LATIHAN TAICHI UNTUK KEMAMPUAN KESEIMBANGAN PADA LANSIA

LITERATURE REVIEW

SKRIPSI

Oleh :
Ayu Nur Fadila
NIM : 17010136

PROGRAM STUDI ILMU KEPERAWATAN
FAKULTAS ILMU KESEHATAN
UNIVERSITAS dr. SOEBANDI
2021

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Untuk Memenuhi Persyaratan
Memperoleh Gelar Sarjana Ilmu Keperawatan (S. Kep)

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HALAMAN PERSEMBAHAN

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Skripsi ini saya persembahkan untuk:

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MOTTO

بِسْمِ اللهِ الرَّحْمَنِ الرَّحِيْمِ

“Dan boleh jadi kamu membenci sesuatu tetapi ia baik bagimu, dan boleh jadi kamu menyukai sesuatu tetapi ia buruk bagimu dan Allah mengetahui dan kamu tidak mengetahui”

(Q.S. Al-Baqarah:216)

"Tidak perlu menjelaskan tentang dirimu kepada siapa pun, karena yang menyukaimu tidak butuh itu. Dan yang membencimu tidak akan percaya itu."

Ali bin Abi Thalib

“Kegagalan dan kesalahan mengajari kita untuk mengambil pelajaran dan menjadikannya lebih baik lagi “

(Ayu Nur Fadila)

HALAMAN PERNYATAAN ORISINALITAS

Yang bertandatangan dibawah ini :

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Menyatakan dengan sesungguhnya bahan skripsi *Literatur Review* saya yang berjudul "Latihan Taichi untuk Kemampuan Keseimbangan pada Lansia" adalah karya saya sendiri dan belum pernah diajukan untuk memperoleh gelar kesarjanaan suatu perguruan tinggi manapun. Adapun bagian-bagian tertentu dalam penyusunan Skripsi *Literatur Review* ini yang saya kutip dari karya hasil orang lain telah dituliskan sumbernya secara jelas sesuai dengan norma, kaidah, dan etika penulisan ilmiah.Apabila kemudian hari ditemukan adanya kecurangan dalam penyusunan skripsi *Literatur Review* ini, saya bersedia menerima sanksi sesuai dengan peraturan perundang undangan yang berlaku.

Jember, 8 Agustus 2021

Ayu Nur Fadila

NIM. 17010136

LEMBAR PERSETUJUAN

Skripsi *literature review* ini telah diperiksa oleh pembimbing dan telah disetujui untuk mengikuti seminar proposal skripsi pada Program Studi Ilmu KeperawatanSTIKES dr. Soebandi Jember

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SKRIPSI

LATIHAN TAICHI UNTUK KEMAMPUAN KESEIMBANGAN PADA LANSIA

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ABSTRAK

Fadila, Ayu Nur* Sasmito,Lulut** Wirasakti, Guruh***. 2021.**Latihan Taichi Untuk Kemampuan Keseimbangan pada Lansia.** Tugas Akhir. Program Studi Ilmu Keperawatan Universitas dr. Soebandi.

Pendahuluan: Kelompok lansia lebih banyak menderita penyakit yang menyebabkan menurunnya kemampuan dalam melakukan aktivitas dibanding dengan orang yang masih muda.Saat seseorang memasuki fase lansia, pada saat itu mulai terjadi penurunan fungsi fisiologis yang mengakibatkan terjadinya gangguan degeneratif. Gangguan degeneratif pada lansia salah satunya yaitu penurunan fungsi keseimbangan dan peningkatan resiko jatuh. Gangguan keseimbangan merupakan penyebab utama yang paling sering mengakibatkan lansia mengalami jatuh. Keseimbangan pada lansia dapat ditingkatkan dengan melakukan latihan fisik dapat mengurangi resiko kelainan tulang yang menyebabkan resiko jatuh pada lansia. Salah satu latihan fisik yang efektif adalah latihan keseimbangan taichi. Latihan keseimbangan taichi ditunjukan untuk membatu meningkatkan kekuatan otot pada anggota gerak bawah (kaki) dan untuk meningkatkan vestibuler atau keseimbangan tubuh.

Metode: desain penelitian ini literature review. Pencarian *database Google Scholar*, *ProQuest* dan *Science Direct* artikel tahun 2018-2021. PICOS digunakan untuk mengidentifikasi lalu alur pencarian artikel dijelaskan melalui PRISMA *flow diagram.* Artikel menggunakan uji coba prospektif acak.

Hasil: didapatkan 6 artikel yang membahas tentang latihan taichi untuk kemampuan keseimbangan pada lansia. diketahui tingkat keseimbangan lansia mengalami berbagai macam permasalahan yang diakibatkan karena menurunnya fungsi fisiologis karena bertambahnya usia lansia. Hasil analisa menunjukkan bahwa latihan taichi yang dilakukan oleh lansia memiliki pengaruh yang baik pada keseimbangan lansia, karena latihan taichi mampu melancarkan peredaran darah sehingga dapat meningkatkan vestibuler atau keseimbangan tubuh.

Kesimpulan: latihan taichi terbukti memiliki efek yang baik untuk kemampuan keseimbangan lansia

Diskusi: diharapkan masyarakat yang mengalami masalah keseimbangan dapat menerapkan latihan taichisebagai salah satu terapi alternatif untuk menurunkan masalah keseimbangan yang dapat berakibat resiko jatuh pada lansia.

Kata Kunci: Lansia, Keseimbangan, Resiko Jatuh, Latihan Taichi

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ABSTRACT

Fadila, Ayu Nur* Sasmito,Lulut** Wirasakti, Guruh***. 2021.**Taichi Exercises for Balance Ability in the Elderly.** Thesis. Nursing Science Study Program, University of dr. Soebandi.

Introduction: The elderly group suffers more from diseases that cause a decrease in the ability to carry out activities compared to young people. When a person enters the elderly phase, at that time, physiological functions begin to decline which results in degenerative disorders. One of the degenerative disorders in the elderly is a decrease in balance function and an increased risk of falling. Balance disorders are the main cause that most often causes the elderly to fall. Balance in the elderly can be improved by doing physical exercise can reduce the risk of bone abnormalities that cause the risk of falling in the elderly. One of the effective physical exercises is taichi balance exercises. Taichi balance exercises are shown to help increase muscle strength in the lower limbs (legs) and to improve vestibular or body balance.

Methods: This research design is a literature review. Search the Google Scholar database, ProQuest and Science Direct articles for 2018-2021. PICOS is used to identify and then the flow of article search is explained through PRISMA flow diagram. The article uses a prospective randomized trial.

Results: 6 articles were found that discussed taichi exercises for balance skills in the elderly. It is known that the level of balance in the elderly experiences various kinds of problems caused by decreased physiological functions due to increasing age of the elderly. The results of the analysis show that taichi exercises carried out by the elderly have a good influence on the balance of the elderly, because taichi exercises are able to improve blood circulation so that they can improve the vestibular or body balance.

Conclusion: Taichi exercise has been shown to have a good effect on the balance ability of the elderly

Discussion: it is hoped that people who experience balance problems can apply taichi exercises as an alternative therapy to reduce balance problems which can result in the risk of falling in the elderly.

Keywords: Elderly, Balance, Fall Risk, Taichi Exercise

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KATA PENGANTAR

Alhamdulillah segala puji bagi Allah SWT yang telah melimpahkan rahmat dan hidayah-Nya sehingga penyusunan Proposal literatur review ini dapat terselesaikan. Literatur review ini disusun untuk memenuhi salah satu persyaratan menyelesaikan pendidikan Program Studi Ilmu Keperawatan Universitas dr. Soebandi dengan judul latihan taichi untuk kemampuan keseimbangan pada lansia.

Selama proses penyusunan Study *literatur review* ini penulis dibimbing dan dibantu oleh pihak, oleh karena itu penulis mengucapkan terima kasih kepada:

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Dalam penyusunan proposal *literature review* ini penulis menyadari masih jauh dari kesempurnaan, untuk itu penulis sangat mengharapkan kritik dan saran untuk perbaikan di masa mendatang.

Jember, 8 Agustus2021

Penulis

Ayu Nur Fadila

DAFTAR ISI

DAFTAR TABEL

DAFTAR GAMBAR

BAB 1

PENDAHULUAN

1.1 Latar Belakang

Proses kehidupan seseorang akan mengalami perkembangan dari bayi hingga usia lanjut. Ketika seseorang berusia lanjut secara alamiah tubuhnya akan mengalami berbagai macam kemunduran fungsi tubuh yang menyebabkan lansia memiliki masalah kesehatan(Jayanti, 2016). Kelompok lansia lebih banyak menderita penyakit yang menyebabkan menurunnya kemampuan dalam melakukan aktivitas dibanding dengan orang yang masih muda.Saat seseorang memasuki fase lansia, pada saat itu mulai terjadi penurunan fungsi fisiologis yang mengakibatkan terjadinya gangguan degeneratif. Gangguan degeneratif pada lansia salah satunya yaitu penurunan fungsi keseimbangan dan peningkatan resiko jatuh (Savira, 2016).

Sebesar 37,3 juta kejadian jatuh pada lansia terjadi karena masalah keseimbangan dan membutuhkan penanganan medis setiap tahunnya (World Health Organization, 2018). Selain itu peningkatan jumlah penduduk lansia juga terus terjadi setiap tahunnya, diperkirakan kurang lebih seperempat dari populasi penduduk dunia berusia 60 tahun ke atas*(United Nations,* 2017*)*. Jumlah penduduk lansia di dunia sebanyak 13,4% padatahun 2013dan diperkirakan meningkat pada tahun 2050 sebanyak 25,3% dan tahun selanjutnya akan terus meningkat menjadi 35,1% (Kemenkes RI, 2016). Lansia yang terdapat di Asia yang berusia lebih dari 60 tahun sebanyak kurang lebih 11% pada tahun 2010 dan diperkirakan pada tahun 2020 kurang lebih sebanyak 15% serta ditahun 2030

diperkirakan kurang lebih sebanyak 19%. Jumlah lansia di Indonesia sebanyak 7,56% (World Health Organization, 2018).

Lansia mengalami kontraksi otot yang relative tinggi namun hal itu tidak seiring dengan berbagai macam penurunan fungsi hal tersebut dikaitkan dengan degenerasi sendi, kelelahan, penurunan kinerja fisik dan peningkatan angka kejadian jatuh yang dialami lansia (Peterson & Martin, 2010). Peningkatan kontraksi yang dialami lansia dikaitkan dengan adanya penurunan mobilitas sendi hal tersebut mengakibatkan terjadinya kompensasi penurunan control postural dan pemprosesan gerak sensorik lansia sehingga mengakibatkan lansia mengalami penurunan keseimbangan (Nagai, et al., 2011). Lansia akan mengalami penurunan gangguan keseimbangan karena adanya fungsi fisiologis yang berubah pada lansia akibat degenarasi dan beberapa komponnen keseimbangan utama tubuh, seperti visual, ambang rangsang vestibular, kekuatan otot, lingkup gerak sendi dan sensorik. komponen tersebut merupakan peran penting dalam menjaga kontrol postural pada tubuh. Kontrol postural berfungsi dalam menjaga keseimbangan tubuh agar tidak mudah terjatuh saat berdiri, berjalan maupun beraktivitas lainnya (D'Silva, 2015).

Gangguan keseimbangan merupakan penyebab utama yang paling sering mengakibatkan lansia mengalami jatuh (Hwang, 2016). Jatuh dapat mengancam keselamatan jiwa lansia. Jatuh dapat mengakibatkan berbagai jenis cedera, kerusakan fisik dan psikologis. Keseimbangan pada lansia dapat ditingkatkan dengan cara latihan fisik yang baik, benar, terukur dan teratur (BBTT) serta latihan yang sesuai dengan tingkat kesehatan, tingkat aktifitas fisik dan tingkat

kebugaran masing-masing individu. Latihan fisik dapat mengurangi resiko kelainan tulang yang menyebabkan resiko jatuh pada lansia. Salah satu latihan fisik yang efektif adalah latihan keseimbangan taichi. Latihan keseimbangan taichi ditunjukan untuk membatu meningkatkan kekuatan otot pada anggota gerak bawah (kaki) dan untuk meningkatkan vestibuler atau keseimbangan tubuh. Berdasarkan hal tersebut latihan keseimbangan yang dapat dilakukan lansia adalah dengan latihan taichi karena latihan ini sangat membantu untuk mempertahankan tubuhnya agar stabil sehingga mencegah terjatuh yang sering terjadi pada lansia (Nurkoncoro, 2015)

1.2 Rumusan Masalah

Berdasarkan uraian latar belakang diatas maka yang menjadi pokok permasalahan pada penelitian ini adalah “bagaimanalatihan taichi untuk keseimbangan pada lansia?"berdasarkan artikel penelitian yang terunggah pada jurnal.

1.3 Tujuan penelitian

1.3.1 Tujuan Umum

Tujuan dari penelitian melakukan literature riview dari jurnal yaitu untuk mengetahui manfaat taichi untuk keseimbangan pada lansia

1.3.2 Tujuan Khusus

a) Mendeskripsikan keseimbangan pada lanjut usia melalui *literature review*
b) Menganalisa latihan taichi terhadap kemampuan keseimbangan pada lanjut usia melalui *literature review*

1.2 Manfaat Penelitian

1.4.1 Peneliti

Hasil literatur riview ini diharapkan dapat di jadikan sebagai bahan masukan atau informasi tambahan tentang pentingnya latihan taichi untuk keseimbangan yang di lakukan pada lansia.

1.4.2 Institusi

Hasil literatur riview ini dapat di gunakan sebagai informasi yang berguna bagi para pembaca untuk menambah wawasan, pengetahuan, dan juga sebagai acuan pembelajaran tentang penerapan asuhan keperawatan terkait dengan latihan keseimbangan taichi untuk kemampuan pada lansia.

1.4.3 Masyarakat

Hasil literatur riview ini dapat di gunakan sebagai informasi berguna bagi masyarakat terkhususnya bagi orang yang mengalami gangguan keseimbangan.

BAB 2

TINJAUAN PUSTAKA

2.1 Konsep lansia

2.1.1 Definisi lansia

Lansia atau lanjut usia adalah seseorang yang telah mencapai usia 60 tahun ke atas. Menua bukanlah suatu penyakit,tetapi merupakan proses yang berangsur-angsur mengakibatkan perubahan kumulatif, merupakan proses menurunnya daya tahan tubuh dalam menghadapi rangsangan dari dalam dan luar tubuh. Pada manusia, penuaan berkaitan dengan perubahan perubahan degeneratif pada kulit, tulang, pembuluh darah, paru-paru,saraf, dan jaringan tubuh lainnya. Karena kapasitas regenerasi yang terbatas, mereka lebih mungkin menderita untuk menderita berbagai penyakit, sindrom dan penyakit dibandingkan orang dewasa lainnya(Kholifah, 2016).

Lansia secara perlahan akan mengalami penurunan jaringan untuk memperbaiki dan mempertahankan keadaan normal, sehingga lansia sering kali berisiko mengalami berbagai macam penyakit (WHO, 2018). Sebagian besar lansia berusia 60 tahun ke atas akan mulai mengalami perubahan fisik dan mental.sejak seseorang memasuki usia tua kesehatan fisik akan memburuk dan kualitas hidup menurun seiring dengan berubahnya usia dan status ekonomi (Budi, 2016).

Seseorang yang telah memasuki masa lanjut usia akan terjadi kecenderungan menurunnya berbagai kapasitas fungsional ditubunya baik pada tingkat selular, maupun pada ingkat organ yang megakibatkan terjadinya

degenerasi pada proses menua. Hal ini, ini dapat berpengaruh pada perubahan fisiologis secara fisik, fungsi dan persepsi dikehidupan sehari-hari. Setiap individu mengalami perubahana-perubahan pada tubuhnya secara berbeda, ada yang laju penurunannya cepat dan dramatis serta ada juga yang perubahnnya lambat. Pada lanjut usia terjadi kemunduran sel-sel karena proses penuaan yang dapat berakibat pada kelemahan organ, kemunduran fisik, timbulnya berbagai macam penyakit (Fauzan; Aldhi, 2019)

2.1.2 Batasan Lanjut Usia

Di indonesia seseorang dikatakan lanjut usia ketika berumur 60 tahun ke atas. Hal ini sesuai dengan undang-undang nomor 13 tahun 1998 tentang kesejahteraan lanjut usia menekankan hal ini pada Bab 1, pasal 1, ayat 2 (Nugroho, 2008). Usia seorang lansia yang menjadi acuan berbeda hal ini sesuai dengan beberapa pendapat ahli tentang batasan usia lansia adalah sebagai berikut :

1. Menurut organisasi kesehatan dunia(WHO, 2018)ada empat tahapan yaitu:
    a. Usia pertengahan (middle age) lansia dengan usia 45-59 tahun
    b. Lansia (elderly) lansia dengan usia 60-74 tahun
    c. Lansia tua (old)lansia dengan usia 75-90 tahun
    d. Usia sangat tua (very old) lansia dengan usia >90 tahun
2. Menurut (Kemenkes RI, 2019)pembagian usia lanjut ada 3 yaitu :
    a. Kelompok lansia dini (45 sampai dengan <60 tahun) merupakan kelompok yang baru memasuki lansia atau pra lansia
    b. Kelompok lamsia usia pertengahan (60-70 tahun)

c. Kelompok lansia yang berisiko tinggi yaitu lansia yang berusia >70 tahun

Menurut (Elipoulus, 2010)batasan usia lanjut dibagi menjadi 3 yaitu :

1. Setengah tua yaitu lansia berusia antara 60-74 tahun
2. Tua yaitu lansia yang berusia antara 75-100 tahun
3. Sangat tua yaitu lansia yang berusia >100 tahun

2.2 Konsep Keseimbangan Tubuh

Menurut (Suhartono, 2006)bahwa keseimbangan tubuh adalah kemampuan seseorang untuk mempertahankan posisi tubuh agar tetap statik dan dinamik. Dapat disimpulkan yang dimaksud dengan keseimbangan tubuh adalah kemampuan tubuh mempertahankan postur agar tetap tegak dengan gravitasi dan tetap dalam landasan penopang untuk mengatur seluruh aktivitas diam (static) atau sedang bergerak (dinamik).

2.2.1 Perubahan Keseimbangan Tubuh Dalam Proses Menua

Proses menua adalah perubahan yang berkaitan dengan berjalanya waktu dan bersifat universal, intrinsik dan progresif. Perubahan tersebut mengakibatkan terjadinya penurunan kemampuan sel dan jaringan beradaptasi dengan lingkungan dan bertahan hidup. Perubahan pada fungsi fisiologis yaitu terjadi perubahan pada sensori, neurologis dan sistem saraf pusat, motorik dan muskuluskeletal (Achamanegara, 2012)

Proses penuaan berkaitan dengan penurunan sistem organ salah satunya sistem muskuluskeletal, menurunya sistem muskuluskeletal berdampak pada sistem keseimbangan tubuh karena terjadi atrofi otot yang menyebabkan penurunan kekuatan otot, terutama pada otot ekstremitas bawah sehingga terlambat mengantisipasi bila terjatuh atau terpeleset. Dengan terganggunya sistem muskuluskeletal akan berdampak pada strategi postural tubuh sehingga mempengaruhi keseimbangan (Maryam, 2010)

2.2.2 Komponen Keseimbangan Tubuh

Penuaan ditandai dengan perubahan komponen dari sistem musksuluskelatal yang berpengaruh terhadap keseimbangan. Konsekuensi dari penuaan adalah pada penurunan keseimbangan yang dimanifestasikan dalam beberapa komponen yaitu berdiri, bersandar, dan membungkuk, performa gerakan terkontrol dan respon terhadap gangguan eksternal(Achamanegara, 2012).

2.2.3 Penilaian Fungsi Keseimbangan

Ada berbagai jenis instrumen yang digunakan untuk melakukan penilaian terhadap keseimbangan. Salah satu instrumen yang memiliki tingkat validitas dan reliabilitas yang tinggi adalah BBS. BBS adalah sebuah skala yang terdiri dari 14 item observasi yang digunakan untuk menilai keseimbangan lansia di komunitas (Bitensky, 2008).

2.2.4 Faktor-Faktor yang Mempengaruhi Keseimbangan Tubuh Lansia

a. Usia Lansia

   Dibandingkan dengan orang yang lebih muda, menunjukan tingkat ketidakseimbangan yang lebih besar ketika berdiri yang ditandai dengan

goyangan postur tubuh. Kebanyakan penelitian menunjukan bahwa ketidakseimbangan meningkat dengan bertambahnya usia semakin bertambah usia sistem tersebut semakin menurun (Achmanegara, 2012).

b. Jenis Kelamin

(Tedeiksar, 2017)mengatakan lansia perempuan menunjukan angka ketidakseimbangan lebih besar daripada laki-laki. sehingga pada lansia perempuan cenderung akan mengalami risiko jatuh. Hasil penelitian maryam 17 diperoleh bahwa pada lansia perempuan kurang dalam melakukan aktivitas fisik dibandingkan dengan lansia laki-laki sehingga dapat mempengaruhi keseimbangan tubuh.

c. Aktivitas Fisik

Aktivitas fisik dapat mempertahankan fungsi muskuluskeletal sehingga keseimbangan tubuh pada lansia dapat dipertahankan. (Maryam, 2009) menyebutkan bahwa pada lansia yang memiliki aktivitas yang kurang berisiko terjadi gangguan keseimbangan dari pada lansia yang aktivitasnya baik. Aktivitas yang teratur dapat meningkatkan kebugaran, kekuatan dan koordinasi serta keseimbangan tubuh pada lansia (Harsuki, 2003). Aktivitas fisik mempunyai dampak positif terhadap keseimbangan tubuh, serta menurunkan risiko jatuh (SKelton, 2011)

d. Obat-obatan dan Alkohol

Obat-obatan tertentu mempengaruhi gangguan keseimbangan tubuh pada lansia karena menimbulkan efek mengantuk dan lansia menjadi kurang waspada. Beberapa diantaranya obat sedatif. Lansia dengan konsumsi obat yang banyak dapat mempengaruhi keseimbangan. Alkohol dapat menurunkan kewaspadaan dan dapat mempengaruhi keseimbangan tubuh lansia(Savira, 2016).

2.3 Konsep Senam Taichi

2.3.1 Pengertian Senam Taichi

Senam merupakan latihan tubuh yang dapat membentuk dan mengembangkan pribadi secara harmonis dengan terdapat beberapa unsur seperti melompat, memanjat, dan keseimbangan (Widiantri & Proverawati , 2012). Taichi merupakan suatu bentuk gaya seni bela diri dari china yang terdiri atas latihan meditasi, pergerakan melingkar, peregangan yang halus dan posisi seimbang pada tubuh. Taichi merupakan suatu keterampilan, kemampuan, atau usaha yang pada umumnya diterapkan pada pelatihan bela diri (Serikali, 2006). Senam taichi pada prinsipnya berbeda dengan senam yang lainnya seperti membakar kalori, membuat jantung berdebar-debar atau mengecilkan perut yang membedakan adalah senam ini melatih kekuatan otot (Sutanto, 2013). Senam taichi dapat dilakukan sebanyak 3 kali dalam seminggu selama sebulan dengan hasil yang efektif (Putri, 2014). Senam taichi juga dapat dengan efektif dilakukan selama 3 minggu dengan frekuensi 3 kali dalam seminggu (Ismiati, 2013).

2.3.2 Tujuan senam taichi

Tujuan dari senam taichi adalah untuk mengembangkan hubungan yang lebih erat antara tubuh, pikiran dan jiwa bagi pelaksana senam taichi ini. Senam taichi ini dilakukan dengan teknik gerakan yang sangat lambat untuk menyebarkan energi dalam tubuh. Taichi sangat berpengaruh pada tubuh dalam hal keseimbangan dan ketenangan. Tujuan senam taichi menurut (Sutanto, 2013)yaitu sebagai berikut:

a. Dapat diaplikasikan kepada anak-anak hingga manula untuk meningkatkan kesehatan fisik, keseimbangan jiwa dan mental serta memperkuat daya tahan tubuh yang merupakan suatu akibat dari adanya meditasi dalam senam sehingga mengaktifkan sistem endokrin serta pelepasan neurotransmitter.
b. Mengurangi kecemasan dan depresi
c. Memperbaiki keseimbangan, fleksibilitas dan kekuatan otot
d. Mengurangi resiko jatuh
e. Memperbaiki kualitas tidur
f. Menstabilkan tekanan darah sebab terdapat unsur meditasi, teknik relaksasi yang berdampak baik bagi denyut jantung
g. Memperbaiki kapasitas jantung pada lansia
h. Menghilangkan nyeri kronik pada gangguan neuromuskuluskeletal
i. Meningkatkan kapasitas energi
j. Meningkatkan kemampuan antioksidan dan imunitas
k. Mencegah osteoporosis

l. Merangsang organ internal untuk dapat berjalan dengan baik dan

m. Mempertahankan kualitas hidup yang maksimal

2.3.3 Prinsip Senam Taichi

Terdapat 10 prinsip dalam melakukan gerakan *Tai Chi* yaitu sebagai berikut (Sutanto, 2013):

a. Titik berat atau gravitasi tubuh terletak pada beberapa centimeter dibawah pusar (Tan Tiem);

b. Gerakan yang diberikan terus sambung menyambung tanpa putus;

c. Menggunakan pernafasan perut bukan pernafasan dada

d. Pikiran masuk ke dalam titik berat atau gravitasi tubuh

e. Terdapatnya gerakan membuka (ekspansi) dan menutup (kontraksi), maju mundur, naik turun, clockwise serta counter clockwise dan nafas yang masuk serta keluar secara berkesinambungan.

f. Gerakannya yang melingkar seperti ulir

g. Melatih rasa bukan otot;

h. Merupakan satu kesatuan yang dimana satu anggota tubuh bergerak yang lain juga ikut bergerak;

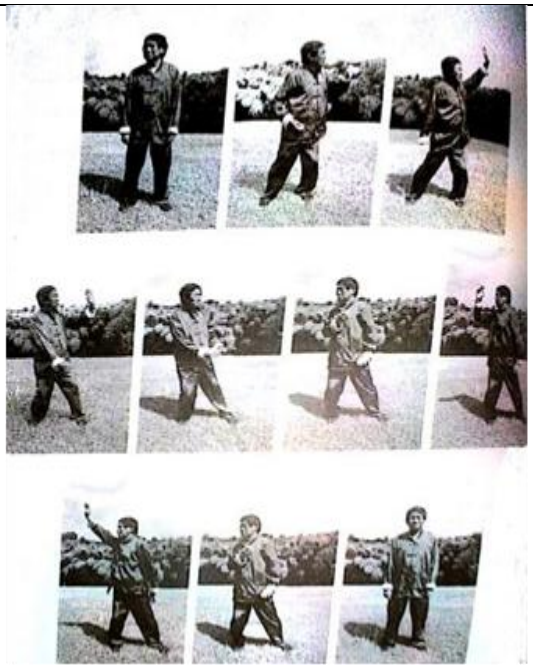
i. Pada saat bergerak mencari suatu ketenangan dan begitu juga sebaliknya; serta

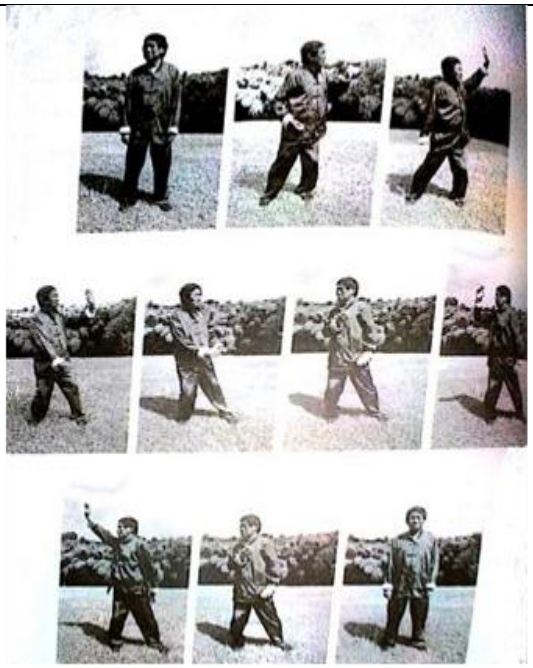
j. Gerakannya yang lincah.

2.3.4 Penatalaksanaan Senam Taichi

Gerakan-gerakan yang terdapat di dalam Senam *Tai Chi* ini adalah sebagai berikut (Sutanto, 2010)

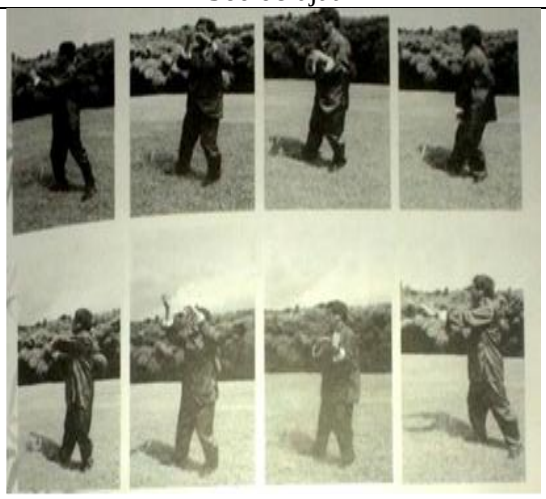
No	Gambar Gerakan	Keterangan
1	 Gambar 2.1 Gerakan Awal	Posisi awal, yaitu tubuh dalam posisi tegak lalu lutut menekuk bersamaan dengan kedua tangan yang diangkat dan siku menekuk membentuk sudut 45 derajat mendekati dada. Gerakan dilakukan secara perlahan lalu diturunkan secara bersamaan;
2	 Gambar 2.2 Gerakan Memeluk Rembulan	Posisi memeluk rembulan, yaitu kedua tangan diangkat ke atas dan siku menekuk 45 derajat mendekati dada lalu diikuti dengan lutut yang ditekuk. Lakukan secara perlahan lalu kembali ke posisi semula;

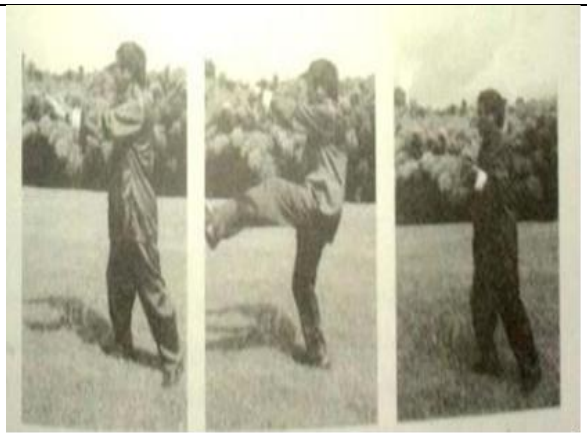
3	 Gambar 2.3 Gerakan Membuka Tirai	Membuka tirai kehidupan, yaitu kedua tangan mengumpul diperut naik hingga ke dada lalu melakukan gerakan menyamping hingga tangan sejajar dengan lengan. Lakukan gerakan dengan perlahan lalu kembali ke posisi semula;
4	 Gambar 2.4 Gerakan Menyanggah Langit	Menyanggah langit dengan dua kaki, yaitu kedua tangan mengumpul di perut tangan kanan menari ke bawah dan tangan kiri menarik ke atas lalu lakukan sebaliknya. Kembali ke posisi awal;

5	 Gambar 2.5 Gerakan Menyanggah Langit dengan Satu Kaki	Menyanggah langit dengan satu kaki, yaitu berawal dengan tubuh menghadap ke depan namun kepala menoleh ke arah kiri begitu juga dengan kaki kiri mengikuti kepala sedangkan kaki kanan tetap lurus ke depan. Gunakan kaki kanan untuk menyanggah tarik tangan kanan ke bawah dan tarik tangan kiri ke atas. Lakukan hal yang sama pada kaki yang kiri. Kembali ke posisi semula;
6	 Gambar 2.6 Gerakan Tangan Awan	Tangan awan, yaitu posisi tubuh menghadap ke kanan dengan tangan kanan sejajar dengan dada membentuk sudut 45 derajat sedangkan tangan kiri berada di pusar menghadap ke atas. Kaki membuka dengan kaki kanan menghadap ke kanan dan kaki kiri menghadap ke depan. Tangan kanan bergeser ke arah kiri begitu juga dengan kaki bergesar mengikuti gerak tubuh menghadap ke kiri. Lakukan sebaliknya dengan membelokkan tubuh ke arah yang berlawanan.

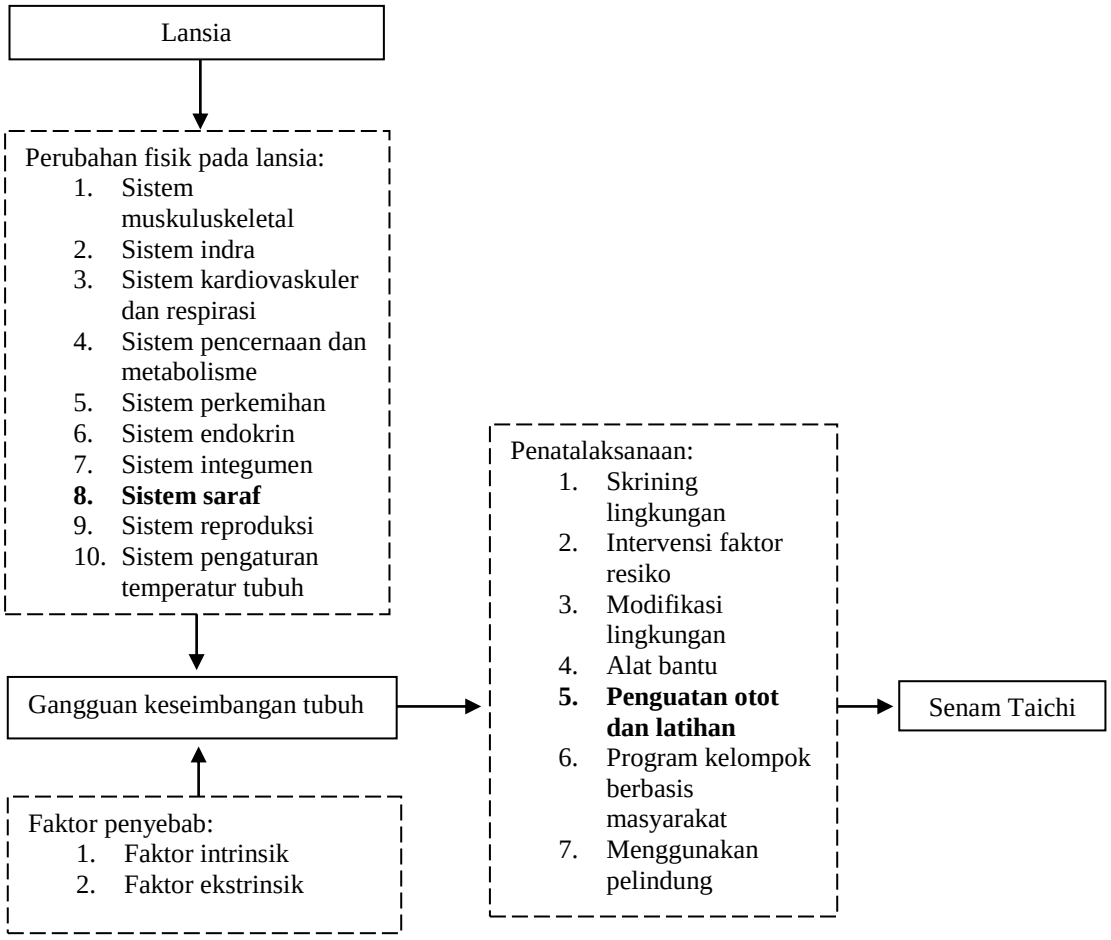
7	 Gambar 2.7 Gerakan Mengelus Ekor Burung	Mengelus ekor burung, tubuh dalam posisi menghadap ke arah kanan dengan kaki menekuk lalu kaki kanan maju ke depan menjadi tumpuan tubuh sedangkan tangan kiri ke belakang dan tangan kanan ke arah ke depan dan atas. Lalu tarik kedua tangan hingga berkumpul ke pusar dan menjadikan kaki kiri menjadi tumpuan tubuh. Tubuh berputar ke arah yang berlawan dan lakukan gerakan mengelus ekor burung kembali. Lalu kembali ke posisi semula;
8	 Gambar 2.8 Gerakan Memindahkan Gunung Mengeruk Lautan	Memindahkan gunung mengeruk lautan, yaitu tubuh menghadap ke arah kiri lalu kaki kiri maju ke depan dan mejadikan kaki kanan sebagai tumpuan. Lalu kedua tangan mengangkat ke atas dan mengayun ke arah sebaliknya. Lakukan pada arah yang sebaliknya pula;

9	 Gambar 2.9 Gerakan Pecut Tunggal	Pecut tunggal, yaitu tubuh menghadap ke arah kanan lalu kaki kanan sebagai tumpuan maju ke arah depan, tangan kanan mengangkat sejajar dengan lengan sedangkan tangan kiri di bawah. Lalu lakukan gerakan memecut perlahan menuju arah yang sebaliknya
10	 Gambar 2.10 Gerakan Putri Cantik Menenun	Gerakan putri cantik menenun, yaitu tubuh menghadap ke arah kiri dengan tangan melakukan gerakan mengayun ke atas seperti menenun lalu kaki berbelok ke arah depan. Lalu tetap melakukan gerakan mengayun ini dan tubuh berputar 270 derajat;

11	 Gambar 2.11 Gerakan Tendangan Datar Berputar 360 derajat	Tendangan datar berputar 360 derajat, yaitu posisi tubuh menghadap ke depan lalu menghadap ke kiri dan selanjutnya tubuh berputar 360 derajat ke arah kanan. Kaki kiri diletakkan di depan dan tangan berkumpul di dada. Kaki kiri diangkat sebisanya dan kedua tangan sejajar dengan lengan. lalu kembali ke posisi awal;
12	 Gambar 2.12 Gerakan Memutar Roda Kehidupan	Memutar roda kehidupan, yaitu tubuh menghadap ke kanan dan menjadikan kaki kanan sebagai tumpuan lalu pinggang mengayun dengan tangan berputar membentuk lingkaran;

13	 Gambar 2.13 Gerakan Tendangan Mengayun	Tendangan mengayun, yaitu tubuh menghadap ke arah kanan dengan kaki kanan sebagai tumpuan, kedua tangan sejajar dengan lengan lalu kaki kiri menendang ke arah depan;
14	 Gambar 2.14 Gerakan Memungut Batu dan Memetik Daun Muda	Memungut batu dan memetik daun muda, yaitu gerakan tubuh dari posisi berdiri ke posisi tubuh jongkok (seperti mengambil batu) lalu mengangkat tangan ke arah atas dan disejajarkan dengan lengan tubuh.

2.4 Kerangka Teori



Gambar 2.15 Kerangka Teori Latihan Taichi untuk Keseimbangan Lansia

BAB 3

METODE PENELITIAN

3.1 Strategi Pencarian Literature

3.1.1 Protokol dan Registrasi Desain penelitian

Dalam protokol dan registrasi keseluruhan rangkuman dari *literature review* mengenai latihan keseimbangan taichi Protokol dan evaluasi dari *literature review*akan menggunakan PRISMA *flow diagram*untuk menentukan penyeleksian studi yang telahditemukan dan disesuaikan dengan tujuan dari *literature review*(Nursalam, 2020). Sebagai upaya menentukan pemilihan studi dari beberapa literatur yang telah ditemukan dan disesuaikan dengan tujuan dari *literature review.* Desain penelitian ini menggunakan studi *literatur review*, yaitu serangkaian penelitian yang dilakukan dengan metode pengumpulan data pustaka atau yang objek penelitiannya digali melalui berbagai artikel. Fokus penelitian ini dengan mencari berbagai referensi yang relevan dengan permasalahan atau topik yang diangkat oleh peneliti yang digunakan untuk menganalisis dan memecahkan pertanyaan penelitian yang dirumuskan

3.1.2 Database Pencarian

Sumber data adalah tempat didapatkan data yang digunakan tentang informasi. Sumber data terbagi menjadi dua yaitu sumber data primer dan sumber data sekunder (Sugiono, 2018). Pencarian literature dilakukan pada bulan September 2020 sampai Maret 2021 menggunakan tiga database dengan kriteria kualitas sedang hingga tinggi yaitu *Google Scholar, ProQuest dan Science Direct.*

Data yang digunakan dalam penelitian ini adalah data sekunderyang diperoleh bukan dari pengalaman langsung, akan tetapi diperolehdari hasil penelitian yang telah dilakukan oleh peneliti-peneliti terdahulu.Sumber data sekunder yang didapat berupa artikel jurnal bereputasi baiknasional maupun internasional dengan tema yang sudah ditentukan(Nursalam, 2020).

3.1.3 Kata Kunci

Pencarian artikel atau jurnal menggunakan *keyword* dan*Boolean operator (AND, OR NOT or AND NOT)* yang digunakan untukmempeluas atau menspesifikasikan pencarian, sehingga mempermudahdalam penentuan artikel atau jurnal yang digunakan. Pada penelitian ini khususnya menggunakan *boolen operator* AND dan OR untuk menjelaskan alur pencarian kata kunci. Dengan rincian sebagai berikut:

Tabel 3.1 Kata Kunci pencarian literature latihan taichi untuk kemampuan keseimbangan pada lansia

Kata Kunci						
Balance	*AND*	*Exercise*	*AND*	*Taichi*	*AND*	*Elderly*
OR		*OR*		*OR*		*OR*
Stability	*AND*	*Physical Activity*	*AND*	*Taichi Cuan*	*AND*	*Older Adult*
		OR		*OR*		*OR*
		Physical Exercise	*AND*	*TCC*	*AND*	*Older People*
				OR		
				Traditional Taichi		

3.2 Kriteria Inklusi dan Eksklusi

Strategi yang digunakan dalam mencari artikel menggunakan PICOS *framework,* yaitu terdiri dari :

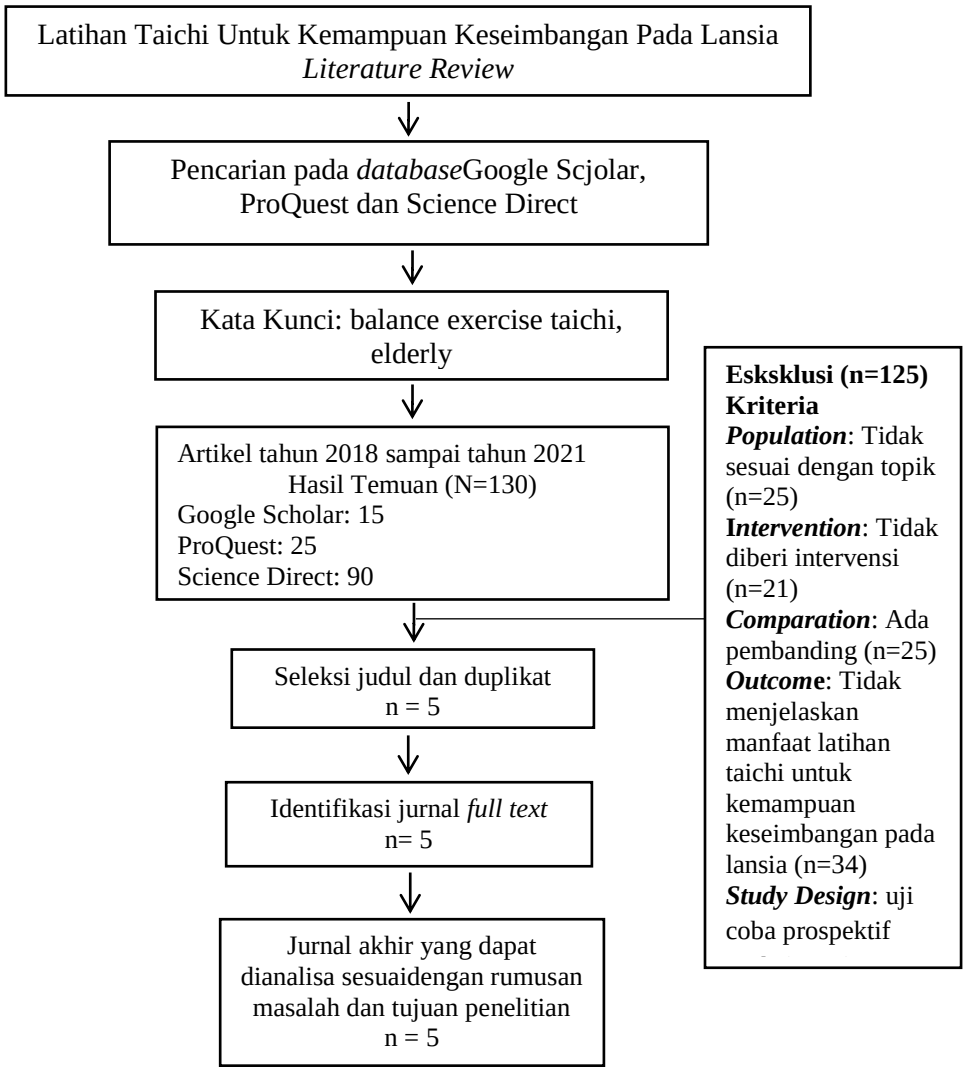
1) *Population/Problem* merupakan populasi atau masalah yang akan dianalisis sesuai dengan tema yang sudah ditentukan dalam *literature review;*
2) *Intervention* merupakan tindakan penatalaksanaan terhadap kasus baik individu atau kelompok masyarakat serta pemaparan tentang penatalaksanaan studisesuai dengan tema yang sudah ditentukan dalam *literature review;*
3) *Comparation* merupakan penatalaksanaan atau intervensi lainnya yang digunakan sebagai pembanding, namun jika tidak ada bisamenggunakan kelompok control pada artikel yangdipakai;
4) *Outcome* merupakan hasil atau luaran yang diperoleh pada studi terdahulu yang sesuai dengan tema yang sudah ditentukan dalam *literaturereview*;
5) *Study design* merupakan desain penelitian yang digunakan dalam artikel-artikel yang akan direview.

Tabel 3.2 PICOS latihan taichi untuk kemampuan keseimbangan pada lansia

Kriteria	Inklusi	Eksklusi
Population/problem	Kelompoklansia berusia 60 tahun keatas	Kecuali kelompoklansia
Intervention	Semua kelompok lansia yang mengalami penurunan kemampuan keseimbangan	Tidak terdapat intervensi
Outcomes	Mengetahui manfaat latihan taichi untuk kemampuan keseimbangan pada lansia	Tidak mengetahui manfaat latihan taichi untuk kemampuan keseimbangan pada lansia
Study Design	*Experimen randme*	Selain *ekspermen*
Publication years	2018-2021	Sebelum 2018
Language	Bahasa Indonesia dan Bahasa Inggris	Selain Bahasa Indonesia dan Bahasa Inggris

3.3 Seleksi Studi dan Penilaian Kualitas

3.3.1 PRISMA *Flow Diagram*



Gambar 3.1 PRISMA Flow Diagram Latihan Taichi Untuk Kemampuan Keseimbangan Pada Lansia

3.2.2 Hasil Pencarian *Literature Review*

Penelitian ini menggunakan data sekunder yaitu data yang diperoleh tidak dari pengamatan langsung tetapi mengambil dari penelitian yang pernah dilakukan oleh peneliti-peneliti sebelumnya. Pencarian *literature* dilakukan pada bulan september 2020 sampai dengan Maret 2021. Artikel yang ditemukan kemudian dilakukan seleksi menggunakan PICOS dan PRISMA Flow Diagram untuk menentukan artikel mana yang akan dipilih untuk dilakukan *literature review*. Ditemukan sebanyak 130 artikel yang kemudian dilakukan seleksidan diekslusikan 125 artikel dengan rincian *Population*: Tidak sesuai dengan topik (n=25)I*ntervention*: Tidak diberi intervensi (n=20)*Comparation*: Ada pembanding (n=25) *Outcom*e: Tidak menjelaskan latihan taichi untuk kemampuan keseimbangan pada lansia (n=34)*Study Design*: uji coba prospektif acak (n=20) lalu tersisa 5 artikel untuk diseleksi judul, duplikat dan untuk dinilai kelayakannya. Sampai hasil akhir didapatkan 5 artikel untuk dilakukan analisa

BAB 4

HASIL DAN ANALISIS

4.1 Hasil

4.1.1 Hasil Pencarian Literatur

Setelah dilakukan pencarian artikel dengan dua database, kemudian artikel yang telah ditemukan dilakukan analisa dan hasil akhir ditemukan enam artikel untuk dilakukan analisa dengan rincian sebagai berikut:

Tabel 4.1 Hasil Temuan Artikel Latihan Taichi untuk Keseimbangan pada Lansia

No	Peneliti, Tahun Terbit	Judul Artikel	Metode Penelitian (Desain, Populasi, Sampel, Sampling, Variabel, Instrumen, Analisis)	Hasil penelitian	Sumber (Nama Jurnal, No. Jurnal)
1.	Po-Jung Chen, I-Wen Penn, Shun-Hwa Wei, Long-Ren Chuan, Wen-Hsu Sung 21 Mei 2020	Augmented reality-assisted training with selected Tai-Chi movements improves balance control and increases lower limb muscle strength in older adults: A prospective randomized trial	**Desain Penelitian:** *randomized controlled trial* **Populasi:** Penduduk Distrik Beitou Taipei City, Taiwan **Sampel:** Lansia berusia diatas 65 tahun dan dengan skor MMSE > 24 **Sampling:** Purposive Sampling **Variabel:** Gerakan Taichi, keseimbangan, kekuatan otot **Instrumen:** • MMSE: dimensia dan kemampuan kognitif • Beng Balance Scale: tes keseimbangan fungsional • Time up and Go	Hasil Evaluasi terdiri dari 3 tes keseimbangan fungsional, BBS, TUG, dan FRT, dan penilaian kekuatan otot tungkai bawah. Pada kelompok sTC, skor BBS, TUG, dan FRT menunjukkan signifikan tidak bisa diperbaiki secara keseluruhan. Kekuatan setiap otot tungkai bawah juga meningkat rata-rata 3,1 ± 1,0 kgw. Penilaian kekuatan otot menunjukkan peningkatan di semua otot tungkai bawah, dengan rata-rata 1,6 ± 0.8	Journal of Exercise Science & Fitness 18 Science direct

			test: tes keseimbangan fungsional • Function Reach Test: pengukuran otot ekstermitas bawah **Analisis:** distribusi normal dan dievaluasi dengan uji Shapiro-Wilk, uji Wilcoxon digunakan untuk uji dalam kelompok dan uji Mann-Whitney digunakan untuk uji antar kelompok	kgw. kelompok sTC dan tTC, peserta dalam kelompok sTC menunjukkan peningkatan pada semua 19 item setelah intervensi sTC, sementara hanya 6 dari 19 item yang menunjukkan peningkatan setelah intervensi tTC.	
2.	Thomson W.L. Wong 6 Mei 2019	Feasibility and preliminary efficacy of Ai Chi aquatic exercise training in Hong Kong's older adults with risk of falling: Design and methodology of a randomized controlled trial	**Desain Penelitian:** *randomized controlled trial* **Populasi:** Lansia di pusat komunitas di Hongkong **Sampel:** Empat puluh orang lansia berusia diatas 65 tahun dengan risiko jatuh sedang hingga tinggi **Sampling:** Pengambilan sampel secara praktis **Variabel:** Gerakan Taichi, keseimbangan, kekuatan otot **Instrumen:** • MMSE: dimensia dan kemampuan kognitif • Beng Balance Scale: tes keseimbangan fungsional • Time up and Go test: tes keseimbangan fungsional • Function Reach Test: pengukuran	penelitian ini memberikan kontribusi untuk mengevaluasi keefektifan dari dua program latihan pencegahan jatuh komunitas dengan membandingkan kelayakan dan pendahuluan tingkat program (yaitu, program latihan akuatik Ai Chi dan program latihan berbasis lahan), kelayakan Efektivitas dan kesesuaian program untuk orang dewasa yang lebih tua di Hong Kong bisa lebih dipahami. Dari penelitian ini diketahui bahwa pencegahan jatuh berbasis bukti global pada lansia oleh Terapis Fisik memiliki efek yang baik terhadap	Contemporary Clinical Trials Communications Science direct

			otot ekstermitas bawah **Analisis** alysis of Variance (ANOVA)	pencegahan jatuh dan keseimbangan lansia.	
3.	Sheng Chen 2019	Effect of Tai Chi Exercises on the Balance, Functional Gait, and Flexibility of Elderly Filipino Males	**Desain Penelitian:** Randomized controlled Pre dan Post Test **Populasi:** Lansia di kota Pasay Filiphina **Sampel:** Empat puluh orang lansia berusia diatas 55-60 tahun dengan risiko jatuh sedang hingga tinggi **Sampling:** Tidak dijelaskan dengan detail **Variabel:** Latihan Taichi, keseimbangan, kekuatan otot **Instrumen:** • Beng Balance Scale: tes keseimbangan fungsional • Time up and Go test: tes keseimbangan fungsional • Sit and reach flexibility (cm): fleksibilitas lansia **Analisis** Menggunakan paired t-test	Studi ini menunjukkan bahwa Tai Chi menawarkan manfaat potensial bagi pria lanjut usia dalam hal keseimbangan dan fungsi fisik lainnya. Perbaikan terlihat pada keseimbangan fungsional, gaya berjalan dan fleksibilitas. Studi membuktikan bahwa Tai Chi harus menjadi metode alternatif bagi pria lanjut usia untuk memperlambat penurunan normal dalam keseimbangan, kinerja gaya berjalan dan fleksibilitas fisik.	Advances in Social Science, Education and Humanities Research Google Scholar
4.	Wei Sun, Xiujie Ma, Lin Wang, Cui Zhang, Qipeng Song Houxin Gu, Dewei Mao	Effects of Tai Chi Chuan and Brisk Walking Exercise on Balance Ability in Elderly Women: A Randomized	**Desain Penelitian:** *randomized controlled trial* **Populasi:** Lansia wanita di Jinan, Provinsi Shandong China **Sampel:** 48 lansia wanita **Sampling:** Random sampling	Hasil penelitian menunjukkan bahwa 12 dan 16 minggu TCC dan BW, masing-masing penting untuk meningkatkan keseimbangan dengan mata	Human Kinetics Article Science direct

	2018	Controlled Trial	**Variabel:** Latihan Taichi, keseimbangan, kekuatan otot **Instrumen:** • Keseimbangan diukur dengan *single leg stance* SLS **Analisis:** Menggunakan uji ANOVA	tertutup di antara wanita berusia 60 tahun. - 70 tahun.	
5	Chenfu Huang and Tzu-Hsiang Yang September 2018	The Benefits of Tai-Chi Exercise On Balance Control in Elderly During Stair-To-Floor Transition	**Desain Penelitian:** *Randomized Controlled Trial* dengan *pretest, posttest dan control group* **Populasi:** Lansia yang berada di Taipei Taiwan **Sampel:** 24 lansia yang terdiri dari 12 kelompok control dan kelompok yang diteliti **Sampling:** Purposive sampling **Variabel:** Latihan Taichi, keseimbangan, kekuatan otot **Instrumen:** • Beng Balance Scale: tes keseimbangan fungsional • Time up and Go test: tes keseimbangan fungsional **Analisis** Uji T-test	Peserta latihan Tai Chi jangka panjang dapat meningkatkan keseimbangan pada lansia selama transisi dari tangga ke lantai. Disarankan bahwa partisipasi dalam latihan Tai-Chi akan meningkatkan keseimbangan dan kinerja dalam aktivitas sehari-hari.	Department of Physical Education, National Taiwan Normal University Google Scholar

4.1.2 Karakteristik Studi

Lima artikel yang telah diperoleh melalui pencarian sesuai dengan protokol dan registrasi memenuhi kriteria inklusi yang sudah ditetapkan yaitu

berdasarkan kriteria populasi dalam penelitian ini merupakan seluruh kelompok lansia, intervensi yang diinklusikan adalah lansia yang melakukan senam taichi, dalam penelitian ini tidak terdapat pembanding karena dalam penelitian ini hanya ingin mengetahui manfaat taichi untuk keseimbangan lansia. Luaran yang diinginkan yaitu artikel yang menjelaskan manfaat latihan taichi untuk kemampuan keseimbangan pada lansia. Studi desain yang menjadi inklusi adalah penelitian dengan desaineksperimental *randomized controlled trial*. Berdasarkan topik *literature review* tentang manfaat latihan taichi untuk kemampuan keseimbangan pada lansia diketahui dari 5 artikel menggunakan studi desain *randomized controlled trial*atau prospektif. Penelitian dilakukan dengan mengambil data langsung pada setiap responden.

4.1.3 Karakteristik Responden Studi

Tabel 4.2 Karakteristik Responden Studi

No	Peneliti, Tahun Terbit	Judul Artikel	Karaktersitik Responden				
			Umur	Jenis Kelamin	Pendidikan	Status Kesehatan	Terapi
1.	Po-Jung Chen, I-Wen Penn, Shun-Hwa Wei, Long-Ren Chuan, Wen-Hsu Sung 21 Mei 2020	Augmented reality-assisted training with selected Tai-Chi movements improves balance control and increases lower limb muscle strength in older adults: A prospective randomized trial	28 orang lansia berusia 65 tahun	Karakteristik responden Jenis kelamin laki-laki sebanyak 2 orang untuk kelompok intervensi taichi pilihan dan 1 orang untuk kelompok taichi tradisional. Kemudian kelompok perempuan 12 orang	Tidak dijelaskan secara detail	Skor MMSE >24 memiliki fungsi kognitif normal. Tidak memiliki penyakit gangguan sistem saraf pusat atau sistem muskuloske letal, termasuk stroke, cedera kepala,	Mampu berpartisipasi pada penelitian dengan melakukan gerakan senam taichi tradisional (tTC) dan melakukan gerakan senam taichi pilihan (sTC)

				untuk intervensi taichi pilihan dan 13 orang kelompok taichi tradisional		Parkinson's dan patah tulang	
2.	Thomson W.L. Wong 6 Mei 2019	Feasibility and preliminary efficacy of Ai Chi aquatic exercise training in Hong Kong's older adults with risk of falling: Design and methodology of a randomized controlled trial	40 orang lansia berusia 65 tahun atau lebih	Jenis kelamin tidak dijelaskan secara rinci antara kelompok intervensi dan kelompok control	Tidak dijelaskan secara detail	Lansia dengan skor MMSE >24 atau skor antara 24/28 dengan *Tietti Balance Assessment Tool* serta tidak memiliki riwayat penyakit neurologis, dan tidak memiliki kontraindikasi untuk latihan akuatik	20 peserta diberikan intervensi senam taichi dan 20 peserta lainnya sebagai kelompok control
3.	Sheng Chen 2019	Effect of Tai Chi Exercises on the Balance, Functional Gait, and Flexibility of Elderly Filipino Males	40 orang lansia berusia 55-60 tahun	Pada penelitian ini menggunakan lansia laki-laki sebagai responden	Tidak dijelasakan secara rinci	Status kesehatan responden pada penelitian ini adalah lansia yang tidak memiliki masalah kesehatan seperti gangguan kognitif, penyakit kardiovaskular simptomatik pada	Responden dinilai keseimbangannya terlebih dahulu sebelum diberikan intervensi Taichi kemudian dilakukan latihan taichi dengan 24 gerakan selama 60 menit

						tingkat aktivitas sedang, hipertensi yang tidak terkontrol atau hipotensi ortostatik simtomatik, gangguan neurologis lainnya, neuropati perifer pada ekstremitas bawah, artritis yang melumpuhkan, dan kanker metastasis. Selain itu, responden tidak sedang mengkonsumsi obat-obatan yang dapat mempengaruhi keseimbangannya. Semua responden diminta untuk menahan diri dari mengubah rutinitas gaya hidup sehari-hari mereka.	
4.	Wei Sun, Xiujie Ma, Lin Wang, Cui	Effects of Tai Chi Chuan and Brisk Walking	48 lansia wanita berusia 60-70 tahun	Responden pada penelitian ini merupakan kelompok	Tidak dijelaskan secara rinci	Pada penelitian ini status kesehatan lansia yang	Peserta melakukan penilaian awal

	Zhang, Qipeng Song Houxin Gu, Dewei Mao 2018	Exercise on Balance Ability in Elderly Women: A Randomized Controlled Trial		lansia wanita		diesklusikan adalah lansia yang melakukan olahraga teratur, pernah jatuh dan mengalami penyakit kardiovaskular, neurologis dan masalah pada muskuloskeletal	kemudian peserta diacak untuk melakukan taichi, *birsk walking* (BW) dan kelompok control atau kelompok yang tidak diberi intervensi
5	Chenfu Huang and Tzu-Hsiang Yang September 2018	The Benefits of Tai-Chi Exercise On Balance Control in Elderly During Stair-To-Floor Transition	Total 24 orang lansia dengan rincian 12 orang responden lansia sebagai kelompok intervensi dan 12 orang lagi sebagai kelompok kontol dengan usia diatas 60 tahun	Karakteristik responden Jenis kelamin tidak dijelaskan secara rinci antara laki-laki dan perempuan	Tidak dijelaskan secara rinci	Lansia yang tidak memiliki masalah penyakit neurologis atau ortopedi yang diketahui dan kesulitan saat ini yang menghambat gerak khas mereka	12 orang responden lansia sebagai kelompok intervensi melakukan latihan taichi regular dan 12 orang lagi sebagai kelompok kontol

Karakteristik responden dari lima artikel pada penelitian ini adalah lansia yang melakukan latihan keseimbangan dengan senam taichi. Dalam penelitian melibatkan lansia dengan skor MMSE diatas 24 yang masih aktif secara fisik dan tidak mengalami masalah atau gangguan fisiologis seperti mengalami penyakit pada sistem kardiovaskula, pada sistem neurologis dan pada sistem muskuluskeletal. Sebagian besar penelitian hanya melakukan penelitian kurang

dari 50 responden dengan rata-rata hanya sebanyak 20 responden. Responden dalam penelitian ini sebagian besar berusia diatas 60 tahun. Karakteristik *gender* pada responden hampir sama antara laki-laki dan perempuan dikarenakan studi bersifat menyeluruh terhadap lansia yangberada di komunitas.

4.2 Analisis

4.2.1 Kemampuan Keseimbangan Pada Lanjut Usia

Hasil *review* dari 5 artikel yang membahas tentang kemampuan keseimbangan pada lanjut usia dapat dilihat dari tabel berikut:

Tabel 4.3 Keseimbangan Pada Lanjut Usia

No	Artikel	Hasil temuan
1	Augmented reality-assisted training with selected Tai-Chi movements improves balance control and increases lower limb muscle strength in older adults: A prospective randomized trial (Chen, et al., 2020)	Pada penelitian keseimbangan lansia diketahui memiliki permasalahan yang diakibatkan karena proses penuaan dan perubahan fisiologis, pada penelitian ini mengecualikan responden yang mengalami gangguan system syaraf pusat dan system musculoskeletal, termasuk stroke, patah tulang, cidera kepala dan Parkinson. Penelitian ini melakukan Tes keseimbangan fungsional, termasuk Berg Balance Scale (BBS), Timed Up and Go test (TUG) dan Functional Reach Test (FRT), serta pengukuran kekuatan otot ekstremitas bawah.
2	Feasibility and preliminary efficacy of Ai Chi aquatic exercise training in Hong Kong's older adults with risk of falling: Design and methodology of a randomized controlled trial (Wong, 2019)	Pada penelitian ini dibagi 2 kelompok kedalam kelompok intervensi dan kelompok kontrol. Diketahui kedua kelompok tersebut memiliki masalah yang sama pada keseimbangan dan diukur menggunakan *Beng Balance Scale*dan *Time up and Go test*
3	Effect of Tai Chi Exercises on the	Pada penelitian ini diketahui sebagian lansia memiliki masalah keseimbangan. Pada penelitian

	Balance, Functional Gait, and Flexibility of Elderly Filipino Males (Chen S. , 2019)	skor keseimbangan diukur dengan kuesioner *Time up and Go test* didapatkan hasil skor keseimbangan sebesar 42,3%
4	Effects of Tai Chi Chuan and Brisk Walking Exercise on Balance Ability in Elderly Women: A Randomized Controlled Trial (Sun, et al., 2018)	Pada penelitian ini menyebutkan bahwa 48 lansia dinilai keseimbangannya dengan kuesioner *single leg stance* (SLS) yaitu peserta diminta untuk berdiri menggunakan satu kaki dan diuji setiap 4 minggu sekali selama 12 minggu jadi total terdapat 3 kali pengambilan data untuk mengetahui keseimbangan lansia. diketahui bahwa lansia memiliki masalah pada keseimbangan diketahui dari skor SLS sebesar 35,5%
5	The Benefits of Tai-Chi Exercise on Balance Control in Elderly During Stair-to-Floor Transition (Huang & Yang, 2018)	Penelitian ini dilakukan untuk mengetahui keseimbangan lansia dalam turun tangga, lansia, dengan menggunakan COP yaitu untuk mengetahui perubahan pusat tekanan dan COM untuk mengetahui pergerakan masa tubuh, maka dapat diketahui tingkat keseimbangan lansia. Lansia memiliki masalah pada saat menuruni anak tangga disebabkan oleh perubahan fisiologis pada tubuhnya

Berdasarkan hasil analisa dari lima artikel di atas, diketahui sebagian besar lansia mengalami masalah keseimbangan, berdasarkan artikel di atas diketahui tingkat keseimbangan lansia memiliki masalah disebabkan oleh perubahan fisiologis pada tubuhnya dengan skor pretest setiap responden tinggi.

4.2.2 Latihan Taichi Untuk Kemampuan Keseimbangan Pada Lanjut Usia

Hasil *review* dari lima artikel yang membahas tentang latihan taichi untuk keseimbangan pada lanjut usia dapat dilihat dari tabel berikut:

Tabel 4.4Latihan Taichi untuk Kemampuan Keseimbangan Pada Lanjut Usia

No	Artikel	Hasil temuan

1	Augmented reality-assisted training with selected Tai-Chi movements improves balance control and increases lower limb muscle strength in older adults: A prospective randomized trial (Chen, et al., 2020)	Berdasarkan penelitian diketahui latihan taichi yang dilakukan selama 8 minggu oleh dua kelompok responden memiliki pengaruh terhadap meningkatnya keseimbangan lansia, hal tersebut dapat terlihat dari skor keseimbangan yang diukur *dengan Beng Balance Scale* (BBS) dan *Timed Up and Go* (TUG) **Skor minggu pertama:** Kelompok sTC: • *Beng Balance Scale* (BBS): 50,3% • *Timed Up and Go* (TUG): 8,7% Kelompok tTC: • *Beng Balance Scale* (BBS): 49,2% • *Timed Up and Go* (TUG): 9,0% **Skor setelah 8 minggu:** Kelompok sTC: • *Beng Balance Scale* (BBS): 54,0% • *Timed Up and Go* (TUG): 6,9% Kelompok tTC: • *Beng Balance Scale* (BBS): 51,1% • *Timed Up and Go* (TUG): 8,4% Setelah intervensi nilai p value BBS: 0,044 dan TUG: 0,016
2	Feasibility and preliminary efficacy of Ai Chi aquatic exercise training in Hong Kong's older adults with risk of falling: Design and methodology of a randomized controlled trial (Wong, 2019)	Pada penelitian ini dibagi 2 kelompok kedalam kelompok intervensi dan kelompok kontrol. Kelompok intervensi melakukan latihan taichi selama 16 sesi dan dilakukan selama 8 minggu. Selanjutnya kelompok kontrol diberikan intervensi latihan *Land-based exercise*. Diketahui kedua kelompok tersebut memiliki masalah yang sama pada keseimbangan sebelum dilakukan intervensi, keseimbangan diukur menggunakan *Beng Balance Scale*(BBS), *Tinetti Balance Assessment* (TBS) dan *Time up and Go test* (TUG). Setelah penelitian diketahui bahwa skor dari skor BBS dan TBS yang meningkat dan skor TUG yang lebih rendah
3	Effect of Tai Chi Exercises on the Balance, Functional Gait, and Flexibility of Elderly Filipino Males (Chen S. , 2019)	Pada penelitian ini diketahui sebagian lansia memiliki masalah keseimbangan. Pada penelitian skor keseimbangan diukur terlebih dahulu dengan kuesioner *Time up and Go test* sebelum diberikan intervensi didapatkan hasil skor keseimbangan sebesar 42,3% setelah diberikan intervesi skor post tes meningkat menjadi 51,7%. Setelah intervensi latihan Tai Chi Chuan 16 minggu, keseimbangan fungsional meningkat secara signifikan (p = 0,02).
4	Effects of Tai Chi Chuan and Brisk Walking Exercise on Balance Ability in Elderly Women:	Pada penelitian ini menyebutkan bahwa 48 lansia dibagi menjadi 3 kelompok untuk melakukan Taichi, jalan cepat (BW) dan kelompok kontrol kemudian dinilai keseimbangannya dengan kuesioner *single leg stance* (SLS) yaitu peserta diminta untuk berdiri

	A Randomized Controlled Trial (Sun, et al., 2018)	menggunakan satu kaki dan diuji setiap 4 minggu sekali selama 12 minggu. Didapatkan hasil program pelatihan intervensi selama 60 menit di lima sesi setiap minggu selama 16 minggu memiliki pengaruh pada keseimbangan lansia. Keseimbangan berdiri satu kaki diuji setiap 4 minggu. Hasil penelitian menunjukkan bahwa semua responden penelitian membaik pada minggu kedelapan ($p<.05$) di kelompok TCC dan pada minggu ke-12 ($p<.01$) di grup BW.
5	The Benefits of Tai-Chi Exercise on Balance Control in Elderly During Stair-to-Floor Transition (Huang & Yang, 2018)	Penelitian ini dilakukan untuk mengetahui keseimbangan lansia dalam turun tangga, lansia dengan menggunakan COP yaitu untuk mengetahui perubahan pusat tekanan dan COM untuk mengetahui pergerakan masa tubuh, maka dapat diketahui tingkat keseimbangan lansia. Lansia memiliki masalah pada saat menuruni anak tangga disebabkan oleh perubahan fisiologis pada tubuhnya. Hasil penelitian menunjukkan bahwa kelompok Tai-Chi memiliki perpindahan AP COP yang lebih besar, yang konsisten dengan penelitian sebelumnya didapatkan hasil bahwa nilai p value untuk pemisah antara COM dan COP <.01

Berdasarkan hasil analisa dari lima artikel mengenai latihan taichi untuk keseimbangan lansia didapatkan hasil bahwa dari lima artikel keseluruhan menyebutkan adanya perubahan positif pada responden setelah melakukan latihan taichi untuk keseimbangan mereka. Mereka melaporkan perubahan yang terjadi tidak hanya pada keseimbangan tetapi juga pada fungsi tubuh lansia yang lain. Selain itu perubahan yang terjadi pada keseimbangan lansia setelah diberikan latihan taichi dapat dilihat dari nilai p value yang menunjukan hasil <.01 pada hampir semua penelitian.

BAB V

PEMBAHASAN

5.1 Kemampuan Keseimbangan pada Lanjut Usia

Hasil Hasil *literature review* dari lima artikel, menunjukkan bahwa sebagian besar lansia mengalami masalah keseimbangan hal tersebut ditunjukkan pada artikel pertama yang menyatakan bahwa hampir setengah dari jumlah responden mengalami masalah pada keseimbangan (Chen, et al., 2020). Penelitian selanjutnya membagi responden menjadi 2 kelompok yaitu kelompok intervensi dan kelompok kontrol. Diketahui kedua kelompok tersebut memiliki masalah yang sama pada keseimbangan dan diukur menggunakan *Beng Balance Scale* dan *Time up and Go test* (Wong, 2019) Selanjutnya diketahui sebagian lansia memiliki masalah keseimbangan. Pada penelitian skor keseimbangan diukur terlebih dahulu dengan kuesioner Time up and Go test sebelum diberikan intervensi didapatkan hasil skor yang lebih rendah terkait keseimbangan lansia (Chen S. , 2019). Pada penelitian selanjutnya diketahui bahwa keseimbangan lansia diukur menggunakan kuesioner keseimbangan *single leg stance* (SLS) yaitu peserta diminta untuk berdiri menggunakan satu kaki (Sun, et al., 2018). Penelitian ini ingin mengetahui keseimbangan lansia dalam turun tangga, lansia, dengan menggunakan COP yaitu untuk mengetahui perubahan pusat tekanan dan COM untuk mengetahui pergerakan masa tubuh, maka dapat diketahui tingkat keseimbangan lansia. Lansia memiliki

masalah pada saat menuruni anak tangga disebabkan oleh perubahan fisiologis pada tubuhnya (Huang & Yang, 2018).

Penurunan yang terjadi pada fisiologis tubuh makin bertambah seiring bertambahnya usia, terutama yang berpengaruh pada pengontrol keseimbangan. Keseimbangan yang kurang baik pada lansia dapat mengakibatkan jatuh. Hal ini sejalan dengan teori yang menyatakan bahwa Keseimbangan merupakan kontrol motor yang kompleks melibatkan deteksi dan integrasi informasi sensori untuk memeriksa posisi dan gerakan tubuh dalam ruang dan eksekusi respons muskulokeletal yang tepat untuk mengontrol posisi tubuh dengan konteks lingkungan dan tugas. Oleh karena itu, kontrol keseimbangan memerlukan interaksi sistem nervous dan muskuloskeletal dan pengaruh kontekstual (Widarti, 2020). Pada penelitian yang dilakukan di Taiwan diketahui bahwa keseimbangan pada lansia mengalami penurunan siring dengan berjalan nya waktu. Penelitian yang dilakukan juga menyimpulkan bahwa beberapa latihan fisik dapat membantu lansia menjaga keseimbangan mereka (Wang, et al., 2016).

Berdasarkan hasil analisa dari lima artikel peneliti menyimpulkan bahwa keseimbangan memiliki peran yang penting bagi lansia, karena keseimbangan merupakan sebuah kontrol dari system gerak lansia yang kompleks hal tersebut melibatkan integrase informasi sensori dan respon yang baik. Oleh karena itu beberapa peneliti melakukan penelitian tentang keseimbangan dengan cara melakukan berbagai rangkaian tes seperti

kemampuan keseimbangan lansia dalam turun tangga, kemudian dilakukan tes berdiri dengan satu kaki hal tersebut juga dilakukan untuk mengetahui keseimbangan yang ada pada lansia.

5.2 Latihan Taichi terhadap Kemampuan Keseimbangan pada Lanjut Usia

Hasil *literature review* dari lima artikel, menunjukkan bahwa latihan taichi yang dilakukan lansia memiliki efek yang positif terhadap keseimbangan lansia hal tersebut terlihat dari meningkatnya skor keseimbangan lansia yang diukur menggunakan *beng balance scale* (BBS) dan kuesioner *timed up and go* (TUG) yang terus menerus meningkat dari pada sebelumnya. Selain itu latihan taichi yang diberikan selama 16 sesi dan dilakukan dalam 8 minggu akan meningkatkan skor keseimbangan pada lansia hal tersebut diketahui dari skor *Tinetti Balance Assessment* yang dilakukan pada responden lansia. penelitian lainnya yang menilai keseimbangan lansia menggunakan kuesioner *single leg stance* (SLS) yaitu peserta diminta untuk berdiri menggunakan satu kaki dan diuji setiap 4 minggu sekali selama 12 minggu. didapatkan hasil program pelatihan intervensi selama 60 menit lima sesi setiap minggu selama 16 minggu. Keseimbangan berdiri satu kaki diuji setiap 4 minggu didapatkan hasil bahwa keseimbangan meningkat pada lansia yang menjalankan latihan taichi.

Masalah keseimbangan sering kali mengancam kualitas hidup lansia, karena lansia yang mengalami penurunan keseimbangan akan memiliki ketergantungan fisik pada orang lain. Jatuh merupakan salah satu

penyebab multifaktorial, faktor resiko jatuh, penurunan keseimbangan serta penurunan kognitif terjadi karena terkait usia (Kim, 2019). Pada lansia kehilangan keseimbangan sering kali terjadi diakibatkan oleh sarcopenia dan kerapuhan (Landi, et al., 2012). Untuk menangani masalah keseimbangan dikenal berbagai macam latihan yang dapat dilakukan lansia salah satunya menggunakan latihan taichi. Taichi dilakukan dengan gerakan lembut, tidak memaksa dan terkoordinasi adalah bentuk latihan yang tepat dilakukan oleh lansia karena gerakan dilakukan tanpa perlu memaksa gerak persendian dan system kardiovaskular (Huang & Liu, 2015). Senam tai chi berasal dari seni bela diri Cina kuno. Aktivitas fisik ini mempraktikkan rangkaian gerakan yang mesti dilakukan secara perlahan dan penuh konsentrasi, disertai dengan teknik bernapas dalam. Dalam pelaksanaan latihan taichi perlu diperhatikan terkiat waktu dan durasi pemberian latihan taichi terutama pada lansia, idealnya waktu dilakukannya latihan hanya selama kurang lebih 30 menit (Huang & Liu, 2015). Disebut juga tai chi chuan, olahraga ini bersifat nonkompetitif dan lebih menitikberatkan pada latihan fisik individual serta peregangan. Sehingga latihan taichi sangat sesuai dengan kebutuhan aktivitas fisik yang dianjurkan bagi lansia karena setiap gerakan dalam senam tai chi akan berlanjut ke gerakan berikutnya dalam aliran yang lembut tanpa jeda, untuk memastikan tubuh tidak berhenti bergerak (Wang, et al., 2016). Senam tai chi terdiri dari beberapa aliran. Tiap aliran memiliki prinsip gerakan dan metode latihan masing-masing. Ada aliran tai chi yang

berfokus pada menjaga kebugaran dan kesehatan, dan ada juga aliran yang lebih berfokus pada sisi seni bela diri (Day, et al., 2015). Berdasarkan penelitian yang dilakukan tentang taichi pada lansia. Diketahui bahwa taichi yang dilakukan secara rutin dapat mengatasi berbagai macam masalah kesehatan yang terjadi pada lansia seperti masalah pada sendi, pada ekstermitas dan anggota gerak tubuh lainnya. Selain itu latihan taichi juga berpengaruh kepada fungsi kognitif seseorang terutama lansia, karena secara fisiologis lansia sudah mengalami penurunan kognitif tetapi dengan taichi terbukti mampu mengurangi efek penurunan kognitif lansia (Miller & Taylor-Piliae, 2014). Pada penelitian yang pernah dilakukan menunjukkan bahwa taichi dapat meningkatkan kekuatan otot di ekstermitas bawah dan meningkatkan kontrol keseimbangan, proprioception dan adaptasi postural sehingga mengurangi resiko jatuh dan meningkatkan keseimbangan (Huang, et al., 2017).

Berdasarkan analisa dari lima artikel peneliti dapat menyimpulkan bahwa bentuk latihan taichi yang sangat sederhana dan tidak memerlukan banyak gerakan juga dinilai sangat sesuai dengan kemempuan lansia dalam melakukan aktivitas fisik sehingga latihan taichi dinilai seusai dengan kebutuhan lansia. Latihan taichi secara teratur setidaknya setiap sesi 30 menit dan dilakukan selama kurang lebih 3 kali seminggu memiliki efek yang baik pada kesehatan lansia, taichi akan meningkatkan keseimbangan lansia selain itu taichi juga bermanfaat mengurangi resiko jatuh dan masalah kognitif pada lansia.

BAB VI

KESIMPULAN DAN SARAN

6.1 Kesimpulan

Berdasarkan analisis dari beberapa artikel tentang latihan taichi untuk keseimbangan lansia dapat disimpulkan:

6.1.1 Kemampuan Keseimbangan Pada Lansia

Kemampuan keseimbangan memiliki peran yang penting bagi lansia, karena keseimbangan merupakan sebuah kontrol dari system gerak lansia yang kompleks hal tersebut melibatkan integrase informasi sensori dan respon yang baik. Oleh karena itu beberapa peneliti melakukan penelitian tentang keseimbangan dengan cara melakukan berbagai rangkaian tes seperti kemampuan keseimbangan lansia dalam turun tangga, kemudian dilakukan tes berdiri dengan satu kaki hal tersebut juga dilakukan untuk mengetahui keseimbangan yang ada pada lansia.

6.1.2 Latihan Taichi terhadap Kemampuan Keseimbangan Pada Lansia

Latihan taichi secara teratur setidaknya setiap sesi 30 menit dan dilakukan selama kurang lebih 3 kali seminggu memiliki efek yang baik pada kesehatan lansia, taichi akan meningkatkan keseimbangan lansia selain itu taichi juga bermanfaat mengurangi resiko jatuh dan masalah kognitif pada lansia. Bentuk latihan taichi yang sangat sederhana dan tidak memerlukan banyak gerakan juga dinilai sangat sesuai dengan kemempuan lansia dalam melakukan aktivitas fisik sehingga latihan taichi dinilai seusai dengan kebutuhan lansia.

6.2 Saran

Berdasarkan hasil penelitian diatas maka peneliti menyarankan beberapa hal sebagai berikut:

6.2.1 Bagi Peneliti

Diharapkan literature reviewdapat menambah pengetahuan terkait latihan taichi dan keseimbangan pada lansia serta dapat diaplikasikan pada saat melakukan asuhan keperawatan pada lansia.

6.2.2 Bagi Institusi Keperawatan

Diharapkan hasil *literature review* ini dapat menambah bahan refrensi bagi institusi pendidikan mengenai terapi latihan taichi sebagai salah satu terapi alternatif untuk meningkatkan keseimbangan pada lansia.

6.2.3 Bagi Masyarakat

Diharapkan masyarakat yang mengalami masalah keseimbangan dapat menerapkan latihan taichisebagai salah satu terapi alternatif untuk menurunkan masalah keseimbangan yang dapat berakibat resiko jatuh pada lansia.

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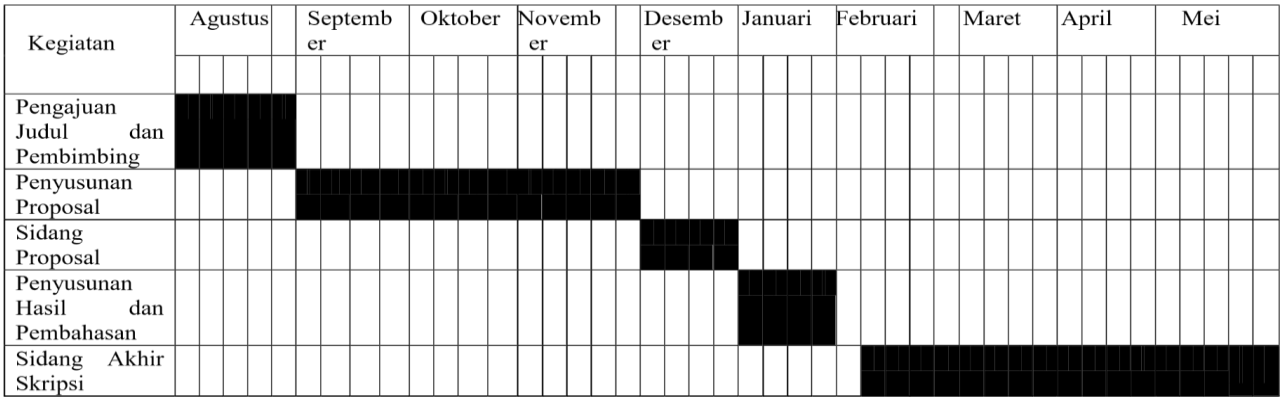
LAMPIRAN

Lampiran 1

PENYUSUNAN SKRIPSI



Lampiran Artikel

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Augmented reality-assisted training with selected Tai-Chi movements improves balance control and increases lower limb muscle strength in older adults: A prospective randomized trial

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ABSTRACT

Background: Tai-Chi benefits older adults by enhancing balance control and increasing the muscle strength of the lower limbs. However, a complete set of traditional Tai-Chi exercises is sometimes too difficult for beginners. We investigated whether practicing augmented reality-assisted training with selected Tai-Chi movements tailored to the practitioner's ability (selected Tai-Chi, or sTC) is as effective as performing a complete set of Tai-Chi sequences (complete traditional Tai-Chi, or cTC).

Methods: In this prospective randomized trial carried out in the Beitou District of Taipei City, Taiwan, community-dwelling adults aged ≥65 and without any debilitating diseases (n = 28) were included. Participants were randomly assigned to the sTC group (n = 14) or the cTC group (n = 14). Participants in the sTC group practiced selected Tai-Chi movements using the augmented reality Tai-Chi training system. Participants of the cTC group were asked to complete the 24-form Yang-style Tai-Chi following the instructions of Tai-Chi masters. Each training session lasted 30 min, with 3 sessions per week for 8 weeks. Pre- and post-intervention evaluations included functional balance tests, comprising the Berg Balance Scale (BBS), Timed Up and Go test (TUG), and Functional Reach Test (FRT), as well as muscle strength measurements of the lower extremities.

Results: Pre-intervention evaluations showed significant differences in FRT ($p = 0.034$) and left hip abductor muscle strength ($p = 0.048$) between the sTC and cTC groups. After 8 weeks of training, the BBS, TUG, and FRT scores in the sTC group showed significant improvement overall. Although all three functional balance test scores improved in the cTC group, only the improvement in BBS was statistically significant ($p = 0.001$). After 8 weeks, all muscle strength measurements increased by an average of 3.1 ± 1.0 kgw in the sTC group and 1.6 ± 0.8 kgw in the cTC group.

Conclusions: The augmented reality-assisted training with selected Tai-Chi movements, designed based on objective measurements of the practitioner's capability, improved balance control and muscle strength of lower limbs at least as effectively as the complete sequence of traditional Tai-Chi exercises. *Trial registration:* This study was approved by the Institutional Review Board of National Yang-Ming University (IRB number: 1000087). Written informed consent was obtained from all participants.

Abbreviations: augmented reality, AR; base of support, BOS; complementary metal-oxide-semiconductor, CMOS; Berg Balance Scale, BBS; center of pressure, COP; electromyography, EMG; Functional Reach Test, FRT; selected Tai-Chi, sTC; Timed Up and Go test, TUG; traditional Tai-Chi, TTC; virtual reality, VR.

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Introduction

Falls are a significant threat to the quality of life in older adults, often causing a decline in self-care and in the participation in physical and social activities. Falls have multifactorial causes. Prominent intrinsic fall-risk factors are age-related decreases in

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balance and strength/power performance, as well as cognitive decline.[1] In the elderly, loss of balance often results from sarcopenia and frailty,[2] and from their inability to shift their feet positions to allow adequate base of support (BOS) function.[3,4] To prevent falls, various training programs have been developed to enhance functional balance control and increase the muscle strength of the lower extremities, with some tailored specifically for the elderly.[5,6]

Tai-Chi, characterized by a sequence of gentle, low-impact, and coordinated movements, is an appropriate form of exercise for older adults because it involves minimal strain on joints and the cardiovascular system.[7] Previous studies have shown that Tai-Chi increased muscle strength in the lower extremities, and improved balance control, proprioception, and postural adaption, thereby reducing fall risk in older adults.[8–11] However, since aging is an individualized process, prescription of exercises, such as Tai-Chi, should be customized based on the health status and physical functioning of each individual. We have previously demonstrated that a set of simplified Tai-Chi exercises, consisting of only three to five movements, selected based on the subjective measurements of the practitioner's capability, could be beneficial to people with no prior experience with Tai-Chi.[12,13]

Augmented Reality (AR) is a technology that projects virtual information on the real world through image recognition, which can increase users' awareness and understanding of their surroundings.[14] In addition to games and entertainment, AR technology is currently used in medical-related fields, such as medical teaching and training, surgical simulation, and neurological rehabilitation.[15,16] In 2017, Yoo et al. used AR with electromyography (EMG) signals for neuromuscular coordination training in children with cerebral palsy. Compared to using EMG signal feedback alone, EMG combined with AR resulted in better neuromuscular effects on elbow control.[17] In the same year, Villiger et al. applied AR technology to assist in training lower limbs in patients with incomplete spinal cord injury and found significant improvements in lower limb muscle strength, balance, and functional activity.[18] Using AR with the Otago Exercise has significantly improved the strength of muscles associated with knee flexion and ankle dorsiflexion in older women, and the scores of the Morse Fall Scale among the same participants were significantly improved. There was also an improvement in the degree of asymmetry relative to the body center of gravity that provides a measure of balance.[12]

In the present study, we enhanced the participants' performance of the simplified Tai-Chi exercises by using an AR training system. We compared the beneficial effects of this AR assisted selected Tai-Chi (sTC) intervention with the complete sequence of traditional Tai-Chi (TTC) exercises.

Methods

This study was a prospective randomized trial. Participants received baseline assessments, with follow-up after 8 weeks. The study was approved by the Institutional Review Board of the National Yang-Ming University (#1000087). Written informed consent was obtained from all participants.

Participants

As shown in Fig. 1, 28 residents of the Beitou District of Taipei City, Taiwan participated in the study. The inclusion criteria required that participants were ≥65 years of age and achieved a score of >24 on the Mini-Mental Status Examination (MMSE), indicating normal cognitive function. A certified physical therapist performed the evaluation. Exclusion criteria were disorders of the central nervous system or musculoskeletal system, including strokes, head injuries, Parkinson's Disease, fractures, or the presence of orthopedic implants. Individuals with previous experience in Tai-Chi exercise were also excluded. After assignment to the exercise groups, all participants completed the 8 weeks of sessions as advised.

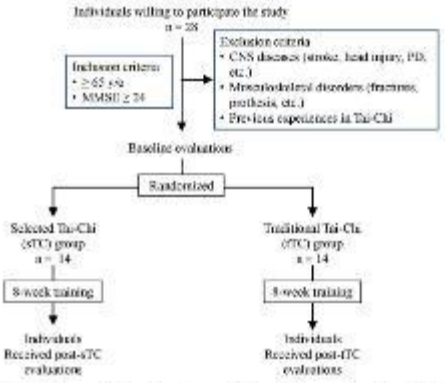

Fig. 1. Flowchart explaining the assignment of the participants to the selected Tai Chi (sTC) group and the complete traditional Tai-Chi (TTC) group.

The AR-assisted training system

The AR assisted Tai-Chi training system was developed to facilitate the practice of Tai-Chi. Microsoft Kinect system (Microsoft Corporation) was used as a body motion detector. Kinect has a three-dimension depth sensor composed of an infrared emitter and an infrared complimentary metal-oxide semi-conductor (CMOS) camera. This system can capture the movements of the entire body, as well as gestures and sounds. The Kinect software development kit was utilized to construct the digital skeleton from the spatial position of all four limbs of the performer and calculate skeletal information.[20] We used the skeletal tracking system to detect critical changes in movement of the lower limbs and collect movement data when a participant stepped forward or moved to the side. As shown in Fig. 2, a computer vision-based interaction method was employed where the skeletal data and the movements of the Tai-Chi coach were displayed to create an AR scenario for the practitioner to follow. The movements and the skeletal information of participants were also displayed. Thus, the practitioners could compare their performance of the exercises with that of the

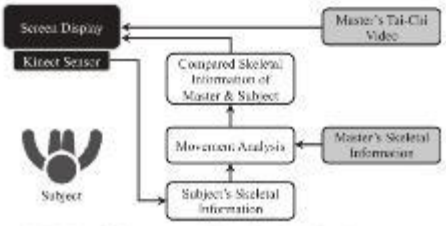

Fig. 2. Setup for the augmented reality-assisted Tai-Chi training system.

masters. The accuracy of the practitioner's movement using the skeletal information of the coach as a reference was calculated and the practitioner received real-time feedback.

Selected Tai-Chi (sTC) exercise

We monitored the base of support (BOS) of each participant by measuring the displacement of the Center of Pressure (COP) using a computerized evaluation system.[16,17] We extracted 8 simple steps from the original 24-form Yang-style Tai-Chi sequences, based on the COP analyses, for development of computer-assisted Tai-Chi exercises. Participants in the sTC group were asked to perform COP tests and were assigned one individual Tai-Chi movement at an appropriate difficulty level based on their maximum COP displacement and endurance.[15] Participants in the sTC group repeated the individually selected movement for 30 min in each training session, with three sessions per week for 8 weeks. The exercise program commenced with movements of low difficulty, then progressed to higher difficulty as participants became adept at each movement.[15,17]

Traditional Tai-Chi (tTC) exercise

Participants of the complete traditional Tai-Chi (tTC) program learned and practiced the classical 24-form Yang-style Tai-Chi exercise under the instruction of a certified Tai-Chi master. The exercise program consisted of three sessions per week for 8 weeks and the duration of each session was 30 min. During each session, participants usually practiced a complete Yang-style Tai-Chi exercise two or three times.

Outcome measurements

Functional balance tests, including the Berg Balance Scale (BBS), Timed Up and Go test (TUG) and Functional Reach Test (FRT), as well as measurements of lower-extremity muscle strength were conducted before and after the Tai-Chi intervention. The tests and measurements were conducted by a certified physical therapist who was blinded to the sTC or tTC exercise allocation.

The BBS consisted of 14 items that evaluated the balance of each individual in sitting, standing, and transitional positions. The scores were determined using an ordinal 5-point scale with a total score ranging from 0 to 56, where higher scores indicated better balance control.[12]

The TUG is a simple test used to assess a person's mobility that requires both static and dynamic balance.[13] The test measures the time taken by a participant to stand up from a chair, walk 3 m at a comfortable speed, turn around, return to the chair, and then sit down. Three timed trials are needed to ensure performance stability in the TUG test. Mean values for three trials, with a 1-min rest between each trial, were used for analysis.

The FRT was used to assess dynamic balance. This test measures the maximal forward distance a participant could reach beyond the length of their arms. Participants were asked to stand next to a wall and reach forward as far as possible without moving their feet. The extra reaching distance was then recorded in centimeters.[14]

Lower-extremity muscle strength was measured using a hand-held isometric dynamometer, MicroFET®3 (Hoggan Health Industries). This portable digital dynamometer performs accurate, objective muscle testing and enables assessors to stabilize and assist individuals while keeping one hand free. In this study, the following 8 lower-limb muscles were bilaterally measured: hip flexor, hip extensor, hip abductor, hip adductor, knee extensor, knee flexor, ankle dorsi-flexor, and ankle plantar flexor. The participants were asked to perform maximal isometric contractions for 3 s. The average of three measurements, at a 60-sec resting interval, were calculated and recorded.

Statistical analysis

Most of the parameters showed normal distribution and were evaluated with Shapiro-Wilk tests; only the TUG and left hip extensor muscle strength measurements of the sTC group and right ankle dorsi-flexor muscle strength measurements of tTC group showed non-normal distribution. If the parameters demonstrated normal distribution, we use a paired t-test for the within-group test and an independent t-test for the between-group test. If the parameters demonstrated non-normal distribution, the Wilcoxon test was used for the within-group test and the Mann-Whitney test was used for the between-group test. If the parameter used nonparametric statistics, it was indicated via "ᵃ" in the table. All statistical analyses were performed using PASW Statistics version 18.0 (SPSS Inc.). Statistical significance was defined as a p value < 0.05.

Results

Demographic characteristics

A flowchart depicting the assignment of the participants to the sTC group and tTC group is shown in Fig. 1. The demographic characteristics of the participants are listed in Table 1. No significant difference was observed in the distribution of age, sex, height, and weight between the sTC and tTC groups.

Significant improvements in balance control and muscle strength were observed following the Tai-Chi interventions

The baseline and follow-up evaluation results in the sTC and tTC groups are presented in Table 2. The evaluations consisted of 3 functional balance tests, BBS, TUG, and FRT, and lower-limb muscle strength assessments. In the sTC group, BBS, TUG, and FRT scores showed significant improvement overall. The strength of each lower limb muscle also increased by an average of 3.1 ± 1.0 kgw. In the tTC group, although all three functional balance test scores improved, only the BBS improvement was statistically significant ($p = 0.001$). The muscle-strength assessments showed increases in all lower limb muscles, with an average of 1.6 ± 0.8 kgw. Improvements of the right hip flexor (RH F, $p = 0.032$), left hip flexor (LH F, $p = 0.033$), left hip abductor (LH Ab, $p = 0.001$), right ankle dorsi-flexor (RA Df, $p = 0.001$), and left ankle dorsi-flexor (LA Df, $p = 0.002$) reached statistical significance. Comparing the baseline and follow-up assessments in the sTC and tTC groups, participants in the sTC group exhibited improvements in all 19 items after the sTC intervention, while only 6 out of 19 items showed improvement after the tTC intervention.

Table 1
Demographic characteristics of participants.

	sTC Group	tTC Group	p value
Number	14	14	
Male	2	1	
Female	12	13	
Age, y/o, mean ± SD	72.2 ± 2.8	73.1 ± 5.5	0.591
Height, cm, mean ± SD	156.1 ± 6.1	154.3 ± 3.8	0.449
Weight, kg, mean ± SD	59.1 ± 8.6	58.1 ± 6.6	0.735

sTC = selected Tai-Chi; tTC = traditional Tai-Chi; SD = standard deviation.

Table 2
Baseline and follow-up evaluation results in sTC and tTC group.

	sTC Group (n = 14)			tTC Group (n = 14)		
	Baseline (mean ± SD)	Follow up (mean ± SD)	p value	Baseline (mean ± SD)	Follow up (mean ± SD)	p value
Functional Balance						
BBS	50.3 ± 2.1	54.0 ± 1.1	<0.001*	49.2 ± 4.5	51.1 ± 4.7	0.001*
TUG	8.7 ± 0.7	6.9 ± 0.9	0.001*†	9.0 ± 1.8	8.4 ± 1.6	0.115
FRT	28.7 ± 4.2	32.5 ± 4.1	<0.001*	24.3 ± 5.6	24.8 ± 3.8	0.766
Muscle Strength						
RH F	17.7 ± 6.1	22.2 ± 7.5	0.001*	16.6 ± 3.9	18.5 ± 3.1	0.070*
LH F	17.1 ± 6.2	21.7 ± 7.7	0.001*	15.4 ± 4.3	17.7 ± 3.4	0.033*
RH E	17.1 ± 5.1	20.8 ± 7.4	0.007*	16.4 ± 2.9	18.2 ± 3.8	0.091
LH E	17.8 ± 5.8	21.5 ± 8.6	0.001*†	16.2 ± 2.9	17.1 ± 3.4	0.310
RH Ab	12.9 ± 3.4	16.8 ± 5.9	0.003*	15.7 ± 3.4	16.8 ± 2.6	0.276
LH Ab	13.5 ± 3.2	15.2 ± 5.5	0.032*	13.3 ± 2.0	15.8 ± 2.9	0.001*
RH Ad	11.6 ± 3.2	14.3 ± 4.8	0.026*	11.1 ± 2.1	12.9 ± 2.9	0.050
LH Ad	10.7 ± 3.2	13.9 ± 4.7	0.007*	12.1 ± 2.8	13.4 ± 2.6	0.121
RK F	11.7 ± 3.7	13.7 ± 4.8	0.010*	13.3 ± 2.6	14.1 ± 2.5	0.371
LK F	11.0 ± 3.7	13.1 ± 4.9	0.029*	12.8 ± 2.6	13.8 ± 2.9	0.226
RK E	19.1 ± 4.2	21.4 ± 5.8	0.019*	18.2 ± 3.5	18.8 ± 4.6	0.418
LK E	18.1 ± 4.0	21.2 ± 5.8	<0.001*	16.9 ± 2.6	17.8 ± 4.3	0.424
RA Df	13.3 ± 3.9	15.4 ± 5.0	0.003*	11.1 ± 2.3	13.9 ± 2.7	0.001*†
LA Df	13.5 ± 3.7	15.1 ± 4.7	<0.001*	11.4 ± 2.5	14.0 ± 2.9	0.002*
RA Pf	18.3 ± 4.1	22.8 ± 8.3	0.015*	17.6 ± 2.5	19.3 ± 3.6	0.128
LA Pf	18.6 ± 3.9	21.7 ± 6.7	0.010*	16.7 ± 2.8	17.3 ± 4.0	0.645

* nonparametric statistics; *p < 0.05; sTC = selected Tai-Chi; tTC = traditional Tai-Chi; SD = standard deviation; BBS = Berg Balance Scale; TUG = Timed Up and Go test; FRT = Functional Reach Test; RH = right hip; F = flexor; LH = left hip; E = extensor; Ab = abductor; Ad = adductor; RK = right knee; LK = left knee; RA = right ankle; Df = dorsi-flexor; LA = left ankle; Pf = plantar flexor.

Beneficial effects of the AR-assisted selected Tai-Chi program were comparable to the complete Tai-Chi sequence

Comparisons of the functional balance tests and muscle strength measurements between the sTC and tTC groups are shown in Table 3. Pre-intervention evaluations showed significant differences in FRT (p = 0.034) and RH Ab (p = 0.046) between the sTC and tTC groups and post-intervention evaluations showed significant differences in BBS (p = 0.044), TUG (p = 0.015), and FRT (p < 0.001) between groups.

Discussion

The Kinect depth sensor and skeleton tracking system senses the body movement of the participant without using other input devices and limits the disturbance of movement, which is especially important for elderly people.

The measurements used in the current study were not tests specific to Tai-Chi, however, assessments such as BBS[25,28], TUG[27], and lower limb muscle strength[29–31] have been widely used in the other Tai-Chi studies. In this study, we found that both sTC and tTC

Table 3
Baseline and follow up evaluation results between sTC and tTC groups.

	Baseline			Follow up		
	sTC group (mean ± SD)	tTC group (mean ± SD)	p value	sTC group (mean ± SD)	tTC group (mean ± SD)	p value
Functional Balance						
BBS	50.3 ± 2.1	49.2 ± 4.5	0.444	54.0 ± 1.1	51.1 ± 4.7	0.044*
TUG	8.7 ± 0.7	9.0 ± 1.8	0.598*	6.9 ± 0.9	8.4 ± 1.6	0.015*†
FRT	28.7 ± 4.2	24.3 ± 5.6	0.034*	32.5 ± 4.1	24.8 ± 3.8	<0.001*
Muscle Strength						
RH F	17.7 ± 6.1	16.6 ± 3.9	0.594	22.2 ± 7.5	18.5 ± 3.1	0.119
LH F	17.1 ± 6.2	15.4 ± 4.3	0.413	21.7 ± 7.7	17.7 ± 3.4	0.094
RH E	17.1 ± 5.1	16.4 ± 2.9	0.673	20.8 ± 7.4	18.2 ± 3.8	0.283
LH E	17.8 ± 5.8	16.2 ± 2.9	0.390*	21.5 ± 8.6	17.1 ± 3.4	0.301*
RH Ab	12.9 ± 3.4	15.7 ± 3.4	0.040*	16.8 ± 5.9	16.8 ± 2.6	0.990
LH Ab	13.5 ± 3.2	13.3 ± 2.0	0.841	15.2 ± 5.5	15.8 ± 2.9	0.998
RH Ad	11.6 ± 3.2	11.1 ± 2.1	0.645	14.3 ± 4.8	12.9 ± 2.9	0.372
LH Ad	10.7 ± 3.2	12.1 ± 2.8	0.278	13.9 ± 4.7	13.4 ± 2.6	0.760
RK F	11.7 ± 3.7	13.3 ± 2.6	0.207	13.7 ± 4.8	14.1 ± 2.5	0.320
LK F	11.0 ± 3.7	12.8 ± 2.6	0.151	13.1 ± 4.9	13.8 ± 2.9	0.572
RK E	19.1 ± 4.2	18.2 ± 3.5	0.551	21.4 ± 5.8	18.8 ± 4.6	0.234
LK E	18.1 ± 4.0	16.9 ± 2.4	0.382	21.2 ± 5.6	17.8 ± 4.3	0.087
RA Df	13.3 ± 3.9	11.1 ± 2.3	0.089*	15.4 ± 5.0	13.9 ± 2.7	0.470*
LA Df	13.5 ± 3.7	11.4 ± 2.5	0.416	15.1 ± 4.7	14.0 ± 2.9	0.458
RA Pf	18.3 ± 4.1	17.6 ± 2.1	0.582	22.8 ± 8.3	19.3 ± 3.6	0.171
LA Pf	18.6 ± 3.9	16.7 ± 2.8	0.180	21.7 ± 6.7	17.3 ± 4.0	0.054

* nonparametric statistics; *p < 0.05; sTC = selected Tai-Chi; tTC = traditional Tai-Chi; SD = standard deviation; BBS = Berg Balance Scale; TUG = Timed Up and Go test; FRT = Functional Reach Test; RH = right hip; F = flexor; LH = left hip; E = extensor; Ab = abductor; Ad = adductor; RK = right knee; LK = left knee; RA = right ankle; Df = dorsi-flexor; LA = left ankle; Pf = plantar-flexor.

training could improve a practitioner's balance control and increase lower limb muscle strength after an 8 week intervention. Furthermore, the added benefits of performing simplified and personalized Tai-Chi exercises were substantial compared to the complete set of traditional Tai-Chi sequences, even if not to the level of statistical significance. An explanation of these results might be that the traditional Tai-Chi sequences contained movements that were too difficult for elderly practitioners. It has been shown that the amplitude of weight-shifting estimated by the degree of COP displacements differed among Tai-Chi movements.[11] Practitioners with limited ability to voluntarily shift their weight in different spatial directions and to briefly maintain stability in different positions may encounter difficulty in conducting the movements. Thus, not all older individuals can complete the full set of exercises included in a traditional Tai-Chi program. We noted that the participants in the rTC group often omitted or skipped complicated movements or performed the steps at their own will. Therefore, older participants may require special considerations when a Tai-Chi exercise program is developed for them.[12]

Many researchers have tried to simplify Tai-Chi programs.[33–36] However, most of the simplified exercises were designed primarily based on the advice of experts rather than on the practitioner's abilities, and the training course was typically conducted at a predetermined level of difficulty. With such a design, the only option for many participants would be to give up when encountering movements that were beyond their capabilities. For example, the one-legged station step of the traditional Tai Chi exercise was too difficult for most elderly practitioners, yet could be readily accomplished by some older individuals. Therefore, simplified Tai-Chi exercises need to be customized to achieve optimal outcomes. We previously reported the development of personalized Tai-Chi exercise programs for older adults based on the practitioners' COP displacement values.[12,13] Therefore, the individual Tai-Chi movements assigned to the practitioner were not only feasible but were also at an appropriate level of difficulty. In the present study, we have developed this sTC program further by incorporating virtual reality (VR)-augmented or AR-assisted Tai-Chi training systems[37] in the exercise intervention protocols. The trainees could perform individual Tai-Chi movements at a high level of accuracy by comparing their own skeletal information with that of the Tai-Chi master, thereby achieving increased optimal training goals set by the trainer.

In the present study, participants in the sTC group were asked to practice only one movement repeatedly in each session. The movement was assigned according to the practitioner's balance control as assessed through COP measurements. The training was also designed to be progressive, with the practitioner continuously challenged in a gradual manner. When the original movement was learned and mastered, the trainer assigned another Tai-Chi movement that required an increased COP displacement or was at a higher difficulty level. The superior training results observed in the sTC group might have been attributable to the individually tailored Tai-Chi movements and the progressive intensity and complexity of the practice.

Tai-Chi exercises require the coordination of breathing and motor functions. It has been reported that Tai-Chi movements stimulated the part of the brain that governs balance, thereby increasing overall steadiness.[38–41] Previous studies have also shown that a relatively long period of practice, typically from 12 to 48 weeks, was required for older practitioners to benefit from Tai-Chi exercises.[8,10,42,43] In our study, we demonstrated that merely 8 weeks of intervention with simplified and personalized Tai-Chi training could provide significant benefit, comparable to that achieved with extended periods of Tai-Chi practice. Thus, simplified and personalized Tai-Chi exercises are particularly useful for Tai-Chi beginners and provide substantial benefit for those who cannot learn and practice the complete Tai-Chi sequence, such as frail or disabled elderly individuals and those who cannot comprehend or memorize the full Tai-Chi sequence. Moreover, the AR-assisted Tai-Chi training program developed in the present study can serve as an operative assistive methodology to help the practitioner exercise without the physical presence of a coach, improve exercise adherence, achieve the trainer's goals, and maximize the training outcome. The results of our study suggest that performing selected Tai-Chi exercises was at least as useful and, for certain practitioners, even more beneficial than conducting the full sets of traditional Tai-Chi exercises.

The primary limitations of this study are the relatively small number of participants and imbalance among the sexes. There were more female individuals recruited than males. It is not possible to separate the statistics based on sex. Thus, the conclusions from this study should be made with caution, with the caveat that the evidence supports the benefit of sTC only for women. The included participants had prior exercise habits, but none had previous experience with Tai-Chi. The frequency of exercise of the participants was generally 2–3 times per week and types of exercise included walking, swimming, and social dance. The study did not ask participants to stop their current exercise during the intervention. In addition, the functional assessments of this study focused mainly on balance control and muscle strength of the lower limbs, without considering other beneficial effects typically associated with the complete set of traditional Tai-Chi sequences. It would be informative to conduct a follow-up survey to compare differences in cognition, adherence rate, or personal mental health status between the rTC and sTC group participants in the future.

Conclusions

We found that simplified and personalized Tai-Chi training, designed based on objective measurements of the practitioner's capability and conducted under the guidance of a VR-augmented training system with progressive intensity and complexity, could achieve training goals more readily than use of traditional full-course Tai-Chi, especially for beginners or laypersons not familiar with this type of exercise.

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Declaration of competing interest

The authors declare that there is no conflict of interest.

CRediT authorship contribution statement

Po-Jung Chen: Conceptualization, Methodology, Software, Investigation, Data curation, Writing – original draft. **I-Wen Penn:** Conceptualization, Formal analysis, Resources, Writing – review & editing. **Shun-Hwa Wei:** Methodology, Supervision. **Long-Ren Chuang:** Methodology, Resources, Supervision. **Wen-Hsu Sung:** Conceptualization, Methodology, Software, Validation, Visualization, Supervision, Project administration.

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Feasibility and preliminary efficacy of Ai Chi aquatic exercise training in Hong Kong's older adults with risk of falling: Design and methodology of a randomized controlled trial

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ABSTRACT

Falls in older adults are a major global public health concern. Group exercise could mitigate fall risk but the traditional land-based group exercise may not be always suitable for older adults at risk of falling, especially for those with musculoskeletal problems. Ai Chi aquatic exercise program could provide a safe and low-impact exercise training for older adults. However, the feasibility and efficacy of the program has not been well-investigated. The objective of this study is to investigate the feasibility and efficacy of the Ai Chi aquatic exercise program, compared to the land based exercise program for older adults with moderate to high risk of falling. Forty community-dwelling older adults aged 65 or above with moderate to high fall risk will be recruited. They will be randomly allocated to the Ai Chi Aquatic Exercise Group (intervention) or the Land based Exercise Group (active control) receiving 16 sessions (8 weeks) of specific exercise training. Feasibility of both exercise groups will be examined by recruitment, adherence, retention, feedback, subjective exercise experiences and satisfaction. Preliminary efficacy will be determined by whether physical and psychological fall risk factors could be mitigated. Physical fall risk assessment will include tests for flexibility, muscle strength, gait and balance. Psychological fall risk will be evaluated by preliminary cognitive function, anxiety level, level of depression and fear of falling. The results could establish a solid foundation for worldwide development of a feasible, safe and effective Ai Chi aquatic exercise program for prevention of falls in older adults with risk of falling.

1. Introduction

With global aging, fall-related injuries among older adults have been increased continuously, stressing our healthcare systems [1]. A previous study revealed that the prevalence of falls and recurrent falls among Hong Kong older adults was 19.3% and 4.75%, respectively [2]. It is not uncommon that falls lead to undesirable physical and psychological consequences in older adults, such as immobility and fear of falling [3]. In severe incidences, falls may even result in deaths. Therefore, falling has been a prominent health-related problem in the older population in Hong Kong. In 2017, for example, there were 277 registered deaths and 44150 in-patient discharges and deaths in Hong Kong due to falls [4]. The fallers inevitably require additional resources to cure their fall-related health problems. As a result, falling in older adults imposes an extremely heavy economic burden to not only older fallers themselves but also the worldwide health care system. With the frightening trend towards a progressively increasing aging population [5], these problems are likely to affect the society more comprehensively.

It is widely agreed that "prevention is better than cure". Therefore, prevention of falls in older adults is of ultimate importance. According to a recent systematic review, one of the most effective interventions for fall prevention is group exercise [6]. Very strong evidence had illustrated that performing a well-structured group exercise program regularly by older adults could reduce the risk and rate of falls [6]. The favourable influences of group exercise program as a single fall prevention intervention had been demonstrated to be comparable to those of multi-factorial interventions [6]. It has also been suggested that exercise components essential in preventing falls of older adults include strength, balance, flexibility and reaction time [7]. Nevertheless, owing to aging-related physiological changes, such as loss of bone density and diminishing muscular mass [8], land-based exercises are not always be suitable for those older adults who have high risk of falling due to the fear issues [9]. In order to address such influential limitations of land-

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based fall prevention group exercise program, aquatic group exercise program could potentially provide the effective components (i.e., strength and balance training) of fall prevention [7], while minimizing potential problematic issues (e.g., increasing joint pain and fear of falling). Aquatic group exercise program may provide an alternative training to land-based exercise for those older adults who have degenerative joint problems and fear of falling. It may also result in better fall prevention and rehabilitation outcomes.

The characteristics of water (e.g., buoyancy & viscosity) could be utilized in aquatic exercise to provide a 'cushion' environment by reducing loads on weight-bearing joints but at the same instance deliver graded levels of resistance for older adults during exercise [10]. Based on these characteristics, aquatic exercise could provide a potentially feasible, safe and effective therapeutic environment for older adults to perform exercise. Aquatic exercise is indeed well proven, with its benefits in promoting balance and functional mobility. For instance, Lord et al. [10] reported that older adults who completed an aquatic exercise program for nine sessions gained significant improvements in lower limb muscle strength, postural sway, flexibility and joint pain compared with the control group. Comparable results were also found by Tsourlou et al. [11] showing that a 24-week aquatic training program of older adults improved muscular strength. Participants were found to have improvements in muscular strength, flexibility, trunk flexion as well as functional mobility. Providing such benefits, different aquatic exercises, for example, water aerobic exercises, water walking and water dancing had been developed in current fitness program for health improvement and rehabilitation of both healthy older adults and those with disabilities.

One potentially feasible, safe and effective aquatic exercise program for fall prevention in older adults is called Ai Chi, which involves slow-and-broad movements of the limbs and body (Tai Chi element) in a continuously flowing pattern and deep breathing (Qi Gong element) [12]. Ai Chi involves the 19-style aquatic exercise program of 1, Contemplating, 2, Floating, 3, Uplifting, 4, Enclosing, 5, Folding, 6, Soothing, 7, Gathering, 8, Pressing, 9, Shifting, 10, Accepting, 11, Accepting with grace, 12, Rounding, 13, Balancing, 14, Flowing, 15, Reflecting, 16, Suspending, 17, Encircling, 18, Surrounding, and 19, Nurturing [12]. Despite the relatively small number of previous studies, pilot research had demonstrated its potential effectiveness in improving postural balance control for older adults with high and medium risk of falling [13]. Being an aquatic exercise program, Ai Chi provides a safe and low-impact training environment that has been well-recognized as a desirable exercise training environment for older adults [9]. Furthermore, Ai Chi has potential benefits beyond those associated with traditional aquatic exercise. The rationale is that Ai Chi's oriental roots echo well with exercises such as Tai Chi and Qi Gong, which Hong Kong older adults are likely to engage in. Therefore, Ai Chi may be considered as a potentially feasible, safe and effective fall-prevention exercise program for older adults in Hong Kong.

According to a recent review of water-based Tai Chi, there was scanty number of studies investigating on the effect of Ai Chi in reduction of fall risk factors for older adults [14]. The Ai Chi program conducted in previous pilot research was varied and may have not been designed by a group of qualified Ai Chi and rehabilitation experts [13]. In order to enhance the beneficial effects of Ai Chi in fall prevention, an Ai Chi aquatic exercise program for fall prevention in Hong Kong has to be developed by a group of Ai Chi and rehabilitation experts in Hong Kong. To examine the feasibility and preliminary efficacy of this developed Ai Chi aquatic exercise program, the feasibility and preliminary efficacy of this developed program should be compared to the traditional land-based exercise program.

This study protocol aims to investigate the feasibility and preliminary efficacy of the Ai Chi aquatic exercise program that was developed by a group of Ai Chi and rehabilitation experts in Hong Kong through a randomized controlled trial. With reference to the past pilot research, the Ai Chi aquatic exercise program may be more feasible and effective than the traditional land-based fall prevention exercise program [13]. It is hypothesised that the expertly-designed Ai Chi aquatic exercise program could be as feasible as the land-based exercise program in the context of recruitment, adherence, retention and participants feedback, subjective exercise experience and satisfaction of participants. It is also hypothesised that the expertly-designed Ai Chi aquatic exercise program is more effective in mitigating physical and psychological fall risk factors of Hong Kong's older adults with medium to high risk of falling, compared to the land-based exercise program.

2. Method

2.1. Study design

This study will be a randomized controlled trial. Eligible participants will be randomly assigned by concealed block randomization by an independent person with a sealed and opaque envelope system to either the Ai Chi Aquatic Exercise Group (intervention) or the Land-based Exercise Group (active control group). All participants will undergo two assessment sessions before training at baseline (T0) and just after completion of all exercise sessions (T1). In the baseline assessment (T0), a structural questionnaire will be used to ask for demographics, detailed medical history, detailed history of fall incident, social history and socio-economic status of the participants. During the two assessment sessions (T0 and T1), physical and psychological fall risk factors will be assessed. Feasibility outcome variables will be measured during and at the end of the whole study.

2.2. Participants

Forty older adults with moderate to high risk of falling will be recruited from different elderly community centres in Hong Kong by convenience sampling. Participants will only be included if they are aged 65 or above, score a total score of equal or more than 24 in the Chinese version of the Mini-Mental State Examination (MMSE-C) [15], score less than 24/28 in the Tinetti Balance Assessment Tool [16], have no history of any neurological diseases, and have no contraindication for aquatic exercises. The sample size was estimated based on a pilot study conducted by Teixeira and colleagues to compare the effect of a 6-week Ai Chi exercise group with control group on balance ability of older adults, an effect size of = 1.1 of the primary outcome (balance score of the Tinetti Balance Assessment Tool) was suggested [13]. Therefore, the result of sample size calculation of the current study suggests that a sample size of 15 older adult participants (effect size = 1.1, $\alpha = 0.05$, power = 0.8) per group was required for sufficient power to detect the difference in terms of the improvement of balance ability between participants in the Ai Chi exercise and control group. Conservatively, we plan to recruit 30% more participants to account for potential dropouts. As a result, 20 older adult participants per group and total participants of 40 will be recruited for the current study.

2.3. Outcomes

The feasibility and preliminary efficacy of the Ai Chi Aquatic Exercise Group and the Land-based Exercise Group will be assessed. Feasibility of the Ai Chi Aquatic Exercise Group will be examined quantitatively and qualitatively in the context of recruitment, adherence, retention, feedback, subjective exercise experiences and satisfaction of the participants. Recruitment will be assessed by the proportion of potential applicants that remain interested after randomization and being informed about the procedures of the whole study. Adherence will be measured by means of attendance to exercise sessions and compliance to the exercise styles of the participants in different groups. Retention will be determined by the attrition rate as discontinuation of the intervention by different exercise groups. A

structural assessment form will be used to record all participants' feedback. All Participants' subjective exercise experiences and satisfaction will be measured by a Subjective Exercise Experience Scale and a Participant Satisfaction Questionnaire, respectively.

Additionally, preliminary efficacy of the two exercise groups will be identified through examining the mitigation of various physical and psychological fall risk factors. A series of assessment will be completed to assess various physical and psychological fall risk factors of the participants in all two assessment sessions (T0 & T1). Physical fall risk factors assessed will include flexibility, muscle strength, and clinical gait and balance. Flexibility will be measured by the 'sit-and-reach' test [17]. Longer reaching distance represents better flexibility. Muscle strength of the major lower limb's muscles groups (e.g., knee & hip extensors) will be measured using the well-recognized Lafayette manual muscle testing system (e.g., Model 01165). Higher score represents better muscle strength. Clinical gait and balance assessment will be done by the Tinetti Balance Assessment Tool [15], Timed 'Up & Go' Tests (TUG) [18] and the Berg Balance Scale (BBS) [19]. The Tinetti Balance Assessment tool assess gait (12 points) and balance (16 points) components (i.e., total score of 28 points) at the same time [16]. Lower score represents higher risk of falling. The TUG requires participants to stand up from a chair, walk 3 m at a comfortable speed, turn around, walk back for 3 m, turn around and then sit down on the chair. Longer time to complete the TUG represents higher risk of falling. The BBS consists of 14-item tasks (daily activities) in which participants need to maintain balance in performing the tasks and each item can be scored 0 to 4 marks giving a maximum total score of 56. Lower score represents poorer balance ability and therefore higher risk of falling. Psychological fall risk factors assessment will include preliminary cognitive function, anxiety level, level of depression and fear of falling. The Chinese version Mini-Mental State Examination (MMSE-C) [16] will be used to evaluate the preliminary cognitive function at the beginning of training as a screening tool. Anxiety level will be measured by the valid Chinese version of the State-Trait Anxiety Inventory [20]. Higher score represents higher anxiety level and therefore higher risk of falling. Level of Depression will be assessed by the Chinese version 4-item Geriatric Depression Scale (GDS-4C) [21]. The GDS-4C is a reliable and valid psychological measurement of depression in older adults and was demonstrated to be an excellent alternative of the 15-item and 30-item version of the Geriatric Depression Scale with good sensitivity (60–78%) and specificity (65–81%) using the cut-off point of 2 or more [21]. Higher score represents higher level of depression and therefore higher risk of falling. The Chinese version of the Falls Efficacy Scale International (FES-I (Ch)) [22] will be implemented to assess the fear of falling. Higher score represents higher fear of falling and therefore higher risk of falling.

2.4. Intervention

Participants in both Ai Chi Aquatic Exercise Group and Land-based Exercise Group will be invited to participate in their assigned groups sixteen exercise sessions (about 60 mins each) twice per week for a total of 8 weeks (Fig. 1). All training sessions will be conducted by two experienced certified Ai Chi trainers (Ai Chi Aquatic Exercise Group) or two experienced certified fitness instructors (land-based Exercise Group) under the supervision of a Registered Physical Therapist in Hong Kong who is required to have the professional qualifications of both Ai Chi and exercise specialists. During the group exercise session, participants will practice either a nineteen-style Ai Chi aquatic exercise program or a nineteen-style land-based exercise program, depending on their randomly assigned group. The two exercise programs were developed by a group of qualified Ai Chi and rehabilitation experts in Hong Kong based on the Ai Chi styles that was originated from Mr. Jun Konno or the Otago Exercise program to prevent falls in older adults, respectively. In the Ai Chi Aquatic Exercise Group, participants practised the 19-style aquatic exercise program of 1, Contemplating, 2, Floating, 3, Uplifting, 4, Enclosing, 5, Folding, 6, Soothing, 7, Gathering, 8, Freeing, 9, Shifting, 10, Accepting, 11, Accepting with grace, 12, Rounding, 13, Balancing, 14, Flowing, 15, Reflecting, 16, Suspending, 17, Encircling, 18, Surrounding, and 19, Nurturing. In the Land-based Exercise Group, participants practised the 19-style of Otago exercise program of 1, Trunk Movements, 2, Back Extension, 3, Ankle Movements, 4, Front Knee Strengthening Exercise, 5, Stand to Sit (No Hands), 6, Back Knee Strengthening Exercise, 7, Side Hip Strengthening Exercise, 8, Calf Raises (No Support), 9, Toe Raises (No Support), 10, Knee Bends (No Support), 11, Backwards Walking (No support), 12, Walking and Turning Around, 13, Sideways Walking, 14, Heel Toe Standing (No Support), 15, Heel Toe Walking (No Support), 16, One Leg Standing (No Support), 17, Heel Walking (No Support), 18, Toe Walking (No Support), and 19, Heel Toe Walking Backwards.

2.5. Data processing and analysis

Intention-to-treat (ITT) analysis will be adopted. For the feasibility, descriptive statistics will be used to compare the recruitment, adherence, retention and feedback of the participants in the Ai Chi Aquatic Exercise Group and the Land-based Exercise Group. Independent t-tests will be employed to compare the scores of the Subjective Exercise Experience Scale and Participant Satisfaction Questionnaire between the Ai Chi Aquatic Exercise Group and the Land-based Exercise Group.

For the preliminary efficacy, Analysis of Variance (ANOVA) with repeated measures and additional statistical tests, will be utilized to investigate the within group differences (i.e., T0 and T1) and between group differences (i.e., Ai Chi Aquatic Exercise Group & Land-based Exercise Group) in all physical and psychological fall risk factors (i.e., flexibility, muscle strength, scores of the clinical gait and balance assessments, anxiety level, level of depression and fear of falling). We could also determine the Minimal Clinically Important Differences (MCID) of the primary outcome measures (e.g., BBS) in order to help us know more about whether the intervention can lead to reducing fall risk factors.

3. Discussion

It is not uncommon among older adults, both in Hong Kong and worldwide, to suffer from falls and even fall-related injuries that required hospitalization. Given the progressively cumulating evidence to support the role of aquatic exercises for fall prevention in older adults, an expertly-designed Ai Chi aquatic exercise program could provide an alternative exercise choice for older adults who are at risk of falling. Therefore, our current study attempts to examine the feasibility and preliminary efficacy of the Ai Chi aquatic exercise program that was developed by a group of Ai Chi and rehabilitation experts in Hong Kong. If the results can provide evidence that the Ai Chi aquatic exercise program is feasible and can significantly mitigate fall risk factors in Hong Kong's older adults with moderate to high risk of falling compared to the land-based Exercise program, the structured Ai Chi aquatic exercise program could be considered to be incorporated into the standard fall prevention routine program of the Hong Kong's and even worldwide health care system.

The strength of our study is that it represents the first attempt to conduct a randomized controlled trial to examine the feasibility and preliminary efficacy of the expertly-designed Ai Chi aquatic exercise program that was developed by a group of Ai Chi and rehabilitation experts in Hong Kong. The result could provide a foundation to inform a large scale and cross-country randomized controlled trial to further investigate the effectiveness of the Ai Chi aquatic exercise program for prevention of falls in older adults in different countries. The current study may therefore with considerable global public health significance as the results could enhance our contemporary understanding of the structural Ai Chi aquatic exercise program with high practical

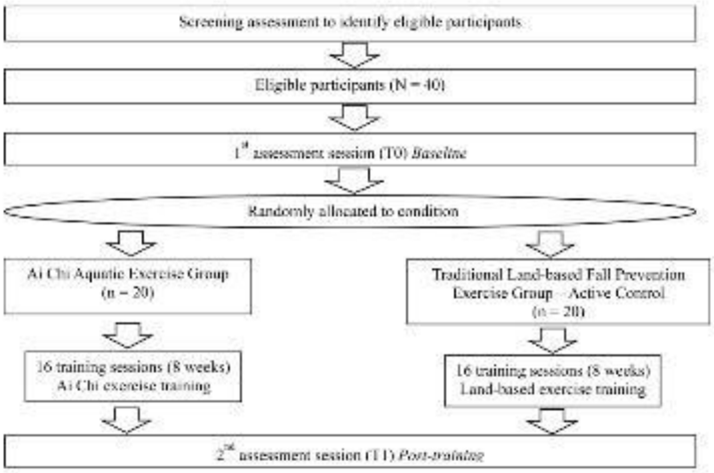

Fig. 1. Schematic diagram of the study design (randomized controlled trial).

implication for older adults. Based on the results of the current study, a large scale and cross-country clinical trial would be needed to further assess and confirm the effectiveness of the Ai Chi aquatic exercise program in different culture before it could be fully incorporated in the routine fall prevention program.

In conclusion, this study contributes to evaluating the effectiveness of two imperial community fall prevention exercise programs in Hong Kong. By comparing the feasibility and preliminary efficacy of the programs (i.e., the Ai Chi aquatic exercise program and the land-based exercise program), the feasibility, effectiveness and suitability of the programs for older adults in Hong Kong could be better understood, benefiting future design of the fall prevention protocol. Consequently, this research will provide a contemporary contribution to the global evidence-based practice of fall prevention in older adults by Physical Therapists. Future follow-up study could consider evaluating the long term adherence of the Ai Chi aquatic exercise program.

Ethics approval

Ethical approval was obtained from the Institutional Review Board of the University of Hong Kong/Hospital Authority Hong Kong West Cluster (IRB Reference Number: UW 18–065). The informed consent will be obtained for eligible participants. At the first meeting with all participants, the study protocol and informed consent form will be described in detail, where all participants will be offered the opportunity to review and ask questions. An incentive of $50 (Hong Kong Dollars) will be paid to each participant as reimbursement for costs that are associated with travelling in each attended session.

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Clinical trial registration

The trial was registered in the HKU Clinical Trial Registry (HKUCTR-2528).

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.conctc.2019.100376.

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Effect of Tai Chi Exercises on the Balance, Functional Gait, and Flexibility of Elderly Filipino Males

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Keywords: Tai Chi

Abstract: The objective of this study is to evaluate the effect of a 16-week Tai Chi Chuan exercise program on the balance, functional gait and sit-and-reach flexibility among selected elderly Filipino males. This research utilized a one-group pre-test and post-test quasi-experimental design. Forty healthy male Filipino respondents aged 55-60 years, with no prior experience or knowledge about Tai Chi Chuan, were recruited from an urban community in Pasay City, Philippines. All of the respondents participated in a 16-week exercise program that was held three times a week every morning. Balance, functional gait and sit-and-reach flexibility were measured at the beginning and the end of the Tai Chi Chuan exercise intervention. This study showed that Tai Chi offers potential benefits to the elderly males in terms of balance and other physical functions. Improvements were evident in functional balance, gait and flexibility. The study proves that Tai Chi should be an alternative method for elderly males to slow down the normal decline in balance, gait performance and physical flexibility.

1. Introduction

Tai Chi Chuan (Taijiquan) is a healing martial art that combines martial arts movements with energy circulation known as qui or chi, breathing, and stretching Techniques [1]. Originally developed for self-defense, tai chi has evolved into a graceful form of exercises that's now used for stress reduction and a variety of other health conditions (Mayo Clinic, 2015). As a proven life-prolonging, healing, and rejuvenating exercise, Tai Chi have been found to be ideal for older people (Liang and Shu, 2005; The Telegraph, 2012). Researchers found that older people who regularly performed the traditional Chinese mind and body technique were less likely to suffer health problems and were physically stronger (Yeh, Wang, Wayne,Phillips, 2008). Tai Chi is ideal for the elderly as it is a low-impact, slow- motion exercise in which a person moves while breathing deeply and naturally, thus, focusing one's attention on bodily sensations, which is similar to some kinds of meditation (Harvard Health, 2015). In addition, Tai Chi has been proven to be beneficial in lowering certain risks that older people are most prone to. Such is the case for their vulnerability to falls which has been an important cause of morbidity among the elderly (Santos, da Silva, de Pinho, Gautério, Pelzer, and da Silveira, 2012). Santos et al. (2012) added that one of the most important physiological factors for falls is impaired balance. Many factors contribute to poor balance, including reduced strength, flexibility, and sensorimotor coordination as well as delayed information processing (Yu and Yang, 2012).

There are several cross-sectional and experimental studies proving how Tai Chi benefits the elderly by improving their balance and physical fitness. In 2012, Yu and Yang found that Tai Chi improved the balance and other physical functions such as flexibility and reaction time of elderly male subjects. The positive effect of Tai Chi on balance were further supported by the study of Konig, Galarza, Goulart, Lanferdini, Tiggeman, and Dias (2014). Their study saw significant improvement in balance through different evaluation methods after three and six months of Tai Chi intervention among elderly women. In an even earlier study, Li, Hamer, Fisher, and McAuley (2001) found that older people who practiced Tai Chi performed significantly better compared to non-practitioners. In addition, while both groups in their study exhibited deterioration in functional

balance measures during post-intervention follow-up, the Tai Chi group showed a significantly slower rate. Other studies proved the benefits of Tai Chi among elderly people by significantly improving different health indices such as blood pleasure (Yeh, et al., 2008) and cognition (Chang, Tsai, Beck, Hagen, Huff, Anand, Roberson, Rosengren, and Beuscher, 2011). The findingsofthese studies support the health benefits of Tai Chi as a form of exercise among elderly men and women. While most studies have focused on evaluating Tai Chi through balance tests, this study aimed to further support Tai Chi's positive effect on other factors such as flexibility and functional gait that may affect balance.

The objective of this study was to evaluate the effect of a 16-week Tai Chi Chuan exercise program on the balance, functional gait, and sit-and-reach flexibility among selected elderly Filipino males. In due course, it is hypothesized that the Tai Chi Chuan intervention conducted three times a week for one hour per session in a span of 16 weeks was sufficient to produce positive changes among the target respondents balance, functional gait, and flexibility.

2. Methods

2.1. Research Design and Sampling

This research utilized a one-group pre-test and post-test quasi-experimental design. Forty male Filipino respondents aged 55-60 years, with no prior experience or knowledge about Tai Chi Chuan, were recruited from an urban community in Pasay City, Philippines. The exclusion criteria included the presence of health problems such as cognitive impairments, symptomatic cardiovascular diseases at moderate exertion levels, poorly controlled hypertension or symptomatic orthostatic hypotension, other neurological disorders, peripheral neuropathy of the lower extremities, crippling arthritis, and metastatic cancers. In addition, the respondents were not taking any medications that could affect their balance. All of the respondents were asked to refrain from changing their daily lifestyle routine. Informed consents were obtained from the respondents after thoroughly explaining the objectives and procedures of the study, including the benefits and risks of participation.

2.2. Exercise Intervention

All of the respondents participated in a 16-week exercise program that was held three times a week every morning. Each Tai Chi Chuan exercise session lasted 60 minutes. A certified Tai Chi Chuan instructor with one assistant facilitated each session in which the 24-posture simplified Tai Chi Chuan was sutilized. In each session, the first 10 minutes were dedicated for warm-up exercises, the next 40 minutes were for the main Tai Chi Chuan exercise, and the concluding 10 minutes were reserved for cool-down exercises. Correct body positioning, joint angles, and form-to-form transitions were constantly monitored during the sessions.

2.3. Outcome Measures

Balance, functional gait, and sit-and-reach flexibility were measured at the beginning and the end of the Tai Chi Chuan exercise intervention. While functional gait and flexibility have been identified as contributing factors to balance, all three are important factors that have been associated with risk of falls among the elderly (Yu and Yang, 2012; Konig, et al., 2014).

2.4. Balance

Functional balance among the elderly respondents was evaluated using the Berg Balance Scale (BBS). It is based on 14 items common to everyday life. The maximum score that can be achieved in this scale is 56 and each item has an ordinal scale consisting of five options ranging from 0 to 4 points according to the level of difficulty (the higher the score, the better the balance). The test is simple, easy to administer, and safe for the evaluation of elderly subjects. (Berg, Wood-Dauphinée, Williams, and Gayton, 1989; Miyamoto, Lombardi, Berg, Natour, and Ramos, 2004)

2.5. Functional Gait

The 'timed up and go' test (TUG) is a simple, quick and widely used clinical performance-based measure of lower extremity function, mobility, and fall risk (Herman, Giladi, and Hausdorff, 2011). TUG is one of the more commonly used clinical tools for quantifying gait, dynamic balance abilities

and fall risk. In this study, TUG was mainly used to measure functional gait. It is a simple test in which the elderly respondents were asked to stand up from a chair (resting position), walk a distance of three meters and then return to the chair and sit again (with their backs on the backrest). The respondents were instructed to perform the task safely and as quickly as possible and their performances were analyzed by counting the time they needed to complete the test (Konig, et al., 2014). Before each test, a familiarization protocol was conducted so as to ensure safety and accurate results.

2.6. Sit-and-Reach Flexibility

Sit-and-reach flexibility was measured using a sit-and-reach apparatus. The evaluation protocol was patterned with the study of Yu and Yang (2012). All of the elderly respondents were asked to sit on the floor with their legs stretched out forward and their shoes removed. Both knees were locked and pressed flat to the floor (the tester assisted by holding them down). With the palms facing downward, the subjects reached forward along the measuring line as far as possible and held that position for one or two seconds while the distance was recorded in centimeters. The subjects were tested twice, and the better results were used.

2.7. Statistical Analysis

Descriptive Statistics was used (weighted mean) for the elderly respondents for both the pre and post-test measures. Inferential statistics, specifically, paired t-test was used in finding out the effect of the Tai Chi Chuan exercise intervention by identifying if there was a significant difference in the outcome measures between the pre-test and the post-test. The level of significance was set at $p < 0.05$.

3. Results

Figure 1 presents the mean of the outcome measure pertaining to balance pre- and post-intervention. After the 16-week Tai Chi Chuan exercise intervention, functional balance significantly improved ($p = 0.02$).

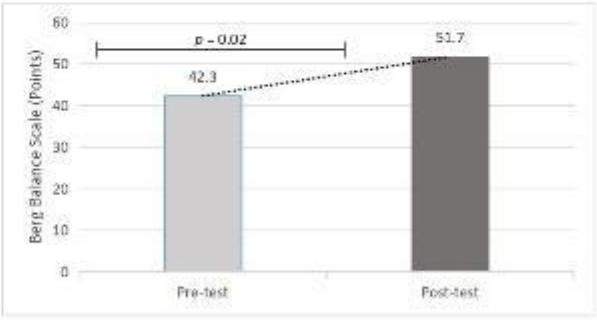

Figure 1 Comparison of functional balance before and after the 16-week Tai Chi Chuan intervention

Figure 2 shows the mean of the outcome measure pertaining to functional gait pre- and post-intervention. Functional gait, which was tested using the Timed Up & Go test, is statistically better after the respondents underwent the Tai Chi intervention ($p = 0.00$).

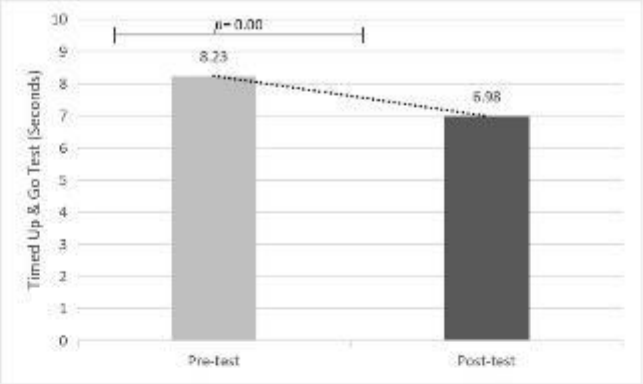

Figure 2 Comparison of functional gait before and after the 16-week Tai Chi Chuan intervention

Figure 3 illustrates the mean of the outcome measure pertaining to flexibility pre- and post-intervention. After the 16-week Tai Chi intervention, the sit-and-reach flexibility of the respondents significantly improved ($p = 0.02$).

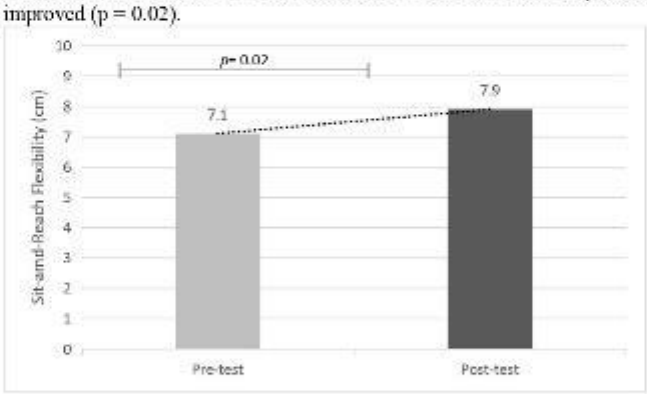

Figure 3 Comparison of measure of flexibility before and after the 16-week Tai Chi Chuan intervention

4. Discussion

This study shows that Tai Chi offers potential benefits to the elderly in terms of balance and other physical functions. Improvements were evident in functional balance, gait, and flexibility. Tai Chi Chuan or Tai Chi is a widely practiced Chinese martial art. It consists of a series of postures combined in slow, smooth, graceful movements and is considered a low intensity exercise that is claimed to develop balance, coordination, and help maintain strength and emotional health (Wu, 2002).

Balance is a required component in the execution of postural control. The capacity to maintain balance decreases with age which results in an increased risk of falls and fractures among the elderly (Nicken, 2010). These findings suggest that Tai Chi exercise may positively influence balance

abilities among older males during the course of 16 weeks of training. Furthermore, flexibility is an important factor in maintaining balance. One possible explanation for this finding is that Tai Chi is a mind-body practice that combines meditation with slow, gentle, graceful movements. It is considered a complex, multi-component intervention that integrates physical, psychosocial, emotional, spiritual, and behavioural elements (Wayne, et al., 2011) and features constant swinging, shifting, and turning in all directions, including left, right, forward, and backward. This activity requires a high degree of concentration and coordination between mind and body and among the different body parts. The motor system, the nervous system and the proprioceptive systems are all mobilized during Tai Chi exercise.

The results of this study proved that Tai Chi could improve the ability to stay balanced and increase muscle strength and flexibility. Moreover, it was also found out that Tai Chi is a form of exercise that can improve the flexibility of the body and mind, as well as adjust breathing, and can increase the cooperation among the hands, eyes and whole body with the mind. Tai Chi can boost the control of the mind on the body and improve the reaction capacity of the respondents. This study shows that the respondents who were subjected to Tai Chi for 16 weeks possessed better trunk and hamstring flexibility than they experienced during their previous sedentary lifestyles. This finding is confirmed by the findings of Lan et al. (2012), who reported significantly superior performance among older Tai Chi practitioners with more than 10 years of experience than their sedentary counterparts with respect to hip joint flexibility, as measured by their stand and reach test scores. Lan et al, et al (2015) found out in their study that the maintenance and development of levels of flexibility closely related to balance are important components of a general health enhancement program during the aging process.

Similarly, Chyu, et al. (2010) also found out in their study that Tai Chi exercises incorporate whole body exercises and some isotonic exercises. Performing Tai Chi exercises can help build muscles on the back and the lower limbs, which can subsequently increase muscle strength. On the other hand, Taylor, et al. (2012) discussed about the steps of Tai Chi which focus on the exchange between deficiency and excess. The so-called 'deficiency and excess' (Xu Shi in Chinese) is the proportion of the body weight excreted on the feet, the foot that withstands more body weight is referred to as 'excess,' and the foot with less body weight is referred to as 'deficiency.' 'The exchange between deficiency and excess' actually refers to the change of body weight between each foot. This theory fully emphasizes the capacity to control the distribution of the body weight and adjust the gestures. With the guidance of this theory and cooperation of a series of movements made while standing with a single leg, standing with two legs, or standing with the other leg, the capacity of the elderly to stay balanced and adjust their steps is improved.

The results indicate that, after the 16-week intervention period, functional gait, which was tested using the Timed Up & Go test, is statistically better after the respondents underwent the Tai Chi intervention ($p = 0.00$). Moreover, the sit-and-reach flexibility of the respondents also significantly improved ($p - 0.02$). It is worth mentioning that the value of the gait speed of the respondents at the baseline in the present study were consistent with those reported in a previous study (Maki, 2007). Wayne et al. (2015) reported that the gait speeds for healthy adults have been shown to range from 1.05 to 1.43 m/s. Reductions in gait speed, stride length, ranges of motion, and force momentum in hip and knee joints are common in older adults [34,35,36]. In particular, the reduction in freely selected gait speed is an indicator of risk of falls [37]. Previous studies have shown that the kinematic parameters of the knee and ankle joints have a positive relationship with gait speed (Kirkwood, et al., 2007). In particular, Kwon, et al. (2015) found that between the pre-swing and the mid-swing, the peak values of the flexion and the external rotation of the knee joint and the peak values of the plantar-flexion of the ankle joint significantly increased with the increase of gait speed.

Meanwhile, a large number of studies have shown that strength training programs have a beneficial impact on gait efficacy (Lamoureux et al., 2013), including slowing down the decline

in gait function due to age. However, with regard to hip flexibility, a few studies have shown that the stretching training program is better than the strength training program to retard the normal, age-related contraction of the muscle groups of the pelvis and hip, like the gluteal and rotator (Christiansen, et al., 2008). The results of the study indicate that the 16-week helped in improving the balance, functional gait, and sit-and-reach flexibility among selected elderly Filipino males. This probably is associated with the "Loosen Waist and Hips (Song Yao Song Kua)" guideline of Tai Chi. From a martial arts standpoint, when the waist and hips are loose, the power generated by the lower limbs can easily be transmitted to the arms. To adhere to this principle, the upper body must be upright and the stance must be comfortable, which may be effective in improving the flexibility of the hip and ankle. Lastly, the Tai Chi pattern includes many movements, which require people to go down on their knees and their waists; this is good for many joints because it increases the movement of the joints and improves flexibility (Lelard, et al, 2010).

However, psychological gains from Tai Chi have been demonstrated only in the elderly, and there is a need therefore to establish benefits in younger age cohorts for whom balance is seldom problematical. In general, there is a paucity of research on the benefits of Tai Chi for the non-elderly population, possibly because of the unwarranted perception that Tai Chi is an exercise appropriate only for the elderly.

5. Conclusion

In conclusion, Tai chi is effective in improving balance, functional gait, and sit-and-reach flexibility among selected elderly Filipino males. Therefore, the Tai Chi Chuan intervention conducted three times a week for one hour per session in a span of 16 weeks was sufficient to produce positive changes among the target respondents' balance, functional gait, and flexibility.

Given the results of the study, it should be thought of as an alternative method for older adults to slow down the normal decline in gait performance and physical flexibility. Future studies should run a similar randomized controlled trial with a large sample size to confirm the beneficial effects of Tai chi on gait parameters and musculoskeletal flexibility in different populations such as healthy female older adults, and those older adults with high risk for falls and those inflicted with disorders like Parkinson's disease and peripheral neuropathy.

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ARTICLE

Effects of Tai Chi Chuan and Brisk Walking Exercise on Balance Ability in Elderly Women: A Randomized Controlled Trial

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This study aims to investigate the effects of Tai Chi Chuan (TCC) and brisk walking (BW) on balance and training duration for the two exercises to significantly improve balance. A total of 48 elderly women were randomly divided into three groups. The TCC and BW groups completed a 60-min intervention training program with five sessions weekly for 16 weeks. Single-leg standing balance was tested every 4 weeks. Results showed that all the variables with eyes open improved on the eighth week ($p < .05$) in the TCC group and on the 12th week ($p < .01$) in the BW group. All variables with eyes closed improved on the 12th week ($p < .01$) in the TCC group and on the 16th week ($p < .05$) in the BW group. The results showed that 12 and 16 weeks of TCC and BW, respectively were essential to improve balance with eyes closed among the women aged 60–70 years.

Keywords: aging, balance control, fall, intervention

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Approximately one of three people aged 65 years and older fall at least once a year, and half of them experience multiple falls (Davis et al., 2010). Falls cause severe injuries in the elderly, especially postmenopausal women with osteoporosis; such injuries include soft tissue injury, fracture, and brain trauma, which can result in death (Konak, Kibar, & Ergin, 2016). Decreased balance with single-leg stance (SLS) was found to be a significant predictor of falls (Enderlin et al., 2015). Falls during SLS, such as stepping over obstacles and climbing stairs, were reported to account for approximately 50% of falls in this population (Novak, Komisar, Maki, & Fernie, 2016). Balance ability is related to mobility, vision, muscle strength, and proprioception (Enderlin et al., 2015); however, the elderly experience a significant decline in organ function, such as poor eyesight, ankle and knee joint proprioception, and muscle strength. This decline in organ function that comes with aging might reduce the ability of older adults to balance with SLS and could increase their risk of falling (Huang & Liu, 2015).

Balance ability should be improved to prevent falls and injuries in the elderly (Kathiresan, Jali, Afiqah, Aznie, & Fidieyana, 2010). Moderate aerobic exercise positively affects the balance ability of older adults (Dixit, Maiya, Shastry, & Guddattu, 2016). Tai Chi Chuan (TCC), a traditional Chinese exercise form known for its slow and graceful movements, has become one of the most popular exercises in China (Chan et al., 2016). Some evidence indicates that short- and long-term TCC exercises can improve the body balance of adults and patients (Kim, Kim, & Lee, 2015; Li et al., 2012; Scianni, 2015; Song et al., 2017; Tsang, 2013; Zhou et al., 2015). Furthermore, regular TCC exercise can enhance joint kinesthesia (Chang et al., 2016; Zhang, Sun, Yu, Song, & Mao, 2014), lower extremity muscle strength (Xu, Hong, & Li, 2008), and neuromuscular reaction in elderly women (Sun et al., 2016; Wang, Xu, & Li, 2017). Brisk walking (BW), with its speed being higher than that of normal walking, is one of the most common moderate aerobic exercise forms with 40–59% maximal oxygen intake (Murtagh, Boreham, & Murphy, 2002). BW is recommended to all age groups as an exercise that requires minimal special skills and facilities. Although a number of studies have indicated that BW can enhance static and dynamic balance that reduces fall risk among elderly adults (Okubo et al., 2015; Paillard, Lafont, Costes-Salon, Rivière, & Dupui, 2004), other studies have yielded inconsistent results about the positive effects of a 10-week BW intervention on static balance ability (Gába et al., 2016).

Regular TCC exercise could improve balance control, but the essential training duration for improvements remains unclear. Moreover, the few studies on the effects of BW on balance ability in the elderly have shown contradictory results. The present study aims to assess the training effects of TCC and BW exercises on balance ability and to identify the ideal training duration necessary for the two exercises to significantly improve balance. We hypothesize that TCC exercise is more efficient than BW exercise in improving body balance in SLS under two visual conditions.

Methods

Study Design

A randomized controlled trial was designed to compare the effects of TCC and BW exercises on balance with SLS during a 16-week training program. Both TCC and

BW groups participated in a 60-min moderate-intensity intervention exercise for at least five sessions weekly for 16 weeks. Balance ability was tested at the baseline and on the 4th, 8th, 12th, and 16th week.

Recruitment of Study Participants

A total of 48 elderly women (aged 60–70 years) were recruited by means of advertisements in newspapers and leaflets and through community advocacies in Jinan, Shandong Province, China. The exclusion criteria are as follows: any regular exercise experience; falling history; and cardiovascular, neurological, and musculoskeletal diseases. The application for human ethics and informed consent forms was approved by the medical ethics committee of Shandong Institute of Sport Science.

Randomization

After baseline assessments, all participants were randomly divided into TCC, BW, and control groups with the use of permuted block randomization at a ratio of 1 : 1 : 1. The randomized list, sealed in an envelope, was provided to the researcher before implementing the intervention.

Intervention

In the first 3 weeks, the participants were individually instructed about the 24-form TCC exercise by a qualified TCC master. Each session included a 10-min warm-up, a 20-min training on new movement forms, a 20-min review of learned movements, and a 10-min cooldown. The participants then practiced under the supervision of a master for the next 13 weeks. Each session included a 10-min warm-up, a 40-min TCC exercise, and a 10-min cooldown.

BW is defined as walking at a speed of 1.79 m/s in an indoor track (Murtagh et al., 2002). The participants in the BW group walked at a speed perceived to cause breathing to accelerate and the body to warm-up and sweat (Gába et al., 2016). The pace and speed on a pedestrian road were set by the professional instructor. The walking duration increased from 10 to 40 min over the first 3 weeks. It was then maintained at 40 min for the next 13 weeks. Each session consisted of a 10-min warm-up, a 40-min BW exercise, and a 10-min cooldown.

The control group was organized to watch TV programs, read newspapers, or attend health education lectures with the same schedule as the other two groups. However, they were prohibited from engaging in any regular exercise and allowed to maintain their own dietary habits.

Measurements

The measurements in the present study consisted of foot pressure plate and SLS time measurements. SLS tests, with an internal consistency reliability ranging from 0.95 to 0.99 (Franchignoni, Tesio, Martino, & Ricupero, 1998), have been extensively used to assess balance and exercise among the elderly. Both measurements were completed in a quiet testing room in the morning.

Foot Pressure Plate Measurement

Balance tests were performed with a foot pressure plate (RSscan for 2D balance with a 0.5-m system, Belgium; Hijmans, Zijlstra, Geertzen, Hof, & Postema, 2009). Each participant was asked to stand barefoot with the dominant leg in a comfortable self-chosen stance facing forward on a plate; the dominant leg is described as the preferred leg for kicking a football (Gribble, Tucker, & White, 2006), as motionless as possible. The other leg was fixed at 90° with the hip and knee joints flexed and both arms relaxed at the sides of the body. Two standing conditions were randomly tested: in one condition, the participants were asked to stand on a single leg for 22 s with their eyes open (i.e., SLS with eyes open, SLO) and looking straight ahead at a dot on a wall 2.5 m away (Nilsson, Ageberg, Ekdahl, & Eneroth, 2006); in the other condition, they performed an SLS for 12 s with their eyes closed (i.e., SLS with eyes closed, SLC; Gerbino, Griffin, & Zurakowski, 2007). The trial failed if the supporting leg moved or the nonsupporting leg touched the floor. Three successful trials for each SLO and SLC were tested after the procedures were familiarized. The time interval for breaks was 1 min between two consecutive trials. All measurement procedures were performed under the supervision of a technician.

The data were sampled at 17 Hz and low-pass filtered with a cutoff frequency of 6 Hz (Butterworth; Hijmans et al., 2009). The data from first and last seconds in the trial were not included in data analysis. On the basis of the displacement of the center of pressure (COP), all outcomes were calculated to assess postural steadiness (Prieto, Myklebust, Hoffmann, & Lovett, 1996; Figure 1). The maximal

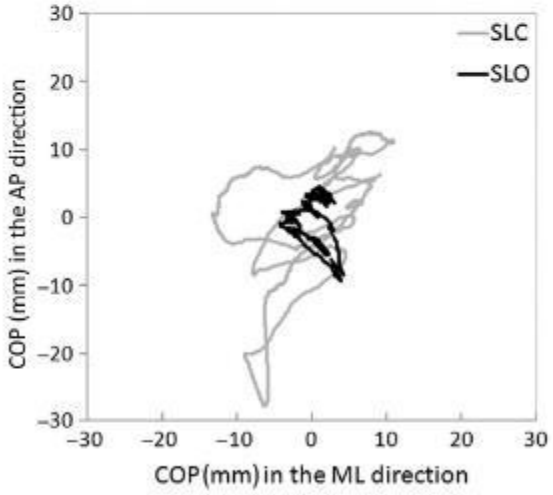

Figure 1 — COP trajectories of SLO and SLC for a representative participant. COP = center of pressure; SLO = SLS with eyes open; SLC = SLS with eyes closed; SLS = single-leg stance; AP = anterior–posterior; ML = medial–lateral.

displacements of COP in the anterior–posterior (AP; D-ap) and medial–lateral (ML; D-ml) directions, as well as the total length of the COP trajectories (Lng) and the 95% confidence ellipse area of COP movements (Area), were derived (Prieto et al., 1996).

SLS Time Measurement

This measurement procedure was similar to the foot pressure plate measure. The participants were asked to stand on the ground with their dominant leg in SLO and SLC and with arms positioned along the sides of the body. The participants performed SLO and SLC three times, and the set with the longest duration was selected for analysis. A 1-min interval was provided as a break between two consecutive trials.

Statistical Analysis

The software SPSS 17.0 (IBM, New York) was used for data analysis, and all the variables were presented as mean ± *SD*. The variables of five measurements were named $week_0$, $week_4$, $week_8$, $week_{12}$, and $week_{16}$ in this study. One-way analysis of variance (ANOVA) was used to compare the differences of the demographic and baseline variables across the three groups. Dunnett's T3 was chosen for post hoc multiple comparisons for nonequal homogeneity of variances. Bonferroni method was selected for equal homogeneity of variances. Two-way repeated-measures ANOVA was used to determine the effects of different groups and time durations, as well as their interaction effects, on the measurements. If any significant main and interaction effects were found, then the Bonferroni method was conducted for post hoc comparisons. The significance level was set at .05.

Results

Baseline Characteristics

A total of 50 persons were screened for eligibility; 48 were deemed qualified and then divided into three groups. A total of 36 participants (12 in the TCC group, 13 in the BW group, and 11 in the control group) completed the entire 16-week study. Furthermore, 64 attendance sessions out of 80 (80%) were required for each participant in the three groups. Twelve individuals dropped out because of health reasons ($n = 2$), low attendance rate ($n = 6$), lack of time ($n = 3$), and no reason ($n = 1$). No statistical difference in baseline characteristics was detected among the three groups (Table 1).

Balance Ability With SLS

As shown in Table 2, in SLS with eyes open, two-way repeated-measures ANOVA showed significant group effects, time effects, and Group × Time interaction effects. No significant difference in all the variables was observed among the three groups at $week_0$. In $week_8$, significant within-group differences in all the variables were observed in the TCC group. The same differences were observed in the BW group in $week_{12}$. The detailed post hoc statistical results are as follows:

Table 1 Baseline Characteristics of Participants

	TCC Group ($n = 12$)	BW Group ($n = 13$)	C Group ($n = 11$)	F	p
Age (years)	64.12 ± 3.21	63.26 ± 2.20	65.36 ± 4.31	0.712	.498
Weight (kg)	62.81 ± 8.37	62.00 ± 7.49	62.63 ± 7.21	0.004	.996
Height (cm)	157.56 ± 5.45	158.50 ± 4.40	156.45 ± 4.43	2.607	.089
BMI (kg/m^2)	25.12 ± 3.19	24.69 ± 2.97	26.21 ± 3.82	0.617	.546
Education (years)	6.83 ± 0.83	7.15 ± 0.80	7.27 ± 0.79	0.926	.406

Note. Data are presented as mean ± *SD*. TCC = Tai Chi Chuan; BW= brisk walking; C = control; BMI = body mass index.

balance ability significantly increased by 57.6% (TCC in week$_8$) and 35.8% (BW in week$_{12}$) for Time and decreased by 40.2% (TCC in week$_8$) and 42.5% (BW in week$_8$) for D-ap, by 45.2% (TCC in week$_8$) and 35.4% (BW in week$_8$) for D-ml, by 39.7% (TCC in week$_8$) and 28.8% (BW in week$_{12}$) for Lng, and by 65.3% (TCC in week$_8$) and 71.0% (BW in week$_8$) for Area relative to the baseline, respectively. No significant change from the baseline was observed in the control group. Significant differences in all the variables were observed between the TCC and control groups in week$_8$, whereas these differences were observed between BW and control groups in week$_{12}$.

As shown in Table 3, in SLS with eyes closed, two-way repeated-measures ANOVA revealed significant group effects, time effects, and Group × Time interaction effects. No significant difference in all variables was observed among the three groups at week$_0$. Significant within-group differences in all variables were observed in the TCC group in week$_{12}$ and in the BW group in week$_{16}$. The detailed post hoc statistical results are as follows: balance ability significantly increased by 94.3% (TCC in week$_{12}$) and 101.5% (BW in week$_{16}$) for Time and decreased by 31.7% (TCC in week$_{12}$) and 30.0% (BW in week$_8$) for D-ap, by 20.2% (TCC in week$_8$) and 26.8% (BW in week$_{16}$) for D-ml, by 36.4% (TCC in week$_4$) and 38.8% (BW in week$_4$) for Lng, and by 42.8% (TCC in week$_8$) and 38.1% (BW in week$_{12}$) for Area from the baseline, respectively. No significant change from the baseline was observed in the control group. Compared with the control group, significant between-group differences were found in Time (TCC at week$_{12}$ and BW at week$_{16}$), Lng (TCC at week$_4$ and BW at week$_4$), Area (TCC at week$_{16}$), and D-ap (TCC at week$_{12}$ and BW at week$_8$).

Discussion

The results of the present study, which support the hypothesis, showed that the variables of balance ability, D-ap, D-ml, Lng, Area, and Time significantly improved in the TCC and BW groups after training. The balance ability in the control group remained unchanged during the 16-week experimental period, thereby indicating no learning effects on the balance test. Thus, both TCC and BW exercises can improve balance under SLO and SLC via intervention training.

Table 2 Comparisons of Study Variables With Eyes Open in Single-Leg Stance Among Three Groups

	TCC Group ($n = 12$)	BW Group ($n = 13$)	C Group ($n = 11$)	Group		Time		Group × Time	
				F	*p*	*F*	*p*	*F*	*p*
Time (s)									
$Week_0$	32.73 ± 16.69	40.80 ± 15.13	38.37 ± 13.73	5.21	.006	4.05	.004	1.22	.291
$Week_4$	39.14 ± 21.57	41.66 ± 14.66	40.22 ± 12.15						
$Week_8$	51.59 ± 15.26[a]	44.61 ± 14.12	40.38 ± 9.58						
$Week_{12}$	53.45 ± 14.23[a,b]	55.44 ± 8.62[a,c]	38.70 ± 12.68						
$Week_{16}$	55.61 ± 10.20[a,b]	55.03 ± 12.80[a,c]	39.94 ± 8.05						
Lng (mm)									
$Week_0$	422.57 ± 105.56	363.43 ± 104.7	427.93 ± 152.3	17.38	<.001	8.88	<.001	1.35	.219
$Week_4$	357.54 ± 114.62	347.50 ± 77.92	404.56 ± 120.10						
$Week_8$	257.92 ± 74.84[a,b]	293.04 ± 86.61	409.0 ± 176.20						
$Week_{12}$	235.62 ± 65.24[a,b]	261.28 ± 98.10[a]	386.1 ± 83.09						
$Week_{16}$	217.89 ± 45.82[a,b]	245.42 ± 80.48[a,c]	375.9 ± 69.78						
Area (cm^2)									
$Week_0$	1.45 ± 0.53	1.32 ± 0.61	1.38 ± 0.71	29.88	<.001	13.22	<.001	2.76	.007
$Week_4$	0.93 ± 0.55	0.98 ± 0.52	1.34 ± 0.72						
$Week_8$	0.50 ± 0.31[a,b]	0.38 ± 0.25[a,c]	1.32 ± 0.20						
$Week_{12}$	0.56 ± 0.39[a,b]	0.58 ± 0.41[a,c]	1.38 ± 0.16						
$Week_{16}$	0.40 ± 0.11[a,b]	0.34 ± 0.25[a,c]	1.29 ± 0.20						

(continued)

Table 2 *(continued)*

	TCC Group ($n = 12$)	BW Group ($n = 13$)	C Group ($n = 11$)	Group		Time		Group × Time	
				F	*p*	*F*	*p*	*F*	*p*
D-ap (mm)									
$Week_0$	30.07 ± 4.82	28.47 ± 7.96	25.95 ± 6.71	25.54	<.001	16.58	<.001	2.25	.026
$Week_4$	23.21 ± 5.13[b]	23.02 ± 4.49	25.30 ± 8.13						
$Week_8$	18.31 ± 5.72[a,b]	16.42 ± 5.44[a,c]	24.92 ± 7.06						
$Week_{12}$	17.98 ± 5.30[a,b]	17.75 ± 6.33[a,c]	25.32 ± 6.00						
$Week_{16}$	16.52 ± 3.62[a,b]	15.60 ± 5.64[a,c]	25.61 ± 6.51						
D-ml (mm)									
$Week_0$	33.62 ± 11.49	31.97 ± 9.88	33.59 ± 7.32	12.08	<.001	13.78	<.001	2.95	.004
$Week_4$	24.01 ± 5.23	29.30 ± 9.39	32.80 ± 4.08						
$Week_8$	18.05 ± 7.21[a,b]	20.22 ± 5.71[a,c]	30.49 ± 5.81						
$Week_{12}$	19.14 ± 4.58[a,b]	21.13 ± 7.23[a,c]	30.83 ± 5.92						
$Week_{16}$	18.61 ± 6.49[a,b]	16.46 ± 6.08[a,c]	29.26 ± 3.96						

Note. Data are presented as mean ± *SD*. TCC = Tai Chi Chuan; BW = brisk walking; C = control; Time = the length of time with single-leg stance; Lng = the total length of the COP trajectories; Area = the area of 95% bivariate confidence ellipse, which encloses approximately 95% of the points on the COP path; D-ap = the maximal displacement of COP in the anterior–posterior direction; D-ml = the maximal displacement of COP in the medial–lateral direction; COP = center of pressure.
[a]Significant difference compared with the value at $week_0$ within each group. [b]Significant difference between TCC and C groups. [c]Significant difference between BW and C groups.

Table 3 Comparisons of Study Variables With Eyes Closed in Single-Leg Stance Among Three Groups

				Group		Time		Group × Time	
	TCC Group ($n = 12$)	BW Group ($n = 13$)	C Group ($n = 11$)	F	p	F	p	F	p
Time (s)									
$Week_0$	16.78 ± 7.1	15.63 ± 8.3	18.26 ± 7.63	7.36	.001	11.67	<.001	2.98	.004
$Week_4$	19.14 ± 7.59	18.95 ± 6.2	18.70 ± 11.66						
$Week_8$	21.88 ± 8.08	23.44 ± 12.89	19.97 ± 8.36						
$Week_{12}$	31.42 ± 9.23[a,b]	27.08 ± 12.08	19.53 ± 9.18						
$Week_{16}$	39.95 ± 11.67[a,b]	31.68 ± 12.4[a,c]	19.11 ± 8.19						
Lng (mm)									
$Week_0$	519.51 ± 105.54	582.20 ± 85.69	545.79 ± 98.21	65.48	<.001	23.25	<.001	5.72	<.001
$Week_4$	330.67 ± 50.40[a,b]	358.65 ± 53.23[a,c]	498.79 ± 60.27						
$Week_8$	243.41 ± 49.19[a,b]	261.39 ± 70.44[a,c]	520.88 ± 63.87						
$Week_{12}$	234.66 ± 56.06[a,b]	279.98 ± 87.23[a,c]	531.70 ± 63.92						
$Week_{16}$	194.70 ± 83.76[a,b]	227.52 ± 113.06[a,c]	558.55 ± 90.29						
Area (cm^2)									
$Week_0$	2.50 ± 1.15	2.28 ± 0.86	2.46 ± 0.91	5.50	.005	5.78	<.001	0.92	.502
$Week_4$	2.37 ± 1.07	2.17 ± 1.04	2.28 ± 0.31						
$Week_8$	1.43 ± 1.09[a]	1.67 ± 1.01	2.33 ± 0.57						
$Week_{12}$	1.40 ± 0.79[a]	1.41 ± 0.82[a]	2.15 ± 0.52						
$Week_{16}$	1.14 ± 0.97[a,b]	1.25 ± 0.94[a]	2.17 ± 0.71						

(continued)

Table 3 *(continued)*

	TCC Group ($n = 12$)	BW Group ($n = 13$)	C Group ($n = 11$)	Group		Time		Group × Time	
				F	*p*	*F*	*p*	*F*	*p*
D-ap (mm)									
$Week_0$	41.15 ± 6.12	40.07 ± 7.55	38.96 ± 9.50	20.16	<.001	12.76	<.001	3.24	.002
$Week_4$	36.35 ± 8.37	37.06 ± 9.13	40.94 ± 11.05						
$Week_8$	37.00 ± 8.20	28.76 ± 8.72[a,c]	40.36 ± 7.57						
$Week_{12}$	28.54 ± 7.42[a,b]	24.52 ± 6.21[a,c]	40.38 ± 8.84						
$Week_{16}$	25.88 ± 8.95[a,b]	21.54 ± 7.38[a,c]	37.98 ± 7.02						
D-ml (mm)									
$Week_0$	39.33 ± 8.85	41.75 ± 6.24	38.96 ± 9.50	21.02	<.001	13.01	<.001	3.24	.002
$Week_4$	38.52 ± 11.89	41.99 ± 18.10	40.94 ± 11.05						
$Week_8$	31.07 ± 7.92[a]	39.24 ± 12.91	36.72 ± 5.54						
$Week_{12}$	27.13 ± 8.15[a]	35.51 ± 17.51	36.74 ± 9.74						
$Week_{16}$	25.40 ± 9.83[a]	30.52 ± 14.98[a]	36.16 ± 8.72						

Note. Data are presented as mean ± *SD*. TCC = Tai Chi Chuan; BW = brisk walking; C = control; Time = the length of time with single-leg stance; Lng = the total length of the COP trajectories; Area = the area of 95% bivariate confidence ellipse, which encloses approximately 95% of the points on the COP path; D-ap = the maximal displacement of COP in the anterior–posterior direction; D-ml = the maximal displacement of COP in the medial–lateral direction; COP = center of pressure.
[a]Significant difference compared with the value at $week_0$ within each group. [b]Significant difference between TCC and C groups. [c]Significant difference between BW and C groups.

This finding is consistent with those of previous studies (Maciaszek & Osinski, 2012; Won, Kim, & Oh, 2015). A previous study (Zhou et al., 2015) found that a 24-week TCC exercise can significantly reduce total, AP, and ML COP sway paths in elderly women. In another study, postural stability with eyes closed was significantly improved after a 10-week BW intervention among the elderly (Gába et al., 2016), whereas in the current work, significant improvement was found after 12 weeks. The difference in age (63.2 vs. 55.9 years) might lead to differences in testing results. Another study (Li, Xu, & Hong, 2008) showed that a 16-week intervention failed to improve the testing scores for SLC. The difference in training frequency might be another factor leading to difference in testing results.

Several factors may improve balance ability after regular TCC and BW interventions. Muscle strength, proprioception, and the neuromuscular reaction ability of low extremities play important roles in controlling body balance (Jacobson, Chen, Cashel, & Guerrero, 1997). TCC intervention reportedly increases the muscle strength of knee flexors and extensors (Xu et al., 2008) and could decrease neuromuscular reaction time in the rectus femoris/semitendinosus/anterior tibialis/gastrocnemius muscles (Sun et al., 2016). Regular TCC and BW interventions could also decrease ankle kinesthesia threshold (Zhang et al., 2014).

Our data indicated that 12-week TCC and 16-week BW exercises could improve balance ability, respectively. To enhance body balance for preventing falls, the elderly must persist in doing exercises for several months. Moreover, TCC exercise may be more efficient than BW in improving balance ability with SLO (TCC after 8 weeks and BW after 12 weeks) and SLC (TCC after 12 weeks and BW after 16 weeks). The more efficient improvement of balance ability in the TCC group than in the BW group could be attributed to the characteristics of the movements involved. The TCC exercise emphasizes a large shift of the center of mass, long durations of SLS, large ankle and knee joint range of motion, and repeated concentric and eccentric contractions of lower muscles (Mao, Hong, & Li, 2006). In addition, a study indicated that the greatest pressure–time integral regions during TCC movements are the great toe and first metatarsal head. By contrast, the greatest pressure–time integral regions during walking are the second and third metatarsal heads (Mao, Li, & Hong, 2006). The cutaneous afferent information from the great toe plays an important role in postural control (Tanaka, Takeda, Izumi, Ino, & Ifukube, 1999). A study found a negative relation between plantar pressure and cutaneous sensation threshold of the great toe (Nurse & Nigg, 2001) from cutaneous mechanoreceptors located on the plantar of the feet, which could detect pressure and skin deformations and provide somatosensory information for the body (Yümin, Şimşek, Sertel, & Ankaralı, 2016). Thus, when the plantar pressure in the great toe is high, the cutaneous sensation is highly sensitive.

Our study showed that the periods to improve balance under SLO were shorter than that under SLC (8 vs. 12 weeks). Vision is one of the most important information input systems contributing to postural control. Clear and precise vision could provide the accurate and necessary spatial location information to the central nervous system. This information on upright posture serves as effective feedback in moderating balance control to prevent falls (Sturnieks, George, & Lord, 2008). Compared with that in the eyes-open condition, the COP sway area under the eyes-closed condition increased at approximately 30% while standing on a firm surface

(Lord, Clark, & Webster, 1991). Postural control ability under SLC could be more difficult than that under SLO. Thus, long periods maybe necessary to improve balance ability under the eyes-closed condition. The authors speculate that visual conditions could be the main reason for the different periods necessary to improve balance ability under such visual conditions.

Our data also showed that balance control improved better in the AP direction than that in the ML direction in the BW group. BW exercise enhanced balance control more than the TCC did in the AP direction. First, BW was more effective in decreasing maximal displacements with SLC in the AP direction (after 8 weeks) than in the ML direction (after 16 weeks). The differences can be associated with the information input system. The standing balance control sway without vision relied on the joint proprioceptive feedback and increased by 20–70% relative to that under visual feedback (Lord & Dayhew, 2001). The kinesthesia threshold of the plantar–dorsal flexion in the AP direction was significantly lower than that of inversion–eversion in the ML direction (Zhang et al., 2014). Moreover, a study found that the ankle joint proprioception in the ML direction failed to significantly improve during a 16-week BW exercise program (Zhang et al., 2014). Second, in our study, the D-ap in the BW group with SLC significantly decreased earlier (TCC vs. BW, 12 weeks vs. 8 weeks) than the TCC group. These results indicated that the balance improvements in the AP direction of the BW group were more efficient than that of the TCC group. The different movement characteristics between the TCC and BW exercises might lead to a discrepancy in intervention effects on postural control. Different postural control mechanisms were found in the AP direction compared with those in the ML direction. Balance stability was primarily controlled by the "ankle joint strategy" in the AP direction and the "hip joint strategy" in the ML direction (Corrigan, Cashman, & Brady, 1992). Walking movements included the ankle/knee joints flexed and repeatedly extended in the sagittal plane. However, ankle joint movement was multidirectional in the TCC exercise. This special uniaxial movement characteristic of BW may help enhance the musculoskeletal system function (muscle strength, neuromuscular reaction, and proprioception) in the AP direction.

The present study has two limitations. First, only female participants were recruited. Thus, further study should explore the effects of TCC and BW on the balance ability of elderly men. Second, only 36 participants completed the entire 16-week study, so the findings of this study should be interpreted with caution. Further studies with large sample sizes should be required to determine the effects of TCC and BW interventions on balance in elderly.

Conclusion

The 12-week TCC and 16-week BW interventions could improve the balance ability of elderly women. Compared with BW, TCC is more efficient in improving the body balance ability under SLS. Moreover, improving balance ability under SLS is quicker with vision than without vision. Thus, adequate periods of TCC and BW exercises are essential to improve the balance ability of elderly women, especially with their eyes closed.

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ORIGINAL ARTICLE

PSYCHIATRIC CARE WILEY

The effectiveness of Tai Chi Chuan on fear of movement, prevention of falls, physical activity, and cognitive status in older adults with mild cognitive impairment: A randomized controlled trial

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Abstract

Purpose: This study aimed to investigate the effectiveness of Tai Chi Chuan (TCC) on fear of movement, prevention of falls, physical activity, and cognitive status in older adults with mild cognitive impairment.

Design and Methods: This controlled trial was conducted with 20 participants in the intervention group, and they did exercises for 35–40 min/session, twice a week for 12 weeks.

Finding: The posttest scores of the scales indicated that the scores of cognitive adaptations, being observant, and changes in level subscales of the fall behavioral scale in the older adults who did Tai Chi exercise in the intervention group significantly increased ($p < .01$).

Practice Implications: The nursing home provider can safely manage TCC exercise interventions for older adults with MCI.

KEYWORDS
mild cognitive impairment, older adults, risk of falling, Tai chi chuan

1 | INTRODUCTION

Mild cognitive impairment (MCI) is being a common disorder experienced by elderly individuals and also a significant public health problem.[1] MCI is regarded as a transient stage between healthy ageing and dementia and is characterized by memory problems and the decline of cognitive functions.[2] The impaired cognitive functions cause a significant decrease in the quality of life, activities of daily living, and independence of individuals with MCI.[3] Also, elderly individuals with MCI have a higher risk of dementia and falls, as well as low balance.[4,5]

There has been no effective treatment yet to alleviate the clinical outcomes of MCI.[1] Therefore, there is a considerable need to develop preventive interventions and therapeutic approaches to prevent the progression of dementia.[1] Recent studies on nonpharmacological interventions have suggested that lifestyle factors, such as physical activity may contribute to modifying disease progression.[6,7] Also, decreased levels of physical activity may be a risk factor for dementia in older adults. The previous study has highlighted the importance of physical activity programs that are effective in fear of movement, prevention of falls, and improving cognitive functions.[8] However, no consensus has yet been reached regarding exercises to be given to patients with MCI.[9] It has been stated that the most appropriate exercise training program that can be given to MCI individuals should include parameters, such as balance, flexibility, lower and upper extremity muscle strengthening exercises, and goal-oriented activities.[10]

Tai Chi Chuan (TCC), one of the aerobic exercises maintaining muscle strength and balance, is the most recommended traditional Chinese exercise for older adults.[11] TCC diminishes the risk of falls, ameliorates balance, and enhances endurance and flexibility of muscle.[12,13] The current evidence has revealed that Tai Chi can be considered as an ideal exercise for older adults to improve cognitive functions and quality of life.[14]

As long as the value of improving cognitive health and preventing falls in the elderly has increased worldwide, MCI has attracted significant attention from researchers. However, there has been no study examining the effectiveness of exercise programs, such as TCC on fear of movement, prevention of falls and cognition in people with MCI in the Turkish population. Furthermore, A research study has highlighted that there are physical inactivity and low levels of regular exercise in older adults in the Turkish population[12] Therefore, it is incredibly crucial to understand better the role of Tai Chi exercise in cognitive and physical health in the Turkish population. This study aimed to investigate the effectiveness of TCC on fear of movement, prevention of falls, physical activity, and cognitive status in older adults with MCI.

Hypotheses of the study

(1) Is TCC exercise effects on the prevention of falls in older adults with MCI in the Turkish population?
(2) Is TCC exercise effective on physical activity and fear of movement in older adults with MCI?
(3) Is TCC exercise effective on cognitive adaptations in older adults with MCI?

2 | METHODS

2.1 | Study design

The present study was a randomized control trial conducted with pretest, posttest, and control-group design.

2.2 | Sample and setting

This study was conducted in a nursing home located in Turkey. Seventy-nine older adults live in this nursing home. The mini-mental state examination (MMSE),[15] Montreal cognitive assessment (MoCA)[16] tests, and clinical dementia rating scale (Stage 0.5–1)[17] were used to determine whether or not the older adults had MCI. The inclusion criteria of the study were determined as follows: (1) having a score of MMSE and MoCA of <25 points, (2) being Turkish and aged 65 years and over, (3) being able to communicate, read, and write independently in their local language, (4) being able to perform Tai Chi physical activity, (5) having no diagnosis of dementia and other psychiatric disorders. The exclusion criteria of the study were determined as follows: (1) having a body-mass index of >30, (2) having infectious diseases or immunological disorders, (3) being users of medications that would affect cognitive functions, (4) not signing the informed consent form.

The sample size of the present study was determined to be 34 (17 per group), with a power of 90% and Type I error of 5% using the power analysis (the program G*Power 3.1 was used). Considering the withdrawal possibility of 15% of participants, we enrolled 47 [control group = 24; intervention group = 23] older adults who met the inclusion and exclusion criteria in this study. All participants were randomly assigned to the intervention (TCC) and control (untrained) groups. Three participants from the intervention group were excluded from the study since they could not continue the 12-week exercise program regularly. Also, two participants from the control group were excluded from the study since one of them refused to participate in the posttest, and the other was on leave for a long time. The data obtained from 42 participants who completed the study were analyzed. The individuals were stratified based on the age (between 65 and 74 years or being aged ≥75 years), gender (female or male) and the history of falling (yes or no) by using the blocked randomization method[18] and assigned to the intervention (TCC exercise) group ($n = 23$) and the control (untrained) group ($n = 24$) by drawing the lot. There was no significant difference between these groups ($p > .05$). The flow diagram of the Tai Chi Chuan exercise trial was shown in Figure 1.

2.3 | Intervention

The data were collected between October 2018 and December 2019. The personal information form, the Tinetti assessment tool (TAT), the Tampa scale of kinesiophobia (TSK), the physical activity scale for the elderly (PASE), and the falls behavioral (FaB) scale were applied as pretest by conducting the face-to-face interview with all the participants. After these forms were completed, patients in the intervention group started to do TCC exercises with the help of the researcher. As previously stated,[12] they performed the TCC exercise program every Wednesday and Thursday per week, like two sessions and 35 and 40-min- sessions (Figure 2).

The PASE, TAT, FaB, and TSK had applied again as post-tests to the intervention group ($n = 20$) at the end of 12 weeks. The individuals in the control group ($n = 22$) were not subjected to any physical practice, and only the data collection forms (pretest and posttests) were applied and evaluated together with the intervention group.

2.4 | Outcome measures

The outcomes were evaluated before the TCC training and at the end of 12 weeks. The researcher was blind to all outcome evaluations to reduce bias. The data were collected using a personal information form, TAT, PASE, TSK, and FaB. Personal Information Form was prepared by the researcher upon the literature review.[12,13] This form includes the life habits and health conditions of the participants.

TAT, which was developed by Mary Tinetti to evaluate the risk of falling in people with MCI, was used in the present study.[19] The scale consists of a total of 28 items, including 12 items for gait and 16 items for balance. TAT was adapted to the Turkish population by Aprtan,[20] and it was found that the value of Cronbach's alpha coefficient was 0.97.[20] In the present study, Cronbach's alpha coefficient was found to be 0.96.

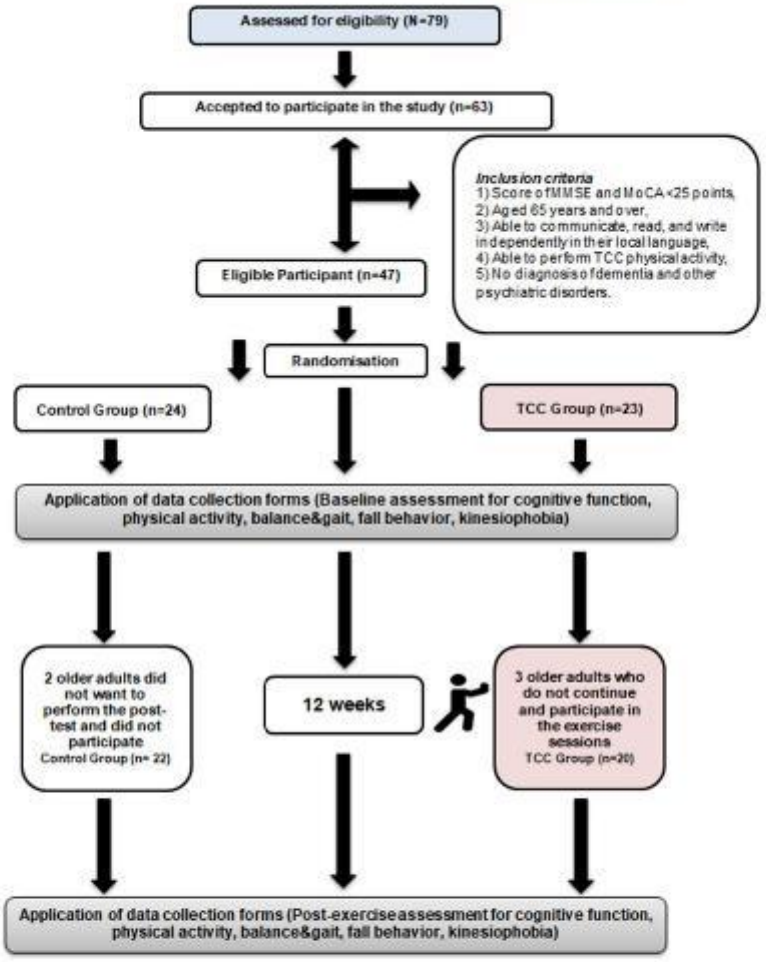

FIGURE 1 Flow diagram of the Tai Chi exercise trial. TCC: Tai Chi Chuan [Color figure can be viewed at wileyonlinelibrary.com]

PASE, which was developed in 1993 to assess the status of physical activity in people with MCI, was used in the present study. The PASE total score varies between 0 and 400, and higher scores signify high levels of physical activity.[21] Ayva et al.[22] adapted this scale to the Turkish population and determined that Cronbach's alpha coefficient of the scale was 0.71. In the present study, Cronbach's alpha coefficient was found to be 0.70.

TSK with 17 items was used to evaluate the fear of movement in the present study. The total score of TSK ranges from 17 to 68.[23] Yılmaz et al. adapted TSK to the Turkish population and found that the test retest reliability was 0.806.[24] In the present study, Cronbach's alpha coefficient was found to be 0.78.

The FaB scale, which was developed by Clemson et al., was used in the study to assess behaviors related to falls in people with MCI. The FaB scale includes 30 items and ten subscales. While higher

FIGURE 2 Example of Yang style of TCC. TCC, Tai Chi Chuan [Color figure can be viewed at wileyonlinelibrary.com]

scores indicate the safe or protective behaviors of the individuals related to falling; lower scores signify the risky behaviors.[25] Uymaz and Nahcivan adapted the FaB to the Turkish population and found that the Cronbach's alpha coefficient was 0.90.[26] In the present study, Cronbach's alpha coefficient was determined to be 0.89.

2.5 | Statistical analysis

The data of the study were analyzed through The statistical package for social sciences 22.0 version, and Graphs in the study were prepared via GraphPad Prism software. All data were represented as the mean ± SD. The Kolmogorov–Smirnov test and the Shapiro–Wilk test were used as the normality distribution test. The data regarding demographic and clinical characteristics in the intervention and control groups were analyzed by using χ^2 and t test. Differences in falls, balance, physical activity, and kinesophobia were compared between intervention and control groups at both beginning and end of the study by using The Wilcoxon signed-rank test or paired t test where appropriate. The value of $p < .05$ was considered statistically significant.

2.6 | Ethical considerations

We obtained ethical approval (no: 2018/120) and institutional permissions before starting the study and conducted this study in accordance with the Declaration of Helsinki. We informed the participants about the current study and stated that the personal identities of the participants will not be published and the participants had the freedom to withdraw from the study at any time without any reason being given. We obtained written informed consent from the elderly people before being included in the study.

3 | RESULTS

The mean age of geriatric individuals participating in the research was 74.21 ± 6.93 years. The %57.4 of the individuals in both groups were male in the experimental and control group (13 [56.5%] and 14 [58.3%], respectively), and the majority of older adults in the experimental and control groups had an education level of elementary school (56.5% and 45.8%, respectively). In both groups, the majority had social insurance (87.0% and 87.5%, respectively). Moreover, most participants in the experimental and control groups had balance issues (69.6% and 66.7%, respectively). Twenty-two males (mean age of 74.14 ± 7.8) and Twenty female (mean age of 74.30 ± 5.7) participants in the control and intervention groups completed the study. Seven participants from the intervention group could not complete the 12-week TCC training and thus were not included in the final analysis.

Tables 1 and 2 show the results of the present study, which was carried out to determine the effects of TCC as a mind-body movement therapy on the fear of movement, gait, risk of falling and cognitive improvement in older adults with MCI. The PASE, TBT & TGT, FaB, and TKS were applied as a pretest to all participants. It was determined in the present study that there was no significant difference between intervention and the control groups ($p > .05$).

TABLE 1 The mean pretest and posttest scores of the scales in the experimental group

	Pretest		Posttest		The value and the significance of the test	
Scales	x	SD	x	SD	t	p
Tinetti balance assessment	9.73	1.95	12.8	1.81	−10.788	.000
Tinetti gait assessment	10.6	0.88	11.7	0.64	−5.234	.000
TSK	42.34	3.31	48.21	5.5	−7.175	.000
PASE score (0–400)	41.77	12.10	62.27	13.82	−6.413	.000
Sub-dimensions scores of the FaB scale						
Cognitive adaptations	2.90	0.47	3.17	0.57	−3.042	.006
Protective mobility	2.48	0.50	2.86	0.62	−4.394	.000
Avoidance	2.38	0.60	2.39	0.61	−0.123	.903
Awareness	2.70	0.69	2.81	0.76	−1.796	.086
Hastiness	2.68	1.01	2.84	0.80	−1.567	.131
Practical strategies	2.00	1.08	2.08	1.04	−1.447	.162
Displacing activities	2.08	0.99	2.21	0.90	−1.817	.083
Being observant	2.04	0.76	2.43	0.72	−3.761	.001
Changes in level	2.82	0.38	3.39	0.49	−4.041	.001
Getting to the phone	2.73	0.81	2.78	0.67	−0.371	.714
Total of FaB scale	2.49	0.28	2.68	0.19	−5.010	.000

Abbreviations: FaB, falls behavioral; PASE, physical activity scale for the elderly; TSK, Tampa scale of kinesiophobia.

In the present study, a significant difference was observed in the pretest and posttest scores of the TAT, PASE, TSK, and FaB scale in the intervention group ($p < .05$). Also, the posttest scores of cognitive adaptations, protective mobility, being observant, changes in level subscales of the FaB scale significantly increased in the intervention group ($p < .05$). On the other hand, the results of this study revealed that there was no significant difference between the pretest and posttest scores of

TABLE 2 The mean pretest and posttest scores of the scales in the control group

	Pretest		Posttest		The value and the significance of the test	
Scales	x	SD	x	SD	t	p
Tinetti balance assessment	9.95	1.73	9.45	1.66	1.906	.069
Tinetti gait assessment	8.50	2.26	8.54	2.24	−0.272	.788
TSK	43.16	3.5	43.37	3.5	−0.666	.512
PASE score (0–400)	42.86	13.01	42.70	13.27	0.335	.742
Sub-dimensions scores of the FaB scale						
Cognitive adaptations	2.76	0.43	2.73	0.53	0.115	.910
Protective mobility	2.47	0.49	2.43	0.56	1.000	.328
Avoidance	2.40	0.59	2.38	0.66	0.485	.632
Awareness	2.67	0.69	2.66	0.69	1.000	.328
Hastiness	2.65	1.00	2.61	0.57	0.296	.770
Practical strategies	1.95	0.75	1.91	0.97	0.272	.788
Displacing activities	2.08	0.97	1.95	0.90	1.141	.266
Being observant	2.20	0.78	2.16	0.76	0.225	.824
Changes in level	2.87	0.34	2.83	0.48	0.569	.575
Getting to the phone	2.79	0.78	2.73	0.73	1000	.328
Total of FaB scale	2.48	0.28	2.44	0.23	1.307	.204

Abbreviations: FaB, falls behavioral; PASE, physical activity scale for the elderly; TSK, Tampa scale of kinesiophobia.

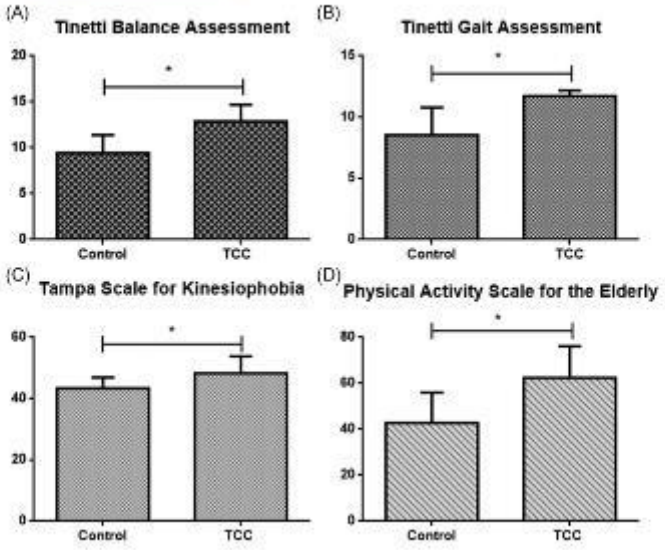

FIGURE 3 Comparison of posttest values of the scales in control and TCC groups. (A) Tinnetti balance assessment, (B) Tinnetti gait assessment, (C) Tampa scale for Kinesiophobia, (D) physical activity scale for elderly. *$p < .01$ compared with the control. All data were presented as mean ± SD. TCC, Tai Chi Chuan

the TAT, TSK, PASE, and subscales of the FaB scale in the control group ($p > .05$).

When TAT, TSK, and PASE posttest scores of the intervention and control groups were examined, all scores of these scales were significantly higher in the intervention group compared to the control group ($p < .01$) (Figure 3). Moreover, the posttest scores of cognitive adaptations, protective mobility, and changes in level subscales of the FaB scale were significantly higher in the intervention group than the control group (Figure 4) ($p < .01$).

It was found that TAT, TSK, and PASE scores of the intervention group significantly increased after the TCC exercise ($p < .01$). Likewise, the posttest scores of the scales revealed that scores of cognitive adaptations, protective mobility, being observant, and changes in level subscales of the FaB scale significantly increased in the older adults in the intervention group whom did TCC exercise ($p < .01$).

4 | DISCUSSION

The effects of 12 week TCC exercise on kinesiophobia, prevention of falls and cognitive functions in older adults with MCI were examined in this study. It was found that TCC exercise affected falls, physical activity levels, kinesophabia, and falls-related safe or protective behaviors in older adults. Furthermore, it was revealed that the TCC exercise positively affected these parameters, and the results of the study supported all three hypotheses. According to a previous study emphasized that aerobic exercise in individuals with MCI reduced cognitive impairment and prevention of falls in elderly individuals was also useful in terms of reducing the transition from MCI to dementia, and TCC was recommended as a new option in reducing the transition from MCI to dementia.[27] However, the effect of TCC on individuals with MCI is not precisely elucidated.

The most common problems experienced by elderly individuals include fear of movement and balance disorders associated with falls, and these factors affect their daily activities and social relationships.[25,29] It was observed that TAT scores of elderly adults who did TCC exercise in the intervention group increased, whereas, their fear of movement decreased. Moreover, an increase was observed in physical activity levels (PASE); on the other hand, a decrease was determined in safety or protective behavior related to falls (Table 1). These results suggested that older adults had a reduced risk of falls, increased safety and protective behaviors related to falls, and increased physical movement levels as a result of TCC training. Physical activities might have a positive effect on cognitive status in individuals with MCI. The previous study demonstrated that decreased physical performance in older adults with MCI might increase the risk of

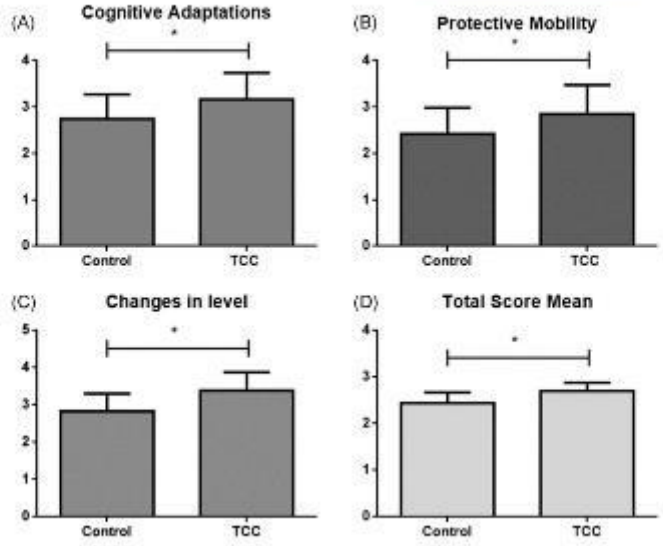

FIGURE 4 The sub-dimensions scores of the FaB scale, such as (A) cognitive adaptations, (B) mobility, and (C) changes in level in the posttest values of the scales in control and TCC groups. *$p < .01$ compared with the control. All data were presented as mean ± SD. TCC, Tai Chi Chuan

Alzheimer's disease.[10] Therefore, increasing physical activity may prevent the development of cognitive impairment in older adults.[11,12] Recent studies have also revealed that TCC is one of the best exercises to achieve this goal since balance can be developed with exercise that helps to improve joint movement and posture.[12,13] It has been reported that older adults had improved balance and walking status after TCC exercise.[12,13] Especially, Yang-style TCC is useful in terms of increasing musculoskeletal flexibility in healthy older women.[14] Balance exercises, such as TCC improve static and dynamic balance as well as performance in healthy older adults.[15] In another study, it was observed that while resistance exercise did not improve posture control, balance exercises improved posture in older adults.[16] In their study, Sangelaji et al. divided 40 individuals with multiple sclerosis into four groups and applied aerobic and resistive exercises in different combinations to those groups. The groups continued their programs four days a week for eight weeks, and at the end of the study, more effective results were obtained in balance, strength, agility, fatigue, speed, and walking distance values in the aerobic exercise group.[17] Fear of movement can lead to the avoidance of physical movements and activities in older adults since they think that movement can cause an injury once again.[18] In the present study, the fear of movement was found to be less in the intervention group compared to the control group, suggesting that regular exercise habits reduce the fear of movement in elderly individuals.

The present study has some limitations. It was a randomized controlled trial with a relatively small population, and the MCI diagnosis of participants in the intervention and control groups was determined using a mini-mental test (the cognitive status assessment with Iscore of MMSE and MoCA <25 points) and clinical dementia rating scale (Stage 0.5–1).

5 | CONCLUSION

The results of the present randomized controlled trial suggested that TCC was effective in decreasing fear of movement and risk of falls and improving cognitive functions. TCC, which is not a challenging and high-speed exercise, is an appropriate exercise for elderly individuals. Furthermore, TCC exercise may be useful in reducing the transition to dementia and improving cognitive functions in patients with MCI. However, further comprehensive studies are required better to understand the effect of TCC in individuals with MCI. It is essential to increase the knowledge and awareness of healthcare professionals about the importance of TCC aerobic exercises in reducing the fear of falling in people with MCI. TCC aerobic exercises into the care practices of older adults.

Also, biochemical studies are needed to support the effectiveness of TCC in people with MCI.

5.1 | Implications for psychiatric nursing practice

The implications of this study suggest that it is exceptionally crucial to nurses' intentions to exercise with older adults in their professional practice in the Turkish population. Also, as far as we know, there is no study investigating the effect of TCC on falls, physical activity, and cognitive status and gait parameters in individuals with MCI in Turkey.

Health care providers should be knowledgeable about the TCC to provide sufficient information to individuals and should teach the elderly different types of physical activity they can perform. Also, care providers and caregivers can safely manage TCC exercise interventions for older adults with MCI. Ongoing support and exercise will promote older adults' commitment to their TCC exercise. Even though the majority of older adults should exercise in nursing homes, older adults in Turkey do not prefer to exercise. The addition of this TCC will interventions to patients with MCI enable nurses to adjust their nursing interventions to the needs of these patient populations. That is why it is crucial to increase the knowledge and awareness of healthcare professionals about the importance of TCC aerobic exercises in reducing the fear of falling, prevention of falls and improving cognitive functions in people with MCI. This article provides new information regarding the reduced risk of falls, sustain mental health, reducing the transition to dementia and improving cognitive functions in patients with MCI, increased safety and protective behaviors related to falls and increased physical movement levels as a result of TCC training. Also, the paper provides recommendations for nurses and other clinicians to assist in the implementation of TCC interventions to patients with MCI.

CONFLICT OF INTERESTS

The authors declare that there are no conflict of interest.

AUTHOR CONTRIBUTIONS

As the authors of this paper, they have declared that they all have made a substantial contribution to the information or material submitted for the publication and they have approved the final version of this manuscript. C.B.O. conceived and designed the study. C.B.O. and E.D. collected data. C.B.O. and E.D. wrote/drafted/edited the manuscript and interpreted the results. C.B.O. and E.D. conducted analyses, prepared graphs/figures and revised the manuscript. All authors approved the content of this manuscript.

ETHICS STATEMENT

Ethic approval from the Clinical Trials Ethics Committee of Medical Faculty of Hatay Mustafa Kemal University (2018/120) and official permission from The Ministry of Family and Social Policies of Hatay were obtained.

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THE BENEFITS OF TAI-CHI EXERCISE ON BALANCE CONTROL IN ELDERLY DURING STAIR-TO-FLOOR TRANSITION

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The purpose of this study is to investigate the benefits of Tai-Chi Exercise on balance control in elderly during the stair-to-floor transition. Twelve Tai-Chi elder participants and 12 normal healthy elderly were recruited. A Kistler force plate (1000Hz) obtained the COP (center of pressure) data and kinematics calculated from ten Vicon high-speed cameras (250Hz). Results revealed that Tai-Chi group descended at a faster speed and had larger step length. Tai-Chi group also had larger A-P (anteroposterior) COM-COP separation, A-P COP path and faster COP average velocity. The results indicated that long-term Tai-Chi exercise can improve the balance in elderly during the stair-to-floor transition.

KEYWORDS: center of pressure, step length.

INTRODUCTION: Falls were the leading cause of injuries in elderly (CDC, 2014), and fatal injuries occurred during stair walking. Falls during the descent of stair negotiation occur at least three times more frequently than those associated with stair ascent (Svanstrom, 1974). The stair-to-floor transition is the unique anticipation of the upcoming surface between stair and level walking (Sheehan & Gottschall, 2011), it would be higher fall risks than stair and level walking.

The change of center of pressure (COP) reflects the response of the central nervous system to the movement of the body's center of mass (COM), and the displacement of COP is used as a key factor of posture control and balance (Mao, Li, & Hong, 2006a). To modulate COP within the appropriate range of COM-COP separation is the key to maintaining dynamic stability and avoiding falls. To avoid falls, elderly adopted safer strategies while stair descent, including smaller A-P (anteroposterior) and M-L (mediolateral) COP displacement and slower COP movements (Kim, 2009a). During level walking and crossing obstacles, elderly reduced the A-P COM-COP separation to maintain balance (Hahn & Chou, 2004; Scarborough, Krebs, & Harris, 1999). However, the A-P distance is limited by the width of the ladder during stair descent, A-P COM-COP separation was no difference between the elderly and the young adults (Mian et al., 2007).

Tai-Chi is a popular traditional Chinese exercise for elderly, and the slow-motion characteristics of movement are quite suitable for older people. Tai-Chi gait emphasizes lowering the center of gravity and larger steps, showed more challenge to the balance ability and the lower limb muscles than the normal gait (Wu, 2008), and large A-P COP movement (Mao, Li, et al., 2006a). Tai-Chi exercise also improved the dynamic balance, increased the balance of single leg stand (Mao, Li, & Hong, 2006b) and reduced the fear of falling (Logghe et. Al., 2010). Even while the single-legged jumping and single-legged landing, the Tai-Chi elderly had better performance (Gyllensten, Hui-Chan, & Tsang, 2010). It indicated that Tai-Chi exercise improved the dynamic balance of elderly, and it might also affect the performance of the daily life. Therefore, the purpose of this study is to investigate the benefits of Tai-Chi exercise on balance control in elderly during the stair-to-floor transition.

METHODS:

Twelve elderly that were regular Tai-Chi practitioners (eight males and four females) (Tai-Chi group), and twelve healthy elderly (eight males and four females) (normal group) participated in this study. Exclusion criteria were any known neurological or orthopedic disease and any current difficulties impeding their typical locomotion. Ethical approval was obtained from the Joint Institutional Review Board at Taipei Medical University. All participants provided their written informed consent before participation in our investigation. Tai-Chi group practiced

Yang style Tai-Chi which included 108 different body postures for an average of 10 years with a range between 2 to 15 years, four to five days per week, for a minimum of one hour per session. Control group of elderly performed leisure exercises (e.g. jogging, swimming) approximately over the same period per session but did not regularly perform Tai-Chi.
A ten camera motion system sampling at 250Hz and one Kistler force plate sampling at 1000Hz were synchronized to collect three-dimensional body motion and COP data. The 46 cm staircase consisted of a series of three steps, each step with a rise 18 cm and a run of 28 cm. Participants walked down the stairs starting with their dominant (right) leg with barefoot at a self-selected speed in a step-over-step manner and ended after the participant walked forward on level ground for approximately 5 m. The speed and step lengths were not restricted to simulate their typical performance. All participants completed at least five successful trials where the entire lead foot mad contact with the force plate.
The stair-to-floor transition analysis began with toe-off of the right leg from the middle step (36cm height) to toe-off of the right leg from ground level. The COM velocity was calculated by averaging the 3-dimensional velocity of COM. Step length was defined as the anteroposterior distance between right toe and left toe during right leg ground contact and right leg toe-off the ground (shown in figure 1). An independent samples t-test was used to examine differences between groups. The alpha level (α) was set to 0.05 and all statistical analyses were conducted within SPSS 21.0.

RESULTS: The information of participants are shown in table 1. There were no significant differences in body weight and height, except in age. Tai-Chi group were older than the normal group.

Table 1: Information of participants.

	Tai-Chi group	Normal group	*p*
Age (years)*	72.7 ± 5.1	67.5 ± 2.7	<.01
Height (m)	1.63 ± 0.07	1.62 ± 0.06	
Weight (kg)	57.9 ± 0.07	63.5 ± 5.7	

The data of COP, temporal and kinematic variables are shown in table 2. Tai-Chi group descended at a faster speed and had larger step length. Tai-Chi group also had larger A-P COM-COP separation, M-L COP displacement and faster COP average velocity.

Table 2: COP, temporal and kinematic variables.

	Tai-Chi group	Normal group	*p*
A-P COM-COP separation			
1st peak (cm)*	24.8 ± 3.5	21.4 ± 3.4	.02
2nd peak (cm)*	35.1 ± 2.6	30.2 ± 4.0	<.01
M-L COM-COP separation (cm)	12.3 ± 2.6	11.3 ± 2.6	.32
A-P COP path (cm)	11.6 ± 2.7	10.2 ± 2.0	.16
M-L COP path (cm)*	10.7 ± 3.5	7.0 ± 1.5	<.01
COP average velocity (cm/s)*	100.2 ± 66.1	56.7 ± 14.3	.04
Stance time (s)	0.66 ± 0.08	0.68 ± 0.10	
1st step length (m)*	0.51 ± 0.07	0.41 ± 0.07	<.01
2nd step length (m)*	0.58 ± 0.04	0.53 ± 0.05	.02
COM velocity (m/s)*	0.93 ± 0.10	0.77 ± 0.12	<.01

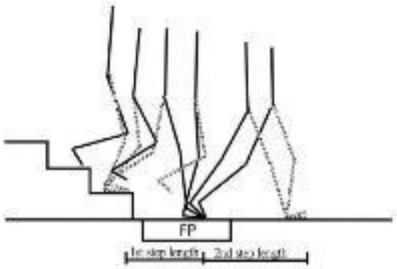

Figure 1. 1st step length and 2nd step length during the stair-to-floor transition.

DISCUSSION: Modulating the translation between COM and COP is an important factor to maintain dynamic stability. The backward displacement of the COP can generate the momentum for forwarding motion (Polcyn, Lipsitz, Kerrigan, & Collins, 1998). Because of weakness in lower extremities muscles, elderly would reduce forward motion of COM and backward displacement of COP. After Tai-Chi exercise intervention, COP displacement increased while level walking, crossing obstacles and descending stairs (Kim, 2009b; Kim, Han, & Cho, 2009). The results showed that Tai-Chi group had larger A-P COP displacement, which is consistent with the previous studies. To simulate the performance in daily life, the study didn't restrict the descending speed and step length. Tai-Chi group had faster speed during stair descent, and a larger step length could modulate the forward rotational momentum (van Dieën, Spanjaard, Konemann, Bron, & Pijnappels, 2007). During gait, greater A-P COM-COP separation provided data that support more mechanic loading and improve ability to tolerate unsteadiness after Tai-Chi training (Gatts & Woollacott, 2007), therefore, older adults used a compensatory strategy by reducing the A-P COM-COP separation to maintain balance (Hahn & Chou, 2004; Scarborough et al., 1999). In this study, the larger 1st peak of A-P COM-COP separation is due to greater step length in Tai-Chi group. It indicated that Tai-Chi group had better ability to maintain dynamic stability during contact ground. At the end of the stair-to-floor transition, Tai-Chi group showed larger 2nd step length and the 2nd peak of A-P COM-COP separation, which COM was front from COP. Due to faster COM velocity and similar stance time, larger A-P COM-COP separation represented Tai-Chi exercise could increase COM path. (Gatts & Woollacott, 2007).

In the frontal plane, Tai Chi exercise could increase the M-L COP path in elderly while contact ground (Kim et al., 2009), and increased M-L COP path indicated an improvement of coordination between hip adduction and abduction muscles after Tai-Chi training (Winter, Patla, Ishac, & Gage, 2003). During stair descent, the hip abductor muscles of the contralateral leg shifted COP to lateral side, and then the hip joint and the ankle joint muscles propelled COM forward until contralateral leg contact ground, therefore, the muscular coordination of frontal hip joint muscles is important for the elderly to maintain lateral stability during the stair-to-floor transition. The study showed that Tai-Chi group had greater M-L COP path, which indicated that Tai-Chi group had better lateral stability during contact ground.

The COP average velocity provided important information on how to modulate the steps when facing challenges, such as stairs (Reid, Novak, Brouwer, & Costigan, 2011). Slower COP average velocity in elderly than that in young adults, because the slower COP average velocity is easier to maintain postural stability (Kim, 2009a; Reid et al., 2011). Previous study indicated COP average velocities were about 102~145cm/s and 58~85cm/s in young adults and elderly, respectively (Kim, 2009b). The results of the study showed that the Tai-Chi group had a faster COP average velocity, and it resembled the performance of young adults, which might reflect that Tai-Chi exercise improved the ability to maintain dynamic balance. The age of all participants in the study was above 65 years or older, the muscular power and work decreased by an average of 6% per decade (Daubney & Culham, 1999). In this study

Tai-Chi group were older than normal group, the better dynamic performance and balance control of Tai-Chi group indicated the benefits of long-term practicing Tai-Chi exercise on dynamic performance and balance control during stair-to-floor transition than the normal elderly.

CONCLUSION: Long-term Tai Chi exercise participant could improve the balance in elderly during the stair-to-floor transition. It is recommended that participation in Tai-Chi exercise will improve the balance and performance in daily activities.

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