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ORIGINAL RESEARCH

Reducing the fear of falling among community-dwelling elderly adults through cognitive-behavioural strategies and intense Tai Chi exercise: a randomized controlled trial

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Abstract

Aim. To examine the effectiveness of cognitive-behavioural strategies with/without intense Tai Chi exercise in reducing fear of falling among community-dwelling elderly adults.

Background. Fear of falling is a major health problem among community-dwelling older persons. The prevalence of this fear ranges from 29% to 77%, indicating the importance of developing effective strategies to reduce fear of falling among elderly adults.

Methods. Data were collected from January to December 2007. A randomized controlled trial with three groups (control, cognitive-behavioural and cognitive-behavioural with Tai Chi). Participants were assessed at baseline for demographic data, falls-related history, and fear of falling. Data on these variables plus falls, mobility, social support behaviour and satisfaction, and quality of life were also collected at 2 and 5 months after interventions.

Results. Participants in the three groups differed significantly in both measures of fear of falling ($F = 20{\cdot}89$, $P < 0{\cdot}001$; $F = 6{\cdot}09$, $P < 0{\cdot}001$) and mobility ($F = 30{\cdot}33$, $P < 0{\cdot}001$), social support behaviour and satisfaction ($F = 3{\cdot}32$, $P < 0{\cdot}05$ and $F = 6{\cdot}35$, $P < 0{\cdot}001$, respectively), and quality of life ($F = 16{\cdot}66$, $P < 0{\cdot}001$). In addition, participants who received the cognitive-behavioural intervention with Tai Chi had significantly lower fear of falling scores ($P < 0{\cdot}001$) and higher mobility ($P < 0{\cdot}001$), social support satisfaction ($P < 0{\cdot}01$) and quality of life ($P < 0{\cdot}001$) than the cognitive-behavioural alone and control groups at 5 months. The three groups did not differ significantly in falls.

Conclusion. The results of this trial suggest that the cognitive-behavioural intervention with Tai Chi exercise helped community-dwelling elderly adults to enhance their mobility, to manage their fear of falling and to increase their quality of life.

Keywords: cognitive behavioural, elderly adults, falls prevention, fear of falling, nursing, Tai Chi exercise

Introduction

Fear of falling (FOF) is a major health problem among community-dwelling older persons both in older persons who have experienced a fall and those who have not (Scheffer *et al.* 2008). The wide range of prevalence estimates for fear of falling (25–77%) may be due to differences between samples in age, gender, functional status, history of falls, measures of fear and other comorbidities (Howland *et al.* 1998, Friedman *et al.* 2002, Suzuki *et al.* 2002). In many respects, FOF is a reasonable response to a probable and potentially risky event and could be regarded as the first step for preventing falls. While some level of FOF is reasonable and can promote effective coping skills for preventing falls, too much fear may compromise physical and mental well-being (Huang 2005).

The effectiveness of interventions to decrease FOF in older persons was examined in a meta-analysis of six studies (Jung *et al.* 2009). The results showed that FOF was significantly decreased in interventions with the following designs: (1) combination of exercise and education, (2) effects measured after 4 months, and (3) setting is community or home based. The first design had a mean weighted-effect size (MWES) = 0·249 ($P < 0·05$) because FOF is impacted not only by physical conditions but also by psychological and cognitive issues; Therefore, the combination intervention is more effective than either exercise or education programme alone. The second design had a MWES = 0·240 ($P < 0·05$) because interventions for FOF need some time to obtain their effects. The third design had a MWES = 0·228 ($P < 0·05$) for community-based and MWES = 0·418 ($P < 0·05$) for home-based (rather than facility-based) settings because older residents of facilities may be frailer than those living in the community. However, the effect of interventions was found to be small (MWES = 0·21), and Jung *et al.* (2009) suggested that FOF treatment interventions should involve cognitive reconstructing and behavioural changes to reduce fear of falling among the elders. No study was found that combined cognitive-behavioural strategies and an exercise programme for reducing FOF among community-dwelling elders.

Cognitive behavioural therapy (CBT) has been shown in many randomized controlled trials to be an effective treatment for depression, panic disorder and anxiety disorder, for which CBT is recommended in evidence-based clinical practice guidelines as a first-line treatment (Haby *et al.* 2006, Kushner *et al.* 2009, Stanley *et al.* 2009, Allen *et al.* 2010). CBT is an intervention modality for changing dysfunctional cognitive schemas and faulty thinking tied to FOF experiences (Haby *et al.* 2006). It is based on the premise that sensory precepts, feelings and actions influence the ways in which FOF is interpreted by the self and the rest of the world. The goal of intervention is to attenuate symptoms tied to automatic thoughts and emotions about FOF. Counsellors arrange for specific learning experiences to help those affected by FOF identify, evaluate and alter automatic thoughts and emotions. Enduring improvement from FOF thus results from modification of faulty thinking and faulty beliefs tied to the faulty behaviour (Tennstedt *et al.* 1998, Gitlin *et al.* 2006). Older adults need to feel comfortable discussing their fears and learning to ask for assistance in fearful situations (Legters 2002, Brouwer *et al.* 2003), thus creating opportunities to devise and carry out fall and FOF prevention strategies. Physical fitness programmes increase elders' level of activity and reduce general physical dysfunction (Li *et al.* 2008, Logghe *et al.* 2009). Tai Chi is highly suitable for elderly people with limitations in balance and mobility because it consists of a series of slow, rhythmic movements that emphasize trunk rotation, weight shifting, coordination and a gradual narrowing of lower extremity stance. In addition to reducing risk of falls and FOF, and improving balance, Tai Chi has benefits in physical and psychological functioning (Sattin *et al.* 2005, Li *et al.* 2008, Logghe *et al.* 2009). In fact, Tai Chi was found to reduce FOF significantly more than other exercise programmes for older adults (Sattin *et al.* 2005). Similarly, more than 94% of the elders who participated in a 12-week Tai Chi intervention improved their functional status and confidence (Li *et al.* 2008). Also, 100% of participants agreed that the Tai Chi movements were appropriate and safe to perform, and they intended to continue doing the activity and to recommend it to others (Li *et al.* 2008).

Therefore, the FOF interventions implemented in this study used two major strategies: Tai-Chi exercise and cognitive-behavioural (CB) intervention. Tai Chi focused on improving lower extremity muscular strength and balance. The CB intervention concentrated on improving awareness of environmental hazards and medically related risk factors, changing faulty thinking tied to FOF experiences, and selecting useful management strategies and resources and improving confidence.

The study

Aim

The aim of the study was to compare the effectiveness of three interventions (control, CB alone and CB with Tai Chi) on primary outcomes (fear of falling and falls), and secondary outcomes [mobility (gait and balance), social support and quality of life] of community-dwelling elderly adults over 5 months.

Design

This prospective, randomized control trial was conducted in a rural area of northeastern Taiwan between January and December 2007.

Sample

In view of general health promotion and primary prevention, we targeted on community-dwelling elderly adults. The sample size was determined based on outcomes of a previous intervention study on FOF in frail elders (Zhang *et al.* 2006). The mean score of the Fall Efficacy Scale (FES) (Tinetti *et al.* 1990) at pretest was 76·2 (SD = 5·2) and at post-test was 78·3 (SD = 4·0). To detect a between-group difference in FES scores at 80% power, $\alpha = 0{\cdot}05$, and two-tailed test. Using the model of $N = [(\sigma)\ (Z_{1-\alpha/2}+Z_{1-\beta})/(\mu-\mu_0)]^2$ ($[(4{\cdot}0)\ (1{\cdot}96+0{\cdot}85)/(78{\cdot}3-76{\cdot}2)]^2 = 28$) (Pagano & Gauvreau 2000), 28 patients were needed in each group. After making allowance for participants to drop out by 5 months, a larger sample was needed.

Thus, the sample included 186 community-dwelling adults, aged 60 and older. Participants were randomized to each of three groups: cognitive-behavioural intervention, CB with Tai Chi intervention, and the control group. Participants were recruited from a randomly selected sample of 660 residents, age ≥60 years, living in registered households of a rural community in Yi-Lan county, northeastern Taiwan by mailing an invitation and following up with a phone call. Potential participants were screened over the telephone by registered nurses. Inclusion criteria for participation were (1) ≥60 years old, mentally intact [Short Portable Mental Status Questionnaire (SPMSQ) score >6 for illiterate individuals, >7 for those with 6 years of education, >8 for those with >6 years of education] (Pfeiffer 1975) reside in the community, and able to communicate in Mandarin or Taiwanese. Participants were excluded if they had an artificial leg or leg brace, had unstable health problems or were terminally ill.

Of the 660 invited to participate, 43·79% ($n = 289$) did not respond, 2·88% ($n = 19$) were ineligible (nine for having not being cognitively intact, and ten for not residing in the community every day), 16·21% ($n = 107$) refused participation, and 9·94% ($n = 59$) had died or moved. The non-participants ($n = 474$) and participants ($n = 186$) were similar in age and gender ($P > 0{\cdot}05$). A research assistant (RA) obtained written informed consent for each participant. Of 186 elderly adults recruited for this trial, 14 withdrew during the 5-month study. Therefore, the final sample consisted of 176 participants (Figure 1). The dropouts and non-dropouts were similar in baseline data (Table 1).

Randomization

The first author used a computer-developed random table to randomly assign patients to three intervention groups: control, CB alone or CB with Tai Chi. Allocation was concealed from the recruiting RA. The RA collecting data, and the second author assessing and analysing outcomes were blind to group assignment.

Intervention

At baseline, all three groups received a brochure explaining how to prevent fall incidents.

Control group

The control group received no extra care; they could use or apply for available services in the area as before participation in the study.

CB group

The CB group received an intervention adapted from previous studies (Tennstedt *et al.* 1998, Zijlstra *et al.* 2005) and the FOF management model developed by the first author (Huang 2005). The CB interventions developed by Tennstedt *et al.* (1998) and Zijlstra *et al.* (2005) include an introduction, older adults' point of view of FOF, positive and negative aspects concerning the topic, associations with falls or fear of falling, and implementation in the older adult's daily life.

The FOF management model (Huang 2005) describes and explains how community-dwelling elders think, feel and act when confronting FOF. FOF occurs in the context of believing that falling is an inevitable part of aging. With these misconceptions in mind, elders with FOF might pose a social problem because they curtail their activities rather than focusing on strategies to manage their FOF. The FOF model suggests that community-dwelling elders manage FOF by various strategies: developing psychosomatic symptoms, adopting an attitude of risk prevention, paying attention to environmental safety, and modifying behaviour. Finally, the FOF model found that outcomes were influenced by three interacting conditions: the management strategies used, satisfaction with strategies used, and the degree to which strategies used were supported by resources. Elders who use more negative strategies, have less satisfaction with their managing strategies and minimal support from their family/significant others, are more likely to suffer from FOF (Huang 2005).

The CB intervention consisted of 8-weekly sessions, lasting 60–90 minutes, and in groups of 8–12 participants. The main strategy was restructuring misconceptions to promote a view of fall risk and fear of falling as controllable. Each session

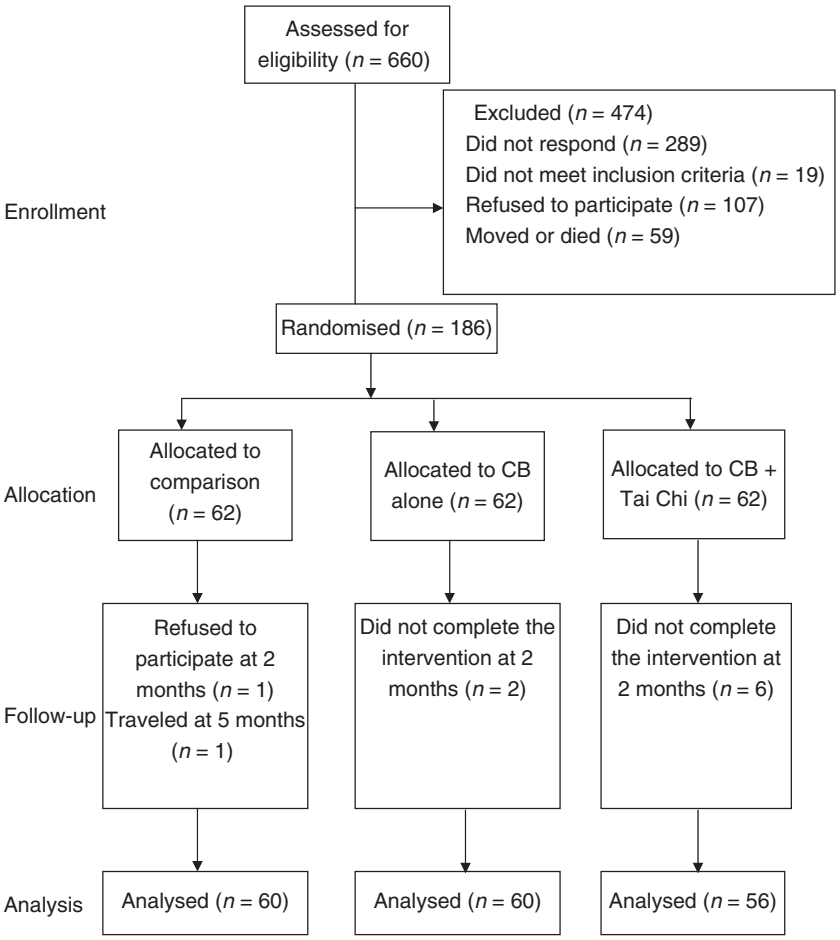

Figure 1 Participant enrollment and flow for this randomized trial.

covered the following topics: (1) introduction; (2) associations with falls or fear of falling; (3) participant's point of view of FOF (positive and negative aspects about the topic); (4) strategies to manage FOF and family support; (5) implementation in the participants' daily life; and (6) problem-solving (during a fall learning how to fall, stand up and call for help). Participants in this study needed to complete all eight sessions of the CB intervention. Each session was conducted by a trained facilitator, who was a nurse qualified in geriatrics and community health nursing.

CB with Tai Chi group

Participants of this combination-intervention group received the same cognitive-behavioural strategies as those in the CB group in addition to Tai Chi exercise training. Two professional Tai Chi instructors, who were experienced in working with older persons, gave the lessons using a predefined protocol. The core of the lessons consisted of ten positions derived from the Yang style. Participants in groups of 10–16 had lessons five times a week, for 8 weeks. Each session of Tai Chi began with warm-up exercises (10 minutes), and was followed by teaching and practicing individual forms of the Tai Chi programme (45 minutes), and ended with cool-down exercises (5 minutes). Participants in the CB with Tai Chi intervention needed to complete the Tai Chi at least three times a week for 8 weeks, and the CB intervention all eight sessions.

Assessment

Data were collected from January to December 2007. Participants in all three groups were assessed in their homes for outcomes (see below) at baseline, 2 months, and 5 months by an RA blinded to their group allocation. Data were also collected at baseline on participants' age, gender, education, marital status, living status, enduring diseases, falls-related history and admitted FOF.

Outcomes

Primary outcomes: FOF and falls. Fear of falling was measured by the Geriatric Fear of Falling Measure (GFFM, Huang 2006) and FES (Tinetti *et al.* 1990). The 15-item GFFM assesses participants' fear of falling in three domains: psychosomatic symptoms (four items), adopting an attitude of risk prevention (five items), and modifying behaviours

Table 1 Participants' baseline characteristics [*N* = 186 at baseline and (176) at 5 months follow-up]

	Comparison [*n* = 62 (60)]		CB [*n* = 62 (60)]		CB + Tai-Chi [*n* = 62 (56)]		
Variable	*n*	%	*n*	%	*n*	%	*P*
Age, years							
60–64	13 (12)	21·0 (20·0)	9 (8)	14·5 (13·3)	13 (10)	21·0 (17·9)	0·57 (0·61)
≥65	49 (48)	79·0 (80·0)	53 (52)	85·5 (86·7)	49 (46)	79·0 (82·1)	
Gender							
Female	35 (34)	56·5 (56·7)	34 (32)	54·8 (53·3)	40 (37)	64·5 (66·1)	0·50 (0·36)
Male	27 (26)	43·5 (43·3)	28 (28)	45·2 (46·7)	22 (19)	35·5 (33·9)	
Education, years							
<6	28 (26)	45·2 (43·3)	31 (30)	50·0 (50·0)	23 (19)	37·1 (33·9)	0·34 (0·22)
≥6	34 (34)	54·8 (56·7)	31 (30)	50·0 (50·0)	39 (37)	62·9 (66·1)	
Marital status							
Single	22 (20)	35·5 (33·3)	12 (10)	19·4 (16·7)	16 (13)	25·8 (23·2)	0·13 (0·11)
Married	40 (40)	64·5 (66·7)	50 (50)	80·6 (83·3)	46 (43)	74·2 (76·8)	
Living status							
Alone	33 (32)	53·2 (53·3)	28 (26)	45·2 (43·3)	31 (28)	50·0 (50·0)	0·66 (0·54)
With family	29 (28)	46·8 (46·7)	34 (34)	54·8 (56·7)	31 (28)	50·0 (50·0)	
Enduring disease							
No	25 (24)	40·3 (40·0)	24 (22)	38·7 (36·7)	27 (25)	43·5 (44·6)	0·86 (0·68)
Yes	37 (36)	59·7 (60·0)	38 (38)	61·3 (63·3)	35 (31)	56·5 (55·4)	
Falls during past year							
No	53 (52)	85·5 (86·7)	50 (48)	77·4 (80·0)	50 (46)	80·6 (82·1)	0·72 (0·61)
Yes	9 (8)	14·5 (13·3)	12 (12)	22·6 (20·0)	12 (10)	19·4 (17·9)	
Admitted fear of falling							
No	25 (24)	40·3 (40·0)	18 (16)	29·0 (26·7)	19 (17)	30·6 (30·4)	0·36 (0·28)
Yes	37 (36)	60·0 (59·7)	44 (44)	71·0 (73·3)	43 (39)	69·4 (69·6)	

Chi-square test.
The numbers are based on 186 participants at baseline; the numbers in parentheses are based on 176 participants who completed the trial.

(six items). Sample items for the three domains include 'I don't sleep well because I worry about falling', 'I will sit on a chair when bathing or hold onto a support', and 'I go out less on rainy days', respectively. Responses to items are indicated on a Likert-type scale from 1 (not at all concerned) to 5 (very concerned), with higher scores indicating greater concern. The total score is calculated by adding all the item responses (Huang 2006). GFFM scores are more strongly associated with physical and psychosocial functioning than FES and Activities-Specific Balance Confidence Scale (ABC, Powell & Myers 1995) scores, suggesting that it is more appropriate for studies on improving all aspects of fear of falling in community-dwelling elders (Huang & Wang 2009). Cronbach's alpha for the GFFM in this study was 88.

The FES (Tinetti *et al.* 1990) has been the tool most used in the literature to measure fear of falling. Respondents rate their confidence in conducting ten non-hazardous activities of daily living that require transferring, bending, reaching, or walking (Tinetti *et al.* 1990). Responses range from 1 to 10, with higher scores indicating greater confidence in maintaining daily living activities. The total score is calculated by adding all the item responses. The Chinese version of the FES had a 2-week, test–retest reliability of 0·90 (Huang & Acton 2004). Cronbach's alpha of the Chinese FES in this study was 0·98.

Number of falls was recorded using the Falls Record Checklist (Huang & Acton 2004), which has a calendar for participants to circle dates when a fall occurred.

Secondary outcomes: mobility, social support and quality of life. Mobility (gait and balance) was assessed using the Tinetti Mobility Scale (Tinetti *et al.* 1986). This scale is simple, requires no equipment and is quick and convenient to use. Each participant took approximately 5 minutes to perform the whole series of activities on the scale. The better is a participant's performance, the higher is the score. The maximum scores for gait and balance are 12 and 16, respectively. Balance and gait scores are summed to give an overall mobility score. Low mobility scores (<14) have been associated with recurrent falling (Tinetti *et al.* 1986). Gait scores <9 and balance scores <10 were also independent predictors for recurrent falls. Interrater reliability for assessing differences in balance and gait scores of ten participants was <10% in all cases (Tinetti *et al.* 1986). Cronbach's alpha of the Tinetti Mobility Scale in this study was 0·89.

Social support behaviours and satisfaction were measured using the Chinese version (Huang & Lin 2004) of the Inventory of Social Supportive Behaviors (ISSB) (Barrera *et al.* 1981). The 13-item ISSB includes two subscales: behaviour and satisfaction. Responses on the behaviour subscale range from 1 (never) to 3 (always); responses on the satisfaction subscale range from 1 (very unsatisfied) to 4 (very satisfied). A higher score indicates better behaviour and satisfaction. Cronbach's alpha of the ISSB in this study was 0·86.

Quality of life (QOL) was measured by the Taiwanese version of the World Health Organisation's WHOQOL-BREF, a widely used, self-administered, reliable and valid generic indicator of physical, psychological, social and environmental relationships (Yao *et al.* 2002). This 28-item scale has four subscales (physical health, psychological, social relationship and environment) that measure different health concepts. Responses to items range from 1 to 5. The total score is calculated by averaging all the item responses, with higher scores indicating better quality of life. Cronbach's alpha of the WHOQOL-BREF in this study was 0·88.

Ethical considerations

Approval for this trial was obtained from the Institutional Review Board of the authors' university. Each participant was assured of confidentiality and the option to decline participation or withdraw from the trial at any time.

Data analysis

Statistical analyses were performed using SPSS 15.0 (SPSS Inc., Chicago, IL, USA). Significance was considered $P < 0{\cdot}05$. Analysis of variance and chi-square statistics were used to test for differences among the three groups at baseline, 2 and 5 months after interventions. Changes in outcome variables at various follow-up times were predicted using a mixed model approach with an intent-to-treat approach whereby all randomized participants were included, and a mixed model was used to account for missing follow-up data. Internal consistency was examined by Cronbach's alpha.

Results

Comparison of three groups at baseline

Regardless of 186 participants at baseline or 176 participants who completed this trial, the majority of participants were 65 years or older, female, with ≥6 years education, married and half were living with their family (Table 1). More than half of them had at least one enduring disease, with little history of falls during the past year and some admitted fear of falling (Table 1). These groups were well-balanced for baseline demographic characteristics and falls-related history (Table 1), and for falling (Table 2), fear of falling, mobility (gait and balance), social support and quality of life (Table 3).

Impact of experimental programmes on outcomes

Elderly adults in the CB with Tai Chi group had significantly better outcomes at 5 months than the control group for all indicators, except for the average rate of falls.

Primary outcomes: fear of falling

GFFM scores. In terms of fear of falling, the average GFFM scores for the CB and CB with Tai Chi groups decreased from 35·66 (SD = 11·60) and 35·82 (SD = 9·77) at baseline to 32·33 (SD = 11·14) and 30·30 (SD = 7·55), respectively 5 months later, whereas scores for elderly adults in the control group

Table 2 Intervention effects on falls for participants by group

	Comparison (n = 62, 60)	CB (n = 62, 60)	CB + Tai Chi (n = 62, 56)	F/χ^2	P
Falls*, mean (SD)					
3-month period before interventions	0·13 (0·34)	0·13 (0·34)	0·09 (0·29)	0·67	0·61
3-month period after interventions	0·13 (0·34)	0·13 (0·34)	0·05 (0·23)		
Fall rate†, n (%)					
3-month period before interventions					
0	54 (87·1)	54 (86·7)	57 (91·9)	0·97	0·62
1	8 (12·9)	8 (12·9)	5 (8·1)		
3-month period after interventions					
0	52 (86·7)	52 (86·7)	53 (94·6)	2·52	0·28
1	8 (13·3)	8 (13·3)	3 (5·4)		

*F-test; †Chi-squared test.

Table 3 Intervention effects on 5-month outcomes for participants by group

	Comparison† (*n* = 62,61,60)	CB‡ (*n* = 62,60,60)	CB + Tai Chi§ (*n* = 62,56,56)	ANOVA		Mixed model		
Variable	Mean (SD)	Mean (SD)	Mean (SD)	*F*	*Post hoc*	Time	Group	T × G
Fear of falling								
GFFM (15–75)								
Baseline	38·39 (12·06)	35·66 (11·60)	35·82 (9·77)	1·16		16·59***	8·65***	20·89***
2 months	38·66 (12·49)	32·03 (11·84)	32·27 (8·75)	7·93**	1 > 2 & 3			
5 months	42·00 (13·21)	32·33 (11·14)	30·30 (7·55)	19·18***	1 > 2 & 3			
FES (10–100)								
Baseline	90·39 (16·83)	88·81 (17·40)	94·26 (16·71)	2·36		4·27*	5·42**	6·09***
2 months	88·69 (20·13)	90·13 (16·85)	96·71 (14·95)	4·09*	3 > 1			
5 months	88·40 (18·71)	90·88 (15·72)	99·14 (11·66)	9·10***	3 > 1&2			
Mobility (0–28)								
Baseline	23·98 (4·34)	24·05 (3·94)	25·19 (3·69)	1·80		23·56***	12·45***	30·33***
2 months	22·46 (5·71)	21·63 (5·07)	26·34 (2·36)	17·06***	3 > 1&2			
5 months	22·53 (5·80)	21·32 (5·26)	26·46 (2·61)	18·58***	3 > 1&2			
Gait (0–12)								
Baseline	10·40 (1·71)	10·69 (1·48)	10·97 (1·56)	1·86		23·60***	12·98***	35·08***
2 months	9·67 (2·32)	9·67 (2·41)	11·57 (0·95)	16·86***	3 > 1&2			
5 months	9·63 (2·37)	9·43 (2·57)	11·62 (1·11)	18·47***	3 > 1&2			
Balance (0–16)								
Baseline	13·63 (2·75)	13·35 (2·75)	14·23 (2·39)	1·77		32·38***	10·76***	25·22***
2 months	12·44 (3·76)	12·05 (2·88)	14·77 (1·68)	14·41***	3 > 1&2			
5 months	12·38 (3·81)	11·87 (3·11)	14·82 (1·65)	15·64***	3 > 1&2			
Social support								
Behaviour (13–39)								
Baseline	28·89 (6·52)	28·73 (3·98)	28·92 (4·69)	0·03		6·00**	0·21	3·32*
2 months	28·56 (4·60)	27·67 (4·76)	27·55 (4·03)	0·96				
5 months	28·03 (4·79)	27·92 (5·09)	29·32 (4·71)	1·65				
Satisfaction (13–52)								
Baseline	38·85 (4·33)	38·18 (5·46)	38·40 (4·54)	0·32		2·25	2·31	6·35***
2 months	37·07 (5·50)	37·57 (5·52)	38·75 (4·53)	1·59				
5 months	36·70 (4·69)	37·50 (6·14)	40·20 (4·18)	7·43**	3 > 1&2			
QOL (16–80)								
Baseline	54·04 (6·16)	52·85 (8·88)	55·21 (6·01)	1·70		9·89***	8·24***	16·66***
2 months	53·08 (6·95)	53·80 (10·32)	58·54 (5·51)	8·19***	3 > 1&2			
5 months	52·27 (6·93)	53·87 (10·67)	59·70 (5·87)	12·95***	3 > 1&2			

F-test for all three groups: $*P < 0{\cdot}05$; $**P < 0{\cdot}01$; $***P < 0{\cdot}001$.
†Comparison group, ‡Cognitive behavioural (CB) group, §CB + Tai Chi group.

over the same period rose from 38·39 (SD = 12·06) to 42·00 (SD = 13·21) (Table 3). Differences among the three groups were shown by mixed-model analysis to be significant (interaction effect, $F = 20{\cdot}89$, $P < 0{\cdot}001$). These results indicate that the decreased FOF of elderly adults in the two experiment groups was significantly higher at 5 months than that of the control group ($F = 19{\cdot}18$, $P < 0{\cdot}001$) (Table 3).

FES scores. Mean total FES scores for elderly adults in the CB and CB with Tai Chi groups rose from 88·81 (SD = 17·40) and 94·26 (SD = 16·71) at baseline to 90·88 (SD = 15·72) and 99·14 (SD = 11·66), respectively, at the 5-month follow-up, whereas scores for elders in the control group descended from 90·39 (SD = 16·83) to 88·40 (SD = 18·71). FES among the three groups was shown by mixed-model analysis to be significantly different (interaction effect, $F = 6{\cdot}09$, $P < 0{\cdot}001$). The mean FES score of the CB with Tai Chi group was significantly higher than those of the CB and control groups at the 5-month follow-up ($F = 9{\cdot}10$, $P < 0{\cdot}001$) (Table 3).

Primary outcomes: falls

The average numbers of falls (comparing 3-month periods before and after intervention) were shown by ANOVA to not

differ significantly among the three groups ($F = 0{\cdot}67$, $P > 0{\cdot}05$) (Table 2). The rates of falls among elderly adults post intervention were slightly lower than those at preintervention in the CB with Tai Chi group, but this difference was not statistically significant (Table 2). Also, the fall rate among the three groups was not significantly different during the 3-month period after the interventions ($\chi^2 = 2{\cdot}52$, $P > 0{\cdot}05$).

Secondary outcomes: mobility

Mobility among the three groups changed significantly over time (Table 3) as demonstrated by mixed-model analysis (interaction effect, $F = 30{\cdot}33$, $P < 0{\cdot}001$). The mean mobility score of the CB with Tai Chi group was higher than that of the CB and control groups ($P < 0{\cdot}001$) at the 5-month follow-up (Table 3). The gait scores among the three groups changed significantly over time as demonstrated by mixed-model analysis (interaction effect, $F = 35{\cdot}08$, $P < 0{\cdot}001$). The mean gait score of the CB with Tai Chi group was significantly higher than that of the CB and control groups ($P < 0{\cdot}001$) at the 5-month follow-up (Table 3). Balance among the three groups also changed significantly over time as demonstrated by mixed-model analysis (interaction effect, $F = 25{\cdot}22$, $P < 0{\cdot}001$). The mean balance score of the CB with Tai Chi group was significantly higher than that of the CB and control groups ($P < 0{\cdot}001$) at the 5-month follow-up (Table 3).

Secondary outcomes: social supports

The three groups were shown by mixed-model analysis to be significantly different for social support behaviour (interaction effect, $F = 3{\cdot}32$, $P < 0{\cdot}05$) and social support satisfaction (interaction effect, $F = 6{\cdot}35$, $P < 0{\cdot}001$) ($F = 6{\cdot}67$, $P < 0{\cdot}001$). Elders who received the CB with Tai Chi intervention reported significantly higher social support satisfaction scores than the CB and control groups ($F = 7{\cdot}43$, $P < 0{\cdot}01$) at the 5-month follow-up (Table 3).

Secondary outcomes: quality of life

Changes over time in total QOL and its subscales (physical health, mental health, social relationships and environment) for the three groups were significantly different at the 5-month follow-up as shown by mixed-model analysis (interaction effect, $F = 16{\cdot}66$, $P < 0{\cdot}001$; subscales $F = 17{\cdot}14$, $13{\cdot}21$, $3{\cdot}39$ and $8{\cdot}80$, $P < 0{\cdot}001$ or $0{\cdot}05$, respectively) (Table 3). The mean scores for total QOL and the four subscales were significantly higher at the 5-month follow-up for the CB with Tai Chi group than those of the CB and control groups ($P < 0{\cdot}01$ or $0{\cdot}001$) (Table 3).

Discussion

Study limitations

This trial had several limitations. First, participants were recruited from only one community. The results from a multisite trial would be more generalizable. Second, participants were followed up over a relatively short period. A longer follow-up period would better estimate effects of intervention on long-term management of FOF. Third, participants were randomly allocated into three different groups, and a Tai Chi only group was not included. Finally, it is unclear how much additional time and costs were incurred by these two individualized experimental approaches. A cost-effectiveness study may be needed.

Discussion of results

This study is the first trial using a combined cognitive-behavioural strategy and Tai Chi intervention to reduce FOF among community-dwelling elders. This trial demonstrated that when community-dwelling elderly adults received CB with Tai Chi exercise, they had less fear of falling, better falls efficacy, better mobility (gait and balance), better social support and better quality of life than elders in the control group. Our findings confirm the results of a meta-analysis (Jung *et al.* 2009), which found that fear of falling was significantly decreased by interventions that combined exercise and education, measured intervention effects after 4 months and were community-based. Moreover, they found that intervention effects were small, and suggested that interventions to reduce FOF among the elders should involve cognitive reconstructing and behavioural changes (Jung *et al.* 2009).

Our interventions adapted cognitive-behavioural strategies from previous studies (Tennstedt *et al.* 1998, Zijlstra *et al.* 2005), and a FOF management model (Huang 2005). The merit of our trial is that it involved two forms of intervention used in everyday clinical practice. Cognitive-behavioural strategies have been useful in programmes to manage fear of falling (Tennstedt *et al.* 1998, Zijlstra *et al.* 2005, Gitlin *et al.* 2006), but are inadequate substitutes for interventions that improve functional ability such as Tai Chi exercise. Therefore, elderly adults in the combination group had best outcomes at 5 months.

We chose Tai Chi as an exercise intervention in our trial since it has been shown to be more effective than other exercises for improving FOF and mobility in elderly adults (Li *et al.* 2005, 2008, Sattin *et al.* 2005). As in our trial, that

What is already known about this topic

- Fear of falling is a major health problem of community-dwelling older persons.
- Few studies exploring Tai Chi or cognitive behavioural strategies could reduce fear of falling among elders.

What this paper adds

- This is the first trial using a cognitive-behavioural strategy with Tai Chi exercise among community-dwelling older adults to manage fear of falling, and the intervention reducing fear of falling effectively.
- This trial helped community-dwelling elderly adults to enhance their mobility and social support and to increase their quality of life.

Implications for practice and/or policy

- The findings of this study indicate that the cognitive-behavioural strategy with Tai Chi intervention is effective for reducing fear of falling among community-dwelling older adults.
- These findings can be used by community health professionals to play an important role in decreasing older adults' fear of falling, and in promoting their mobility, social support, and quality of life.

literature review found strong evidence for the effectiveness of Tai Chi in reducing FOF. The Tai Chi interventions were found to vary greatly in duration, frequency and intensity (Harling & Simpson 2008). For example, in one study (Li *et al.* 2008), the participants needed ≥75% attendance rate of twice weekly 1-hour classes (40–45 minutes of 8-form Tai Chi) for 12 weeks, and ≥30 minutes of in-home practice per week. In another study (Sattin *et al.* 2005), two sessions of Tai Chi were given per week, increasing from 60 to 90 minutes, excluding warm-up and cool down (progressing from 10 to 50 minutes) for 48 weeks. In our combined intervention, we gave 1-hour Tai Chi classes, five times a week, for 8 weeks, which seemed to effectively reduce FOF among community-dwelling elders. However, in this trial, we did not have an experimental group that received a Tai Chi intervention only; therefore, we are not able to distinguish the effectiveness of this trial because of Tai Chi or the combination intervention.

On the other hand, our study found no significant differences in falls among the three groups at the 5-month follow-up. Our findings on falls are consistent with a literature review that found weak evidence supporting the effectiveness of Tai Chi in reducing the incidence of falls in older adults (Harling & Simpson 2008). The follow-up time may be too short to detect enough falls for analysis; also, in view of the relatively health and young participants in this trial.

The participants who received the CB with Tai Chi intervention had better social support. This effect may have been due to about half of the participants being single (n = 83, 47·16%), and living alone (n = 86, 48·86%); thus, participating in Tai Chi group exercise at least three times a week might have created a sense of belonging. Our finding is consistent with a previous report that social support was positively associated with physical activity of older rural women (Plonczynski *et al.* 2008).

All the participants in this group continued doing Tai Chi after the intervention, consistent with previous reports that 100% of 140 community-dwelling older adults intended to continue doing Tai Chi after a 12-week intervention (Li *et al.* 2008) and that peer groups are important to the well-being of single elders (Gupta & Korte 1994). Similarly, elders' well-being was found to be strongly related to a level of social involvement and self-reported quality of social life (Kunzmann 2008).

Our findings that the CB with Tai Chi intervention improved multiple QOL domains of older adults should indicate that this intervention is acceptable to them and that they will adhere to it in the long term (Lin *et al.* 2007). Our results reinforce the need to further examine the meaning of QOL assessments in older adults. First, not all generic QOL measures, usually developed for the general population, are suitable for older people. However, the WHOQOL-BREF has been determined as a reliable, valid and responsive measure of the occurrence of falls in older people (Lin *et al.* 2007). Second, improvements in the physical and psychological QOL domains and mobility scores may have resulted from improved functional status as a consequence of Tai Chi exercise, peer support or the CB programme. Finally, a meaningful interpretation of changes in QOL scores is usually difficult, because the statistical significance of changes in QOL scores implies little about their clinical significance. If the QOL changes are related to more familiar or objective measures, clinicians may more easily grasp the anchor-based interpretation of clinical significance in elderly populations. For instance, changes in scores on the physical QOL domain in this study were significantly correlated with those in balance (r = 0·66) and gait (r = 0·59), and changes in scores on the psychological QOL domain were significantly correlated with those in fear of falling (GFFM and FES, r = 0·54 and r = 0·49, respectively).

Conclusion

This is the first trial using a cognitive-behavioural strategy with Tai Chi exercise among community-dwelling older adults to manage fear of falling and promote their mobility, social support behaviour and satisfaction, and quality of life. This study gives evidence to support the CB with Tai Chi intervention as an appropriate and effective programme for reducing fear of falling in community-dwelling older adults.

Implications for practice and future research

The findings of this study indicate that the CB with Tai Chi intervention is effective for reducing FOF among community-dwelling older adults. These findings can be used by community health professionals to play an important role in decreasing older adults' FOF, and promoting their mobility, social support and QOL. Furthermore, implementing this intervention with a sample of older community-dwelling adults or those with admitted FOF may empower them to deal with FOF. This intervention also needs to be tested on hospitalized and institutionalized elders. Finally, to more precisely study the effects of the intervention, a longer term follow-up period will be needed.

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Author contributions

TTH, LHY and CYL were responsible for the study conception and design. LHY performed the data collection. TTH and LHY performed the data analysis. TTH, LHY and CYL were responsible for the drafting of the manuscript. TTH and CYL made critical revisions to the paper for important intellectual content. TTH provided statistical expertise. TTH provided administrative, technical or material support. TTH supervised the study.

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