



## Research Article

# Physical and Psychological Outcomes of the Integrated Dance Movement Therapeutics (IDMT) on Fall Prevention Among Chinese Older Adults

Yim WCV<sup>1</sup>, Kwok YYC<sup>2</sup>, Wu STC<sup>3\*</sup>

<sup>1</sup>Occupational Therapist, Centre for Community Cultural Development, Hong Kong

<sup>2</sup>Dance and Movement therapist, Centre for Community Cultural Development, Hong Kong

<sup>3</sup>Senior Teaching Fellow, School of Nursing, The Hong Kong Polytechnic University

\*Corresponding author: Cynthia Wu, School of Nursing, Faculty of Health & Social Sciences, The Hong Kong Polytechnic University, Hong Kong

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### Abstract

**Background:** The ageing population in Hong Kong has increased demand for community-based fall prevention program. Dance has been widely promoted to public as a health-promoting approach to embrace physical, cognitive, and emotional health as a whole. Existing fall prevention interventions are mostly focused on the physical and psychological outcomes in the non-Chinese culture. This study aimed to test the outcomes of the integrated dance movement therapeutics (IDMT) on fall risk reduction for Chinese older adults in Hong Kong. **Methods:** Community-dwelling older adults (n = 233) were recruited by the selection criteria in five community venues from Jan 2024 to Oct 2025. A pre-post quasi-experimental intervention without control group was adopted with paired samples was used. Physical health was measured by the uni-pedal stance (Balance) test and Timed-Up & Go (TUG Mobility) test. Psychological health was self-reported by the revised fear of fall questionnaire (FFQ-R); the state of well-being was self-reported by the 5-Item World Health Organization (WHO-5) Well Being Index. Descriptive statistics, paired t-tests, and Wilcoxon signed-rank tests were applied. **Results:** Significant improvements were observed in all outcomes. Uni-pedal stance times increased bilaterally (p < 0.001), and TUG performance improved (p < 0.001), indicating enhanced balance and mobility. Fear of fall scores decreased significantly (p < 0.001), while WHO-5 scores increased, reflecting improved positive well-being (p < 0.001). **Conclusions:** The IDMT program was associated with significant gains in mobility, balance, fear of falling, and psychological well-being among community-dwelling older adults in Hong Kong. The integrated dance movement therapeutics (IDMT) intervention appears promising for community fall prevention. Controlled trials with comparison groups and longer follow-up are warranted to confirm effectiveness and generalizability.

**Keywords:** Fall prevention; Dance; Dance movement therapeutics; Mobility; Balance; Well-being; Fear-of- fall

## Introduction

Falls, defined as an unintentional coming to rest on the ground or at a lower level, with or without loss of consciousness, represent the second leading cause of death from unintentional injury worldwide. It is a major public health concern due to their high incidence among older adults [1]. World Health Organization (WHO) projecting that by 2030 one in six individuals will be aged 60 or older, reflecting a demographic shift towards an aging population globally. According to the Census and Statistics Department local census study in 2023, there will be more than one-third of Hong Kong's population as aged 65 or above after twenty years [2]; whereas fall prevention has emerged as a critical priority in geriatric care; physical frailty and poorer subjective well-being in older adults are widely discussed [3,4].

Alarmingly, there is estimated that 28–35% of older adults aged 65 years or above experience at least one fall annually in Hong Kong, with this proportion escalating to 32 to 42% among those aged 70 and above [1]. Among those hospitalized older fallers, approximately 9.9% sustain fractures and 31.3% suffer soft tissue injuries [5]. The consequences of falls in older adults are substantial, including increased risk of hospitalization, disability, morbidity, and mortality [6]. A higher risk of falling has been demonstrated in older individuals with comorbidity, such as diabetes and hypertension, whereas low levels of physical activity and a history of previous falls constitute additional predisposing factors [7,8]. Beyond these physical and medical determinants, falls can inflict long-lasting psychological sequence, including depression and an increased fear of falling, which has been identified as an important predictor of future falls independent of objective balance performance [9,10]. And it can subsequently limit daily and social activities, deteriorate physical fitness and function, and exacerbate the risk of future falls as a various cycle. Associated with other factors, physical inactivity is one of the common unhealthy lifestyles contributing to adverse health outcomes [11]. In a community-based study of older adults in Hong Kong, it had reported a substantial burden of falls and subsequent health service use, underscoring the need for effective fall prevention strategies [12]. To prevent the suboptimal condition, additional to the above statistics highlighted, there is a pressing need for effective interventions to mitigate the burden of falls on older adults.

Community-based exercise programmes that emphasise balance and strength training have been shown to be effective in reducing fall risk among older adults at average or high risk of falling [13,14]. Recent international guidelines recommend multicomponent exercise or strength training as first-line interventions [1],

reflecting the multifactorial nature of falls, which are commonly categorised into intrinsic and extrinsic risk factors. Intrinsic factors include age-related changes, chronic disease, reduced muscle strength, gait and balance impairments, and cognitive decline, whereas extrinsic factors encompass medication use, environmental hazards, and risk behaviours [15,16]. Despite this recognition, most fall-prevention studies have concentrated on physical outcomes and have paid comparatively little attention to psychological determinants [17]. Systematic reviews and meta-analyses of randomised controlled trials in community-dwelling older adults have predominantly evaluated physical parameters, with limited focus on fear of falling, self-efficacy, or motivation [18,19]. This is problematic given that fear of falling has been identified as both a consequence and a predictor of falls in older Chinese adults [20], underscoring the need to address psychological as well as physical risk factors. Furthermore, the majority of studies have been conducted overseas and tend to examine either physical or psychological outcomes in isolation, with limited assessment of their combined effects. Consequently, although current fall-prevention programmes are increasingly described as multifactorial, they remain largely exercise-centred and may insufficiently incorporate the psychological dimensions that are critical to comprehensive fall risk reduction.

Concurrently, an emerging body of literature has examined dance as a therapeutic modality to mitigate fall risk in healthy older adults because of its multifactorial features. A recent systematic review reported that dance interventions can improve balance, gait, dynamic mobility, muscular strength, and overall physical performance—key physical risk factors for falls [21]. As a light-intensity exercise, dance is widely used in community settings and is recommended as a way to replace sedentary time with active behaviours in older adults [22,23]. Within the spectrum of exercise-based interventions, dance has been identified as a popular leisure-time activity among older people, with the potential for better adherence than more traditional exercise formats [24]. It is considered an engaging and sustainable alternative to conventional balance and strength training because it combines rhythmic movement with physical, emotional, cognitive, and social stimulation. Evidence indicates that dance can improve balance, gait, strength, flexibility, and coordination, while also conferring benefits in cognition, social interaction, quality of life, life satisfaction, and intrinsic motivation to be active, particularly among individuals with chronic conditions [25–29]. Some authors have argued that dance shares the holistic characteristics of Tai Chi, integrating physical, cognitive, and social components [30]. Mechanistically, these benefits may be explained by the multidimensional nature of dance, which integrates sensorimotor demands and cognitive processing relevant to fall prevention [28].

Although some scholars contend that current evidence does not yet support dance as a full substitute for targeted strength and balance training, it is acknowledged as a low-cost, easily accessible, multifactorial intervention that addresses physical, cognitive, and emotional health in older adults [31,32].

Beyond recreational activity, dance or dance and movement therapy have also been conceptualised as psychotherapeutic modalities. According to the American Dance Therapy Association, dance/movement therapy (DMT) aims to foster emotional, social, cognitive, and physical integration to enhance health and well-being [33]. Meta-analyses on DMT and dance have shown that DMT is associated with reductions in depression and anxiety, and improvements in quality of life, interpersonal functioning, and cognitive skills, whereas broader dance-based interventions tend to enhance (psycho-)motor abilities [34,35]. A more recent meta-analysis suggested that dance-based interventions may be superior to other forms of physical activity in improving motivation, aspects of memory, social cognition, and psychological distress. These findings are in line with earlier systematic reviews in the context of fall prevention, which provided preliminary evidence that dance can reduce fear of falling [36]. A small number of studies of integrated DMT fall-prevention programmes have also reported improvements in balance and reductions in fear of falling [37,38]. Collectively, these results highlight the promise of integrative dance and DMT approaches, but their effectiveness and underlying mechanisms warrant further investigation.

Despite the above benefits, there was a paucity of global and Chinese studies investigating the integrated approach of dance and dance movement to fall prevention from physical and psychological health dimensions. A preliminary Integrated Dance and Dance Movement Therapeutic program (IDMT) had positively showed effectiveness on improving balance and mobility of community-dwelling older adults, as well as enhancing their psychological well-being and fall-related emotion in Hong Kong community [38]. A similar study with a larger sample size was repeated to generate a greater generalization to local community-dwelling older population.

### **Study Aim and Objective**

The present study employed a pre and post quasi-experimental intervention without control group. It aimed to examine the effects of an integrated dance and dance/movement therapeutic intervention on physical and psychological factors related to fall prevention among Chinese community dwelling older adults. In order to examine the difference between the pre-post test scores of the paired groups on balance, mobility, fear of fall, as well as psychological well-being after the IDMT intervention with greater sampler size, in order to enhance the generalizability.

## **Methods**

### **Subject Recruitment**

Participates were recruited from collaboration project with various local community centres in different districts of Hong Kong, those were providing primary health service especially serving community-dwelling elderly. One-hours educational health talks on fall prevention presented by occupational therapist were held in centres, subjects were recruited in the talks according to the selection criteria.

Participants were fully informed of the potential risks and benefits associated with participation in the program. Written informed consent was obtained for the use of program evaluation data for research purposes. No personally identifiable information was disclosed in any reports or publications arising from the study. Participants were advised that they could withdraw from the evaluation component at any time without any consequences for their continued participation in the program itself. Health screening for the contraindications to the program involvement such as uncontrolled hypertension, cognitive impairment and audio-visual problems status were conducted A physical fitness checklist was signed by all participants. Participants who were older than 75 years, the additional declaration of the health conditions for the program were also signed.

### **Eligibility Criteria**

Inclusion criteria were as follows: (a) aged 50 years or above; (b) able to read Chinese and understand Cantonese in order to follow verbal and written instructions for the dance activities; (c) able to provide informed consent for participation in the study; and (d) able to attend a minimum of eight sessions, including both the first and final sessions, to enable completion of the pre-test and post-test assessments.

Exclusion criteria comprised: (a) history of bone or joint injury; and (b) history of falls within the preceding three months. Prior to program commencement, all participants were required to complete a self-declaration of physical fitness checklist to confirm their suitability for dance-based exercise. Individuals who were unable or unwilling to complete this fitness declaration were excluded.

### **Intervention**

A total of twelve IDMT fall prevention groups were implemented at different district community centres. Total 240 community-dwelling elderlies were recruited. Each IDMT session consisted of eight-session, a weekly 1.5 hours of rhythmic dance movements, physical exercises, and body-mind awareness training, were facilitated by a dance/movement therapist and an occupational

therapist respectively. Apart from muscle strengthening and balance training, processing of sensory inputs and body-mind awareness training were crucial to the intervention. Rhythmic dance movements and dance choreography involved a greater social and emotion expression, positive group dynamic align with body-mind dance/movement therapy elements. Strength and balance exercises are embedded within varied dance patterns to develop lower-limb strength while maintaining enjoyment. A take-home video was provided for the seniors to practice at home. A community dance troupe was established in order to sustain the benefit and cohesion after completion of the program.

**Outcome Measure**

The subject variables included demographics, history of fall and health conditions. The baseline data were collected at the first session before the IDMT program, the outcome measures were collected at the last session of the program. The outcome measure consisted of the objective assessments on balance and mobility, as well as the self-reported fear of falls and psychological well-being. The details of the selected outcome measures were as follow:

**Unipedal Stance Test (UPST)**

Physical balance was assessed using the unilateral (uni-pedal) stance test, a widely used clinical measure that is sensitive to balance impairment and fall risk in older adults. In this test, participants are instructed to stand on single leg (left or right) while the duration of maintained stance is timed. Shorter uni-pedal stance times have been associated with increased likelihood of falls and functional decline in community-dwelling older adults [39,40].

**Timed-Up & Go Test (TUG)**

Physical mobility was evaluated using the Timed Up and Go (TUG) test, a standardized measure with excellent intra-rater, inter-rater, and test–retest reliability in older populations [41–43]. The TUG is extensively adopted in health and rehabilitation services as a brief screening tool for functional mobility and fall risk, as it captures the integrated performance of sit-to-stand, walking, turning, and sitting down [44,45].

**Fear of Fall (FFQ-R)**

Fear of falling was measured using the Revised Fear of Falling Questionnaire (FFQ-R), a 15-item self-report scale rated on a 4-point Likert scale from 1 (strongly disagree) to 4 (strongly agree). Total scores range from 15 to 60, with higher scores indicating greater fear of falling [46]. The FFQ-R has demonstrated satisfactory internal consistency, with Cronbach’s  $\alpha$  values ranging from 0.72 to 0.83, and good test–retest reliability ( $r = 0.82$ ), supporting its use in older adult populations.

**World Health Organization Well-Being Index (WHO-5)**

Psychological well-being was assessed using the 5-item World Health Organization Well-Being Index (WHO-5), a brief self-report instrument validated across age groups from youth to older adults. The WHO-5 has shown high sensitivity (0.93) and specificity (0.83) for detecting clinically relevant depression, making it a robust indicator of subjective well-being and emotional functioning [47,48].

**Statistical Methods**

All statistical analyses were conducted using IBM SPSS Statistics, version 28.0 (IBM Corp., Armonk, NY, USA). Descriptive statistics were employed to summarize participants’ sociodemographic characteristics and baseline health-related variables. To evaluate changes in physical performance, paired-samples t-tests were used to examine pre–post differences in balance (UPST) and mobility (TUG), under the assumption of approximately normally distributed difference scores. For psychological outcomes-fear of falling (FFQ-R) and psychological well-being (WHO-5)-the paired non-parametric Wilcoxon signed-rank test was applied to compare pre- and post-intervention median scores, given the ordinal nature of the scales and potential deviations from normality. All tests were two-tailed, and the level of statistical significance was set at  $p < 0.05$ . The results of these analyses are summarized in Table 1.

**Results**

Demographics Characteristics (N = 233)	
Gender	
Male	10.34% (24)
Female	89.66% (209)
Age	
Mean (years)	67.9
50-64	34.33% (80)
Above 65	65.67% (153)
Session Adherence	
Attrition rate	3.33%
Average attendance	76.14%
≥ 50% attendance	88.41%
≥ 70% attendance	77.30%

**Table 1:** Summarizes the demographics and attendance of the sample.

**Demographic Data (session attendance)**

Two hundred thirty-three over two-hundreds forty participants completed the program with only 3.33% attrition rate. Over two

hundred (209) of the sample were females (89.7%) and twenty-four of them were males (10.3%). Their age ranged from 50-93, the mean age is 67.9. Eighty (34.3%) of them were young-old seniors aged between 50-64, and most of the seniors (65.7%) were aged over 65. Most of the participants maintained good attendance, with mean attendance achieved at 76.1% of full attendance. Nearly ninety percent (88.4%) of participants showed up more than half of the overall sessions, and above seventy-five percent (77.3%) of participants maintained over 70% attendance.

### Effects on Mobility and Balance

Table 2 summarized the paired T-Test on both the balanced test (UPST) and mobility test (TUG) score. Balance scores of participants showed very strong significantly higher following the intervention ( $p < 0.001$ ) in both legs; there was 81.3% and 66.9% of increase in left and right leg respectively. Similarly, TUG performance demonstrated statistically high significant improvement after completion of the IDDMT program ( $p < 0.001$ ); majority of elderlies gain greater mobility to decrease 15.57% of time to perform the movement in average. Both results reflecting enhanced postural stability and mobility of participated older adults.

df = 232	Mean differences	Paired Differences	t-stat	Significance Two-sided p
		95% Confidence Interval of the Difference (Upper)		
Balance_Lt – Balance_Lt_T2	23.86 – 43.26 (sec)	6.883	-5.552	*** p <0.001
Balance_Rt_T1 –Balance_Rt_T2	25.92 – 43.25 (sec)	5.480	-6.232	*** p <0.001
Mobility_T1 – Mobility_T2	23.00 – 19.42 (sec)	0.590	11.954	*** p <0.001

**Table 2:** Paired T Test.

### Effects on Fear of fall and Well-being

Table 3 summarized the Wilcoxon tests measuring fear of fall and phycological well-being. Results revealed that the fear of falling scores of the participants were significantly reduced ( $p < 0.001$ ). The state of positive well-being (WHO-5) was significantly promoted ( $p < 0.001$ ) with very strong significance as well, there was average 6.8% increase of scores among the participants.

df = 232	Fearoffall_T2 - Fearoffall_T1	WHO5_T2 - WHO5_T1
Mean differences	34.24 – 33.11	14.72 – 16.42
Asymp. Sig. (2-tailed)	***<0.001	***p <0.001

**Table 3:** Wilcoxon Test.

### Comparison of the pilot and actual study

Table 4 summarized the significant values on all four paired tests results, compared those independent domains in pilot program and current study which improved on sampling methods and simple size. In the pilot program, there was statistically significant in all four paired tests, that means the pilot IDMT program showed effectiveness on improving bilateral balance, mobility, fear of fall and psychological well-being of community-dwelling older adults [38]. However, that pilot study may reveal a variation of effectiveness level of IDMT, whereas the improvement of psychological well-being was significantly higher than the other parameters, i.e. bilateral balance. On the contrary, the actual IDMT program showed strong effectiveness in all four selected parameters.



	Pilot IDMT program (N=52)	Actual IDMT program (N= 233)
Balance_Lt_T1 – Balance_Lt_T2	*p<0.05	23.86 – 43.26 *** p<0.001
Balance_Rt_T1 - Balance_Rt_T2	*p<0.05	25.92 – 43.25 *** p<0.001
Mobility_T1 – Mobility_T2	**p<0.01	23.00 – 19.42 *** p<0.001
Fear of fall	**p<0.01	34.24 – 33.11 *** p<0.001
Well-being (WHO5)	***p<0.001	14.72 – 16.42 *** p<0.001

**Table 4:** Comparison of pilot and actual program on its significant values and change in means.

## Discussion

### Generalizability and Significance

Results of this study consistent with our previous preliminary findings in last pilot study [38], the IDMT program showed enhancing elders' physical capacity and psychological state in relation to fall in a larger population with over two-hundreds thirty-three sample size (n=233). This sample size was moderately adequate for detecting statistically significant changes in key outcomes (i.e. balance, mobility, fear of falling, and well-being), and it provides reasonably stable estimates at the group level. For a community-based intervention, this sample size is comparable to many similar fall prevention trials locally and internationally [28,31].

All pre–post changes in balance, mobility, fear of falling, and well-being in current study were statistically significant ( $p < 0.001$ ), indicating that the observed improvements are unlikely to be due to chance. The magnitude of the changes suggests potential clinical relevance. Moreover, multiple groups with over two hundred samples were recruited from local community settings, including different locations of community centres, were increasing the ecological validity of the study.

### Interpretations

#### Mobility and Balance

The results aligned with many previous evidences on the physical activities significantly improve mobility and balance by strengthen the lower limb muscle and sense of balance [19]. Dance, in particular, has been shown to enhance muscle mass, strength, gait, mobility, balance and flexibility in older adults, thereby helping to prevent age-related functional decline [29]. As strength and

balance exercises are embedded within varied dance patterns, those dance steps involving more on dynamic balance and postural control instead of static balance in most of the other trainings [19].

As multifactorial causes of fall were identified in recent studies, including physiological changes, psychological condition, environmental barriers, and socioeconomic backgrounds etc [6]. In this context, the integration of dance and dance movement activities may offer an added value, as dance is a multimodal intervention that addresses physical, cognitive, and emotional aspects of health [49,50]. The combined efforts of dance and dance movement activities integrated and shared the therapeutic effects emphasizing body awareness and stimulation of senses, these activities may enhance proprioceptive responses and vestibular training, contributing to better balance and mobility outcomes [19,32].

#### Fear of fall and Well-being

The Integrated Dance Movement Therapeutics (IDMT) modal promotes emotional expression and body–mind awareness in relation to falls, which may help fostering positive well-being and reduce fear. The psychological findings of this study parallel earlier research on dance and dance/movement therapy and their impact on mental health and well-being. Prior studies have shown that dance therapy was effective in alleviating clinical symptoms such as depression and anxiety, it could reduce negative symptoms [35], while some studies also showed enhancing subjective well-being, positive mood, improve quality of life and body image [34]. The reductions in fear of falling was highlighted by some studies [36], by regaining sense of control and security through integrated of dance movement therapy significantly helped in reducing fear of falling [37,51]. The improvements in well-being observed here may be linked to the integrated body–mind focus of the

intervention. This integrative approach based on the three major components: rhythmic movement, body–mind connection, and social interaction were exercised throughout the dance therapeutic intervention.

Rhythmic movement uses music and enjoyable, relaxed dance sequences rather than repetitive, routine exercise. The factors enjoyment and pleasure have been found to be motivational factors for physical activity among older adults. From neurological perspective, rhythmic auditory stimulation reduced falls and improved gait parameters [52]. Furthermore, improved physical performance may also bolster confidence of elderlies in walking and fall prevention, thereby decreasing fear of falling.

The body–mind connection (embodiment) central to dance/movement therapy has been associated with enhanced psychological well-being in western literatures over decades [54,55]. Increased body awareness can deepen understanding of sensations and emotions, thus supporting self-regulation through heightened sensory and proprioceptive feedback. The meaningful music engaged might even provoke deep emotional responses via connection between auditory sensation to memory and social emotion consolidation [56]. The greater sense of body awareness enhanced better understanding on bodily sense and emotions [55].

In addition, positive social interaction strengthens social support networks and promotes well-being [57]. The integrated dance sessions encouraged social engagement in a relaxed, enjoyable context [58]. Dance/movement therapy has been induced a significant increase in wellbeing and socialization for elders, such as more willingness to participate in other social activities, happiness, and motivation in the face of new friendships stemming from the gathering [59].

### **Synergy effect of Body-Mind or Physical-Psychological**

The comparison between the preliminary study and this study revealed significant improvements across all tested physical and psychological metrics. These results suggest a synergetic relationship between the body and mind, where physical and psychological health function interdependently rather than in isolation. This aligns with extensive literature demonstrating the bidirectional influence of physical and mental well-being [67,68]. Furthermore, Polyvagal Theory posits that body-mind practices within social context can effectively regulate the autonomic nervous system (ANS) [53]. By modulating the ANS, which serves as a regulatory bridge for both physiological and emotional states, these practices can enhance feelings of safety while significantly reducing anxiety and fear, in addition to stronger physical functioning. The synergy effect may be the reason that may heighten more for both physical and psychological results.

### **Treatment adherence and Sustainability**

Furthermore, dance-based integrated fall prevention program with the nature of dance, a joyful activity-based intervention provides opportunity for socialisation [60,61]; it was found to enhance the adherence in a short program duration [27,62]. Compared with conventional exercise, dance tends to be more engaging, and it might lead to high intrinsic motivation with better adherence [24,25,63]. In this study, participants showed high motivation to attend the sessions ( $\geq 88\%$  participants attending  $\geq 50\%$  sessions), which were significantly higher than the suggested good attendance rate ( $\geq 75\%$  participants attending  $\geq 50\%$  sessions) contributed to the program success [13] and effectiveness [61].

Promoting self-practice at home using the recorded dance videos, which facilitated self-directed continuation of practice, likely played a role in reinforcing and sustaining the significant physical and psychological benefits observed. In order to maintain the impact from the IDMT program, a community troupe was organised. It welcomed all the participants who completed of the IDMT program to join, and further maintain regular practice of dance and exercise under minimal supervision, it might be considered as effective to maximize the positive outcomes [13].

The last but not least, IDMT program also addresses the extrinsic factors of fall, for it was considered as a cost-effective intervention compare to those advanced high-technological physical training, which was considerably highly feasible in low socioeconomic community [64,65]. The sustainability may be enhanced by the mechanism facilitated for long-term attendance, as well as health benefits, promote self-efficacy and psychological wellness, social connection and uplifting musical reactivity [56].

### **Limitations and Further research**

There were still some limitations on the sampling frame and recruitment. As this study used a single-group pre–post design without a control group, causal inference and generalisability are limited. Participants were recruited from specific community settings may represent older adults who are more motivated, socially engaged, or physically able than the general older population in the community and might lead to potential “healthy volunteer” bias. As IDMT intervention for fall prevention targeted “Dance” as a medium of service provision, the self-selected bias may limit generalizability as well, however which is considerable for it is only one of the several effective interventions for fall.

Recent geriatric world guideline highlighted that falls in older adults typically have multifactorial causes, including intrinsic functional decline, pathological conditions, risk behaviours, extrinsic environmental hazards, and socioeconomic background; experts and scholars suggested a more personalised multidomain

interventions [6]. In this study, we primary targeted on the intrinsic factors enhancing physical capacity and psychological state, while some areas we still have to develop in order to achieve a more holistic multi-component intervention. For further study, IDMT could explore on postural control [66] and sensory reaction as core elements [32]. It will examine more precisely to the mechanisms linking integrated dance interventions with psychological and social outcomes, deep down investigating the body-mind technique mechanism [17,37], as well as the cost effectiveness of a low-tech dance program [65]. Control trial or qualitative study designs might also be adopted in future research to further confirm the effectiveness, and enhance external validity to rule out the natural improvement over time.

### Conclusions

The findings of this study indicate that the integrated dance movement therapeutics (IDMT) program positively impacted on balance, mobility, fear of falling, and psychological well-being in community-dwelling older adults with greater generalizability in Hong Kong. Further rigorously designed studies are warranted to clarify the effectiveness of such interventions and to delineate this optimal therapeutic modality, and to examine a multimodal fall prevention dance program. A relatively low-cost intervention may yield a high cost effectiveness was looking forwarded as an impact to nowadays healthcare provision.

### Ethics Statement

The studies involving human participants were reviewed and approved by Human Subjects Ethics Sub-Committee of The Hong Kong Polytechnic University (ID: HSEARS20230704002). Written informed consent to participate in this study was provided by the participants.

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### Conflict of Interest

The authors declare no conflict of interest.

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### References

1. World Health Organization (2007) WHO Global Report on Falls Prevention in Older Age. Geneva: World Health Organization.
2. Census and Statistics Department (2023) Hong Kong Population Projections. Hong Kong: Census and Statistics Department.
3. Travers J, Romero-Ortuno R, Bailey J, Cooney M-T (2019) Delaying and reversing frailty: a systematic review of primary care interventions. *British Journal of General Practice*. 69: E61-E69.
4. Ní Mhaoláin AM, Gallagher D, O Connell H, Chin AV, Bruce I, et al. (2012) Subjective well-being amongst community-dwelling elders: what determines satisfaction with life? Findings from the Dublin Healthy Aging Study. *International Psychogeriatrics*. 24: 316-323.
5. Sin CK, Fu SN, Tsang CS, Tsui WW, Chan FH (2021) Prevention in primary care is better than cure: The Hong Kong reference framework for preventive care for older adults-translating evidence into practice. Revised Edition. Hong Kong: Health Bureau.
6. Montero-Odasso M, Velde NVD, Martin FC, Petrovic M, Tan MP, et al. (2022) World guidelines for falls prevention and management for older adults: a global initiative. *Age and Ageing*. 51(9).
7. Xu Q, Ou X, Li J (2022) The risk of falls among the aging population: A systematic review and meta-analysis. *Frontiers in Public Health*. 10: Article 902599.
8. Cunningham C, O' Sullivan R, Caserotti P, Tully MA (2020) Consequences of physical inactivity in older adults: A systematic review of reviews and meta-analyses. *Scandinavian Journal of Medicine & Science in Sports*. 30: 816-827.
9. Garbin A J, Fisher BE (2023) The Interplay Between Fear of Falling, Balance Performance, and Future Falls: Data from the National Health and Aging Trends Study. *Journal of Geriatric Physical Therapy*. 46: 110-115.
10. Vo MTH, Thonglor R, Moncatar TJR, Han TDT, Tejavivaddhana P, Nakamura K (2023) Fear of falling and associated factors among older adults in Southeast Asia: a systematic review. *Public Health*. 222: 215-228.
11. Qin A, Wu Y, Xin T, Xu L, Fu J (2024) Lifestyle factors and subjective well-being among older adults in China: A national community-based cohort study. *Geriatric Nursing*. 57: 232-242.
12. Chu LW, Chi I, Chiu AY (2005) Incidence and predictors of falls in the Chinese elderly. *Annals of the Academy of Medicine Singapore*. 34: 60-72.
13. Sherrington C, Whitney JC, Lord SR, Herbert RD, Cumming RG, Close JCT (2008) Effective Exercise for the Prevention of Falls: A Systematic Review and Meta-Analysis. *JAGS: Journal of the American Geriatrics Society*. 56: 2234-2243.
14. Ganz DA, Latham NK (2020) Prevention of Falls in Community-



- Dwelling Older Adults. *The New England Journal of Medicine*. 382: 734-743.
15. Deandrea S, Lucenteforte E, Bravi F, Foschi R, La Vecchia C, Negri E (2010) Risk Factors for Falls in Community-dwelling Older People : A Systematic Review and Meta-analysis. *Epidemiology*. 21: 658-668.
16. Colón-Emeric CS, McDermott CL, Lee DS, Berry SD (2024) Risk Assessment and Prevention of Falls in Older Community-Dwelling Adults: A Review. *JAMA : The Journal of the American Medical Association*. 331: 1397-1406.
17. Pitluk Barash M, Shuper Engelhard E, Elboim-Gabyzon M, Gidron Y (2025) Effects of Physical Therapy Integrated with Dance/Movement Therapy on Heart Rate Variability and Fall-Related Variables: A Preliminary Controlled Trial. *American Journal of Dance Therapy*. 47: 3-22.
18. El-Khoury F, Cassou B, Charles M-A, Dargent-Molina P (2013) The effect of fall prevention exercise programmes on fall induced injuries in community dwelling older adults: systematic review and meta-analysis of randomised controlled trials. *BMJ: British Medical Journal*. 347: Article f6234.
19. Thomas E, Battaglia G, Patti A, Brusa J, Leonardi V, et al. (2019) Physical activity programs for balance and fall prevention in elderly: A systematic review. *Medicine*. 98: Article 16218.
20. Kong KS-W, Lee F-K, Mackenzie AE, Lee DTF (2002) Psychosocial consequences of falling: the perspectives of older Hong Kong Chinese who had experienced falls. *Journal of Advanced Nursing*. 37: 234-242.
21. Fernández-Argüelles EL, Rodríguez-Mansilla J, Antunez LE, Garrido-Ardila EM, Muñoz RP (2015) Effects of dancing on the risk of falling related factors of healthy older adults: A systematic review. *Archives of Gerontology and Geriatrics*. 60: 1-8.
22. Bull FC, Al-Ansari SS, Biddle S, Borodulin K, Buman MP, et al. (2020) World Health Organization 2020 guidelines on physical activity and sedentary behaviour. *British Journal of Sports Medicine*. 54.
23. World Health Organization (2022) Global status report on physical activity. Geneva: World Health Organization.
24. Blanco-Rambo E, Bandeira-Guimarães M, Vieira AF, Pietta-Dias C, Izquierdo M, Cadore EL (2022) Dance as an intervention to reduce fall risk in older adults : a systematic review with a meta-analysis. *Journal of aging and physical activity*. 30: 1118-1132.
25. Kaltsatou AC, Kouidi EI, Anifanti MA, Douka SI, Deligiannis AP (2014) Functional and psychosocial effects of either a traditional dancing or a formal exercising training program in patients with chronic heart failure : a comparative randomized controlled study. *Clinical Rehabilitation*. 28.
26. Rehfeld K, Lüders A, Hökelmann A, Lessmann V, Kaufmann J, et al. (2018) Dance training is superior to repetitive physical exercise in inducing brain plasticity in the elderly. *PLoS One*. 13: Article e0196636.
27. Fong Yan A, Cobley S, Chan C, Pappas E, Nicholson LL, et al. (2018) The Effectiveness of Dance Interventions on Physical Health Outcomes Compared to Other Forms of Physical Activity: A Systematic Review and Meta-Analysis. *Sports Medicine*. 48: 933-951.
28. Mattle M, Chocano-Bedoya PO, Fischbacher M, Meyer U, Abderhalden LA, et al. (2020) Association of Dance-Based Mind-Motor Activities with Falls and Physical Function Among Healthy Older Adults: A Systematic Review and Meta-analysis. *JAMA Network Open* 3: Article 17688.
29. Li Y, Wang Z, Li J, Yang H, Fang Z (2024) The effects of dance interventions on reducing the risk of falls in older adults: a network meta-analysis. *Frontiers in Public Health*. 12: Article 1496692.
30. Merom D, Cumming R, Mathieu E, Anstey KJ, Rissel C, et al. (2013) Can social dancing prevent falls in older adults? a protocol of the Dance, Aging, Cognition, Economics (DAnCE) fall prevention randomised controlled trial. *BMC Public Health* 13(1).
31. Lazo Green K, Yang Y, Abaraogu U, Eastaugh CH, Beyer FR, et al. (2024) Effectiveness of dance interventions for falls prevention in older adults: systematic review and meta-analysis. *Age and Ageing*. 53: afae104.
32. Nieciecka A, Cyls D, Pasek K, Kędziora-Kornatowska K (2023) Dance as an Element of Prevention and Treatment of Falls, Depression and Dementia in the Geriatric Population. *Journal of Health Study and Medicine*. 1:73-86.
33. Maxine SJ (2010) Why is Movement Therapeutic? (Keynote of the 44th American Dance Therapy Association Conference; 2009 October 9). *American Journal of Dance Therapy*. 32: 2-15.
34. Koch S, Kunz T, Lykou S, Cruz R (2014) Effects of dance movement therapy and dance on health-related psychological outcomes: A meta-analysis. *The Arts in Psychotherapy*. 41: 46-64.
35. Koch SC, Riege RFF, Tisborn K, Biondo J, Martin L, et al. (2019) Effects of Dance Movement Therapy and Dance on Health-Related Psychological Outcomes. A Meta-Analysis Update. *Frontiers in Psychology*. 10: 1806.
36. Veronese N, Maggi S, Schofield P, Stubbs B (2017) Dance movement therapy and falls prevention. *Maturitas*. 102:1-5.
37. Pitluk Barash M, Shuper Engelhard E, Elboim-Gabyzon M (2023) Feasibility and Effectiveness of a Novel Intervention Integrating Physical Therapy Exercise and Dance Movement Therapy on Fall Risk in Community-Dwelling Older Women: A Randomized Pilot Study. *Healthcare (Basel)*. 11: 1104.
38. Crista YY Kwok , VWC Yim, Sabrina KYIP, Augustine CY Mok, Dorcas NS Ung et al. (2024) Integrated Dance and Dance Movement Therapeutics (IDDMT) To Fall Prevention among Chinese Community-Dwelling Older Adults: The Preliminary Findings. *International Journal of Nursing and Health Care Research*. 7: 1556.
39. Springer BA, Marin R, Cyhan T, Roberts H, Gill NW (2007) Normative Values for the Unipedal Stance Test with Eyes Open and Closed. *Journal of Geriatric Physical Therapy*. 30: 8-15.
40. Michikawa T, Nishiwaki Y, Takebayashi T, Toyama Y (2009) One-leg standing test for elderly populations. *Journal of Orthopaedic Science : Official Journal of the Japanese Orthopaedic Association*. 14: 675-685.
41. Podsiadlo D, Richardson S (1991) The Timed "Up & Go": A Test of Basic Functional Mobility for Frail Elderly Persons. *JAGS: Journal of the American Geriatrics Society*. 39: 142-148.
42. Chan PP, Si Tou JI, Tse MM, Ng SS (2017) Reliability and Validity of the Timed Up and Go Test With a Motor Task in People With Chronic Stroke. *Archives of Physical Medicine and Rehabilitation*. 98: 2213-2220.

43. Shumway-Cook A, Brauer S, Woollacott M (2000) Predicting the Probability for Falls in Community-Dwelling Older Adults Using the Timed Up & Go Test. *Physical Therapy*. 80: 896-903.
44. Centers for Disease Control and Prevention (2017) Assessment Timed Up and Go. United States: National Center for Injury Prevention and Control.
45. Nordin E, Rosendahl E, Lundin-Olsson L (2006) Timed "Up & Go" Test: Reliability in Older People Dependent in Activities of Daily Living- Focus on Cognitive State. *Physical Therapy*, 86: 646-655.
46. Bower ES, Wetherell JL, Merz CC, Petkus AJ, Malcarne VL, et al. (2015) A new measure of fear of falling: psychometric properties of the fear of falling questionnaire revised (FFQ-R). *International Psychogeriatrics*, 27: 1121-1133.
47. Topp CW, Østergaard SD, Søndergaard S, Bech P (2015) The WHO-5 Well-Being Index: A Systematic Review of the Literature. *Psychotherapy and Psychosomatics*. 84: 167-176.
48. Heun R, Bonsignore M, Barkow K, Jessen F (2001) Validity of the five-item WHO Well-Being Index (WHO-5) in an elderly population. *European Archives of Psychiatry and Clinical Neuroscience*. 251: 27-31.
49. Callis N (2016) Falls prevention: Identification of predictive fall risk factors. *Applied Nursing Research*, 29: 3-58.
50. Kruschke C, Butcher HK (2017) Evidence-Based Practice Guideline: Fall Prevention for Older Adults. *Journal of Gerontological Nursing*. 43: 15-21.
51. Pitluk Barash M, Elboim-Gabyzon M, Shuper Engelhard E (2023) Investigating the emotional content of older adults engaging in a fall prevention exercise program integrated with dance movement therapy: a preliminary study. *Frontiers in Psychology*. 14: 1260299.
52. Thaut MH, Rice RR, Braun Janzen T, Hurt-Thaut CP, McIntosh GC (2019) Rhythmic auditory stimulation for reduction of falls in Parkinson's disease: a randomized controlled study. *Clinical Rehabilitation*. 33: 34-43.
53. Porges, Stephen W, Sue Carter (2017) "Polyvagal theory and the social engagement system." In *Complementary and integrative treatments in psychiatric practice*, by Patricia L., Philip R. Muskin, and Richard P. Brown, eds. Gerburg, 221-250. United States: American Psychiatric Association Publishing.
54. Berrol CF (1992) The neurophysiologic basis of the mind-body connection in dance/movement therapy. *American Journal of Dance Therapy*, 14: 19-29.
55. Hanley A, Warner A, Garland EL (2015) Associations Between Mindfulness, Psychological Well-Being, and Subjective Well-Being with Respect to Contemplative Practice. *Journal of Happiness Studies*. 16: 1423-1436.
56. Haynes A, Tiedemann A, Hewton G, Chenery J, Sherrington C, et al. (2023) "It doesn't feel like exercise": a realist process evaluation of factors that support long-term attendance at dance classes designed for healthy ageing. *Frontiers in Public Health*. 11:1284272.
57. Lent RW, Singley D, Sheu HB, Gainor KA, Brenner BR, et al. (2005) Social Cognitive Predictors of Domain and Life Satisfaction: Exploring the Theoretical Precursors of Subjective Well-Being. *Journal of Counseling Psychology*. 52: 429-442.
58. Fong Yan A, Nicholson LL, Ward RE, Hiller CE, Dovey K, et al. (2024) 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 Medicine (Auckland)*. 54: 1179-1205.
59. Pessoa RF, Neves CM, Ferreira MEC (2019) Dance therapy in aging: A systematic review. *Journal of Physical Education and Sport*. 19: 1180-1187.
60. Murrock CJ, Graor CH (2016) Depression, Social Isolation, and the Lived Experience of Dancing in Disadvantaged Adults. *Archives of Psychiatric Nursing*. 30: 27-34.
61. Franco MR, Sherrington C, Tiedemann A, Pereira LS, Perracini MR, et al. (2016) Effectiveness of Senior Dance on risk factors for falls in older adults (DanSE): a study protocol for a randomised controlled trial. *BMJ Open*. 6: e013995.
62. Robinson L, Newton JL, Jones D, Dawson P (2014) Self-management and adherence with exercise-based falls prevention programmes: a qualitative study to explore the views and experiences of older people and physiotherapists. *Disability and Rehabilitation*. 36: 379-386.
63. Thomsen MJ, Liston M, Christensen MG, Vestergaard P, Hirata RP (2022) Dancing Against falls in Community-dwelling older adults (DANCE): a study protocol of a stratified, block-randomised trial. *Injury Prevention*. 28: 93-101.
64. Winser S, Chan H, Lam H, Lau S, Lau T, et al. (2020) Dosage for cost-effective exercise-based falls prevention programs for older people : a systematic review of economic evaluations. *Elsevier Masson. Ann Phys Rehabil Med* 63: 69-80.
65. Goldsmith S, Kokolakis T (2021) A cost-effectiveness evaluation of Dance to Health: a dance-based falls prevention exercise programme in England. *Public Health (London)*. 198: 17-21.
66. Purkart B, Bertoncelj B, Podlogar A, Pavletic MS (2023) Improving Postural Stability in Active Older Adults: Argentine Tango Dance as an Alternative Fall-prevention Strategy. *Alternative Therapies in Health and Medicine*. 29: 201-209.
67. Steinmo S, Hagger-Johnson G, Shahab L, Kivimaki M, Brunner EJ, et al. (2014) Bidirectional association between mental health and physical activity in older adults: Whitehall II prospective cohort study. *Preventive Medicine*. 66: 74-79.
68. Firth J, Siddiqi N, Koyanagi A, Siskind D, Rosenbaum S, et al. (2019) The Lancet Psychiatry Commission: a blueprint for protecting physical health in people with mental illness. *The Lancet Psychiatry*. 6: 675-712.