RM for 3 number subject group in each exercise, 1-2 minutes break time between sets, test's process had been begun after of cool down in elderly women with Osteosarcopenia component.	The application of 3 sets of resistance training is more efficient than 1 set of resistance training in elderly women with Osteosarcopenia, also makes to improve Osteosarcopenia risk factors.

Dos Santos et al,.2019.	Brazil	152	Female	Older women with Osteosarcopenia			96	The relationship between physical activity and physical abilities (physical capacities) in elderly women was surveyed, a set of tests includes static balance, speed up, standing next to a chair (It's proper for elderly individuals in the clinical context and a 4-minutewalking test.	Physical activity inversely is related to physical capacity and physical function in elderly women with or without the Osteosarcopenia index. Older women with Osteosarcopenia are active insufficiently in the context of energetic mobility and training in leisure time so it is known as one risk factor in functional inability.

Ghasemikaram et al., 2021.	Germany	21+22=43	Male	Elderly men with Osteosarcopenia	Exercise group: 24.8±3.0 Control group: 24.6±2.1	2-3	8-12	High intensity interval training was designed on muscle quality with 1 set and advanced intensity twice a week also participant's diet protein consumption in overall 4 days of diet protocol was evaluated so, Whey protein supplements, Calcium, and Cholecalciferol were provided for all of them within 18 months of training bout.	Lack of exercise training in 6 months has destructive effects on muscle quality in elderly individuals with Osteosarcopenia. Even the intervention of high intensity interval training was in a long time and physical activities weren't confined so, interval exercise training of healthcare providers with interval training for 6 months should be replaced by continuous training in minimum time which was marked in

									muscle quality parameters.
Ghasemikaram et al., 2021.	Germany	21+22= 43	Male	Elderly men with Osteosarcopenia component	Exercise group: 25.0±3.0 Control group: 24.5±1.9		64	High intensity resistance training with one set of exercise training, acute bouts of resistance training on a machine without any other training or in a parallel situation or form of cooldown was done. All of the big and small muscular groups were marked by periods of various exercises.	A high intensity resistance training abstains from greater penetration of thigh muscle fat which is specified free fat and intramuscular adipose tissue in elderly men with Osteosarcopenia.

Hashemi et al., 2020.	Iran	26+22=48	Female	Elderly women with Osteosarcopenia	Exercise group: 33.72±3.15 Control group: 32.53±2.01	3	12	Resistance training with an elastic band that was designed for all of the big muscle groups and continuous exercise intensity and volume increased.	Resistance training decreased the levels amount of low density lipoprotein and gen expressions which were involved in intra- pass ways of (miR-cellular 146) and also increased the levels of high density lipoprotein.

Lee et al., 2021.	Taiwan	15+12= 27	Female	Exercise group: 26.95±3.31 Control group: 28.93±3.55	Older women with Osteosarco penia	3	12	Resistance training was accomplished with an elastic band and different intensities, a measurement test of public transportation ability and safety with mobility (Timed up and go test), and the evaluative test of balance control and controlling of stature situation in static status (Single leg stance test).	12-week of resistance training with an elastic band increased efficiently physical capacities and bone density.
Lichtenber g et al., 2019.	Germany	21+22=43	Male	Elderly men with Osteosarcopenia and Osteoporosis		2	28	High intensity interval training was done with receiving diet protein supplements and vitamin D, also the rest between sets of training was from90 sec to 120 sec.	High intensity interval training is an effective training in elderly men with Osteosarcopen ia syndrome.

Nabuco et al., 2019.	Brazil	13+13=26	Female	Elderly women with Osteosarcopenia	Protein supplement reception group: 26.4±3.0 Placebo group (control group): 27.4±3.0	2	3	12	Consumption of protein supplements with exercise training makes to increase excrescence of muscle soft tissue (muscle soft tissue mass of upper and under trunk) and also decreases trunk fat mass and total fat mass, so improves Sarcopenia in elderly women.
Kemmler et al., 2021.	Germany	21+22=43	Male	Elderly men with Osteosarcopenia	Exercise group: 25.0±3.0 Control group: 24.5±1.9	2	72	HIT-RT was used. Application of high intensity continuous steps (beyond 85% 1-RM) with numerous motive forces or high mobility speed without any exercise interval within 18 months.	HIT-RT has a positive effect on body muscle mass and the amount of body abdominal fat.

Kemmler et al., 2020.	Germany	21+22=43	Male	Elderly men with Osteosarcopenia	Exercise group: 25.0±3.0 Control group: 24.5±1.9	2	36	HIT-RT from low to high intensity and low volume by using protein supplementation was accomplished.	Muscle mass in the HIT-RT group increased.
Kemmler et al., 2020.	Germany	21+22= 43	Male	Elderly men with Osteosarcopenia	Exercise group: 25.0±3.0 Control group: 24.5±1.9	3	72	HIT-RT training includes Bench press, Leg press, Crunch, and Lateral Crunch with protein supplement consumption.	Using HIT-RT is efficient in elderly men with Osteosarcopenia.
Kemmler et al., 2020.	Germany	21+22=43	Male	Elderly men with Osteosarcopenia	Exercise group: 25.0±3.0 Control group: 24.5±1.9	2	72	HIT-RT with Reverse Flyes, and training to reinforce the muscle behind the shoulder were used with the dumbbell.	HIT-RT is an attractive and effective training method to combat metabolic cardiac risk exclusively in elderly individuals.

Kemmler et al., 2020.	Germany	21+22=43	Male	Elderly men with Osteosarcopenia	Exercise group: 25.0±3.0 Control group: 24.5±1.9	3	72	HIT-RT (8-12 weeks of exercise training) with one set in 8 periods and high intensity and effort was done by using Calcium, Whey protein, and Cholecalciferol.	Muscle strength and body composition improved in elderly men with Osteosarcopenia.
Kemmler et al., 2020.	Germany	21+22= 43	Male	Elderly men with Osteosrcopenia	Exercise group: 25.0±3.0 Control group: 24.5±1.9	2	72	HIT-RT was accomplished on a machine with the consumption of vitamin D, Calcium, and protein.	Resistance training should be more concentrated than interval training programs with short training rest .
Kemmler et al., 2020.	Germany	21+22= 43	Male	Elderly men with Osteosarcopenia	Exercise group: 25.0±3.0 Control group: 24.5±1.9	2	48	A low threshold of resistance training was done on big and small muscle groups with the consumption of protein supplements, vitamin D, and Calcium.	Using this protocol is an effective way in elderly men with Osteosarcopenia.

Discussion

In this Systematic review, we investigated the effects of resistance training types on clinical and functional indices in older individuals with Osteosarcopenia. As for the present study results, resistance training as high intensity interval training, high intensity resistance training results in major and markedly changes in upper and under trunk muscle soft tissue, decrement of trunk fat mass and total body fat mass, refrain from risk factors of metabolic and cardiac disease in older individuals with Osteosarcopenia. In other words, resistance training likely causes changes in body fat mass, muscle mass, and body mass density in older individuals (JafariNasabian, 2018). It seems that resistance training improves parameters of Osteosarcopenia syndrome risk factors among a variety of different mechanisms (Ormsbee et al., 2014). A previous study reported that resistance training can change Estradiol metabolism in women before the menopause phase. In this regard 12 weeks of resistance training with an elastic band causes to increase substantially in the proportion of metabolic antagonism Estrogen Estradiol 1-2 Hydroxy/antagonism Estrogen 16- Hydroxy α in women before menopause period, and also 3 sessions of resistance training with an elastic band makes to decrease serum concentrations of sex hormones such as Estradiol in women with Osteosarcopenia (Smith et al., 2013). A considerable document exists that resistance training only causes energy balance adjustment, anabolic process stimulation, hypertrophy gradation, fat mass decrement, and improvement of bone density (Cunha et al., 2018, a). One of the previous studies insinuated the effect of 8 weeks of augmentative resistance training twice a week in under trunk on foot strength improvement, gait ability, and also affects the increment of neural conduction speed. Also, strength and power athletes have more neural conduction speed than endurance athletes, so resistance training makes to improve force production and walking speed (Shen et al., 2016). Also, resistance training improves Sarcopenia phenotypes in elderly women (Banitalebi et al., 2020, a). Resistance training substantially affects to improve body composition, physical activities, physiological adaptations, and balance (Mazzeo et

al., 1998). Resistance training of body mass density has a positive effect on bone health and causes to increase physical capacities of elderly individuals (Liu, 2017; Kemmler, 2013, b). Resistance training is an effective treatment to increase muscle strength and decrease bone fractures in elderly adults (Shojaa et al., 2020, b). Several studies have been conducted on women after menopause period with an increased risk of Osteoporotic fractures which concentrated on high intensity resistance training on improvement of muscle strength, balance, and enhancement of muscle mass (Ho et al., 2012). Resistance training is accompanied by a low level of arterial adaptation. However chronic resistance training was caused to improve cardiovascular function and decrement of hypertension risk (Fahs, 2010; Ultimo, 2018). 12 weeks of resistance training with 60%-80% 1-RM and 8-10 sets in 10 stations controlled decreased HS- CRP levels in the intervention group toward the control group (Kohut, 2006; Kouhi, 2014). Possible mechanisms for the modification of hs-CRP levels may be caused to decrease body fat mass and increase anti-inflammatory cytokines (Taghian, 2018; Ghafari, 2016). In this regard, 5 weeks of high intensity interval training causes to decrease in plasma insulin levels, insulin resistance, and TNF-α in subcutaneous and visceral fat mass in the exercise group toward the control group (Soori et al., 2011). Most studies reported that resistance training affected fat decrement, HDL-C, and LDL-C levels in fat elderly individuals (Watson, 2018; Pagnotti, 2019). Also, the effect of high intensity resistance training in 8 months significantly is reported in women after the menopause period with Osteosarcopenia and Osteoporosis on body mass density and muscle strength (Dent, 2018; Wittke, 2017). Nevertheless, dynamic resistance training is supported by a sufficient diet which may be the most promising strategy for the perfect improvement of important, and basic aspects such as metabolism, central nervous system, and lateral factors such as cardiovascular endpoints in elderly individuals with Osteosarcopenia (Kalinkovich, 2017; Calvani, 2013). Also, dynamic resistance training may be the most effective treatment method for Osteosarcopenia (Sullivan-Gunn & Lewandowski, 2013). High intensity resistance

training has a markedly effect on muscle mass increment and decrement of cardiac metabolic risk factors (Bowen et al., 2015). Therefore, high intensity resistance training leads to decrease inflammation, oxidative stress, and metabolic abnormalities (Eslami, 2019; Kazemi, 2016; Mohammadkhani, 2013).

Conclusion

Resistance exercise training has markedly beneficial effects on elderly patients with Osteosarcopenia which improves Sarcopenia risk factors, and older patients' performance, clinical status and function of elderly patients. Therefore, the present study results can help older individuals and researchers in this field, so it needs more studies in the context of Osteosarcopenia disease in elderly individuals.

Decleration of Interest

None of the authors have a conflict of interest in publishing this article.

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Authors' contribution

Conception and study of design: Diako Heidary and Rasoul Eslami. Acquisition of data: Diako Heidary and Arezoo Soleymani fard. Data analysis and interpretation: Diako Heidary and Arezoo Soleymani fard. Drafting of the manuscript: Diako Heidary and Arezoo Soleymani fard. Approval of final version of manuscript: Rasoul Eslami. Study supervision: Rasoul Eslami

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