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# The efficacy of a mindfulness-based exercise program in older residents of a long-term care facility in Taiwan☆

Chun-Chin Tsai, Ph.D, Associate professor[a], Hsiu-Li Lee, MS, Health Promotion team Chief[b], Chia-Shan Wu, RN, PhD, Assist professor[c], Pin-Yu Chen, University Student[d], Ting-Wei Chen, College Student[d], Mei-Fang Chen, RN, Ph.D, Professor[c,*]

[a] Department of Refrigeration, Air-Conditioning and Energy Engineering, Far East University, Taiwan, ROC
[b] Veterans Affairs Council Tainan Veterans Home, Taiwan, ROC
[c] Department of Nursing, National Tainan Junior College of Nursing, 78, Sec. 2, Min-Tsu Rd., Tainan City 700, Taiwan, ROC
[d] Department of Nursing, Fooyin University, 151 Jinxue Rd., Daliao Dist., Kaohsiung City 83102, Taiwan, ROC

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ABSTRACT

Older people living in long-term care facilities remain largely inactive, and therefore promoting exercise in this population is necessary. This study evaluated the efficacy of a mindfulness-based exercise program in older residents of a long-term care facility in Taiwan. A convenience sample of 72 older residents of a long-term care facility were recruited and assigned to either an experimental group or a control group. The experimental group ($n = 36$) participated in an 8-week mindfulness-based exercise program, and the control group ($n = 36$) received routine care. The generalized estimating equation showed significantly larger improvements in a fear of falling, exercise self-efficacy, dynamic balance, and muscle strength in the experimental group than in the control group from baseline to the end of the intervention and 3 months after the end of the intervention. This study provides a reference for how to improve exercise practice in older people living in long-term care facilities.



What is already known about the topic?

- Despite the benefits of exercise for older people, long-term care facility residents remain largely inactive.
- Promoting adherence to exercise in older people is important and needs to consider psychological factors.
- A fear of falling and exercise self-efficacy influence the level of exercise in older people.

What this paper adds

- We developed a mindfulness-based exercise program for older people residing in long-term care facilities.
- The mindfulness-based exercise program significantly improved the fear of falling, exercise self-efficacy, dynamic balance and muscle strength.

## Introduction

Exercise can promote physical, psychological and social health in older people.[1] Despite the benefits of exercise for older people, those living in long-term care facilities remain largely inactive because of low exercise self-efficacy and a fear of falling (FOF), with 40% to 70% of long-term care facility residents reporting a FOF.[2–4] A FOF is a person's anxiety towards usual or normal walking or ambulation, with the perception that a fall will occur whether or not there has been a fall experience in the past.[2] Exercise self-efficacy refers to an individual's self-perceived abilities and willingness to exercise.[5] FOF and low exercise self-efficacy may reduce the level of exercise participation, which may then reduce social interactions and further lead to a reduction in physical function and self-care ability, depression, and worse quality of life. This subsequently becomes a vicious circle of FOF, low self-efficacy, reduced physical activity, and poor physical, psychological and social function.[2,4] To promote exercise in older people, it is important to decrease a FOF, improve exercise self-efficacy and consequently improve physical function, especially among older people living in long-term care facilities.[6]

Promoting adherence to exercise in older people cannot be just about teaching exercise, it needs to start from a psychological

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*Correspondence author.
*E-mail address:* meifang0302@gmail.com (M.-F. Chen).

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level.[2,7] Mindfulness-based interventions can effectively stabilize a psychological state and re-establish the ability to exercise.[8,9] Mindfulness is commonly defined as a compassionate way of knowing and being aware in the present moment without judgment.[10] The founder of mindfulness-based stress reduction, Kabat-Zinn, was the first to apply mindfulness-based interventions to athletes. Practicing mindfulness-based interventions has been shown to help athletes to perceive and identify emotions without evaluating or coexisting with them, and then through the usual practice of mindfulness techniques to focus all awareness on the present, to further improve a flow state and achieve their best performance. If mindfulness can be combined with exercise, it can not only improve physical function, but also improve mental health and make exercise more efficient.[9,11]

Mindfulness-based interventions are a suitable activity for older people, and they have been shown to lead to improvements in executive function and depression.[12,13] The second character of the Chinese word for mindfulness (正念) represents the “present mind” (今心), and mindfulness (正念) means putting the mind in the present moment. Connecting mindfulness and exercise emphasizes focusing on the present moment of the exercise, so as to improve concentration and focus on the contraction and relaxation of muscles during exercise and increase the sensation, which can increase exercise effectiveness.[11,14] Mindfulness-based exercises include "Outer Wisdom" and "Inner Wisdom".[15] Outer wisdom is the knowledge of motion. Inner wisdom enables the individual to perceive the body's response and regulation of movement through the practice of mindful behavior.[15] Mindfulness can help older people to be aware of their own behavior, and then put aside past unhealthy habits and change their behavior with an accepting and non-judgmental attitude, calmly face the world in which they live, and focus on living in the present, thereby reducing emotional responses (ie, FOF) and increasing confidence in exercising.[16] In addition, improving the psychological barriers of exercise and increasing self-confidence, so as to promote individual exercise, can improve the physical function of older people. Dynamic balance and muscle strength are important physical functions which can prevent falls.[17] To the best of our knowledge, no mindfulness-based exercise programs have been proposed for older people to reduce a FOF and improve exercise self-efficacy and physical function. Therefore, the aim of this study was to develop and assess the effectiveness of a mindfulness-based exercise program in older residents of a long-term care facility in Taiwan. We hypothesized that older people exposed to a mindfulness-based exercise program would demonstrate improvements in psychological outcomes (i.e., FOF, exercise self-efficacy) and physical function (i.e., dynamic balance and muscle strength) when compared to those who are exposed to routine care.

## Methods

### *Study design*

This quasi-experimental study was based on an intervention-control design.

### *Sample*

The participants were older people recruited by convenience sampling from a veterans' home in Taiwan. The veterans’ home is for veterans who are physically or mentally handicapped due to war or are general seniors over 65 years old, and it is a long-term care facility. The inclusion criteria were as follows: (a) age at least 65 years, (b) be able to communicate in Mandarin or Taiwanese, and (c) have a Short Portable Mental Status Questionnaire (SPMSQ) score ≥8 points. Older people with dementia were excluded from the study.

The sample size for this study was calculated using G power software. A previous mindfulness study indicated an effect size of 0.65 for psychological research in older people.[12] Given the effect size of 0.65, an alpha value of 0.05 and a power of 0.8, the estimated sample size needed was 60 (30 participants in each group). Assuming a 20% attrition rate, 36 participants were required for each group.

### *Procedure*

The researchers contacted the directors of the veterans' home in advance of this study to inform them of the purpose of the study and to ask them to post an announcement. After a 1-month pre-intervention, the announcement was posted on bulletin boards at the veterans' home with details of the study and to invite older people to participate. The study was performed from February 2021 to October 2021. To avoid bias and contamination, we used different areas of the veterans' home. Participants from one area were enrolled as the experimental group, and participants from the other area were enrolled as the control group. The recruitment activities took place on the same day. All of the enrolled participants completed a consent form to participate in the study.

The mindfulness-based exercise program was conducted for 100 minutes per session for a total of 8 weeks. Only the participants who completed all 8 sessions were included in the data analysis.

In order to encourage the older people to participate in all 8 sessions, veterans' home staff reminded the residents to participate one day before each session, and they then brought the older people to participate in each session. Each session was led by the same researchers to ensure consistency of the intervention measures. To evaluate the immediate and short-term effectiveness of the program, outcomes were measured at baseline (T0), at the end of the intervention (T1), and at 3 months after the end of the intervention (T2).

### *Intervention group*

The 8-week mindfulness-based exercise program was designed to educate people about how to incorporate mindfulness while exercising. One 100-minute session was conducted per week. The mindfulness-based exercises were developed using "Outer Wisdom" and "Inner Wisdom" (see Table 1). For outer wisdom, the participants were given exercise cards for that week. To attract the interest of the participants, the words on the cover of the cards were written in Mandarin in a large font with vivid colors. The front of the card provided information on the motor muscles, and the back of the card showed the movements (Fig. 1). In addition, a QR code on the back of the card linked to a video for how to perform the exercises when scanned. A nursing educator from the research team informed the participants about the exercises and muscle groups that would be taught that session, and showed them how to scan the QR code on the card; this took about 20 minutes. For inner wisdom, a mindfulness teacher certified by the University of Oxford instructed the participants about how to practice body scan, breathing meditation, mindfulness-belief development ("pause" techniques: non-evaluative, acceptance to build confidence, allow/as it is), discuss and detect factors of movement and inactivity, exercise body muscles with or without an elastic band and so on; this took about 80 minutes. After completing the first day, the participants in the experimental group were asked to keep the exercise cards and practice the exercises on non-study days. They were encouraged to practice for at least 30 minutes a day. To check whether they practiced on non-study days, a researcher asked them to record in a notebook when they practiced the mindfulness-based exercises. The content validity of the mindfulness-based exercise program was examined by five experts (two nursing educators, two exercise educators, and one researcher with experience in conducting research on older people).

**Table 1**
Content of a mindfulness-based exercise program.

| Course | Main Topic | Content |
|---|---|---|
| 1 | Mindfulness sets sail: Start by focusing on the present | External wisdom:<br>1. Demonstration and discuss body mechanics (lying to sitting, sitting to standing, standing to walking).<br>2. Recognizing head, eyes, face, chewing, swallowing and neck muscle contraction and relaxation (exercise cards).<br>Inner wisdom: Raising exercises, body scans, head, eye, face, chewing, swallowing and neck muscle exercises. |
| 2 | Awaken from autopilot mode | External wisdom:<br>1. Review and practice body mechanics (lying to sitting, sitting to standing, standing to walking)<br>2. Review head, eyes, face, chewing, swallowing and neck muscle contraction and relaxation (exercise cards).<br>Inner wisdom: body scan, mindful walking, awareness practice, head, eyes, face, chewing, swallowing and neck muscle exercises.<br>Practice self-acceptance and forgiveness. |
| 3 | Identify responses: aware of one's interest in exercise | External wisdom:<br>Upper body muscle (hands, chest, back) contraction and relaxation (exercise card).<br>Inner wisdom: body scan, mindful walking, awareness practice, breathing meditation, discuss and detect factors of movement and inactivity, exercise upper body muscles with or without an elastic band. |
| 4 | The relationship between internal and external environment and exercise | External wisdom:<br>Upper body muscle (hands, chest, back) contraction and relaxation (exercise card).<br>Inner wisdom: body scan, breathing meditation, mindful walking, awareness practice, exercise of upper body muscles with or without an elastic band and discuss and perceive the connection between movement and bodily sensations (dynamic scanning). |
| 5 | Mindfulness belief development (building self-confidence, allow/as it is) | External wisdom:<br>Lower body muscle (abdomen, hips, thighs, calves and soles) contraction and relaxation (exercise cards)<br>Inner wisdom: body scan, breathing meditation, mindfulness-belief development (pause, non-evaluative, acceptance to build confidence, allow/as it is techniques), discuss the connection between movement and bodily sensations. Exercise lower body muscles with or without an elastic band and discuss and perceive the connection between movement and bodily sensations (dynamic scanning). |
| 6 | The joy and power of living in the moment | External wisdom: review lower body muscle (abdomen, hips, thighs, calves and soles) contraction and relaxation (exercise cards).<br>Inner wisdom: body scan, breathing meditation, mindfulness-belief practice (pause, non-evaluative, acceptance to build confidence, allow/as it is techniques), exercise lower body muscles with or without an elastic band, discuss arranging your mindfulness movements, life and obstacles. |
| 7 | How to take better care of yourself | External wisdom: review whole body muscle contraction and relaxation (exercise card).<br>Inner wisdom: body scan, breathing meditation, mindfulness-belief practice, exercise whole body muscle contraction and relaxation with or without an elastic band, apply your own mindfulness-based exercises into daily life. |
| 8 | A mindful exercise life | External wisdom: review whole body muscle contraction and relaxation (exercise card).<br>Inner wisdom: body scan, breathing meditation, mindfulness-belief practice, exercise whole body muscle contraction and relaxation with or without an elastic band, discuss how to apply your own mindfulness-based exercise into daily life. |

*Control group: usual care*

The control group participated in routine activities (such as singing, reading newspapers, and religious activities) at the veterans' home.

*Measurements*

Outcomes were assessed in terms of questionnaire results and physical function. The structured questionnaires used in this study were the Short International Falls Efficacy Scale and Exercise Self-efficacy Scale. Personal characteristics were recorded, and physical function was assessed using two items of dynamic balance and muscle strength.

*Structured questionnaires*

*Fear of falling*

FOF was assessed using the Short International Falls Efficacy Scale (Short Falls Efficacy Scale International, Short FES-I) developed by Todd and Yardley, members of the European Fall Prevention Network (ProFaNE). The scale consists of seven questions assessing whether older people have self-confidence and independent execution ability in seven daily life activities. Each item is measured on a 4-point scale ranging from 0 (Not at all concerned) to 4 points (Very concerned). The higher the score, the greater the FOF while performing daily activities.[18] The Short FES-I has been shown to have good criterion-related validity and reliability, with Cronbach's alpha of 0.89.[19] In this study, the content validity index was 0.96 and Cronbach's $\alpha$ was 0.88.

*Exercise self-efficacy*

Exercise self-efficacy was assessed using the Exercise Self-efficacy Scale,[20] a 15-item scale designed to assess the degree of confidence with which the exercise behavior can be performed when faced with a situation that hinders exercise. The items are scored from 0 (never) to 10 points (always). The higher the score, the better the exercise self-efficacy. The Exercise Self-efficacy Scale has been shown to have good psychometric properties in older Taiwanese adults. In this study, the content validity index was 0.94 and Cronbach's $\alpha$ was 0.90.

*Personal characteristics*

Personal characteristics including demographic data (sex, age, education level, religion, marital status, whether or not the participant had children) and disease history were recorded.

*Physical function*

*Dynamic balance*

Dynamic balance was assessed using the Timed Up and Go test (TUGT). This test records the time in seconds it takes to make a circuit starting from seating. The participants started in a seated position, stood up upon the therapist's command, walked 3 meters, turned around, walked back to the chair, and sat down. A timer was started when the instruction was issued and stopped when the subject was seated.[21] The shorter the time, the better the dynamic balance.


**Fig. 1.** (A) The fronts of the cards-front body muscle. (B) The backs of the cards- front body muscle exercise. (C) The fronts of the cards-back body muscle. (D) The backs of the cards-back body muscle exercise.

*Muscle strength*

Muscle strength was measured using the 30 s Chair Stand test. The participants were asked to sit on a 43-cm-high chair with their arms crossed at the wrists and held against their chest. They were asked to stand with their back straight, and then sit down again to regain the starting position (one cycle is usually called "sit-to stand-to-sit"). The participants completed as many 'stand ups' as possible within 30 s. The score was the total number of stands executed correctly within 30 s. The higher the number of completions, the better the lower limb muscle strength. The reliability of this strength test is high ($r = 0.92$).[22]

*Data collection*

This study was approved by the Human Research Ethics Committee of National Cheng-Kung University (NCKU HREC-E-110-055-2). The structured questionnaires were used to collect outcome data at T0, T1, and T2. All questionnaires were administered by a trained research assistant who was blinded to the group assignments and

who did not provide any services to the participants. Each participant took approximately 20 minutes to complete the questionnaires. Personal characteristics were collected only at T0.

*Data analysis*

Statistical analysis was performed using SPSS version 22 (SPSS Inc., Armonk, NY, USA). The chi-square test was used to examine group differences in personal characteristics. The paired-sample t test was used to compare intragroup differences in outcome variables between T0 and T1, between T0 and T2, and between T1 and T2. A generalized estimating equation (GEE) model was used to identify the independent effects of the exercise program, to consider within-person variability, and to account for correlated data resulting from repeated measurements across different time points and multiple observations of the same individual.[23] The interaction effects of group and time on outcome variables were examined using the GEE model.

## Results

*Characteristics and outcome variables at T0 in the experimental and control groups*

Of the 80 participants evaluated for eligibility, 8 declined to participate, and the remaining 72 eligible subjects consented to participate in the study. All participants in the experimental group completed all 8 sessions (attendance rate, 100%). None of the participants in either group were lost to follow-up at T1 or T2. Finally, 36 participants in the experimental group and 36 in the control group completed the study. The average age was 81.9 years in the experimental group and 83.1 years in the control group. Both groups had 100% retention rates at both T1 and T2. Table 2 shows that the personal characteristics did not significantly differ between the two groups at T0, indicating intergroup homogeneity.

*Differences in outcome variables within and between the experimental and control groups*

As shown in Table 3, the participants in the experimental group had significant improvements in FOF, exercise self-efficacy, dynamic balance, and muscle strength from T0 to T1 as well as from T0 to T2. In the control group, there were no significant differences in FOF, exercise self-efficacy, dynamic balance, or muscle strength between T0 and T1, between T0 and T2, or between T1 and T2. Statistically significant interaction effects between time and group were observed in FOF, exercise self-efficacy, dynamic balance, and muscle strength. After adjusting for FOF, exercise self-efficacy, dynamic balance, and muscle strength at T0, the improvements in the experimental group were significantly larger than those in the control group from T0 to T1, and from T0 to T2 in FOF ($\beta = -7.19$, 95% CI = −9.75/-4.64, $p < .001$; $\beta = -7.11$, 95% CI = −9.68/−4.55, $p < .001$), exercise self-efficacy ($\beta = 30.83$, 95% CI = 19.52/42.20, $p < .001$; $\beta = 30.86$, 95% CI = 19.50/42.17, $p < .001$), dynamic balance ($\beta = -1.54$, 95% CI = −2.46/−0.62, $p = .001$; $\beta = -1.76$, 95% CI = −2.77/0.76, $p = .001$), and muscle strength ($\beta = 1.78$, 95% CI = 1.07/2.48, $p < .001$; $\beta = 3.36$, 95% CI = 2.37/4.35, $p < .001$).

## Discussion

The experimental group improved significantly more than the control group in terms of FOF, exercise self-efficacy, dynamic balance, and muscle strength at 3 months after completing the intervention. These findings indicated the efficacy of the mindfulness-based exercise program in having a short-term positive effect on psychological and physical outcomes in the older residents.

**Table 2**
Summary of personal characteristics by group.

| Variables | Experimental group *n* (%) | Control group *n* (%) | $\chi^2$ | *p* |
|---|---|---|---|---|
| Sex | | | | |
| Male | 20(55.6) | 22(61.1) | .23 | .811 |
| Female | 16(44.4) | 14(38.9) | | |
| Age (years) | | | | |
| 70 and below | 5(13.9) | 3(8.3) | 1.18 | .754 |
| 71–80 | 12(33.3) | 14(38.9) | | |
| 81–90 | 15(41.7) | 13(36.1) | | |
| Above 90 | 4(11.1) | 6(16.7) | | |
| Education level | | | | |
| Elementary school and no formal education | 11(30.6) | 13(36.1) | 1.61 | .447 |
| Junior or senior high school | 17(47.2) | 19(52.8) | | |
| College or higher | 8(22.2) | 4(11.1) | | |
| Marital status | | | | |
| Single | 27(75.0) | 30(83.3) | 1.96 | .376 |
| Married | 2(5.6) | 3(8.3) | | |
| Divorce or widowed | 7(19.4) | 3(8.3) | | |
| Whether having children | | | | |
| Yes | 31(86.1) | 26(72.2) | 2.11 | .147 |
| No | 5(13.9) | 10(27.8) | | |
| Disease history | | | | |
| None | 5(13.9) | 4(11.1) | 5.43 | .490 |
| Hypertension | 4(11.1) | 5(13.9) | | |
| Heart Disease + hypertension | 6(16.7) | 14(38.9) | | |
| Diabetes | 4(11.1) | 2(5.6) | | |
| Respiratory disease | 4(11.1) | 3(8.3) | | |
| Gastrointestinal disease | 3(8.3) | 2(5.6) | | |
| Osteoporosis | 10(27.8) | 6(16.7) | | |
| Duration of nursing home stay | | | | |
| Under 5 year | 16(44.4) | 12(33.3) | 1.69 | .793 |
| 5–10 year | 8(22.2) | 7(19.4) | | |
| 11–15 year | 3(8.3) | 4(11.1) | | |
| 16–20 year | 5(13.9) | 6(16.7) | | |
| Above 20 year | 4(11.1) | 7(19.4) | | |
| Past falling experience(times) | | | | |
| None | 23(63.9) | 20(55.6) | 1.08 | .583 |
| 1–2 | 9(25.0) | 13(36.1) | | |
| 3–5 | 4(11.1) | 3(8.3) | | |

The components of outer wisdom of mindfulness in this study included body mechanics, muscle contraction and relaxation of the whole body using demonstration, discussion, and exercise cards. The components of inner wisdom of mindfulness in this study included body scans, mindful exercise practice, awareness, self-acceptance and forgiveness practice. External wisdom allowed the residents to learn how to do movements in place, not just actions. Inner wisdom guided the residents to discover the needs of their bodies, perceive the inertial reaction, focus on the muscles used during the movement, sensory system, and adjust the movement to suit the body without judgment. Integration of outer and inner wisdom of mindfulness could help the residents to be aware, observe and adjust their body and mind to further practice exercise. These principles are consistent with studies indicating that mindfulness is a mind-body practice which can effectively stabilize the emotional state, re-establish the ability to exercise, and improve the overall psychological and physical state.[24]

Regarding psychological outcomes, the participants in the experimental group had significant improvements in FOF and exercise self-efficacy from T0 to T2. These results are consistent with previous studies which have reported that mindfulness-based interventions can promote the mental health of athletes, promote the flow state, and improve on-the-spot performance.[11,25] Three possible mechanisms may explain our findings. First, the outer wisdom used in this study taught about body function from lying to walking, the exercises and muscle groups. In addition, the participants were given cards as a reference to practice the exercises on non-study days. This facilitated exercising by assimilating the knowledge of external wisdom into

**Table 3**
Difference in outcome variables within and between the experimental and control Groups.

| Variables | Fear of falling | | | | Exercise self-efficacy | | | |
|---|---|---|---|---|---|---|---|---|
| | Mean (SD) | B | 95% CI | *p* Value | Mean (SD) | B | 95% CI | *p* Value |
| Intercept | | 15.56 | 13.25/17.87 | <.001 | | 59.94 | 49.45/70.44 | <.001 |
| Group (EG vs. CG) | | 1.78 | −1.60/5.16 | .302 | | 1.42 | −13.85/16.68 | .856 |
| Time overall | | | | <.001 | | | | <.001 |
| EG at T2 | 10.14(3.02) | | | | 92.89(19.87) | | | |
| EG at T1 | 10.31(3.08) | | | | 92.67(19.89) | | | |
| EG at T0 | 17.33(7.65) | | | | 61.36(34.42) | | | |
| CG at T2 | 15.47(6.85) | | | | 59.94(32.59) | | | |
| CG at T1 | 15.72(7.11) | | | | 60.42(32.07) | | | |
| CG at T0 | 15.56(7.17) | | | | 60.61(32.15) | | | |
| EG at T1 vs. EG at T0 | −7.03(7.86) | | −9.69/−4.37 | <.001 | 31.31(35.12) | | 19.42/43.19 | <.001 |
| EG at T2 vs. EG at T0 | −7.19(7.83) | | −9.85/−4.54 | <.001 | 31.53(35.13) | | 19.64/43.41 | <.001 |
| EG at T2 vs. EG at T1 | −1.67(0.74) | | −0.42/0.08 | .183 | 0.22(0.64) | | 0.01/0.44 | .044 |
| CG at T1 vs. CG at T0 | 0.17(1.00) | | −0.17/0.50 | .324 | 0.47(2.36) | | −0.33/1.27 | .238 |
| CG at T2 vs. CG at T0 | −0.08(1.44) | | −0.57/0.40 | .731 | 0.68(2.27) | | −0.10/1.43 | .086 |
| CG at T2 vs. CG at T1 | −0.25(1.42) | | −0.73/0.23 | .299 | 0.19(0.62) | | −0.02/0.41 | .070 |
| Time*Group overall | | | | <.001 | | | | <.001 |
| EG * (T1 vs. T0) vs. CG * (T1 vs. T0) | | −7.19 | −9.75/−4.64 | <.001 | | 30.83 | 19.52/42.20 | <.001 |
| EG * (T2 vs. T0) vs. CG * (T2 vs. T0) | | −7.11 | −9.68/−4.55 | <.001 | | 30.86 | 19.50/42.17 | <.001 |

| Variables | Dynamic balance | | | | Muscle strength | | | |
|---|---|---|---|---|---|---|---|---|
| | Mean (SD) | B | 95% CI | *p* Value | Mean (SD) | B | 95% CI | *p* Value |
| Intercept | | 10.43 | 8.70/12.16 | <.001 | | 16.47 | 13.18/19.76 | <.001 |
| Group (EG vs. CG) | | .71 | −1.81/3.22 | .582 | | −0.92 | −5.35/3.52 | .685 |
| Time overall | | | | .002 | | | | <.001 |
| EG at T2 | 9.42(2.98) | | | | 18.78(7.58) | | | |
| EG at T1 | 9.67(3.30) | | | | 17.06(8.54) | | | |
| EG at T0 | 11.14(5.67) | | | | 15.56(9.23) | | | |
| CG at T2 | 10.47(5.15) | | | | 16.47(10.20) | | | |
| CG at T1 | 10.50(5.25) | | | | 16.28(9.76) | | | |
| CG at T0 | 10.43(5.37) | | | | 16.39(9.89) | | | |
| EG at T1 vs. EG at T0 | −1.47(2.78) | | −2.41/−0.53 | .003 | 1.50(1.89) | | 0.86/2.14 | <.001 |
| EG at T2 vs. EG at T0 | −1.72(3.03) | | −2.75/−0.70 | .002 | 3.22(2.93) | | 2.23/4.21 | <.001 |
| EG at T2 vs. EG at T1 | −0.25(0.59) | | −0.42/−0.08 | .005 | 1.72(2.47) | | 0.89/2.56 | <.001 |
| CG at T1 vs. CG at T0 | 0.68(0.65) | | −0.15/0.29 | .536 | −0.19(1.04) | | −0.55/0.16 | .268 |
| CG at T2 vs. CG at T0 | 0.04(0.76) | | −0.22/0.30 | .751 | −0.08(0.84) | | −0.37/0.20 | .556 |
| CG at T2 vs. CG at T1 | −0.03(0.38) | | −0.16/0.10 | .661 | 0.11(0.40) | | −0.02/0.25 | .103 |
| Time*Group overall | | | | .002 | | | | <.001 |
| EG * (T1 vs. T0) vs. CG * (T1 vs. T0) | | −1.54 | −2.46/−0.62 | .001 | | 1.78 | 1.07/2.48 | <.001 |
| EG * (T2 vs. T0) vs. CG * (T2 vs. T0) | | −1.76 | −2.77/0.76 | .001 | | 3.36 | 2.37/4.35 | <.001 |

*Note:* T0, baseline; T1, at the end of the intervention; T2, at 3 months after the end of the intervention.
EG, experimental group; CG, control group.

exercising. Second, the mindfulness-based exercises in this study incorporated inner wisdom, which emphasizes that where the body is the mind is also. For example, mindful walking means to experience the sensation of the feet touching the ground and the movement of the legs or body while walking. Regardless of how fast or slow you are, you should pay attention to the physical experience of exercise. The down-to-earth feeling of clearly knowing the correct position and feeling of your feet can increase self-confidence in exercise and reduce the FOF in older people.[9,14] Third, the inner wisdom used in this study incorporated awareness practice to detect automated behavior and develop mindfulness-belief (pause, non-evaluative, acceptance to build confidence, allow/as it is techniques), and breathing meditation. Mindfulness emphasizes intentionally paying attention to present-moment experiences in an accepting and nonjudgmental way. This can help participants to be aware of the onset of stress earlier, increase the coping methods of stress relief, and be calmer to deal with the priorities of various tasks.[26] Mindfulness can reduce reactions to stress and improve coping skills, attention, awareness, memory, sensory perception and cognitive regulation of emotions and help develop a more coherent sense of self and identity.[27]

In terms of physical function, dynamic balance and muscle strength both significantly improved from T0 to T2 in the experimental group. In term of dynamic balance, the TUGT score in the experimental group was 11.14 s at T0, which then significantly improved to 9.67 at T1 and 9.42 at T2. In terms of muscle strength, the mean number of 30 s chair stands in the experimental group was 15.56 at T0, which then significantly improved to 17.06 at T1 and 18.78 at T2. Previous studies have indicated that a longer TUGT and fewer 30 s chair stands are risk factors for falls.[20] The TUGT cut-off point for older people aged 75-84 years has been reported to be 12.51 s.[28] In addition, the mean number of 30 s chair stands in participants not at risk of falls and in those at risk of falls have been reported to be 18.12 and 13.84, respectively.[20] Therefore, the participants receiving the mindfulness-based exercise program in this study may have had a reduced risk of falls. In addition, the exercises in this study included sitting to standing to walking, active exercise to resistance exercise, and head to lower body muscle contraction and relaxation. Active exercise and resistance exercise increased physical function in this study. These results are compatible with those reported by Mullen and McAuley et al.,[29] who indicated that exercise improved lower extremity function and functional performance and reduced functional limitations

among older people. Moreover, a barrier to exercise in older people is that their body cannot keep up with the heart. They want to walk faster, but if they do not pay attention to changes in their body, they will fall and hurt themselves, and consequently not want to exercise.[3,30] Inner wisdom in this study guided the participants to recognize the needs and changes of their body, such as detecting muscle contraction, adjusting the exercise pattern, changes in breathing and heartbeat, and increases in exercise flexibility, muscle strength and balance. A mindfulness-based exercise program can improve physical performance and make exercise more efficient.[9]

## Limitations

There are several limitations to this study. First, the mindfulness-based exercise program in this study was only tested in a population of older people in Taiwan. Further studies are warranted to investigate whether a mindfulness-based exercise program can be applied to populations of all generations and in other countries. Second, this study focused only on the outcomes of a mindfulness-based exercise program and did not focus on the process. To confirm that the participants were truly performing mindfulness-based exercises, further studies are needed to assess how they perceived their own mindfulness during and after the intervention. Third, the effect of the intervention was evaluated only at 3 months after the end of the intervention. Additional longitudinal studies are needed to confirm the results obtained in this study.

## Conclusion

The mindfulness-based exercise program was beneficial and safe in promoting health among older Taiwanese people by improving physical and psychosocial outcomes. The results of this study can provide a reference for healthcare providers and researchers when designing health promotion programs for older people.

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## Data statement

The datasets generated and/or analyzed during the present study are not publicly available, but they are available from the corresponding author on reasonable request.

## Declaration of Competing Interest

None.

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