*Full-Length Article*

# Feasibility Study of a Music Therapy Intervention for Breast Cancer Survivors with Cognitive Dysfunction: *The MusIC Study*

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**Abstract**

Cognitive impairment following treatment is a common complaint among breast cancer patients. Commonly affected cognitive domains include executive level functioning, working and verbal memory, concentration and information processing. A feasibility study was conducted to evaluate the ability to recruit for a choral-based music therapy intervention study and to refine the design of the intervention. The intervention was conducted over a 2-month period and included group music therapy sessions and choral participation. Participants were given a DVD and CD with music-based exercises with the suggestion to do ten minutes of exercises daily. Nine patients were enrolled and six completed the intervention. The most common reason for not enrolling was perceived lack of singing ability. Conflict with work schedule was the main factor associated with study drop out. The group music therapy sessions were highly valued by the participants, None adhered to the daily exercises. The participants were very positive about their experience. A choral-based music therapy intervention for the treatment of chemotherapy-related cognitive impairment is feasible and should be further evaluated in a randomized clinical trial. Including a non-singing component of the intervention, such as bell ringing or other instrument, may improve recruitment.

**Keywords:** *[needed]*

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## Introduction

Long complained about by patients but slow to be recognized by clinicians and researchers as a side effect of chemotherapy, chemotherapy-related cognitive impairment (CRCI), commonly referred to as "chemobrain" or "chemo fog", is now a well documented adverse effect of treatment , both chemotherapy and hormone therapies. [1] [2] Improvements in the sensitivity of methods of cognitive assessment methods, use of brain imaging studies to document alterations in brain function associated with chemotherapy, dose-response effects, and publication of prospective studies comparing cognitive testing before and after chemotherapy have led to a wider acceptance of the reality of cognitive dysfunction associated with cancer treatment. [1, 3] In addition, recent studies using functional neuroimaging document structural changes associated with chemotherapy, such as altered white matter integrity, in areas of the brain consistent with observed neurocognitive deficits. [4-7]

Cognitive domains affected by cancer treatments include executive level functioning, working and verbal memory, concentration, and information processing. [1, 8] Symptoms include inability to quickly switch between tasks ("multi-tasking"), difficulty with learning new concepts, problems with reading and comprehension, and decreased verbal fluency. [9, 10]. These symptoms have a substantial emotional impact leading to increased distress, anxiety, depression, frustration, irritation and fears of having dementia. [9] Further, cognitive impairments lead to social withdrawal, family tensions, job loss or changes in work positions, missed promotions and loss of confidence. [9]

Estimates of the frequency of CRCI from cross-sectional studies vary; however, longitudinal prospective studies with a pre-treatment assessment, suggest an incidence in the range of 33 to 50%. [11] Many patients have improvement in their

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cognitive functioning one year after completing chemotherapy, but about a third continue to show cognitive decline [12], and studies suggest subtle long lasting cognitive effects. [13]

While CRCI is now well documented, there is no known effective prevention or treatment other than providing coping tools. Taking clues from treatment of early dementia, where learning new complex activities, such as singing or playing an instrument, have shown promise in preventing or reversing cognitive decline, [14-16] we conducted a pilot study to evaluate the feasibility of using a choral-based music intervention in partnership with recorded musical tasks for the treatment of CRCI among breast cancer survivors. The goals of the study were to evaluate the ability to recruit patients for a choral-based music therapy intervention and to obtain patient feedback on the design of the intervention.

## Methods

The study used a quasi-experimental before/after study design recruiting breast cancer patients who completed adjuvant chemotherapy prior to enrollment. Patients who complained of at least moderate intensity forgetfulness or trouble concentrating were eligible. Participants were recruited by placing flyers in a cancer center of an academically affiliated hospital. The intervention was conducted over a two month period and consisted of two group sessions with a music therapist, exercises (available on a DVD and CD) to be done at home during the intervention period, and participating in five rehearsals of a community chorus. The Healing Power of Music Chorus was established in cooperation with the Maryland State Boychoir to provide an opportunity for cancer survivors, health care providers, parents of boychoir members, and community friends to experience singing in community. All musical experience levels are represented in the chorus. The chorus convenes annually for five rehearsals, learning four to five pieces of music, culminating in a joint concert with the boychoir. The pilot study was timed to take advantage of this existing mechanism to incorporate the study participants into the community choral activity. Taking part in the concert performance was optional, but all who enrolled in the study chose to participate.

Participants completed a brief questionnaire at entry and post-intervention. Cognitive assessment was conducted pre- and post-intervention using a computer-based battery of tests (CNS Vital Signs) that focused on executive level function, sustained attention and concentration [17]. The panel was chosen so that it could be completed in 30 minutes or less. The battery of tests included: Attention Switching Task (assesses cognitive flexibility), Spatial Working Memory (assesses executive dysfunction), Rapid Visual Processing (measure of sustained concentration), One Touch Stockings of Cambridge Test (assesses spatial planning), and Verbal Recognition Memory Test (assesses immediate and delayed verbal memory).

There was no formal sample size calculation for this feasibility study. The goal was to recruit ten to twenty participants. Data presentation is descriptive.

The study was approved by the Institutional Review Board and participants gave written informed consent.

### Description of the Intervention:

Participants met with the music therapist for two one-hour group sessions preceding two of the five scheduled chorus rehearsals. Rehearsals were of 90 minutes duration and varied between weekday evening and Saturday morning rehearsals. In addition, participants were given a DVD and CD recording of exercises designed by the music therapist to enhance verbal memory, working memory and completion of complex task and were asked to practice about ten to fifteen minutes each day, choosing one or two exercises each day. Exercises (see Table) included a vocal warm-up, physical stretching/movement, repeating rhythmic drumming patterns (simple and complex), combining singing and recreating rhythms, learning song lyrics for two songs, and an attentive listening task recalling lyrics within a category/theme found in the song's lyrics.

The music therapist designed tasks that could be utilized in between choral rehearsals with specific cognitive functions in mind including concentration, language recall, processing and memorizing new information, executive functioning, creative thinking, and comprehension. Some of the tasks were building blocks to complete a later task.

Vocal Warm ups: Vocal warm ups included humming a 5 note scale, adding vowel and consonant sounds, and a "tongue twister" warm up for concentration.

Movement: The subjects followed instructions to stretch upper body. Subjects were instructed to repeat 4 counts of movement after watching the therapist. Then MT-BC presented 4 beat counts that subjects were to repeat while watching MT-BC present a new 4 beat movement they were to repeat.

Learning a song by rote: MT-BC presented "Somebody Sang for Me" to the tune of African American spiritual "Somebody Prayed for Me", which the MT-BC had previously learned by rote in a choral setting. The verse was chosen due to 16 measure length and clear 2-4 measure phrasing. MT-BC presented the song, which was unfamiliar to the subjects. MT-BC taught the song by phrase and then combined phrases until the entire song was sung. Subjects were not provided sheet music or lyrics. At the end of the task, subjects were to sing the entire song.

Recreating rhythms: MT-BC played short 1-2 measure rhythms that subjects were to repeat clapping or drumming. MT-BC lengthened rhythms up to 3 measures. Rhythms included half notes, quarter notes, eighth notes, rests, and dotted rhythms. Rhythms began with simple patterns and

increased in complexity.

Combining singing and rhythm: Subjects were taught an ostinato rhythm (a rhythmic pattern that is repeated continuously). Subjects were instructed to clap/play the ostinato rhythm while also recalling and singing the song they learned in the previous task.

Lyric recall/Lyric substitution: MT-BC instructed subjects to sing a song that was also being rehearsed in the choir ('How Can I Keep from Singing?;' Quaker Song, arranged by Ginger Littleton.) MT-BC left out lyrics as it was sung and subjects were to fill in the blanks as they continued singing. MT-BC also invited subjects to create their own lyrics for the blanks if they wished to do so to promote creative thinking.

Attentive listening: MT-BC sang "My Favorite Things," a song by Rogers and Hammerstein. MT-BC chose the song selection based on the song's lyrical content and asked subjects to identify and state how many times these themes were mentioned in the song: Animals, colors, weather related words, and clothing items. MT-BC also encouraged subjects to recreate the song substituting their own favorite things to promote creative thinking.

The in-person sessions with the music therapist were held before 2 of the choir rehearsals. The music therapist led the group in completing tasks similar to those presented on DVD. The live sessions allowed for subjects to express needs in regards to changing tempo or repeating tasks as needed to be successful. MT-BC also facilitated a discussion the subjects initiated about the ease vs difficulty of the tasks, utilizing the DVD/CD, and choral participation. Music therapy sessions also allowed time for discussion about the subjects' specific cognitive/mental/emotional experiences.

**Results:**

Nine patients were enrolled and six completed the intervention. A common reason expressed for not enrolling was a perceived inability to sing. All participants had a history of breast cancer; one patient also had a history of colon cancer. The average age was 54 (standard deviation 9.2), with a range in age from forty-three to seventy-two years. Eight of the nine were employed full time, and work conflict was the primary reason given for not completing the intervention. Seven of the nine had completed college or higher degrees and two were African American. The time since last chemotherapy treatment ranged from one to twenty-seven years.

The figure displays the average pre- and post-intervention cognitive assessment scores among the six participants who completed the intervention. A small improvement was observed in the overall neurocognitive index. No change was noted in visual memory and motor speed; psychomotor speed decreased. The remainder of the domains showed small improvements.

Participants who completed the intervention were asked to evaluate the program. Participants were asked about their preference for individual or group music therapy sessions, the number of time they practiced the exercises, and what they liked the most and least. General comments were also solicited. The comments are summarized below.

Participant B was treated with chemotherapy twice for two primary cancers; last chemotherapy was completed five years prior to the intervention. B stated "I loved the practices. I really found them therapeutic and cathartic. There is something about singing in a group that makes you live in exactly that moment and not worry about up-coming tests or past experiences." Participant B desired to have more time with the music therapist and found it hard to find time every day to watch the DVD. Participant B was able to use the DVD about two to three times and the CD five to six times over the intervention period.

Participant H completed chemotherapy one and a half years prior to the intervention. Participant H enjoyed the interaction with others and the DVD exercises which she did about two to four times per week during the intervention period. She had no preference about having individual or group sessions.

Participant Z completed her chemotherapy eight years prior to the intervention. Participant Z noted that the intervention "re-awakened music for me." She had played violin in the past but not recently. She found meeting new people and singing "stimulating." What she liked least was the distance that she had to travel to the rehearsals. She was not able to make it to the sessions with the music therapist but used the DVD about two to three times per week and the CD about three to five times per week. She found the CD most helpful, as she could listen to it in the car.

Participant O completed chemotherapy about ten years prior to the intervention and completed hormone therapy one year prior to the intervention. She liked the group sessions and having the CD; she had no preference regarding individual versus the group music therapy sessions. She was most challenged by the drum pattern exercise and reported doing the exercises about three times per week.

Participant G completed chemotherapy about twenty-seven years prior to the intervention. She liked the group meetings with the music therapist, choir rehearsals and the concert. She found memorizing the words challenging and liked that the least. She did the exercises about six times during the intervention period. She suggested future studies have both individual and group sessions with a music therapist.

Participant S reported serious problems with word finding and remembering driving directions. She was the only participant who returned to the chorus the following year. She enjoyed the singing and group interaction. S reported doing the exercises five times per week and suggested more sessions with the music therapist. During one of the sessions, she noted that she had less hesitancy with word finding.

**Discussion:**

Our patients' neurocognitive tests were consistent with impairments in domains commonly affected by chemotherapy, such as working memory, concentration, psychomotor speed and speech. [1, 11, 13]

Despite the widespread recognition of the adverse cognitive effects of chemotherapy, effective treatment remains elusive [18]. We embarked on this feasibility study based on evidence that active music therapy, such as choral or musical instrument training, may improve cognitive functioning of patients with early Alzheimer's disease. [14] [15] Recruitment was challenging. Anecdotally, many of those approached for recruitment were not interested in participating in a singing-based intervention. Thus, providing an instrument-based intervention in addition to singing should be considered as a means to broaden and increase recruitment and study participation. In addition, only six of the nine who enrolled completed the brief intervention. The primary reason for dropping out of the study was work conflicts. Thus, providing flexibility in terms of timing and location of the intervention may help to avoid dropouts. Individual sessions with a music therapist would provide more scheduling flexibility and may help in participant retention. However, the participants enjoyed the interaction provided with the group music therapy sessions, thus a combination of group and individual sessions may be the best approach. The choral part of the intervention was brief at only five sessions and was not specifically designed for this study. This study took advantage of an existing choral group that comes together over a brief period of time for a few rehearsals, and the time between study approval and commencing the intervention was short. A full-fledged study should have a specifically designed choral intervention that would target the critical cognitive domains, similar to our designed exercises, and should include a longer intervention period to maximize the potential impact on cognitive function.

Participants enjoyed the group music therapy sessions and desired more interaction with the music therapist. Providing the exercises in multiple formats helped with adherence but none reported doing daily practice. Future interventions should increase the frequency of in-person music therapy sessions. Reminder calls to increase home practice should be considered in designing future interventions. In addition, "virtual" meeting sessions could be considered as a means to maintain the intensity of the intervention while increasing accessibility.

The small sample size and brief intervention period prohibits drawing any conclusions regarding the impact of the music therapy intervention on cognitive functioning. It is encouraging that, on average, the participants had a small improvement in cognitive test scores; however, a "learning" effect from repeat testing cannot be ruled out. A randomized trial design would provide the best method to evaluate the impact of music therapy on CRCI.

In summary, an interactive music therapy intervention holds promise for the treatment of CRCI. Future studies should evaluate the role of music therapy for the prevention and treatment of CRCI.

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## Biographical Statements

Kathy J. Helzlsouer, M.D., M.H.S., is a medical oncologist and epidemiologist whose research focuses on cancer survivorship. Dr. Helzlsouer is an adjunct professor of epidemiology.

Kelly Phair, MT-BC is a board certified music therapist with a clinical focus on music therapy for cancer patients.

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## APPENDIX

**Table:** Description of the musical tasks and the targeted cognitive functions.

| Musical Task/Cognitive Functions Addressed | Task Description |
|---|---|
| Vocal Warm ups:<br>• Sustained attention<br>• Language<br>• Concentration | • Scales<br>• Humming<br>• Mah, Meh, Mee, Moh, Moo-then changed consonant<br>• Tongue twister |
| Physical movement warm up:<br>• Hand-eye coordination<br>• Sustained attention<br>• Processing speed<br>• Concentration<br>• Multitasking | • Stretching<br>• Repeating/mirroring 4 beat movements after watching therapist<br>• Repeating 4 beats of movement while watching therapist present the a different four beat movement |
| Learning unfamiliar song by rote<br>• Memory<br>• Language-word recall | • Therapist taught "Somebody Sang For Me" (African American Hymn) a cappella by phrases and combing phrases until the whole song was presented and sung in full. |
| Recreating rhythms<br>• Memory<br>• Comprehension<br>• Sustained attention<br>• Concentration | • Short 1-2 measure phrases of rhythm were presented and time allowed for subjects to repeat through instrument play or clapping.<br>• Phrases were lengthened up to three measures.<br>• Therapist utilized rhythms including half notes, quarter notes, eighth notes, rests, and syncopation<br>• Two segments were included with the second increasing in complexity |
| Combing rhythm recreation and singing<br>• Multi-tasking<br>• Memory<br>• Concentration | • Subjects were taught an ostinato rhythm (a rhythmic pattern that is repeated continuously)<br>• Subjects were instructed to repeat ostinato rhythm through drumming or clapping while also singing song they learned by rote. |
| Lyric recall/lyric substitution<br>• Language-word recall<br>• Executive functioning when creating new lyrics<br>• Memory | • Therapist presented/rehearsed song selection utilized in choir rehearsal (How can I keep from singing?-Traditional Quaker Hymn)<br>• Therapist repeated song, leaving some lyrics out. Subjects were instructed to fill in the missing lyrics.<br>• Subjects were also instructed to create their own lyrics while therapist played the tune. |
| Attentive listening<br>• Memory,<br>• Comprehension,<br>• Sustained attention,<br>• Language<br>• Executive functioning | • Therapist sang "My Favorite Things" and then instructed subjects: to<br>  • Name the animals mentioned the song<br>  • Name the colors mentioned in the song<br>  • Name weather related words in the song<br>  • Name clothing items mentioned in the song<br>• Subjects were also encouraged to recreate the song substituting their own favorite things. |

**Figure:** Average Pre- and Post-Intervention Cognitive Assessment Standardized Test Scores, n=6