



## Sleep quality, depression state, and health status of older adults after silver yoga exercises: Cluster randomized trial

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### Abstract

**Background:** Sleep disturbances, depression, and low perception of health status are commonly seen in elderly population; however, clinicians tend to underestimate or overlook the presence of these symptoms and assume them to be a part of normal aging. Non-pharmacological methods that promote a mind–body interaction should be tested to enhance the mental health of older adults.

**Objective:** To test the effects of 6 months of silver yoga exercises in promoting the mental health of older adults in senior activity centers, especially their sleep quality, depression, and self-perception of health status.

**Design:** Cluster randomized trial.

**Settings:** Eight senior activity centers, southern Taiwan.

**Participants:** A sample of 139 participants was recruited, and 128 of them completed the study. Inclusion criteria: (1) community-dwelling older adults ages 60 and over, (2) no previous training in yoga, (3) able to walk without assistance, (4) cognitively alert based on the Short Portable Mental Status Questionnaire (SPMSQ) score of eight or higher, and (5) independent or mildly dependent in self-care based on a Barthel Index (BI) score of 91 or higher. The mean age of the participants was  $69.20 \pm 6.23$  years, and the average number of chronic illness was  $0.83 \pm 0.90$ . The average BI score of the participants was  $99.92 \pm 0.62$ , and the mean SPMSQ score was  $9.90 \pm 0.30$ .

**Methods:** Participants were randomly assigned into either the experimental ( $n = 62$ ) or the control ( $n = 66$ ) group based on attendance at selected senior activity centers. A 70-min silver yoga exercise program was implemented three times per week for 6 months as the intervention for the participants in the experimental group.

**Results:** Most of the mental health indicators of the participants in the experimental group had significantly improved after the silver yoga interventions, and many of the indicators improved after 3 months of intervention and were maintained throughout the 6 months study. The mental health indicators of the participants in the experimental group were all better than the participants in the control group (all  $p < .05$ ).

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**Conclusions:** After 6 months of silver yoga exercises, the sleep quality, depression, and health status of older adults were all improved.

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**Keywords:** Aged; Depression; Health; Intervention; Sleep quality; Yoga

### What is already known about the topic?

- Sleep disturbances, depression, and low perception of health status are commonly seen in the elderly population; however, many clinicians tend to underestimate or overlook the presence of these symptoms and assume them to be a part of normal aging.
- Pharmacological treatment of sleep disorder and depression in older adults is associated with hazardous side effects; thus, non-pharmacological methods that promote a mind–body interaction should be tested to enhance the mental health of older adults.
- The silver yoga program, a type of mind–body–spirit exercise, is a safe and manageable yoga program created to accommodate the reduced body flexibility experienced by many older adults.

### What this paper adds

- After 6 months of regular silver yoga exercises, young-older adults' sleep latency, daytime dysfunction and depression state decreased, and subjective sleep quality, physical health perception, and mental health perception improved.
- The silver yoga program is recommended to be incorporated as an exercise activity in senior activity centers or community-settings to promote the mental health of community-dwelling older adults.

## 1. Introduction

Epidemiologic studies indicate that about 60% of older adults have sleep complaints most of the time (Foley et al., 1995). The three most commonly reported sleep disturbance symptoms include: difficulty initiating sleep, difficulty maintaining sleep, and early morning awakening (Ohayon, 2002). Sleep disturbances in older adults are attributed to inactive life styles, such as repetitive daily routines, lack of physical exercise, and poor sleep practices (e.g., excessive napping, drinking, and smoking) (Foley et al., 2004) that could result in tiredness, fatigue, depression, greater anxiety, irritability, pain sensitivity, muscle tremors, immunosuppression, and lack of daytime alertness (Pandi-Perumal et al., 2002). Clinicians tend to underestimate the presence of these symptoms, especially depression, possibly because depressive symptoms may be assumed to be a part of normal aging and, therefore, are sometimes overlooked (Jackson and Baldwin, 1993). Depression is a costly and potentially

disabling condition affecting substantial proportions of older adults. The prevalence of depressive symptoms in the general population is at its lowest during middle age, and then increases throughout late adulthood until reaching its highest level in adults aged 80 years and above (Mirowsky and Rose, 1992). Pharmacological treatment of sleep disorder and depression in older adults is most commonly seen in clinical practice; however, it is associated with hazardous side effects, such as tremor, anxiety, restlessness, drowsiness, dizziness, weakness, and fatigue (Manjunath and Telles, 2005). Non-pharmacological methods that promote a mind–body interaction without side effects should be tested to enhance the mental health of older adults (Lai and Good, 2006).

Yoga, a type of mind–body–spirit exercise, originated in India more than 2000 years ago (Hewitt, 1977). In its original form, yoga has a complex system of spiritual, moral, and physical directives, and the purpose of yoga practice is to attain “spiritual self-realization” (Feuerstein, 1998). Traditional yoga therapy focuses on a holistic treatment for people with various somatic or psychological dysfunctions (Feuerstein, 2000). Through the years, people practiced yoga without knowledge of its spiritual origins (Hewitt, 1977). The goals of yoga therapy are to promote health benefits and self-awareness (Feuerstein, 2000). Yoga is a meditative discipline and is a way of gaining insight into the nature of the mind and reality. The practice of yoga heals and strengthens the body, sharpens the mind, and calms the spirit (Cameron, 2002). As the body, mind, and spirit come into harmony with one another and with the infinite, the person experiences compassion, well being, and inner peace (Cameron, 2002).

Studies of yoga-based interventions performed on healthy populations have shown that yoga decreased depression and anxiety (Pilkington et al., 2005; Waelde and Thompson, 2004; Woolery et al., 2004), decreased stress (Anand, 1999), and improved perceived self-efficacy (Waelde and Thompson, 2004). Wood (1993) further demonstrated that a yogic stretching and breathing program had a markedly invigorating effect on perceptions of both mental and physical energy, and increased mood positively in a group of 71 adults with ages ranging from 21 to 76 years. The effects of yoga on mood were examined in 113 psychiatric inpatients; results suggested that yoga was associated with improved mood, and maybe a useful way of reducing stress during inpatient psychiatric treatment (Lavey et al., 2005). Moreover, in a randomized trial on the effects of yoga intervention in 39 patients with lymphoma, the

researchers found that participants in the yoga group reported significantly lower sleep disturbances, better subjective sleep quality, faster sleep latency, longer sleep duration, and less use of sleep medications during follow-up compared with participants in the wait-list control group (Cohen et al., 2004). Similar findings were found in Manjunath and Telles (2005): after 6 months of yoga practice, yoga improved different aspects of sleep in a geriatric population. The group showed a significant decrease in the time taken to fall asleep, an increase both in the total number of hours slept and in the feeling of being rested in the morning.

The silver yoga exercise program is a safe and manageable yoga program developed by Chen et al. (2007) to accommodate the reduced body flexibility experienced by many older adults. The program includes four phases: (1) warm-up (20 min): eight postures to loosen up the body structure; (2) hatha yoga (20 min): seven gentle, stretching postures to increase range of motion and progressive muscle relaxation of older adults with special consideration for their physical abilities and tolerance; (3) relaxation (10 min): three activities to rest the body; and (4) guided-imagery meditation (15 min): two imagery-guiding directions to facilitate a state of relaxation. A 5-min break is arranged between the warm-up and hatha yoga phases to accommodate the physical tolerance of older adults; the whole program takes 70 min to complete. Abdominal breathing is emphasized in each phase of the program, and the postures in the silver yoga program are considered to be less strenuous than those used in traditional yoga (Chen et al., 2007). The purpose of this study was to test the effects of a 6-month silver yoga exercise program in promoting the mental health of older adults in senior activity centers, especially sleep quality, depression, and health status. The specific research hypotheses were: (1) the participants' sleep quality and self-report of health status would improve, and their depression state would decrease after 6 months of regular silver yoga exercises; and (2) the sleep quality and self-reported health status of participants in the experimental group would be significantly better than those participants in the control group; the depression state of participants in the experimental group would be significantly less than those participants in the control group.

## 2. Methods

### 2.1. Design

A cluster randomized trial was used. Eight senior activity centers were randomly assigned into either the silver yoga experimental group or a wait-list control group. The groups assignment used a black box drawing method, which the names of the eight senior activity centers were written on slips of paper, the slips were folded and placed into a box, and then the slips were blindly drawn. Before

intervention started, all of the participants were examined on their sleep quality, depression state, and self-perception of health status. After intervention started, these variables were examined again at 3-month and 6-month intervals in order to reveal when the intervention had significant impact. These time points were specifically chosen to reflect the most frequent intervention periods suggested in the literature.

### 2.2. Setting and participants

This study was conducted in eight senior activity centers in Kaohsiung city, southern Taiwan. Kaohsiung city is the second largest metropolitan city in Taiwan. Older adults aged 60 and over comprise 13.11% of the residents in Kaohsiung city and are eligible to receive various senior care services and social welfare benefits from the Social Affairs Bureau of the Kaohsiung City Government (Civil Affairs Bureau, Kaohsiung City Government, 2008). Participating in activities held by the senior activity centers is one of the services. The inclusion criteria for the participants were: (1) community-dwelling older adults ages 60 and over, (2) no previous training in any form of yoga, (3) able to walk without assistance, (4) cognitively alert as demonstrated by a Short Portable Mental Status Questionnaire (SPMSQ) score of eight or higher, and (5) independent or mildly dependent in self-care as indicated by a Barthel Index (BI) score of 91 or higher. Based on the Statistical Software Sample Power 2.0, the required sample size was 56 participants for each group (power = .8; alpha = .05;  $R^2$  of covariate in medium level .13; effect size in medium level .25). The parameter of medium level was used for both  $R^2$  of covariate and effect size because the silver yoga exercise program was a newly developed exercise program and no previous research and data could be used as the reference for the parameter estimation.

A total sample of 139 participants were recruited from the eight senior activity centers and were randomly assigned into either the experimental ( $n = 62$ ) or the control ( $n = 66$ ) group based on the senior activity centers where they participated. One hundred and thirty participants completed the 6-month study (attrition rate: 6.47%): seven participants, evenly distributed from each study site, withdrew by the 3-month interval (experimental group = three participants; control group = four participants) and two participants in the control group withdrew at the end of the 6-month interval. The reasons for withdrawal from the experimental group included: motorcycle accident ( $n = 1$ ) and moved out of the area ( $n = 2$ ). Participants withdrew from the control group for the following reasons: moved out of the area ( $n = 2$ ), motorcycle accident ( $n = 1$ ), being a caregiver for a spouse ( $n = 1$ ), physical discomfort ( $n = 1$ ), and not interested ( $n = 1$ ) (see Fig. 1). The characteristics of the participants who withdrew from the study were similar to those participants who remained in the study.

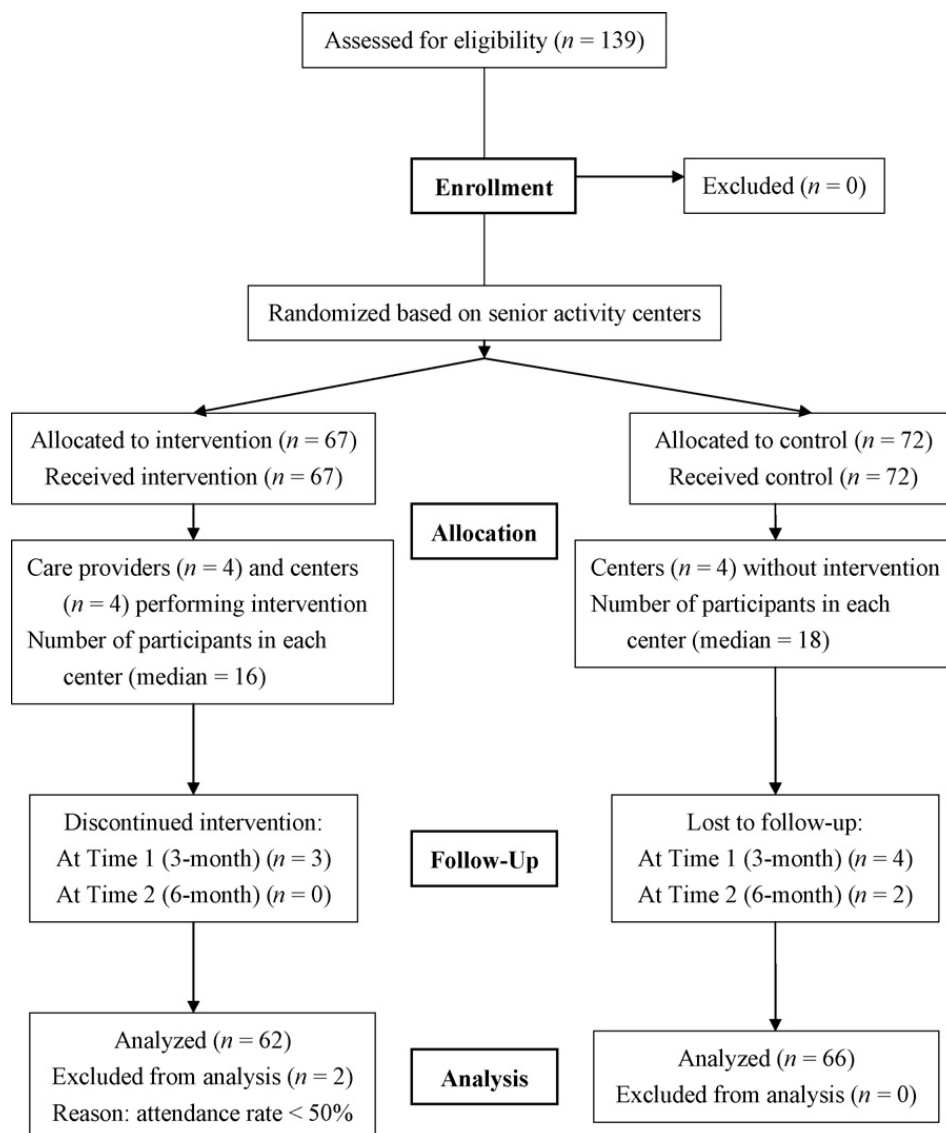


Fig. 1. Flow of participants.

### 2.3. Intervention

The 70-min silver yoga exercise program, which included warm up, hatha yoga gentle stretching, relaxation, and guided-imagery meditation, was implemented in four randomly selected senior activity centers as the intervention for the participants in the experimental group. The group intervention (about 15–20 older adults per group) in each senior activity center was led by two certified silver yoga instructors three times per week for 6 months. These certified instructors were middle-aged, female adult volunteers, ranging in age from 48 to 60 years. To make this exercise program a part of the regular activities in each senior activity center, the instructors were staff or volunteers from each senior activity center. They completed a 9-h training course, which included 1 h on the theoretical basis and use of yoga, 6 h on learning the techniques, and 2 h on elderly teaching

and group-leading strategies, and were certified by the principle investigator (PI).

To ensure intervention consistency across the study sites and among the instructors, a pre-recorded tape made by the PI verbally guided the intervention process and directed participants in performing each yoga posture. Two instructors were present at each yoga session: one instructor followed the pre-recorded tape of the program and demonstrated the yoga postures; the other instructor adjusted participants' postures and prevented any possible harm to the participants from the yoga exercises. It was emphasized in the program that each posture was to be done gently and in moderation. The instructors constantly reminded the participants not to strain themselves in any harmful manner while doing yoga postures. Any signs and symptoms of discomfort that occurred during any yoga session were required to be recorded by the instructors; no special concerns occurred.

The attendance rate of the participants was 87.04%. The most frequent absence reasons were: family vacation (17.15%), family gathering, such as children's visits (13.14%), and scheduling conflicts with their volunteer works (7.51%). The participants in the wait-list control group participated in the regular activity programs in the senior centers (such as singing, arts and crafts), and remained usual daily activities. They were invited to participate in the silver yoga exercises after completion of the study.

#### 2.4. Data collection

Three instruments, which had acceptable psychometric properties and were commonly used by clinicians and researchers, were selected to measure the three main outcome variables of the study. The sleep quality of the participants was measured by the Pittsburgh Sleep Quality Index (PSQI), which is an 18-item, self-reported questionnaire that assesses quality of sleep and sleep disturbances over 1 month (Buysse et al., 1989). A total score, ranging from 0 to 21, is derived as well as seven subscales that include subjective sleep quality (1 item), sleep latency (2 items), sleep duration (1 item), habitual sleep efficiency (2 items), sleep disturbances (9 items), use of sleeping medications (1 item), and daytime dysfunction (2 items). A higher score indicates more severe complaints and worse sleep quality. A score of five and above on the PSQI total scale, which is computed as a sum of the seven subscales, is associated with clinically significant sleep disruptions, including insomnia and major mood disorders (Buysse et al., 1989). The Chinese version of the PSQI was available and was used in this study. Based on the baseline scores of this study, a Cronbach's alpha of .78 was obtained.

The depression state of the participants was measured by the Taiwanese Depression Questionnaire (TDQ). The TDQ is an 18-item scale used to measure the emotional feelings of the respondents during the previous week (Lee et al., 2000). The participants were asked to rate their emotions on a Likert-type scale, ranging from 0 to 3. Zero means that the described symptoms have happened for less than 1 day during the previous week; one means that the described symptoms have happened for 1–2 days during the previous week; two means that the described symptoms have occurred for 3–4 days during the previous week; and three means that the described symptoms have occurred for 5–7 days during the previous week. The scores range from 0 to 54, and a score of 19 and above indicates the tendency toward depression and warrants counseling and visits to the psychiatrist. In a sample of 107 Taiwanese community residents, mean age 51.8 years (S.D. = 14.7), the Cronbach's alpha coefficient was .90, sensitivity of .89, and a specificity of .92 at a cut-off score of 19 (Lee et al., 2000). Based on the baseline scores of this study, a Cronbach's alpha of .88 was obtained.

The self-perception of health status was measured by the SF-12 Healthy Survey, Chinese version. The SF-12 is a self-report, Likert-type scale designed to assess respondents' health status (Ware et al., 1993). It was developed to be a much shorter, yet valid, alternative to the SF-36 for use in large surveys of general and specific populations as well as large longitudinal studies of health outcomes. All SF-12 items come from the SF-36. It has two components with eight health concepts measured. The physical health component (6 questions) includes the concepts of physical functioning (2 items), role-physical (2 questions), bodily pain (1 question), and general health perception (1 item). The mental health component (6 questions) includes the concepts of vitality (1 item), social functioning (1 item), role-emotional (2 questions), and mental health (2 items). Various questions were asked to reflect each health concept measured in this instrument, and different types of Likert-scales were used. A higher score indicates better physical and mental health. Based on the baseline scores of this study, Cronbach's alphas of .79 and .72 were obtained for physical health and mental health components, respectively.

#### 2.5. Procedure

This study was approved by the Institutional Review Board of the University. Following approval by the administrators of the senior activity centers, potential participants were contacted by the staff of the centers. From those older adults who were willing to participate in the study, the staff of the centers made selections for further referral to the research team. The research assistants, who were different from the certified silver yoga instructors, met with the participants individually, explained the study and the use to be made of the data, and then had them sign the written informed consent form. The demographic data were gathered first, and then the questionnaires for sleep quality, depression state, and self-perception of physical and mental health status were administered through individually structured interviews.

#### 2.6. Data analysis

The Statistical Package for the Social Sciences (SPSS) Version 11.0 was used to analyze the data. Descriptive statistics such as mean, standard deviation, range, and frequency distribution were used to describe the participants' demographic data in each group. Pearson  $\chi^2$ -test or a *t*-test was used to test group differences in demographic profiles and baseline data. The mixed-design, two-way analysis of variance (two-way ANOVA) was used to detect the variables on which time and group had interaction effects. For those variables on which time and group had interaction effects, one-way repeated measures ANOVAs were performed to analyze the simple main effect of different time points in each group. To further understand the group differences at the 3-month point and at the end of the 6

months of study, analysis of covariance (ANCOVA) was computed on those variables in which time and group had interaction effects, using the baseline data as the covariate to offset the group differences at the beginning of the study.

### 3. Results

#### 3.1. Participants' demographic profiles

To enhance the consistency of intervention intensity across the participants, those participants with an attendance rate of 50% or less ( $n = 2$ ) were screened from the study, which yield a final sample size of 128: experimental group ( $n = 62$ ) and control group ( $n = 66$ ). The average age for this sample of 128 older adults was  $69.20 \pm 6.23$  years; most of them were young-older adults whose ages ranged from 60 to 75 years (107/128). The majority of them were females (93/128), married (77/128), lived with their families (113/128), and were elementary school graduates (44/128) or high school graduates (56/128). Most of the participants lived a healthy life style with no smoking (123/128) or drinking habits (126/128), and were regular exercisers (106/128) who exercised an average of  $4.49 \pm 3.53$  times per week. The most frequent types of exercise reported by the participants were ballroom or folk dancing (44/128), walking (24/128), tai chi (14/128), qigong (13/128), and morning calisthenics (12/128). The cognitive function of the participants was intact with an average SPMSQ score of  $9.90 \pm 0.30$ . Although more than half of the participants (71/128) had chronic illnesses, the average number of chronic illness was  $0.83 \pm 0.90$ . An average Barthel Index score of  $99.92 \pm 0.62$  further indicated that the participants were nearly independent in self-care, such as bathing, eating, or toileting.

Most of the demographic profiles of the participants across study sites were similar; however, the participants

in the experimental and control groups had significant differences in the following variables: age, gender, marital status, and number of chronic illnesses ( $t = -7.20, p = .000$ ;  $\chi^2 = 7.61, p = .006$ ;  $\chi^2 = 9.89, p = .002$ ;  $t = -2.07, p = .041$ , respectively). The average age of the participants in the control group ( $72.42 \pm 6.04$  years) was significantly older than the participants in the experimental group ( $65.77 \pm 4.32$  years). The majority of the participants in the two groups were female; however, the percentage of female in the control group (41/66) was smaller than the experimental group (52/62). In terms of marital status, most of the participants in the experimental group had spouse (46/62); however, more than half of the participants in the control group had no spouse (35/66).

#### 3.2. Baseline comparisons between the two groups

Results of the  $t$  tests indicated that only habitual sleep efficiency ( $t = -2.74, p = .007$ ) and physical health perception ( $t = 2.37, p = .020$ ) had significant differences between the subjects in the experimental and the control groups. Non-significant differences were found in subjective sleep quality, sleep latency, sleep duration, sleep disturbances, use of sleeping medications, daytime dysfunction, mental health perception, and depression state (all  $p > .05$ ).

#### 3.3. Interaction effects between different time points and different groups

Results of mix-design, two-way ANOVA indicated that there were significant interaction effects between time points and groups in the following variables: PSQI total score ( $F = 7.10, p = .001$ ), subjective sleep quality ( $F = 14.02, p = .000$ ), sleep latency ( $F = 6.75, p = .002$ ), daytime dysfunction ( $F = 8.93, p = .000$ ), physical health perception ( $F = 15.24, p = .000$ ), mental health perception ( $F = 9.28, p = .000$ ), and depression state ( $F = 14.48, p = .000$ ).

Table 1

Differences among baseline, time 1 (3 months), and time 2 (6 months) on those variables with significant interaction effects in the experimental group ( $n = 62$ )

Variables	Baseline		Time 1		Time 2		$F (p)$	Post hoc <sup>a</sup>
	M	S.D.	M	S.D.	M	S.D.		
PSQI total score <sup>b</sup>	4.65	3.16	4.48	3.38	3.34	3.01	6.02 (.003**)	Pre > Post II, Post I > Post II
Subjective sleep quality <sup>b</sup>	1.18	0.61	1.05	0.56	0.65	0.68	16.30 (.000***)	Pre > Post II, Post I > Post II
Sleep latency <sup>b</sup>	0.87	1.00	0.82	0.80	0.77	0.78	0.30 (.717)	–
Daytime dysfunction <sup>b</sup>	0.53	0.67	0.29	0.52	0.27	0.52	4.38 (.015*)	Pre > Post I
Physical health perception <sup>c</sup>	47.77	7.13	48.87	7.71	53.35	4.94	15.58 (.000***)	Post II > Pre, Post II > Post I
Mental health perception <sup>c</sup>	50.29	8.75	55.62	8.18	56.81	6.88	16.45 (.000***)	Post I > Pre, Post II > Pre
Depression state <sup>b</sup>	6.58	7.57	3.34	4.99	3.27	6.78	10.92 (.000***)	Pre > Post I, Pre > Post II

Note. \* $p < .05$ ; \*\* $p < .01$ ; \*\*\* $p < .001$ .

<sup>a</sup> Bonferroni post hoc test; Post hoc analysis was not performed due to non-significant  $F$  value.

<sup>b</sup> Higher score indicated a worse situation.

<sup>c</sup> Higher score indicated a better situation.



Table 2

Differences among baseline, time 1 (3 months), and time 2 (6 months) on those variables with significant interaction effects in the control group ( $n = 66$ )

Variables	Baseline		Time 1		Time 2		$F (p)$	Post hoc <sup>a</sup>
	M	S.D.	M	S.D.	M	S.D.		
PSQI total score <sup>b</sup>	5.47	3.41	5.92	3.68	6.38	3.98	2.10 (.127)	–
Subjective sleep quality <sup>b</sup>	1.05	0.75	1.23	0.70	1.23	0.76	2.50 (.086)	–
Sleep latency <sup>b</sup>	0.82	0.93	0.91	0.87	1.32	1.05	10.50 (.000***)	Post II > Pre, Post II > Post I
Daytime dysfunction <sup>b</sup>	0.64	0.60	0.95	0.79	0.94	0.84	4.73 (.010*)	Post I > Pre, Post II > Pre
Physical health perception <sup>c</sup>	44.19	9.83	41.58	10.53	41.37	11.02	4.13 (.018*)	n.s.
Mental health perception <sup>c</sup>	52.51	7.47	52.85	8.64	51.68	9.08	0.47 (.629)	–
Depression state <sup>b</sup>	5.02	5.52	6.68	7.67	7.85	8.31	5.13 (.010*)	Post II > Pre

Note. \* $p < .05$ ; \*\*\* $p < .001$ .

<sup>a</sup> Bonferroni post hoc test; Post hoc analysis was not performed due to non-significant  $F$  value; n.s. non-significant.

<sup>b</sup> Higher score indicated a worse situation.

<sup>c</sup> Higher score indicated a better situation.

However, the variables of sleep duration, habitual sleep efficiency, sleep disturbances, and use of sleeping medications had no significant interaction effects (all  $p > .05$ ).

### 3.4. Simple main effect of different time points in each group

#### 3.4.1. Experimental group

Results indicated that all of the variables, except sleep latency ( $F = 0.30, p = .717$ ), were significantly changed (all  $p < .05$ ) (see Table 1). After the silver yoga exercises, participants' daytime dysfunction and depression state decreased ( $F = 4.38, p = .015$ ;  $F = 10.92, p = .000$ ; respectively) and subjective sleep quality, PSQI total score, physical health perception, and mental health perception improved ( $F = 16.30, p = .000$ ;  $F = 6.02, p = .003$ ;  $F = 15.58, p = .000$ ;  $F = 16.45, p = .000$ ; respectively) (see Table 1).

#### 3.4.2. Control group

Unlike the experimental group, significant changes only occurred in the following variables in the control group: sleep latency ( $F = 10.50, p = .000$ ), daytime dysfunction ( $F = 4.73, p = .010$ ), physical health perception ( $F = 4.13, p = .018$ ), and depression state ( $F = 5.13, p = .010$ ) (see Table 2). However, these changes were not positive: the participants' sleep latency significantly prolonged, daytime dysfunction and depression state increased, and physical health perception decreased (see Table 2).

### 3.5. Group differences in each time point

#### 3.5.1. Three-month time point

Results indicated that the two groups had significant differences at the 3-month point in the study, in the following variables: subjective sleep quality ( $F = 4.62, p = .033$ ),

Table 3

Comparisons between the experimental and control groups on the variables with significant interaction effects at the 3-month of the study ( $n = 128$ )

Variables	Adjusted M <sup>a</sup>		SS	d.f.	MS	$F (p)$	Post hoc <sup>b</sup>	Power
	E	C						
PSQI total score <sup>c</sup>	4.74	5.69	28.45	1	28.45	3.24 (.074)	–	–
Subjective sleep quality <sup>c</sup>	1.03	1.25	1.60	1	1.60	4.62 (.033*)	C > E	0.39
Sleep latency <sup>c</sup>	0.81	0.92	0.36	1	0.36	0.63 (.427)	–	–
Daytime dysfunction <sup>c</sup>	0.30	0.94	13.13	1	13.13	29.55 (.000***)	C > E	1
Physical health perception <sup>d</sup>	47.79	42.59	826.64	1	826.64	13.57 (.000***)	E > C	1
Mental health perception <sup>d</sup>	55.96	52.54	367.24	1	367.24	5.59 (.020*)	E > C	0.46
Depression state <sup>c</sup>	2.89	7.10	559.59	1	559.59	19.14 (.000***)	C > E	0.92

Note. \* $p < .05$ ; \*\*\* $p < .001$ ; E = experimental group; C = control group.

<sup>a</sup> Due to group differences in the baseline data, the adjusted mean was used to bring the data in a common ground.

<sup>b</sup> Bonferroni post hoc test; Post hoc analysis was not performed due to non-significant  $F$  value.

<sup>c</sup> Higher score indicated a worse situation.

<sup>d</sup> Higher score indicated a better situation.

Table 4

Comparisons between the experimental and control groups on the variables with significant interaction effects at the 6-month of the study ( $n = 128$ )

Variables	Adjusted M <sup>a</sup>		SS	d.f.	MS	$F (p)$	Post hoc <sup>b</sup>	Power
	E	C						
PSQI total score <sup>c</sup>	3.52	6.21	228.81	1	228.81	21.20 (.000***)	C > E	1
Subjective sleep quality <sup>c</sup>	0.62	1.25	12.61	1	12.61	27.40 (.000***)	C > E	1
Sleep latency <sup>c</sup>	0.76	1.33	10.13	1	10.13	13.46 (.000***)	C > E	0.92
Daytime dysfunction <sup>c</sup>	0.28	0.94	13.83	1	13.83	27.90 (.000***)	C > E	1
Physical health perception <sup>d</sup>	52.58	42.10	3365.37	1	3365.37	54.41 (.000***)	E > C	1
Mental health perception <sup>d</sup>	57.10	51.41	1017.69	1	1017.69	16.53 (.000***)	E > C	0.95
Depression state <sup>c</sup>	2.83	8.27	933.12	1	933.12	20.80 (.000***)	C > E	0.96

Note. \*\*\* $p < .001$ ; E = experimental group; C = control group.

<sup>a</sup> Due to group differences in the baseline data, the adjusted mean was used to bring the data in a common ground.

<sup>b</sup> Bonferroni post hoc test.

<sup>c</sup> Higher score indicated a worse situation.

<sup>d</sup> Higher score indicated a better situation.

daytime dysfunction ( $F = 29.55$ ,  $p = .000$ ), physical health perception ( $F = 13.57$ ,  $p = .000$ ), mental health perception ( $F = 5.59$ ,  $p = .020$ ), and depression state ( $F = 19.14$ ,  $p = .000$ ) (see Table 3). The subjective sleep quality, physical health perception, and mental health perception of the participants in the experimental group were significantly better than those participants in the control group, and the daytime dysfunction and depression state of the participants in the experimental group were significantly less than those participants in the control group (all  $p < .05$ ) (see Table 3).

### 3.5.2. Six-month time point

At the end of the 6 months study, the two groups had significant differences in all of the outcome measures (all  $p < .05$ ) (see Table 4). The subjective sleep quality, PSQI total score, physical health perception, and mental health perception of the participants in the experimental group were significantly better than those participants in the control group, and the sleep latency, daytime dysfunction, and depression state of the participants in the experimental group were significantly less than those participants in the control group (all  $p < .05$ ) (see Table 4).

## 4. Discussion

Results indicated that most of the mental health indicators of the participants in the experimental group had significantly improved after silver yoga interventions, and many of the indicators improved at the 3-month point in the intervention and were maintained throughout the 6 months of the study. Further, these mental health indicators of the participants in the experimental group were all better than the indicators of the participants in the control group.

The improved sleep quality, including better subjective sleep quality, faster sleep latency, and less daytime dysfunction, was congruent with previous studies done by Cohen et al. (2004) and Manjunath and Telles (2005). An overall enhancement of self-perception in both physical and mental health statuses of the participants in the experimental group was supported by Wood (1993) in that yogic stretching and breathing program had a markedly invigorating effect on perceptions of both mental and physical energy in a group of 71 adults with ages ranging from 21 to 76 years. Finally, a decrease in depression state found in this group of older adults was consistent with various previous studies (Pilkington et al., 2005; Waelde and Thompson, 2004; Woolery et al., 2004).

According to Cameron (2002), yoga is a meditative discipline and is a way of gaining insight into the nature of the mind and reality. The practice of yoga heals and strengthens the body, sharpens the mind, and calms the spirit. The silver yoga exercise program is specifically designed to accommodate the reduced body flexibility experienced by many older adults. Through the progression of a sequence of static physical postures, yoga uses stretching to improve joint flexibility and muscular strength; massage blood vessels; and improve blood circulation (Luskin et al., 2000). A 15-min guided-imagery meditation was incorporated at the end of the silver yoga exercise program to facilitate a state of relaxation (Chen et al., 2007). The elderly participants experienced stretching and relaxing in the program, and their bodies and minds were challenged and comforted at the same time, which might be the possible reason for the enhanced sleep quality and self-perception of health status, and the decreased depression state of the participants. A low withdrawal rate and high attendance rate further supported the premise that the elderly participants enjoyed the program, and were highly motivated and committed to the program.



#### 4.1. Study limitations

Although considerable efforts were made to design a sound study and significant outcomes were found in this study, there were limitations. First, although the method of cluster randomization by study sites into different groups was applied, it was possible that some elders who met the sample selection criteria and represented critical differences from the sample studied, were not recruited. For instance, male older adults and elders aged 75 and over were under-represented, which may be due to a lower number of men available for the intervention or to lower acceptability of the intervention to men, and should be further explored. Secondly, there were significant differences between the groups in the demographic characteristics, such as age, gender, marital status, and number of chronic illness. Although only the main outcome variables of habitual sleep efficiency and physical health perception had significant differences between the two groups in the baseline data and ANCOVA was applied in the data analysis to offset the group differences at the beginning of the study, these differences might have had an impact on the results of the study and warrant further investigation of these dynamics.

Third, not all of the participants in the clusters participated in the study and clustering was not considered in the analysis, which may reduce its statistical power and diminish the reliability of the results. Fourth, in order to enhance the consistency of the intervention intensity, two participants with attendance rate of 50% and below were excluded from the study. Although the characteristics of the excluded participants were not significantly different from the participants included in the study, the excluded participants may have had very different reactions toward the silver yoga program and, thus, might have had minor influences on the results of the study. The issue of intention to treat should be considered in interpreting the results. Fifth, this study sample was comprised of healthy older adults who had less than one chronic illness, on average, which may be very different from the elderly population in general. Thus, the generalizability of the results is limited. Finally, these participants were highly educated, possessed good health promotion concepts, and most of them had regular exercise habits. Although the exercise habits were not significantly different among the participants in the two groups, without true randomization these exercise behaviors might have confounded the study and weakened the interpretations of the results. A randomized control trial with a large random sample might result in stronger causal relationships.

#### 5. Conclusions

Results indicated positive outcomes in applying the silver yoga exercise program to a sample of healthy, community-dwelling, young-older adults. However, the applications of the program should be further examined by including other

elderly populations, such as male older adults, an old-older adult population, or transitional frail or frail elders. It is recommended that the silver yoga program be incorporated as an exercise activity in senior activity centers or community-settings to promote the mental health of community-dwelling older adults.

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#### Ethical approval

The study was approved by Fooyin University Internal Review Board.

#### Conflict of interest

None declared.

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#### References

- Anand, M.P., 1999. Non-pharmacological management of essential hypertension. *Journal of the Indian Medical Association* 97, 220–225.
- Buysse, D.J., Reynolds, C.F., Monk, T.H., Berman, S.R., 1989. Pittsburgh sleep quality index: a new instrument for psychiatric practice and research. *Psychiatric Research* 28, 193–213.
- Civil Affairs Bureau, Kaohsiung City Government (2008, May). Statistics on the age of citizens of Kaohsiung city. Retrieved July 3, 2008, from <http://cabu.kcg.gov.tw/cabu2/statis61B5.aspx>.
- Cameron, M.E., 2002. Yoga. In: Snyder, M., Lindquist, R. (Eds.), *Complementary/Alternative Therapies in Nursing*. 4th ed. Springer, New York, NY, pp. 81–88.
- Chen, K.M., Tseng, W.S., Ting, L.F., Huang, G.F., 2007. Development and evaluation of a yoga exercise programme for older adults. *Journal of Advanced Nursing* 57 (4), 432–441.
- Cohen, L., Warneke, C., Fouladi, R.T., Rodriguez, M.A., Chaoul-Reich, A., 2004. Psychological adjustment and sleep quality in a randomized trial of the effects of a Tibetan yoga intervention in patients with lymphoma. *Cancer* 100 (10), 2253–2260.

- Feuerstein, G., 1998. *The Yoga Tradition: Its History, Literature, Philosophy, and Practice*. Hohm, Prescott, AZ.
- Feuerstein, G., 2000. Toward a definition of yoga therapy. *International Journal of Yoga Therapy* 10, 5–10.
- Foley, D.J., Monjan, A.A., Brown, S.L., Simonsick, E.M., Wallace, R.B., Blazer, D.G., 1995. Sleep complaints among elderly persons: an epidemiologic study of three communities. *Sleep* 18, 425–432.
- Foley, D., Ancoli-Israel, S., Britz, P., Walsh, J., 2004. Sleep disturbances and chronic disease in older adults: results of the 2003 National Sleep Foundation Sleep in America Survey. *Journal of Psychosomatic Research* 56, 497–502.
- Hewitt, J., 1977. *The Complete Yoga Book*. Cresset, London, England.
- Jackson, R., Baldwin, B., 1993. Detecting depression in elderly medically ill patients: The use of the Geriatric Depression Scale compared with medical and nursing observations. *Age and Ageing* 22, 349–353.
- Lai, H.L., Good, M., 2006. Music improves sleep quality in older adults. *Journal of Advanced Nursing* 53 (1), 134–146.
- Lavey, R., Sherman, T., Mueser, K.T., Osborne, D.D., Currier, M., Wolfe, R., 2005. The effects of yoga on mood in psychiatric inpatients. *Psychiatric Rehabilitation Journal* 28 (4), 399–402.
- Lee, Y., Yang, M.J., Lai, T.J., Chiu, N.M., Chau, T.T., 2000. Development of the Taiwanese depression questionnaire. *Chang Gung Medical Journal* 23 (11), 688–694.
- Luskin, F.M., Newell, K.A., Griffith, M., Holmes, M., Telles, S., DiNucci, E., Marvasti, F.F., Hill, M., Pelletier, K.R., Haskell, W.L., 2000. A review of mind/body therapies in the treatment of musculoskeletal disorders with implications for the elderly. *Alternative Therapies* 6 (2), 46–56.
- Manjunath, N.K., Telles, S., 2005. Influence of yoga and ayurveda on self-rated sleep in a geriatric population. *The Indian Journal of Medical Research* 121 (5), 683–690.
- Mirowsky, J., Rose, C.E., 1992. Age and depression. *Journal of Health and Social Behavior* 33 (3), 187–205.
- Ohayon, M.M., 2002. Epidemiology of insomnia: what we know and what still need to learn. *Sleep Medicine Review* 6, 97–111.
- Pandi-Perumal, S.R., Seils, L.K., Kayumov, L., Ralph, M.R., Lowe, A., Moller, H., Swaab, D.F., 2002. Senescence, sleep, and circadian rhythms. *Ageing Research Reviews* 1 (3), 559–604.
- Pilkington, K., Kirkwood, G., Rampes, H., Richardson, J., 2005. Yoga for depression: the research evidence. *Journal of Affective Disorders* 89, 13–24.
- Waelde, L.C., Thompson, L., 2004. A pilot study of a yoga meditation intervention for dementia caregiver stress. *Journal of Clinical Psychology* 60 (6), 677–687.
- Ware, J.E., Snow, K.K., Kosinski, M., Gandek, B., 1993. *SF-36 Health Survey Manual and Interpretation Guide*. The Health Institute, New England Medical Center, Boston, MA.
- Wood, C., 1993. Mood change and perceptions of vitality: a comparison of the effect of relaxation, visualization and yoga. *Journal of Royal Society of Medicine* 86, 254–257.
- Woolery, A., Myers, H., Sternlieb, B., Zeltzer, L., 2004. A yoga intervention for young adults with elevated symptoms of depression. *Alternative Therapeutic* 10 (2), 60–63.