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Human Kinetics
ORIGINAL RESEARCH

The Effects of Poi on Physical and Cognitive Function in Healthy Older Adults

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This study investigated the effects of poi (a weight on the end of a cord which is swung in circular patterns around the body) compared with Tai Chi on physical and cognitive function in healthy older adults. A total of 79 participants (60–86 years) were randomly allocated to the poi or Tai Chi group. Physical and cognitive function was measured 1 month before, immediately before, immediately after, and 1 month after the intervention (two lessons a week, for 4 weeks). Immediately postintervention, both groups improved postural stability, upper limb strength, and simple attention. Tai Chi also improved systolic blood pressure. One-month postintervention, compared with immediately postintervention, both groups improved upper limb strength, upper limb range of motion, and memory. Poi also improved systolic blood pressure. Therefore, poi seems to be as effective as Tai Chi for improving physical and cognitive function in healthy older adults.

Keywords: poi spinning, exercise, Tai Chi, quality of life

Globally, the number of older adults is expected to more than double in the next 30 years. As the young-old balance shifts throughout the world, so does the prevalence of chronic disease. Simple and effective strategies for maintaining quality of life in old age are sorely needed (United Nations, 2015). The aim of this study was to determine if a novel intervention, poi, has a beneficial effect on physical and cognitive function in healthy older adults.

Poi is a ball on a string, which is swung in circular patterns around the body. There are many different styles of poi, the earliest known being that of the Māori in New Zealand, where poi continues to play an important role in Māori culture (Paringatai, 2009). This study is concerned with international poi, an overarching term which is used here to refer to poi practiced outside of Māoridom. International poi was the poi style chosen for this study, as the primary research aim was to measure the effects of learning poi separate from any specific cultural context.

Although there is no research on the effects of poi on health, there is research on activities which possess similar characteristics to poi such as Tai Chi. Tai Chi and poi are inexpensive to practice, can be done anywhere (alone or with others) with minimal equipment, challenge coordination and balance, share some similar arm movements, involve cognitive and motor resources during learning, and both may be considered as a form of meditative movement. Literature on Tai Chi and healthy older adults posits that Tai Chi is a means to, or is potentially a means to: improve balance (Chiang, Cebula, & Lankford, 2009; Hackney & Wolf, 2013; Huang & Liu, 2015; Komagata & Newton, 2003; Liu & Frank, 2010; Maciaszek & Osinski, 2010; Schleicher, Wedam, & Wu, 2012; Wu, MacDonald, & Pescatello, 2016), reduce falls (Chiang et al., 2009; Gregory & Watson, 2009; Low, Ang, Goh, & Chew, 2009; Schleicher et al., 2012), reduce risk of falls (Hu et al., 2016; Huang, Feng, Li, & LV, 2017; Low et al., 2009; Rogers, Larkey, & Keller, 2009), reduce fear of falls (Harling & Simpson, 2008; Schleicher et al., 2012), improve cardiorespiratory function (Chiang et al., 2009; Rogers et al., 2009; Zheng et al., 2015), and enhance cognitive function (Miller & Taylor-Piliae, 2014; Wayne et al., 2014). Although there is substantial support for Tai Chi's potential to improve physical and cognitive function in healthy older adults, specifically regarding balance and falls, a lack of well designed, methodologically sound trials has resulted in inconsistent results. The most frequent methodological criticisms are small sample size (Harling & Simpson, 2008; Huang & Liu, 2015; Lee, Lee, Kim, & Ernst, 2010; Rogers et al., 2009; Maciaszek & Osinski, 2010; Wayne et al., 2014), lack of randomization and control groups to account for confounding variables (Gregory & Watson, 2009; Komagata & Newton, 2003; Maciaszek & Osinski, 2010; Rogers et al., 2009; Wu, 2002; Zheng et al., 2015), wide variation of Tai Chi styles (Lee et al., 2010; Liu & Frank, 2010; Low et al., 2009; Wu, 2002), lack of long-term follow-up (Harling & Simpson, 2008; Liu & Frank, 2010; Verhagen, Immink, van der Meulen, & Bierma-Zeinstra, 2004; Wayne et al., 2014; Zheng et al., 2015), means of measuring variables too varied (Harling & Simpson, 2008; Huang & Liu, 2015; Rogers et al., 2009, Wu, 2002), duration of intervention period too varied (Huang & Liu, 2015; Rogers et al., 2009; Wu, 2002), and a lack of blinding (Lee et al., 2010; Verhagen et al., 2004; Zheng et al., 2015). Although further rigorous research on Tai Chi is needed, this study assumes that Tai Chi does positively impact physical and cognitive function in healthy older adults.

Beyond sharing characteristics with Tai Chi, poi possesses unique characteristics such as rhythmic object manipulation, leading us to hypothesize it might be a powerful tool for improving physical and cognitive function. As this was the first study to systematically investigate the effects of poi on health, an exploratory approach was considered to determine the most relevant measures for detecting the potential effects of poi and establish priorities for future research.

Research Design and Methods

Design

An assessor-blind randomized controlled study was conducted in two rounds between January 2016 and July 2017. Participants

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were randomly allocated to either the poi or Tai Chi group using free software (www.rando.la) to minimize between group differences in age and sex. The intervention consisted of 1-hr lessons, twice a week, for 4 weeks. Physical and cognitive function was measured at four time points: 1 month prior to intervention (T0), immediately prior to intervention (T1), immediately postintervention (T2), and 1-month postintervention (T3). Two baseline measures were made (T0 and T1) to detect any effects of practice on the measures prior to beginning the intervention. Assessments were carried out by trained assessors who were blinded to group allocation, using standardized protocols. The study was approved by the University of Auckland Human Participants Ethics Committee, and all participants gave written informed consent.

Participants

A total of 79 adults ($M_{age} = 68.4$ and range 60–86 years) were recruited. Exclusionary criteria were age less than 60 years; health factors that might put the participant at risk, which were determined through the self-screening Adult Preexercise Screening Tool (Exercise and Sports Science Australia, 2011) and prior experience with poi or Tai Chi.

Intervention

Participants in both groups took part in 1-hr lessons, twice a week, for 1 month. Tai Chi lessons were taught by a full-time instructor with over 30 years of Tai Chi Chuan experience and were comprised of three phases: (a) energizing the joints: strengthening the joints and tendons, (b) silk reeling—Chen style: basic warm-up movements to connect the upper and lower body, and (c) Tai Chi Qigong Shibashi: movements from the Yang style Tai Chi Chuan, with an emphasis on synchronizing 18 movements with proper breathing techniques. Poi lessons were taught by a former circus artist with over a decade of experience practicing and teaching poi. Each lesson involved a short warm-up and cool down stretch and focused on exploring timing, direction, and plane with 1 and 2 poi through variations of the following poi moves: butterfly, figure eight, pendulum, flowers, and chasing the sun. The number of participants at each lesson varied, as they were free to choose between different session times, but there were typically four to eight participants at any given lesson in each group.

Assessment

Participants were assessed across physical and cognitive domains. Measures were chosen using the following criteria: relevance to older adults, relevance to the intervention activities, validity, reliability, cost, and execution time. Invasive measures were excluded. The following assessments were chosen.

Physical.

(a) Balance: Functional Reach Test measures the maximum distance the participant can reach forward, while standing in a fixed position (Whitney, Poole, & Cass, 1998), and the four-Stage Balance Test assesses static balance by requiring participants to hold four different positions of increasing difficulty for 10 s each (Rossiter-Fornoff, Wolf, Wolfson, & Buchner, 1995).

(b) Bimanual coordination: participants were asked to trace circles with both hands in a clockwise direction, while paced with an auditory cue that increased in frequency. The critical frequency at which participants spontaneously switch to either an inward or outward direction with both hands is a measure of bimanual coordination (Byblow, Summers, Semjen, Wuyts, & Carson, 1999; Kelso, Scholz, & Schöner, 1998).

(c) Cardiovascular function: blood pressure was taken with a standard sphygmomanometer and stethoscope, and pulse was taken manually.

(d) Grip strength: pinch and hand grip were measured using a digital Baseline® dynamometer (Young et al., 1989)

(e) Lower body strength: 30-Second Chair Stand Test assesses functional lower extremity strength by counting the number of times a participant can come to a full stand from sitting in 30 s (Jones, Rikli, & Beam, 1999).

(f) Manual dexterity: Nine-Hole Peg Test assesses upper extremity function by timing how quickly a participant can place and remove pegs from holes (Yancosek & Howell, 2009).

(g) Upper limb range of motion (ROM): wrist, elbow, and shoulder ROM measured with a goniometer to determine pain-free ROM at each joint (Desrosiers, Hébert, Bravo, & Dutil, 1995).

Cognitive. Participants completed a battery of cognitive tests from CNS Vital Signs, a computerized test battery utilizes validated neuropsychological tests to evaluate neurocognitive status (Gualtieri & Johnson, 2006).

(a) Verbal memory (VBM) and visual memory (VIM): the participant is instructed to remember 15 words (VBM) or shapes (VIM), then identify them among 15 new words or shapes. For delayed recognition, the test was repeated at the end of the test battery.

(b) Finger tapping: the participant presses the space bar with the index finger as many times as possible in 10 s.

(c) Symbol digit coding: symbols and numbers are linked in an answer key. A bank of symbols is presented, and the participant enters the number that corresponds with each symbol.

(d) Stroop: the Stroop test has three parts. First, the participant presses the space bar as soon as any word appears on the screen (reaction time). Second, they press the space bar when the color of the word matches the name of the word. Third, they press the space bar when the color of the word does not match the name of the word.

(e) Shifting attention: the participant matches geometric objects either by shape or by color.

(f) Continuous performance: letters are presented on the screen one by one, and the participant presses the space bar as quickly as possible every time the letter "B" is shown.

The tests administered were as follows: These tests were used by the CNS Vital Signs software to calculate scores for the following: composite memory (VBM and VIM); VBM; VIM; psychomotor speed (finger tapping and symbol digit coding); motor speed (finger tapping); processing speed (symbol digit coding); reaction time (Stroop); simple attention (continuous performance); complex attention (Stroop, shifting attention and continuous performance); cognitive flexibility (shifting attention and Stroop); and executive function (shifting attention). The Neurocognition Index, which represents a global score of neurocognition, was also calculated by taking the average of five domain scores (composite memory, psychomotor speed, reaction time, complex attention, and cognitive flexibility).

Two of the measures, the four-Stage Balance Test and the Neurocognition Index score, were only available for a subset of participants, as they were added during the second round of the study. Two questionnaires were used to gather additional data: a questionnaire to determine participants' physical activity level prior to beginning the study (Gill, Jones, Zou, & Speechley, 2012) and a questionnaire to determine if participants had, or would like to, continue engaging with the intervention activity upon completion of the study.

Analysis

For linear, continuous variables that were normally distributed, a repeated measures analysis of variance was used with group as a between-subject factor and age binarized at the median into young-old (<69 years Tai Chi and <68 poi) and old-old as a covariate. A median split was used because age was not normally distributed. This allowed detection of effects of time, group and age, and their interactions. Sex was not a useful covariate due to the low number of men. A modified Bonferroni correction was used for multiple comparisons (Rom, 1990).

Results

Participants

Study population flow is shown in Figure 1. A total of 226 potential participants were screened. About 130 participants did not meet the inclusion criteria of age less than 60 years, no previous experience with poi or Tai Chi, and health factors that might put the potential participant at risk. Ninety-six completed Pretest 1 and were randomized. Seventeen participants withdrew due to health problems, schedule conflicts, family issues, and a stolen car, leaving data from 79 participants available for analysis. The study was completed in two rounds. Round 1 had 37 participants available for analysis (18 poi and 19 Tai Chi), and Round 2 had 42 participants available for analysis (18 poi and 24 Tai Chi). For both poi and Tai Chi, the mean number of completed lessons was seven, with a range of five to eight. The low variability and number of sessions precluded an exploration of possible dose effects.

Baseline Data: T0 (1 Month Prior to Intervention)–T1 (Immediately Prior to Intervention)

Baseline characteristics of the randomized participants are provided in Table 1. Mean age was 67.6 years in the poi group, with

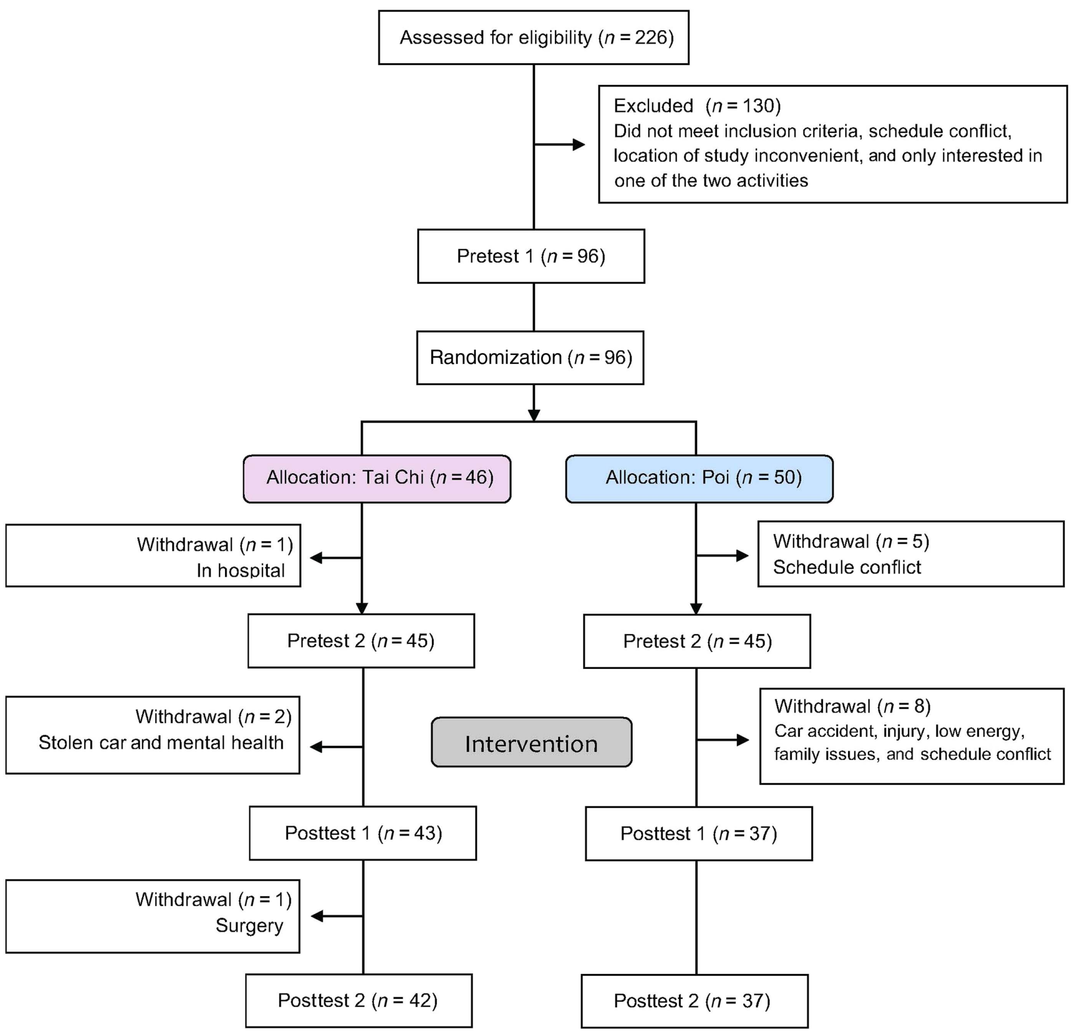

Figure 1 — Flowchart of the study population.

Table 1 Participant Baseline Characteristics

Demographics			
	Poi ($N = 36$)		**Tai Chi ($N = 43$)**
Age			
mean (range)	67.6 (60–80)		69.1 (60–86)
between-group *p* value		.214	
Sex			
female, *n* (%)	29 (80.5%)		32 (74.4%)
male, *n* (%)	7 (19.4%)		11 (25.6%)
between-group *p* value		.569	

	Mean T0		**Mean T1**		***p* values**				**Sample size**
	Poi	**Tai Chi**	**Poi**	**Tai Chi**	**Time**	**Group**	**Time × Group**	**Difference between groups at T0**	
Physical: RM-ANOVA									
Cardiovascular function									
systolic blood pressure (mmHg)	124.7	118.3	122.3	121.2	.642	.158	.111	.068	75
diastolic blood pressure (mmHg)	77.8	72.6	73.1	73.1	.073	.253	**.014**	**.037**	75
heart rate (bpm)	67.2	70.8	67.3	69.7	.591	.199	.515	.167	79
Balance									
4-stage balance (max = 20)	15.3	14.8	15.6	15.0	.403	.239	.986	.356	42
functional reach (mm)	55.9	58.5	52.3	56.4	.094	.656	.677	.517	79
Strength									
hand grip (lbs)	114.9	121.4	114.0	121.3	.491	.406	.622	.416	79
pinch grip (lbs)	17.2	17.6	17.9	18.2	.093	.65	.596	.710	79
chair stand (*n* of stands)	15.8	16.7	18.0	18.6	**.000**	.642	.447	.504	77
Coordination									
9-hole peg (s)	38.3	38.9	37.9	38.5	.438	.839	.769	.615	78
critical frequency (bpm)	104.3	100.7	109.5	107.4	**.002**	.656	.677	.549	79
Upper limb ROM[a]									
shoulder ROM (degrees)	777.3	783.7	768.8	779.5	.372	.123	.735	.675	79
elbow ROM (degrees)	290.8	289.6	293.4	293.8	**.002**	.503	.992	.694	78
wrist ROM (degrees)	280.7	289.0	279.5	287.6	.859	.287	.923	.237	78
Cognitive (CNS Vital Signs battery): RM-ANOVA									
Memory									
composite memory	97.6	97.1	98.2	97.9	.388	.606	.852	.769	76
VBM	52.9	52.0	53.3	52.8	.421	.371	.895	.410	78
VIM	44.8	44.8	45.0	45.1	.668	.882	.882	.954	78
Flexibility									
cognitive flexibility	37.2	39.3	41.2	43.6	**.009**	.335	.927	.426	77
attention									
simple attention	39.2	39.4	39.8	39.6	.093	.796	.353	.696	40
complex attention[b]	9.3	7.9	7.5	6.1	**.020**	.355	.778	.507	40
Executive function									
executive function	38.5	40.4	41.2	45.7	**.002**	.218	.425	.488	77
Speed									
psychomotor speed	153.8	148.7	160.3	155.0	**.003**	.203	.928	.327	76
motor speed	104.9	101.9	111.4	106.7	**.001**	.254	.621	.478	79
processing speed	45.0	45.1	47.7	46.6	.070	.784	.921	.967	77
reaction time[b]	755.7	737.5	724.3	721.6	**.002**	.588	.465	.408	77
Overall NCI score									
NCI	211.1	199.8	207.7	200.0	.196	.084	.157	**.043**	38

Note. For linear continuous data, an independent samples *T* test was used for difference between groups at T0. The bold *p*-values are the significance values. ROM = range of motion; VBM = verbal memory; VIM = visual memory; NCI = Neurocognition Index; RM-ANOVA = repeated measures analysis of variance.
[a]Upper limb ROM represents the sum across both limbs. [b]Denotes that a lower score is better and higher scores are better for all other cognitive tests.

29 women and seven men. Mean age was 69.1 years in the Tai Chi group, with 32 women and 11 men.

For both groups, the following physical measures improved between T0 and T1: 30-Second Chair Stand Test, $F(1, 74) = 37.5$, $p < .001$; critical frequency for bimanual coordination, $F(1, 76) = 10.8$, $p = .002$; and elbow ROM, $F(1, 58) = 10.9$, $p = .002$. For both groups, the following cognitive measures improved between T0 and T1: cognitive flexibility, $F(1, 74) = 7.2$, $p = .009$; complex attention, $F(1, 37) = 5.9$, $p = .020$; executive function, $F(1, 74) = 10.8$, $p = .002$; psychomotor speed, $F(1, 73) = 9.2$, $p = .003$; motor speed, $F(1, 76) = 11.8$, $p = .001$; and reaction time, $F(1, 74) = 10.5$, $p = .002$. These improvements were most likely due to the effects of practice.

There was a between-group difference in diastolic blood pressure at T0, as the mean was lower for Tai Chi (72.6 mmHg) than for poi (77.8 mmHg, $p = .037$). There was an interaction between time and group for diastolic blood pressure between T0 and T1, $F(1, 72) = 6.4$, $p = .014$. The interaction arose because diastolic blood pressure decreased for the poi group ($M = -4.3$ mmHg and $SD = 8.5$ mmHg), but not the Tai Chi group ($M = -0.6$ mmHg and $SD = 8.4$ mmHg). There was also an interaction between time and age for VBM between T0 and T1, $F(1, 75) = 4.29$, $p = .042$. The interaction arose because the old-old (>69 years, $M = 1.2$, and $SD = 3.97$) improved more than the young-old ($M = -1.7$, $SD = 3.99$, and $T_{76} = 0.037$). The variables which improved between T0 and T1 are not readily analyzed moving forward, as improvement was likely due to effects of practice. All measures not mentioned previously were similar between T0 and T1.

T1 (Immediately Prior to Intervention)–T2 (Immediately Postintervention)

For both groups, three physical measures and one cognitive measure showed no practice effects between T0 and T1 and improved between T1 and T2: four-Stage Balance Test, $F(1, 39) = 9.9$, $p = .003$; Functional Reach Test, $F(1, 76) = 7.5$, $p = .008$; hand grip, $F(1, 76) = 11.6$, $p = .001$; and simple attention, $F(1, 38) = 4.6$, $p = .038$. For both groups, two cognitive measures showed no practice effects between T0 and T1 and declined between T1 and T2: composite memory, $F(1, 76) = 7.8$, $p = .001$; and VIM, $F(1, 76) = 8.8$, $p = .002$. There were no effects of group and no interactions between group and time for these measures.

There was an interaction between time and group for systolic blood pressure, $F(1, 76) = 4.3$, $p = .041$. The interaction arose because systolic blood pressure decreased for the Tai Chi group ($M = -5.1$ mmHg, $SD = 12.7$ mmHg, and $T_{77} = 2.25$), but not the poi group ($M = 2.2$ mmHg and $SD = 16.3$ mmHg). There was an interaction between time and age for simple attention $F(1, 38) = 10.2$, $p = .003$. The interaction arose because the young-old (<69 years, $M = 0.88$, and $SD = 1.3$) improved more than the old-old ($M = -0.16$, $SD = 8.0$, and $T_{39} = 3.5$).

There were also significant effects of time on elbow ROM, 30-Second Chair Stand Test, complex attention, cognitive flexibility, psychomotor speed, and executive function between T1 and T2. However, these are not readily interpreted due to practice effects between T0 and T1 (Table 2).

T2 (Immediately Postintervention)–T3 (1-Month Postintervention)

One-month postintervention, 25 Tai Chi participants had continued their practice, 17 had not, and 20 poi participants had continued their practice, 16 had not. For both groups, two physical measures and three cognitive measures (no practice effects between T0 and T1) improved between T2 and T3: hand grip, $F(1, 75) = 4.9$, $p = .029$; shoulder ROM, $F(1, 75) = 10.6$, $p = .002$; composite memory, $F(1, 73) = 10.3$, $p = .002$; VIM, $F(1, 73) = 6.3$, $p = .014$; and VBM, $F(1, 75) = 4.2$, $p = .043$. There were no effects of group and no interactions between group and time for these measures.

There was an interaction between time and group for systolic blood pressure, $F(1, 75) = 7.4$, $p = .008$. The interaction arose because systolic blood pressure decreased for the poi group ($M = -5.05$ mmHg, $SD = 14.4$ mmHg, and $T_{76} = -2.47$), but not the Tai Chi group ($M = 3.71$ mmHg and $SD = 13.75$ mmHg).

There were also significant effects of time on elbow ROM and psychomotor speed between T2 and T3. However, these are not readily interpreted due to practice effects between T0 and T1 (Table 3).

Discussion and Implications

This is the first investigation of the effects of poi on physical and cognitive function. After 1 month of training, both the poi and Tai Chi interventions improved postural stability, upper limb strength, and simple attention. Tai Chi also improved systolic blood pressure. One-month postintervention, both groups improved upper limb strength; shoulder ROM; and memory (composite, visual, and verbal). Poi improved systolic blood pressure. There was no main effect of group in any analysis; therefore, improvements did not significantly differ between groups. As the first of its kind, this study is hypothesis generating and the mechanisms underlying the effects of poi on some aspects of function and not others need to be considered by future work.

This study has some limitations. A larger sample size and longer intervention period may have increased the study's sensitivity to differences in the effects of the two interventions. A third, inactive control group would provide a more robust study design than a dual baseline approach (assessing practice effects between two baseline measures). It could be that measures which showed practice effects at T1 were no longer susceptible to further practice effects at T2 or T3. It could also be that measures which showed no practice effects at T1, might show a practice effect at T2 or T3. However, this is unlikely as practice effects are typically more prominent on the second attempt than later attempts, and many measures which did not improve at baseline also did not improve during the intervention. A third baseline measure could have been considered to better capture practice effects, but this was precluded by limited time and resources.

Participants were given no instruction in regard to practicing poi or Tai Chi outside of the study, either during or postintervention. During the intervention, no record was kept of participant activity outside of the study. In the 1-month postintervention, two-thirds of participants in each group continued practicing poi or Tai Chi to varying degrees (from *daily* to *very little*). The follow-up questionnaire which asked about continued practice was not coded, so it is impossible to draw relationships between continuation of poi or Tai Chi and outcomes at T3.

Practicing poi involves wrist flexibility and strength along with coordination and controlling both hands independently; thus, improvements in wrist ROM and bimanual coordination may be expected but were not seen. In general, it is difficult to discern if poi's unique characteristics, such as the coordination required between hands, the innately rhythmic nature, and the manipulation of objects, had a specific effect on outcomes.

Table 2 T1–T2 Results

	Mean T1		Mean T2		*p* values			
	Poi	Tai Chi	Poi	Tai Chi	Time	Group	Time × Group	Sample size
Physical: RM-ANOVA								
Cardiovascular function								
systolic blood pressure (mmHg)	122.3	121.2	124.5	116.7	.452	.090	**.041**	79
diastolic blood pressure (mmHg)	73.1	73.1	74.7	73.0	.349	.850	.590	79
heart rate (bpm)	67.3	69.7	66.1	67.2	.056	.435	.501	79
Balance								
4-stage balance (max = 20)	15.6	15.0	15.9	15.7	**.003**	.139	.423	42
functional reach (mm)	52.3	56.4	56.1	59.0	**.008**	.294	.570	79
Strength								
hand grip (lbs)	114.0	121.3	120.0	126.7	**.001**	.383	.869	79
pinch grip (lbs)	17.9	18.2	19.0	18.4	.054	.937	.109	79
chair stand (*n* of stands)	18.0	18.6	19.7	19.1	**.003**	.883	.175	76
Coordination								
9-hole peg (s)	37.9	38.5	37.2	38.3	.183	.456	.402	79
critical frequency (bpm)	109.5	107.4	111.3	112.2	.057	.953	.395	79
Upper limb ROM[a]								
shoulder ROM (degrees)	768.8	779.5	780.0	778.0	.320	.663	.182	79
elbow ROM (degrees)	293.4	293.8	297.7	297.6	**.004**	.869	.722	79
wrist ROM (degrees)	279.5	287.6	278.3	290.5	.752	.087	.510	78
Cognitive (CNS Vital Signs battery): RM-ANOVA								
Memory								
composite memory	98.2	97.9	95.2	95.0	**.001**	.873	.918	79
VBM	53.3	52.8	52.0	52.1	.106	.831	.584	79
VIM	45.0	45.1	43.2	42.9	**.002**	.952	.714	79
Flexibility								
cognitive flexibility	41.2	43.6	45.7	45.1	**.025**	.682	.243	79
Attention								
simple attention	39.8	39.6	40.0	39.8	**.038**	.243	.870	41
complex attention[b]	7.5	6.1	5.0	5.6	**.04**	.889	.185	41
Executive function								
executive function	41.2	45.7	45.8	47.2	**.019**	.186	.175	79
Speed								
psychomotor speed	160.3	155.0	163.3	159.1	**.010**	.297	.914	78
motor speed	111.4	106.7	113.2	107.9	.119	.108	.852	79
processing speed	47.7	46.6	48.4	49.4	.184	.843	.312	78
reaction time[b]	724.3	721.6	716.0	719.9	.585	.994	.637	78
Overall NCI score								
NCI	207.7	200.0	200.6	202.2	.236	.532	.082	40

Note. The bold *p*-values are the significance values. ROM = range of motion; VBM = verbal memory; VIM = visual memory; NCI = Neurocognition Index; RM-ANOVA = repeated measures analysis of variance; T1 = immediately prior to intervention; T2 = immediately postintervention.
[a]Upper limb ROM represents the sum across both limbs. [b]Denotes that a lower score is better and higher scores are better for all other cognitive tests.

Of the measures which showed improvement at T2, postural stability and blood pressure are consistent with that reported in the literature on Tai Chi, which has shown benefits in balance and cardiovascular function for healthy older adults (Field, 2011; Guoyan, Liqiong, Jun, Yan, & Jianping, 2014). There is not enough literature to comment on the plausibility of improvements in upper limb strength or attention at T2, or improvements in memory or upper limb ROM at T3.

Finally, any intervention that gave participants individual attention in a small group setting, provided a peer group, and/or got them up and moving, may have produced similar results. Prior to beginning the study, the majority of participants identified as *vigorously* or *moderately* active (15 poi and 20 Tai Chi) for at least 30 min, three times a week, and few identified as seldom active (2 poi and 3 Tai Chi). Although this helps allay the concern that any marked increase in physical activity would produce benefits, self-reported exercise

Table 3 T2–T3 Results

	Mean T2		Mean T3		*p* values			
	Poi	Tai Chi	Poi	Tai Chi	Time	Group	Time × Group	Sample size
Physical: RM-ANOVA								
Cardiovascular function								
systolic blood pressure (mmHg)	124.5	116.7	119.4	120.8	.649	.245	**.008**	78
diastolic blood pressure (mmHg)	74.7	73.0	72.6	74.6	.716	.937	.078	78
heart rate (bpm)	66.1	67.2	67.3	68.19	.238	.703	.987	78
Balance								
4-stage balance (max = 20)	15.9	15.7	15.9	15.9	.303	.301	.279	41
functional reach (mm)	56.1	59.0	56.1	58.8	.993	.392	.987	78
Strength								
hand grip (lbs)	120.0	126.7	121.4	132.3	**.029**	.295	.213	78
pinch grip (lbs)	19.0	18.4	19.0	19.4	.147	.968	.177	78
chair stand (*n* of stands)	19.7	19.1	20.1	19.2	.214	.526	.794	76
Coordination								
9-hole peg (s)	37.2	38.3	36.7	37.6	.067	.361	.679	78
critical frequency (bpm)	111.3	112.2	111.7	107.1	.164	.818	.103	78
Upper limb ROM[a]								
shoulder ROM (degrees)	780.0	778.0	799.5	790.5	**.002**	.594	.507	78
elbow ROM (degrees)	297.7	297.6	292.6	295.8	**.010**	.541	.174	78
wrist ROM (degrees)	278.3	290.5	281.7	281.8	.868	.195	.454	77
Cognitive (CNS Vital Signs battery): RM-ANOVA								
Memory								
composite memory	95.2	95.0	98.1	97.8	**.002**	.88	.996	76
VBM	52.0	52.1	53.0	53.3	**.043**	.850	.871	78
VIM	43.2	42.9	45.0	44.5	**.014**	.696	.998	76
Flexibility								
cognitive flexibility	45.7	45.1	47.2	47.8	.091	.968	.580	40
Attention								
simple attention	40.0	39.8	40.0	39.7	.731	.146	.761	40
complex attention[b]	5.0	5.6	4.2	4.7	.117	.399	.756	40
Executive function								
executive function	45.8	47.2	48.0	48.9	.339	.460	.814	77
Speed								
psychomotor speed	163.3	159.1	164.5	162.7	**.003**	.586	.296	77
motor speed	113.2	107.9	113.7	109.0	.227	.128	.698	78
processing speed	48.4	49.4	47.8	48.6	53.790	.211	.170	37
reaction time[b]	716.0	719.9	732.7	706.8	713.96	.756	.927	76
Overall NCI score								
NCI	200.6	202.2	203.2	200.9	202.73	.682	.925	37

Note. The bold *p*-values are the significance values. ROM = range of motion; VBM = verbal memory; VIM = visual memory; NCI = Neurocognition Index; RM-ANOVA = repeated measures analysis of variance; T2 = immediately postintervention; T3 = 1-month postintervention.
[a]Upper limb ROM represents the sum across both limbs. [b]Denotes that a lower score is better and higher scores are better for all other cognitive tests.

levels may be inaccurate. A major shortcoming of this study is the lack of a control group to check for practice effects of the assessments over all four assessment time points.

Conclusions

Poi, a simple and novel intervention, seems to be equally as effective as Tai Chi at improving physical and cognitive function in healthy older adults. Immediately postintervention both groups improved in postural stability, upper limb strength, and simple attention. Tai Chi also improved systolic blood pressure. One-month postintervention both groups improved in upper limb strength, upper limb ROM, and memory. Poi also improved systolic blood pressure. Improvements in postural stability and blood pressure for the Tai Chi group are consistent with Tai Chi literature. A major limitation of this study is the lack of a control group for which no benefits were predicted, which was somewhat addressed by examining practice effects with two baseline assessments. It is recommended that future studies on poi explore whether its physical and cognitive benefits may be more wide reaching, and if poi may improve emotional well-being and quality of life. This was the first study to systematically investigate the effects of poi on health, and further research on poi is needed to replicate results, to better understand why poi has thus far improved certain outcomes and not others, and to understand its potential long-term benefits.

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