The number of new cancer cases diagnosed each year is on the rise (World Health Organization, 2019). The aggressive nature of cancer and cancer treatment often result in devastating side effects such as fatigue, pain, depressed mood, insomnia, or gastrointestinal symptoms and are experienced across various cancer sites and multiple cytotoxic treatment modalities (Madmoli, 2018). Research examining exercise as an intervention for individuals with cancer has demonstrated promising results in side effect reduction (Dhawan, Andrews, Kumar, Wadhwa, & Shukla, 2019; Kleckner et al., 2018; Quist et al., 2015), thereby improving the quality of life.
life (QOL) of patients with cancer (Dhawan et al., 2019; Zimmer et al., 2018).

Finding suitable exercise for individuals undergoing chemotherapy is difficult due to adverse symptoms of the disease and chemotherapy. Because of the physiological and psychosocial strain associated with cytotoxic treatment, holistic exercise focusing on harmony between the mind, body, and spirit is essential. Meditative movement exercises such as tai chi (TC), are easier to adopt than vigorous aerobic and resistance training for health-compromised individuals (Larkey et al., 2015; Vanderbyl et al., 2017). As a mind–body exercise, TC is comprised of smooth, low-impact movements suitable for persons of all fitness levels (Mayo Clinic, 2015; Wayne et al., 2018) and has demonstrated positive effects among specific cancer diagnoses (Larkey et al., 2015; Mustain, Sprod, Janelins, Peppone, & Mohile, 2012; Oh et al., 2012; Wayne et al., 2018; Zhang, Wang, Chen, & Yuan, 2016). While the literature supports the use of exercise as an intervention for persons receiving chemotherapy, the influence of the specific TC exercise on self-efficacy, QOL, and cancer-related fatigue (CRF) in this population is inconclusive. Additionally, persons with cancer in rural areas often do not have access to exercise programs and most programs are not equipped to accommodate the special considerations needed for persons receiving chemotherapy. Therefore, the purposes of this study were to (a) evaluate the effects of an 8-week TC program on self-efficacy, QOL, and CRF among individuals with cancer receiving chemotherapy and (b) understand the experiences and perceived benefits of a TC program for individuals receiving chemotherapy residing in rural East Texas.

**Review of Literature**

As a weight bearing, mind–body exercise, TC is known to have psychosocial and physical benefits across various populations (Chang, Nien, Tsai, & Etnier, 2010; Mayo Clinic, 2015; Sprod et al., 2012; Wang et al., 2016). TC exercise, grounded in complementary and alternative Chinese medical practices, consists of slow, gentle movements with minimal physical impact (Mayo Clinic, 2015). Research supports substantial benefits to persons with cancer engaged in TC including a reduction in side effects with improved QOL and physical function (Mustain et al., 2012). In a 12-week TC intervention involving 30 women with breast cancer, the TC intervention group had positive effects on self-esteem, fatigue, cortisol, and QOL when compared with a control group (Thongteratham et al., 2015). In women with a history of breast cancer, TC interventions were deemed feasible (Campo et al., 2013), reduced anxiety, depressive symptoms, and fatigue, and improved emotional well-being within the 8-week study period (Galantino, Callens, Cardena, Piela, & Mao, 2013). Breast cancer survivors involved in TC reported higher functioning, lower breast cancer–related concerns (Fong et al., 2013), improvement in physical role limitations, increased social functioning, increased mental health (Sprod et al., 2012), fewer neuropsychological complaints, and increased psychological functioning (Reid-Arndt, Matsuda, & Cox, 2012).

Few studies using TC as an exercise intervention for persons with cancer have focused on individuals receiving chemotherapy (Murley, Haas, & Wang, 2018). In an experimental study of participants receiving chemotherapy for cancer engaged in TC, Oh et al. (2012) reported an increase in QOL and cognitive functioning with a significant decrease in systemic inflammatory marker when compared with the cancer-control group. In a study of patients with lung cancer receiving chemotherapy, Zhang et al. (2016) reported lower fatigue scores and higher vigor in the TC intervention group, compared with the low-impact control group. These early studies suggest TC is a feasible and beneficial form of exercise for persons receiving chemotherapy, but research is limited.

**Research Questions**

Using Bandura’s social cognitive theory (Bandura & National Institute of Mental Health, 1986) to guide the study, it was hypothesized that participants in a TC exercise program would have lower CRF and higher QOL scores than those who were not exercising. The following research questions were also addressed:

**Research Question 1:** What are the experiences and perceived benefits of patients receiving chemotherapy involved in an 8-week TC program?

**Research Question 2:** Are patients with cancer able to maintain an 8-week TC exercise interven-
Research Question 3: Do participants’ experiences and perceived benefits to participating in TC support the quantitative results?

Method

Design and Sample

An explanatory sequential mixed method quasi-experimental design with postintervention interviews was used. Following Institutional Review Board approval, a convenience sample was recruited through oncology staff at local facilities in rural east Texas. Eligibility criteria included (a) ≥ 18 years of age; (b) active solid-tumor cancer diagnosis (any type or stage); (c) anticipated survival rate ≥ 12 months; (d) currently in Cycles 1, 2, or 3 of adjuvant or neoadjuvant chemotherapy; (e) receiving one or more of the commonly used chemotherapy agents docetaxel (Taxotere), paclitaxel (Taxol), doxorubicin (Adriamycin); (f) ability to ambulate with or without assistive device; (g) physician approval; (h) ability to read and understand English; and (i) access to cell phone or e-mail. Exclusion criteria include (a) currently enrolled in a research study involving physical activity, (b) self-reported current diagnosis of major psychiatric disorder (i.e., schizophrenia, major depressive disorder), and (c) delirium or dementia. Of the 15 individuals who agreed to participate in the TC intervention, 10 dropped out within the first 2 weeks, leaving just three participants in the intervention group. Three additional participants not engaged in TC or exercise were also recruited. Participants ranged in age from 30 to 69 years (M = 49.8, SD = 14.5). All participants were female with a diagnosis of breast cancer receiving chemotherapy. The sample was 33% African American/Black with remaining participants self-reporting race as White, 66% married, 66% primary caregiver to a minor, 50% held a college degree. At baseline, 66% of the sample reported no previous exercise within the past 3 months. At baseline, 83% of participants (n = 5) received weekly docetaxel, while the remaining participant received paclitaxel every 3 weeks.

Intervention

The intervention consisted of an 8-week Wheelchair Tai Chi 10 (WCT10) Forms (Fox et al., 2011; Wang et al., 2016), modified to have participants standing rather than seated. Three 50-minute TC exercise sessions were performed weekly over 8 weeks; two sessions were held in class with a TC instructor and one session was performed at home. Of the 24 total TC sessions, participants were required to attend 80% of in class sessions and self-report 90% of home sessions. Participants signed in at each exercise encounter to monitor attendance. Each participant was provided a video of the Wheelchair Tai Chi 10 exercise to guide their weekly home session and complete a log detailing the length of the home session, which day of the week TC was completed, and the number of breaks taken. The principal investigator (PI) collected home exercise logs on a weekly basis from each participant. The TC program was structured to increase exercise difficulty over the course of the intervention yet remained applicable to all physical activity levels (Table 1).

Measures and Data Collection

In addition to demographic and treatment-related information, self-efficacy for exercise, CRF, and QOL were assessed at baseline and at 8 weeks. Surveys were completed prior to exercise for those in the TC group.

Self-Efficacy for Exercise. Self-efficacy, defined as a person’s belief in his or her ability to perform a certain task or produce effects (Bandura, 1998), was measured using the Exercise Confidence Survey (ECS). The ECS, a 12-item scale with two subscales: Self-Efficacy for Resting Relapse (8 items) and Self-Efficacy for Making Time (4 items), was developed to evaluate self-efficacy for exercise behavior adoption and maintenance (Sallis, Pinski, Grossman, Patterson, & Nader, 1988). Each item on the survey elicits perceived self-efficacy by asking how confident the respondent is that he or she could exercise under specific circumstances using a 6-point scale (0 = not sure I could do it, 5 = sure I could do it). The total score is obtained by calculating mean scores, higher scores indicate better self-efficacy. The ECS has been validated in the general population and in certain chronic conditions. Internal consistency with Cronbach’s alpha coefficients has been reported as .83 and .85 for both subscales, respectively. Test–retest reliabilities were 0.68 for both subscales (Sallis et al., 1988).
Quality of Life. QOL is a subjective, multidimensional concept composed of four components: (a) physical well-being, perceived and observed bodily function or disruption; (b) social well-being, perceived social support, maintenance of leisure activities, family functioning, and intimacy; (c) emotional well-being, positive affect such as well-being, and negative affect, such as distress; and (d) functional well-being, the ability to perform activities related to ones’ needs, ambitions, and social role (Cella, 1994). The Functional Assessment of Cancer Therapy–General (FACT-G Version 4) is a 27-item QOL measurement tool measuring four primary QOL domains: physical well-being, social/family well-being, emotional well-being, and functional well-being (Cella et al., 1993). Items are scored on a 5-point Likert-type scale (ranging from 0 not at all to 4 very much) and the four subscales are summed for a total score with higher scores indicate a better QOL (Cella et al., 1993; Luckett et al., 2011). The FACT-G has been used in numerous studies to measure the QOL of patients with cancer and is considered a valid and reliable instrument in the target population (Cella et al., 1993; Luckett et al., 2011).

Cancer-Related Fatigue. CRF, defined as a persistent, distressing, sense of tiredness, or exhaustion,
related to cancer or cancer treatment that is not proportional to recent activity, inhibiting usual functioning (National Comprehensive Cancer Network, 2016), was assessed using the Functional Assessment of Chronic Illness Therapy–Fatigue (FACIT-F). Items on the 13-item scale are scored on a 5-point Likert-type scale (ranging from 0 not at all to 4 very much). The total score is obtained by summing the individual items with higher scores indicating higher fatigue (Yellen, Cella, Webster, Blendowski, & Kaplan, 1997). FACIT-F has been validated with test–retest correlation coefficients of .87 and a Cronbach’s alpha for reliability .95 reported (Yellen et al., 1997).

**Interviews.** Semistructured interviews led by the PI and with time allotted for participant discussion were held at the end of the 8-week TC exercise program. Interviews took place over a 45-minute period. Interviews were conducted in a private university setting and a private room at the participating oncology clinic. Detailed notes regarding the tone of the session, nonverbal communication, environmental observations, and distractions were documented. Interviews were audio recorded using a digital recorder.

**Data Analysis and Results**

**Quantitative.** De-identified data were entered into an electronic database; statistical analyses were conducted using Statistical Package for the Social Science version 24.0. There were no significant differences in QOL or CRF scores between groups based on independent sample t test. The ECS scores were significantly different at both baseline (t = −3.02; p ≤ .05) and posttest (t = −3.22; p ≤ .05). Paired t tests for the control group QOL, CRF, and ESC scores were nonsignificant (Table 2). Intervention group scores over time significantly improved for emotional well-being and fatigue but decreased for social well-being.

**Qualitative.** To address Research Question 1, which explored experiences and perceived benefits of an 8-week TC program, postintervention interviews were conducted. The interviews were transcribed and manually coded using inductive thematic analysis within the context of SCT (Bandura & National Institute of Mental Health, 1986). Transcripts were read and reread; audio recordings were used to recall the atmosphere of the interviews to promote understanding of data. To gain deeper insight, field notes were integrated into data analysis and comparison with data was performed. Data were then categorized into clusters of themes and validated with original text, comparing the transcriptions and categories to identify any discrepancies and validate the results (Wojnar & Swanson, 2007). Two expert qualitative researchers verified the coding and thematic analysis of the qualitative data.

Strength was the overarching theme that depicted the experience and perceived benefits of the TC program. Strength was divided into two subthemes: (a) Mind Strength (psychosocial and emotional strength) and (b) Body Strength (physical strength). Participants referred to both emotional and physical strength, as illustrated in the statements below:

And even when I came and wasn’t feeling well a couple of times, I actually felt better physically and emotionally.

You know, you feel, you feel as if you’ve helped yourself mentally and physically. Like you feel the sense of calm like and peace after you get done. And some exercise, you don’t. You feel tired.

Participants referred to their psychosocial strength in terms of increased confidence through peer and instructor support. All participants preferred attending TC class over the home sessions and agreed having peer and instructor support increased adherence to the program. Psychosocial strength is evidenced in the following statements.

And it helped with the confidence . . . I mean just cause knowing that we could make it through this definitely says, yeah, “I can do, I can do something else.”

It’s kind of a support system. I mean, not that they’re, not a rah-rah kind of thing, but just a support that we can all do this and it benefits everybody.

Emotional strength was shared by participants as they experienced a regaining of awareness, increased mental focus, becoming more centered, and finding peace because of TC practice. Participants enjoyed
the distraction of learning a new form of exercise that required concentration on individual movements allowing them to focus on the exercise as opposed to thinking about their current health status.

I could have all kinds of things rolling around in my head and when I would come to class it was like I unplugged and all that just went away because I was focusing on the music, people, and the exercises. And I think that affects a lot of everything because if you can mentally fight it, you’re golden, no matter what part of chemo you’re in. If you’re mentally strong, and I really do think that [tai chi] helps you become more mentally strong and able to take deep breaths, “I can do this.”

The TC intervention also affected physical strength. Participants spoke of having more energy after TC sessions with increased flexibility and muscle strength reported. Participants agreed that TC was feasible for their activity level and less strenuous than other forms of exercise, which made exercise sustainable while undergoing chemotherapy.

When I get in and out of a vehicle, especially my husband’s truck, that I didn’t have to hold on like I usually did. . . . But it seemed like my balance improved. When we first started, we would do little steps and I’d be real wobbly.

I absolutely felt more energized because occasionally when I would be thinking about not coming, my husband would encourage me to go ahead. And after class, I was ready to go shopping or do a few errands.

**Discussion**

**Sample**

The small sample size and homogeneity of the sample limits generalizability. While previous studies focused on cancer survivors (Campo et al., 2013; Cramer, Rabilber, Lauche, Kümmel, & Dobos, 2015; Irwin et al., 2017; Vadiraja et al., 2017) or a specific disease (Oh et al., 2012; Zhang et al., 2016), using chemotherapy regimens as an eligibility criterion provided an opportunity to explore the effect of TC from a different perspective. Despite the recruiting plan, only patients with Stages II and III breast cancer participated in the study. Two physicians at the referring practices and who specialized in breast cancer were particularly supportive of the study. This may have contributed to selection bias resulting in a homogenous sample. Meetings with the entire practice group prior to implementation may have resulted in a more heterogeneous sample.

While 15 participants were initially interested, the brisk attrition at the beginning of the study is a concern and limits interpretation of findings. Those who did continue reported they reaped many benefits from the TC, suggesting TC is feasible for this population. To accommodate those traveling from a rural community, classes were held on site at the cancer treatment center. Despite these efforts, the fragility of the chemotherapy population is a major challenge in engaging these patients in any type of exercise program.

**Table 2. Quality of Life, Fatigue, and Self-Efficacy Scores Over Time**

<table>
<thead>
<tr>
<th>Scale</th>
<th>Control group scores (SD)</th>
<th>Intervention group mean scores (SD)</th>
<th>t</th>
</tr>
</thead>
<tbody>
<tr>
<td>Functional Assessment of Cancer Therapy–General (FACT-G) Physical Well-Being Subscale</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FACT-G Emotional Well-Being Subscale</td>
<td>20.00 (3.61)</td>
<td>20.33 (3.22)</td>
<td>−1.0</td>
</tr>
<tr>
<td>FACT-G Social Well-Being Subscale</td>
<td>25.33 (1.16)</td>
<td>24.00 (4.00)</td>
<td>0.555</td>
</tr>
<tr>
<td>FACT-G Functional Well-Being Subscale</td>
<td>21.67 (0.58)</td>
<td>19.33 (5.69)</td>
<td>0.69</td>
</tr>
<tr>
<td>FACT-G Quality of Life Total</td>
<td>89.33 (8.74)</td>
<td>84.67 (7.57)</td>
<td>0.51</td>
</tr>
<tr>
<td>Functional Assessment of Chronic Illness Therapy–Fatigue</td>
<td>127.00 (15.88)</td>
<td>118.67 (14.30)</td>
<td>0.49</td>
</tr>
<tr>
<td>Exercise Self-Confidence</td>
<td>3.53 (0.54)</td>
<td>2.69 (1.68)</td>
<td>1.42</td>
</tr>
</tbody>
</table>

*p ≤ .05
The three participants in the waitlist-control group denied participation in TC following the 8-week study period. The three waitlist-control participants provided brief reasons for not participating in the available TC program. Two waitlist-control group participants stated they were nearing completion of chemotherapy, while one waitlist-control group participant stated an interference with work schedule.

Those who dropped out of the intervention group were compared with those who continued in the TC program. No differences were observed on any demographic or disease and treatment variables. Participants who withdrew from the study were called by the PI on the phone number provided by participant and asked to provide a reason for study withdrawal. Only five participants provided a reason for study withdrawal: One participant stated her chemotherapy time was changed and interfered with class, one participant stated she no longer had transportation available to participate in the class, three participants spoke to experiencing overwhelming disease and treatment burden.

Quality of Life

Results of the quantitative assessments were compared with qualitative findings. While quantitative results were not statistically significant, the qualitative findings depicted a different outcome, suggesting clinical significance. Contrary to those not exercising, the individuals participating in the 8-week TC intervention reported improved QOL, though only emotional well-being was statistically significant. During the interviews, participants indicated an increase in emotional well-being, which supported quantitative findings. Participants also discussed the physical and functional benefits they attributed to TC, such as improved balance, more energy, and increased flexibility. These qualitative findings were not supported by the quantitative findings depicted on scores of the FACT-G. However, the qualitative findings from this study are congruent with previous studies involving mind–body interventions in patients with cancer in that intervention effects may show clinical significance rather than statistical significance (Brazier, Cooke, & Moravan, 2008; Leal, Engebretson, & Cohen, 2014).

While the quantitative findings were not statistically significant, there was a trend toward improvement in all the QOL measures except social well-being. The small sample size limited the ability to detect differences. Social well-being was an exception to demonstrating improvement on the quantitative measure using FACT-G scores. One item on the social well-being subscale refers to satisfaction with sex life. At baseline, only half of the participants responded to this item; however, all answered it at the posttest. The difference in response rates and the sample size may have contributed to the discrepancy in scores. Qualitative findings suggest that participants in the TC intervention did experience an increase in social support but none of the participants specifically mentioned satisfaction with sex life.

Cancer-Related Fatigue

The FACIT fatigue scores supported the positive effect of TC on CRF. Those in the intervention group improved significantly over time, while those in the control group became more fatigued. Both findings support SCT, which posits that behavior (i.e., TC) will affect the person (i.e., fatigue). Qualitative data also supported the quantitative measures as participants discussed “feeling energized” and noted that “when I left [tai chi], it didn’t feel that [tired]. I mean I just feel overall better.”

Self-Efficacy for Exercise

Although not statistically significant, quantitative findings suggest the 8-week TC intervention may have an impact on self-efficacy for exercise. The control group exhibited a decline in self-efficacy scores, while the intervention group scores were stable over time. Even though ECS scores did not statistically improve over time, qualitative data supported the positive impact of TC on participants’ confidence in their ability to exercise while undergoing chemotherapy. Participants noted “It helped with the confidence . . . I mean just knowing that we could make it through this definitely says, yeah, ‘I can do, I can do something else.’”

The quantitative and qualitative findings from reported self-efficacy are consistent with SCT. In SCT, self-efficacy can be developed and strengthened by four factors: enactive mastery experiences, vicarious experiences, verbal persuasion, and physiological and affective states (Bandura, 1998; Keller, Fleury, Gregor-Holt, & Thompson, 1999). Participants spoke of increased confidence to exercise through
each of the four factors: (a) watching individuals going through similar diagnoses and treatments encouraged participants to exercise (vicarious experiences), (b) successfully learning a new form of exercise (mastery experiences), (c) receiving encouragement from instructors and support from the other participants (verbal persuasion), and (d) decreased stress (physiological and affective states). Bandura (1998) also noted that self-efficacy may be negatively affected by physiological and affective states, such as those experienced by someone receiving chemotherapy. The participants’ lack of confidence in their ability to perform TC throughout chemotherapy may explain the high attrition rate. The negative affective state may also account for the decrease in self-efficacy among the control group. The fact that the intervention group self-efficacy scores remained stable while receiving chemotherapy suggests TC may moderate the impact of a physiological state (i.e., chemotherapy) on exercise confidence.

Implications for Future Research

Results from this small sample indicate TC has demonstrated to be an effective and feasible exercise for persons receiving chemotherapy. Given the high rate attrition, effective interventions to maintain exercise participation need to be developed. Since few studies have included persons receiving chemotherapy, research is needed with this population. Researchers are encouraged to explore the impact of a group TC program on social support and adherence of persons receiving chemotherapy to an exercise program.

Summary

This study examined the experiences, perceived benefits, and effects of an 8-week TC exercise intervention on self-efficacy, QOL, and CRF in persons with cancer receiving chemotherapy in a rural setting. Unlike previous studies, this mixed methods study included participants actively receiving chemotherapy, used TC as a holistic exercise intervention, and incorporated the experiences and perceptions of participants. Qualitative data in this study provided a deeper insight into not only the feasibility of participating in TC while receiving chemotherapy, but also the impact TC can have on self-efficacy, QOL, and CRF. The perspective of one participant sums up the benefit of incorporating TC to build strength through gentle, peaceful exercise while receiving chemotherapy: “I love it [tai chi]. I want to do it for the rest of my life, I really do.”

ORCID iDs

Brittany Murley https://orcid.org/0000-0003-3256-5586
Melinda Hermanns https://orcid.org/0000-0003-3456-0420

References


Vanderbyl, B., Mayer, M., Nash, C., Tran, A., Windholz, T.,


Brittany Murley received a PhD in nursing from The University of Texas at Tyler in 2018. She is currently an assistant professor of nursing at East Texas Baptist University. Her program of research focuses on quality of life for persons with cancer with an emphasis on exercise interventions.

Barbara Haas is a professor in nursing, is executive director for the School of Nursing and associate dean for the College of Nursing & Health Sciences. Her program of research focuses on quality of life for persons with cancer with an emphasis on exercise interventions. She serves as research director for the Cancer Foundation for Life’s exercise program, titled FitSTEPS for Life.

Melinda Hermanns is an associate professor in nursing, is the MSN program director for the School of Nursing. Her health-related program of research focuses on improving the quality of life for persons with a chronic illness, specifically cancer and Parkinson’s disease.

Yong Tai Wang is with the College of Nursing and Health Sciences at the University of Texas at Tyler. Dr. Wang’s research interests focus on biomechanics of rehabilitation, specifically on wheelchair locomotion and rehabilitation for individuals with spinal cord injury, and Tai Chi and Wheelchair Tai Chi for individuals with spinal cord injury and disability.

Eric Stocks received a PhD in Social Psychology from the University of Kansas in 2005. He is currently a professor of Social Psychology at the University of Texas at Tyler. His research focuses on social emotions and motivation processes.