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Development of a 12-week unsupervised online Tai Chi program for people with hip and knee osteoarthritis: A mixed-methods study

Shiyi Julia Zhu, Kim Louise Bennell, Rana Shane Hinman, Jenny Harrison, Alexander Jared Kimp, Rachel Kate Nelligan

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Abstract

Background: Osteoarthritis (OA) is a leading contributor to global disability, with the hip and knee being the most common joints affected. While evidence supports the effectiveness of Tai Chi for improving symptoms for people with hip and knee OA, access to in-person Tai Chi classes may be difficult for many due to logistical constraints and cost. Design of an unsupervised online Tai Chi intervention for people with OA has the potential to overcome these barriers. Use of the Approach to Human-Centered, Evidence-Driven Adaptive Design (AHEAD) framework provides a practical guide for co-designing such an intervention.

Objective: To develop an unsupervised online Tai Chi program for people with hip/knee OA.

Methods: An iterative process using the AHEAD framework. A panel of Tai Chi instructors and consumers with OA was assembled. A literature review was conducted to identify characteristics of effective supervised OA Tai Chi interventions. Findings informed content of a survey (survey 1), that was completed by the panel and additional Australian Tai Chi instructors, to identify Tai Chi movements for potential inclusion into the program. Selection of Tai Chi movements was based on 3 criteria: appropriate (for people with knee/hip OA aged over 45 years old); safe (to be performed at home unsupervised); and practical (to be delivered online using pre-recorded videos). Movements meeting these criteria were then ranked in a second survey (using conjoint analysis methodology) from the most appropriate/safe to least appropriate/safe. Survey findings were discussed in a focus group and the Tai Chi movements to be used in the program were identified. A draft of the online Tai Chi program was developed, and a final survey (Survey 3) was conducted with the panel to rate the proposed Tai Chi program's appropriateness and safety. The final program was developed, and usability testing (Think-Aloud protocol) conducted with people with knee OA.

Results: The panel consisted of 10 Tai Chi instructors and 3 consumers with OA. The literature review identified Yang style 24 as a common and effective Tai Chi style used in hip/knee OA studies. Survey 1 (n=35) and 2 (n=27) produced a ranked list of 24 Tai Chi movements for potential inclusion in the program. This list was refined, informed by focus group discussion, resulting in 10 Tai Chi movements being selected for inclusion (known as the Yang style 10 form). The third survey (n=13) found 92% of the panel believed that the proposed draft Tai Chi program was appropriate and safe resulting in its adoption for the online program. The final program was produced and housed within a customized website "My Joint Tai Chi" which was refined based on user feedback (n=5). "My Joint Tai Chi" is currently being evaluated in a randomised controlled trial.

Conclusions: This study demonstrates use of the AHEAD framework to develop an unsupervised online Tai Chi intervention ("My Joint Tai Chi") for people with hip/knee OA.

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Abstract

Background:
Osteoarthritis (OA) is a leading contributor to global disability, with the hip and knee being the most common joints affected. While evidence supports the effectiveness of Tai Chi for improving symptoms for people with hip and knee OA, access to in-person Tai Chi classes may be difficult for many due to logistical constraints and cost. Design of an unsupervised online Tai Chi intervention for people with OA has the potential to overcome these barriers. Use of the Approach to Human-Centered, Evidence-Driven Adaptive Design (AHEAD) framework provides a practical guide for co-designing such an intervention.

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To develop an unsupervised online Tai Chi program for people with hip/knee OA.

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Results:
The panel consisted of 10 Tai Chi instructors and 3 consumers with OA. The literature review identified Yang style 24 as a common and effective Tai Chi style used in hip/knee OA studies. Survey 1 (n=35) and 2 (n=27) produced a ranked list of 24 Tai Chi movements for potential inclusion in the program. This list was refined, informed by focus group discussion, resulting in 10 Tai Chi movements being selected for inclusion (known as the Yang style 10 form). The third survey (n=13) found 92% of the panel believed that the proposed draft Tai Chi program was appropriate and safe resulting in its adoption for the online program. The final program was produced and housed within a customized website "My Joint Tai Chi" which was refined based on user feedback (n=5). "My Joint Tai Chi" is currently being evaluated in a randomised controlled trial.

Conclusions:
This study demonstrates use of the AHEAD framework to develop an unsupervised online Tai Chi intervention ("My Joint Tai Chi") for people with hip/knee OA. This intervention is now being tested for effectiveness and safety in a randomised controlled trial.

Keywords: Intervention development; osteoarthritis; Tai Chi, web-based intervention, online, telehealth, unsupervised exercise

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Introduction

Osteoarthritis (OA) is a leading contributor to disability and chronic pain with a global prevalence of 365 million in 2019 [1]. The knee is the most common lower limb site for OA, followed by the hip [2]. Globally, it is estimated that cases of OA will increase by 75% for knee, and nearly 80% for hip by 2050 compared to 2020 [2]. People with hip and knee OA often experience pain and impaired function, as well as co-morbidities such as depression and anxiety [3, 4].

All OA clinical guidelines recommend education and physical activity, including structured exercise, as the fundamental approach to treatment [5-7]. Tai Chi is a recommended exercise option for people with hip and knee OA [5, 7]. Tai Chi is a traditional Chinese mind-body land-based exercise that combines meditation with slow, gentle movements, deep diaphragmatic breathing and relaxation [8]. Clinical trials indicate that Tai Chi is effective in improving pain, function and quality of life for people with OA [5, 9-13]. With its meditative and mindfulness component, Tai Chi has also been shown to have broader benefits such as improved psychological health, cognitive function, and sleep quality [14, 15]. Tai Chi is generally performed in person in a group setting with demonstration and supervision from an instructor. However, such a format may be difficult or inconvenient for many people to access, especially in regional/rural areas where there is a higher prevalence of people with OA but Tai Chi classes may not be readily available [16].

An online unsupervised Tai Chi program may be a scalable way to help patients participate in Tai Chi in their own home. Online exercise interventions have the potential to reach a wide audience regardless of location and at less cost to users and the healthcare system [17]. Since the COVID-19 pandemic, a number of Tai Chi schools and organisations now deliver Tai Chi classes online [18-22]. These classes are generally conducted in a ‘synchronous’ videoconferencing format with an instructor and require payment [23-26]. Most Tai Chi programs have not been specifically designed for people with OA, which may make them challenging to perform correctly and safely [27]. To date, there is no Tai Chi exercise program that is online, unsupervised, free, and tailored for people with lower limb OA.

When designing interventions, the use of a theoretical framework is recommended to provide researchers with systematic and clear guidance [28, 29]. The Approach to Human-Centered, Evidence-Driven Adaptive Design (AHEAD) is a 7-step framework that provides a practical guide for co-designing pragmatic and impactful health care interventions [30]. Using the AHEAD

framework, this study aimed to develop an online, unsupervised Tai Chi program for people with hip and knee OA.

Methods

Development of the online Tai Chi program followed the 7 steps of the AHEAD framework: a) define the problem and assemble a team; b) review evidence; c) seek inspiration; d) synthesize; e) develop guiding principles; f) ideate; and g) evaluate [30]. Approval was obtained from the Human Research Ethics Committee at University of Melbourne (2023-25788-36959-4).

Step A: Define the problem and assemble the team

We defined the problem as poor accessibility of evidence-based Tai Chi classes for people with OA. To address this issue, we first assembled an advisory panel that included Tai Chi instructors and people with OA (consumers). Tai Chi instructors were eligible to be part of the panel if they: 1) were a member of a Tai Chi association in Australia, and 2) had at least 5 years of experience teaching Tai Chi for adults (aged 45+) with musculoskeletal conditions. Potentially eligible instructors were identified by searching websites of Tai Chi associations. Consumers were eligible if they had: 1) self-reported symptomatic knee and/or hip OA, and 2) participated in supervised Tai Chi exercise in the past year in Australia. It is suggested that around 10 people is an ideal size for panel group discussion [31]. Therefore, we planned to recruit around 10 panel participants. Recruitment was via email invitations to the Tai Chi instructors and email advertisements to our Centre's consumer network. Interested instructors and consumers were asked to email the researchers and were followed up by phone to assess eligibility. A Plain Language Statement was provided to eligible panellists, and consent was obtained online via REDCap. Gift vouchers of $350 were provided as an honorarium. To gain broader insights from the Tai Chi community, additional Tai Chi instructors were recruited Australia-wide to participate as non-panel participants. Recruitment was via dissemination of study information by Presidents of Australian Tai Chi organisations, Facebook advertisements and snowball sampling. Eligibility and consent procedures were consistent with panellist recruitment, but with no remuneration provided.

Step B: Gather Information - Review Evidence

There are many different styles of Tai Chi, each with different forms (a series of connected movements executed in a certain order) [32]. To identify the style and movements of Tai Chi to be considered for the online program, one researcher (SZ) first conducted a literature search (via Ovid,

PubMed and Google) to identify systematic reviews and randomised controlled trials (RCT) evaluating the effects of Tai Chi in people with OA and of online Tai Chi programs in any condition. The research team (RKN, KLB, RSH, JH) discussed the findings from the literature search via meetings, phone, and email and proposed a draft list of Tai Chi movements for consideration for inclusion in the unsupervised online Tai Chi program.

Step C: Gather Information - Seek inspiration

It was proposed by the Tai Chi instructor in the research team (JH) that an ideal number of Tai Chi movements to be included in an online program should be between 8-12, as it was thought more than 12 movements would be challenging to effectively learn and practice independently. To select the specific movements from those identified in Step B, two online surveys were conducted, involving both panel and non-panel participants.

Survey 1: The purpose of this survey (using REDCap software) was to identify which Tai Chi movements would be appropriate, safe and practical for inclusion in the program. The survey asked participants to rate each identified Tai Chi movement (from Step B) against two criteria: 1) *appropriateness* of the movement for people with knee/hip OA who are over 45 years old, when performed correctly and 2) *safety* of the movement if performed at home unsupervised. Each movement was scored using separate 11-point numeric rating scales (NRS) from 0 (not appropriate/safe at all) to 10 (completely appropriate/safe). Participants were also asked whether each Tai Chi movement would be *practical* to be delivered online using pre-recorded videos that someone would watch at home (Response options Yes/No). Participants also provided feedback regarding Tai Chi exercise prescription, including the recommended length of each Tai Chi video session (response options 20, 30, 40, 50 and 60 minutes), weekly practice frequency (days/week, range 1-7), and total weekly practice time (min/week). Open-ended questions gathered additional suggestions for developing the program. The research team determined a priori that a Tai Chi movement would be retained for potential inclusion in the program if at least 70% of participants scored it at least 5/10 for both appropriateness and safety, and it was deemed practical.

Survey 2: The purpose of this survey was to rank the Tai Chi movements retained from survey 1 so that 12 movements could be selected. Using a pair-wise ranking technique (1000Minds) [33], participants were shown pairs of Tai Chi movements (selected based on those considered

appropriate, safe and practical from survey 1), and asked to identify which of the pair should take priority for inclusion in the program. The number of pairwise rankings required from each participant varied depending on their responses to the presented alternatives. The pairwise ranking process continued until the background mathematics established a ranked list of all Tai Chi movements for each participant and averaged over the sample.

Step D: Synthesize

To synthesize information gathered from the first two surveys, an online focus group was conducted with panel participants, facilitated by the researchers (KLB, SZ, RKN, JH).

Discussion topics included results of the first two surveys, practicalities of recording the online Tai Chi program, Tai Chi exercise prescription and Tai Chi education content that would supplement the Tai Chi exercise program. The focus group discussion was recorded (audio and visual) and transcribed verbatim. Notes and recordings were reviewed, replayed and analysed qualitatively to gather the panellist's perspectives and to identify areas of consensus for the design of the Tai Chi program.

Step E: Intervention Design - Develop and apply guiding principles

The criteria of appropriateness, safety and practicality were deemed as the guiding principles for this 12-week online unsupervised Tai Chi program. Based on the results from the first two surveys and focus group, a proposed 12-week Tai Chi program was filmed by the research team Tai Chi instructor (JH). Panellists were then sent the prototype video, via a final REDCap survey, and asked to rate their level of agreement that the proposed program as a whole was: 1) appropriate (for people aged over 45 years old with knee and/or hip OA), and 2) safe (to be performed at home unsupervised). Each criterion was scored using a 5-point Likert scale from 1 (strongly disagree) to 5 (strongly agree). For the proposed program to be approved, 70% or more of participants were required to 'strongly agree' or 'agree' that the program was 'appropriate' and 'safe'. As all movements included in the program had already been judged to be practical, it was unnecessary to vote on this.

Step F: Intervention Design - Ideate (Brainstorm - Prototype -Test)

Finally, the 12-week unsupervised online Tai Chi program was filmed in a studio at the University of Melbourne. The produced videos were incorporated into a website prototype, "My Joint Tai Chi",

which was constructed by the research team and two research assistants. The website was based on our other evidence-based unsupervised exercise programs for knee/hip OA “My Knee Exercise” [34] and “My Hip Exercise” [35], and developed in accordance with recommendations outlined by The Health on the Net Foundation’s Code of Conduct [36].

The website prototype underwent extensive usability testing with people with OA, following a Think-Aloud protocol [37]. Volunteers from our previous OA studies in Australia, who agreed to be contacted again, were invited via email to participate (by researcher SZ). Participants were eligible if they 1) had symptomatic knee OA and 2) no prior experience in Tai Chi exercise (in person or online) in the past 2 years. Purposive sampling was used to ensure diversity in age, sex, and symptom duration. A Plain Language Statement was provided, and consent was obtained online via REDCap. Participants received $50 gift vouchers as an honorarium.

Participants were scheduled for a 60-minute one-on-one online usability test with a researcher (SZ) via Zoom. During the usability test, participants were asked to share their screen and navigate the "My Joint Tai Chi" website prototype, as if they were commencing the Tai Chi program, while the researcher observed. Participants were encouraged to vocalize their thoughts on the website design, content, and functionality, with the researcher asking open-ended questions for further feedback. Notes on usability were taken and sessions were audio and video recorded. Field notes and recordings were qualitatively analysed to identify usability issues, which were addressed before the next participant. This iterative process continued until no further issues were identified.

Step G: Evaluate

The research team has designed and is currently conducting a two-arm, parallel-design, superiority pragmatic RCT to assess the effectiveness of this unsupervised online Tai Chi intervention (“My Joint Tai Chi”) compared with online OA education control. Primary outcomes of self-reported pain during walking [38] and physical function [39] will be evaluated. A nested qualitative study has also been designed to explore the experience of people with OA who use the “My Joint Tai Chi” intervention during the RCT. The RCT protocol and the results of the RCT will be published in separate subsequent papers.

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Results

A summary of the development of the “My Joint Tai Chi" intervention using the AHEAD Framework is provided in Table 1 [30].

Table 1. Summary of the design of the “My Joint Tai Chi” intervention using the AHEAD Framework [30]

AHEAD Framework Domains	Intervention design stages
Define the problem and assemble the team (a)	Problem: Poor accessibility of evidence-based Tai Chi classes for people with OA Team (n=17): Advisory panel including Tai Chi instructors (n=10) and consumers with OA (n=3), and research team including OA researchers/physiotherapists (n=4) and a Tai Chi instructor recruited from the panel.
Review evidence (b)	Literature review identified Yang Style 24 form as a common and effective style/form of Tai Chi for OA. 12-weeks was the most common length.
Seek inspiration (c)	Two surveys were completed by panel participants (Tai Chi instructors and consumers with OA) and additional non-panel Tai Chi instructors. - Survey 1 (n=35) rated Yang Style 24 form and modifications (total 33 Tai Chi movements) based on appropriateness, safety, and practicality. 24 movements identified as appropriate, safe, and practical. - Survey 2 (n=27) produced a ranked list of the 24 movements retained from Survey 1 (ranked based on most appropriate/safe to least appropriate/safe).
Synthesize (d)	Meeting with panel (n=12) discussed results from surveys and additional Tai Chi program design considerations. This resulted in adoption of the Yang Style 10 form.
Develop and apply guiding principles (e)	Final survey with panel participants (n=13) rated a draft of the proposed program against the guiding principles of appropriateness (for people over 45 years old with OA) and safety (to be performed at home unsupervised). 92% rated the program as both appropriate and safe.
Ideate (f)	A 12-week Tai Chi exercise program was developed/produced and housed within a website prototype called “My Joint Tai Chi”. Usability test was conducted with people with OA (n=5) using a think-aloud protocol. Usability problems were identified and the prototype refined.
Evaluate (g)	The final “My Joint Tai Chi” intervention is currently being evaluated in a two-arm, parallel-design, superiority pragmatic RCT (ACTRN12623000780651) and nested qualitative study. The methods and results of this RCT will be reported subsequently in separate papers.

RCT=Randomised controlled trial; OA=osteoarthritis

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Step A: Define the problem and assemble the team

We recruited 10 Tai Chi instructors and 3 consumers with OA (1 with hip and knee OA, 2 with knee OA only) as advisory panel participants and another 22 Tai Chi instructors as non-panel participants. One Tai Chi instructor (JH) was recruited to join the research team (that comprised OA researchers and physiotherapists) to provide professional opinions about Tai Chi during the development process. Participant demographic information is provided in Table 2.

Table 2. Demographic characteristics of participants in Step A.

Participant Characteristics	**Survey 1 Participants (n=35)**	
	Panel n=13	Non-panel n=22
Tai Chi instructor	n=10	n=22
Sex, female, n (%)	6 (60)	11 (50)
Predominant style of Tai Chi taught, n (%) #		
Yang	9 (90)	19 (86)
Sun	5 (50)	5 (23)
Chen	2 (20)	1 (5)
Wu	1 (10)	1 (5)
Hao	2 (20)	0 (0)
Mean (SD) years of experience teaching Tai Chi	24 (11)	16 (10)
Mean (SD) number of Tai Chi classes taught per week	8 (6)	3 (2)
Consumers with OA	n=3	
Sex, female, n (%)	2 (67)	
Age, mean (SD)	73 (2)	n/a
Years of symptom duration, mean (SD)	7 (3)	
Years of Tai Chi practice, mean (SD)	7 (2)	

Some Tai Chi instructors taught more than one style of Tai Chi.

Step B: Gather Information - Review Evidence

Six systematic reviews and 14 RCTs were identified evaluating Tai Chi programs in people with OA. Programs varied in length from 8-20 weeks, with 12 weeks being the most common [40-51]. The average Tai Chi exercise prescription was 3 Tai Chi sessions per week each lasting 60 minutes [40-51]. Yang style 24 form was the most commonly practiced [52]. This style was created in China in the 20th century and is known for its slow and graceful movements emphasizing weight shifting in a

wide stance [53]. It has been found to be effective in improving pain and physical function in people with OA [54]. Hence, Yang style was chosen as the foundational basis for the online Tai Chi program. There are 24 Tai Chi movements in the Yang style 24 form. However, the Tai Chi instructor in the research team (JH) perceived some movements to be unsuitable for people with OA and challenging to learn through online delivery. For example, movements that involve single-leg stance, sustained end-of-range hip and knee flexion, and multiple 180 degree turns. Therefore, the research team introduced 7 modifications and broke down certain movements, resulting in a total of 33 movements (Multimedia Appendix 1) for possible inclusion in the online program.

Four studies (2 feasibility trials, 1 longitudinal pilot study and 1 RCT protocol) utilised telehealth-delivered Tai Chi for other chronic conditions such as long-term mobility disability, Parkinson's disease, mild cognitive impairment, and cancer therapy-induced joint pain [23-25]. Programs were most commonly delivered synchronously using videoconferencing software Zoom (n=3). One study integrated Tai Chi training videos into a mobile phone app for people with Parkinson’s disease, which was connected to a clinician app to monitor adherence [55]. Professional oversight via phone calls was also provided [55]. The Tai Chi for Arthritis program, endorsed by the US Centers for Disease Control and Prevention, does offer an online asynchronous course [56] but this has not been formally evaluated.

The research team determined that pre-recorded videos of Tai Chi exercises would be the most convenient approach, allowing broader access without class scheduling or professional oversight. Moreover, it was decided to deliver the Tai Chi pre-recorded videos via a dedicated website that also included OA and Tai Chi education and exercise adherence support resources to allow for a potentially more effective multi-component OA digital self-management intervention [57].

Step C: Gather Information - Seek inspiration

Survey 1: All 35 participants (13 panel, 22 non-panel) completed survey 1 (Multimedia Appendix 1). Of the 33 movements, 24 (73%) achieved consensus (defined as at least 70% of participants rating it at least 5/10 for appropriateness and safety, and considering it to be practical). For the 9 excluded movements, refer to Multimedia Appendix 2. Additional Tai Chi exercise prescription suggestions are summarized in Table 3.

Survey 2: As 24 movements met the criteria in survey 1 (exceeding the 12 required), a 1000Minds

survey was conducted for further prioritisation. 27 participants (13 panel, 14 non-panel) completed survey 2, producing a ranked list of movements (Multimedia Appendix 3) for potential inclusion. Kendall's W was 0.124, indicating high variance and low agreement among participants [58]. Thus, this ranked list was used only as a guide to inform further discussions with the panel participants via a focus group.

Table 3. Tai Chi exercise prescription suggestions from Survey 1 (n=35)

Tai Chi exercise prescription	n=35
Length of each pre-recorded video (minutes), n (%)	
30	17 (55)
20	9 (29)
40	2 (6)
50	2 (6)
60	1 (3)
Frequency of Tai Chi practice (days/week), n (%)	
Three	12 (40)
Five	6 (20)
Four	4 (13)
Seven	4 (13)
Two	3 (10)
One	1 (3)
Six	0 (0)
Weekly dosage of Tai Chi practice (total min/week), mean (SD)	114 (60)

Step D: Synthesize

Panel participants (n=12/13) were then involved in a 2-hour online focus group. Suggestions provided during the focus group are listed in Multimedia Appendix 4. In summary, Tai Chi instructors advocated for use of a recognised Tai Chi sequence, as opposed to solely relying on the ranked list of movements from the second survey (1000Minds). This is because the transition, stance, and flow between movements is vital in Tai Chi, rather than just presenting isolated "movements". It was decided to use the modified Yang style 10 form (Table 4) for the program, because ~~6~~ 7 out of the 10 movements aligned with top 10 ranked movements in Survey 2 and it is a recognised Tai Chi sequence [54]. The other 3 moves were ranked 13th, 16th and 20th respectively out of the 24 moves in the results of Survey 2 (Multimedia Appendix 3). Modifications were also discussed for certain Tai Chi movements to ensure suitability for people with OA and little prior Tai Chi experience. It was also decided that each 12-week video should include 5-10 minutes of Qigong exercise for warm-up and cool-down (an ancient wellness practice that is performed with minimal footwork [59]). All panellists agreed on the program duration (12-weeks) and it was decided that the program should

start with 30-40 minute sessions and progress to 40-45 minute sessions to build endurance. Incorporating explanations of the martial applications of each selected Tai Chi movement and the practicalities of recording the program were discussed. Finally, resources for those wanting to continue Tai Chi practice after completing the online program were suggested.

Table 4. The Yang Style 10 form Tai Chi movements

	Movement Name
1	Commencement
2	Repulse Monkey
3	Brush Knee
4	Part the Wild Horse's Mane
5	Cloud Hands
6	Golden Rooster Stands on One Leg
7	Cross Hands and Kick
8	Stroke Peacock's Tail
9	Embrace the Tiger
10	Closing

Step E: Intervention Design - Develop and apply guiding principles

All panel participants (n=13) took part in the final survey which involved voting on the draft program's alignment with the guiding principles. 92% (12/13) of participants rated "strongly agree" or "agree" to the draft 12-week Tai Chi program being i) appropriate for people with knee/hip OA, and ii) safe to be performed at home unsupervised (see Figure 1). Agreement reached the pre-determined threshold (70%), and therefore the draft online Tai Chi program was adopted as the final version.

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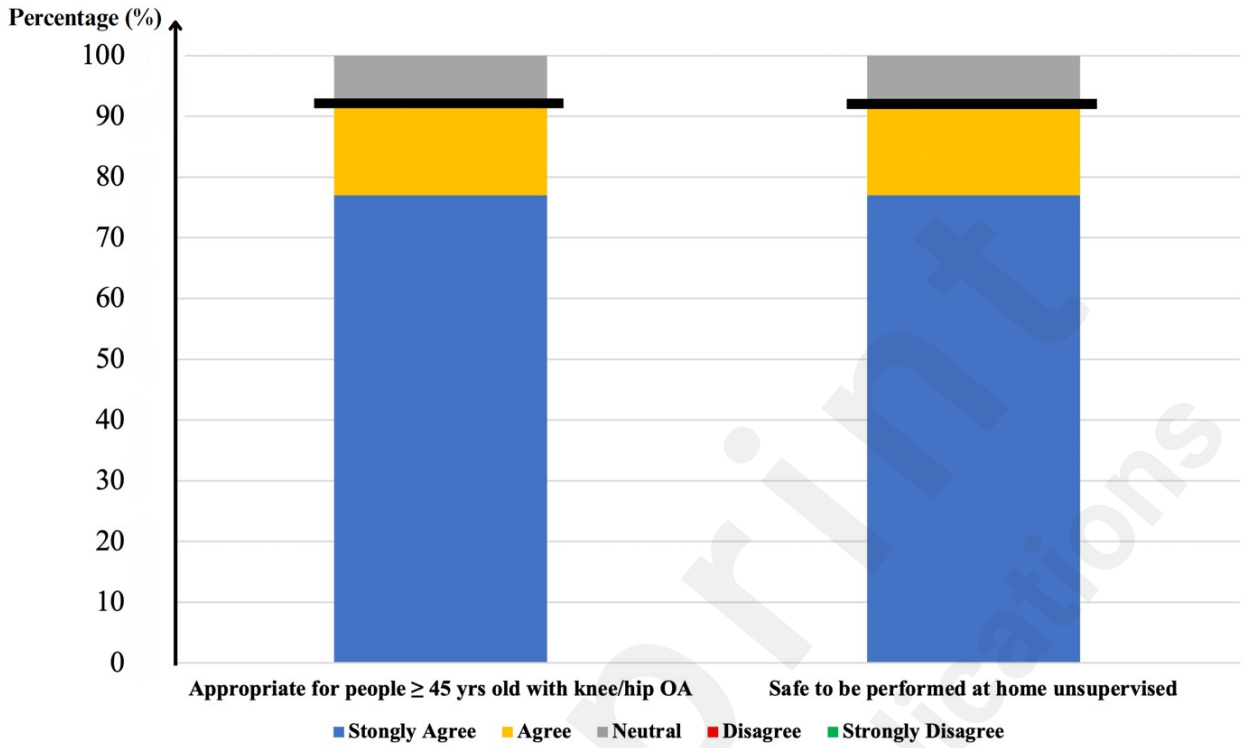
Figure 1. Agreement on the draft of the final 12-week Tai Chi program (n=13). Key: Bold horizontal lines indicate the percentage of panel participants who rated "strongly agree" or "agree" to the draft program against the guiding principles.

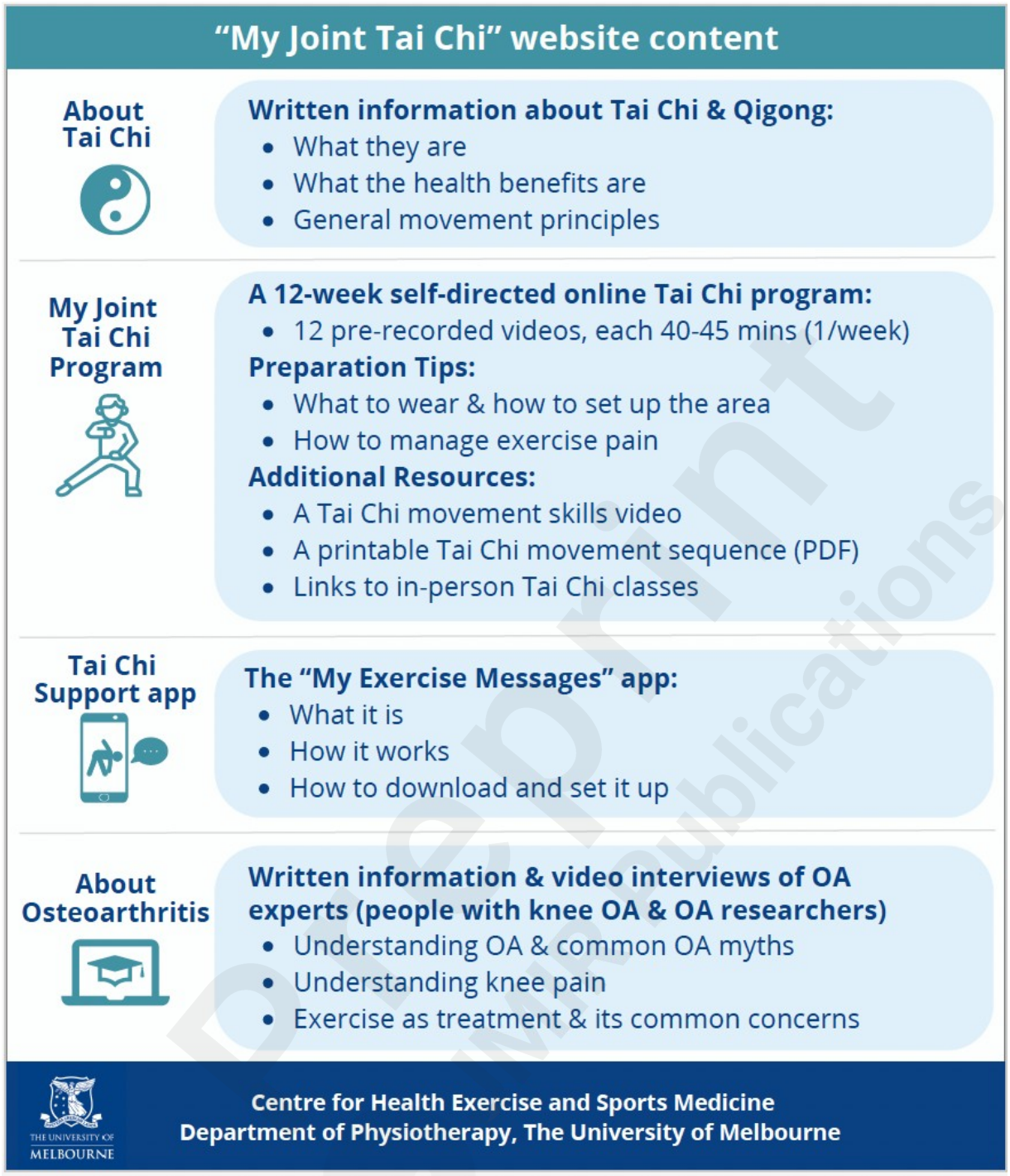


Step F: Intervention Design - Ideate (Brainstorm - Prototype -Test)

"My Joint Tai Chi" website

The 12 professionally filmed videos showing a Tai Chi instructor (JH) demonstrating the Tai Chi movements were housed on a website called "My Joint Tai Chi" (The website was built specifically for research purposes and was not yet widely publicly available). **"**My Joint Tai Chi" contains a home page with a video tutorial explaining how to use the website and four sections including 1) the Tai Chi program, 2) information about Tai Chi, 3) information about OA, and 4) instructions on how to access an exercise adherence app to support engagement with the Tai Chi program. Figure 2 outlines the contents of the website and further detail is provided in Multimedia Appendix 5. The still images of modified Yang Style 10 form in the "My Joint Tai Chi" program is provided in Multimedia Appendix 6.

Figure 2. Description of the content in the four discrete sections of the "My Joint Tai Chi" website.



OA= Osteoarthritis

Usability test

Five participants with OA conducted website prototype usability testing. On average, they were 60 years old (SD:10) and experienced knee pain for 2 years (SD:1). Identified issues and implemented solutions are outlined in Multimedia Appendix 7. In summary, usability testing resulted in the re-design of the user interface and several pages for easier navigation. Page instructions were re-worded for clearer and more explicit guidance.

Step G: Evaluate

The RCT evaluating the “My Joint Tai Chi” intervention is currently recruiting and expected to complete data collection in February 2025. The RCT has been prospectively registered (ACTRN12623000780651). The nested qualitative study is anticipated to commence data collection in July 2024. The RCT protocol will be published separately.

Discussion

This study reports the systematic co-development of an unsupervised online Tai Chi intervention for people with OA using the AHEAD framework. The intervention is a 12-week web-based Tai Chi program that is complemented with educational information about OA and Tai Chi and supported by an app to facilitate Tai Chi exercise adherence. Once the RCT evaluation is complete (and subsequently any required modifications are made), the finalised program will be released online for public access at no cost to the user. The program has the potential to boost participation in physical activity among people with OA.

This study has several strengths. First, use of the AHEAD framework provided a structured foundation for the transparent and thorough reporting of intervention design and intervention components. This approach addresses the previous lack of clarity in intervention development with evidence showing most Tai Chi studies do not meet the expected intervention reporting standards [60-62]. Second, by using an evidence-based, iterative, and robust process, we were able to incorporate opinions from a broad panel of Tai Chi experts and people with OA (n=35 in total), along with physiotherapists and OA researchers. To the best of our knowledge, only one other study has incorporated end user feedback (n=14) into the design of an online seated Tai Chi program for people with mobility disabilities [25]. However, that program was designed to include remote supervision and its effectiveness has not been tested in a RCT [25]. Hence, no prior unsupervised online Tai Chi program has been co-developed by such a large sample group nor subjected to rigorous evaluation. Thirdly, since this Tai Chi exercise program was designed for people with knee/hip OA, the panel also deemed it appropriate for people over 45 years of age who do not have OA. Hence, the Tai Chi exercise program videos developed could potentially be used as a strategy to increase access to Tai Chi exercise for a broader audience.

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One limitation is that there were only 3 consumers with OA out of a total of 35 participants involved in Step C (Seek Inspiration), indicating a potential underrepresentation of consumers with OA. However, these 3 consumers provided constructive feedback in Step D (Synthesize), and an additional 5 consumers with OA were involved in final website usability testing in Step F. Another potential limitation is that we have developed an intervention that requires access to digital technologies and technological literacy. To fully gain the benefit from the "My Joint Tai Chi" program, the user is required to have a computer with internet access and preferably to have a mobile phone (to use the exercise support app). However, given that 94% of Australian households have a computer with 86% of them having internet access [63], and that 78% of Australian adults above 65 years of age use a mobile phone [64], this suggest that the use of "My Joint Tai Chi" website is broadly accessible by most Australians.

Conclusions

A systematic design approach using the AHEAD framework was successful in developing this user-centred intervention and may serve as a guide for others developing unsupervised digital interventions. To our knowledge, "My Joint Tai Chi" is the first unsupervised online Tai Chi intervention designed for people with OA. The program is now being evaluated in an RCT which will provide insights into the effectiveness and safety of the program compared with online OA education control. The pre-recorded Tai Chi exercise videos in the program can also be used to increase physical activity for people without OA in the community at large.

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Tai Chi instructor Panellists (listed in alphabetical order based on surnames: Sam Au, Tara Brayshaw, Konrad Dorn, James Gao, Jin Song Han, Jenny Harrison, Suzette Hosken, Jenny Lucy, Su Rule, and Tunde Takacs. Consumer panellists (listed in alphabetical order based on surname): Roger Corfield and Jennifer Leighton.

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Conflicts of Interest

Jenny Harrison (the Tai Chi instructor within the research team) owns and runs a Tai Chi school and makes financial profits from teaching Tai Chi. All other authors have no conflicts to declare.

Ethics

The University Institutional Human Research Ethics Committee approved this study (2023-25788-36959-4).

Abbreviations

AHEAD: Approach to Human-Centered, Evidence-Driven Adaptive Design

NHMRC: National Health & Medical Research Council

NRS: numeric rating scales

OA: osteoarthritis

RCT: randomised controlled trial

REDCap: Research Electronic Data Capture

Reference:

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Supplementary Files

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Figures

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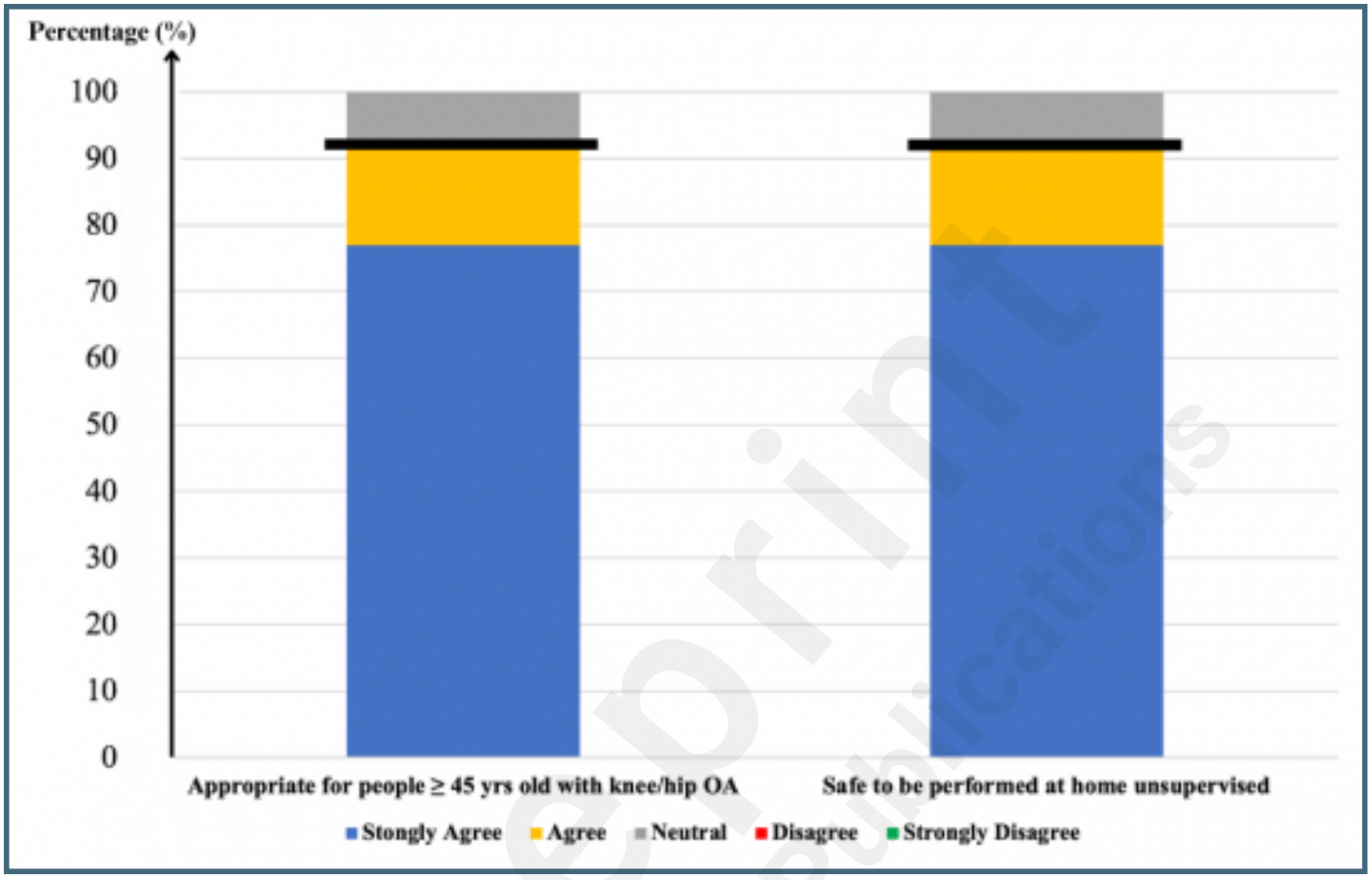
Agreement on the draft of the final 12-week Tai Chi program (n=13). Key: Bold horizontal lines indicate the percentage of panel participants who rated “strongly agree” or “agree” to the draft program against the guiding principles.



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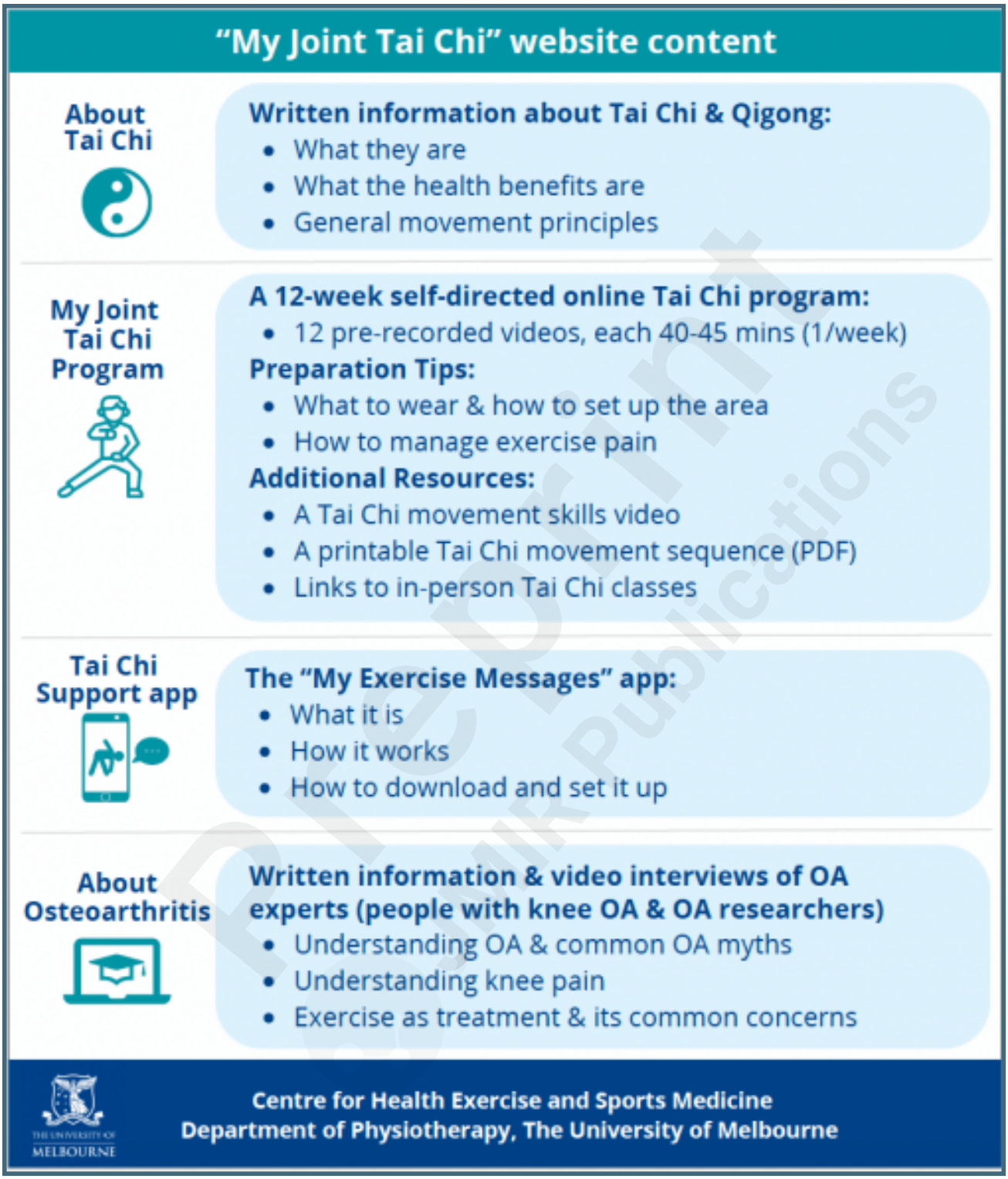
Description of the content in the four discrete sections of the "My Joint Tai Chi" website.



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Multimedia Appendixes

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Survey 1 including the 33 Tai Chi movements for potential inclusion in the Tai Chi program.
URL: http://asset.jmir.pub/assets/3a78f083994572f452ffac4990262577.pdf

The 9 movements excluded from Survey 1.
URL: http://asset.jmir.pub/assets/381d10f2d3483aa3b004502c94e5e9b2.docx

The ranked list of Tai Chi movements based on Survey 2 (n=27).
URL: http://asset.jmir.pub/assets/0bcb7b6c89fa2ca2875424e8db75f7f1.docx

Suggestions and recommendation from focus group discussion (n=12).
URL: http://asset.jmir.pub/assets/f5e88b1c51227d9c3bcdce851aa44d42.docx

“My Joint Tai Chi” website section description.
URL: http://asset.jmir.pub/assets/c2930af78c6288734be5c3666d957bb6.docx

Still images of modified Yang Style 10 form in the final “My Joint Tai Chi” program.
URL: http://asset.jmir.pub/assets/77f4d70d0ee63851de6d003e65f86b31.pdf

Usability issues identified and corresponding implemented solutions.
URL: http://asset.jmir.pub/assets/0e52588a0b787543f07ffa2286f2c697.docx

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