Tesis Doctoral

EFECTOS DE LA PRÁCTICA DEL TAICHI EN MUJERES Y HOMBRES CON FIBROMIALGIA

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La más alta bondad es como el agua.

La bondad del agua consiste en

beneficiar todas las cosas,

sin preferencia.

Tao Te King.

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EFECTOS DE LA PRÁCTICA DEL TAICHI EN MUJERES Y HOMBRES CON FIBROMIALGIA

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Que la Tesis Doctoral titulada “Efectos de la práctica de Taichi en hombres y mujeres con fibromialgia” que presenta D. ALEJANDRO ROMERO ZURITA al superior juicio del Tribunal que designe la Universidad de Granada, ha sido realizada bajo mi dirección durante los años 2008-2012, siendo expresión de la capacidad técnica e interpretativa de su autor en condiciones tan aventajadas que le hacen merecedor del Título de Doctor, siempre y cuando así lo considere el citado Tribunal

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ÍNDICE DE CONTENIDOS

Proyectos de investigación…….....17

Publicaciones……...19

Resumen……..21

Abreviaturas…….24

Introducción…….25

Bibliografía……...31

Objetivos……..35

Material y Métodos……..37

Resultados y Discusión……41

1. Efectos del Taichi sobre la salud física y psicológica, y en diferentes patologías en población adulta.(Artículo I)…….43

1.2 Effects of Tai-Chi on Physical Fitness, Phychological and Disease Outcomes in Adults: A Systematic Review……...45

2. Efectos de un programa de intervención con Taichi sobre el grado de dolor, función física, calidad de vida relacionada con la salud y variables psicológicas en hombres con fibromialgia.(Artículo II-III)…….77

2.1 Preliminary Findings of a 4-MonthTaichi Intervention on Tenderness, Functional Capacity, Symptomatology, and Quality of Life in Men with Fibromyalgia.……79

2.2 Tai-Chi Intervention in Men with Fibromyalgia: A Multiple-Patient Case Report.……91

3. Beneficios de la práctica del Taichi sobre el grado de dolor, función física, calidad de vida relacionada con la salud y variables psicológicas en mujeres con fibromialgia. (Artículo IV-V)…….97

3.1 A 12 week Tai-Chi intervention in women with fibromyalgia improves functional capacity, quality of life and symptomatology.……..99

3.2 Effectiveness of a Tai-Chi intervention in functional capacity, symptomatology and psychological outcomes in women with fibromyalgia.……....127

Conclusiones……155

Currículum Vitae…….156

Agradecimientos…….....159

PROYECTOS DE INVESTIGACIÓN

El trabajo desarrollado y los artículos que se muestran en esta tesis Doctoral forman parte de los siguientes proyectos de investigación:

- Intervención para la mejora de la calidad de vida relacionada con la salud. Financiado por la Asociación Granadina de Fibromialgia (AGRAFIM). Duración: 18/01/2008 al 18/01/2011.

- Evaluación y promoción de calidad de vida relacionada con la salud para enfermos de fibromialgia. Instituto Andaluz del Deporte. Consejería de Comercio, Turismo y Deporte. Junta de Andalucía. Duración:04/01/2008 al 03/01/2009.

- Mejora de la calidad de vida en personas con fibromialgia a través de programas de actividad física y multidisciplinares (2008-2009). VIII convocatoria de proyectos de cooperación universitaria para el desarrollo, transferencia de conocimientos en el ámbito de la acción social y sensibilización y educación para el desarrollo. Centro de Iniciativas de Cooperación al Desarrollo. Universidad de Granada. Duración:3/12/2008 al 3/12/2009.

- Efectos de programas de actividad física en la calidad de vida de personas con fibromialgia (EPAFI). Fundación MAPFRE. Ayudas a la investigación 2009. Duración: 01/01/2010 al 31/12/2010.

LISTA DE PUBLICACIONES

Esta tesis doctoral está compuesta por los siguientes artículos científicos

I. **Alejandro Romero**, Virginia A. Aparicio, Ana Carbonell-Baeza, Pablo Tercedor, Manuel Delgado-Fernández.Effects of Tai-Chi on Physical Fitness, Psychological and Disease Outcomes in Adults: A Systematic Review.*Submitted.*

II. Ana Carbonell-Baeza, **Alejandro Romero**, Virginia A. Aparicio, Francisco B. Ortega, Pablo Tercedor, Manuel Delgado-Fernández, Jonatan R. Preliminary findings of a 4-month Tai Chi intervention on tenderness, functional capacity, symptomatology and quality of life in men with fibromyalgia**.** *American Journal of Mens Health* 2011; 5(5):421-429.

III. Ana Carbonell-Baeza, **Alejandro Romero**, Virginia A. Aparicio, Francisco B. Ortega, Pablo Tercedor, Manuel Delgado-Fernández, Jonatan R. Ruiz. Tai chi intervention for male with fibromyalgia: A multiple-patient case report**.** *TheJournal of Alternative and Complementary Medicine* 2011; 17(3):187-189.

IV. **Alejandro Romero,** Ana Carbonell-Baeza, Virginia A. Aparicio, Jonatan R. Ruiz, Pablo Tercedor, Manuel Delgado-Fernández. A 12-week Tai-Chi intervention in women with fibromyalgia improves functional capacity, quality of life and symptomatology. *Submitted*.

Alejandro Romero, Ana Carbonell-Baeza, Virginia A. Aparicio, Pablo Tercedor, Manuel Delgado-Fernández.Effectiveness of Tai-Chiintervention in functional capacity, symptomatology and psychological outcomes in women with fibromyalgia.*Evidence-BasedComplementary and Alternative Medicine. Accepted.*

RESUMEN

La fibromialgia (FM)es un síndrome caracterizado por la existencia de dolor crónico generalizado y que afecta a la calidad de vida del paciente. El carácter multiorgánico de esta enfermedadcomplica mucho el protocolo terapéutico, que debe individualizarse según las manifestaciones clínicas específicas de cada paciente y contemplar diferentes tipos de intervención, entre las que se puede incluir el ejercicio físico. El Taichi es un ejercicio físico de intensidad moderada de origen chinoque ha demostrado ser eficaz en la mejora de la salud en pacientes con patologías crónicas.Las características de esta disciplina hace que se pueda adaptar a participantes de diferente edad y género, lo que puede favorecer el desarrollo de una mejor calidad de vidasobre una amplia población.

Los principales objetivos de este proyecto son:realizar una revisión sistemática sobre los estudios previos que han analizado los efectos del Taichi en población adulta sana o con algún tipo de patología yvalorar los efectos dela práctica delTaichien mujeres y hombres con FM sobre el grado de dolor, capacidad funcional, sintomatología, calidad de vida relacionada con la salud yvariables psicológicas.

La muestra con que se ha contado para el desarrollo de este estudio está compuesta por 74 adultos con FM, 68mujeres y 6 hombres, que cumplen con el criterio de diagnóstico de la enfermedad del Colegio Americano de Reumatología (1990).

Para conocer el efecto de la práctica de Taichi en hombres se llevo a cabo una intervención de 16 semanas de duración (3 sesiones semanales de 60 minutos cada una). Se evaluaron las siguientes variables: composición corporal, puntos de

dolor, umbral de dolor, capacidad funcional, sintomatología, calidad de vida relacionada con la salud, afrontamiento del dolor, ansiedad y depresión, antes de la intervención, después de la intervención y tras un periodo de desentrenamiento de 12 semanas.Se analizó el efecto del entrenamiento en todo el grupo y adicionalmente, se llevo a cabo un análisis de caso múltiple con el objetivo de comprobar las mejoras de cada paciente en las variables medidas.

Asimismo, para conocer el efecto de la práctica de Taichi en mujeres, se desarrolló una intervención a largo plazo (28semanas) analizando el efecto de la misma a las 12 y 28 semanas. Tras 12 semanas de Taichi se evaluaron las siguientes variables: composición corporal, puntos de dolor, umbral de dolor, capacidad funcional, sintomatología, calidad de vida, afrontamiento del dolor, ansiedad, depresión, autoestima y autoeficacia. Las diferentes variables fueron medidas antes y después de la intervención tanto en el grupo de intervención como en un grupo control, que no recibió ningún tipo de terapia física y al que se le indico no modificar su estilo de vida y medicación durante ese periodo. Finalmente, se llevo a cabo un análisis de la intervención después de 28 semanas en las variables citadas anteriormente, antes y después de la intervención y al finalizar un periodo de desentrenamiento de 12 semanas.

Los principales resultados de la tesis concluyen que

- Los resultados de las diferentes investigaciones revisadas indican que el Taichi es un ejercicio saludable que puede tener efectos positivos sobre la salud física y psicológica,densidad mineral,inmunodeficiencia,perfil lipídico, síndrome metabólico, lesión cerebral, dolor de cabeza por tensión,cáncer, salud cardiovascular, diabetes tipo 2,espondilitis anquilosante,múltiple esclerosis y fibromialgia. Por otro lado, son

necesarios más estudios que apliquen diseños metodológicos de mayor calidad.

- Una intervención de 16 semanas de Taichi mejora la flexibilidad de las extremidades inferiores en hombres con fibromialgia. Esta mejora se mantuvo después de 3 meses sin intervención.
- La práctica de Taichi durante 12 semanas mejora la capacidad funcional, la calidad de vida relacionada con la salud, la autoestima y reduce el impacto de la enfermedad en mujeres con fibromialgia.
- Una intervención de Taichide28 semanas tiene efectos positivos sobre el dolor, la capacidad funcional, la sintomatología, la calidad de vida relacionada con la salud,las estrategias de afrontamiento del dolor activas, autoeficacia y autoestimaen mujeres con fibromialgia.

ABREVIATURAS

- **FIQ**Fibromyalgia Impact Questionnaire
- **FM** Fibromialgia
- **GC**Grupo Control
- **GSES**General Self Efficacy Scale
- **GTC** Grupo Taichi
- **HADS**Hospital Anxiety and Depression Scale
- **IMC** IndiceMasa Corporal
- **RSES**Rosenberg Self-Esteem Scale
- **SF-36** Short Form Health Survey 36
- **TC** Taichi
- **VPMI**Vanderbilt Pain Management Inventory

INTRODUCCIÓN

1. Características de la enfermedad

1.1 Definición y diagnóstico

La Fibromialgia (FM) se caracteriza por la existencia de dolor musculoesqueléticogeneralizado de carácter crónico[1], existiendo una mayor incidencia de la enfermedad en mujeres (4,2%) que en hombres (0,2%)[2].Su diagnóstico se fundamenta en la identificación de diferentes puntos de dolorsiguiendo el criterio del Colegio Americano de Reumatología, según el cual, se deben cumplir las siguientes circunstancias: dolor generalizado durante más de 3 meses y sentir dolor a una presión por debajo de 4 kilogramos/cm de presión en 11 o más de los 18 puntos de dolor posibles[1]. También se ha considerado la ausencia de otra enfermedad sistémica que pudiera ser la causa del dolor subyacente (tales como la artritis reumatoidea, lupus o problemas de tiroides).Actualmente se ha propuesto un nuevo criterio de diagnostico preliminar basado enla sintomatología del paciente. Esta propuesta incluye dos escalas, un índice de dolor generalizado y un índice de gravedad de los síntomas.Este nuevo criterio de diagnóstico establece 3 condiciones: i) índice de dolor generalizado ≥7y severidad de los síntomas≥ 5 o índice de dolor generalizado entre 3-6 y severidad de los síntomas ≥9. ii) Si los síntomas han estado presentes al mismo nivel durante los últimos 3 meses. iii) La inexistencia de otra patología que pueda ser la causante del dolor[3-4].

1.2 Sintomatología

Los síntomas más característicos son: dolor generalizado, fatiga, problemas para conciliar el sueño, dificultades cognitivas, depresión y ansiedad[1,5-6]. Otros síntomas comunes en estos pacientes son el dolor en la zona lumbar, dolor de cabeza, artritis, espasmos musculares y problemas de equilibrio[5]. Un estudio reciente ha mostrado que el dolory la fatiga son los síntomas que más determinan la severidad de la enfermedad y la calidad de vida relacionada con la saluden estos pacientes[7]. Además, la sintomatología asociada a la enfermedad, la cual limita la capacidad del paciente para realizar actividades cotidianas[8], puede verse exacerbada por elementos como el estrés, cambios climáticos, insomnio y realización deactividades agotadoras[5].

1.3 Etiología

Este síndrome está considerado como un desorden en la regulación del dolor[9-10], que puede estar relacionado con la existencia de anormalidades en el sistema nervioso central en relación a los procesos sensoriales[11] y con un anómalo procesamiento del dolor[6].Aunque se desconoce la etiología de la FM, las evidencias sugieren que hay diferentes factores genéticos relacionados con la patofisiología de la enfermedadentre los que destaca los relacionados con los sistemas serotoninérgicos, dopaminérgicos y catecolaminérgicos[12-13].

1.4 Enfermedad y costes directos

Los pacientes con FM son usuarios habituales del sistema sanitario público, experimentan una elevada comorbilidad e incurren en elevados costes directos[14,15,30]. Todo ello, supone un gasto de 614€ más de media anual en costes de sistema sanitario y 4.397€ más en costes indirectos (bajas por enfermedad y

prejubilaciones) en comparación con un grupo de referencia, lo que implica un coste total anual extra por paciente de 5.010€[15].

2. Fibromialgia y capacidad funcional

La FM tiene un enorme impacto sobre la calidad de vida relacionada con la salud en los pacientes[16-17]y su sintomatología limita la mayoría de actividades cotidianas[8,23]. Además, la capacidad funcional esta disminuida en estos pacientes[18-22], siendo similar a la de personas mayores[21].

La capacidad aeróbica,flexibilidad, equilibrio estático y dinámico y la fuerza muscularen estos pacientes están por debajo de los valores medios asociados a mujeres sanas de su rango de edad[18,27,29] pudiendo esto último tener como consecuencia una reducción de la capacidad de movimiento y funcionalidad[28]. Los pacientes con FM también pueden presentar problemas de equilibrio e incremento del riesgo de caídas[20],hallándose los parámetros de locomoción alterados en comparación con mujeres sanas[22].

Un estudio reciente[29] ha demostrado que los test que evalúan la capacidad funcional (30-s chair stand,8-feet up&go, handgripstrength, chairsit&rech, 30-s blindflamingo and 6-min walkingtests)pueden ayudar a discriminar entre ausencia o presencia de la FM en estos pacientes.

Se ha comprobado que el mantenimiento de un peso adecuado reduce el riesgo de padecer FM[25]. En este sentido, algunos estudios han analizado la asociación entre el índice de masa corporal y el dolor en mujeres con FM y han encontrado una correlación positiva[24,26].

3.Tratamiento

Las evidencias muestran que el tratamiento multidisciplinar tiene efectos positivos sobre la sintomatología[31-33].Entre las terapias no farmacológicas utilizadas por los pacientes con FM encontramos los programas educativos psicológicos y el ejercicio físico[34].

3.1 Ejercicio físico

El ejercicio físico en general de baja intensidad afecta de forma positiva a la salud de los pacientes y disminuye la sintomatología de la enfermedad[35]. Por otro lado, un reciente estudio ha encontrado que el ejercicio físico tiene efectos sobre los procesos cerebrales que afectan a la percepción y modulación del dolor en los pacientes con FM[36].

Es necesaria la adaptación o graduación del ejercicio físico para estos pacientes en función a su nivel de tolerancia a la actividad física. En este sentido, la prescripción de un programa de ejercicio adecuado puede tener efectos positivos sobre el dolor, la fatiga y el sueño en estos pacientes[65].

El panel de expertos de Ottawa recomienda el ejercicio aeróbico y de fuerza para tratar los síntomas de la FM[37-38]. Las evidencias sugieren que el ejercicio aeróbico y de fuerza mejora el bienestar en general en estos pacientes, afectando de forma positiva a la función física, sintomatología y calidad de vida[39-40].Actualmente se han estudiado los efectos de otras modalidades de ejercicio físico como el Taichi, yoga, chi gong o el paseo nórdico[40].

3.2 Terapias alternativas y complementarias

La medicina alternativa y complementaria está en proceso de evaluación por parte de la ciencia[41].Entre los medios utilizados en la misma se encuentran diferentes terapias cuerpo-mente (mind-bodytherapies),prácticas biológicas basadas en suplementos dietéticos y herbales, así como otras prácticas manipulativas y corporales como el masaje o el Reiki[42].El uso de las terapias alternativas está extendido entre los pacientes con FM, sin embargo, no hay evidencias determinantes sobre los efectos de este tipo de terapias en la sintomatología de la enfermedad[34,41,43].Por otro lado, una reciente revisión sistemática ha encontrado que las terapias cuerpo-mente y la balneoterapia son efectivas en los pacientes con FM[44].

3.3Taichi como tratamiento

La práctica de ejercicio físico no extenuante y de algunas terapias de relajación puede aumentar la tolerancia al dolor y afectar de forma positiva a la calidad de vida[45-47]. El Taichies un tipo de ejercicio que forma parte de la medicina tradicional china[48], cuyos fundamentos están basados en la ejecución de movimientos lentos, rítmicos y controlados acompañados de una respiración profunda y de concentraciónmental[49].Las características de esta disciplina, basadas en ejercicio físico de baja intensidad[50], hace que se pueda adaptar a participantes de diferente edad y género, lo que puede favorecer el desarrollo de una mejor calidad de vida[51]. En la actualidad las investigaciones sobre los efectos del Taichien la salud están aumentando de forma significativa[52].

Las diferentes investigaciones sugieren que el Taichi proporciona efectos positivos a nivel psicológico[53-54], psicosocial[55],fisiológico[56], cognitivo[57], y

neurológico[58]siendo un sistema seguro y efectivo para mejorar el equilibrio, la flexibilidad y la salud cardiovascular en pacientes con condiciones crónicas[59-62].En este sentido, la práctica del Taichi puede ser considerada como un método efectivo para pacientes con dolor crónico generalizado[62].

Dos estudios han mostrado los efectos de la práctica del Taichi en mujerescon FM. Taggart et al[63], evidenciaron una reducción de los síntomas y una mejora en la calidad de vida después de 6 semanas de intervención con Taichi. En un estudio más reciente, Wang et al[64], encontraron mejoras en la calidad de vida, sintomatología y capacidad aeróbica después de 12 semanas de intervención con Taichi.

Los efectos del Taichi solo se han evaluado sobre mujeres con FM, lo que hace necesario nuevas investigaciones que analicen los beneficios de este ejercicio en hombres. Por otro lado, los estudios existentes de Taichien mujeres con FM son limitados en cuanto al número de variables que miden la capacidad funcional,el umbral de dolor y puntos de dolor,así como en el tiempo de intervención, queno supera las 12 semanas. Por todo ello, son necesarias nuevas investigaciones que evalúen el efecto a largo plazo de la práctica del Taichi en diversas variables relacionadas con la capacidad funcional y el dolor.

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OBJETIVOS

General

Revisar sistemáticamente los efectos de la práctica del Taichi en adultos sanos o con algún tipo de patología. Analizar los efectos de una intervención de Taichi sobre el grado de dolor, capacidad funcional, sintomatología yvariables psicológicas.

Específicos

1. Revisar sistemáticamentelos diferentes efectos que la práctica del Taichi tiene sobre la salud física y psicológica,densidad mineral,inmunodeficiencia,perfil lipídico, síndrome metabólico, lesión cerebral, dolor de cabeza por tensión,cáncer, salud cardiovascular, diabetes tipo 2,espondilitis anquilosante,múltiple esclerosis y fibromialgia en adultos.(Artículo I)

2. Comprobar los efectos de una intervención de Taichide 16 semanas de duración sobre la composición corporal, grado de dolor, capacidad funcional, sintomatología, calidad de vida relacionada con la salud, afrontamiento del dolor, ansiedad y depresión.Comprobar el efecto que tiene dejar de realizarTaichi de forma sistemática durante 3 meses sobre las variables estudiadas. (Artículo II)

3. Analizar los efectos de la intervención de Taichi de 16 semanas sobre el grado de dolor, la capacidad funcional y sintomatología paciente a paciente (Artículo III).

4. Analizar los efectos de la práctica de 12 semanasde Taichisobre lacomposición corporal, grado de dolor, capacidad funcional, sintomatología, calidad de vida

relacionada con la salud, afrontamiento del dolor, ansiedad, depresión, autoestima y autoeficaciaen mujeres con FM. (Artículo IV)

5. Analizar los efectos de la práctica de 28 semanas de Taichisobrela composición corporal, grado de dolor, capacidad funcional, sintomatología, calidad de vida relacionada con la salud, afrontamiento del dolor, ansiedad, depresión, autoestima y autoeficacia. Comprobar los efectos de 3 meses sin intervención sobre las variables estudiadas. (Artículo V)

Material y métodos

El método y materiales más relevantes utilizados en los diferentes artículos se resume en la siguiente tabla**.**

Tabla 1.Resumen de la metodología empleada en los artículos.

Artículo	Diseño	Participantes	Intervención	Variables	Método
Effects of Tai-Chi on Physical Fitness, Psychological and Disease Outcomes in Adults: A Systematic Review	Revisión sistemática.		No aplicable.	Salud física y psicológica,densidad mineral,inmunodeficiencia,perfil lipídico, síndrome metabólico, lesión cerebral, dolor de cabeza por tensión,cáncer, salud cardiovascular, diabetes tipo 2,espondilitis anquilosante,múltiple esclerosis y fibromialgia.	Búsqueda en las bases de datos:Web of Science, Scopus, Pudmed y Cochrane. Incluidos estudios publicados desde 1979 hasta el 2011.Utilización de End-Note X3 (Thompson USA). Análisis de la calidad de los estudios mediante la escala Jadad de 3 items.
Preliminary findings of a 4-month Tai Chi intervention on tenderness, functional capacity, symptomatology and quality of life in men with fibromyalgia	Quasi-experimental	6 hombres con FM	4 meses de TC. (60 min;3 días/semana)	Peso, IMC, puntos de dolor, umbral de dolor, capacidad funcional,sintomatología, calidad de vida, ansiedad, depresión yafrontamiento del dolor.	Inbody,presión en puntos de dolor con algómetro, 30-s chair stand, dinamómetria manual, chair sit& reach, back scratch, 8 ftup&go 6-min walk y blind flamingo tests. FIQ, SF-36,VPMI,HADS.
A 12 Tai-Chi intervention in women with fibromyalgiaimproves functional capacity, quality of life and symptomatology.	Experimental	68 mujeres con FM GTC=34. GC =34	12 semanas de TC. (60 min, 3 días /semana).	IMC, porcentaje graso, perímetro cintura, puntos de dolor, umbral de dolor,capacidad funcional, sintomatología, calidad de vida, afrontamiento del dolor,ansiedad, depresión, autoestima y autoeficacia.	Inbody, cinta métrica, presión en puntos de dolor con algómetro, 30-s chair stand, dinamometria manual,chairsit&reach, back scratch, 8 ftup&go, 6-min walk y blindflamingotests. FIQ, SF-36,VPMI,HADS,RSES y GSES.

Effectiveness of a Tai-Chi intervention in functional capacity, symptomatology and psychological outcomes in women with fibromyalgia.	Quasi-experimental	38 mujeres con FM GTC=38	7 meses de TC.(60 min, 3 días /semana).	IMC, perímetro de cintura, puntos de dolor, umbral de dolor,capacidad funcional, sintomatología, calidad de vida, afrontamiento del dolor, ansiedad, depresión, autoestima y autoeficacia.	Inbody, cinta métrica, presión en puntos de dolor con algómetro, 30-s chair stand, dinamometría manual,chairsit&reach, back scratch, 8 ftup&go, 6-min walk y blindflamingotests. FIQ,SF-36,VPMI,HADS,RSES y GSES.

GTC: Grupo de Tai-Chi; **GC**: Grupo control;**FIQ**: Fibromyalgia Impact Questionnaire;**SF-36**: Short Form Health Survey 36;**VPMI**:Vanderbilt Pain Management Inventory;**HADS**:Hospital Anxiety and Depression Scale;**RSES**:Rosenberg Self-Esteem Scale; **GSES**:General Self Efficacy Scale.

Resultados y discusión

Los resultados y discusión se presentan en la forma en que han sido previamente publicados/sometidos en revistas científicas.

Efectos del Taichi sobre la salud física y psicológica, y en diferentes patologías en población adulta

(Artículo I)

Artículo I

Effects of Tai-Chi on Physical Fitness, Psychological and Disease Outcomes in Adults: A Systematic Review

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Submitted

Effects of Tai-Chi on Physical Fitness, Psychological and Disease Outcomes in Adults: A Systematic Review

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ABSTRACT

The present systematic review aimed to critically appraising published clinical trials designed to assess the effects of Tai-Chi on physical fitness, psychological and diseases outcomes in adult subjects. The search was based on articles through November 2011 using electronic databases including Web of Science, Scopus, PubMed, and Cochrane Database of Controlled Trials.This review just included studies developed in adult subjects aged 18-65 years old and having Tai-Chi as the main intervention. Were excluded: case studies, those written in non–English or non-Spanish languages, reports based on technical Tai-Chi descriptions and studies that did not show numerical data. Twenty-three studies were selected for inclusion.

We have categorizedthe studiesbased on the followingtopics:psychological status, physical fitness, bone mineral density, immunodeficiency, lipid profile,metabolic syndrome, brain injury, tension headache, cancer, cardiovascular health, type 2 diabetes, ankylosing spondylitis, multiple sclerosis and fibromyalgia.

Tai-Chi showed a positive effect on the majority of the subjects studied.To note is its effectiveness on improving physical fitness, psychological outcomes and immunodeficiency. However, more studies are needed to confirm or contrast the effects Tai-Chi over the rest of variables analyzed.

Key words: Tai-Chi, exercise, adults, physical activity, fitness, benefits, health and quality of life.

INTRODUCTION

Tai-Chi, an ancient Chinese form of exercise derived from the martial arts, is a low-speed and low-impact exercise.[1] Initially, Tai-Chi was practiced as a fighting form, emphasizing strength, balance, flexibility and speed.[2] Nowadays, Tai-Chi is a 'balanced' exercise that integrates key components of exercise training: cardio-respiratory function, strength, balance and flexibility.[1,3] Furthermore, Tai-Chi integrates movements with deep breathing and incorporates elements of relaxation and mental concentration.[4] Therefore, Tai-Chi exercises combine aspects of mind-body therapy and physical exercise.[4]

People practices Tai-Chi for several health-related purposes such as the benefits associated with low-impact activity, aerobic exercise, muscle strength, coordination or flexibility.[5-8] Furthermore, Tai-Chi practice improves balance, decreases the risk of falls, especially in old people, reduces pain and stiffness, improves sleep quality and increases overall wellness.[7,9]

In recent years, Tai-Chi practice has gained in popularity. A 2007 survey performed by the National Center for Health Statistics and the National Center for Complementary and Alternative Medicine analyzed the American use of Complementary and Alternative Medicine and they found that 1% of the sample (23,300 adults) had practiced Tai-Chi in the past 12 months.[7]

Tai-Chi practice has been deeply explored in old population samples[10-14] and we have found recent reviews on the topic.[15-18] In fact, the effects of Tai-Chi on psychological and psychosocial well-being,[19-20] breast cancer,[21] blood pressure,[22] osteoarthritis,[23] chronic musculoskeletal pain,[24] osteoporosis,[25] diabetes,[26] cardiovascular disease,[27] coronary heart disease,[28] rheumatoid arthritis,[29] or bone mineral density,[30] have been

further analyzed and reviewed in old people. However, to the best of our knowledge, the effects of Tai-Chiin adult population (18-65 years old) have not been deeply analyzed until date. The aim of the present systematic review is to critically appraise published clinical trials designed to assess the effects of Tai-Chi on physical fitness, psychological and diseases outcomes in adults aged 18-65 years old.

MATERIALS AND METHODS

Search strategy process

Literature research

The search was based on articles through November 2011 using electronic databases including Web of Science, Scopus, PubMed and Cochrane. Key words used were: Tai-Chi, exercise, adults, physical activity, fitness, benefits, health, and quality of life. Research terms used for our systematic review included different combinations: Tai-Chi-exercise; Tai-Chi-adults; Tai-Chi-physical activity; Tai-Chi-fitness; Tai-Chi-benefits; Tai-Chi-health, and Tai-Chi-quality of life. All titles and abstracts referred to Tai-Chi interventions in adult subjects aged 18-65 years old were pre-selected.

The search was conducted by two authors (AR, VA). The same two independent reviewers (AR, VA) read all the abstracts and a consensus meeting was arranged to sort out differences between them.

Articles were merged using End-Note X3 (Thompson USA) resulting in a total of 3.566 titles. Duplicates and abstracts, or studies focused on people aged over 65 years or aged lower to 18 years were excluded (3.476).After this preliminary step, a total of 90 studies were selected.

Inclusion and exclusion criteria

Studies were excluded if they belonged to any of the following categories: (1) case reports, letters or reviews; (2) not written in English or Spanish language; (3) based on technical Tai-Chi description; (4) methodological studies; (5) intervention was mixed (Tai-chi together with other practices); (6) not clearly showed the range of age (18-65 years old).

Following the above mentioned criteria were included all the studies developed from 1979 until November 2011 and performed in adults aged 18-65-yers-old that used Tai-Chi exercise as the main intervention. Finally, a total of 23 randomized controlled, non-randomized controlled, and uncontrolled trials met the whole inclusion criteria and were analyzed in the present review.

(Here Figure 1)

Data management and extraction

Information from each study was extracted and summarized: sample size and characteristics, methodological quality of the studies, frequency and duration of the intervention(s), the outcomes variable(s) used, results, and main relevant conclusions.

Methodological quality assessment

The methodological quality of the studies was evaluated based on the Jadad 3-items scale,[31] designed to assess whether a study describes randomization, blinding, and withdrawals/dropouts. The score for each article ranges from 0 to 5, where 2 points or less indicate low methodological quality and more than 2 points indicate high methodological quality.

RESULTS

Such as has been mentioned in the method section, for the best understanding of the present review, articles have been classified by topics:

Psychological outcomes.

Three studies have shown that Tai-Chi may be a clinically effective tool for reducing anxiety and depression levels in adults. Esch et al.[32] observed a significant reduction of salivary cortisol values in 9 Tai-Chi practitioners after 14 weeks of intervention. Moreover, the authorsobserved improvements in all the subscales of The Short Form Health Survey 36 (SF-36). In the study ofHoffmann-Smith et al.[33] after 10 weeks of Tai-Chi intervention, 19 volunteers diagnosed with moderate-severe anxiety demonstrated a high reduction in their anxiety levels. Finally, Dechamps et al.[34] observed that 10 weeks Tai-Chi intervention improved depression levels in 21 obese adult women.

In summary, Tai-Chi could be used as an alternative exercise intervention in order to reduce anxiety and depression levels. However, the overall methodological studies quality was poor and thus more randomized control trials with larger sample size and longer treatment periodsare needed.

Physical fitness.

Three studies have analyzed the effects of Tai-Chi on physical fitness in adult population.Jones et al.[35]reported beneficial physiologic effects in 51 subjects after 12 weeks of Tai-Chi intervention. The Tai-Chi group displayed improvements in handgrip strength, flexibility and peak expiratory flow rate.Hart et al.[36]examined the effects of

Tai-Chi in 18 community-dwelling subjects who had suffered strokes.After 12 weeks, the Tai-Chi group displayed improvements on general functioning, assessed by the Duke Health Profile. However, they did not find changes on balance or speed of walking in the Tai-Chi group, whereas the control group, which received physiotherapy exercises, displayed it. Finally, Tamin et al.[37] studied the effects of a work-place Tai-Chi intervention of 12 weeks on musculoskeletal fitness in 52 female university employees whose were computer users. The authors observed improvements in heart rate, handgrip strength and flexibility.

The authors of the present review consider that Tai-Chi practice might help to improve strength, flexibility and cardiovascular health in adult population. However, based on the low quality of the analyzed studies, the present findings should be taken with caution. Future studies about this topic should improve methodological quality, especially on designing a control group.

Bone mineral density.

In the study of Chan et la.[38] the authors compared a Tai-Chi exercise group with a sedentary control group. After 12 weeks, they observed that the Tai-Chi exercise intervention could delay bone loss in postmenopausal women. Bone mineral density measurements revealed a general bone loss in both Tai-Chi exercise and sedentary control groups at all measured skeletal sites, but with a reportedly slower rate in the Tai-Chi exercise group. In a posterior study,[39] the authors observed significantly greater bone mineral density in the neck of the proximal femur, ward´s triangle, and trochanter after 24 weeks of Tai-Chi intervention in 30 women with osteoarthritis. However, no changes were observed in the control group.

Tai-Chi could be used as an alternative exercise intervention in order to improvement bone mineral density. Nevertheless, the evidence for the effects of Tai-Chi for bone mineral density is limited and further studies are need.

(Here Table 1)

Immunodeficiency.

Four studies examined the effect of Tai-Chi intervention on immunodeficiency. In the study of Galantino et al.[40]carried out with patients with the human immunodeficiency virus, three groups were compared: Tai-Chi, aerobic exercise and control group. After 8 weeks, Tai-Chi and aerobic exercise groups improved physiological parameters, functional outcomes, and quality of life. The authors also highlighted the qualitative data, including: positive physical changes, enhanced psychological coping, and better social interactions. Similarly, after 10 weeks of Tai-Chi intervention in 59 patients with human immunodeficiency, Robins et al.[41] observed improvements on emotional and social well-being, quality of life, and on the frequent use of appraisal-focused coping.Yeh et al.[42] studied the effects of Tai-Chi on the regulatory T-cell function in 37 middle-aged volunteers. After 12 weeks, significant increases in the ratio of T-helper to suppressor cells and an increase in CD4CD25 regulatory T-cells were found. Finally, Yang et al.[43] reported beneficial immune effects in 23 healthy adults after 12 weeks of Tai-Chi intervention. The authors observed an increment in complement factor B concentrations, which is involved in the protection against microangiopathy and macular degeneration.

Moderate exercise, such as Tai-Chi, has been shown to have beneficial effects on immunity. However, most of the studies analyzed did not describe the sequence of randomization and did not specificity the number and reasons of withdrawal.

In summary, more rigorous randomized control trials with longer Tai-Chi interventions are required to determine the effects of Tai-Chi on the immune system.

Lipid profile.

In the study of Ko et al.[44] 10 weeks of Tai-Chi training reduced total cholesterol and low-density lipoprotein cholesterol concentrations in 20 healthy female. Similarly, in a posterior study, Lan et al.[50] found a reduction in triglyceride, total cholesteroland low-density lipoprotein cholesterol concentrations in patients with dislypidemia after 12 weeks of Tai-Chi intervention.

Despite these hazards, studies analyzing the effects of Tai-Chi on lipid profile are scarce and further randomized controlled trials are needed. The present findings should be replicated in future control trials with better methodological design, larger sample sizes, and longer exercise period.

Metabolic syndrome.

Liu et al.[45] evaluated the effects of Tai-Chi on indicators of metabolic syndrome and glycaemic control in 11 adults with raised blood glucose. They observed improvements on body mass index, waist circumference, diastolic and systolic blood pressure, fasting insulin and insulin resistance after 12 weeks of Tai-Chi intervention.

The small sample size together with the low methodological quality of the study make us to conclude that the evidence in not convincing enough to suggest that Tai-Chi is an effective treatment for metabolic syndrome. Future studies should design the same study with larger samples and a control group.

Tai-Chi effects on brain injury.

Blake and Batson.[46] examined the effects of a brief Tai-Chi exercise intervention on 20 individuals with traumatic brain injury.The authors compared such Tai-Chi exercise group with a non-exercise control group based on social and leisure activities.After 12 weeks, mood and self-esteem improved in the Tai-Chi group.

Tai-Chi may be an alternative exercise intervention for improving mood and self-esteem in adult patients with brain injury, but futures studies should confirm it.

Tension headaches.

After 15 weeks, Abbott et al.[47]observed improvements in favor of the Tai-Chi groupwhen compared to a control group in the Headache Status Score and the SF-36 pain, energy/fatigue, social functioning, emotional well-being and mental health subscales in 30 adults with tension headaches. The Tai-Chi intervention was effective also reducing headache impact and improving the perception of other physical and mental health outcomes.

Tai-Chi could be an alternative exercise intervention to improve quality of life and symptomatology in patients with tension headache. We have just found one study in adult population and thus evidence is not enough to conclude that Tai-Chi is effective for patients with tension headache.

(Here Table 2)

Cancer.

Janelsins et al.[48] observed a decreased in fat mass and an increased in fat-free mass in 19 breast cancer survivors after 12 weeks of Tai-Chi intervention. Furthermore, the

authors found that levels of insulin remained stable in the Tai-Chi group, while in the control group the levels of insulin increased.

More number of randomized control trials studying the effects of Tai-Chi on different types of cancers patients are needed for the better knowledge of Tai-Chi effects on cancer.

Cardiovascular health.

Lan et al.[49] evaluated the effects of Tai-Chi in 20 patients with coronary artery bypass surgery. The authors observed an increase in VO2 peak and peak work rate after 12 months.

Tai-Chi could be used as an alternative modality on treating patients with cardiovascular disease. These findings should be replicated in future studies with more completes methodological designs.

Type 2 Diabetes.

In the study of Chen et al.[51] Tai-Chi group and a conventional exercise groups were compared. After 12 weeks of Tai-Chi intervention, the authorsobserved improvements on body mass index, triglycerides, high-density lipoprotein cholesterol, malondialdehyde and C-reactive protein concentrations in 56 obese patients with type 2 diabetes. No changes were found in the studies variables in the conventional exercise group.

Whether Tai-Chi can reduce or prevent diabetic complications requires further rigorous studies with larger patient samples and longer treatment periods.

Ankylosing spondylitis.

Lee et al.[52] observed that 8 weeks of Tai-Chi interventionmight be beneficial for 13 patients with ankylosing spondylitis. Compared to the non-exercise control group, Tai-Chi groupdisplayed improvements in the Bath Ankylosing Spondylitis Disease Activity Index and Finger to Floor Distance.

Tai-Chi may be an alternative exercise intervention to improve physical fitness and symptomatology in patients with ankylosing spondylitis. However, evidence is scarce due to the short-time intervention period and low sample size of the analyzed study.

Multiple sclerosis.

Only one study has examined the effect of a Tai-Chi intervention on multiple sclerosis.[53] In such study, the authorsreported improvements on depression and tension-anxiety in 8 patients with multiple sclerosis after 8 weeks.

These findings should be replicated in future studies performed with better methodological design and larger samples sizes and time interventions

Fibromyalgia

Carbonell et al[54]evaluated the effects of 16 weeks of Tai-Chi intervention in 6 men with fibromyalgia. Among all the fitness and psychological outcomes analyzed the authors only observed significant changes in lower body flexibility, that increased. These findings should be replicated in future studies performed with larger samples sizes and with a control group.

(Here Table 3)

Methodological characteristics of the studies.

We have analyzed the methodological quality of the studies included in the present review. From the total sample of 23 studies justfive studies described how randomization was performed[34,40,46,39,48], seven studies were randomized but they did not describe how randomization was performed[41,36,38,49,51,47,52] and fifteen studies reported the causes of the dropout [32,34,36,37,40,42,49,50,51,46,47,52,39,48,54].Only five studies of the total sample were classified as high-quality trials[34,40,46,39,48]whereas the rest of studies were classified as poor-quality trials.

CONCLUSIONS

Tai-Chi exercise therapy might have beneficial effects on physical fitness, psychological and disease outcomes in adults.

In general, Tai-Chi interventions induced a positive effect on the majority of the subjects studied. To note is its effectiveness on improving physical fitness, psychological outcomes and immunodeficiency. Although the results suggest that Tai-Chi may be an effective therapy on cardiovascular health, cancer,bone mineral density, lipid profile, metabolic syndrome, tension headache, brain injury, ankylosing spondylitis, multiple sclerosis and fibromyalgia, further studies are needed to confirm these findings.

Tai-Chi is a form of risk-free exercise suitable for people aged 18-65 years whose can-not participates on high intensity physical activity. None of the reviewed studies reported any adverse events related with Tai-Chi or serious adverse effects. From author's point of view, the beneficial effects of Tai-Chi practice need further research with larger samples sizes and longer training periods.

In summary, the evidence for the effects of Tai-Chi in adults (18-65 years) is limited. The number of trials and the total sample sizes are too small to draw any firm conclusions. Furthermore, the findings of the present systematic review should be taken with caution due to the fact that the methodological quality of most of theanalyzed studies, included in the present review, was low.

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Table 1. Summary of studies of Tai-Chi on psychological outcomes, physical fitness and bone mineral density

Study	Jadad[a]	Design	*Subjects*	*Age(years)*	*Intervention*	Outcomes variables	Results
				Psychological status			
Esch et al. 2007.	1	Uncontrolled trial.	9 young adults.	21-37	90 min/week, for 14 weeks.	Salivary cortisol, perceived stress and significant events. Quality of life (SF-36). Blood pressure and heart rate.	Reductions of saliva cortisol ($p<0.05$). SF-36 showed increases in general health, vitality, social functioning and psychological well-being dimensions after intervention ($p<0.05$).
Hoffman Smith et al. 2009.	0	Uncontrolled trial.	19 patients diagnosed with moderate-severe anxiety.	18-65	60 min, 2 times /week, for 10 weeks.	Anxiety (Ham-A scale).	Ham-A scale showed improvements in the areas of anxious mood (84%), autonomic symptoms (79%), insomnia (68%), gastrointestinal symptoms (68%) and tension (74%). Reduction of depressed mood (63%) pains and bruxism (63%).
Dechamps et al.2008.	3	Randomized controlled trial.	21 women. A.11 B.10	44.4±11.9	A. Tai-Chi 120 min, 1 times/week, for 10 weeks. B. Structured exercise.	Depression (BDI-SF).	BDI-SF scores decreased in the two groups with a trend in favor of the A group.

				Physical fitness			
Jones et al. 2005.	0	Uncontrolled trial.	51 participants.	35-62	Tai-Chi. 90 min, 3 times/week, for 12 weeks.	Physical fitness (handgrip strength, flexibility, balance). Resting heart rate, blood pressure and oxygen saturation.	Increased in handgrip strength, flexibility and peak expiratory.
Hart et al. 2004.	2	Randomized controlled trial.	18 participants first-stroke survivors. A. 9 B. 9	45-65	A. Tai-Chi 60 min/week, for 12 weeks. B. Control.	Duke Health Profile Balance (Romberg Test of Balance, Berg Balance Test, Timed 'Up and Go', standing on the unaffected leg) and walking time in 5 environmental circumstances.	Improvements in the Duke Health Profile in general functioning (*p=0.08*) in A group. No changes in balance or speed of walking.
Tamin et al. 2009.	1	Uncontrolled trial.	52 female.	23–62	50 min/session, 2 times/week, for 12 weeks.	Musculoskeletal fitness (grip strength, sit and reach, vertical jump tests). Anthropometric measures (BMI, waist circumference).Resting heart rate and resting blood pressure.	Increased handgrip strength and flexibility. Decreased resting heart rate and waist circumference, no significant change was observed in BMI or in resting blood pressure.

				Bone mineral density			
Chan et al. 2004.	1	Randomized controlled trial.	132 healthy women. A. 67 B. 65	54.0±3.5	A. Tai-Chi. 45 min, 5 times/week, for 12 months. B. Control.	BMD was measured in the lumbar spine and proximal femur by using dual-energy x-ray absorptiometry and in the distal tibia by using multislicepQCT.	2.6-3.6%-f retardation of bone loss (*p<0.01*) measured by pQCT in both trabecular and cortical compartments of the distal tibia. BMD measurements revealed a reportedly slower rate general bone loss in A group.
Song et al. 2010	3	Randomized controlled trial.	65 women. A. 30 B. 35	A.63.03 ±7.27 B.61.20±7.96	A. Tai-Chi 20-65 min, for 24 week, every day. B. Control.	BMD was measured in the neck of the proximal femur, ward´s triangle and trochanter using dual-energy x-ray absorptiometry.	The changes in the BMD was significantly higher in the A group that in the B group in the femoral neck (*p<0.001*), ward's triangle (*p=0.002*), and trochanter *(p<0.001*).

SF-36: Short Form Health Survey 36; **Ham-A Scale**: Hamilton Anxiety Rating Scale;**BDI-SF:** Beck Depression Inventory Short Form;**BMI**: Body Mass Index;**BMD**: Bone Mineral Density;**pQCT**: Peripheral Quantitative Computed Tomography.
[a]Jadad 3-items scale. 2 points or less indicate low methodological quality and more than 2 points indicate high methodological quality.

Table 2. Summary of studies of Tai-Chi on immunodeficiency, cholesterol level, metabolic syndrome and glycaemic control, brain injury, and tension headache.

Study	Jadad[a]	Design	*Subjects*	*Age (years)*	*Intervention*	Outcomes variables	Results
				Immunodeficiency			
Galantino et al. 2005.	3	Randomized controlled Trial	38 subjects with human immunodeficiency virus. A. 13 B. 13 C. 12	20-60	A. Tai-Chi. 60 min, 2 times/week, for 8 weeks. B. Aerobic exercise. C. Control	Functional measured (functional reach for balance, sit and reach, sit-up test for endurance). Overall function (PPT). Quality of life (MOS-HIV). Spirituality well-being (SWB). Mood state (POMS).	Balance, flexibility and sit-up improved in A and B groups ($p<0.001$). A similar significance level was found in the C group in flexibility. A and B improved in the overall health perception subscale of MOS-HIV compared to C group ($p=0.04$). The POMS showed significant effect for time in confusion–bewilderment ($p<0.001$) and tension-anxiety (p=0.005) in A and B groups. SWB showed improvement in all three groups, with no significant differences.
Robins et al. 2006.	1	Uncontrolled trial.	59 subjects with human immunodeficiency virus.	42.3±8.3	Tai-Chi 60 min, 1 times/week, for 10 weeks.	Psychological distress (IES)	Improved on HIV-related psychological distress ($p\leq0.05$).

Yeh et al. 2006.	1	Uncontrolled trial.	37 middle-aged volunteers	55.41±1.77	60 min, 3 times/week, for 12 weeks.	Complete blood count, T lymphocyte subset and regulatory T cell mediators. Functional mobility (Timed 'Up and Go'). Expectations for exercise.	Decrease in monocyte count occurred (*p<0.001*). Increase in the ratio of T helper to suppressor cells (CD4:CD8) (*p<0.05*). Increase in CD4CD25 regulatory T cells (*p=0.015*). Tai-Chi exercise had a significant positive effect on functional mobility (*p=0.001*) and beliefs about the health benefits of exercise (*p=0.013*).
Yang et al. 2010	0	Uncontrolled trial.	23 healthy adults.	52.1±2.2	60 min, 3 times/week, for 12 weeks.	Proteomic markers (dimensional fluorescence gel electrophoresis). Protein spots (mass spectrometry).	Increased in complement factor H (*p=0.003*) associated with decreases in C1 esterase inhibitor (*p=0.004*) and complement factor B (*p=0.003*).

				Lipid profile			
Ko et al. 2006.	0	Uncontrolled trial.	20 Chinese healthy female.	40.8±5.9	60 min, 2 times/week, for 10 week.	Systolic blood pressure and lipid profiles.	Decreased total cholesterol and LDL-C (*p<0.001*).
Lan et al. 2008.	1	Controlled trial.	53 patients with dislypidemia. A. 28 B. 25	A. 52.8 ± 9.4 B. 50.1 ± 9.6	A. 54 min, 3 times/ week, for 12 months. B. Control	Anthropometric measures (BMI, waist, hip circumference). Systolic and diastolic blood pressure and resting heart rate. Fasting blood tests for glucose, glycosylated hemoglobin, insulin resistance, homeostasis model assessment, total cholesterol and triglycerides.	A group showed a decrease in triglyceride (*26.3%*), total cholesterol (*7.3%)* and in LDL-C *(11.9%).*
				Metabolic syndrome			
Liu et al. 2009.	0	Uncontrolled trial	11 patients with raised blood glucose levels	42-65	60–90min, 3times/week, for 12 weeks.	BMI, waist circumference, blood pressure, fasting blood glucose, triglycerides, high-density lipoprotein cholesterol). Glucose control (glycosylated hemoglobin, fasting insulin, insulin resistance).	Decreased BMI (*p<0.001*), waist circumference (*p<0.05*) and both systolic (*p<0.01*) and diastolic blood pressure (*p<0.001*). Decreased in glycosylated hemoglobin (*p<0.01*) and insulin resistance (*p<0.05*).

Brain injury							
Blake et al. 2009.	3	Randomized controlled trial.	20 patients with traumatic brain injury. A. 10 B. 10	A. 20-63 B. 30-62	A. 60 min/week, for 8 weeks. B. Control.	Mood (The General Health Questionnaire-12).Self-esteem, flexibility, coordination and physical activity (Physical Self-Description Questionnaire). Social support (The Social Support for Exercise Habits Scale).	Mood and self-esteem improvements ($p<0.05$). There were no significant differences in physical functioning between groups.
Tension headache							
Abbott et al. 2007.	2	Randomized controlled trials.	30 patients with tension headache A. 13 B. 17	23-64	A. 60 min, 2 times/week, for 15 weeks. B. Control.	Quality of life (SF-36). Headache impact (HIT-6™).	Improvements in Headache Status Score and the SF-36 in pain, energy/fatigue, social functioning and emotional well-being and mental health dimensions ($p<0.05$) in A group.

PPT: Physical performance test; **MOS-HIV:** Medical outcomes short form-human immunodeficiency virus, **SWB**: Spirituality Well-Being Scale; **POMS**: Profile of Mood States **IES**: Impact of Events Scale; **BMI**: Body Mass Index, **SF-36**: Short Form Health Survey 36; **HIT-6™**:Headache Impact Test;**LDL-C:**Low-density lipoprotein cholesterol.

[a]Jadad 3-items scale. 2 points or less indicate low methodological quality and more than 2 points indicate high methodological quality.

Table 3. Tai-Chi effects on cancer, cardiovascular health, type 2 diabetes, ankylosing spondylitis, multiple sclerosis and fibromyalgia.

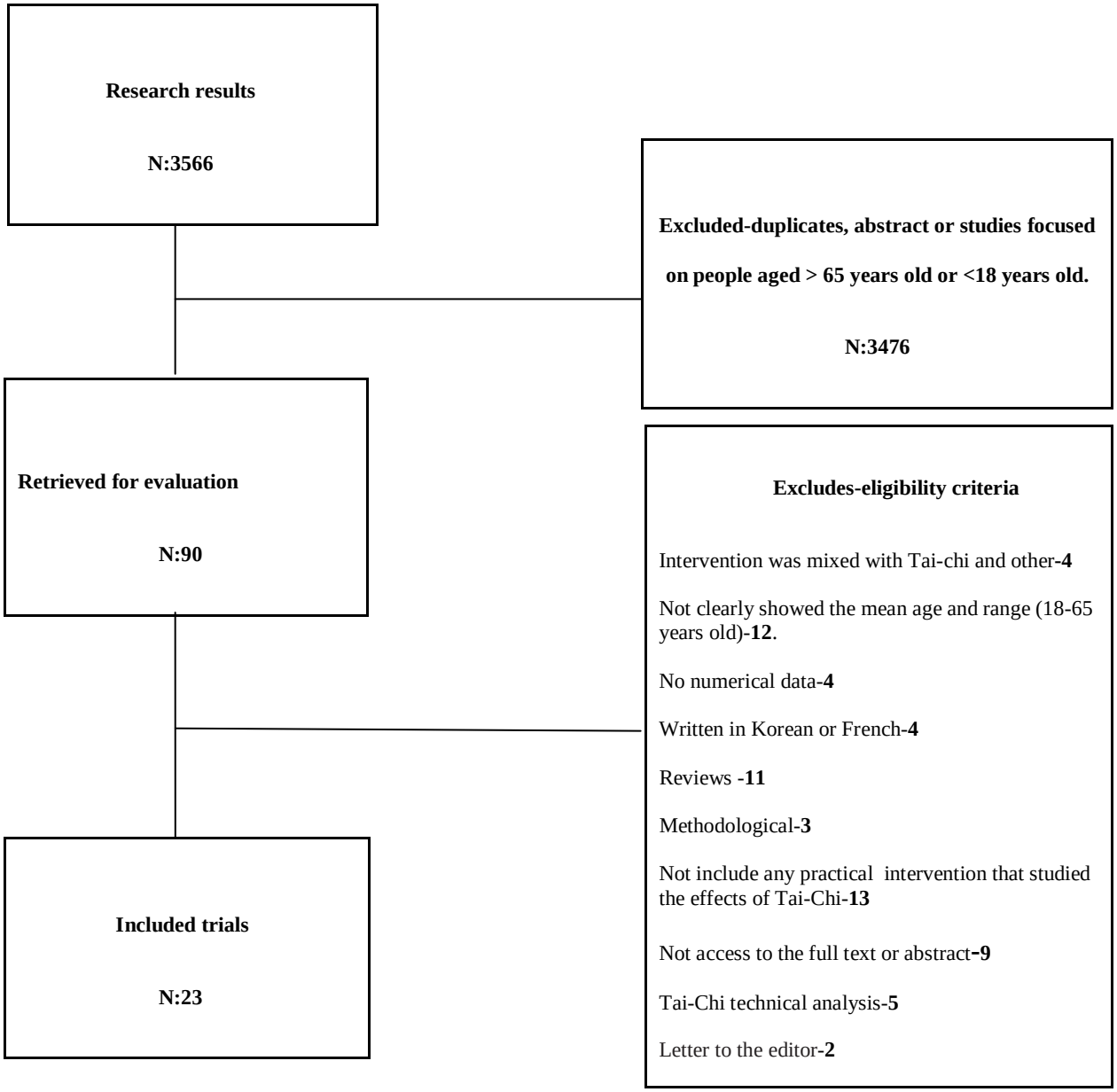
Study	**Jadad[a]**	**Design**	***Subjects***	***Age(years)***	***Intervention***	**Outcomes variables**	**Results**
				Cancer			
Janelsins et al. 2011.	3	Randomized controlled trial.	19 breast cancer survivors. A. Tai-Chi group B. Control group	A.54.33±10.64 B.52.70±6.67	60 min, 3 times/week for 12 weeks.	Serum concentrations of insulin (radioimmunoassay). IGF-I, IGFBP-I, and IGFBP-3 (immunoradiometric). Serum cytokines (OPT-EIA ELISA kits from BD Biosciences). Body composition (bioelectrical impedance analysis).	BMI decreased in A group and increased in B group (*p<0.10*). Fat mass decreased in A group and increased in B group. Fat-free mass decreased in A group and increased in B group. Insulin levels remained stable in the A group and increased in B group (*p=0.009*).
				Cardiovascular health			
Lan et al.1999.	2	Uncontrolled trial.	20 patients with coronary artery bypass surgery.	56.5 ± 7.4	54 min, every morning for 12 months.	Blood pressure, ventilator threshold, heart rate and exercise intensity.	10% VO2 peak increasing (*P<0.01*) and 12% in peak work rate (*P<0.01*).

				Diabetes type 2			
Chen et al. 2010.	2	Randomized controlled trial.	104 patients with type 2 diabetes. A. 56 B. 48	A.59.1±6.2 B. 57.±5.8	A. Tai-Chi60 min, 3 times/week, for 12 weeks. B. Aerobic dance.	Hemoglobin A1C, serum lipid profile, serum malondialdehyde and C-reactive protein were measured. BMI.	Improvements in A group on triglyceride (*p=0.012*), high density lipoprotein cholesterol (*p=0.023*) Serum Malondialdehyde (*p=0.035*) and in C-reactive protein (*p=0.014*).
				Ankylosing spondylitis			
Lee et al. 2008.	2	Randomized controlled trial.	30 patients with ankylosing spondylitis. A. 13 B. 17	A.35.2±11.5 B. 34.9±12	A. Tai-Chi 60 min, 2 times/week, for 8 weeks. B. Control.	Ankylosing spondylitis symptoms measured (BASDAI). Flexibility (finger to floor distance). Depression (CES-D).	Improves on BASDAI (*p<0.01*) and on finger to floor distance (*p<0.01*) in A group.

				Multiple sclerosis			
Mills et al. 2000	0	Uncontrolled trial.	8 patients with multiple sclerosis	42±56	Tai-Chi 8 weeks.	Anxiety, Depression (POMS)	Decreased in depression scores and in tension-anxiety.
				Fibromyalgia			
Carbonell et al. 2011	0	Uncontrolled Trial	6 patients with fibromyalgia	52.3±9.3	Tai-Chi 60 min, 3 times/week, for 16 weeks.	BMI. Tender points (Standard pressure algometer). Physical fitness (6 m walking test, Timed 'Up and Go, grip strength, sit and reach , 30-second chair stand, back scratch, blind flamingo) Psychological outcomes (FIQ) (SF-36), (HADS), (VPMI).	Improvements on chair sit and reach (p=0.028).

CES-D:Center for Epidemiologic Studies Depression Scale; **FACT-G**:Functional Assessment of Cancer Therapy-Genera; **BMI**: Body Mass Index; **SF-36**: Short Form Health Survey 36; **BASDAI**: Bath Ankylosing Spondylitis Disease Activity Index; **POMS**: Profile of Mood State; **FIQ**: Fibromyalgia Impact Questionnaire; **HADS:** Hospital Anxiety and Depression Scale**; VPMI:** Vanderbilt Pain Management Inventory;
[a]Jadad 3-items scale. 2 points or less indicate low methodological quality and more than 2 points indicate high methodological quality.

Figure 1- Flow chart of the trial selection process



Efectos de un programa de intervención con Taichisobre el grado de dolor, función física, calidad de vida relacionada con la salud y variables psicológicas en hombres con fibromialgia.

(Artículos II-III)

Artículo II

Preliminary Findings of a 4-Month Taichi Intervention on Tenderness, Functional Capacity, Symptomatology, and Qualityof Life in Men with Fibromyalgia.

Ana Carbonell-Baeza, Alejandro Romero, Virginia A. Aparicio, Francisco B. Ortega, Pablo Tercedor, Manuel Delgado-Fernández, Jonatan R. Ruiz.

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Artículo III

T'ai-Chi Intervention in Men with Fibromyalgia: A Multiple-Patient Case Report.

Ana Carbonell-Baeza, Alejandro Romero, Virginia A. Aparicio, Francisco B. Ortega, Pablo Tercedor, Manuel Delgado-Fernández, Jonatan R. Ruiz.

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Beneficios de la práctica del Taichi sobre el grado de dolor, función física, calidad de vida relacionada con la salud y variables psicológicas en mujeres con fibromialgia.
(Artículos IV-V)

Artículo IV

A 12 week Tai-Chi intervention in women with fibromyalgia improvesfunctional capacity, quality of life and symptomatology.

Alejandro Romero-Zurita, Ana Carbonell-Baeza,Virginia A. Aparicio, Jonatan R.Ruiz, Pablo Tercedor, Manuel Delgado-Fernández.

Submitted

A 12 week Tai-Chi intervention in women with fibromyalgia improves functional capacity,quality of life and symptomatology.

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Abstract

BACKGROUND: Tai-Chi has gained popularity as an alternative form of exercise, especially in disease people. The purpose of this study was to analyze the effects of a 3-month Tai-Chi intervention on functional capacity, symptomatology and psychological outcomes in women with fibromyalgia (FM).

MATERIALS AND METHODS: A controlled trial was conducted from November 2009 through February 2010. Sixty-eightwomen with FM (mean age, 51.6±6.9 years) were allocated to a 3-month Tai-Chi intervention group (3times/week) (n=34) or to a usual care group (n=34). The outcomes variables studied were tender points, body fat, (body mass index and waist circumference), functional capacity, (30-s chair stand, handgrip strength, chair sit&reach, back scratch, blind flamingo, 8-feet up&go, and 6-min walk test) and psychological outcomes (Fibromyalgia Impact Questionnaire (FIQ), Short Form Health Survey 36 (SF-36), Vanderbilt Pain Management Inventory (VPMI), Hospital Anxiety and Depression Scale (HADS), General Self-Efficacy Scale, and Rosenberg Self-Esteem Scale (RSES).

RESULTS: Tai-Chi group had greater improvements on chair sit&reach ($P<0.001$), chair stand ($P<0.001$), 8-feet up&go ($P<0.001$) and blind flamingo ($P=0.003$) tests, as well as in FIQ total score ($P<0.001$) and in five FIQ-subscales: feel good ($P<0.001$), pain ($P=0.005$), fatigue ($P=0.003$), anxiety ($P=0.006$) and, depression ($P=0.006$) in the Tai-Chi group. Tai-Chi intervention was also effective on SF-36-vitality ($P=0.021$), SF-36-social functioning ($P=0.003$) and self-esteem ($P<0.001$).

CONCLUSIONS: This study found that 3 months of Tai-Chi intervention improved functional capacity, quality of life and symptomatology in female FM patients.

Introduction

Fibromyalgia (FM) is a chronic syndrome characterized by widespread non-articular musculoskeletal pain[1]. The syndrome is also often associated with other symptoms such as debilitating fatigue, sleep disturbance and joint stiffness[1-2], and patients may also experience conditions such as anxiety, depression and cognitive difficulties[2-3]. Furthermore, patients with FM usually report higherfunctional disability and impact in their quality of life[4-5].

Interest in non-pharmacological management of the FM has increased in last years[6-9], with several treatment modalities including exercise programs[7-8]. Physical exercise with low mechanical impact such as low-impact aerobics, walking, or water aerobics has frequently been recommended in the treatment of FM[9-10].

Tai-Chi is a balance exercise that integrates key components of exercise training, cardiorespiratory function, strength, balance and flexibility[11-12].The intensity of Tai-Chi is low and equivalent to walking 6 km/h, with a moderate increase in heart rate[13]. During Tai-Chi practice, diaphragmatic breathing is coordinated with graceful motions to achieve mind tranquility[11].Tai-Chi seems to benefits in patients with chronic rheumatic conditions, such as rheumatoid arthritis and osteoarthritis[14-15]. Three studies have analyzed the benefit of Tai-Chi in women with FM[16-18] and more studies are needed to confirm such results.

The purpose of this control trial was to determine the effectiveness of a 12-week Tai-Chi intervention on pain, functional capacity and psychology outcomes in women with FM.

Materials and Methods

Study participants

We contacted with two local associations of patients with FM (Granada and Motril, Spain). Seventy-nine potentially eligible patients responded, and gave their written informed consent after receiving detailed information about the aims and study procedures. The inclusion criteria were: (i) meeting the American College of Rheumatology (ACR) criteria: widespread pain for more than 3 months and pain with 4 kg/cm of pressure for 11 or more of 18 tender points[1]; (ii) not to have other severe somatic or psychiatric disorders, such as stroke or schizophrenia, or other diseases that prevent physical loading; and (iii) no to be attending another type of physical therapy at the same time. A total of 5 patients were not included in the study because they did not have 11 of the 18 tender points. After the baseline measurements, 6 patients refused to participate due to incompatibility with job schedule. Therefore, a final sample of 68 women with FM participated in the study. Patients were not engaged in regular physical activity >20 minutes on >3 days/week.

The study flow of patients is presented in Figure 1.

Study design

We had an ethical obligation with the associations of fibromyalgia patients (Granada and Motril, Spain) to provide treatment to all patients willing to participate in the study, but due to limitation of resources, we only could offer the intervention in a particular schedule. Those patients that could attend the intervention in that schedule were

allocated in the intervention group (n=34) and the other patients that due to work or family commitment could not attend were allocated in the control group (n=34).

The research protocol was reviewed and approved by the Ethics Committee of the *Virgen de las NievesHospital* (Granada, Spain). The study was carried out between November 2009 and February 2010, following the ethical guidelines of the Declaration of Helsinki, last modified in 2000.

Intervention

The Tai-Chi program was based on the classical Yang Style. The characteristics of Yang Tai-Chi are: extended and natural postures, slow and even motions, light and steady movements, and curved, flowing lines of performance[19]. Patients participated in three 60-minute Tai-Chi sessions conducted weekly for 12 weeks. Each session included: 15 minutes of warm up with stretching, mobility and breathing techniques; 30 minutes of Tai-Chi exercises principles and techniques and finally, 15 minutes of various relaxation methods. The intervention consisted of 8 forms from Yang Style Tai-Chi, with minor modifications that were suitable for patients with FM. For example, the first month some exercises were realized with the participants sitting to avoid too much fatigue.

Classes were taught by a Tai-Chi master with teaching experience. The first two weeks of the intervention were focused on learning fundamental movement patterns. In subsequent sessions, patients practiced 8-Form, Yang Style Tai-Chi under master supervision.

Outcomes measures

Pre- and post intervention assessment were carried out on 2 separate days with at least 48 hours between each session. This was done in order to prevent patient's fatigue and flare-ups (acute exacerbation of symptoms). The assessment of the tender points, blind flamingo test, chair stand test, and psychological outcomes were completed on the first visit. Body composition and the chair sit&reach, back scratch, 8-feet up&go, handgrip strength, and 6-min walk tests were performed on the second day.

Tender points assessment

We assessed 18 tender points according to the American College of Rheumatology criteria for classification of FM using a standard pressure algometer (EFFEGI, FPK 20, Alfonsine, Italy)[1]. The mean of two successive measurements at each tender point was used for the analysis. Tender point scored as positive when the patient noted pain at pressure of 4 kg/cm^2 or less. The total count of such positive tender points was recorded for each participant. Analgometer score was calculated as the sum of the minimum pain-pressure values obtained for each tender point.

Body composition and anthropometric assessment

We performed a bioelectrical impedance analysis with an eight-polar tactile-electrode impedanciometer (InBody 720, Biospace). The validity of this instrument was reported elsewhere[20-21]. Height (cm) was assessed using a stadiometer (Seca 22, Hamburg, Germany), body mass index (BMI) was calculated as weight (in kilograms) divided by height (in meters) squared. Waist circumference (cm) was measured with the participant standing at the middle point between the ribs and ileac crest (Harpenden anthropometric tape Holtain Ltd)

Functional capacity

To assess functional capacity we used the "Senior Functional Fitness Test Battery[22]. Additionally, we also measured the handgrip strength and the blind flamingo test, which have been used in patients with FM[23]. The fitness test battery was administered by a trained physical therapists and sport scientists.

Lower-body muscular strength. The "30-s chair stand test" involves counting the number of times within 30 s that an individual can rise to a full stand from a seated position with back straight and feet flat on the floor, without pushing off with the arms[22]. The patients carried out 1 trial after familiarization.

Upper-body muscular strength. "Handgrip strength" was assessed using a digital dynamometer (TKK 5101 Grip-D;Takey, Tokyo, Japan) as described elsewhere[24]. Patient performed (alternately with both hands) the test twice allowing a 1-minute rest period between measures. The best value of 2 trials for each hand was chosen and the average of both hands was registered.

Lower-body flexibility.In the "chair sit & reach test", the patient seated with one leg extended, slowly bends forward sliding the hands down the extended leg in an attempt to touch (or past) the toes. The number of centimeters short of reaching the toe (minus score) or reaching beyond it (plus score) are recorded[22]. Two trials with each leg were measured and the best value of each leg was registered, being the average of both legs used in the analysis.

Upper-body flexibility. The "back scratch test", a measure of overall shoulder range of motion, involves measuring the distance between (or overlap of) the middle fingers behind the back[22]. This test was carried out alternately with both hands twice and the best value was registered. The average of both hands was used in the analysis.

Static balance. It was assessed with the blind flamingo test[25]. The number of trials needed to complete 30 s of the static position is recorded, and the chronometer is stopped whenever the patient does not comply with the protocol conditions. One trial was accomplished for each leg and the average of both values was selected for the analysis.

Motor agility/dynamic balance. The "8 ftup&go test" involves standing up from a chair, walking 8 ft to and around a cone, and returning to the chair in the shortest possible time[22]. The best time of two trials was recorded and used in the analysis.

Aerobic endurance. We assessed the "6-min walk test". This test involves determining the maximum distance (meters) that can be walked in 6 min along a 45.7 meters rectangular course[22,26].

Psychological outcomes

Symptomatology was assessed by means of the Spanish version of the Fibromyalgia Impact Questionnaire (FIQ)[27]. The FIQ contains 10 subscales of disabilities and symptoms, ranging from 0 to 10. A total score may be obtained after normalization of some subscales and summing the subscales. The FIQ total score, range from 0 to 100, in which a higher score indicates a greater impact of the syndrome. The total score, and the subscales for physical function, feel good, pain, fatigue, morning tiredness, stiffness, anxiety, and depression were applied in the study.

Quality of life was assessed by means of the Spanish version of the Short-Form Health Survey 36 (SF-36)[28]. The SF-36 contains 36 statement grouped into 8 subscales: physicalfunctioning, physical role, bodily pain, general health, vitality, social functioning, emotional role, and mental health. The range of scores goes between 0 and 100 in every subscale, in which higher scores indicate better health.

The Spanish version of the Hospital Anxiety and Depression Scale (HADS)[29] was used to assess anxiety and depression. The HADS contains 14 statements, ranging from 0 to 3, in which a higher score indicates a higher degree of distress. The scores build 2 subscales: anxiety (0-21) and depression (0-21)[30].

The Spanish version of the Vanderbilt Pain Management Inventory (VPMI)[31] was used to assess coping strategies. The VPMI contains18 statements divided into two subscales designed to assess how often chronic pain sufferers use active and passive coping strategies[32].

The Rosenberg Self-Esteem Scale (RSES)is a self-report measure designed to assess the concept of global self-esteem[33-34].The RSES comprises just 10 items scored on a 4-point scale that are summed to produce a single index of self-esteem. In this study we used the Spanish version[34].

The Spanish version of the General Self-Efficacy Scale[35] was uses to assess the individual beliefs in her/his own capabilities to attain aims. This instrument contains 10 items scored on a 4-point Likert scale from 1 (not at all true) to 4 (exactly true). In this case, higher scores indicate a higher level of perceived general self-efficacy.

Statistical analysis

Independent t test and chi-square test were used to compare demographic variables between groups. To investigate the intervention effect, the change score was calculated by subtracting the score at pretest from that at postest (postest-pretest). Then, the difference in change score between groups was examined using analysis of covariance (ANCOVA) with age and pretest score (for each variable) entered as covariables. We conducted a per-protocol analysis to study the participants who complied with the study

protocol, which was defined as attendance at least 70% of the sessions. Analyses were performed using the Statistical Package for Social Sciences (SPSS, v. 16.0 for WINDOWS; SPSS Inc, Chicago).The differences were considered significant for P <0.05.

Results

Four women from the intervention group discontinued the program due to family and work commitments, and personal problems, and another two were not included in the final analysis for attending less than 70% of the program (attendance: 58%). Adherence to the intervention was 84% (range 70-100%). A total of 28 (82%) women from the intervention group and 32 (94%) from the usual care group completed the 3-month follow –up and were included in the final analysis. (See figure 1).

During the study period, no participant reported an exacerbation of the FM symptoms beyond normal flares, and there were no serious adverse events. No women changed from the control group to the intervention group or *vice versa*, and there were no protocol deviations from the study, as planned.

Sociodemographic characteristics of women with FM by group are shown in Table 1. We observed differences between groups on educational status (P=0.009). The effectsof Tai-Chi intervention on pain are shown in Table 2. The scores (post-pre) were not different between the two groups in pain threshold of tender point, tender points count and algometer score with the exception of change score on the left side of the trapezius (P=0.032) and second rib tender point (P=0.005). The intervention group showed an increase in the pain threshold whereas control group showed a decrease in pain threshold in both tender points.

Differences between pre and post from baseline to the 12 weeks in physical functional capacity assessment also differed significantly between the two groups (Table 3; change score). The Tai-Chi group had greater improvements on the chair sit&reach (P<0.001), chair stand (P<0.001), 8 feet up&go (P<0.001) and blind flamingo (P=0.003) tests.

Tai-Chi intervention was also effective on FM symptomatology (Table 4). Tai-Chi group had a significantly greater decrease (positive) in FIQ total score (P<0.001) and in five subscales from the FIQ: feel good (P<0.001), pain (P=0.005), fatigue (P=0.003), anxiety (P=0.006) and depression (P=0.006) than did the control group.

At week 12, the Tai-Chi group had greater improvements when compared to the control group in SF-36 vitality (P=0.021), social functioning (P=0.003) and self-esteem (P<0.001), (Table 5).

Discussion

The main finding of the present study is that a 3-month Tai-Chi intervention improved lower body flexibility, lower body strength, dynamic balance and static balance in female FM patients. Improvements were also observed on symptomatology, vitality, social functioning and self-esteem. The program was well tolerated and did not have any deleterious effects on the patients´ health. The results extend previous observations and suggest that Tai-Chi might be a safety and promising complementary therapy for women with FM.

In the present study, we analyzed the effects of Tai-Chi intervention in variables that have not been previously explored in female FM patients, as tender points, balance, flexibility or strength. We did not find improvement on the tender points; similarly, in a previous study[18], we did not observe improvements on tender points after 3-months of

Tai-Chi intervention in men with FM. On the other hand, we have observed improvements on lower body flexibility, lower body strength, dynamic balance and static balance. These results support the use of Tai-Chi exercise as a suitable intervention on female FM patients with reduced muscular strength[36-37], balance[38] or flexibility[5]. In a previous study, we observed improvements in lower flexibility after 3-months of Tai-Chi intervention in men with FM, but not in others physical functional capacity outcomes[18].

The results of the present studyconcur with other studies that have analyzed the effects of Tai-Chi intervention in other pain chronic conditions[14-15,39]. Lee et al[39], studied the effects of a 8-week Tai-Chi intervention (2 times/week) in adult with ankylosing spondylitis and observed improvements on low body flexibility. Wang et al[15], reported improvements on lower body strength after a 12-week Tai-Chi intervention (2 times/week) in patients with knee osteoarthritis, however, they did not observe significant improvements in the 6 min-walk test. Accordingly to Wang et al[15]and to our results, Uhlig et al[14], investigated the effects of a 12 weeks Tai-Chi intervention (2 times/week) in patients with rheumatoid arthritis and also observed improvements in the lower body muscular strength.

The better lower body strength observed after the Tai-Chi intervention in our patients with FM might be explained by the degree of flexion at the hips and knees performed during Tai-Chi practice[40]. Furthermore, Tai-Chi practice involves a series of movements that carried out as a continuous sequence causing that the body to constantly shift weight from one foot to the other as rotational movements of the head, trunk, and extremities[41-42]. The later, could also, be related with the improvements observed on balance and low body flexibility in our FMpatients.

To note is that we did not observe improvements in the 6-min walk test (21 meters), as was expected due the fact that Tai-Chi exercise is considered an aerobic exercise form[12]. Indeed, Wang et al[16], observed improvements in the distance walked after 3 months of Tai-Chi intervention in women with FM. The different methodology of the Tai-Chi intervention developed for the mentioned study might explain this contradictory result. In the study of Wang et al[16] despite the intervention took place twice a week for 12 weeks, throughout the intervention period, participants were instructed to practice Tai-Chi at home for at least 20 minutes each day.

We observed improvements in the FIQ totalscoreand in five subscales: feel good, pain, fatigue, anxiety and depression, as well as, in SF-36 vitality and social functioning. These results concur with previous studies in which Tai-Chi exercise was found to be effective in improving the symptoms and quality of life of women with FM[16-17]. Taggart et al[17], reported significant changes on 6 subscales from the FIQ (physical function, feel good, pain, morning tiredness, stiffness and anxiety) and in 5 subscales from the SF-36 (physical functioning, bodily pain, general health, vitality and emotional role) after 6 weeks of Tai-Chi intervention (2 times/week).

A recent study[16], analyzed the effects of 12-week Tai-Chi intervention (2 times/week) in women with FM (49.7±11.8 years) and the authors found improvements in the FIQ total score whenTai-Chi intervention group was compared with a control intervention group consisting in wellness education group and stretching.

We observed significant changes on self-esteem, which concurs with results obtained by others studies carried out with brain injury and breast cancer patients[43-44]. Blake et al[43], observed better self-esteem in patients with brain injury after an 8 weeks (1 times/week)

Tai-Chi intervention. Similarly, Mustian et al[44], found improvements on self-esteem after a 12 weeks (3 times/week) Tai-Chi intervention in patients with breast cancer.

We were not able to randomize the participant into the intervention group and control group is a limitation of our study. On the other hand, we have assessed a large range of physical and psychological outcomes, which are very limited in other studies.

Tai-Chi intervention in patients with FM need further research, especially focused in the effect of this intervention on the tender points count, physical function and self-esteem to confirm our results.

Conclusion.

The present study findings indicate that Tai-Chi may be a useful and feasible treatment in the management of FM because of the positive changes observed in women with FM as well as the minimum requirement and cost on equipment and space needed. Further studies should help to better understand the usefulness of this therapy in FM patients.

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Table 1-Sociodemographic characteristics of women with FM

	Usual-caregroup (n=34)	Interventiongroup (n=34)	P
Age, years	51.6 (7.3)	51.6 (6.5)	1.000
Years since clinical diagnosis, n(%)[a]			0.455
≤5 years	16 (47.1)	18 (56.3)	
> 5 years	18 (52.9)	14 (43.8)	
Marital Status,n(%) [b]			0.087
Married	24 (70.6)	30 (90.9)	
Unmarried	6 (17.6)	1 (3.0)	
Separated/divorced/widowed	4 (11.8)	2 (6.1)	
Educational status, n(%)[c]			0.009
Unfinished studies	2 (5.9)	4 (12.1)	
Primary school	11(32.4)	21(63.6)	
Secondary school	9 (26.5)	6 (18.2)	
University degree	12(35.3)	2 (6.1)	
Occupational status,n(%)[d]			0.393
Housewife	14(45.2)	19 (61.3)	
Working	11(35.5)	6 (19.4)	
Unemployed	2 (6.5)	3 (9.7)	
Retired	4(12.9)	2 (6.5)	
Income,n(%)[e]			0.676
<1200,00€	16(47.1)	15 (57.7)	
1200,00-1800.00€	7 (20.6)	5 (19.2)	
>1800,00€	11 (32.4)	6 (23.1)	
Menstruation, n(%)[f]			
Yes	11(32.4)	10 (31.3)	0.923
No	23(67.6)	22 (68.8)	

a: two missing in the intervention group.
b: one missing in the intervention group.
c: one missing in the intervention group
d: four missing in the intervention group and three in the usual care group.
e: eight missing in the intervention group.
f: two missing in the intervention group

Table 2. Effects of 12-week Tai-Chi intervention on tender points.

	N	Pre	N	Post	N	Change score (Post-Pre)*
Occiput R						
Control	34	2.88 (0.65)	32	2.39 (0.51)	32	-0.46 (0.62)
Intervention	34	1.56(0.60)	28	2.08 (0.75)	28	0.43 (0.93)
P (groups)		<0.001		0.058		0.928
Occiput L						
Control	34	2.85 (0.69)	32	2.39± 0.58	32	-0.46 ± 0.61
Intervention	34	1.66 ±0.61	28	2.29 ± 1.21	28	0.53 ± 1.24
P (groups)		<0.001		0.684		0.210
Anterior cervical R						
Control	34	2.35 ±0.80	32	1.84 ± 0.66	32	-0.53±0.64
Intervention	34	1.22 ±0.40	28	1.51 ±0.58	28	0.25±0.58
P (grupos)		<0.001		0.032		0.284
Anterior cervical L						
Control	34	2.19 ± 0.78	32	1.86± 0.63	32	-0.35±0.60
Intervention	34	1.12 ± 0.31	28	1.50 ± 0.53	28	0.29±0.43
P (groups)		<0.001		0.017		0.207
Trapezius R						
Control	34	2.97 ±0.88	32	2.63 ± 0.88	32	-0.34±0.59
Intervention	34	1.78±0.67	28	2.26 ± 0.75	28	0.40±0.88
P (groups)		<0.001		0.080		0.164
Trapezius L						
Control	34	3.16 ±0.85	32	2.75 ± 0.84	32	-0.42±0.58
Intervention	34	1.75 ±0.74	28	2.38 ± 0.71	28	0.58±0.87
P (groups)		<0.001		0.091		**0.032**
Supraspinatus R						
Control	34	3.37 ±0.90	32	3.06 ± 0.96	32	-0.31±0.85
Intervention	34	1.84 ±0.97	28	2.52 ± 0.92	28	0.54±1.15
P (groups)		<0.001		0.036		0.670
Supraspinatus L						
Control	34	3.46 ±0.84	32	3.16 ± 0.94	32	-0.30±0.75
Intervention	34	1.93 ±0.98	28	2.62 ± 0.99	28	0.55±1.22
P (groups)		<0.001		0.037		0.564
Second rib R						
Control	34	2.26 ±0.55	32	2.15 ± 0.74	32	-0.09±0.69
Intervention	34	1.51 ±0.53	28	2.06 ± 0.68	28	0.48±0.68
P (groups)		<0.001		0.608		0.069
Second rib L						
Control	34	2.31±0.57	32	2.05 ± 0.76	32	-0.22±0.53
Intervention	34	1.45 ±0.49	28	2.08 ± 0.67	28	0.58±0.73
P (groups)		<0.001		0.885		**0.005**

Lateral epicondyle R						
Control	34	2.65 ±0.61	32	2.43 ± 0.83	32	0.63±0.99
Intervention	34	1.83 ±0.69	28	2.50 ± 0.85	28	-0.21±0.79
P (groups)		<0.001		0.840		0.140
Lateral epicondyle L						
Control	34	2.76 ±0.71	32	2.53 ± 0.79	32	-0.24±0.87
Intervention	34	1.84 ±0.76	28	2.63 ± 0.89	28	0.73±1.04
P (groups)		<0.001		0.613		0.102
Gluteal R						
Control	34	2.89 ±0.88	32	3.13 ± 1.08	32	0.26±0.97
Intervention	34	1.81 ±0.85	28	2.72 ± 0.78	28	0.86±1.12
P (groups)		<0.001		0.095		0.936
Gluteal L						
Control	34	3.02 ±1.02	32	3.34 ± 1.03	32	0.35±0.97
Intervention	34	1.96 ±0.86	28	2.84 ± 0.73	28	0.84±1.15
P (groups)		<0.001		0.040		0.541
Great trochanter R						
Control	34	2.88 ±0.89	32	2.93 ± 0.83	32	0.06±0.87
Intervention	34	1.86 ±0.74	28	2.87 ± 0.73	28	0.96±0.96
P (groups)		<0.001		0.805		0.231
Great trochanter L						
Control	34	2.97 ±0.85	32	3.06 ± 0.98	32	0.09±0.84
Intervention	34	1.94 ±0.88	28	2.67 ± 0.67	28	0.68±1.14
P (groups)		<0.001		0.092		0.830
Knee R						
Control	34	2.67± 0.81	32	2.76 ± 0.89	32	0.68±0.76
Intervention	34	1.62 ±0.68	28	2.37 ± 0.75	28	0.12±0.98
P (groups)		<0.001		0.086		0.954
Knee L						
Control	34	2.65 ±0.89	32	2.78 ± 0.92	32	0.17±0.81
Intervention	34	1.66 ±0.68	28	2.39± 0.76	28	0.67±0.73
P (groups)		<0.001		0.097		0.460
Algometer score						
Control	34	50.27±10.31	32	47.26 ± 11.11	32	-2.89±8.00
Intervention	34	30.41±10.64	28	42.26 ± 11.34	28	10.69±13.22
P (groups)		<0.001		0.097		0.118
Total number of points						
Control	34	16.26 ± 2.34	32	16.34 ± 2.30	32	0.13±1.81
Intervention	34	17.85 ± 0.44	28	17.71± 0.71	28	-0.11±0.86
P (groups)		<0.001		0.005		0.471

Data are means and (standard deviations), unless otherwise stated. Co-varianza analysis (ANCOVA) one factor (dependent variable=post-pre differences, fixed factor=group). Comparisons were performed using the Bonferroni adjustment.* P values are adjusted by age and pretest score.

Table 3. Effects of 12 week Tai-Chi intervention on physical function.

	N	Pre	N	Post	N	Difference (Post-Pre)*
Weight (kg)						
Control	33	67.01±12.36	31	68.45±12.52	30	0.22±0.46
Intervention	34	70.32±13.08	28	70.26±12.84	26	0.24±2.15
P (groups)		0.264		0.662		0.368
Waist circumference (cm)						
Control	33	85.71±12.11	30	86.05±10.82	29	-1.68±4.53
Intervention	34	91.00±16.21	28	88.77±11.16	26	-2.72±9.96
P (groups)		0.097		0.367		0.756
BMI (kg/m2)						
Control	33	27.32 ±5.81	30	28.05±5.79	29	0.12±0.78
Intervention	34	28.61±5.37	26	28.72±5.11	24	0.23±1.29
P (grupos)		0.288		0.696		0.745
Chair sit&reach (cm)						
Control	32	-11.23±12.78	31	-14.79±17.59	29	-2.78±15.60
Intervention	34	-12.37±14.26	28	-2.82±13.74	26	9.49±10.95
P(groups)		0.705		P=0.005		<**0.001**
Back scratch test (cm)						
Control	32	-6.14±10.56	29	-9.55±12.91	27	-2.08±8.18
Intervention	34	-10.49±11.80	27	-11.41±12.33	27	-0.85±5.01
P (groups)		0.096		0.682		0.665
Handgrip strength (kg)						
Control	33	16.17±6.56	30	17.38±6.17	29	1.55±4.32
Intervention	33	16.12±6.22	28	17.19±6.26	27	1.21±5.05
P (groups)		0.968		0.910		0.985
Chair stand test (n)						
Control	30	7.17±2.80	32	8.06±2.61	28	0.82±1.68
Intervention	28	7.32±2.31	26	9.85±2.78	23	2.74±2.51
P (groups)		0.871		0.014		<**0.001**
8-feet up&go (s)						
Control	32	8.18±2.06	31	7.78±1.62	29	-0.50±1.12
Intervention	34	8.93±2.93	27	6.51±1.88	27	-2.21±2.35
P (groups)		0.226		0.010		<**0.001**
30-s blind flamingo (failures)						
Control	26	9.61±4.05	33	10.86±4.98	25	0.92±4.55
Intervention	31	10.45±6.19	26	7.56±4.73	25	-2.58±3.39
P (groups)		0.390		0.007		**0.003**
6-min walk (m)						
Control	32	466.04±81.90	31	453.61±73.13	29	0.43±57.21
Intervention	34	438.05±88.18	27	469.84±79.17	27	21.98±76.54
P (groups)		0.171		0.390		0.268

Table 4. Effects of 12 week Tai-Chi intervention on symptomatology.

	N	Pre	N	Post	N	Difference (Post-Pre)*
FIQ						
Total score						
Control	34	69.88±13.91	32	74.51±13.30	32	4.31±12.01
Intervention	34	67.21±15.36	28	61.02±13.92	28	-6.05±15.36
P (groups)		0.461		0.000		**<0.001**
Physical function						
Control	34	4.30±1.87	31	4.80±1.91	31	0.51±1.66
Intervention	34	4.87±1.95	28	4.51±1.82	28	-0.11±2.17
P (groups)		0.232		0.575		0.321
Feel good						
Control	31	8.13±2.15	31	8.77±2.78	29	-0.31±2.28
Intervention	34	7.04±2.84	28	6.14±2.66	28	0.66±3.88
P (grupos)		0.095		0.000		**<0.001**
VAS pain						
Control	34	7.31±1.67	32	8.02±1.62	32	0.72±1.61
Intervention	33	7.52±1.75	28	6.75±2.32	28	-0.84±2.47
P (groups)		0.406		0.019		**0.005**
VAS fatigue						
Control	34	8.30±1.70	32	8.65±1.42	32	0.36±1.69
Intervention	33	8.58±1.80	28	7.62±1.71	28	-0.98±1.88
P (groups)		0.395		0.016		**0.003**
VAS morning tiredness						
Control	34	8.06±1.96	32	8.16±1.92	32	0.12±1.88
Intervention	33	8.91±1.59	28	7.61±2.05	28	-1.20±1.87
P (groups)		0.058		0.416		0.051
VAS stiffness						
Control	34	7.61±2.26	31	8.02±1.98	31	0.35±1.65
Intervention	33	8.19±2.04	28	7.26±2.78	28	-0.87±2.70
P (groups)		0.360		0.200		0.065
VAS anxiety						
Control	34	7.21±2.19	32	7.98±2.02	32	0.63±1.83
Intervention	33	7.42±2.82	28	6.53±2.44	28	-0.68±2.88
P (groups)		0.734		0.012		**0.006**
VAS depression						
Control	34	6.07±2.88	32	7.09±2.96	32	1.08±2.08
Intervention	33	6.78±3.20	28	5.71±3.05	28	-0.68±2.72
P (groups)		0.354		0.084		**0.006**

FIQ: Fibromyalgia Impact Questionnaire

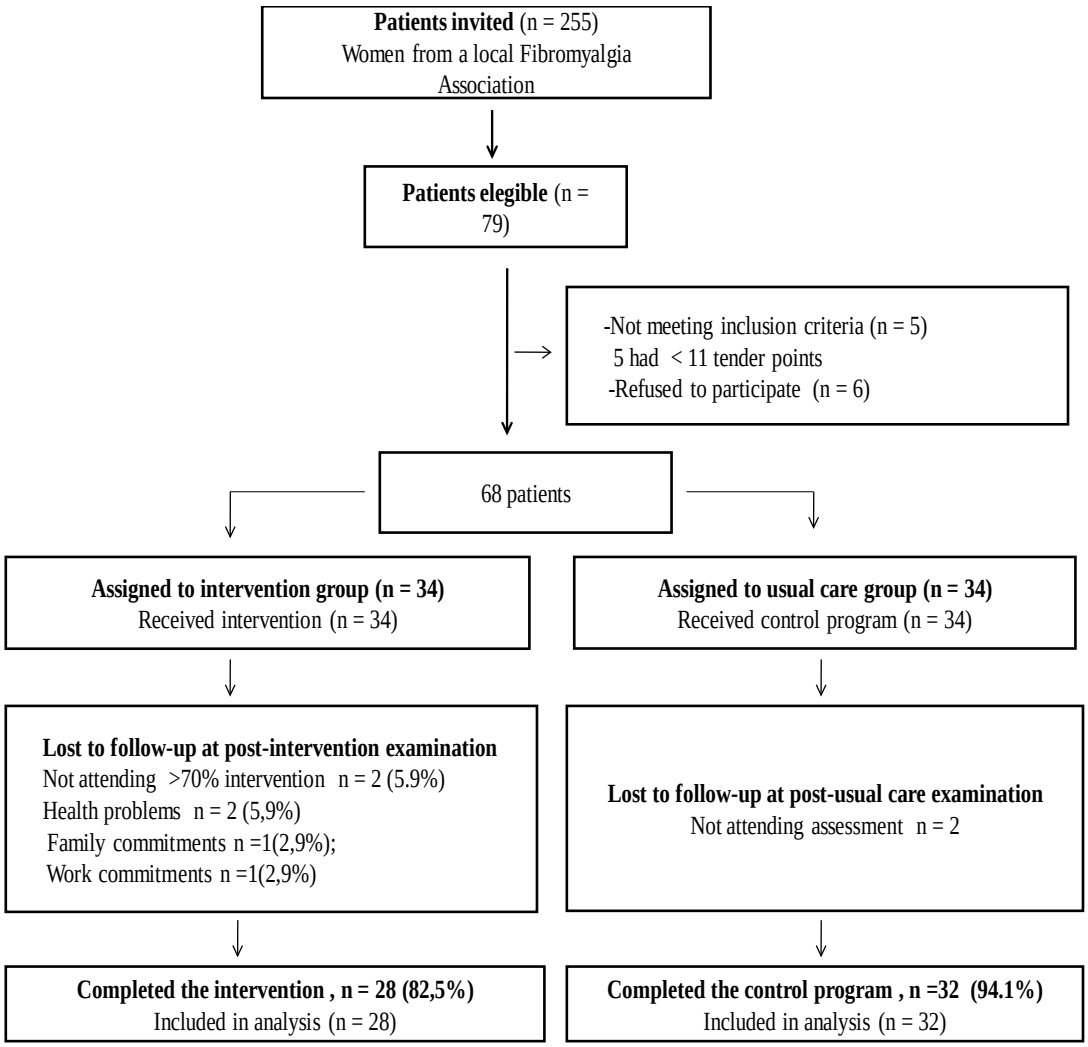
Table 5. Effects of 12 week Tai-Chi intervention on quality of life, pain-coping strategies, anxiety, depression, self-efficacy and self-esteem.

	N	Pre	N	Post	N	Difference (Post-Pre)*
SF-36						
Physical function						
Control	34	38.68±18.80	32	37.66±14.42	32	-1.09±16.31
Intervention	34	32.50±15.34	28	39.46±19.02	28	6.43±18.25
P (groups)		0.144		0.700		0.244
Physical role						
Control	34	4.41±14.31	32	2.34±9.75	32	-2.34±9.75
Intervention	34	2.94±17.15	28	14.29±30.75	28	10.71±37.53
P (groups)		0.700		0.051		0.052
Bodily pain						
Control	34	21.10±13.89	32	21.48±13.01	32	0.16±12.51
Intervention	34	19.49±16.33	28	29.46±19.06	28	9.82±26.57
P (groups)		0.663		0.072		0.058
General health						
Control	34	27.35±14.18	32	29.06±14.91	32	2.50±12.64
Intervention	34	26.01±11.86	28	33.57±16.60	28	8.39±16.33
P (groups)		0.686		0.269		0.133
Vitality						
Control	34	17.50±15.4	32	18.28±17.81	32	0.31±14.64
Intervention	34	24.85±16.26	28	31.96±18.22	28	7.50±21.84
P (groups)		0.062		0.006		**0.021**
Social functioning						
Control	34	42.21±22.89	32	35.70±24.11	32	-7.81±17.94
Intervention	34	41.84±26.77	28	51.34±23.81	28	7.14±23.38
P (groups)		0.951		0.018		**0.003**
Emotional role						
Control	34	33.34±42.64	32	37.50±44.60	32	4.16±44.60
Intervention	34	26.47±40.85	28	28.57±42.28	28	-0.00±49.69
P (groups)		0.500		0.457		0.562
Mental health						
Control	34	45.77±18.14	32	44.50±23.56	32	-1.00±14.72
Intervention	34	43.41±22.29	28	52.00±18.51	28	7.57±22.93
P (groups)		0.634		0.164		0.071
VPMI						
Passive coping						
Control	34	24.56±4.81	32	24.25±3.45	32	-0.78±0.63
Intervention	34	26.03±5.06	28	23.46±4.70	28	-0.53±3.84
P (groups)		0.226		0.510		0.298

Active coping						
Control	34	15.88±3.95	32	15.94±3.84	32	0.00±3.85
Intervention	34	15.79±3.86	28	16.86±4.86	28	0.89±4.54
P (groups)		0.926		0.462		0.396
HADS						
Anxiety						
Control	34	11.21±3.95	32	11.06±4.16	32	-0.22±2.83
Intervention	34	12.03±4.25	28	10.18±4.09	28	-1.43±3.39
P (groups)		0.413		0.347		0.114
Depression						
Control	34	9.44±3.94	32	9.09±4.69	32	-0.25±3.58
Intervention	34	9.76±4.39	28	7.86±3.93	28	-1.86±3.64
P(groups)		0.752		0.291		0.105
SELF-EFFICACY						
Control	34	25.56±7.17	32	25.47±7.44	32	0.38±4.01
Intervention	34	25.29±6.76	28	27.46±6.39	28	2.32±7.53
P(groups)		0.876		0.270		0.189
RSES						
Control	34	27.94±6.16	32	25.13±7.26	32	-2.78±5.17
Intervention	34	27.79±4.98	28	29.96±5.11	28	1.96±5.22
P(groups)		0.913		0.006		**<0.001**

SF-36: Short Form Health Survey 36; ***VPMI***: Vanderbilt Pain Management Inventory;***HADS***: Hospital Anxiety and Depression Scale;***SELF-EFFICACY:*** General Self -Efficacy Scale; ***RSES***: Rosenberg Self-Esteem Scale.

Figure 1. Flow of subjects.



Artículo V

Effectiveness of a Tai-Chi intervention in functional capacity, symptomatology and psychological outcomes in women with fibromyalgia.

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Effectiveness of a Tai-Chi intervention in functional capacity, symptomatology and psychological outcomes in women with fibromyalgia.

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Effectiveness of a Tai-Chi intervention in functional capacity, symptomatology and psychological outcomes in women with fibromyalgia.

Abstract

Background: The purpose of this study was to analyze the effects of a 28-weeks Tai-Chi intervention on functional capacity, symptomatology and psychological outcomes in women with fibromyalgia (FM). The effect of a 3 months detraining period was also analyzed.

Methods:A quasi-experimental design was applied. This study used a controlled design as each patient served as his own control to compare pretest, post-test at 28-weeks, and detraining after 3-months. Thirty-two women with FM (mean age, 51.4±6.8 years) recruited from two local FM associations attended to Tai-Chi intervention 3 sessions weekly for 28-weeks.The outcome measures included the following: Tenderness (pain threshold, algometer score and total number of tender points), body composition (body mass index and waist circumference), functional capacity (chair stand, handgrip strength, chair sit&reach, back scratch, blind flamingo, 8-feet up&go, and 6-min walk tests) and psychological outcomes (Fibromyalgia Impact Questionnaire (FIQ), Short-Form Health Survey 36 (SF-36), Vanderbilt Pain Management Inventory (VPMI), Hospital Anxiety and Depression Scale (HADS), General Self-Efficacy Scale, and Rosenberg Self-Esteem Scale (RSES)).

Results: Tai-Chi group showed improvements on pain threshold ($P<0.001$), total number of tender points ($P<0.001$) and algometer score ($P<0.001$). We observed improvements on the following functional capacity tests: chair sit&and reach ($P<0.001$), back scratch ($P=0.002$), handgrip strength ($P=0.006$), chair stand ($P<0.001$), 8-feet

up&go (P<0.001), blind flamingo (P<0.001) and 6-min walk (P=0.006). Tai-Chi group had improvements in the FIQ total score (P<0.001) and insix FIQ-subscales: pain (P<0.001), fatigue (P<0.001), morning tiredness (P<0.001), stiffness (P=0.005), anxiety (P<0.001) and depression (P<0.001). Tai-Chi intervention was also effective in six SF-36-subscales: physical functioning (P<0.001), physical role (P<0.001), bodily pain (P=0.003), general health (P<0.001), vitality (P=0.018) and mental health (P<0.001). Likewise, the patients showed improvements after Tai-Chi intervention in VPMI-active coping subscale (P=0.019), HADS-depression (P<0.001) and HADS-anxiety (P=0.009) subscales, Self-Efficacy Scale (P<0.001) and RSES (P<0.005). These positive changes were maintained after detraining phase on tender points, the SF-36-subscales physical functioning, physical role, bodily pain, general health, vitality and mental health and in the VPMI-active coping subscale.

Conclusions: A 28-weeks (3times/week) Tai-Chi intervention showed improvements on pain, functional capacity, symptomatology and psychological outcomes in female FM patients.

BACKGROUND.

Fibromyalgia (FM) is a chronic diffuse pain condition that probably results from abnormal central pain processing[1-2]. The symptoms most frequently are chronic pain, characterized by generalized pain, stiffness, fatigue, disturbed sleep, psychological distress, and impaired cognitive function[3-4].

Physical exercise therapy may be an alternative approach [5-9].Furthermore, non-extenuating physical exercise, mind-body exercise and some relaxation therapies can also increase pain tolerance, producing a global improvement in the quality of life of FM patients [10,12,46,49].

As a traditional Chinese style mind-body exercise [13-45],Tai-Chi practice requires tranquility of mind during slow movements [47-48] and is regarded as a light exercise [14-15]that consists in a series rhythmic movements that emphasize trunk rotation, weight shifting and coordination [16].

A recent review suggested potential benefits from Tai-Chi exercise on balance and psychological health [17].In addition, the benefits of Tai-Chi therapy include improvements in physical and mental well-being in patients with a variety of diseases and disorders [18,19].

Three previous studies have analyzed the benefit of Tai-Chi in women and men with FM[20-22]and new studies are needed to confirm their results. Furthermore, to our knowledge, this is the first study that analyzed the effect of Tai-Chi long-term intervention in FM patients. Thus, the purpose of the present study was to analyze the effects of a 7-month Tai-Chi intervention on functional capacity, symptomatology and psychological outcomes in women with FM.

Materials and Methods

Study participants and design

We contacted with two local associations of patients with FM (Granada and Motril, Spain). Thirty-eight potentially eligible patients responded, and gave their written informed consent after receiving detailed information about the aims and study procedures. The inclusion criteria were: (i) meeting the American College of Rheumatology (ACR) criteria: widespread pain for more than 3 months and pain with 4 kg/cm^2 of pressure for 11 or more of 18 tender points(4) (ii) not to have other severe somatic or psychiatric disorders, such as stroke or schizophrenia, or other diseases that prevent physical loading, and (iii) no to be attending another type of physical therapy at the same time. After the baseline measurements, 6 patients refused to participate due to incompatibility with job schedule. Therefore, a final sample of 32 women with FM participated in the study. Patients were not engaged in regular physical activity >20 minutes on >3 days/week.

The study flow of patients is presented in Figure 1.

Originally, the aim was to assess a control group of age- and gender-matched patients but we had an ethical obligation with theAssociation of Fibromyalgia Patients(Granada, Spain) to provide treatmentto all patients willing to participate inthe study. Then, a quasi-experimental reversal design was applied, that is, lacking a control group. The purpose of the research design was determine a baseline measurement, evaluate a treatment (Tai-Chi intervention), and evaluate a return to a non-treatment condition (detraining) in the same group of participants. This type of design particularly controls participant bias well, as the same individual is used at each testing time point. The study outcomes were measured before the intervention (baseline), after 28 weeks of

intervention (post-test), and after 3 months of a detraining period (detraining) during which the patients stopped practicing Tai-Chi and did not engage in any structured exercise intervention.

The research protocol was reviewed and approved by the Ethics Committee of the *Virgen de las NievesHospital* (Granada, Spain). The study was carried out between November 2009 and September 2010, following the ethical guidelines of the Declaration of Helsinki, last modified in 2000.

Intervention

Patients participated in three 60-minutes Tai-Chi sessions conducted weekly for 28-weeks. Each session included: 15 minutes of warm up with stretching, mobility and breathing techniques; 30 minutes of Tai-Chi exercises principles and techniques and finally, 15 minutes of various relaxation methods. The intervention consisted of 8 forms from Yang Style Tai- Chi, with minor modifications that were suitable for patients with FM. For example, the first month some exercises were realized with the patients sitting to avoid too much fatigue.

Classes were taught by a Tai-Chi master with teaching experience. The first two weeks of the intervention were focused on learning fundamental movement patterns. In subsequent sessions, patients practiced 8-Form, Yang Style Tai-Chi under master supervision.

Training intensity was controlled by the rate of perceived exertion (RPE) based on Borg´s conventional (6-20 point) scale. The medium value of RPE was11±1. This RPE value corresponds to a subjective perceived exertion of“light”, that is, low intensity.

Outcomes measures

Pretest, posttest and detraining intervention assessments were carried out on two separate days with at least 48 hours between each session. This was done in order to prevent patient's fatigue and flare-ups (acute exacerbation of symptoms). The assessment of the tender points, blind flamingo test, chair stand test, and psychological outcomes were completed on the first visit. Body composition and the chair sit&reach, back scratch, 8-feet up&go, handgrip strength, and 6-min walk tests were performed on the second day.

Tender points assessment

We assessed 18 tender points according to the American College of Rheumatology criteria for classification of FM using a standard pressure algometer (EFFEGI, FPK 20, Alfonsine, Italy)[4].The mean of two successive measurements at each tender point was used for the analysis. Tender point scored as positive when the patient noted pain at pressure of 4 kg/cm^2 or less. The total count of such positive tender points was recorded for each participant. An algometer score was calculated as the sum of the minimum pain-pressure values obtained for each tender point.

Body composition and anthropometric assessment

We performed a bioelectrical impedance analysis with an eight-polar tactile-electrode impedanciometer (InBody 720, Biospace). The validity of this instrument was reported elsewhere[23-24].Height (cm) was assessed using a stadiometer (Seca 22, Hamburg, Germany), body mass index (BMI) was calculated as weight (in kilograms) divided by height (in meters) squared. Waist circumference (cm) was measured with the participant

standing at the middle point between the ribs and ileac crest (Harpenden anthropometric tape Holtain Ltd).

Functional capacity

To assess functional capacity we used the Senior Functional Fitness Test Battery[25]. Additionally, we also measured the handgrip strength and the blind flamingo test, which have been used in FM patients [26].The fitness test battery was administered by trained and qualified researchers.

Lower-body muscular strength. The "Chair stand test" involves counting the number of times within 30 second that an individual can rise to a full stand from a seated position with back straight and feet flat on the floor, without pushing off with the arms[25]. The patients carried out 1 trial after familiarization.

Upper-body muscular strength. "Handgrip strength" was assessed using a digital dynamometer (TKK 5101 Grip-D;Takey, Tokyo, Japan) as described elsewhere[27]. Patients performed (alternately with both hands) the test twice allowing a 1-minute rest period between measures. The best value of 2 trials for each hand was chosen and the average of both hands was registered.

Lower-body flexibility. In the "chair sit&reach test", the patient seated with one leg extended, slowly bends forward sliding the hands down the extended leg in an attempt to touch (or past) the toes. The number of centimeters short of reaching the toe (minus score) or reaching beyond it (plus score) are recorded [25].Two trials with each leg were measured and the best value of each leg was registered, being the average of both legs used in the analysis.

Upper-body flexibility. The “back scratch test”, a measure of overall shoulder range of motion, involves measuring the distance between (or overlap of) the middle fingers behind the back[25].This test was carried out alternately with both hands twice and the best value was registered. The average of both hands was used in the analysis.

Static balance. It was assessed with the blind flamingo test[28].The number of trials needed to complete 30 second of the static position is recorded, and the chronometer is stopped whenever the patient does not comply with the protocol conditions. One trial was accomplished for each leg and the average of both values was selected for the analysis.

Motor agility/dynamic balance. The “8 feet up&go test” involves standing up from a chair, walking 8 feet to and around a cone, and returning to the chair in the shortest possible time[25].The best time of two trials was recorded and used in the analysis.

Aerobic endurance. We assessed the “6-min walk test”. This test involves determining the maximum distance (meters) that can be walked in 6 min along a 45.7 meters rectangular course[25, 29].

Psychological outcomes

Symptomatology was assessed by means of the Spanish version of the Fibromyalgia Impact Questionnaire (FIQ)[30].The FIQ contains 10 subscales of disabilities and symptoms, ranging from 0 to 10. A total score may be obtained after normalization of some subscales and summing the subscales,the FIQ total score, range from 0 to 100, in which a higher score indicates a greater impact of the syndrome. The FIQ total score, and the subscales for physical function, feel good, pain, fatigue, morning tiredness, stiffness, anxiety, and depression were applied in the study.

Quality of life was assessed by means of the Spanish version of the Short-Form Health Survey 36 (SF-36)[31].The SF-36 contains 36 statement grouped into 8 subscales: physical functioning, physical role, bodily pain, general health, vitality, social functioning, emotional role, and mental health. The range of scores goes between 0 and 100 in every subscale, in which higher scores indicate better health.

The Spanish version of the Hospital Anxiety and Depression Scale (HADS)[32]was used to assess anxiety and depression. The HADS contains 14 statements, ranging from 0 to 3, in which a higher score indicates a higher degree of distress. The scores build 2 subscales: anxiety (0-21) and depression (0-21)[33].

The Spanish version of the Vanderbilt Pain Management Inventory (VPMI)[34]was used to assess coping strategies. The VPMI contains 18 statements divided in two subscales designed to assess how often chronic pain sufferers use active and passive coping strategies[35].

The Rosenberg Self-Esteem Scale (RSES)is a self-report measure designed to assess the concept of global self-esteem [36-37]. The RSES comprises just 10 items scored on a 4-point scale that are summed to produce a single index of self-esteem. In this study we used the Spanish version [37].

The Spanish version of the General Self-Efficacy Scale [38]was uses to assess the individual beliefs in her/his own capabilities to attain aims. This instrument contains 10 items scored on a 4-point Likert scale from 1 (not at all true) to 4 (exactly true). In this case, higher scores indicate a higher level of perceived general self-efficacy

Statistical analysis

Demographic variables were analysed using descriptive analysis. Because of the small sample size of thedata and the non-normality in the distributions of somevariables, traditional multilevel modeling techniques thatrely on large sample theory for accurate p values were notappropriate. The Friedman Test, a nonparametric technique, was used to assess the training effectson the outcome variablesacross multiple observations. When Friedman test was significant, differences between two testing time points (pretest vs. posttest, pretest vs. detraining, posttest vs. detraining) were tested with Wilcoxon test.

We performed a per-protocol analysis to study the participants who complied with the study protocol, which was defined as attendance at least 60% of the sessions. Analyses were performed using the Statistical Package for Social Sciences (SPSS, v. 16.0 for WINDOWS; SPSS Inc, Chicago). The differences were considered significant for $P < 0.05$**.**

Result

Five women discontinued the program due to health problem, and personal conflict, and four women were not include in the final analysis because they did not assist to any of the assessment sessions. Five women were not included in the final analysis for attending less than 60% of the program (attendance 15.56%). Adherence to the intervention was 79.8% (range 61-94%). A total of 23 women with FM completed the 28-week follow-up. There were no mayor adverse effects and no major health problems in the patients during the intervention and detraining periods.

Sociodemographic characteristics of women with FM are showed in the Table 1.

The effects of Tai-Chi intervention on pain are showed in the Table 2. We observed significant changes on pain threshold of all the tender points (P<0.001), tender point count (P<0.001) and algometer score (P<0.001). Post hoc analysisrevealed that thepain threshold of all the tender points, tender point count and algometer score significantly improvedfrom pretest to posttest. These changes were maintained after detraining phase (posttest-retest) (Table 2).

Significant changes for sit&and reach (P<0.001), back scratch (P=0.002), handgrip strength (P=0.006), chair stand (P<0.001), 8-feet up&go (P<0.001), blind flamingo (P<0.001) and 6-min walk (P=0.006) tests were identified. Post hoc analysis revealed that these functional capacity tests improved from pretest to posttest. The positive changes were not maintained after detraining phase in functional capacity, although the scores on handgrip strength, chair stand, 8-feet up & go, blind flamingo and 6-min walk tests were better than the pretest score. Indeedthese tests showed significant improvements from pretest to retest (Table 3).

In addition, we found significant changes in FIQ total score (P<0.001) and in six FIQ-subscales: pain (P<0.001), fatigue (P<0.001), morning tiredness (P<0.001), stiffness (P=0.005), anxiety (P<0.001) and depression (P<0.001). Post hoc analysis revealed that the FIQ total score and the FIQ-subscales decreased (positive) from pretest to posttest. Thesepositive changes in FIQ total scores and in the six FIQ-subscales were not maintained after detraining phase, but the FIQ-subscales fatigue, morning tiredness, anxiety and depression decreased from pretest to retest (Table4). The statistical analysis showed changes in the following SF-36-subscales: physical function (P<0.001), physical role (P<0.001), bodily pain (P=0.003), general health (P<0.001), vitality (P=0.018) and mental health (P<0.001). Post hoc analysis revealed that the SF-36-subscales physical function, physical role, bodily pain, general health, vitality and

mental health increased (positive) from pretest to posttest. These improvements were maintained after detraining phase in all the previous SF-36-subscales except physical role (Table 4).

We observed changes in the VPMI-active coping subscale (P=0.019) as well as in HADS-depression (P<0.001) and HADS-anxiety (P=0.009) subscales.Post hoc analysis revealed that these variables improved from pretest to posttest, but only the improvement in VPMI-active coping subscale was maintained after detraining phase (Table 5).

We foundchanges on Self-Efficacy Scale and RSES scores (P<0.001 and P<0.005 respectively). Post hoc analysis revealed that both variables improved from pretest to posttest. These improvements were not maintained after detraining phase but the detraining scores were better than pretest score and significant improvements from pretest to retest were identified (Table 4).

Discussion

This study shows that Tai-Chi exercise is potentially a useful therapy for women with FM. The main finding of the present study is that 28-weeksTai-Chi intervention improved pain and functional capacity. The effects of Tai-Chi intervention were evident on symptomatology, depression, quality of life, active coping, self-esteem and self-efficacy. The improvements persisted after the detraining phase in pain threshold, tender points count, algometer score, SF-36-subscales (physical functioning, bodily pain, general health, vitality, emotional role and mental health) and in VPMI-active coping subscale. The program was well tolerated and had not any deterious effects on the patients´ health.

The improvement in lower body flexibility concurs with our previous study[20] performed in 6 men with FM (52.3±9.3 years). In that study, we founda positive change in lower body flexibility after 16 weeks Tai-Chi intervention (3times/week) that was maintained after 12 weeks of detraining period. However in the present study, the gains of flexibility were not maintained after detraining period.

The results of this study suggest that a Tai-Chi long-term intervention could be an effective therapy for FIQ total score and the FIQ-subscales: pain, fatigue, morning tiredness, stiffness, anxiety and depression, as well as, on the following SF-36-subscales: physical function, physical role, bodily pain, general health, vitality and mental health. Similarly, in a recent study, Wang et al [22],observed improvements on the FIQ total score, and on mental and physical component of the SF-36 after 12 weeks of Tai-Chi intervention (2 times/week) in 33 women with FM (49.7±11.8 years). On the other hand, this study did not report the SF-36 and FIQ subscales scores or tender point count, and the assessment of functional test is very limited.

Similarly,Taggart et al [21],found significant changes on theFIQ-subscales physical functioning, feel good, pain, morning tiredness, stiffness and anxiety and in the SF-36 subscales physical functioning, bodily pain, general health, vitality and emotional role,after 6 weeks of Tai-Chi intervention (2 times/week) in 21 FM patients (56.2±11.9 years).However, this study did not show the effects of the intervention in functional testor tender points count.

In our study, the FM patients were able to walk greater distances (~40 meters) after Tai-Chi interventionon 6-min walk test. This finding concurs with the study of Wang et al [22] that also observed improvements on this test (~55.4 meters).

To note is that this is the first study that analyzed the effect of long-term Tai-Chi intervention in female FM patients and it is difficult to compare our results with others previous studies. However, the results of present study concur with other studies that have analyzed the effects of long-term Tai-Chi intervention in others diseases.

We observed improvements on aerobic capacity, dynamic balance and lower-body strength. Similarly, Lan et al[39]found improvement in cardiorespiratory function in 9 adults patients with coronary artery bypass (56.5±7.4 years) after 52 weeks of Tai-Chi intervention (45 minutes/every days). Lan et al [40],found improvements in aerobic capacity after 52 weeks of Tai-Chi intervention (3 times/week) in 53 patients (52.8±9.4 years) with dislypidemia. Likewise, Li et al [41]observed improvements on aerobic capacity, dynamic balance and lower-body strength in 25 patients (71±12 years) with peripheral neuropathy after 24 weeks (3 times/week) Tai-Chi intervention. However, it should be noted that these studies did not perform a detraining phase.

The biologic mechanics by which Tai-Chi might affect the clinical course of FM remains to be known. However, the degree of flexion at the hips and knees[42],the constantly shift weight from one foot to the other, as well as the rotational movements of the head, trunk, and extremities[43-44] performed during Tai-Chi practice could be related with the improvements found in strength, balance and flexibility in our study. The interesting findings of the present study should be interpreted in the context of the following limitations. We were not able to perform a randomized trial with a control group and it was not possible to control the changes in the FM pharmacological treatment during the intervention. In addition, we did not control the influence of preexisting beliefs and expectations with respect to Tai-Chi in FM patients. On the other hand, we have analyzed the effects of Tai-Chi intervention in variables that have not been previously explored in female FM patients, such as tender points, balance,

flexibility, strength, depression, coping strategies, self-esteem and self-efficacy. Moreover, our study analyzed the effects of 12 weeks detraining phase.

The effects of long-term Tai-Chi intervention need further randomize controlled trials, especially focused in the biologic and psychological mechanics by which Tai-Chi exercise might affect the clinical course of FM.

Conclusions

The improvements observed in pain, symptomatology, functional capacity,psychological outcomes, pain coping strategies, self-esteem and self-efficacy in women with FM after a 7-months Tai-Chi intervention indicate that Tai-Chi may be a useful and feasible treatment in the management of FM.

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Table 1-Sociodemographic characteristics of women with FM.

	Tai-Chi group (n=23)
Age, years	51.35 (6.753)
Years since clinical diagnosis, n(%)[a]	
≤5 years	11 (52.4)
> 5 years	10 (47.6)
Marital Status, n(%) [b]	
Married	19 (86.4)
Unmarried	1 (4.5)
Separated/divorced/widowed	2 (9.1)
Educational status, n(%)[c]	
Unfinished studies	2 (9.1)
Primary school	14 (63.6)
Secondary school	4 (18.2)
University degree	2 (9.1)
Occupational status, n(%)[d]	
Housewife	13 (65.0)
Student	1 (5.0)
Working	2 (10.0)
Unemployed	3 (15.0)
Retired	1 (5.0)
Income, n(%)[e]	
<1200,00€	13 (76.5)
1200,00-1800.00€	3 (17.6)
>1800,00€	1 (5.9)
Menstruation, n(%)[f]	
Yes	7 (33.3)
No	14 (66.7)

a: two missing.
b: one missing.
c: one missing.
d: three missing.
e: eight missing.
f: two missing.

Table 2. Effects of 28-week Tai-Chi intervention on tender points.

	Pretest	Posttest	Detraining	P	Pre-post	Pre -retest	Post-retest
Occiput R	1.49 (0.51)	2.43 (0.65)	2.56 (0.58)	<0.001	<0.001	<0.001	0.172
Occiput L	1.57 (0.49)	2.43 (0.61)	2.49 (0.72)	<0.001	<0.001	<0.001	0.526
Anterior cervical R	1.17 (0.28)	1.72 (0.40)	1.66 (0.47)	<0.001	<0.001	<0.001	0.474
Anterior cervical L	1.17 (0.24)	1.78 (0.43)	1.81 (0.47)	<0.001	<0.001	<0.001	0.767
Trapezius R	1.81 (0.64)	2.78 (0.72)	2.94 (0.67)	<0.001	<0.001	<0.001	0.218
Trapezius L	1.68 (0.64)	2.87 (0.64)	3.03 (0.59)	<0.001	<0.001	<0.001	0.287
Supraspinatus R	1.77 (0.88)	3.19 (1.01)	3.10 (0.83)	<0.001	<0.001	<0.001	0.761
Supraspinatus L	1.90 (0.89)	3.36 (1.07)	3.09 (0.86)	<0.001	<0.001	<0.001	0.196
Second rib R	1.42 (0.40)	2.45 (0.74)	2.44 (0.70)	<0.001	<0.001	<0.001	0.808
Second rib L	1.39 (0.41)	2.68 (1.01)	2.91 (2.56)	<0.001	<0.001	<0.001	0.273
Lateral epicondyle R	1.72 (0.59)	3.37 (0.88)	3.27 (1.21)	<0.001	<0.001	<0.001	0.369
Lateral epicondyle L	1.74(0.59)	3.50 (1.28)	3.75 (1.51)	<0.001	<0.001	<0.001	0.420
Gluteal R	1.76 (0.87)	3.38 (0.88)	3.06 (0.93)	<0.001	<0.001	<0.001	0.088
Gluteal L	1.85 (0.78)	3.33 (1.00)	3.02 (1.01)	<0.001	<0.001	<0.001	0.100
Great trochanter R	1.84 (0.72)	3.68 (1.01)	3.55 (1.31)	<0.001	<0.001	<0.001	0.361
Great trochanter L	1.79 (0.78)	3.62 (1.08)	3.40 (1.14)	<0.001	<0.001	<0.001	0.236
Knee R	1.52 (0.50)	2.93 (0.75)	2.93 (0.94)	<0.001	<0.001	<0.001	0.976
Knee L	1.58 (0.54)	2.99 (0.66)	2.78 (0.78)	<0.001	<0.001	<0.001	0.071
Algometer score	28.86 (8.81)	52.81 (12.10)	52.00 (13.84)	<0.001	<0.001	0.010	0.581
Total number of points	17.91 (0.43)	15.50 (3.21)	16.36 (2.70)	<0.001	0.003	<0.001	0.071

Note. Data are presented as means (standard deviation). R = right; L = left.

Table 3. Effects of 28-week Tai-Chi intervention on physical function.

	Pretest	**Posttest**	**Detraining**	**P**	**Pre-post**	**Pre -retest**	**Post-retest**
Weight (kg)	68.44 (12.27)	69.12 (12.60)	69.00 (12.67)	0.790	0.438	0.721	0.728
Waist circumference (cm)	90.85 (18.39)	87.64 (11.89)	84.82 (12.92)	0.100	0.404	0.008	0.015
BMI (kg/m^2)	27.41 (4.78)	27.67 (4.70)	28.08 (5.29)	0.781	0.429	0.404	0.970
Chair sit & reach (cm)	-11.84(13.53)	0.80 (12.62)	-5.74 (15.09)	<0.001	<0.001	0.064	<0.001
Back scratch test (cm)	-10.34 (13.65)	-6.25 (10.11)	-10.17 (13.15)	0.002	0.009	0.702	0.002
Handgrip strength (kg)	16.31 (6.50)	20.83 (6.58)	18.07 (6.60)	0.006	<0.001	0.048	0.003
Chair stand test (n)	6.68 (1.89)	13.11 (2.71)	10.58 (2.43)	<0.001	<0.001	<0.001	<0.001
8-feet up& go (s)	10.45 (2.04)	6.43 (2.03)	6.86 (1.75)	<0.001	<0.001	<0.001	0.008
Blind flamingo (failures)	9.58 (5.01)	5.23 (4.25)	6.65 (4.42)	<0.001	<0.001	<0.001	0.008
6-min walk (m)	442.67 (94.71)	481.10 (74.05)	457.42 (62.72)	0.006	0.023	<0.001	0.002

Note. Data are presented asmeans (standard deviation). BMI: body mass index

Table 4. Effects of 28-week Tai-Chi intervention on symptomatology.

	Pretest	Posttest	Detraining	P	Pre-post	Pre -retest	Post-retest
FIQ							
Total score	68.58 (8.94)	56.90 (14.52)	67.10 (17.83)	<0.001	<0.001	0.951	0.002
Physical function	4.53 (1.78)	3.63 (1.74)	3.81 (2.35)	0.335	0.101	0.170	0.573
Feel good	6.48 (2.86)	5.98 (2.78)	6.97 (2.52)	0.101	0.397	0.959	0.106
VAS pain	7.64 (1.64)	5.79 (2.20)	7.04 (2.26)	<0.001	<0.001	0.064	<0.001
VAS fatigue	9.00 (0.79)	6.51 (1.70)	7.59 (2.14)	<0.001	<0.001	0.003	0.008
VAS morning tiredness	9.15 (0.87)	6.87 (1.94)	7.96 (2.08)	<0.001	<0.001	<0.001	0.009
VAS stiffness	8.17 (1.60)	6.43 (2.22)	7.54 (2.16)	0.005	0.003	0.083	0.013
VAS anxiety	7.63 (2.32)	5.10 (2.77)	6.29 (2.41)	<0.001	<0.001	0.010	0.013
VAS depression	6.97 (2.63)	4.85 (2.44)	5.91 (2.72)	<0.001	<0.001	0.020	0.035

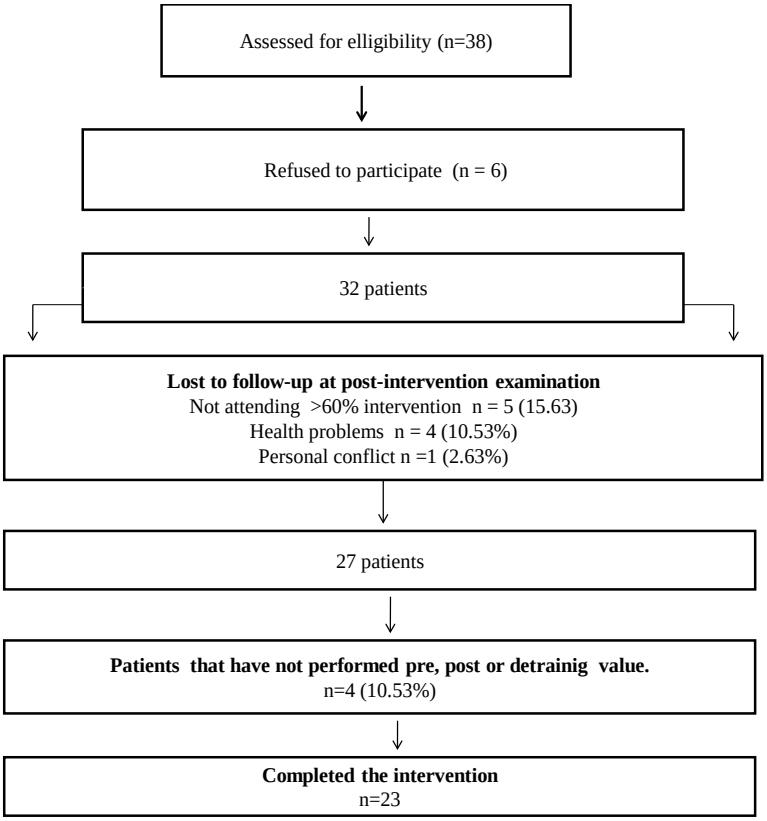
Note. Data are presented asmeans (standard deviation). FIQ: FibromyalgiaImpactQuestionnaire; VAS: Visual AnalogueScale.

Table 5. Effects of 28-week Tai-Chi intervention on quality of life, pain-coping strategies, anxiety, depression, self-efficacy and self-esteem.

	Pretest	Posttest	Detraining	P	Pre-post	Pre -retest	Post-retest
SF-36							
Physical function	30.87 (13.54)	48.04 (18.93)	46.96 (22.04)	<0.001	<0.001	<0.001	0.519
Physical role	0.00 (0.00)	25.00 (31.81)	7.96 (22.34)	<0.001	0.004	0.059	0.009
Bodily pain	18.86 (15.37)	38.07 (19.12)	28.86 (22.44)	0.003	0.005	0.034	0.080
General health	23.91 (11.87)	36.96 (16.43)	33.26 (18.38)	<0.001	<0.001	0.010	0.190
Vitality	21.30 (12.81)	36.74 (16.90)	29.13 (23.24)	0.018	<0.001	0.148	0.087
Social functioning	45.22 (26.95)	56.74 (20.69)	46.52 (25.57)	0.044	0.085	0.602	0.033
Emotional role	28.79 (41.53)	48.49 (47.95)	33.33 (42.42)	0.138	0.100	0.684	0.125
Mental health	43.83 (22.11)	61.57 (20.88)	56.35 (24.71)	<0.001	0.002	0.012	0.115
VPMI							
Passive coping	25.30 (4.42)	22.17 (4.42)	21.96 (6.00)	0.068	0.015	0.017	0.714
Active coping	15.52 (4.31)	18.00 (3.94)	16.70 (4.55)	0.019	0.013	0.078	0.169
HADS							
Anxiety	11.43 (4.20)	8.39 (4.34)	10.35 (5.18)	0.009	0.004	0.250	0.020
Depression	9.57 (4.37)	5.91 (3.13)	8.48 (4.60)	<0.001	<0.001	0.055	0.009
SELF-EFFICACY	24.70 (6.52)	30.78 (5.59)	28.57 (5.84)	<0.001	<0.001	<0.001	0.043
RSES	28.00 (4.90)	31.74 (3.96)	29.30 (5.95)	0.005	0.002	0.056	0.013

Note. Data are presented as means (standard deviation). SF-36: Short Form Health Survey 36; VPMI: Vanderbilt Pain Management Inventory; HADS: Hospital Anxiety and Depression Scale; SELF-EFFICACY: General Self -Efficacy Scale; RSES: Rosenberg Self-Esteem Scale

Figure 1. Flow of subjects.



Conclusiones

- Los resultados de las diferentes investigaciones revisadas indican que el Taichi es un ejercicio saludable que puede tener efectos positivos sobre la salud física y psicológica,densidad mineral,inmunodeficiencia,perfil lipídico, síndrome metabólico, lesión cerebral, dolor de cabeza por tensión,cáncer, salud cardiovascular, diabetes tipo 2,espondilitis anquilosante,múltiple esclerosis y fibromialgia. Por otro lado, son necesarios más estudios que apliquen diseños metodológicos de mayor calidad.Una intervención de 16 semanas de Taichi mejora la flexibilidad de las extremidades inferiores en hombres con fibromialgia. Esta mejora se mantuvo después de 3 meses sin intervención.
- La práctica de Taichi durante 12 semanas mejora la capacidad funcional, la calidad de vida relacionada con la salud, la autoestima y reduce el impacto de la enfermedad en mujeres con fibromialgia.
- Una intervención de Taichi durante 28 semanas tiene efectos positivos sobre el dolor, la capacidad funcional, la sintomatología, la calidad de vida relacionada con la salud, las estrategias de afrontamiento del dolor activas, autoeficacia y autoestima en mujeres con fibromialgia.

Conclusión general

La práctica del Taichi es una terapia útil y efectiva en el tratamiento de la fibromialgia.

Curriculum Vitae

Actividad Académica

Licenciado en Ciencias de la Actividad Física y del Deporte. Universidad de Granada, Facultad de Ciencias de la Actividad Física y el Deporte (Septiembre 2008).

Doctorado en Nuevas Perspectivas de Investigación en Ciencias del Deporte y la Actividad Física.Universidad de Granada.Facultad de Ciencias de la Actividad Física y el Deporte (2009-2010).

Prácticas Formativas. Convenio entre la Universidad de Granada y Mando De Adiestramiento y Doctrina. Secretaria Relaciones Universidad.
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Contrato investigación con cargo a proyectoPhysicalactivity in womenwithfibromyalgia: effectsonpain, health and quality of life (Actividad física en mujeres con fibromialgia: efectos sobre el grado de dolor, salud y calidad de vida). Plan Nacional I+D+i 2008-2011. Resolución de 30 de diciembre de 2009 (BOE de 31 de diciembre). Convocatoria año 2010 Ayudas para la realización de proyectos de investigación (subprograma de Proyectos de Investigación Fundamental no Orientada, Programa Nacional de Proyectos de Investigación Fundamental, en el marco del VI Plan Nacional de Investigación Científica, Desarrollo e Innovación Tecnológica 2008-2011). Ministerio de Ciencia e Innovación. DEP2010-15639 (subprograma DEPO)
Desde 05/05/2011 a 31/01/2012.

Participación en Proyectos

- Physical Activity in Women with Fibromyalgia: Effects on Pain, Health and Quality of Life (ActividadFísica en Mujeres con Fibromialgia: EfectosSobre El Grado de Dolor, Salud y Calidad de Vida). Proyecto I+D. Universidad de Granada.Facultada de Ciencias de la Actividad Física y el Deporte (2011-2013).

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- Mejora de la calidad de vida en personas con fibromialgia a través de programas de actividad física y multidisciplinares (2008-2009). CICODE. Vicerrectorado de Extensión Universitaria y Cooperación al Desarrollo.

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Lo ligero y lo débil, arriba.
-Lao Tse-