Original Article

Effectiveness of Applying the Theory of Planned Behavior with Yoga Program on the Physical Activity and Mental Health of the Prefrailty Older Adults

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Abstract

Objectives: Grounded in the theory of planned behavior (TPB), this study evaluated the effectiveness of a yoga program intervention on the physical functioning and mental health in older adults. **Materials and Methods:** This was a quasi-experimental two-group, pre- and posttest, single-blind study. The participants were older adults above 65 years of age and in the early stage of frailty. The intervention for the experimental group was a twice weekly 60-min yoga session for 12 weeks; the control group received physical activity lectures in the 1st and 8th weeks. Pretest is conducted before the intervention, posttest one is conducted in the 8th week, and posttest two is conducted in the 12th week. Outcome indicators include physical activity level, body balance, flexibility, lower limb muscle strength, mental health (Brief Symptom Rating Scale [BSRS]), exercise behavior questionnaire, etc., **Results:** After 12-week silver yoga intervention, there were 31 participants in the experimental group with a loss of 9% (29% loss rate), whereas there were 29 participants in the control group with a loss of 6% (20% loss rate). Results from generalized estimating equations that grip strength index ($P = 0.000$), right lower limb muscle strength ($P = 0.000$), left lower limb muscle strength ($P = 0.000$) were significant between groups for both experimental and control groups, whereas other outcome indicators such as physical activity level, balance, flexibility, and mental health were not significant between groups. However, experimental within-group mean differences at week 12 for grip strength ($P = 0.000$), BSRS ($P = 0.016$), physical activity level ($P = 0.000$), right lower limb muscle strength ($P = 0.000$), left lower limb muscle strength ($P = 0.000$), simple physical function assessment ($P = 0.000$), single-leg standing ($P = 0.000$), upper limb flexibility ($P = 0.000$), lower limb flexibility ($P = 0.000$), exercise behavior evaluation attitude ($P = 0.000$), and exercise behavior evaluation perceived behavioral control ($P = 0.000$) were all significant. **Conclusions:** This study uses Ajzen's TPB as a basis to explore the behavioral intention after silver yoga intervention. This theory believes that an individual's specific behavior is affected by his or her behavioral intention, and the behavioral intention depends on the actor's attitude and subjective attitude toward the behavior. Norms perceived behavioral control. The research results show that yoga intervention attitude has the highest impact on behavioral intention, followed by perceived behavioral control and finally subjective norms. The experimental group has changed their attitudes and cognitions to increase their behavioral intentions. They have a deeper understanding of yoga asanas. They have broken through the difficult limb bending and kneeling postures seen in the past, which has increased their participation in yoga activities and confidence in their perceived behaviors. It also enhances behavioral intention, which means that the attitude and personal behavior of the research subjects after the intervention increase the elder's exercise intention, making the elder more clearly aware that yoga asanas are competent, thereby increasing the regularity of activity participation.

Keywords: *Mental health, physical function, planned behavior theory, prefrailty, yoga*

Introduction

According to the World Health Organization,[1,2] between 2000 and 2050, the global population over 60 years of age will increase from 11% to 22%, of which about 10% of the population over 65 years of age will be classified as frail. Older adults with symptoms of depression are 160% more likely to be physically frail, and the symptoms have a negative impact on self-balance, including social interaction and quality of life, leading to increased nationwide attention to mental health issues.[2-4] Hanlon *et al.*[5] pointed out that 41% of people over 65 years old were

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in the early stage of frailty, and only 28%–34% of these people participated in physical exercise in leisure time. The proportion of people engaging in exercise has gradually declined. In 2019, a Sports Administration survey on the current situation of inactivity revealed that 60–64 years old accounted for 13.5% of inactive populations, 65–69 years olds accounted for 12.8%, and 70 years old and above accounted for 18%. A number of local and international studies also confirmed that the physical fitness tests for early stage frailty (such as 8 foot up and go test, single leg stance, handgrip strength, five times sit to stand test, 2-min step test, 30-s sit-to-stand test, back scratch test), psychological sleep, emotional anxiety, and depression are all associated with frailty.[4,6-9] Research from various countries have pointed out that exercise is the most widely recommended means of frailty prevention.[10,11]

According to the theory of planned behavior (TPB) proposed by Ajzen and Madden (1986), this core factor is the individual's belief in executing intentions and actions. In the planned behavior model, behavioral intention is affected by three endogenous factors, namely attitude, subjective norms, and perceived control ability. All three can independently predict behavioral intention. The other influencing factor will vary depending on the behavior and situation, and may there will be a direct link between perceived behavioral control and behavior, and in many cases the execution of the behavior depends not only on motivation but also on adequate control of the behavior in question, so to a certain extent, perceived behavioral control can help predict goal achievement independently of behavioral intention [Figure 1]. The TPB is mainly based on the common theoretical framework of behavior change interventions.[12]

Ajzen and Madden's TPB[12] mainly explores the motivation of motor behavior, and behavioral intention is affected by three endogenous factors, namely attitude, subjective norms, and perceived behavioral control, which can independently predict behavioral intention. The more positive an individual's behavioral attitude is, the more they believe that a certain behavior is expected to have a valuable outcome, and when the people important to them think that the behavior is meaningful, the stronger the individual's intention to perform the behavior, and the more control they have over the behavior. Generally, the higher the influence of attitudes and perceived subjective norms, the stronger the behavioral control, and the stronger the individual's intention to perform the behavior [Figure 1].[13,14]

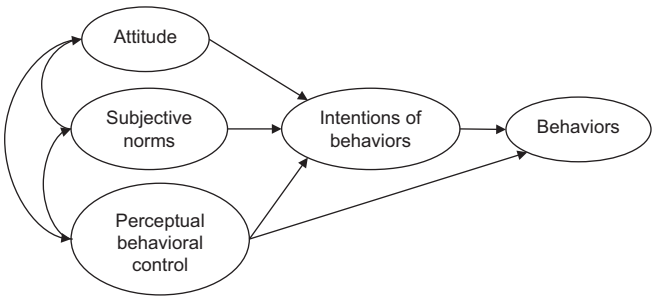

Figure 1: Conceptual diagram of behavioral theory. Ajzen I, Madden TJ. Prediction of goal-directed behavior: Attitudes, intentions, and perceived behavioral control. J Exp Soc Psychol 1986;22:458

Yoga is a nonpharmacological therapy. Western medicine lists yoga as an adjunctive alternative therapy to physical and mental exercises for achieving the meaning of harmony and unity.[15,16] The design steps of yoga classes start with warm-up, followed by the main posture (asana), and finally relaxation, breathing and meditation, which belong to a variety of forms of combined activities, from standing postures that improve strength, flexibility, and balance to forms based on relaxation and meditation, which can improve muscle strength and joint flexibility, enhance health status, and promote physiological, mental, social, and spiritual well-being.[17,18]

To formulate evidence-based intervention programs, this study used an empirical database to conduct a systematic literature search for from April 2016 to April 2021, and five studies were included, including three systematic reviews and meta-analyses and two randomized controlled trials. This study followed the PRISMA flow chart [Figure 2].

After reviewing and analyzing the five studies, using chairs, resistance bands, and yoga blocks as tools in older adult yoga programs that were implemented for 60 min twice a week over 8–24 weeks had improve the physical and mental health and quality of life of older adults.[16,18-21] During the literature search and review, the authors noted a lack of existing theoretical frameworks and interventions for prefrail older adults, as well as a lack of emphasis on activity continuity. By integrating the TPB into our study design, the purpose of this study is to explore the effectiveness of a yoga intervention program in improving physical activity, lower limb muscle strength, balance, flexibility, and mental health among prefrail elders.

Materials and Methods

Study design and setting

This was a quasi-experimental two-group, pre- and post-test, single-blind study. Purposive sampling method was used to recruit willing participants from four older adult community care centers and one senior living apartment in the northern region of Taiwan. The eligibility criteria of the participants were at least 65 years old, without physical functioning impairments, and meeting one or two frailty indicators. Research subjects who meet the prefrailty conditions were selected through Fired's frailty assessment.[22] The exclusion conditions are: (1) Those who have had major diseases and surgeries (such as thoracic and lumbar spine surgeries) in the past year, (2) Those who are unable to attend the event on time, (3) Fried frailty meets three of the five filtering conditions, and (4) Those

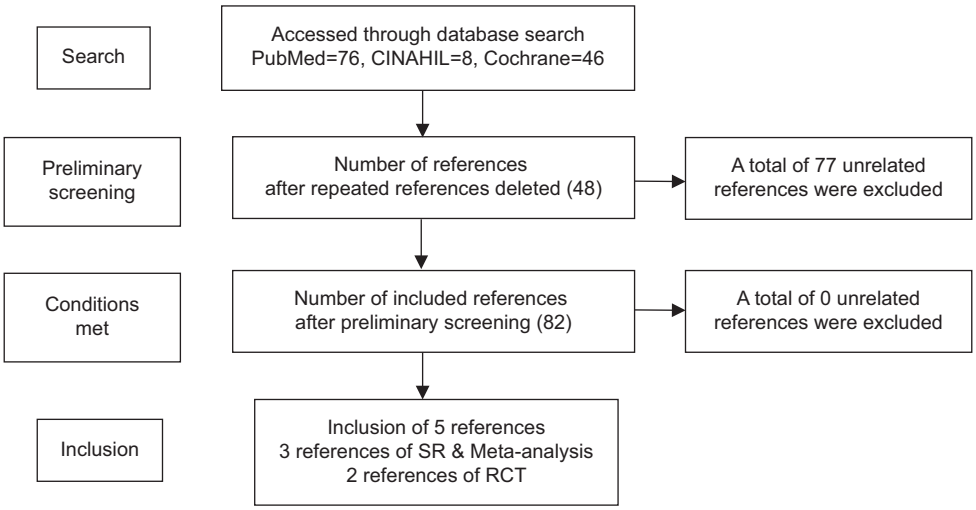

Figure 2: Literature search flow chart. RCT: Randomized control trial

with severe shoulder and neck pain that prevent them from lifting their hands (such as frozen shoulder). The 60 participants were divided into an experimental group (31 older adults recruited from two care centers and the senior living apartment) and a control group (29 older adults recruited from the two other care centers). After providing their consent to participate, the experimental group received the yoga intervention and regular activities at the care centers, whereas the control group received health and exercise lectures in the 1st and 8th weeks of the study in addition to regular activities at the care centers. The research intervention plan was implemented by researchers with yoga certificates in the research team, and the research data collection was entrusted to physical therapists to assist in three effectiveness indicator tests. The testers did not know the distribution of the two groups. This study was reviewed and approved by the Human Research Ethics Committee of Cheng Hsin General Hospital (protocol number: (884) 110A-30).

Selection of participants

The sample size was estimated using G*Power3.1 free software. Due to the interventional nature of this study, the participants were divided into two groups. The effect size was based on the standing balance data in the study by Tew *et al.* (2017).[18] At an effect size of 0.3, a significance level (α) of 0.05, and a power of 0.95, the sample size was estimated to be 32. The estimated attrition rate of study subjects was 30% (10), resulting in a total required sample size of at least 42.

Forty participants were included in the experimental group initially. Nine participants dropped out (indicating a dropout rate of 22.5%), leaving a total of 31 participants who completed all three tests: five missed out over a third of the 12-week program due to personal reasons; one was hospitalized before the posttest and was unable to complete the second test; three were diagnosed with COVID-19 during the second posttest and had to undergo isolation. Thirty-five participants were included in the control group initially. Six participants dropped out (indicating a dropout rate of 17.1%), leaving a total of 29 participants who completed all three tests: two failed to complete two courses and tests, two failed to complete the second test due to personal reasons; whereas two were hospitalized. The total number of dropouts for both groups was 15, and the combined dropout rate was below the specified 30% range. A total of 60 participants were included in this study [Figure 3].

Design of the intervention

Based on the literature review and analysis on yoga programs for older adults, a twice-weekly older adult yoga program for 12 weeks was designed. The first effectiveness evaluation (posttest 1) was in week 8, whereas the second (posttest 2) was in week 12, toward the end of the program. The older adult yoga program consisted of three phases. The first phase consisted of 10-min warmup activity in the form of breathing and meditating. The second phase consisted of 40-min main yoga exercises (weeks 1–6 covered joint flexibility and stretching exercises; weeks 7–12 covered muscle strength, stretching, and balance exercises). The third phase consisted of 10-min cool down and relaxation activities. Due to the older adults' physical limitations and chronic illnesses, they were allowed to use chairs, yoga blocks, and ropes as assistive tools during the exercises. The content validity of the yoga program was analyzed by five experts (1 rehabilitation medicine doctor, 1 physical therapist, 1 nursing professors, department of physical therapy professor, 1 senior yoga expert). The first phase had a content validity index (CVI) of 0.89; the second phase had a CVI of 0.91 for weeks 1–6 and 0.94 for weeks 7–12; the third phase had a CVI of 0.94 [Table 1].

Research tools

Grip strength

The grip strength device model was TTM-YO, range: 5–110 kg, size: 2.4 cm × 14.3 cm × 6.2 cm. Measured

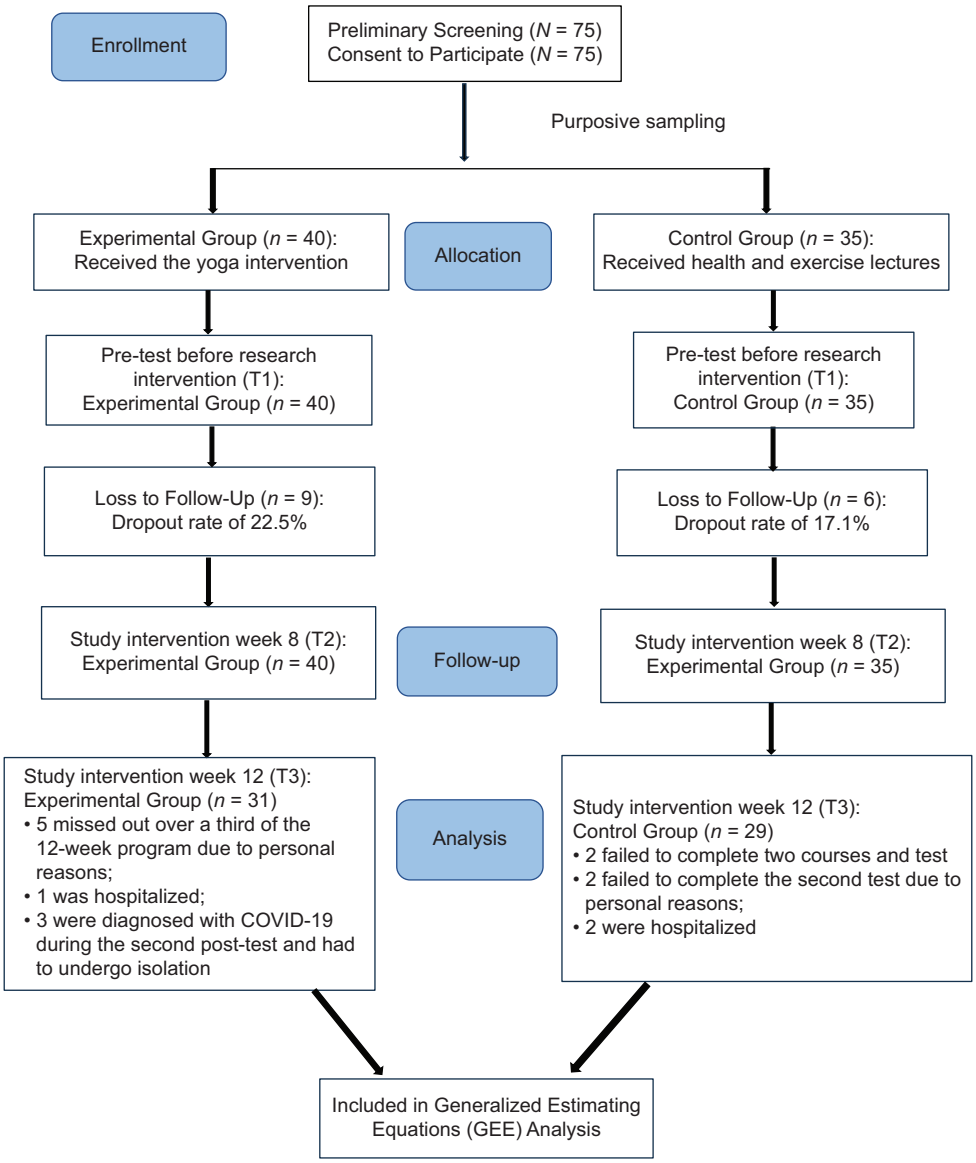

Figure 3: Enrollment flowchart. T1: Pre-test 1; T2: Post-test 1; T3: Post-test 2. GEE: Generalized estimating equations

using the participant's dominant hand while standing with their elbows straight and without touching their body.

Lower limb muscle strength

The model was a HOGGAN MicroFET2 gauge instrument. The body parts involved in the test were knee extension strength, knee flexion strength, hip flexion strength, and ankle dorsiflexion strength. The same movements were performed for 5 s in alternation on both feet and in triplicate. The sum of both feet based on three mean values was taken. Wang *et al*.[23] studied the reliability of lower limb muscle strength assessment and test–retest in community-dwelling older adults and reported that an intraclass correlation above 0.9 indicates good reliability.

Balance

The short physical performance battery (SPPB) covers three tests: standing balance, chair stand test, and 8 foot up and go test. Each major task is scored on a scale of 0–4 points, with a total score ranging from 0 to 12 points, with higher scores indicating better balance. Gómez *et al*. (2013)[24] reported the SPPB had a test–retest reliability of 0.87 in older adults.

Flexibility

Based on Taiwan's 2018 national physical fitness testing methodology, the upper limb flexibility was measured through the back scratch test, whereas the lower limb flexibility was measured through the seated forward bend test. In the back scratch test, the participant stood up and placed one hand behind their shoulders on the same side with the palm kept straight and facing inward. With the elbow facing upward, the arm is extended down the center of the back as far as possible, with the goal of approaching, touching, or interlocking with the other palm, which is moving upward and facing outward. In the seated forward

Table 1: Yoga intervention

Weeks	Intervention
1, 2 weeks	Step 1: Square breathing, meditation (10 min)
	Step 2: Easy pose, butterfly pose, cobbler pose, staff pose, forward bending pose, single leg forward bend post, chair cat/cow pose, baby pose (40 min)
	Step 3: Corpse post (10 min)
3, 4 weeks	Step 1: Square breathing, meditation (10 min)
	Step 2: Easy pose, butterfly pose, cobbler pose, staff pose, forward bending pose, single leg forward bend post, lateral bend with twist pose, half lord of the fishes pose, chair cat/cow pose, cow face pose, baby pose (40 min)
	Step 3: Corpse post (10 min)
5, 6 weeks	Step 1: Square breathing, meditation (10 min)
	Step 2: Easy pose, cobbler pose, butterfly pose, staff pose, leg forward bend post, lateral bend with twist pose, half lord of the fishes pose, chair downward facing dog pose, bridge pose, baby pose (40 min)
	Step 3: Corpse post (10 min)
7, 8 weeks	Step 1: Square breathing, meditation (10 min)
	Step 2: Easy pose, staff pose, cobbler pose, butterfly pose, extended puppy pose, chair downward facing dog pose, mountain pose, tree pose, sun salutation, high lunge pose, chair king dancer pose (40 min)
	Step 3: Corpse post (10 min)
9, 10 weeks	Step 1: Square breathing, meditation (10 min)
	Step 2: Easy pose, butterfly pose, cobbler pose, staff pose, tree pose, sun salutation, high lunge pose, chair king dancer pose, warrior I pose, warrior II pose (40 min)
	Step 3: Corpse post (10 min)
11, 12 weeks	Step 1: Square breathing, meditation (10 min)
	Step 2: Easy pose, cobbler pose, butterfly pose, tree pose, sun salutation, chair pose, high lunge pose, warrior I pose, warrior II pose, chair triangle pose, chair *half Moon pose* (40 min)
	Step 3: Corpse post (10 min)

bend test, the participant is seated at one-third of the edge of a chair, with one foot extended forward and the toes facing upward. Keeping both palms facing downward with the fingers interlocked, the participant slowly bends the upper body forward when exhaling, and the distance between the tip of the shoe and the middle fingers is measured. The tests were performed in duplicate and the best value was taken.

Mental health

Lee[25] of National Taiwan University developed the "5-item Brief Symptom Rating Scale (BSRS-5)," which has a total of 6 items with a total score from 0 to 20 points, with a higher score representing a higher level of mental health problems. The BSRS-5 has a good internal consistency (Cronbach's α = 0.77–0.90) and a test–retest reliability of 0.82.

Assessment of motor behavior

By referring to Ahmad *et al*.'s[26] questionnaire for older adults with sarcopenia, this study designed a structural questionnaire integrated with the TPB. It included four components: "attitude," "subjective norm," "perceived behavioral control," and "behavioral intention." The questionnaire was translated and then validated by five experts. The expert validity analysis of all four components was 0.98. The Cronbach's α of each component was 0.69, 0.75, 0.55, and 0.91, respectively.

Statistical analysis

This study used IBM SPSS 21.0 (Armonk, New York, USA) statistical software to organize and analyze the data. The basic participant characteristics, including sex, education level, marital status, living arrangement, chronic diseases, and chronic medication use were presented in descriptive statistics (percentages). *t*-tests and Chi-square tests were used to compare the differences in the basic characteristics of the two groups; linear regression was used to analyze the experimental group's pretest and posttest correlations with respect to the TPB components; generalized estimating equations (GEE) were used to analyze the differences between the two groups with respect to grip strength, muscle strength, balance, flexibility, mental health, and motor behavior of the two groups.

Results

Baseline characteristics

There were a total of 60 participants in this study, and the experimental group initially consisted of 40 participants. The intervention was implemented from June 15, 2022 to December 15, 2022. The results showed that there were significant differences in height (P = 0.034), sex (P = 0.021) and living arrangement (P = 0.03) between the two groups, whereas the comparative analysis of the homogeneity of basic data of the other subjects did not reach a statistically significant difference [Table 2].

Comparative analysis of the primary outcomes in the two group pre- and post-intervention

Indicators of physical and mental health: Statistical analyses using GEEs revealed that the β coefficient of the main effect of grip strength after 12 weeks of intervention was = 2.1 and statistically significant (P = 0.042). The β coefficient of the main effect of right lower limb muscle strength was −9.44 and statistically significant (P = 0.002). Compared with the preintervention test, the experimental group's right lower limb muscle strength was 10.27 pounds (P < 0.001) and 19.08 pounds (P < 0.001) higher than the control group at weeks 8 and 12, respectively. The β coefficient of the main effect of left lower limb muscle strength was 10.50 and statistically significant (P = 0.001), and the group-time interactions were statistically significant. The experimental group's left lower limb

Table 2: Descriptive data analysis on the distribution of basic attributes of participants and the homogeneity of the two groups

Variable	Experimental group (*n*=31) (%)	Mean (SD)	Control group (*n*=29) (%)	Mean (SD)	t/χ^2	*P*
Age	76.77	7.78	75.45	6.78	5.67	0.527
Height	151.7	6.08	155.3	6.74	2.17	0.034*
Weight	56.1	8.16	56.5	6.81	−0.21	0.407
Frailty index						
1 point	19 (61)		11 (38)		−1.83	0.073
2 points	12 (39)		18 (62)			
Gender						
Male	1 (3.2)		7 (24.1)		5.67	0.021*
Female	30 (96.8)		22 (75.9)			
Education level						
Elementary school	14 (45.2)		6 (20.7)		6.61	0.25
Junior high school	6 (19.4)		4 (13.8)			
High school (or vocational school)	6 (19.4)		8 (27.6)			
Associate bachelor	2 (6.5)		5 (17.2)			
Bachelor	3 (9.7)		5 (17.2)			
Master or PhD	0		1 (3.4)			
Marriage						
Married	11 (35.5)		15 (51.7)		4.69	0.196
Widowed	19 (61.3)		11 (37.9)			
Divorced or separated	0		2 (6.9)			
Single	1 (1.7)		1 (1.7)			
Living status						
Children	7 (22.6)		9 (31)		18.54	0.001*
Spouse	4 (12.9)		8 (27.6)			
Family group with three generations	3 (9.7)		9 (31)			
Living alone	3 (9.7)		3 (10.3)			
Apartments for the elderly	14 (45)		-			
Religious beliefs						
None	3 (9.7)		4 (13.8)		1.98	0.738
Buddhism	15 (48.4)		17 (58.6)			
Taoism	5 (16.1)		2 (6.9)			
Christianity	3 (9.7)		3 (10.3)			
Other	5 (16.1)		3 (10.3)			
Chronic disease						
None	11 (35.5)		5 (17.2)		11.7	0.624
Hypertension	11 (35.5)		14 (48.2)			
Diabetes	4 (12.9)		4 (13.7)			
Hyperlipidemia	2 (6.4)		2 (6.8)			
Heart disease	3 (9.6)		2 (6.8)			
Prostate hypertrophy	0		2 (6.8)			
Knee joint degeneration	1 (3.2)		0			
Immune diseases	0		2 (6.8)			
Eye diseases	1 (3.2)		1 (3.4)			
Medication taking						
Yes	18 (58.1)		22 (75.7)		2.13	0.114
No	13 (41.9)		7 (24.1)			
Retired						
Yes	30 (96.8)		28 (96.6)		0.002	0.962
No	1 (3.2)		1 (3.4)			
Economic sources						

Contd...

Table 2: Contd...

Variable	Experimental group (*n*=31) (%)	Mean (SD)	Control group (*n*=29) (%)	Mean (SD)	t/χ^2	*P*
Salary	1 (3.2)		0		6.97	0.051
Savings	7 (22.6)		8 (27.6)			
Support from children	10 (32.3)		6 (20.7)			
Social assistance	2 (6.5)		1 (3.4)			
Other	3 (9.7)		0			
Pension	8 (25.8)		14 (48.3)			
Exercise habits						
Yes	28 (90.3)		28 (96.6)		0.93	0.613
No	3 (9.7)		1 (3.4)			

*P<0.05 independent t-test. Pearson Chi-square between the two groups. SD: Standrad deviation

muscle strength was 10.50 pounds (P = 0.001) and 18.34 pounds (P < 0.001) higher than the control group at weeks 8 and 12, respectively. Although there were no statistically significant differences in the other items such as SPPB score, upper limb flexibility, and lower limb flexibility, the scores of the experimental group were all higher than those of the control group at week 12 with respect to preintervention values. Regarding mental health measured using the BSRS-5, the β coefficient of the main effect of the experimental group was-0.18 (P = 0.834), and the group-time interactions were statistically significant. The experimental group's BSRS-5 score was 0.37 points (P = 0.642) and 0.16 points (P = 0.819) higher than the control group at weeks 8 and 12, respectively. However, these differences were not statistically significant [Table 3].

In terms of motor behavior assessment, the β coefficient of the main effect of the experimental group's attitude was −1.28 (P = 0.273). The group-time interaction of the experimental group showed that the experimental group was significantly higher than the control group by 2.31 (P = 0.036) and 4.21 (P = 0.001) at weeks 8 and 12, respectively. The β coefficient of the main effect of the experimental group's subjective norms was 2.98 (P = 0.080). The group-time interaction of the experimental group showed that the experimental group was higher than the control group by 0.25 (P = 0.902) at week 8 and lower than the control group by 0.12 (P = 0.953) at week 12. However, these differences were not statistically significant. To summarize, the group-time interactions in terms of motor behavior were statistically significant for attitudes but were not statistically significant for subjective norms, perceived behavioral control, and behavioral intention. Both groups did improve their perceived behavioral control and behavioral intention scores, with the experimental group scoring higher than the control group [Table 4].

Outcomes of applying the theory of planned behavior in the yoga intervention for older adults

In this study, the TPB was integrated into a motor behavior questionnaire for analyzing the influence of each behavioral intention variable in the second posttest after the older adult yoga program. The questionnaire items were scored on a five-point Liker scale. Linear regression was used in statistical analysis. The variances of the independent variables of attitude, subjective norms, and perceived behavior control on behavioral intention were 41.7, and the F-statistic was 8.161 (P < 0.001). The regression model showed that the questionnaire results had a statistically significant predictive power. The explained variance for each dimension is: attitude 29%, subjective norm 13%, perceived behavioral control 24%. The standardized regression coefficient of attitudes, subjective norms, and perceived behavior control with respect to behavioral intention was 0.670, −0.015, and 0.174, respectively. The older adults' attitudes and perceived behavior control had significant influences on the continuity of the yoga program.

Discussion

In this study, a total of 60 individuals were included in the study. The analysis of their basic characteristics revealed significant differences in height (P = 0.034), sex (P = 0.021), and living arrangement (P = 0.03). The control group had a considerably higher proportion of males, with a male–female sex ratio 13% to 87% (1:7). This particular sex distribution aligns with the findings of Wei *et al*.[27] and the 2022 National Sports Status Survey,[28] which both highlight the predominance of women in yoga participation. Furthermore, the gender ratio of participants in this study mirrors the predominantly female demographic observed in the literature on chair yoga. These findings are in line with the 2018 Survey of Living Conditions of the Older Adults in Taiwan, in which the most popular living arrangements among the older adults were living together with their spouse, children-in-law, and grandchildren (54.34%), or residing in an institutional care setting (12.7%).

The two groups had significant differences in grip strength, right lower limb muscle strength, left lower limb muscle strength, and attitude toward motor behavior assessment. These findings were partially similar to other studies[18,29] in which yoga improved the muscle strength, balance,

Table 3: Physical physiological function and psychology two groups of performance indicators generalized estimating equations model (*n*=60)

Parameter	Estimated value of β	SD	95% CI	Significance
Grip strength	−2.1	1.29	−5.13–−0.09	0.042*
Interaction (experimental group vs. control group × pretest)				
Experimental group × T1	1.52	0.35	0.84–2.19	0.000***
Experimental group × T2	1.65	0.42	0.82–2.48	0.000***
Right lower limb muscle strength	−9.44	2.98	−15.29–−3.06	0.002**
Interaction (experimental group vs. control group × pretest)				
Experimental group × T1	10.27	2.76	4.87–15.67	0.000***
Experimental group × T2	19.08	3.26	12.69–25.48	0.000***
Left lower extremity muscle strength	−10.50	3.22	−16.81–−4.19	0.001***
Interaction (experimental group vs. control group × pretest)				
Experimental group × T1	1.04	3.20	4.24–16.77	0.711
Experimental group × T2	0.40	3.31	11.86–24.83	0.821
Simple physical function assessment	−0.59	0.36	−1.29–0.11	0.097
Interaction (experimental group vs. control group × pretest)				
Experimental group × T1	−0.02	0.34	−0.68–0.65	0.961
Experimental group × T2	0.23	0.38	−0.52–0.98	0.546
Upper limb flexibility	−1.39	2.74	−6.76–3.98	0.611
Interaction (experimental group vs. control group × pretest)				
Experimental group × T1	1.19	1.35	−1.47–3.84	0.380
Experimental group × T2	2.12	1.28	−0.39–4.63	0.098
Lower limb flexibility	0.84	2.30	−5.34–3.67	0.715
Interaction (experimental group vs. control group × pretest)				
Experimental group × T1	1.88	1.04	−0.15–3.92	0.069
Experimental group × T2	1.97	1.44	−0.86–4.80	0.172
Simplified Health Scale	−0.18	0.84	−1.83–1.48	0.834
Interaction (experimental group vs. control group × pretest)				
Experimental group × T1	0.37	0.80	−1.20–1.95	0.642
Experimental group × T2	0.16	0.70	−1.54–1.22	0.819

*P<0.05, **P<0.01, ***P<0.00 GEE. T1=First test, 8 weeks after the intervention, T2=Second test, 12 weeks after the intervention. CI: Confidence interval, SD: Standard deviation, GEE: Generalized estimating equations

Table 4: Comparative analysis of the two sets of performance indicators for exercise behavioral evaluation (*n*=60)

Parameter	Estimated value of β	SD	95% CI	Significance
Attitudes	−1.28	1.16	−3.56–1.01	0.273
Interaction (experimental group vs. control group × pretest)				
Experimental group × T1	2.31	1.11	0.15–4.48	0.001***
Experimental group × T2	4.21	1.26	1.75–6.68	0.036*
Subjective norms	2.98	1.70	6.32–0.36	0.080
Interaction (experimental group vs. control group × pretest)				
Experimental group × T1	0.25	2.02	−3.70–4.20	0.902
Experimental group × T2	−0.12	1.98	−3.99–3.75	0.953
Perceived behaviors	−0.17	0.84	−1.82–1.48	0.839
Interaction (experimental group vs. control group × pretest)				
Experimental group × T1	1.00	1.27	−1.48–3.49	0.429
Experimental group × T2	0.62	1.24	−1.82–3.06	0.618
Intentions	0.09	0.28	−0.46–0.65	0.749
Interaction (experimental group vs. control group × pretest)				
Experimental group × T1	0.16	0.24	−0.31–0.64	0.501
Experimental group × T2	0.15	0.27	−0.38–0.69	0.578

*P<0.05, ***P<0.00. T1=8 weeks of intervention after test 1, T2=Posttest 2, GEE statistics. CI: Confidence interval, SD: Standard deviation, GEE: Generalized estimating equations

flexibility, mental health, and quality of life of participants. In a similar vein, Shin[30] reported that 9–12 weeks of yoga practice had the greatest impact on physical function. Kwok *et al*.[19] studied a total of 138 mild and

moderate Parkinson's disease cases in four community rehabilitation centers in Hong Kong, with the experimental group completing 12 basic Hatha yoga exercises and the control group completing resistance exercise. Despite the improvements in motor symptoms and activity level, the results were not statistically significant, which was similar to this study.

However, the 12-week yoga intervention did not yield significant differences among the two groups in terms of simple physical function assessment, standing on one-foot, physical activity, upper and lower limb flexibility, and short-form health scale. In terms of grip strength index, the experimental group improved by 1.65 kg compared with the control group, the right lower limb muscle strength increased by 19.08 pounds compared with the control group at 12 weeks, and the left lower limb muscle strength was 18.34 pounds higher than that of the control group at 12 weeks, which is the same as the previous yoga studies in terms of muscle strength, balance and flexibility, mental health, and quality of life[18,29,30] also noted that 9–12 weeks of yoga practice had the greatest impact on physical function; However, Kwok *et al*.[19] studied a total of 138 mild and moderate Parkinson's disease cases in four community rehabilitation centers in Hong Kong, with 12 basic Hatha yoga in the experimental group and resistance exercise in the control group, and the results showed significant improvement in motor symptoms and mobility, but there was no statistical difference between the two groups, which was similar to this study. One reason for the differences is that the control group in this study not only received exercise lectures, but also in-person activities at care centers, whereas the control groups in previous studies were either on standby or did not participate in any intervention. Another reason for the differences is that the first half of the 12-week intervention consisted of stretching, whereas the second half focused on lower limb muscle strength.

Many past research papers[18,29] have stated that yoga is helpful for muscle strength, balance and flexibility, mental health, and quality of life. The yoga process is composed of it consists of breathing method, posture method, and meditation method. The posture includes standing, sitting, and lying down. The types of standing postures in this study include a half-knee squat with feet side by side ("chair pose"), one-legged standing with arms extended ("tree pose"), one-legged standing with torso flexed and rotated ("half-moon" pose), hip Research on the process and posture of joint abduction with trunk lateral flexion (triangle posture) has proven that it can increase muscle strength, flexibility, and balance, whereas breathing meditation can enhance concentration, relieve physical and mental tension, fatigue, and stress, and reduce anxiety and depression. Intermediately improve happiness and quality of life to achieve physical, mental and spiritual health.

Both groups improved their mental health scores, which was similar to the study by Kwok *et al*.,[19] who reported that participating in 12 basic types of Hatha yoga improved the experimental group's anxiety, depression, and quality of life. In the study by Welford *et al*.,[31] 27 participants were randomly assigned to the yoga group, 29 were assigned to the aerobic exercise group, and 26 were assigned to a standby group. The interventions were carried out for 12 weeks. The results showed that the yoga and aerobic exercise groups improved their satisfaction with life indexes, whereas the standby group's decreased, which was similar to this study.

According to the linear regression results of the experimental group's second posttest TPB questionnaire responses, the older adults' attitudes toward the yoga intervention had the highest effect on behavioral intention ($P < 0.001$), followed by perceived behavioral control at 0.174 ($P = 0.641$), and lastly, subjective norms at −0.015 ($P = 0.919$). These results are similar to those of Chen[32] who examined older adults' behaviors toward participating in the *Lezhi* artificial intelligence board game and Sur *et al*.[33] who explored the behaviors toward physical functioning impairments. The explained variances of all components revealed that attitudes were the primary factor influencing behavioral intention, which changes previous perceptions about the highly complex bending and kneeling postures in yoga for improving exercise regularity among older adults.

Conclusion

After 12 weeks of intervention, it was understood that the changes in the attitude and cognition of the experimental group increased their behavioral intentions, and they had a deeper understanding of yoga postures, breaking the difficult limb bending and kneeling postures seen in the past, and allowing them to participate in yoga activities in their perceived behavior. The improvement in attitude and confidence also enhanced behavioral intention, which means that the attitude and personal behavior of the elderly in this study increased the elderly's exercise intention after the 12-week intervention, making the elderly competent in the operation of yoga asanas, thereby increasing the regularity of activity participation.

The study period overlapped with the peak of the COVID-19 pandemic, which increased the difficulty of the participant recruitment process. The sample could not be randomly distributed and was therefore dispersed across the activity venues. Future studies should randomly distribute the sample to enhance the accuracy of the study findings. Although previous studies have highlighted the high correlation between yoga and flexibility, the results of the present study failed to yield significant differences despite the improved scores. A reason for this is because the flexibility exercises were held in weeks 1–6, and therefore the time of intervention lacked consistency.

Previous interventional studies have mostly targeted health and frail older adults, rather than prefrail older adults. Taiwanese older adults have a relatively lower yoga participation rate than older adults in other countries. By integrating the TPB into the yoga intervention, this study found that the flexibility, balance, and mental health scores of prefrail older adults had improved, particularly in muscle strength, in which there were significant differences. The intentions to participate in yoga also achieve participation consistency. In recent years, the government has continuously advocated for frailty prevention. The results of this study are expected to be extended to communities and institutions so that prefrail older adults can achieve holistic health and shape communities for healthy aging-in-place.

Suggestions

In future research, the sample can be centralized in homogeneous groups and randomly assigned to increase statistical power. Relevant personnel can be trained to guide yoga activities for older adults to ensure consistency in the intervention time and yoga postures, so as to improve the effectiveness of the intervention.

Ethical statement

The study was approved by the institutional Ethics Committee of Cheng Hsin General Hospital (Approval No: (884)110A-30).

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Conflicts of interest

There are no conflicts of interest.

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