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Mindfulness and Tai Chi for Cancer Health (MATCH) Study: Primary Outcomes of a Preference-Based Multisite Randomized Comparative Effectiveness Trial

Linda E. Carlson, PhD[1]; Jennifer M. Jones, PhD[2]; Devesh Oberoi, MD, PhD[1]; Katherine-Ann Piedalue, BSc[1]; Peter M. Wayne, PhD[3]; Daniel Santa Mina, PhD[2]; Oluwaseyi A. Lawal, PhD[1]; and Michael Speca, PhD[1]

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ABSTRACT

PURPOSE Many cancer survivors have high levels of distress and psychosocial symptoms. Two mind-body interventions for treating these problems are Mindfulness-Based Cancer Recovery (MBCR) and Tai Chi/Qigong (TCQ). However, while both interventions show efficacy compared with usual care, they have never been studied together. This trial was the first, to our knowledge, to incorporate innovative design features including patient choice while evaluating two interventions to treat distressed cancer survivors.

METHODS A preference-based multisite randomized comparative effectiveness trial design with broad pragmatic inclusion criteria was used. Participants with a preference for either MBCR or TCQ received their preferred intervention, while those without a preference were randomly assigned 1:1 into either intervention. Furthermore, participants were all randomly assigned 2:1 into immediate intervention or waitlist control. Total mood disturbance (TMD) on the Profile of Mood States after intervention was the primary outcome.

RESULTS Five hundred eighty-seven participants provided baseline data, 75% were female, with an average age of 60.7 years. Of 12 cancer types, the most prevalent were breast (40.7%), prostate (11.2%), and GI (9.7%) cancers. Most had stage 0-II (50.1%) diagnoses, with 17% having more advanced disease. Approximately two thirds had a preference, with 57% of those choosing TCQ and 43% choosing MBCR. The remaining 36% were equally randomly assigned. Choosing a specific program or choosing to be randomly assigned had no significant effect on outcomes. Both the combined random assignment and preference MBCR and TCQ groups improved more than their respective waitlists on TMD scores with small to medium effects. The largest improvements occurred for MBCR on subscales of tension, anger, and vigor and in TCQ on anger, depression, and vigor.

CONCLUSION This large, pragmatic trial demonstrated both mindfulness and TCQ interventions improved mood in distressed cancer survivors, whether they chose a program or chose to be randomly assigned.

ACCOMPANYING CONTENT

Data Sharing Statement

Data Supplement

Protocol

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INTRODUCTION

People diagnosed with cancer face many difficulties, including high levels of distress, anxiety, and depression and symptoms such as fatigue, pain, and sleep disturbance,[1,2] which often persist well into survivorship.[3,4] A significant body of evidence and clinical practice guidelines support the efficacy of a range of mind-body therapies (MBTs) such as mindfulness-based interventions (MBIs), yoga, imagery, relaxation, hypnosis, and Tai Chi and Qigong (TCQ) in alleviating these and other symptoms.[5-8] However, most evidence is based on randomized controlled trials (RCTs) that compared MBTs with usual care, not active controls or other evidence-based interventions. There are also very few supportive care studies in cancer that emulate the real world by allowing people to choose a program. Accordingly, we designed the Mindfulness and Tai Chi for Cancer Health (MATCH) study to incorporate both patient choice and a traditional RCT design, compared two evidence-based MBT treatments, included only distressed cancer survivors, and allowed people with all stages and types of cancers to participate.

CONTEXT

Key Objective

This study investigated the effects of Mindfulness-Based Cancer Recovery (MBCR) and Tai Chi/Qigong (TCQ) and the effects of choosing or being randomly assigned to programs in a broad range of cancer survivors using a unique study design.

Knowledge Generated

Both MBCR and TCQ were effective for improving mood compared with waitlist control, whether people chose a specific group or were randomly assigned. MBCR improved tension, anger, and vigor the most, and TCQ improved anger, vigor, and depression the most. Women improved more than men in MBCR, and both younger people and those with more advanced disease improved more in TCQ than older and early-stage participants.

Relevance *(S.B. Wheeler)*

Mindfulness and Tai Chi were found to be effective in improving mood, regardless of randomization or preference assignment. Such supportive interventions may have important benefits for people with advanced cancer.*

*Relevance section written by *JCO* Associate Editor Stephanie B. Wheeler, PhD, MPH.

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Motivating the novel MATCH study design was the MINDSET RCT wherein women with breast cancer who were randomly assigned to their preferred intervention (either Mindfulness-Based Cancer Recovery [MBCR] or supportive expressive therapy) improved more on quality of life and stress symptoms than those who did not receive their preferred treatment.[8] Hence, patient preference was included in the MATCH study design to further explore this effect.

In this study, we report findings related to the primary research question of the MATCH trial: Compared with a waitlist control, are MBCR and TCQ more effective in managing mood disturbance, and does having preference for MBCR versus TCQ affect the magnitude of effectiveness?

METHODS

Objectives and Hypotheses

A total of six study objectives and 10 specific hypotheses were published in the MATCH study protocol.[9] In this study, we address only objective 1 and associated hypotheses:

Hypothesis 1: When randomly assigned, both MBCR and TCQ will be superior to waitlist control pre-post intervention.

Hypothesis 2: When chosen by participants, both MBCR and TCQ will be superior to waitlist control pre-post intervention.

Hypothesis 3 (exploratory): Mean between-group pre-post differences in total mood disturbance (TMD) for both MBCR and TCQ will be larger in the preference versus random assignment groups.

Study Design

Full details and rationale for the protocol have been previously published.[9] Briefly, if participants had a preference for either of the treatments, they joined the preference arms and got their preferred treatment, but were still randomly assigned to either immediate or waitlisted subgroups in a 2:1 ratio. In the random assignment arms, participants were first randomly assigned to either MBCR or TCQ in a 1:1 ratio and then to either the immediate or waitlist group in a 2:1 ratio. The resulting eight study groups are outlined in Figure 1. Assessments occurred twice, at baseline and after intervention/after the wait period. Research ethics board approval was obtained at both study sites, and the trial was registered on ClinicalTrials.gov (identifier: NCT02801123).

Participants

Our intention was to offer this program as widely as possible to cancer survivors older than 18 years, still struggling with significant overall distress after treatment. Hence, we have used the broadest inclusion criteria deemed feasible by the study team. See the Data Supplement (Table S1, online only) for inclusion and exclusion criteria and rationale.

Sample Size

On the basis of the Profile of Mood States (POMS) TMD, we sought to recruit sufficient participants to adequately power an analysis to detect a differential effect size of $d = 0.5$ (often considered clinically significant) between each of the two randomly assigned intervention arms and randomly assigned waitlist controls. With β (power) at .8, α at $P < .05$, and a two-sided pattern, this only required 63 participants per group (each

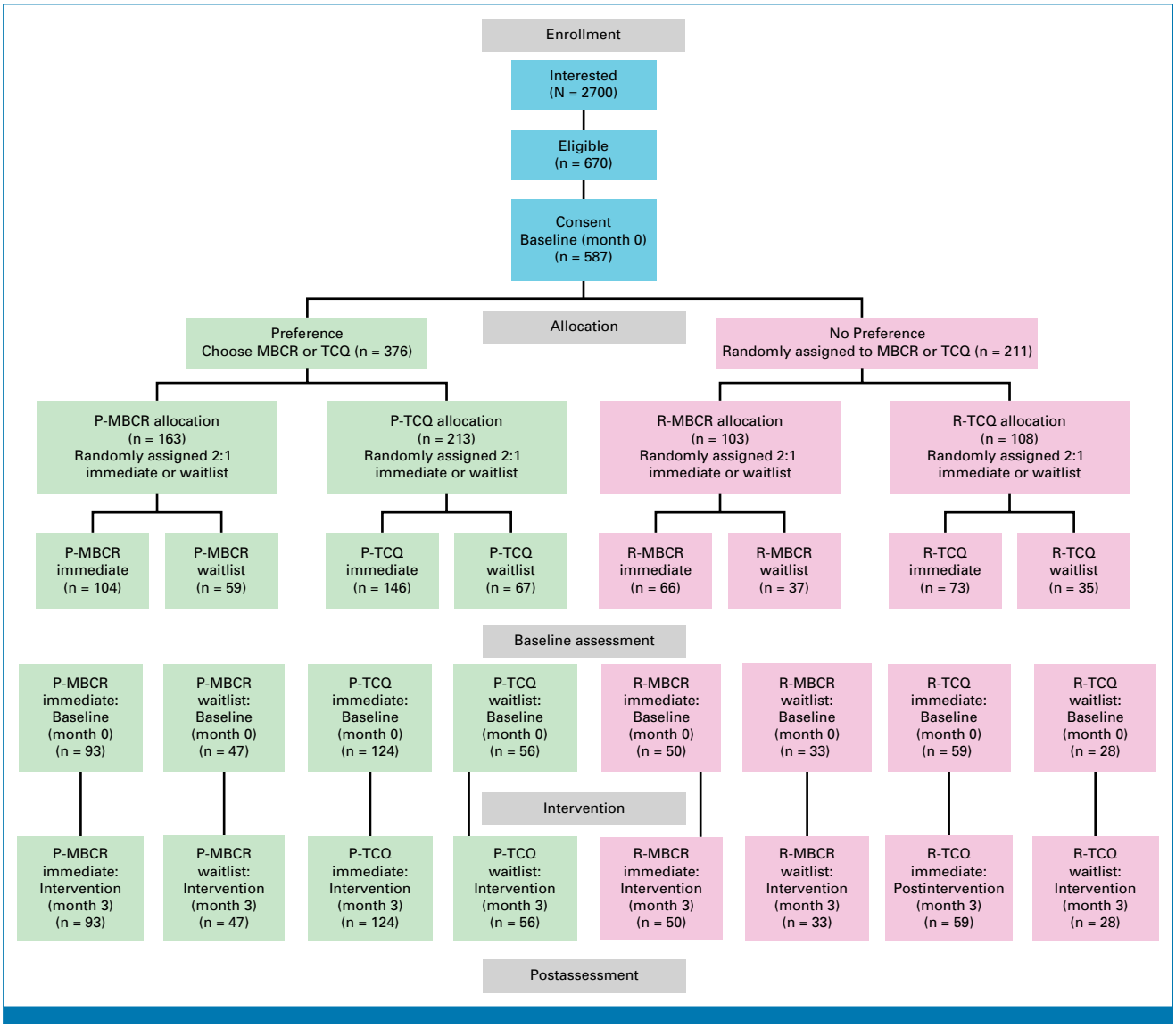

FIG 1. CONSORT diagram. MBCR, Mindfulness-Based Cancer Recovery; P-MBCR, preference Mindfulness-Based Cancer Recovery; P-TCQ, preference Tai Chi/Qigong; R-MBCR, random assignment Mindfulness-Based Cancer Recovery; R-TCQ, random assignment Tai Chi/Qigong; TCQ, Tai Chi/Qigong.

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intervention and control). A larger sample was initially recruited to power for subsequent analyses (not included here).

Recruitment

Two study sites were recruited for the trial between 2017 and 2020: Tom Baker Cancer Centre in Calgary, AB, Canada, and Princess Margaret Cancer Centre in Toronto, ON, Canada. Recruitment at both sites occurred through advertising and referrals to participating study sites. Participants self-referred or were referred by a health care professional. A study Web site was updated and continually available for recruitment and information purposes.

When interested participants called one of the study telephone lines, they were told about the study and screened for eligibility using predetermined scripts and an online screening protocol in the Research Electronic Data Capture (REDCap) system. This included standard descriptions of each program. If potentially eligible, in-person visits were scheduled where eligibility was confirmed, consent obtained, and the initial assessment completed.

Random Assignment

After completion of baseline assessments, for each cohort (up to 40 people), participants in the random assignment arms underwent block random assignment (the proportion of each cohort choosing random assignment constituted each block) into either the MBCR or TCQ program. All participants (preference and nonpreference groups) were further randomly assigned to receive their intervention either

immediately (beginning within the next month) or after a 4-6 month waiting period in a 2:1 ratio favoring the immediate intervention condition. Random assignment was performed by the team biostatistician using software methods that allowed replication. Permuted blocks were used to help conceal the allocation. Cohorts were stratified by age, sex, and cancer diagnosis. Initially, we also hoped to stratify by cancer stage, but this was not practically possible. Because the distribution of strata within and across cohorts was not always consistent, we used an adaptive approach to adjust the sampling probability to help maintain balance over the course of the trial. Random assignment results were concealed from everyone, except the study coordinator who informed patents of their group assignments after the baseline assessment.

Masking

At the baseline assessments, everyone (participants, study coordinator, research assistants, and statistician) were masked to condition because they had not yet been assigned. Once participants were randomly assigned or chose their group, the study coordinator informed them of their group assignments and became unmasked to the condition, as did the participants. Program instructors were not aware which participants had chosen the intervention versus those who had been randomly assigned.

Group Formation

The randomly assigned participants joined those with a preference in the MBCR and TCQ group sessions. Group numbers did not exceed 25 per group, and those coming off the waitlist were added to ongoing groups as appropriate. Wait times after enrollment for those in the immediate group were between 2 and 12 weeks, depending on how soon the next groups were scheduled to begin, as programs did not run over the summer months. Those in the waitlist could wait a maximum of 7 months if they enrolled in May or June, as they would therefore have to wait until the following January to participate, but the average wait time was 4-6 months.

Assessment Procedures

Once recruited, an in-person 90-minute visit to a study center was scheduled, up to 2 months before the intervention groups began (to allow testing of 40/cohort). When participants arrived, they were again fully screened for eligibility, they provided written informed consent, and they chose which intervention they preferred from standard descriptions or indicated equal interest in both interventions (20 minutes). Once consented, they completed the baseline questionnaires on a laptop, tablet, or paper on REDCap (their preference; 30 minutes).

Interventions

MBCR

MBCR was offered as a standard 9-week program of weekly in-person group meetings of 1 hour 45 minutes. A 6-hour weekend retreat was offered on a Saturday between weeks 6 and 7. As the weeks progressed, different forms of meditation were introduced, beginning with a body scan sensory awareness experience, progressing to sitting and walking meditations. Gentle Hatha yoga was incorporated throughout, as a form of moving meditation. Didactic instruction as well as group discussion and reflection, problem solving, and skillful inquiry were commonly applied teaching tools during group meetings. See Speca et al[10] for a description of the program and Carlson[11] for a summary of its efficacy.

TCQ

The intervention follows the structure and content of multiple mind-body exercise protocols used in studies based at the Harvard Medical School[12-20] and incorporates simple training elements common to both Taichi and Qigong.[17,21,22] For this reason, we call it Tai Chi/Qigong (TCQ), following nomenclature of Klein and others.[23-25] TCQ both integrate flowing rhythmic movements, along with breath awareness and a variety of cognitive skills including focused attention, heightened body awareness, and imagery. Both practices target multiple physiologic, motor, and cognitive processes that make them particularly well suited for cancer survivors with complex constellations of comorbidities.[11] The Tai Chi movements were based on the traditional Cheng Man-Ch'ing's Yang-style short form.[26] In addition to these five core movements, the intervention included a complementary set of traditional Tai Chi warm-up exercises that focus on loosening the physical body and providing moderate aerobic activity.[27] Our TCQ intervention had equal contact time as MBCR but was structured as an 11-week program consisting of a 1.5-hour weekly group meeting and a 4-hour weekend retreat. See Wayne et al for a meta-analysis of TCQ program efficacy in cancer care.[23]

Adaptations

Both programs included mild physical activity, and all ages were welcome. Adjustments to program content and delivery in both groups were made in response to functional needs of participants, including limitations in stamina and fatigue, for example, lying, sitting down, or using furniture or a wall for support in TCQ; adjusting yoga and meditation postures in MBCR; and imagining instead of undertaking difficult movements.

Home Practice

Both groups were encouraged to practice at home daily for 30-45 minutes and given specific home practice recommendations during each class. Links to online practice videos and guided audio meditations and/or CDs were given to all participants along with homework logs to record home practice. Protocols of both interventions are available upon request.

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Teacher Training/Fidelity

Instructors delivering MBCR and TCQ were experienced teachers who underwent additional training in their respective modality. Toronto MBCR instructors (n = 3) watched a full series of videotaped MBCR classes taught by L.E.C. and M.S. and had regular Q&A sessions to discuss the recordings and teaching strategies before leading groups. Calgary MBCR instructors (n = 3) were already experienced in the modality. TCQ instructors (Calgary n = 2; Toronto n = 3) attended a weekend training program hosted in person in both Calgary and Toronto with P.M.W. to review the full curriculum. All classes were videotaped and a random selection viewed by M.S. and P.M.W. as content experts, with regular feedback sessions to instructors to provide supervision throughout the trial, with more frequent sessions during the first two cohorts.

Measures

A large battery of measures was included in the full study.[9] We detail only those included in this report.

Screening Measure

Distress thermometer. Distress thermometer is a 10-point visual scale for perceived distress.[28] A clinically significant cutoff level of 4 (indicating moderate distress) was used as an inclusion criterion.[29]

Baseline Measures

Demographic characteristics. We assessed age; socioeconomic status; medical history; psychiatric history and current medications; and previous experience with yoga, Tai Chi, Qigong, or meditation. Disease parameters including stage and type of disease and date of diagnosis and treatments at the time of study enrollment were collected and later verified through chart reviews.

Outcome Measures

Primary outcome.

POMS. The POMS assesses various dimensions of mood, which can be summed to generate a TMD score, and six subscale scores: tension-anxiety, depression, anger-hostility, vigor-activity, fatigue, and confusion.[30] The POMS has been widely used in clinical populations, including cancer survivors.[31]

Data Analysis

We used linear mixed models and an intention-to-treat (ITT) principle to assess several planned comparisons across the groups on the basis of identified aims and hypotheses. Details of the analysis plan are provided in the Data Supplement.

RESULTS

Participants

Demographic and Cancer-Related Data

Five hundred eighty-seven participants were enrolled, 319 from Calgary and 265 from the Greater Toronto Area; however, the city for three participants was not specified. Women accounted for 75% (440 individuals) of participants. The average age was 60.7 years. Of the many different types of cancers represented in the study, the most prevalent were breast (40.7%), prostate (11.2%), and GI (9.7%) cancers. Most were in stage 0-II (50.1%), with 17% having more advanced disease (stages III or IV) and 29.5% reporting uncertainty of their cancer stage (Table 1).

The distribution across random assignment and preference groups was 376 (64%) preferring either TCQ (213; 57% of those with a preference) or MBCR (163; 43% of those with a preference), and the remaining 36% with no preference were randomly assigned (Fig 1). As shown in the as-treated CONSORT diagram in the Data Supplement (Fig S1), 83.5% of the 587 participants provided data at baseline and 66.1% provided self-report data during month 3 intervention assessment, which was used for the pre-post analyses.

Hypothesis 1. For ITT results, see Table 2. For as-treated analyses results, see the Data Supplement (Table S2).

The random assignment Mindfulness-Based Cancer Recovery immediate (R_MBCR_IM) group (N = 50) exhibited a significant reduction in POMS TMD scores from a mean of 19.9 (standard deviation [SD], 20.2) at baseline to 12.5 (SD, 19.3) after treatment. The interaction effect of time and group was significant (estimate, −7.29; 95% CI, −13.95 to −0.62; P = .03), indicating that the R_MBCR_IM group experienced a more substantial reduction in mood disturbance compared with the waitlist group (Fig 2A). The as-treated analysis showed a similar interaction effect (estimate, −8.29; 95% CI, −14.93 to −1.71; P = .02).

The random assignment Tai Chi/Qigong immediate (R_TCQ_IM) group (N = 59) demonstrated a reduction in POMS TMD scores from 17.7 (SD, 17.7) to 12.0 (SD, 19.3) after treatment. The interaction effect was trending toward significance (estimate, −6.80; 95% CI, −14.00 to 0.44; P = .07; Fig 2A). However, for the as-treated analysis, the interaction effect achieved a significant reduction in POMS TMD scores (estimate, −9.32; 95% CI, −16.70 to −2.20; P = .01).

Hypothesis 2. The preference Mindfulness-Based Cancer Recovery immediate (P_MBCR_IM) group (N = 93) showed a reduction in POMS TMD scores from 18.9 (SD, 21.2) at baseline to 11.8 (SD, 18.7) after treatment, whereas the waitlist group (N = 47) showed a reduction from 19.3 (SD, 20.1) to 12.5 (SD, 20.1). The interaction effect was not significant (estimate, −2.24; 95% CI, −9.88 to 5.39; P = .57; Fig 2B).

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TABLE 1. Demographics and Cancer-Related Data

Demographic Variable	Overall (N = 587)	P_MBCR_IM (n = 104)	P_MBCR_WL (n = 59)	P_TCQ_IM (n = 146)	P_TCQ_WL (n = 67)	R_MBCR_IM (n = 66)	R_MBCR_WL (n = 37)	R_TCQ_IM (n = 73)	R_TCQ_WL (n = 35)
Age, years									
Mean (SD)	60.7 (11.0)	60.7 (10.1)	60.9 (13.3)	60.2 (11.1)	62.4 (10.7)	61.7 (11.8)	58.2 (10.0)	59.6 (10.8)	61.8 (10.1)
Missing, No. (%)	50 (8.5)	6 (5.8)	1 (1.7)	16 (11.0)	7 (10.4)	8 (12.1)	2 (5.4)	7 (9.6)	3 (8.6)
Sex, No.(%)									
Male	146 (24.9)	33 (31.7)	10 (16.9)	35 (24.0)	15 (22.4)	18 (27.3)	6 (16.2)	16 (21.9)	13 (37.1)
Female	440 (75.0)	71 (68.3)	49 (83.1)	111 (76.0)	52 (77.6)	47 (71.2)	31 (83.8)	57 (78.1)	22 (62.9)
Missing	1 (0.2)	0	0	0	0	1 (1.5)	0	0	0
BMI									
Mean (SD)	26.9 (6.0)	26.5 (5.6)	26.6 (5.4)	26.8 (5.9)	28.1 (5.8)	26.3 (5.7)	27.3 (7.8)	27.2 (6.5)	26.6 (6.1)
Employment status, No. (%)									
Unemployed	42 (7.2)	7 (6.7)	3 (5.1)	9 (6.2)	6 (9.0)	6 (9.1)	2 (5.4)	6 (8.2)	3 (8.6)
Full-time	185 (31.5)	33 (31.7)	22 (37.3)	50 (34.2)	15 (22.4)	18 (27.3)	15 (40.5)	21 (28.8)	11 (31.4)
Part-time	65 (11.1)	14 (13.5)	4 (6.8)	17 (11.6)	11 (16.4)	5 (7.6)	7 (18.9)	5 (6.8)	2 (5.7)
Retired	182 (31.0)	36 (34.6)	21 (35.6)	42 (28.8)	20 (29.9)	20 (30.3)	7 (18.9)	24 (32.9)	12 (34.3)
Disabled	29 (4.9)	4 (3.8)	2 (3.4)	8 (5.5)	5 (7.5)	2 (3.0)	2 (5.4)	3 (4.1)	3 (8.6)
Missing	84 (14.3)	10 (9.6)	7 (11.9)	20 (13.7)	10 (14.9)	15 (22.7)	4 (10.8)	14 (19.2)	4 (11.4)
Marital status, No. (%)									
Single	80 (13.6)	7 (6.7)	9 (15.3)	34 (23.3)	9 (13.4)	7 (10.6)	1 (2.7)	10 (13.7)	3 (8.6)
Cohabitating	37 (6.3)	5 (4.8)	4 (6.8)	12 (8.2)	7 (10.4)	1 (1.5)	0	4 (5.5)	4 (11.4)
Married	298 (50.8)	69 (66.3)	25 (42.4)	64 (43.8)	30 (44.8)	29 (43.9)	28 (75.7)	36 (49.3)	17 (48.6)
Divorced	56 (9.5)	7 (6.7)	8 (13.6)	10 (6.8)	7 (10.4)	11 (16.7)	3 (8.1)	6 (8.2)	4 (11.4)
Widowed	31 (5.3)	6 (5.8)	6 (10.2)	6 (4.1)	3 (4.5)	3 (4.5)	1 (2.7)	3 (4.1)	3 (8.6)
Missing	85 (14.5)	10 (9.6)	7 (11.9)	20 (13.7)	11 (16.4)	15 (22.7)	4 (10.8)	14 (19.2)	4 (11.4)
Years of education									
Mean (SD)	15.9 (4.8)	15.9 (6.4)	16.3 (3.8)	16.0 (5.2)	16.2 (4.8)	15.5 (4.4)	16.1 (3.8)	15.1 (3.4)	16.5 (3.0)
Cancer site, No. (%)									
Lung	27 (4.6)	3 (2.9)	4 (6.8)	10 (6.8)	2 (3.0)	2 (3.0)	0	4 (5.5)	2 (5.7)
Breast	239 (40.7)	40 (38.5)	30 (50.8)	66 (45.2)	30 (44.8)	15 (22.7)	20 (54.1)	29 (39.7)	9 (25.7)
Prostate	66 (11.2)	16 (15.4)	4 (6.8)	14 (9.6)	10 (14.9)	5 (7.6)	3 (8.1)	9 (12.3)	5 (14.3)
Head and neck	7 (1.2)	2 (1.9)	0	1 (0.7)	0	1 (1.5)	0	2 (2.7)	1 (2.9)
Testicular	6 (1.0)	1 (1.0)	2 (3.4)	1 (0.7)	0	0	0	1 (1.4)	1 (2.9)
Leukemia	2 (0.3)	1 (1.0)	1 (1.7)	0	0	0	0	0	0
Gynecologic	44 (7.5)	7 (6.7)	3 (5.1)	9 (6.2)	4 (6.0)	6 (9.1)	3 (8.1)	6 (8.2)	6 (17.1)
Skin	27 (4.6)	5 (4.8)	2 (3.4)	6 (4.1)	1 (1.5)	2 (3.0)	2 (5.4)	5 (6.8)	4 (11.4)
Thyroid	14 (2.4)	2 (1.9)	1 (1.7)	1 (0.7)	4 (6.0)	0	1 (2.7)	5 (6.8)	0

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TABLE 1. Demographics and Cancer-Related Data (continued)

Demographic Variable	Overall (N = 587)	P_MBCR_IM (n = 104)	P_MBCR_WL (n = 59)	P_TCQ_IM (n = 146)	P_TCQ_WL (n = 67)	R_MBCR_IM (n = 66)	R_MBCR_WL (n = 37)	R_TCQ_IM (n = 73)	R_TCQ_WL (n = 35)
Lymphoma	18 (3.1)	5 (4.8)	2 (3.4)	5 (3.4)	2 (3.0)	1 (1.5)	2 (5.4)	1 (1.4)	0
GI	57 (9.7)	8 (7.7)	3 (5.1)	13 (8.9)	4 (6.0)	15 (22.7)	3 (8.1)	7 (9.6)	4 (11.4)
Hematologic	5 (0.9)	1 (1.0)	0	0	3 (4.5)	0	0	0	1 (2.9)
Other	57 (9.7)	9 (8.7)	6 (10.2)	17 (11.6)	5 (7.5)	13 (19.7)	3 (8.1)	2 (2.7)	2 (5.7)
Missing	18 (3.1)	4 (3.8)	1 (1.7)	3 (2.1)	2 (3.0)	6 (9.1)	0	2 (2.7)	0
Cancer stage, No. (%)									
Stage 0	5 (0.9)	1 (1.0)	0	3 (2.1)	1 (1.5)	0	0	0	0
Stage I	172 (29.3)	33 (31.7)	19 (32.2)	42 (28.8)	16 (23.9)	22 (33.3)	12 (32.4)	17 (23.3)	11 (31.4)
Stage II	117 (19.9)	22 (21.2)	12 (20.3)	32 (21.9)	9 (13.4)	11 (16.7)	7 (18.9)	21 (28.8)	3 (8.6)
Stage III	91 (15.5)	12 (11.5)	5 (8.5)	23 (15.8)	15 (22.4)	8 (12.1)	9 (24.3)	15 (20.5)	4 (11.4)
Stage IV	9 (1.5)	0	0	7 (4.8)	0	1 (1.5)	1 (2.7)	0	0
Unsure	173 (29.5)	31 (29.8)	22 (37.3)	36 (24.7)	24 (35.8)	18 (27.3)	8 (21.6)	17 (23.3)	17 (48.6)
Missing	20 (3.4)	5 (4.8)	1 (1.7)	3 (2.1)	2 (3.0)	6 (9.1)	0	3 (4.1)	0
What was your last treatment? No. (%)									
Chemotherapy	73 (12.4)	13 (12.5)	3 (5.1)	18 (12.3)	8 (11.9)	7 (10.6)	3 (8.1)	13 (17.8)	8 (22.9)
Radiation	180 (30.7)	29 (27.9)	18 (30.5)	52 (35.6)	19 (28.4)	15 (22.7)	14 (37.8)	23 (31.5)	10 (28.6)
Surgery	211 (35.9)	37 (35.6)	19 (32.2)	51 (34.9)	22 (32.8)	32 (48.5)	13 (35.1)	23 (31.5)	14 (40.0)
Other	15 (2.6)	2 (1.9)	2 (3.4)	6 (4.1)	2 (3.0)	0	0	3 (4.1)	0
Missing	108 (18.4)	23 (22.1)	17 (28.8)	19 (13.0)	16 (23.9)	12 (18.2)	7 (18.9)	11 (15.1)	3 (8.6)
Number of alcoholic drinks consumed per week									
Mean (SD)	3.1 (5.0)	2.8 (4.0)	3.0 (3.8)	3.1 (4.8)	3.2 (6.7)	4.4 (7.1)	3.4 (4.7)	2.2 (3.1)	2.9 (4.9)
Missing, No. (%)	88 (15.0)	10 (9.6)	8 (13.6)	20 (13.7)	11 (16.4)	15 (22.7)	4 (10.8)	14 (19.2)	6 (17.1)
Heavy alcohol consumption (>14 drinks per week), No. (%)									
No	479 (81.6)	92 (88.5)	50 (84.7)	121 (82.9)	53 (79.1)	45 (68.2)	31 (83.8)	59 (80.8)	28 (80.0)
Yes	20 (3.4)	2 (1.9)	1 (1.7)	5 (3.4)	3 (4.5)	6 (9.1)	2 (5.4)	0	1 (2.9)
Missing	88 (15.0)	10 (9.6)	8 (13.6)	20 (13.7)	11 (16.4)	15 (22.7)	4 (10.8)	14 (19.2)	6 (17.1)
Number of nicotine products used per day									
Mean (SD)	0.2 (1.2)	0.1 (1.4)	0.1 (0.3)	0.2 (1.2)	0.1 (0.7)	0.2 (1.2)	0.7 (1.8)	0.2 (1.4)	0.0 (0.0)
Missing, No. (%)	87 (14.8)	10 (9.6)	7 (11.9)	20 (13.7)	11 (16.4)	15 (22.7)	4 (10.8)	14 (19.2)	6 (17.1)
Regular smoker (>1 nicotine products per day), No. (%)									
No	478 (81.4)	93 (89.4)	50 (84.7)	120 (82.2)	54 (80.6)	47 (71.2)	28 (75.7)	57 (78.1)	29 (82.9)
Yes	22 (3.7)	1 (1.0)	2 (3.4)	6 (4.1)	2 (3.0)	4 (6.1)	5 (13.5)	2 (2.7)	0
Missing	87 (14.8)	10 (9.6)	7 (11.9)	20 (13.7)	11 (16.4)	15 (22.7)	4 (10.8)	14 (19.2)	6 (17.1)

(continued on following page)

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TABLE 1. Demographics and Cancer-Related Data (continued)

Demographic Variable	Overall (N = 587)	P_MBCR_IM (n = 104)	P_MBCR_WL (n = 59)	P_TCQ_IM (n = 146)	P_TCQ_WL (n = 67)	R_MBCR_IM (n = 66)	R_MBCR_WL (n = 37)	R_TCQ_IM (n = 73)	R_TCQ_WL (n = 35)
Number of physically active minutes per day									
Mean (SD)	36.9 (41.2)	43.8 (53.0)	32.8 (36.8)	30.8 (31.5)	39.5 (45.3)	40.7 (33.3)	52.2 (63.7)	33.1 (29.3)	26.5 (27.8)
Missing, No. (%)	88 (15.0)	11 (10.6)	8 (13.6)	20 (13.7)	10 (14.9)	15 (22.7)	4 (10.8)	14 (19.2)	6 (17.1)
Do you practice meditation? No. (%)									
No	494 (84.2)	87 (83.7)	49 (83.1)	118 (80.8)	59 (88.1)	55 (83.3)	29 (78.4)	66 (90.4)	31 (88.6)
Yes	75 (12.8)	13 (12.5)	9 (15.3)	25 (17.1)	6 (9.0)	5 (7.6)	8 (21.6)	5 (6.8)	4 (11.4)
Missing	18 (3.1)	4 (3.8)	1 (1.7)	3 (2.1)	2 (3.0)	6 (9.1)	0	2 (2.7)	0
Do you practice Tai Chi? No. (%)									
No	561 (95.6)	100 (96.2)	58 (98.3)	141 (96.6)	64 (95.5)	59 (89.4)	35 (94.6)	69 (94.5)	35 (100)
Yes	8 (1.4)	0	0	2 (1.4)	1 (1.5)	1 (1.5)	2 (5.4)	2 (2.7)	0
Missing	18 (3.1)	4 (3.8)	1 (1.7)	3 (2.1)	2 (3.0)	6 (9.1)	0	2 (2.7)	0
Distress thermometer									
Mean (SD)	5.5 (1.5)	5.6 (1.5)	5.7 (1.5)	5.6 (1.5)	5.5 (1.5)	5.5 (1.4)	5.6 (1.6)	5.6 (1.5)	5.0 (1.1)

NOTE. Overall: all the groups.

Abbreviations: P_MBCR_IM, preference Mindfulness-Based Cancer Recovery immediate; P_MBCR_WL, preference Mindfulness-Based Cancer Recovery waitlist; P_TCQ_IM, preference Tai Chi/Qigong immediate; P_TCQ_WL, preference Tai Chi/Qigong waitlist; R_MBCR_IM, random assignment Mindfulness-Based Cancer Recovery immediate; R_MBCR_WL, random assignment Mindfulness-Based Cancer Recovery waitlist; R_TCQ_IM, random assignment Tai Chi/Qigong immediate; R_TCQ_WL, random assignment Tai Chi/Qigong waitlist; SD, standard deviation.

TABLE 2. Primary Outcome: Profile of Mood States

	Intention-to-Treat Analysis							
	Baseline		Post-Treatment					
Comparison	n	Mean (SD)	n	Mean (SD)	Estimate (time × group)	95% CI	*P*	Effect Size
R_MBCR_WL *v* R_MBCR_IM	33	17.6 (19.4)	33	11.3 (20.1)				
	50	19.9 (20.2)	50	12.5 (19.3)	−7.29	−13.95 to −0.62	.03*	0.06
R_TCQ_WL *v* R_TCQ_IM	28	13.0 (21.1)	28	11.5 (20.6)				
	59	17.7 (17.7)	59	12.0 (19.3)	−6.80	−14.00 to 0.44	.07	0.03
P_MBCR_WL *v* P_MBCR_IM	47	19.3 (20.1)	47	12.5 (20.1)				
	93	18.9 (21.2)	93	11.8 (18.7)	−2.24	−9.88 to 5.39	.57	0.04
P_TCQ_WL *v* P_TCQ_IM	56	15.8 (20.1)	56	9.8 (21.5)				
	124	20.0 (20.7)	124	12.6 (19.4)	−4.19	−9.07 to 0.69	.09	0.14
R_MBCR_IM *v* P_MBCR_IM	50	19.9 (20.2)	50	8.0 (21.8)				
	93	18.9 (21.2)	93	10.3 (12.3)	6.74	−0.39 to 13.89	.06	0.13
R_TCQ_IM *v* P_TCQ_IM	59	17.7 (17.7)	59	5.7 (14.9)				
	124	20.0 (20.7)	124	10.0 (17.0)	−0.11	−5.52 to 4.68	.96	0.27
R/P_MBCR_WL *v* R/P_MBCR_IM	80	18.6 (19.8)	80	18.4 (23)				
	143	19.2 (20.8)	143	9.5 (17.0)	−4.15	−9.57 to 1.27	.10	0.44
R/P_TCQ_WL *v* R/P_TCQ_IM	84	14.9 (20.4)	84	13.2 (20.0)				
	183	19.3 (19.8)	183	8.7 (16.5)	−5.13	−9.44 to −1.23	.01	0.25

Abbreviations: P_MBCR_IM, preference Mindfulness-Based Cancer Recovery immediate; P_MBCR_WL, preference Mindfulness-Based Cancer Recovery waitlist; P_TCQ_IM, preference Tai Chi/Qigong immediate; P_TCQ_WL, preference Tai Chi/Qigong waitlist; R/P_MBCR_IM, Mindfulness-Based Cancer Recovery immediate; R/P_MBCR_WL, Mindfulness-Based Cancer Recovery waitlist; R/P_TCQ_IM, Tai Chi/Qigong immediate; R/P_TCQ_WL, Tai Chi/Qigong waitlist; R_MBCR_IM, random assignment Mindfulness-Based Cancer Recovery immediate; R_MBCR_WL, random assignment Mindfulness-Based Cancer Recovery waitlist; R_TCQ_IM, random assignment Tai Chi/Qigong immediate; R_TCQ_WL, random assignment Tai Chi/Qigong waitlist; SD, standard deviation.
*P <.05.

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The preference Tai Chi/Qigong (P-TCQ) immediate group (N = 124) showed a reduction in POMS TMD scores from 20.0 (SD, 20.7) at baseline to 12.6 (SD, 19.4) after treatment, while the waitlist group (N = 56) showed a reduction from 15.8 (SD, 20.1) to 9.8 (SD, 21.5). The interaction effect approached significance but was not significant (estimate, −4.19; 95% CI, −9.07 to 0.69; P = .09; Fig 2B).

Hypothesis 3. Comparing the R_MBCR_IM group (N = 50) with the P_MBCR_IM group (N = 93), there was no significant difference in the reduction in POMS TMD scores (estimate, 6.74; 95% CI, −0.39 to 13.89; P = .06; Fig 2C). Comparing the R_TCQ_IM group (N = 59) with the P-TCQ immediate group (N = 124), there was no significant difference in the reduction in POMS TMD scores (estimate, −0.11; 95% CI, −5.52 to 4.68; P = .96; Fig 2C). These results indicate no greater treatment effect in the preference compared with random assignment groups.

Combined Groups: This exploratory analysis was not planned in the hypotheses, but because there were no differences in outcomes between the P and R groups for either MBCR or TCQ, we combined P and R groups across each intervention to increase power for the overall comparisons of immediate versus waitlist conditions. Comparing the combined immediate groups (Mindfulness-Based Cancer Recovery immediate [R/P_MBCR_IM] and Tai Chi/Qigong immediate) with their respective waitlist groups showed substantial reductions in mood disturbance for MBCR (estimate, −4.15; 95% CI, −9.57 to 1.27; P = .10) and a significant reduction for TCQ (estimate, −5.13; 95% CI, −9.44 to −1.23; P = .01; Fig 2D).

Effect sizes observed across the various group comparisons presented in Table 2 for the ITT analyses ranged from negligible to small. The largest effect size of 0.44 is observed for the Mindfulness-Based Cancer Recovery waitlist versus R/P_MBCR_IM comparison.

Subgroup Analyses

Subgroup results on the POMS for ITT analyses are summarized in Table 3. Subgroups analyzed were within male and female participants, early (0, I, II) versus advanced disease stages, and younger (≤61) versus older age groups. Female participants showed more robust effects than male participants for MBCR programs across the random assignment (−8.06; P = .04) and combined (−7.81; P = .02) group comparisons of immediate versus waitlist and in TCQ combined immediate groups versus waitlist (−5.62; P = .03). People with advanced-stage disease improved more on TCQ

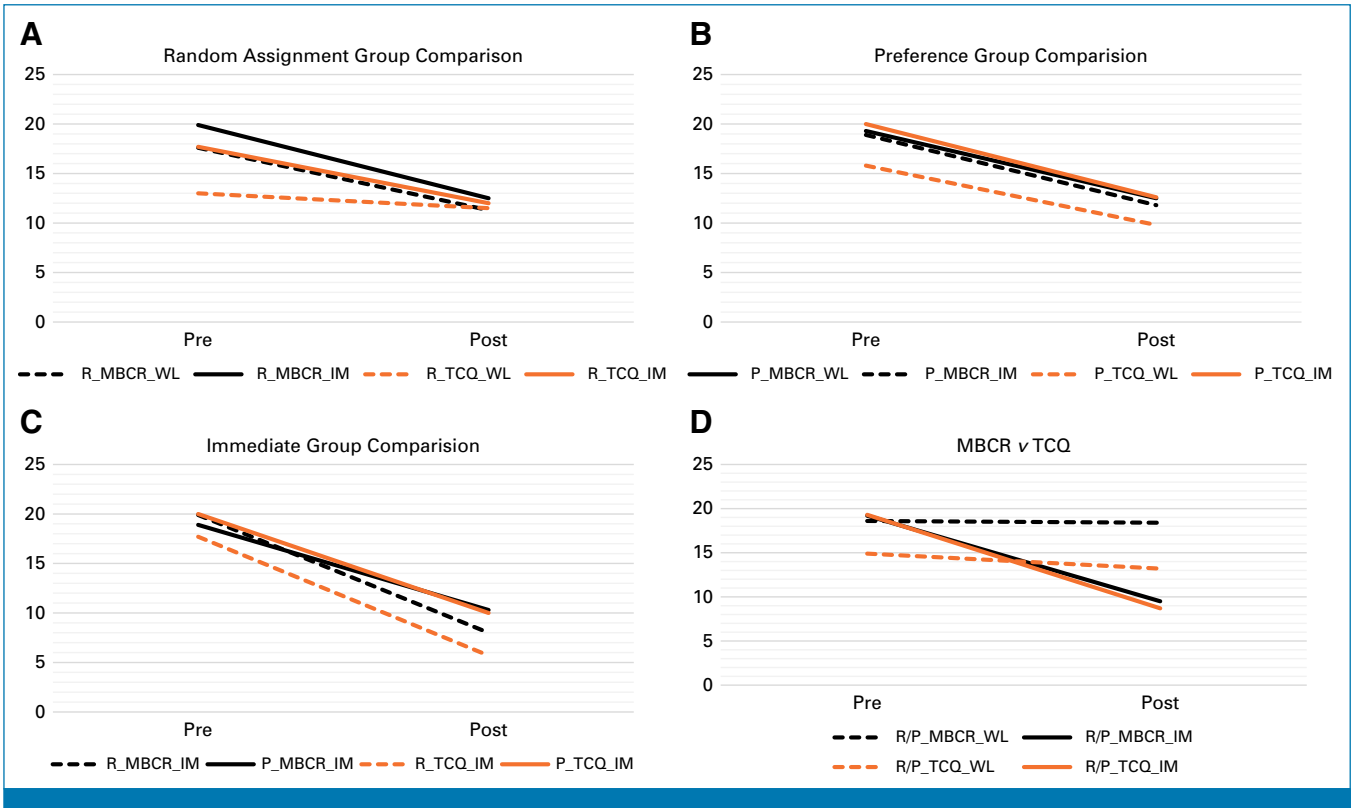

FIG 2. POMS comparison graphs. (A) Random assignment group comparison = R_MBCR_WL, R_MBCR_IM, R_TCQ_WL, and R_TCQ_IM. (B) Preference group comparison = P_MBCR_WL, P_MBCR_IM, P_TCQ_WL, and P_TCQ_IM. (C) Immediate group comparison = R_MBCR_IM, P_MBCR_IM, R_TCQ_IM, and P_TCQ_IM. (D) MBCR versus TCQ = R/P_MBCR_WL, R/P_MBCR_IM, R/P_TCQ_WL, and R/P_TCQ_IM. MBCR, Mindfulness-Based Cancer Recovery; P_MBCR_IM, preference Mindfulness-Based Cancer Recovery immediate; P_MBCR_WL, preference Mindfulness-Based Cancer Recovery waitlist; P_TCQ_IM, preference Tai Chi/Qigong immediate; P_TCQ_WL, preference Tai Chi/Qigong waitlist; POMS, Profile of Mood States; R/P_MBCR_IM, Mindfulness-Based Cancer Recovery immediate; R/P_MBCR_WL, Mindfulness-Based Cancer Recovery waitlist; R/P_TCQ_IM, Tai Chi/Qigong immediate; R/P_TCQ_WL, Tai Chi/Qigong waitlist; R_MBCR_IM, random assignment Mindfulness-Based Cancer Recovery immediate; R_MBCR_WL, random assignment Mindfulness-Based Cancer Recovery waitlist; R_TCQ_IM, random assignment Tai Chi/Qigong immediate; R_TCQ_WL, random assignment Tai Chi/Qigong waitlist; TCQ, Tai Chi/Qigong.

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than those with earlier stage disease, both in the preference TCQ group (−7.48; P = .02) and the combined TCQ group (−7.19; P < .01) compared with waitlist. Younger people also improved more on TCQ than older people, both in the preference TCQ group (−9.24; P = .01) and the combined TCQ group (−9.75; P < .01) compared with waitlist.

POMS Subscale Results

Subscales of POMS for ITT are presented in Table 4, as-treated in the Data Supplement (Table S3), and graphs are in the Data Supplement (Figs S2-S7).

Anger

The as-treated analysis results showed that both MBCR and TCQ significantly reduced anger scores, with TCQ having a larger magnitude of effect on anger than MBCR. The interaction effect was significant for the combined effect of TCQ on anger scores (estimate, −1.19; 95% CI, −2.17 to −0.21; P = .01), indicating an overall stronger effect for TCQ on anger.

Depression

Only TCQ significantly reduced depression subscale scores, as indicated by the intention-to-treat combined random assignment and preference analysis results (estimate, −1.24; 95% CI, −2.22 to −0.27; P = .01), MBCR did not show a statistically significant impact on reducing the depression score in the intention-to-treat analysis, which was supported by the as-treated analysis.

Tension

Only MBCR showed a significant reduction in tension-anxiety scores, as indicated by the intention-to-treat analysis results of random assignment Mindfulness-Based Cancer Recovery waitlist versus R_MBCR_IM (estimate, −1.91; 95% CI, −3.69 to −0.12; P = .04). Furthermore, the combined R/P_MBCR showed a significant reduction in tension score for the as-treated analysis (estimate, −1.36; 95% CI, −2.66 to −0.08; P = .04). However, the reduction in tension scores noted in the TCQ group was not statistically significant.

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TABLE 3. POMS Subgroup Analysis Result

Group	Male (group × time) Estimate (*P*)	Female (group × time) Estimate (*P*)	Early Stage (stage ≤2; group × time) Estimate (*P*)	Advanced Stage (stage >2; group × time) Estimate (*P*)	Age ≤61 (group × time) Estimate (*P*)	Age>61 (group × time) Estimate (*P*)
R_MBCR_WL *v* R_MBCR_IM	−5.14 (.50)	−8.06 (.04)*	−7.91 (.08)	−6.49 (.18)	−5.96 (.17)	−9.13 (.11)
R_TCQ_WL *v* R_TCQ_IM	−11.13 (.06)	−5.65 (.22)	−6.71 (.28)	−6.62 (.11)	−10.40 (.07)	−3.14 (.48)
P_MBCR_WL *v* P_MBCR_IM	7.18 (.27)	−7.85 (.12)	−2.39 (.63)	−4.86 (.46)	−2.17 (.71)	−5.32 (.38)
P_TCQ_WL *v* P_TCQ_IM	−0.84 (.74)	−5.62 (.08)	−0.97 (.81)	−7.48 (.02)*	−9.24 (.01)*	0.73 (.84)
R_MBCR_IM *v* P_MBCR_IM	12.08 (.06)	2.43 (.60)	3.74 (.47)	7.28 (.24)	6.19 (.27)	4.18 (.46)
R_TCQ_IM *v* P_TCQ_IM	6.94 (.02)*	−2.38 (.45)	−0.59 (.87)	−0.38 (.92)	−1.58 (.68)	1.16 (.71)
R_MBCR_IM/P_MBCR_IM *v* R_MBCR_WL/P_MBCR_WL	3.29 (.55)	−7.81 (.02)*	−4.47 (.21)	−5.28 (.27)	−3.31 (.41)	−6.88 (.11)
R_TCQ_IM/P_TCQ_IM *v* R_TCQ_WL/P_TCQ_WL	−4.22 (.12)	−5.62 (.03)*	−2.87 (.40)	−7.19 (<.01)**	−9.75 (<.01)**	−0.63 (.82)

NOTE. Sixty-one years is the median age.

Abbreviations: P_MBCR_IM, preference Mindfulness-Based Cancer Recovery immediate; P_MBCR_WL, preference Mindfulness-Based Cancer Recovery waitlist; P_TCQ_IM, preference Tai Chi/Qigong immediate; P_TCQ_WL, preference Tai Chi/Qigong waitlist; POMS, Profile of Mood States; R/P_MBCR_IM, Mindfulness-Based Cancer Recovery immediate; R/P_MBCR_WL, Mindfulness-Based Cancer Recovery waitlist; R/P_TCQ_IM, Tai Chi/Qigong immediate; R/P_TCQ_WL, Tai Chi/Qigong waitlist; R_MBCR_IM, random assignment Mindfulness-Based Cancer Recovery immediate; R_MBCR_WL, random assignment Mindfulness-Based Cancer Recovery waitlist; R_TCQ_IM, random assignment Tai Chi/Qigong immediate; R_TCQ_WL, random assignment Tai Chi/Qigong waitlist.

*$P < .05$.

**$P < .01$.

TABLE 4. POMS Subscale Outcomes

Subscale	R_MBCR_WL *v* R_MBCR_IM (n = 84)	R_TCQ_WL *v* R_TCQ_IM (n = 87)	P_MBCR_WL *v* P_MBCR_IM (n = 139)	P_TCQ_WL *v* P_TCQ_IM (n = 186)	R_MBCR_IM *v* P_MBCR_IM (n = 84)	R_TCQ_IM *v* P_TCQ_IM (n = 187)	R/P_MBCR_WL *v* R/P_MBCR_IM (n = 223)	R/P_TCQ_WL *v* R/P_TCQ_IM (n = 273)
Anger								
Estimate (95% CI)	−0.96 (−2.76 to 0.84)	−1.87 (−3.87 to 0.12)	−0.28 (−2.13 to 1.55)	−0.85 (−1.93 to 0.23)	1.40 (−0.28 to 3.14)	0.41 (−0.83 to 1.66)	−0.53 (−1.87 to 0.81)	−1.19 (−1.19 to −2.17)*
Effect size	0.30	0.47	0.36	0.28	0.21	0.25	0.33	0.34
Confusion								
Estimate (95% CI)	−0.14 (−1.53 to 1.25)	−0.56 (−1.54 to 0.41)	0.97 (−0.45 to 2.40)	−0.44 (−1.37 to 0.49)	0.75 (−0.60 to 2.11)	0.11 (−1.14 to 1.30)	0.55 (−0.48 to 1.58)	−0.27 (−1.02 to 0.47)
Effect size	0.21	0.21	0.16	0.22	0.19	0.24	0.18	0.20
Depression								
Estimate (95% CI)	−1.77 (−3.88 to 0.33)	−1.52 (−3.40 to 0.36)	0.01 (−1.99 to 2.02)	−1.08 (−2.20 to 0.05)	1.71 (−0.13 to 3.55)	−0.16 (−1.40 to 1.03)	−0.65 (−2.15 to 0.84)	−1.24 (−2.22 to −0.27)*
Effect size	0.37	0.40	0.33	0.24	0.10	0.33	0.37	0.30
Fatigue								
Estimate (95% CI)	−1.42 (−3.40 to 0.54)	−0.15 (−1.87 to 1.57)	−0.39 (−2.27 to 1.48)	−0.32 (−1.52 to 0.87)	0.60 (−1.81 to 0.61)	−0.60 (−1.81 to 0.61)	−0.78 (−2.17 to 0.60)	−0.30 (−1.30 to 0.70)
Effect size	0.33	0.07	0.12	0.02	0.24	0.18	0.20	0.00
Tension								
Estimate (95% CI)	−1.91 (−3.69 to −0.12)*	−0.52 (−2.30 to 1.26)	−0.86 (−2.89 to 1.17)	−0.12 (−1.75 to 1.36)	0.98 (−0.98 to 2.95)	−0.50 (−2.02 to 1.01)	−1.25 (−2.69 to 0.20)	−0.34 (−1.54 to 0.86)
Effect size	0.32	0.40	0.34	0.07	0.23	0.29	0.35	0.23
Vigor								
Estimate (95% CI)	1.46 (0.05 to 2.88)*	2.82 (0.89 to 4.75)*	1.00 (−0.65 to 2.63)	1.52 (0.18 to 2.86)*	−0.66 (−2.13 to 0.80)	−1.07 (−2.45 to 0.32)	1.16 (−0.001 to 2.31)	1.91 (0.82 to 3.03)*
Effect size	0.53	0.24	0.54	0.11	0.15	0.14	0.55	0.17

Abbreviations: P_MBCR_IM, preference Mindfulness-Based Cancer Recovery immediate; P_MBCR_WL, Preference Mindfulness-Based Cancer Recovery waitlist; P_TCQ_IM, preference Tai Chi/Qigong immediate; P_TCQ_WL, preference Tai Chi/Qigong waitlist; POMS, Profile of Mood States; R/P_MBCR_IM, Mindfulness-Based Cancer Recovery immediate; R/P_MBCR_WL, Mindfulness-Based Cancer Recovery waitlist; R/P_TCQ_IM, Tai Chi/Qigong immediate; R/P_TCQ_WL, Tai Chi/Qigong waitlist; R_MBCR_IM, random assignment Mindfulness-Based Cancer Recovery immediate; R_MBCR_WL, random assignment Mindfulness-Based Cancer Recovery waitlist; R_TCQ_IM, random assignment Tai Chi/Qigong immediate; R_TCQ_WL, random assignment Tai Chi/Qigong waitlist.
*$P < .05$.

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Vigor

The intention-to-treat analysis results showed that the TCQ group showed greater improvement in vigor scores than the MBCR group; this was supported by the as-treated analysis results. However, the R_MBCR showed a significant similar improvement (estimate, 1.46; 95% CI, 0.05 to 2.28; $P = .04$) in the intention-to-treat analysis only.

Confusion and Fatigue

None of the changes were statistically significant. On the basis of Table 3, the effect sizes across the various POMS subscales and group comparisons predominantly fall within the small-to-medium range. Effects are larger in the as-treated analyses provided in the Data Supplement. Overall, the largest effects are observed in the vigor subscale, suggesting that the interventions may have had the most substantial impact on this aspect of mood.

DISCUSSION

This is the first study, to our knowledge, to use a preference-based non-randomized effectiveness design alongside a fully randomized efficacy trial of two evidence-based interventions for treating dimensions of mood disturbance in people with cancer and include randomized waitlists in each case. To our knowledge, it is also the largest trial of MBTs in oncology to date, enrolling close to 600 participants. This unique design offers important advantages, namely (1) participants with a strong preference (approximately two thirds) got the intervention they wanted, maximizing recruitment and also allowing exploration of the effects of preference on outcome; (2) a full standard comparative efficacy RCT with two active interventions and a waitlist control was embedded in the design, which allowed testing of efficacy of both interventions compared with waitlist controls and each other, and; (3) randomized waitlisted control groups allowed us to see the natural course of changes over time, which gave us context to interpret the changes seen in the two active interventions.

In this study, we analyzed effects of the interventions on our primary outcome, the POMS, and its subscales in the first three study hypotheses. In the people who chose to be randomly assigned, both MBCR and TCQ immediate groups experienced a more substantial reduction in TMD and most subscales compared with their respective waitlist groups, as hypothesized, with small-to-medium effects. However, when either MBCR or TCQ was chosen, there was not a significantly larger improvement in mood for immediate groups compared with waitlist controls, despite the larger sample sizes in the preference arms, and contrary to hypotheses. Indeed, whether choosing to be randomly assigned or picking a specific program, both interventions showed similar levels of improvement. This lack of differential outcomes between our preference and random assignment arms is in contrast to our results in the MINDSET study, in which those who were assigned nonpreferred interventions improved less, regardless of the intervention they undertook.[10] However, the MATCH design does not perfectly mirror a traditional RCT, as even those who were randomly assigned chose to be so; hence, they were presumably happy to undertake either intervention, and no one was assigned a nonpreferred program. This suggests that choice may not be as important for influencing outcomes in MBTs as hypothesized, so long as people are willing to be randomly assigned at the outset. In that case, when participants are randomly assigned into acceptable evidence-based treatments, they may benefit equally.

These mood results are consistent with findings of recent meta-analyses of RCTs showing that both MBIs and TCQ interventions improve anxiety and depression with small-to-medium effect sizes.[7] This study expands our understanding of these effects beyond the samples previously studied, which largely consisted of women with breast cancer who were highly educated. Approximately one quarter of our sample were men, and 60% had been diagnosed with cancers other than breast cancer, significantly expanding the generalizability of results.

The role of preference in treatment outcomes has been inconsistent when evaluated in reviews and meta-analyses of trials using preference-based designs. For example, a review of 44 partially randomly assigned patient preference trials included 24,873 participants across a wide range of medical conditions and interventions, including complementary therapies such as acupuncture and exercise.[32] The loss to follow-up rate was significantly higher in the random assignment cohorts, but the reported primary outcomes were comparable between both random assignment and chosen groups,[32] similar to our findings of no strong effect of preference on outcomes. Contrary to these findings, in earlier interim analysis of data from this trial, program preference was not a predictor of dropout or loss to follow-up. Rather, being assigned to any of the waitlist conditions significantly predicted dropouts.[33] This reinforces that making participants wait for desired interventions by using waitlist conditions may significantly affect internal validity by resulting in higher dropout rates. In terms of specificity of mindfulness versus TCQ programs, our hypotheses were partially supported in that MBCR seemed more effective for stress, tension, and anxiety-related outcomes with medium effects, whereas TCQ had a stronger effect on depression and vigor. Both groups showed medium effects for improving anger. These differences are most obvious in the as-treated analyses. In previous meta-analyses, MBIs have medium effects on both anxiety and depression,[5-7] but in this case, the effects on POMS depression were small. Similarly, TCQ effects in meta-analyses are typically larger for depression than for anxiety, so these results are consistent.[5-7]

Interestingly, women seemed to improve more in MBCR groups than men, and both younger people and those with more advanced disease improved more in TCQ than older and

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early-stage participants, but age and stage had no such effect in the MBCR programs. These subgroup differences hint at the possibility of personalized prescriptions to MBTs on the basis of disease stage, sex, and age, but more work exploring these differences is needed.

The study is not without limitations, including potential baseline imbalances between those choosing MBCR versus TCQ or choosing to be randomly assigned. For example, people may have considered TCQ a more rigorous program than MBCR, and therefore, those with more stamina may have preferentially chosen it and thereby influenced outcomes. However, we did try to mitigate baseline imbalances by adjusting for age, sex, and cancer stage in the analyses. We also cannot definitively conclude that random assignment does not influence outcomes, given that everyone in the random assignment arms chose to be randomly assigned and were presumably satisfied with their program assignment at the outset. There were some discrepancies in dropout rates across groups, but these did not violate missing at random data analytic assumptions. General limitations of in-person programs apply as well, in that attendance requires enough mobility, time, and energy to be able to travel to the program venue, thereby de facto excluding anyone without these capabilities.

In summary, both MBCR and TCQ proved beneficial for improving overall mood in a broad swath of people living with cancer of different types and stages after treatment completion who were experiencing significant distress.

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AFFILIATIONS

[1]Department of Oncology, University of Calgary, Calgary, AB, Canada
[2]Department of Supportive Care, Princess Margaret Cancer Centre, Toronto, ON, Canada
[3]Osher Center for Integrative Health, Harvard Medical School and Brigham and Women's Hospital, Boston, MA

CORRESPONDING AUTHOR

Linda E. Carlson, PhD; Social Media Handle: @Linda_E_Carlson; e-mail: l.carlson@ucalgary.ca.

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AUTHOR CONTRIBUTIONS

Conception and design: Linda E. Carlson, Jennifer M. Jones, Peter M. Wayne, Michael Speca
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Provision of study materials or patients: Linda E. Carlson, Jennifer M. Jones, Peter M. Wayne, Michael Speca
Collection and assembly of data: Linda E. Carlson, Jennifer M. Jones, Devesh Oberoi, Katherine-Ann Piedalue, Daniel Santa Mina
Data analysis and interpretation: Linda E. Carlson, Jennifer M. Jones, Peter M. Wayne, Oluwaseyi A. Lawal
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AUTHORS' DISCLOSURES OF POTENTIAL CONFLICTS OF INTEREST

Mindfulness and Tai Chi for Cancer Health (MATCH) Study: Primary Outcomes of a Preference-Based Multisite Randomized Comparative Effectiveness Trial

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Daniel Santa Mina
Employment: Shoppers Drug Mart
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