Osteoarthritis in The Elderly

Subjects: Nutrition & Dietetics

Contributor: Liao Chun-De

Lower-extremity osteoarthritis (OA) is a prevalent musculoskeletal disease in elder population. The main symptom of OA is pain which leads to muscle weakness and physical disability. Recently, most studies indicated that muscle weakness, function limitation, and severity of disease are closely associated with ageing-related muscle attenuations. Therefore, elder individuals with OA have potential sarcopenia risks. Under multifactor risks of OA, it is important to identify effectiveness and efficiency of multidisciplinary management for such elder population to achieve healthy status. Previous studies have indicated that protein supplementation (PS) enhances exercise efficacy by additionally increasing muscle mass and strength for elder individuals with high sarcopenia and frailty risks who were undergoing exercise training (ET). However, it remains unclear whether PS in combination with ET augments benefits in lean mass, strength, and physical function of older adults with lower-extremity OA. In addition, few systematic reviews and meta-analysis studies regarding the effects of PS plus ET have emphasized on elder people with OA. Therefore, this study aimed to investigate whether PS plus ET exert beneficial effects on functional outcomes in older individuals with lower-extremity OA by using the methods of systematic reviews and meta-analysis.

Keywords: sarcopenia ; osteoarthritis ; protein supplementation ; exercise training ; lean mass ; physical function

1. Introduction

Osteoarthritis (OA), especially in joints in the lower extremity, is one of the most prevalent musculoskeletal diseases in older adults [1]. Its prevalence increases rapidly from the sixth to ninth decades of life, and it is a major health issue at individuals and population levels [2]. In particular, hip or knee OA is associated with impaired functional activity, potentially leading to disability [3].

Deficits in muscle volume and function have been observed in older adults with mild to moderate hip OA [4] as well as in people with mild to severe knee OA [5]. Such deterioration of muscle mass occurring with disease progression has been attributed to sarcopenia, a condition associated with muscle attenuation in older adults [6]. Recently, it has been reported that older adults with knee OA are at a high risk of sarcopenia [7]. This finding of high risk is based on previous observations that older adults with OA have lower appendicular lean mass in the lower limbs relative to healthy controls [8], and that low skeletal muscle mass is independently associated with radiographic knee OA [9]. Because lower-limb lean mass is closely associated with muscle power in OA [10] and because low skeletal muscle mass is closely associated with physical difficulty and poor health status among older adults [11][12], sarcopenia may lead to physical decline through muscle weakness during OA progression. Therefore, the maintenance of muscle strength and the prevention of sarcopenia are crucial for enabling older adults with hip or knee OA to successfully perform physical tasks.

2. Development

OA has been recognized as a major musculoskeletal disease [13]. The management of mild to moderate OA comprises multidisciplinary interventions, including pain medications and nonpharmacological treatments; however, for end-stage OA, total joint replacement is recommended [14]. Several recent studies have indicated physical activity and nutrition as nonpharmacological and preventive treatments for OA and sarcopenia [15][16][17][18][19]. Among treatment interventions for OA, exercise training (ET) has been recommended as the first-line treatment [20]. In addition, conservative ET—administered in combination with a variety of training tools, such as kinesio tape [21] and whole-body vibration (or electromyostimulation) [19]—has been effectively employed to improve muscle mass, muscle strength, and physical function [19][22]. Additionally, dietary interventions, such as dietary protein or protein supplementation (PS), have been incorporated into the multidisciplinary management of OA [23][24][25]. Studies have noted that 30.3%–65.1% of older adults with knee or hip OA had a daily protein intake lower than the recommended daily allowance of 0.8 g/kg/day [26][27]. PS and protein-based diet interventions are believed to additionally increase the efficacy of ET in older adults [28][29]. However, inconsistent results have been obtained regarding the effectiveness of PS combined with ET (PS + ET), specifically in

older adults with OA or in individuals who recently underwent total joint replacement. Previous studies have shown that PS + ET significantly improved muscle mass [30] and strength [31][32] in older adults with OA, but other studies have not [33] [34]. Because older adults with OA have a high risk of sarcopenia [7], which may further affect postoperative outcomes in those who have recently undergone total joint replacement [33][34][35], the skeletal muscle plays an important role in functional recovery after total joint replacement and has thus been targeted in the management of OA [7][36][37]. Therefore, determining the effectiveness of PS + ET in preserving muscle mass in older adults with OA is crucial, especially in those who have recently undergone total joint replacement.

Evidence regarding the effects of PS + ET on healthy, sarcopenic, and frail older adults has been well established by previous systematic reviews and meta-analyses [38][39][40]; however, few studies have focused on older adults with OA or those who underwent total joint replacement. Thus, this study examined the effects of PS + ET on muscle mass and functional outcomes in older adults with OA in the lower extremity.

3. Conclusions

This meta-analysis demonstrated that PS is effective as a nutritional intervention; it yields improvements in muscle mass and strength during postoperative rehabilitation (mostly in multicomponent ET regimes) for older adults with lower-extremity OA who have undergone total joint replacement. Postoperative PS further reduces pain, increases physical mobility, and improves global functioning after 2−7 weeks of rehabilitative ET. Considering the small number of RCTs included in this meta-analysis, more future studies are required to more robustly determine the efficacy of PS + ET in this specific population. In addition, only one RCT enrolled patients without prosthesis in our meta-analysis; therefore, we could not definitively conclude that PS + ET is effective in older adults with OA who did not undergo total joint replacement. Thus, future studies on the effectiveness of PS + ET should focus on people with OA who have not undergone total joint replacement. The results elucidate nutritional and exercise interventions that benefit older adults with OA, particularly those who have undergone total joint replacement. The results also facilitate the formulation of practical and interdisciplinary approaches to counteracting muscle loss and functional decline. Practitioners in geriatric care and in rehabilitation settings, such as clinics, hospitals, institutions, and communities, can use our findings as a reference. Nevertheless, to better identify more optimal supplementation protocols, our results must be further validated by additional studies with relatively large samples.

References

1. Lewis, R.; Gómez Álvarez, C.B.; Rayman, M.; Lanham-New, S.; Woolf, A.; Mobasheri, A. Strategies for optimising mus culoskeletal health in the 21st century. BMC Musculoskelet. Disord. 2019, 20, 164.
2. Hunter, D.J.; Bierma-Zeinstra, S. Osteoarthritis. Lancet 2019, 393, 1745–1759.
3. Palazzo, C.; Ravaud, J.F.; Papelard, A.; Ravaud, P.; Poiraudeau, S. The burden of musculoskeletal conditions. PLoS O NE 2014, 9, e90633.
4. Loureiro, A.; Constantinou, M.; Diamond, L.E.; Beck, B.; Barrett, R. Individuals with mild-to-moderate hip osteoarthritis have lower limb muscle strength and volume deficits. BMC Musculoskel. Disord. 2018, 19, 303.
5. Taniguchi, M.; Fukumoto, Y.; Kobayashi, M.; Kawasaki, T.; Maegawa, S.; Ibuki, S.; Ichihashi, N. Quantity and Quality of the Lower Extremity Muscles in Women with Knee Osteoarthritis. Ultrasound Med. Biol. 2015, 41, 2567–2574.
6. Cruz-Jentoft, A.J.; Bahat, G.; Bauer, J.; Boirie, Y.; Bruyere, O.; Cederholm, T.; Cooper, C.; Landi, F.; Rolland, Y.; Sayer, A.A.; et al. Sarcopenia: Revised European consensus on definition and diagnosis. Age Ageing 2019, 48, 16–31.
7. Shorter, E.; Sannicandro, A.J.; Poulet, B.; Goljanek-Whysall, K. Skeletal Muscle Wasting and Its Relationship with Oste oarthritis: A Mini-Review of Mechanisms and Current Interventions. Curr. Rheumatol. Rep. 2019, 21, 40.
8. Lee, S.Y.; Ro, H.J.; Chung, S.G.; Kang, S.H.; Seo, K.M.; Kim, D.K. Low Skeletal Muscle Mass in the Lower Limbs Is In dependently Associated to Knee Osteoarthritis. PLoS ONE 2016, 11, e0166385.
9. Jeon, H.; Lee, S.U.; Lim, J.Y.; Chung, S.G.; Lee, S.J.; Lee, S.Y. Low skeletal muscle mass and radiographic osteoarthri tis in knee, hip, and lumbar spine: A cross-sectional study. Aging Clin. Exp. Res. 2019, 31, 1557–1562.
10. Davison, M.J.; Maly, M.R.; Keir, P.J.; Hapuhennedige, S.M.; Kron, A.T.; Adachi, J.D.; Beattie, K.A. Lean muscle volume of the thigh has a stronger relationship with muscle power than muscle strength in women with knee osteoarthritis. Clin. Biomech. 2017, 41, 92–97.
11. Lee, J.S.; Auyeung, T.W.; Kwok, T.; Lau, E.M.; Leung, P.C.; Woo, J. Associated factors and health impact of sarcopenia in older chinese men and women: A cross-sectional study. Gerontology 2007, 53, 404–410.

12. Janssen, I.; Heymsfield, S.B.; Ross, R. Low relative skeletal muscle mass (sarcopenia) in older persons is associated with functional impairment and physical disability. J. Am. Geriatr. Soc. 2002, 50, 889–896.

13. Hawker, G.A. Osteoarthritis is a serious disease. Clin. Exp. Rheumatol. 2019, 37, 3–6.

14. Ariani, A.; Manara, M.; Fioravanti, A.; Iannone, F.; Salaffi, F.; Ughi, N.; Prevete, I.; Bortoluzzi, A.; Parisi, S.; Scire, C.A. The Italian Society for Rheumatology clinical practice guidelines for the diagnosis and management of knee, hip and hand osteoarthritis. Reumatismo 2019, 71, 5–21.

15. Szychlinska, M.A.; Castrogiovanni, P.; Trovato, F.M.; Nsir, H.; Zarrouk, M.; Lo Furno, D.; Di Rosa, M.; Imbesi, R.; Musumeci, G. Physical activity and Mediterranean diet based on olive tree phenolic compounds from two different geographical areas have protective effects on early osteoarthritis, muscle atrophy and hepatic steatosis. Eur. J. Nutr. 2019, 58, 565–581.

16. Castrogiovanni, P.; Di Rosa, M.; Ravalli, S.; Castorina, A.; Guglielmino, C.; Imbesi, R.; Vecchio, M.; Drago, F.; Szychlinska, M.A.; Musumeci, G. Moderate Physical Activity as a Prevention Method for Knee Osteoarthritis and the Role of Synoviocytes as Biological Key. Int. J. Mol. Sci. 2019, 20, 511.

17. Szychlinska, M.A.; Imbesi, R.; Castrogiovanni, P.; Guglielmino, C.; Ravalli, S.; Di Rosa, M.; Musumeci, G. Assessment of Vitamin D Supplementation on Articular Cartilage Morphology in a Young Healthy Sedentary Rat Model. Nutrients 2019, 11, 1260.

18. Trovato, F.M.; Castrogiovanni, P.; Szychlinska, M.A.; Purrello, F.; Musumeci, G. Impact of Western and Mediterranean Diets and Vitamin D on Muscle Fibers of Sedentary Rats. Nutrients 2018, 10, 231.

19. Musumeci, G. Sarcopenia and exercise “The State of the Art”. J. Funct. Morphol. Kinesiol. 2017, 2, 40.

20. Skou, S.T.; Roos, E.M. Physical therapy for patients with knee and hip osteoarthritis: Supervised, active treatment is current best practice. Clin. Exp. Rheumatol. 2019, 37, 112–117. [Google Scholar]

21. Castrogiovanni, P.; Di Giunta, A.; Guglielmino, C.; Roggio, F.; Romeo, D.; Fidone, F.; Imbesi, R.; Loreto, C.; Castorina, S.; Musumeci, G. The effects of exercise and kinesio tape on physical limitations in patients with knee osteoarthritis. J. Funct. Morphol. Kinesiol. 2016, 1, 355–368.

22. Lo, J.H.; Uk, P.; Yiu, T.; Ong, M.T.; Lee, W.Y. Sarcopenia: Current treatments and new regenerative therapeutic approaches. J. Orthop. Translat. 2020, 23, 38–52.

23. Miller, M.J.S.; Butler, R. Relief of osteoarthritis with an herbal-amino acid supplement: A randomized double-blind placebo controlled trial. Adv. Biosci. Biotechnol. 2012, 3, 504.

24. Zenk, J.L.; Helmer, T.R.; Kuskowski, M.A. The effects of milk protein concentrate on the symptoms of osteoarthritis in adults: An exploratory, randomized, double-blind, placebo-controlled trial. Curr. Ther. Res. 2002, 63, 430–442.

25. Colker, C.M.; Swain, M.; Lynch, L.; Gingerich, D.A. Effects of a milk-based bioactive micronutrient beverage on pain symptoms and activity of adults with osteoarthritis: A double-blind, placebo-controlled clinical evaluation. Nutrition 2002, 18, 388–392.

26. De Zwart, A.H.; van der Leeden, M.; Roorda, L.D.; Visser, M.; van der Esch, M.; Lems, W.F.; Dekker, J. Dietary protein intake and upper leg muscle strength in subjects with knee osteoarthritis: Data from the osteoarthritis initiative. Rheumatol. Int. 2019, 39, 277–284.

27. Purcell, S.; Thornberry, R.; Elliott, S.A.; Panton, L.; Ormsbee, M.J.; Vieira, E.R.; Kim, J.S.; Prado, C.M. Body Composition, Strength, and Dietary Intake of Patients with Hip or Knee Osteoarthritis. Can. J. Diet Pract. Res. 2016, 77, 98–102.

28. Woo, J. Nutritional interventions in sarcopenia: Where do we stand? Curr. Opin. Clin. Nutr. Metab. Care 2018, 21, 19–23.

29. Hidayat, K.; Chen, G.-C.; Wang, Y.; Zhang, Z.; Dai, X.; Szeto, I.M.Y.; Qin, L.-Q. Effects of milk proteins supplementation in older adults undergoing resistance training: A meta-analysis of randomized control trials. J. Nutr. Health Aging 2018, 22, 237–245.

30. Nishizaki, K.; Ikegami, H.; Tanaka, Y.; Imai, R.; Matsumura, H. Effects of supplementation with a combination of beta-hydroxy-beta-methyl butyrate, L-arginine, and L-glutamine on postoperative recovery of quadriceps muscle strength after total knee arthroplasty. Asia Pac. J. Clin. Nutr. 2015, 24, 412–420. [Google Scholar]

31. Dreyer, H.C.; Strycker, L.A.; Senesac, H.A.; Hocker, A.D.; Smolkowski, K.; Shah, S.N.; Jewett, B.A. Essential amino acid supplementation in patients following total knee arthroplasty. J. Clin. Investig. 2013, 123, 4654–4666.

32. Ikeda, T.; Matsunaga, Y.; Kanbara, M.; Kamono, A.; Masuda, T.; Watanabe, M.; Nakanishi, R.; Jinno, T. Effect of exercise therapy combined with branched-chain amino acid supplementation on muscle strength in elderly women after total hip arthroplasty: A randomized controlled trial. Asia Pac. J. Clin. Nutr. 2019, 28, 720–726.

33. Dreyer, H.C. Tourniquet Use During Knee Replacement Surgery May Contribute to Muscle Atrophy in Older Adults. Exe rc. Sport Sci. Rev. 2016, 44, 61–70.
34. Kouw, I.W.K.; Groen, B.B.L.; Smeets, J.S.J.; Kramer, I.F.; van Kranenburg, J.M.X.; Nilwik, R.; Geurts, J.A.P.; ten Broek e, R.H.M.; Poeze, M.; van Loon, L.J.C.; et al. One Week of Hospitalization Following Elective Hip Surgery Induces Sub stantial Muscle Atrophy in Older Patients. J. Am. Med. Dir. Assoc. 2019, 20, 35–42.
35. Petterson, S.C.; Barrance, P.; Marmon, A.R.; Handling, T.; Buchanan, T.S.; Snyder-Mackler, L. Time course of quad stre ngth, area, and activation after knee arthroplasty and strength training. Med. Sci. Sports Exerc. 2011, 43, 225–231.
36. Bennell, K.L.; Wrigley, T.V.; Hunt, M.A.; Lim, B.W.; Hinman, R.S. Update on the role of muscle in the genesis and mana gement of knee osteoarthritis. Rheum. Dis. Clin. N. Am. 2013, 39, 145–176.
37. Krishnasamy, P.; Hall, M.; Robbins, S.R. The role of skeletal muscle in the pathophysiology and management of knee o steoarthritis. Rheumatology 2018, 57, iv22–iv33.
38. Liao, C.D.; Tsauo, J.Y.; Wu, Y.T.; Cheng, C.P.; Chen, H.C.; Huang, Y.C.; Chen, H.C.; Liou, T.H. Effects of protein supple mentation combined with resistance exercise on body composition and physical function in older adults: A systematic re view and meta-analysis. Am. J. Clin. Nutr. 2017, 106, 1078–1091.
39. Liao, C.D.; Lee, P.H.; Hsiao, D.J.; Huang, S.W.; Tsauo, J.Y.; Chen, H.C.; Liou, T.H. Effects of Protein Supplementation Combined with Exercise Intervention on Frailty Indices, Body Composition, and Physical Function in Frail Older Adults. Nutrients 2018, 10, 1916.
40. Morton, R.W.; Murphy, K.T.; McKellar, S.R.; Schoenfeld, B.J.; Henselmans, M.; Helms, E.; Aragon, A.A.; Devries, M.C.; Banfield, L.; Krieger, J.W.; et al. A systematic review, meta-analysis and meta-regression of the effect of protein supple mentation on resistance training-induced gains in muscle mass and strength in healthy adults. Br. J. Sports Med. 2018, 52, 376–384.