

RESEARCH ARTICLE

Dance-based Exercise Participation and Frailty

Ray Marks¹

¹Osteoarthritis Research Centre

Corresponding Author: Ray Marks, Unit 2, Box 5B, Willowbrook-Charnwood Postal Depot, Markham, Ont L3T, 5H3, Canada. E-mail: rm226@columbia.edu, Dr.RayMarks@osteoarthritisreserachcenter.com

Received: March 23, 2025

Published: March 31, 2025

Citation: Marks R. Dance-based Exercise Participation and Frailty. Int J Complement Intern Med. 2025;6(2):305–314. DOI: 10.58349/IJCIM.2.6.2024.00146

Copyright: ©2025 Marks R. This is an open access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and build upon your work non-commercially.

Abstract

Background: Aging is often deemed a declining state. But can dance participation in any form impact emergent or prevailing frailty among the older population?

Approach: A scoping review was conducted using the key words: *dance, dance therapy, frailty, healthy aging, and older adults*. Databases used were **PubMed, PubMed Central and Google Scholar**.

Results: Dance is a health fostering mode of activity that has been shown to impact cognitive and physical frailty, regardless of mode and population studied.

Conclusion: Dance participation is a health affirming activity that should be recommended for frailty prevention and mitigation albeit earlier rather than later, and for promoting healthy happy aging.

Keywords: aging, dance, dance therapy, frailty, intervention, older adults, prevention

Introduction

Aging, an emergent state commonly accepted to represent a declining and vulnerable one is a major public health concern in most countries and is expected to be an increasingly challenging one as time progresses.¹ Yet, science is revealing some ‘aging’ adults do seem to decline less rapidly than others, and one reason given here by many to explain this is that activity or movement participation in some form is a key variable in this regard.^{2,3} Thus in line with the growing belief that certain lifestyles and health behaviours are key to optimal aging, healthy high quality longevity, and functional outcomes,⁴ it is widely advocated that exercise as a potent health protector and promoter should not be overlooked.^{3,5}

Indeed, consistently associated with increases in mobility and overall wellness and physical fitness, including mental and social health and vitality attributes,⁴ the current proposition that ‘*exercise is medicine*’ is generally not disputed to any degree. In particular, exercise that incorporates dance elements or is applied as a single standalone entity appears to raise and induce numerous measurable improvements in physical health, social health, emotional health, and life quality, while reducing possible signs or offsetting signs of encroaching cognitive as well as physical frailty.⁶ This may include the risk of falling⁷ as well as possible depression.^{6,8,10}

Hence, although dance may yet prove unable to impact certain outcomes to the degree anticipated,¹¹ dance therapy, creative dancing and dance movement interventions have been advocated as effective healthy aging approaches especially owing to their ability to counter against frailty, an immense problem faced by many aging adults.^{2,3,12-15} Moreover, even those older adults with mild cognitive impairment appear to benefit in terms of physical health, as well as mental health and general well-being when they partake in some form of dance activity.⁸

1.1 Aims

This review aimed to specifically examine the value of dance-based therapy or exercise for alleviating or minimizing frailty in the older population in general. Its second aim was to offer recommendations for clinicians and researchers in the field based on these findings.

It was designed to explore and provide an overview of current frailty, pre frailty, and frailty syndromes that are increasing as aging populations themselves are increasing. The frailty topic was deemed especially significant to explore because its manifestations are commonly highly disabling and challenging to avert, revert, or mitigate. This is attributed to their predictable

independent and cumulative adverse impacts on several physical health determinants such as a loss of muscle mass, power output and balance, as well on walking ability and overall functions of daily living. In addition, with an associated rise in the risk of fatigue and depression, falls may be common and persistent among frail older adults when trying to carry out self-care functions or social activities.

On the other hand, it is reported that physical exercise participation can favorably induce marked improvements in one or more frailty correlates, even in advanced cases. In addition, the presence of cognitive impairments that also occur in some cases of frailty syndrome may improve as well.⁴

Methods

To obtain a snapshot of the most pertinent dance-frailty observations and data, the electronic data sources **PubMed**, **Google Scholar** and **Pub Med Central** were selected and searched. The years searched ranged from January 1 2020-March 15 2025. The key words included: *dance, dance therapy, frailty, and older adults*. Excluded were non-English based articles, those focused on young adults or children and those reporting on adults residing in the nursing home or diagnosed as having specific health conditions such as dementia. Selections were made by the author. No categorical restrictions other than time [last 5 years] was placed on those articles selected and broadly related to frailty, dance participation or both in the context of healthy or successful aging. A narrative overview of the most prominent recent studies including cases believed be of vital significance to the field with no restrictions was deemed to be most feasible for establishing what is known, what is needed and why. Other essential or promising adjunctive interventions designed to counter frailty are not discussed, but may prove critical. The term frailty was used in a generic sense and denoted either cognitive or physical frailty or both and as occurs in the older adult population (60 years of age or older).

Results

3.1 Frailty

Frailty, an emerging global health concern and one being increasingly studied clearly has enormous implications and ramifications for both clinical practice and public health resource needs, allocations, and costs due to its complex physiological and social interactions.¹⁶ A health state expected to become more rather than less prevalent in the future, frailty is commonly characterized as a progressive declining state with a far reaching array of adverse impacts on overall health and functioning.

While possibly of genetic origin in some cases, many aging adults, even those in advanced countries, appear susceptible to multiple extrinsic factors and health behaviors found to play a key interactive role in fostering frailty states progressively across multiple physiological systems and health domains. For example, being sedentary and subject to poor or limited nutrients that build bone and muscle may hasten a frail state and perpetuate it.

This can be serious especially if remediable because being frail places the affected older or aging adult at increased risk for poor overall or adverse aging outcomes, including falls, excess hospitalizations, and premature mortality. As well, numerous studies have reported and attested to a link between increased health-care costs, adverse health outcomes, and frailty, and that this costly outcome alone is clearly substantially more profound among those older adults suffering with co-morbid conditions such as arthritis.¹⁵ Those who are simultaneously exposed to poor diets and food insecurity, and those pursuing sedentary lifestyles and who may show losses in the ability to carry out instrumental acts of daily living independently may require multi-disciplinary long term care and support.^{16,18}

Zhang et al.¹⁹ indicate that cognitive frailty alone as opposed to physical frailty may well prove an independent risk factor for multiple adverse health outcomes such as falls, disability, and excess hospitalization that raise the costs of frailty substantively. There is also evidence that there are an increasing number of older adults undergoing spine surgery and that frailty is associated with an increased risk of morbidity and mortality in this patient population.²⁰ Other evidence reveals genetic evidence of a bidirectional association between frailty and chronic pain where the coexistence of both conditions will likely exacerbate the other.²

Frailty is also a syndrome where there is an overall increase in vulnerability to stressors and resulting in a declining ability to adapt to stress, a decline in energy or physiological reserves, and diverse adverse outcomes. The evidence in this regard extracted from cohort studies and meta-analyses shows associations between preoperative frailty and adverse operative outcomes following general surgery, where required²¹⁻²³ and a host of interacting biopsychosocial variables.²⁴

Possible strategies to prevent approaches, or mitigate frailty include lifestyle or behavioral interventions, a

focus on nutrition, drug-based interventions, increased activity levels and social engagement,^{22,25} plus multi component exercise programs that build muscle as well as bone and improve balance and flexibility.²⁶

3.2 Dance as therapy

Dance as a movement and oftentimes creative mind-body form of exercise commonly employs a combination of structured and unstructured movements shown to consistently minimize performance declines associated with aging.²⁷ Its consistent practice also impacts mental health status favorably in general, including sizeable reductions in depression and anxiety symptoms that may otherwise foster or reinforce a perpetual frail state of physical wellbeing inadvertently, but short term results of improved physical function after 12 weeks of dance participation have been observed among older adults deemed multi frail with cognitive impairments.²⁸

Additional reported benefits include a heightened quality of life, cognitions, interpersonal competence, an improved body image, and life satisfaction. Similarly, a study on a mode of dance termed 'line dancing' showed participation here enhanced the dancers balance, coordination, and cardiovascular fitness, all projected to foster future favorable, rather than unfavorable physical outcomes. In relation to mental health, the program reduced depression and anxiety symptoms, and fostered community engagement and friendships. Cognitively, participants reported experiencing improvements in memory and executive functions.²⁹

Other reports show dance movement therapy can also serve an important complement to other forms of therapy commonly used to alleviate long-lasting and chronic pain, metabolic health challenges, and Parkinson's Disease, all often otherwise leading to or generating reactive depression. As such, one or more forms of dance therapy may help diverse groups of older adults to overcome health problems that would otherwise possibly result in physical limitations and disability as well as psychological distress. Importantly, benefits may extend to a degree of heightened self-esteem or self-concept, as well as an improved degree to which they can pursue desirable social interactions.³⁰

As well, dance participation by the older who is chronically stressed may help induce a more profound relaxation state as well as one associated with an improved state of muscle tone, balance, physical performance and the ability to function physically and mentally that can mitigate excess frailty even if the individual is already suffering from a cognitive decline.³¹ Very key to fostering healthy longevity, regular dance participation may help improve balance, muscle and bone

mass, and with this an unwanted fear of falling that often leads to the adoption of a sedentary lifestyle, a pre frailty and frail state risk factor³² and possible falls injuries and premature death.³³ Mattie et al.³⁴ affirm healthy older adults who dance regularly show a decreased risk of falling, while demonstrating improved balance and mobility, and an increase in overall body strength.

In addition, regardless of mode of application and duration, dance - even that of very short duration - seems to consistently evoke widespread positive effects including feelings of subjective wellbeing.³⁰ Dance is observed furthermore to be a desirable exercise mode even in the face of metabolic disorders such as cardiovascular disease and obesity,³⁵ although modifications may be desirable.³⁶ Among elders who participate in dance therapy accompanied by music³⁷ benefits of movements on a specific dance theme were often found to elicit positive memories, and opportunities for socializing and combating cognitive frailty, and possible dementia states.⁶

It is also reported that consistently participating in dance potentially increases opportunities for greater self-expression abilities, wellbeing and healing as well as health status.^{37,39} This occurs regardless of whether dance is encouraged through a remote device, or as a direct form of therapeutic intervention.^{40,41} Haynes et al.⁴² conclude dance classes that create camaraderie (social connection, mutual support, rapport with the teacher), and are uplifting (raises spirits, is fun, can foster synchrony, musical reactivity) and can be created and implemented at low cost in efforts to facilitate successful aging, as well as societal costs of failing to do this.³¹ It has also been observed that dance-based aerobic exercises can improve the health of the dementia sufferer³¹ as well as balance capacity, executive function, walking abilities and agility.³² Moreover, performed individually or in a group, dance based therapy may be extremely helpful for improving physical fitness, mood enhancements, opportunities for social interactions and expressiveness,^{30,43} plus mobility and functional capacity even among older adults with arthritis unable to participate in vigorous or stressful aerobic exercises as well as those who are frail and reside in a residential care facility⁴⁴ or live alone with no support.

In sum, in the context of this present review, even with limited numbers of studies that can be deemed well controlled, and the fact only favourable studies are published, Liu et al⁴⁵ found participation in dance based exercises improved mobility function and endurance performance when compared with control groups for

healthy older adults, as did Groneck et al.⁴⁶ Dance practice has also been found to relieve feelings of psychological distress among individuals with health challenges including, anxiety and depression and overall stress and has a large potential to aid coping and resilience at multiple levels of the human experience.⁴⁷

This is further supported by multiple works including one integrative review performed using PubMed, Web of Science and Scopus databases, that included randomized clinical trials, quasi-experimental, cross-sectional and cohort studies published in English, between 2010-2020. Among the 12 articles selected, dance practice was associated with an improvement in functional connectivity, cognitive performance, and increased brain volumes possibly demoting there is some degree of neural plasticity that can be induced by dance training in healthy older people and possibly even those with challenges.^{5,59}

As per Muinos and Ballesteros,⁴⁸ there is a protective effect of dance training on cognition in older adults. The fact that dance can be tailored to fit cultures and preferences plus the possibility of adapting intensity and style to suit possible physical and cognitive limitations renders this activity very suitable for many aging and older adults and more effective than any other mode of exercise for fostering psychological and cognitive health.⁶⁰

Common mechanisms to explain findings across varied dance modalities other than neural plasticity are enhanced physical features such as increased muscle strength; measurable neurochemical effects,¹⁰ such as circulating amyloid precursor protein and serotonin concentration and endorphin release. An enhanced self-concept and strengthened agency and mastery as well as processing and communication of emotions is another set of cognitive benefits. Others implicate dance activity as a potent one in helping the aging adult to mitigate depression and anxiety that may enhance cultural or creative expression opportunities and impacts, while fostering aesthetic pleasure, favorable memory enhancement plus social benefits such as decreased loneliness, all possible frailty determinants.^{49,50}

3.3 Dance therapy and frailty

Among the multiple forms of dance therapy most appear to have beneficial frailty impacts such as ballroom and Latin dance, dance exercise, cultural dance, dance

therapy, Zumba and low-impact dance.⁵¹ Joung et al.⁴¹ for example, who investigated the effects of a creative dance program on fitness, functional balance, and mobility among 82 community-dwelling older adults randomly allocated to either a dance group or a stretching group showed both approaches may benefit fitness and balance among older adults. However, dance may improve dynamic balance and mobility more than stretching. In another study of dance-based intervention that lasted 16 weeks, the researchers showed this improved frailty, depression, and physical performance among Chinese older adults living in the community setting.⁵²

In another study that examined the effects of a progressive 15 week dance curricula of one hour duration; conducted twice weekly for community-dwelling older adults aged 60+ with early cognitive or mobility impairments, but able to follow three-step commands and move independently, this proved feasible and enjoyable especially if personally tailored.²⁷ Another similar study aimed at evaluating the feasibility of a 12-week Dance-Up program and its effects on the physical and psychosocial well-being of older adults with pre-frailty in the community setting revealed:

- 1) Acceptance of the program among participants;
- 2) Emergence of overall health promoting beliefs.¹⁵

Wolozyn et al.⁵³ who strove to assess the influence of physical exercises with dance movement therapy elements on strength and other fitness components of the upper limbs and overall functional performance of wheelchair bound nursing home residents compared to standard exercise programs and usual care found improved post 12-week exercise strength and fitness measures. Meng et al.⁵⁴ assert dance intervention may reduce the presence and severity of frail states and in older adults in respect to mobility slowness, weakness, and declines in physical activity, and may indeed be as safe and effective as costly risky drugs.

Li et al.⁵⁵ report on a square dance exercise that was applied to promote the participant's attitude toward aging, while enhancing their subjective well-being that could counter frailty and appeared acceptable and feasible and welcomed by the older adult. While only preliminary, their observations implied this type of approach could yield significant positive changes in mood and mobility that are both accepted frailty correlates and without the damaging side effects of medications.

This idea has some support relative to selected dance modes.⁵⁷

Other results showed that (a) square dance exercise positively predicts group cohesion among middle-aged and older adults, and (b) related positive psychological qualities.⁵⁸

Safety factors though are often hard to discern and warrant study. Additionally, whether the dance routines studied were possibly simplified and adapted could not be clarified. Whether a possible frailty determinant - sleep quality⁵⁶ is influenced in some way by dance participation is also relatively unknown.

In sum, the studies reviewed above, even if not all inclusive, consistently report positive outcomes for various forms of dance as applied to older people to a high degree. This set of findings may prove of immeasurable import in a health realm dominated by suffering and excess costs and where outcomes across the mental and physical health spectra are hard to overcome effectively.

Applied in the context of the many disease related problems experienced by older people, and for improving frailty related falls and falls injuries one can expect all aspects of wellbeing will benefit, Health system usage and costs plus numbers of house bound dependent adults with increasingly higher health risk concerns will be reduced as well in all likelihood.

Discussion

Frailty, a burgeoning costly public health problem among older adult populations with few means of averting or attenuating its widespread health declining impacts is of great clinical and fiscal relevance in the public health as societies age.⁶¹ As noted by multiple careful analyses over time, the course of frailty is commonly one displaying a decline in functioning across multiple physiological systems. Moreover, it is a health state that places the person at increased risk of adverse health outcomes, including falls, hospitalization, and mortality, thus much effort directed towards halting this cycle of downward health declines has emerged.⁶¹ Indeed, as per Cohen et al.²⁴ since the original conceptual landscape of frailty was put forth the term has evolved to represent a complex, multidimensional biopsychosocial syndrome of health correlates, and accordingly its management is highly complex and multidimensional. Adverse outcomes here include but are not limited to:

Cognitive impairments
Bone mass declines
Death
Decreased biological reserves
Falls
Fractures
Hospitalizations
Institutionalizations
Muscle mass declines
Poor life quality
Sleep challenges
Social restrictions
Stress vulnerability.⁵⁴

Since poor diet, and sedentary lifestyles are potentially its key explanatory factors, modifiable by specific interventions and preventive actions, especially the possible usage of exercise in the form of dance has emerged and is examined accordingly in this mini narrative overview. Indeed, based on this current overview and despite the obvious limitations of this and the inclusion of studies with limited external validity, it appears safe to say vulnerable aging or older adults who suffer unduly from frailty syndrome or who are pre frail or are at risk for this adverse health state can be influenced positively in multiple health-affirming ways by regular dance-based exercise participation.

Hence, until more is known about aging, it seems reasonable to suggest an adult who embraces this possible mode of keeping active may find they have more optimal health advantages, and a high life quality. This is not only an untested idea but one showing a number of current authors to affirm and argue in favor of examining dance and its possible multiple cognitive benefits as well as physical post dance exercise benefits more intently in the future. As shown in some current and well-designed and controlled studies as well as studies with design limitations, it appears more substantive usage of a) solid pre frailty and manifest frailty terms and measures, b) dance impacts on attributes such as self-efficacy and morale, and c) plus creative dance versus programmatically organized dance on diverse frailty risk factors in longitudinal future studies will prove beneficial.

Moreover, it is possible that a broader array of samples if studied can prove especially insightful as it is possible only those adults who were motivated or able to dance or under supervision may have been asked to join a study and some may have been receiving other forms of therapy that were not always detailed, or controlled for. In addition, the impact of instructor, health status, intervention mode, frequency and dosage of the intervention, may have influenced the overall findings, but whether these are

influential or not is hard to discern without further examination.

In the interim, despite the obvious limitations of this current review and the inclusion of studies with questionable limited external validity, it appears safe to say vulnerable aging or older adults who suffer unduly from frailty syndrome or are pre frail or are at risk this adverse health state can be influenced positively in multiple health-affirming ways by regular dance-based exercise participation. Dance therapy, commonly associated with an exercise intensity that may be less injurious to joints than commonplace high intensity exercises often advocated for improving aerobic capacity, may also impart important physical health benefits to the participant with pain that is likely to foster independence and wellbeing.

An activity readily enjoyed by older adults who have been surveyed, it seems dance in any form is an exercise mode likely to be pursued in the long term when compared to more standard exercise approaches deemed vital for optimally well and successful aging but are often not adhered to. In the interim, many authors tout dance as a therapy mode for many and quite uniformly of late express a need for further study to be pursued to help unlock possible additional insights such as dose response relationships as regards physical versus cognitive frailty that could have immense personal, clinical and public health significance. For example exploring the degree to which dance can foster or maintain and optimal functionally beneficial states of motor control, as well as bone and mental health, muscle power, and pain control that often underpins falls and falls injuries rather than the adoption of a sedentary health negating set of behaviours that can perpetuate frailty may be highly valuable.

Of specific clinical importance to people with frailty genes and those who are pre frail who cannot take medication to offset health declines dance participation modified as needed, can potentially provide benefits that are risk free and low cost and commensurate with pharmacologic interventions. Along with its cognitive mediating effects, the effects of dance interventions on other health correlates also appear especially noteworthy and may be of special value in preventing, combating, or even reversing excess bone mass losses, dementia, depression, and excess muscle wasting.

Implications

To advance dance as a form of therapy, which seems beneficial for the healthy aging adult whether frail or not, as well for older persons with substantive frailty and other impairments, health educators and other clinicians may want to encourage their vulnerable clients who have never thought about practicing dance to do so. They could provide primary

care personnel and nursing homes and similar venues with information about the potential benefits of this mode of intervention and what options are available. In addition, they can explain the different forms of dance options available to clients, and recommend which forms may be most beneficial for the individual in light of the person's individual health and physical ability status, desires and interests, as well as their cognitive health.

In particular, they could be proactive in careful evaluations of their clients as well as in finding sites or modes of dance that appear to meet their needs. Active clients might be referred to in the community for initial assessment and training and in recommending certified instructors and related programs in the community to them if they desire this. They could also educate their families and caregivers, and organizational personnel at aging centers about the potential benefits of these interventions so that they can assist them in a supportive motivating and encouraging way. Those with comorbid diseases such as Parkinson's disease, and poor balance capacity, as well as those in nursing homes may be especially benefited by participating in structured classes carried out actively twice a week or even by passively observing live or video taped dance performances with the expectation their overall wellness status will be strengthened physically, mentally, socially, and emotionally for years to come.

Frail older adults should be treated cautiously though, especially if surgery is indicated. Unsupervised or directed dance participation is best avoided at all times.

Acknowledgement

None

Funding

None

Conflicts of Interest

None

References

1. Ambegaonkar JP, Matto H, Ihara ES, et al. Dance, music, and social conversation program participation positively affects physical and mental health in community-dwelling older adults: a randomized controlled trial. *J Dance Med Sci.* 2022;26(4):255-264.
2. Dai L, Tang Y, Guo Y, et al. The association between exercise, activities, and frailty in older Chinese adults: a cross-sectional study based on the Chinese Longitudinal Healthy Longevity Survey (CLHLS) data. *BMC Geriatr.* 2025;25(1):131.
3. Izquierdo M, de Souto Barreto P, Arai H, et al. Global consensus on optimal exercise recommendations for enhancing healthy longevity in older adults (ICFSR). *J Nutr Health Aging.* 2025;29(1):100401.
4. Cadore EL, Sáez de Asteasu ML, Izquierdo M. Multicomponent exercise and the hallmarks of frailty: Considerations on cognitive impairment and acute hospitalization. *Exp Gerontol.* 2019;122:10-14.
5. Nascimento CM, Ingles M, Salvador-Pascual A, et al. Sarcopenia, frailty and their prevention by exercise. *Free Radic Biol Med.* 2019;132:42-49.
6. Dewari AS, Chandel S. Strides towards healthy longevity: harnessing the power of sports and elements of Kathak, an Indian classical dance form through social participation to combat cognitive frailty among older adults. *Ageing Res Rev.* 2025;105:102671.
7. Simpkins C, Yang F. Recreational older ballet dancers fall less with more effective reactive balance control than non-dancers after a slip during gait. *Exp Brain Res.* 2025;243(3):75.
8. Sánchez-Alcalá M, Aibar-Almazán A, Carcelén-Fraile MDC, et al. Effects of dance-based aerobic training on frailty and cognitive function in older adults with mild cognitive impairment: a randomized controlled trial. *Diagnostics (Basel).* 2025;15(3):351.
9. Yu Y, Min H, Pan W, et al. Network analysis of the relationships between depressive symptoms and social participation activities among Chinese older adults and its implications for nursing. *Int J Nurs Sci.* 2024;11(4):465-472.
10. Rodziewicz-Flis EA, Kawa M, Skrobot WR, et al. The positive impact of 12 weeks of dance and balance training on the circulating amyloid precursor protein and serotonin concentration as well as physical and cognitive abilities in elderly women. *Exp Gerontol.* 2022;162:111746.
11. Hernandez-Martinez J, Guzmán-Muñoz E, Cid-Calfucura I, et al. Elastic band training versus multicomponent training and group-based dance on morphological variables and physical performance in older women: a randomized controlled trial. *Life (Basel).* 2024;14(11):1362.
12. Douka S, Zolidou VI, Lilou O, et al. Traditional dance improves the physical fitness and well-being of the elderly. *Front Aging Neurosci.* 2019;11:75.
13. Pessoa RF, Neves CM, Ferreira MEC. Dance therapy in aging: A systematic review. *J Phys Ed Sport.* 2019;19(2):1180-1187.
14. Saumaa H. Dance and movement in the advanced age. *Alt Compl Ther.* 2020;26(6):239-242.
15. Xu T, Soo V, Chang HY, et al. Dance programme for older adults with pre-frailty: a mixed-methods feasibility study. *Arch Gerontol Geriatr Plus.* 2024;1(4).
16. Hoogendoijk EO, Afilalo J, Ensrud KE, et al. Frailty: implications for clinical practice and public health. *The Lancet.* 2019;394(10206):1365-1375.
17. Salaffi F, Farah S, Di Carlo M. Frailty syndrome in rheumatoid arthritis and symptomatic osteoarthritis: an emerging concept in rheumatology. *Acta Biomed.* 2020;91(2):274-296.
18. Tornero-Quiñones I, Sáez-Padilla J, Espina Díaz A, et al. Functional ability, frailty and risk of falls in the elderly: relations with autonomy in daily living. *Int J Environ Res Public Health.* 2020;17(3):1006.

19. Zhang XM, Wu XJ, Cao J, et al. Association between cognitive frailty and adverse outcomes among older adults: a meta-analysis. *J Nutr Health Aging*. 2022;26(9):817-825.
20. Chan V, Wilson JRF, Ravinsky R, et al. Frailty adversely affects outcomes of patients undergoing spine surgery: a systematic review. *Spine J*. 2021;21(6):988-1000.
21. Hewitt J, Long S, Carter B, et al. The prevalence of frailty and its association with clinical outcomes in general surgery: a systematic review and meta-analysis. *Age Ageing*. 2018;47(6):793-800.
22. Gielen E, Dupont J, Dejaeger M, Laurent MR. Sarcopenia, osteoporosis and frailty. *Metabolism*. 2023;145:155638.
23. Panayi AC, Orkaby AR, Sakthivel D, et al. Impact of frailty on outcomes in surgical patients: a systematic review and meta-analysis. *Am J Surg*. 2019;218(2):393-400.
24. Cohen CI, Benyaminov R, Rahman M, et al. Frailty: a multidimensional biopsychosocial syndrome. *Med Clin North Am*. 2023;107(1):183-197.
25. Walston J, Buta B, Xue QL. Frailty Screening and Interventions: Considerations for Clinical Practice. *Clin Geriatr Med*. 2018;34(1):25-38.
26. Dent E, Daly RM, Hoogendoijk EO, Scott D. Exercise to prevent and manage frailty and fragility fractures. *Curr Osteoporos Rep*. 2023;21(2):205-215.
27. Hewston P, Kennedy C, Ioannidis G, et al. Development of GERAS DANcing for Cognition and Exercise (DANCE): a feasibility study. *Pilot Feasibility Stud*. 2022;8(1):9. Published 2022 Jan 19.
28. Kennedy CC, Hewston P, Ioannidis G, et al. Effect of the GERAS DANcing for cognition and exercise program on physical function in older adults. *J Aging Phys Act*. 2022;31(2):182-190.
29. Cleary M, Le Lagadec D, West S, Kornhaber R, et al. 5, 6, 7, 8: The many and interrelated benefits of line dancing - a scoping review. *Issues Ment Health Nurs*. 2025;1-11.
30. Jiménez J, Bräuninger I, Meekums B. Dance movement therapy with older people with a psychiatric condition: a systematic review. *The Arts in Psychother*. 2019;63:118-127.
31. Ho RTH, Fong TCT, Chan WC, et al. Psychophysiological effects of dance movement therapy and physical exercise on older adults with mild dementia: a randomized controlled trial. *J Gerontol B Psychol Sci Soc Sci*. 2020;75(3):560-570.
32. Veronese N, Maggi S, Schofield P, et al. Dance movement therapy and falls prevention. *Maturitas*. 2025;102:1-5.
33. Blanco-Rambo E, Bandeira-Guimarães M, Vieira AF, et al. Dance as an intervention to reduce fall risk in older adults: a systematic review with a meta-analysis. *J Aging Phys Act*. 2022;30(6):1118-1132.
34. Mattle M, Chocano-Bedoya PO, Fischbacher M, et al. Association of dance-based mind-motor activities with falls and physical function among healthy older adults: a systematic review and meta-analysis. *JAMA Netw Open*. 2021;4(1):e2037105.
35. Bajaj S, Verma M, Sharma HB, et al. Southeast Asian, African, and Middle East expert consensus on structured physical activity-dance, exercise, and sports. *Adv Ther*. 2025;42(4):1692-1715.
36. Parial LL, Lam SC, Sumile EF, et al. Mix-and-Match or Mismatch? exploring the perspectives of older adults about zumba dance and its potential utilization for dual-task training. *J Aging Phys Act*. 2022;30(5):893-905.
37. O'Malley N, O'Reilly S, Byrne S, et al. 'Excellent for mind, body and spirit': Participant, facilitator, and community stakeholder experiences of Music and Movement for Health. *Complement Ther Clin Pract*. 2024;57:101917.
38. Capello PP. Dance/movement therapy and the older adult client: healing pathways to resilience and community: the 2017 ADTA international panel. *Am J Dance Ther*. 2018;40(1):164-178.
39. Toohey B, Hutchinson M, Moloney G. More than just movement: exploring embodied group synchrony during seated dance for older adults living in residential aged care communities. *J Appl Gerontol*. 2024;43(6):657-669.
40. Marquez DX, Tellez M, Ocampo-Mota J, et al. C.E.R.E.B.R.O.: A home-based physical activity study for older Latino adults. *Contemp Clin Trials Commun*. 2025;44:101436.
41. Joung H J, Lee Y. Effect of creative dance on fitness, functional balance, and mobility control in the elderly. *Gerontol*. 2019;65(5):537-546.
42. Haynes A, Tiedemann A, Hewton G, et al. "It doesn't feel like exercise": a realist process evaluation of factors that support long-term attendance at dance classes designed for healthy ageing. *Front Public Health*. 2023;11:1284272.
43. Sodums DJ, Kim S, Gallucci CE, et al. Impact of Sharing Dance Older Adults on physical and psychosocial outcomes. *Can J Aging*. 2024;43(2):297-310.
44. Gomaa YS, Slade SC, Tamplin J, et al. Therapeutic Dancing for Frail Older People in Residential Aged Care: A Thematic Analysis of Barriers and Facilitators to Implementation. *Int J Aging Hum Dev*. 2020;90(4):403-422.
45. Liu X, Shen PL, Tsai YS. Dance intervention effects on physical function in healthy older adults: a systematic review and meta-analysis. *Aging Clin Exp Res*. 2021;33(2):253-263.
46. Gronek P, Boraczyński M, Haas AN, et al. Body adaptation to dance: a gerontological perspective. *Aging Dis*. 2021;12(3):902-913.
47. Klaperski-van der Wal S, Skinner J, Opacka-Juffry J, et al. Dance and stress regulation: A multidisciplinary narrative review. *Psychol Sport Exerc*. 2025;78:102823.
48. Muiños M, Ballesteros S. Does dance counteract age-related cognitive and brain declines in middle-aged and older adults? A systematic review. *Neurosci Biobehav Rev*. 2021;121:259-276.
49. Dunphy K, Baker FA, Dumaresq E, et al. Creative arts interventions to address depression in older adults: a systematic review of outcomes, processes, and mechanisms. *Front Psychol*. 2019;9:2655.
50. Jaldin MA, Balbim GM, Pinto J, et al. Systematic review and meta-analysis of the effects of dance on cognition and depression in healthy older adults. *Med Sci Sports Exerc*. 2025;57(3):490-500.
51. Lazo Green K, Yang Y, Abaraogu U, et al. Effectiveness of dance interventions for falls prevention in older adults: systematic review and meta-analysis. *Age Ageing*. 2024;53(5):afae104.

52. Zhang X, van der Schans CP, Liu Y, et al. Efficacy of dance intervention for improving frailty among Chinese older adults living in the community: a randomized controlled trial. *J Aging Phys Act.* 2023;31(5):806-814.
53. Wołoszyn N, Brożonowicz J, Grzegorczyk J, et al. The impact of physical exercises with elements of dance movement therapy on anthropometric parameters and physical fitness among functionally limited older nursing home residents. *Int J Environ Res Public Health.* 2023;20(5):3827.
54. Meng X, Li G, Zhang G, et al. Effects of dance intervention on frailty among older adults. *Arch Gerontol Geriatr.* 2020;88:104001.
55. Li R, Yan Q, Qu Y, et al. Square dance, loneliness, quality of life, and attitude toward aging in middle-aged and older women in China. *Front Public Health.* 2025;13:1508556.
56. de Souza ÂMN, Fernandes DPS, Castro IS, et al. Sleep quality and duration and frailty in older adults: a systematic review. *Front Public Health.* 2025;13:1539849.
57. Qu Y, Liu Z, Wang Y, et al. Relationships among square dance, group cohesion, perceived social support, and psychological capital in 2721 middle-aged and older adults in China. *Healthcare (Basel).* 2023;11(14):2025.
58. Zhang H, Gao Y, Zhang Y, et al. Effects of dance interventions on cognitive function, balance, mobility, and life quality in older adults: A systematic review and Bayesian network meta-analysis. *Arch Gerontol Geriatr.* 2025;131:105775.
59. Salihu D, Kwan RY, Wong EM. The effect of dancing interventions on depression symptoms, anxiety, and stress in adults without musculoskeletal disorders: an integrative review and meta-analysis. *Compl Ther Clin Practice.* 2021;45:101467.
60. Fong Yan A, Nicholson LL, Ward RE, et al. The effectiveness of dance interventions on psychological and cognitive health outcomes compared with other forms of physical activity: a systematic review with meta-analysis. *Sports Med.* 2024;1-27.
61. Hoogendoijk EO, Afilalo J, Ensrud KE, et al. Frailty: implications for clinical practice and public health. *Lancet.* 2019;394(10206):1365-1375.
62. Proietti M, Cesari M. Frailty: What Is It?. *Adv Exp Med Biol.* 2020;1216:1-7.