

# Effects of Online Yoga and Tai Chi on Physical Health Outcome Measures of Adult Informal Caregivers

## Abstract

**Aims:** This study aimed to investigate the effects of online Vinyasa Yoga (VY) and Taijifit™ (12 weeks) in informal caregivers ( $\geq 18$  years of age). **Methods:** Twenty-nine participants were randomized to two groups: VY ( $n = 16$ ,  $55.87 \pm 12.31$  years) or Taijifit™ ( $n = 13$ ,  $55.07 \pm 12.65$  years). **Main Outcome Measures:** Prior to and following the study, assessments were made for muscle strength (1-RM leg press, chest press, and handgrip), muscle endurance (leg press and chest press; maximal number of repetitions performed to fatigue at 80% and 70% baseline 1-RM, respectively), abdominal endurance (maximum number of consecutive curl-ups to fatigue), tasks of functionality (dynamic balance and walking speed), and flexibility (sit and reach). **Results:** There was a significant increase over time for muscle strength, muscle endurance, tasks of functionality, and flexibility ( $P = 0.001$ ). The VY group experienced a greater improvement in chest press endurance (VY: pre  $19.25 \pm 5.90$ , post  $28.06 \pm 7.60$  reps; Taijifit™ pre  $15.69 \pm 4.49$ , post  $21.07 \pm 5.85$  reps;  $P = 0.019$ ) and abdominal endurance (VY: pre  $37.12 \pm 31.26$ , post  $68.43 \pm 55.07$  reps; Taijifit™ pre  $19.23 \pm 19.00$ , post  $32.07 \pm 20.87$  reps;  $P = 0.034$ ) compared to the Taijifit™ group. **Conclusions:** VY and Taijifit™ are effective for improving muscle strength and endurance, tasks of functionality, and flexibility in informal caregivers. VY led to greater gains in chest press endurance and abdominal curl-ups.

**Keywords:** Endurance, flexibility, functionality, informal caregiving, strength, Tai Chi, yoga

## Introduction

Informal caregiver is a term used to describe individuals who do not receive financial compensation for helping others with deficiencies related to disability, disease/illness, old age, or a mental disorder.<sup>[1,2]</sup> Research on the physical health of informal caregivers has grown, highlighting numerous physical impacts and the neglect of health-promoting behaviors.<sup>[3]</sup> Notably, it has been hypothesized that part of the negative impact on caregiver health may be a result of the reduced likelihood that informal caregivers engage in regular physical activity (PA).<sup>[4-6]</sup> Despite the potential benefits of regular PA and the desire of informal caregivers to take part in such programs,<sup>[7]</sup> there is currently a lack of interventions designed to explicitly address the needs of this population through systematic and supervised PA.

Novel forms of PA, such as mind–body medicines (MBMs), have gained popularity due to their objective of equitably utilizing

the pillars of health-related fitness (i.e., cardiovascular fitness, muscle strength and endurance, flexibility, and balance). Furthermore, MBMs fuse these components with breath work, bringing a meditative quality to a physical practice.<sup>[8]</sup> Currently, two of the most widely used PAs categorized as MBMs are yoga and Tai Chi. Although few interventions have targeted informal caregivers, the potential beneficial effects of yoga and Tai Chi have consistently been recognized in the literature.<sup>[9-13]</sup> Yoga improves muscular strength, endurance, flexibility, and balance.<sup>[14-19]</sup> Markedly, there are hundreds of different styles of yoga; however, the most popular, widespread, and frequently practiced *Hatha Yoga* style in the West is Vinyasa Yoga (VY).<sup>[20-23]</sup>

Similar to yoga, some of the Tai Chi's purported benefits include improvements in balance, muscle strength, cardiovascular fitness, and flexibility.<sup>[24,25]</sup> A commonly practiced style of Tai Chi in North America is Taijifit™, which combines the elements of fitness, meditation, and martial arts.<sup>[26]</sup>

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While both VY and Taijifit™ have the potential to improve the indices of physical health, no study has investigated the effects of VY and Taijifit™ in adult informal caregivers. Furthermore, an emerging trend in the fitness world involves the continual increase of online fitness programs and classes. Using Internet-based PA interventions to support informal caregivers may offer an efficient and accessible alternative to traditional face-to-face interventions and reduce some of the purported barriers to PA in this population (e.g., transportation, time constraints, and arranging alternative care).

Therefore, this study investigated the effects of online VY and Taijifit™ (12 weeks) on muscle strength, muscle endurance, abdominal endurance, tasks of functionality, and flexibility in adult informal caregivers. It was hypothesized that VY would lead to greater improvements in upper body and abdominal strength and endurance, while Taijifit™ would lead to greater improvements in lower body strength and endurance and tasks of functionality.

## Methods

*A priori* power analysis (G\* Power v. 3.1.9.2; Heinrich-Heine-Universität Düsseldorf) revealed that a total of 28 participants were required (14 per group). The *a priori* power analysis calculation was based on a moderate effect size (Cohen's  $d = 0.25$ ), an alpha level of 0.05, and a  $\beta$ -value of 0.8 for a repeated measures analysis: within-between interactions, analysis of variance (ANOVA) approach<sup>[27]</sup> for the four primary physical outcomes (muscular strength and endurance, walking speed, balance, and flexibility).

## Subjects

Informal caregivers who provided help with activities of daily living, were  $\geq 18$  years of age, provided care to a variety of recipients (e.g., parents, siblings, spouses, neighbors, friends), and who were not participating in yoga or Tai Chi for  $\geq 6$  weeks prior to the start of the study were enrolled in the study. Both males and females were included to increase the impact of the study findings to the general informal caregiver population. Participants completed Leisure Time Exercise Questionnaire prior to the start of the study (baseline) and upon completion of the study (week 12). The Leisure Time Exercise Questionnaire indicated the average number of times they performed strenuous (i.e., heart beats rapidly), moderate (i.e., not exhausting), and mild exercises (i.e., minimal effort) per week.<sup>[28]</sup> At baseline, participants also filled out a Physical Activity Readiness Questionnaire (PAR-Q+), which assessed their readiness for participation in exercise programs. Participants were instructed not to change their diet or engage in any additional PA that was not part of their normal daily routine. The Research Ethics Board at the University of Regina approved the study and participants were informed of the risks and purposes of the study before their written informed consent was obtained.

Prior to the start of the study, participants were properly shown how to use the equipment and infrastructure for the assessment of muscle strength, muscle endurance, functionality, and flexibility (familiarization session).

## Assessments

### *Muscle strength and endurance*

Following a 5-min warm-up on a stationary cycle ergometer and a demonstration, participants were positioned in a bilateral, leg press machine so that a 90° angle at the knee was achieved and feet were shoulder width apart. Participants pushed the weight to full extension without locking the knees. Participants were then positioned in a bilateral, chest press machine so that the adjacent bars line up mid-chest level with both feet on the floor following another demonstration. Participants grasped the bars (overhand grip) shoulder width apart and pushed the weight until full extension, without lifting their buttocks off the bench or arching their back during the lift. Seat position and settings were recorded for each participant to ensure consistency. For both leg and chest press 1-RM, participants performed 1 set of 5 repetitions using a load that was comfortable. Two minutes after the warm-up set, the load was progressively increased for each subsequent 1-RM attempt. Participants rested (passively) between 1-RM attempts and reached their 1-RM in 6 sets or less.

Leg press and chest press muscular endurance was determined as the maximum number of repetitions that could be performed for one set using 70% baseline 1-RM for chest press and 80% baseline 1-RM for leg press. The different percentages of 1-RM used for the muscular endurance tests reflect observations that, for a given percentage of 1-RM, more repetitions can be performed during lower body exercises than during upper body exercises.<sup>[29,30]</sup>

Abdominal endurance was determined as the maximum number of consecutive curl-ups performed to volitional fatigue.

Handgrip strength was assessed using a handgrip dynamometer (Jamar® Hydraulic Hand Dynamometer by Sammons Preston Rolyan). The test was conducted in an upright standing position and the arm to be tested was abducted from the body at a 45° angle, with the elbow by the side of the body. Grip width was adjusted to the participants' hand size and recorded to ensure consistency. Participants were instructed to squeeze the dynamometer with maximal isometric effort for 3 s. Participants performed two test trials for each hand with 1-min rest between trials. For both hands, the average strength was used to for handgrip strength.

### *Tests of functionality*

Walking speed and dynamic balance were assessed by recording the time it took participants to perform backward

tandem walking (i.e., toe to heel) over a distance of 6 m on a 10 cm-wide board that was raised about 4 cm off the ground. The number of errors (i.e., number of times the participant stepped off the walking board) during the test was recorded. Participants performed one practice trial, followed by two test trials with a 1-min break between trials, for which the time and errors were recorded and averaged.

### Flexibility

Hamstring flexibility was assessed using a sit-and-reach flexometer. Participants sat on the floor with their legs fully extended and soles of the feet flat against the flexometer 6" apart. With palms facing downward and one hand on top of the other, participants exhaled and reached forward along the measuring line, holding the stretch for 2 s while the distance was recorded. Participants performed one practice trial followed by two test trials with a 1-min break between trials, for which the scores were recorded to the nearest 0.5 cm and averaged.

All testing procedures were conducted on the same day and in the following order: (1) leg press strength, (2) chest press strength (3), leg press endurance, (4) chest press endurance, (5) abdominal curl-ups, (6) handgrip strength, (7) walking speed and dynamic balance, and (8) flexibility. Five minutes of passive rest separated each assessment for a particular muscle group.

## Design

### Yoga

All sessions were taught by certified instructors through the online yoga community, YogaGlo.com. Participants were required to filter yoga classes by style – VY – as well as by session length ( $\geq 15$  min) for the duration of the intervention. Participants were also required to filter by level (*beginner*) for the first 2 weeks of the intervention, after which participants could participate in intermediate classes in consultation with the researchers. Participants were free to choose any instructors they preferred.

VY sessions included *savasana* (corpse pose) – a pose that helps to calm down the mind, promotes relaxation, and relieves stress and pressure off of the body; guided meditation; *Ujjayi* breath cultivation and maintenance; and *asanas* (standing, sitting, forward bending, twisting, inverting, balancing, reclining, and back-bending poses), which are personally altered in order for the practitioner to achieve the maximum benefits.

### Tai Chi

All Tai Chi sessions were taught by certified instructors through the online Tai Chi community, Taijifit.net. Participants were required to practice Taijifit™ – style Tai Chi and filter classes by level (*beginner*) for the first 2 weeks of the intervention and by session length ( $\geq 15$  min) for the duration of the intervention. After the first 2 weeks,

participants could participate in intermediate classes in consultation with the researchers. Participants were free to choose any instructors they preferred.

Taijifit™ sessions included guiding practitioners through multiple Tai Chi forms, which are personally altered in order for the practitioner to achieve the maximum benefits. Taijifit™ sessions began with or included *qigong*, preparing practitioners to control the flow and distribution of chi/qi in their body during a Tai Chi sequence.

A VY or Taijifit™ profile was created for each participant and the researcher showed the participants how to navigate the online VY or Taijifit™ websites. Participants were required to perform 150 min of VY or Taijifit™ per week, in accordance with the Canadian Sedentary Behaviour Guidelines for individuals aged 18 years and older.<sup>[31,32]</sup> Participants were instructed to fill out training logs to assess adherence to the VY or Taijifit™ programs and to log their hours of informal caregiving throughout the 12-week interventional period.

### Statistical analysis

A 2 (group: VY vs. Taijifit™)  $\times$  2 (time: baseline vs. week 12) repeated measures ANOVA was conducted to determine differences between groups over time for total leisure activity and self- and Internet-reported PA and for the primary dependent variables of muscle strength, muscle endurance, abdominal endurance, balance, walking speed, and flexibility. If statistically significant main effects or interactions were found, descriptive data, profile plots, and file splitting were used to confirm the main effects and interactions. An ANOVA was used to assess differences in baseline characteristics. ANCOVA was used to analyze flexibility with the baseline measurement being used as the covariate due to differences at baseline between groups. A one-way ANOVA was conducted to compare reported training volume (self-report PA logs vs. Internet PA logs) between groups (VY vs. Taijifit™). Dependent samples *t*-tests were conducted to determine differences in reported training volume (self-report PA logs vs. Internet PA logs) for the VY and Taijifit™ groups.

Significance was set at an alpha level  $< 0.05$  and all results were expressed as means  $\pm$  standard deviation. Exact *P* values were presented for all findings along with the magnitude of the difference between significant means, as determined by partial eta squared ( $\eta^2$ ) effect size. This is a measure of the effect size and therefore of the proportion of the total variance that can be explained by the effects of the treatment. An  $\eta^2$  value of  $\geq 0.15$  represents large differences, 0.06–0.14 represents medium differences, and 0.01–0.05 represents small differences. Statistical analyses were performed using IBM® SPSS® Statistics, v. 21; Armonk, NY: IBM Corp.

## Results

### Subjects and randomization

Thirty-five participants were randomized to either VY or Taijifit™ and completed baseline testing. Six female participants (three VY and three Taijifit™) withdrew before the study was finished [Figure 1 shows a summary of recruitment, allocation/randomization, and analysis]. Twenty-nine participants (VY = 16 [11 females and 5 males], 55.87 ± 12.31 years; Taijifit™ = 13 [7 females and 6 males], 55.07 ± 12.65 years) completed the study. Baseline characteristics of the participants who completed the study are shown in Table 1.

### Self-report and Internet physical activity logs

Participants (16 VY, 13 Taijifit™) recorded an average of 1626.07 ± 224.05 min of VY or Taijifit™ over the 12-week period, averaging 135.51 ± 7.72 min of VY or Taijifit™ per week. Specifically, the VY group recorded an average of 1712.93 ± 190.20 min of VY over the 12-week period, averaging 142.74 ± 11.88 min/week. The Taijifit™ group recorded an average of 1519.15 ± 222.50 min of Taijifit™ over the 12-week period, averaging 126.60 ± 17.12 min/week.

According to the online activity tracking system, participants (16 VY, 13 Taijifit™) performed an average of 1738.79 ± 308.01 min of VY or Taijifit™ over the 12-week period, averaging 144.90 ± 10.62 min of VY or Taijifit™ per week. Specifically, the online activity tracking system recorded an average of 1858.43 ± 326.48 min of VY and 1591.54 ± 213.45 of Taijifit™ over the 12-week period, averaging 154.87 ± 20.40 of VY and 132.63 ± 16.42 of Taijifit™ min/week.

### Muscle strength and endurance

There were no statistically significant differences between groups at baseline for muscular strength or endurance. There was a time main effect for 1-RM leg press strength ( $P < 0.001$ ,  $\eta^2 = 0.608$ ), 1-RM chest press strength ( $P < 0.001$ ,  $\eta^2 = 0.545$ ), total body strength (leg press and chest press combined;  $P < 0.001$ ,  $\eta^2 = 0.659$ ), leg press endurance ( $P < 0.001$ ,  $\eta^2 = 0.521$ ), total body endurance (leg press and chest press combined;  $P < 0.001$ ,  $\eta^2 = 0.611$ ), right handgrip strength ( $P < 0.001$ ,  $\eta^2 = 0.647$ ), left handgrip strength ( $P < 0.001$ ,  $\eta^2 = 0.515$ ), and total handgrip strength (both hands combined;  $P < 0.001$ ,  $\eta^2 = 0.630$ ), with no differences between groups over time [Table 2].

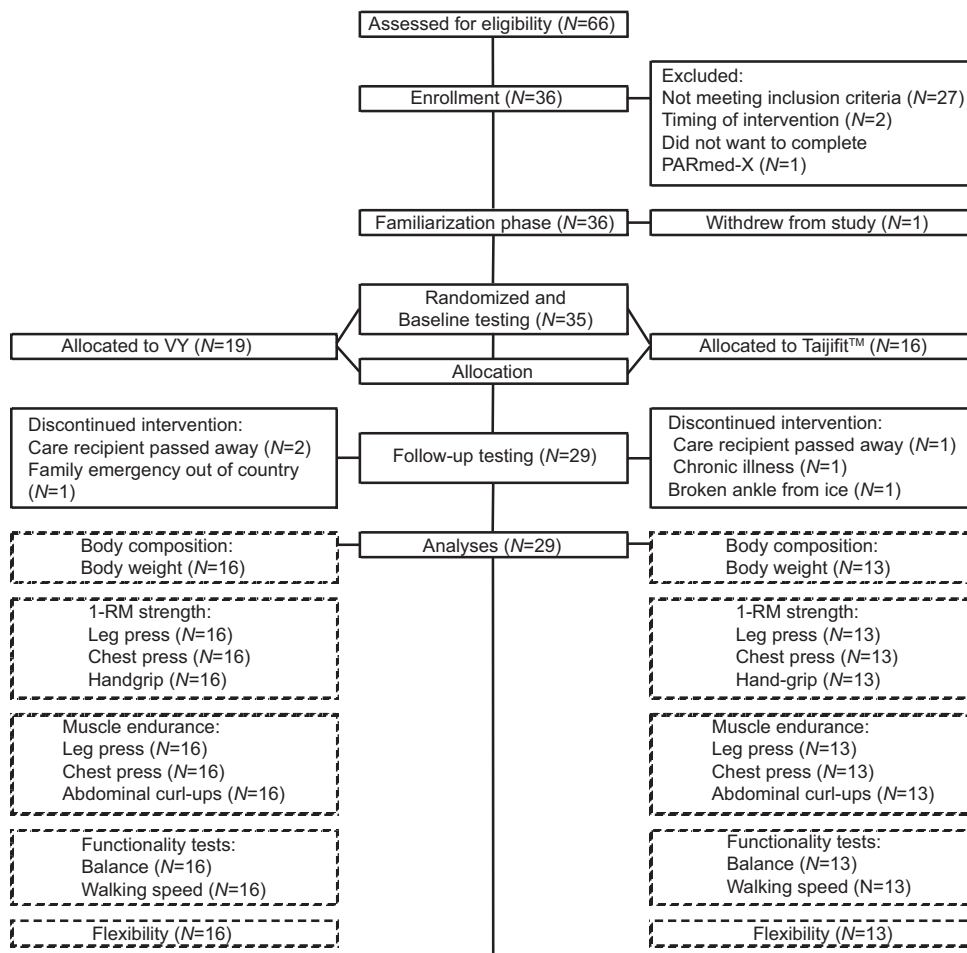


Figure 1: Summary of recruitment, allocation, and analysis

There was a time main effect ( $P < 0.001$ ,  $\eta^2 = 0.799$ ) and a group  $\times$  time interaction for chest press endurance ( $P = 0.019$ ,  $\eta^2 = 0.188$ ). Both the VY and Taijifit™ groups increased chest press endurance over time, but the change was greater in the VY group compared to the Taijifit™ group. Similar to chest press endurance, there was a time main effect ( $P < 0.001$ ,  $\eta^2 = 0.513$ ) and a group  $\times$  time interaction ( $P = 0.034$ ,  $\eta^2 = 0.155$ ) for abdominal curl-up. Both the VY and Taijifit™ groups increased abdominal curl-ups over time, but the change was greater in the VY group compared to the Taijifit™ group [Table 2].

**Functionality and flexibility**

There were no statistically significant differences between groups at baseline for tasks of functionality. There was a statistically significant difference with respect to baseline flexibility ( $P = 0.002$ ); the VY group had greater flexibility ( $32.0 \pm 7.0$ ) at baseline compared to the Taijifit™

group ( $21.6 \pm 8.8$ ). There was a time main effect for balance ( $P < 0.001$ ,  $\eta^2 = 0.381$ ), walking speed ( $P < 0.001$ ,  $\eta^2 = 0.521$ ), and flexibility ( $P < 0.001$ ,  $\eta^2 = 0.496$ ), with no differences between groups over time [Table 3].

**Discussion**

This is the first study to investigate the effects of 12 consecutive weeks of online VY and Taijifit™ practice (150 min/week) on muscle strength and endurance, balance, walking speed, and flexibility in adult informal caregivers. Results showed that online VY and Taijifit™ were effective in improving muscle strength and endurance, indices of functionality, and flexibility, with VY producing greater gains in chest press and abdominal endurance. This study also provides evidence that an online delivery method of VY and Taijifit™ is safe, effective, and feasible for informal caregivers (there were no reported injuries or adverse events related to the program). The potential for

**Table 1: Participant characteristics at baseline for the Vinyasa Yoga group and Taijifit™ group**

Group	Age (years)	Weight (lbs)	Height (cm)	Total leisure activity
VY (n=16)	55.87±12.31	172.90±31.90	167.57±8.71	26.68±15.39
Taijifit™ (n=13)	55.07±12.65	187.80±39.07	167.92±6.48	30.46±30.07

Values are mean±SD. SD: Standard deviation, VY: Vinyasa Yoga

**Table 2: Muscle strength (1-RM) and endurance for leg press, chest press, abdominal curl-up, and handgrip before and after 12 weeks of Vinyasa Yoga and Taijifit™**

Strength	VY		Taijifit™		P	$\eta^2$
	Pre	Post	Pre	Post		
<b>Exercise</b>						
1-RM leg press (kg)	156.39±64.62	183.10±59.95*	154.16±59.23	177.41±55.60*	<0.001	0.608
1-RM chest press (kg)	42.75±18.74	47.09±22.40*	45.28±17.69	48.95±19.23*	<0.001	0.545
1-RM total strength (kg)	199.15±76.65	230.18±74.89*	199.44±70.51	226.36±68.03*	<0.001	0.659
Right handgrip (kg)	26.28±13.43	29.81±12.10*	27.26±6.96	29.92±8.94*	<0.001	0.647
Left handgrip (kg)	24.43±12.67	27.71±12.29*	24.76±7.59	27.46±8.27*	<0.001	0.515
Total handgrip (kg)	50.71±25.98	57.53±24.18*	52.03±14.02	57.38±16.79*	<0.001	0.630

**Endurance (number of repetitions)**

<b>Exercise</b>						
Leg press	27.37±11.35	56.93±34.81*	29.00±15.67	50.23±25.57*	<0.001	0.521
Chest press	19.25±5.90	28.06±7.60**	15.69±4.49	21.07±5.85*	0.019	0.799
Abdominal curl-ups	37.12±31.26	68.43±55.07**	19.23±19.00	32.07±20.87*	0.034	0.513
Total endurance	46.62±14.62	85.00±38.49*	44.69±17.77	71.30±28.22*	<0.001	0.611

Values are mean±SD, \*Indicates a significant change over time ( $P < 0.05$ ), \*\*Indicates VY group had greater improvements compared to the Taijifit™ group ( $P < 0.05$ ). SD: Standard deviation, VY: Vinyasa Yoga

**Table 3: Functionality tests (balance and walking speed) and flexibility before and after 12 weeks of Vinyasa Yoga and Taijifit™**

Tests	VY		Taijifit™		P	$\eta^2$
	Pre	Post	Pre	Post		
<b>Functionality</b>						
Balance (step-offs)	3.34±5.61	1.53±2.67*	4.92±5.42	2.11±2.74*	<0.001	0.381
Walking speed (s)	43.42±21.25	30.31±14.74*	42.24±23.64	28.35±15.78*	<0.001	0.521
<b>Flexibility</b>						
Flexometer (cm)	32.04±7.08	36.04±6.04*	21.67±8.89	28.79±9.63*	<0.001	0.496

Values are mean±SD. \*Indicates a significant change over time ( $P < 0.05$ ). SD: Standard deviation, VY: Vinyasa Yoga

successful implementation of an online VY and Taijifit™ intervention in the informal caregiver population is also evidenced by the studies' ability to reach and engage this population, 29 participants completing the study, the high VY and Taijifit™ adherence rates (both self- and Internet-reported PA), and the low dropout rate (17.14%). The feasibility of these studies may help to build the foundation for future planned online intervention studies and randomized controlled trials (RCTs) in this population and with these MBM-based PAs.

Results of the present study are also meaningful in that the participation and cessation effects of two MBMs were compared. Unfortunately, there was no control group, which limits our ability to conclude that improvements and maintenance in muscle strength and endurance, balance, walking speed, and flexibility were from VY and Taijifit™ and not other confounding variables. However, previous RCTs of both yoga and Tai Chi have reported these benefits in yoga and Tai Chi groups, but not in control groups.<sup>[11,33,34]</sup>

From a health promotion and knowledge translational perspective, these results are important as the consequences of physical inactivity in this population could ultimately lead to more demands on the formal health system, either directly or indirectly. Further, since nearly every family will at some point in time be in the position of having to provide care for a loved one, reducing negative outcomes associated with informal caregiving represents a very large health concern.

Both the VY and Taijifit™ groups experienced significant increases in muscle strength, muscle endurance, indices of functionality, and flexibility. These results are consistent with previous research demonstrating that yoga and Tai Chi can improve strength, endurance, balance, and flexibility<sup>[14-19,24,33-43]</sup> as well as studies demonstrating yoga's benefits to walking,<sup>[16,44,45]</sup> lower body flexibility and endurance, and handgrip strength<sup>[46]</sup> and Tai Chi's benefits to run time (800/1000 m),<sup>[43]</sup> sit-and-reach flexibility,<sup>[34]</sup> and abdominal muscle strength.<sup>[42]</sup>

The VY group experienced a greater increase in chest press and abdominal endurance compared to the Taijifit™ group, which may be related to training volume. Participants' total leisure activity scores do not include activities performed from the VY/Taijifit™ programs; therefore, there were no differences in activities performed outside of the VY/Taijifit™ programs. The VY group performed significantly more PA compared to the Taijifit™ group. As a result, the VY group adhered more closely to the 150 min/week protocol, averaging 142.74 min/week (95.16%) of VY compared to the Taijifit™ group, which averaged 126.60 min/week (84.40%) of Taijifit™. What's more, the majority (52.61%) of the VY sessions lasted 16–30 min, while the majority (52.79%) of the Taijifit™ sessions lasted ≤15 min, which may have contributed to

the greater improvements in upper body and abdominal endurance – but not upper body strength – in the VY group. The VY group may have experienced a greater increase in chest press and abdominal endurance since yoga focuses on using the arms and core to hold one's body weight and provide the necessary support, while Tai Chi focuses on developing and using the muscles in the legs for support.<sup>[47-50]</sup> Finally, the weekly average of informal caregiving hours was more than double in the Taijifit™ group (32.12 h/week) as compared to the VY group (14.07 h/week), which may have contributed to the Taijifit™ group, only achieving 84.40% of the recommended 150 min/week.

### Future directions

Due to the small number of studies having been conducted with PA or MBMs and informal caregivers as well as the limitations of the current study, these results should be regarded as preliminary. There is a need for the participation effects of these two MBM-based PAs to be tested utilizing a RCT to be able to determine whether any benefits to physical outcome measures stem from VY and Taijifit™ or other potential confounding variables. In addition, there is no evidence to suggest the optimal volume, frequency, style, or length of yoga/Tai Chi program for improving informal caregiver health.

While several benefits exist in delivering face-to-face interventions to informal caregivers (e.g., socializing and meeting other caregivers), previous research has noted difficulty in retaining this population in face-to-face interventions;<sup>[51-54]</sup> mostly noting time constraints as a main reason why caregivers drop out. Consequently, further investigations are necessary to investigate how technological advances may enhance PA, yoga, and Tai Chi delivery and improve informal caregiver health and outcomes.

As the literature has developed on informal caregivers, further predictor variables for health problems have been identified, such as caregiver age, sex, relationship to the care recipient,<sup>[55-57]</sup> ethnicity,<sup>[58]</sup> social isolation,<sup>[59,60]</sup> and weekly hours of informal caregiving.<sup>[61,62]</sup> Future research may be needed to examine the effectiveness, feasibility, and likeability of MBMs and telehealth PA programs across these variables. Future research should also seek to conduct more qualitative research with this population, particularly with regard to assessing intervention delivery methods (face to face vs. nonface to face) and PA modalities, including yoga and Tai Chi.

Finally, the use of a theoretical framework can offer a foundation upon which to build evidence-based interventions. Theory plays a critical role in the development and implementation of best practices, and theoretical models present a systematic way of understanding events and can help explain how health behaviors such as PA can be influenced.<sup>[63]</sup>

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## Conflicts of interest

There are no conflicts of interest.

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