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Exercise Technique Recall in Individuals Who Received Chemotherapy

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Exercise Technique Recall in Individuals Who Received Chemotherapy

By

Nicholas A. Holtzman

B.S., Southern Illinois University, 2010

A Research paper
Submitted in Partial Fulfillment of the Requirements for the
Master of Science Degree

Department of Kinesiology
in the Graduate School
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RESEARCH PAPER APPROVAL

EXERCISE TECHNIQUE RECALL IN INDIVIDUALS WHO RECEIVED CHEMOTHERAPY

By

Nicholas A. Holtzman

A Research Paper Submitted in Partial

Fulfillment of the Requirements

for the Degree of

Master of Science

In the field of Kinesiology

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CHAPTER 1

INTRODUCTION

Cancer treatment often involves invasive treatment procedures such as chemotherapy, radiation therapy and surgery. Individuals who undergo these therapies/procedures are often left with adverse side effects which frequently persist for months to years after the cessation of treatment (Avis, Crawford, & Manuel, 2005; Ganz, Desmond, & Leedham, 2002). These adverse effects can include chronic fatigue, weight gain, loss of muscle strength, insomnia, and an overall decrease in well-being and quality of life (Cancer Treatment Centers of America, 2008; deJong, Courtens, & Abu-Saad, 2002).

Another adverse effect of cancer treatment, "chemo brain" or "chemo fog" has recently begun to receive increased attention. Research shows that chemo brain affects the majority of individuals who receive chemotherapy, at least at a moderate level (~17-75%) (Cancer Treatment Centers of America, 2008; Myers, 2009). The severity of chemo brain varies based on a number of factors such as age, chemotherapy type, treatment dosage, and the elapsed time from treatment cessation (Hampton, 2008). Some investigations report changes so mild that cognitive tests look normal, while others report a significant difference in mental function (Cancer Treatment Centers of America, 2008). Researchers have used different tests to measure the symptoms of chemo brain and this may contribute to the varied range of impact as well.

Disorders associated with chemo-brain may include decreased executive function, and information-processing speed, impaired spatial and language skills, diminished

learning ability and memory capacity, and decreased motor function (Jansen, Miaskowsmki, Dodd, Sowling, & Kramer, 2005). In some instances, the first signs may be subtle and perceived as an almost imperceptible development of forgetfulness or loss of concentration. In other cases, patients experience a sudden onset of severe cognitive dysfunction many months after treatment has ceased (Hampton, 2008). Some researchers suggest that the drop in cognitive function actually happens before any chemotherapy occurs (Cimprich, et al., 2010); however, the majority of investigations have indicated that it begins after a single standard dose of chemotherapy treatment (Jamie & Myers, 2008).

Chemo brain was first documented in the 1970s but did not become well-known as a treatment-related symptom until the 1990's (Myers, 2009). Patients who perceive a defect in their cognitive ability may score within normal limits on existing measures of cognitive function (Wefel et al., 2004). This fact may help to explain why this issue has been overlooked for so long.

Exercise has been shown to elicit a wide variety of benefits for cancer patients, such as reduced risk of cancer recurrence and mortality, reduction in risk of other chronic diseases (osteoporosis, diabetes, cardiovascular disease, etc.), lower fatigue, and decreased levels of depression (Hayes, et al., 2009; Meyerhardt, et al., 2006). Exercise has been shown to elicit cognitive benefit in both apparently healthy and cognitively compromised populations. Older adults who experience cognitive decline similar to that noted with chemo brain have experienced exercise-related improvements in general cognitive function as well as executive functions, such as category fluency and tasks, such as trail making (Barella, Etnier, & Yu-Kai, 2010). Apparently healthy adults with no

diagnosis of cognitive dysfunction have experienced exercise-related improvements in memory, information processing ability, and executive function (van Uffelen, Chin, Hopman, & van Mechelen, 2008).

During and following cancer treatment caution is often advised when it comes to physical activity. Patients are normally told to “take it easy” and/or “get as much rest as possible”. This recommendation often translates into a sedentary lifestyle that can exacerbate the severity of treatment-related side-effects (Cancer Treatment Centers of America, 2008). It is certainly possible that a reduction in physical activity could intensify the impact of chemo brain on cognitive ability. Although cancer and cancer treatment may compound the effects of aging on mental acuity, regular exercise may elicit enhanced cognitive function in individuals when compared to their sedentary counterparts (Barella et al., 2010).

Participants in exercise interventions are frequently supervised by exercise trainers and instructed on proper exercise technique. When these interventions reach their conclusion, it is hoped that participants will continue to engage in regular exercise and utilize appropriate technique. While a number of studies have examined general exercise adherence following supervised interventions from an exercise session completion perspective (Courneya, et al., 2008; Courneya., et al., 2004; Courneya, & Friedenreich, 1997; Hayes, et al., 2009; Meyerhardt, et al., 2006; Nelson, et al., 2007), little research has investigated exercise technique recall in either apparently healthy or chronic disease populations.

Research in the area of exercise recall primarily examines the validity of the instruments used to measure recall of exercise after an injury. One such study evaluated

physical activity adherence recall following injury (Cunningham, 1994). Another study on exercise recall examined the validity of several different assessment tools used to measure previous physical activity in people with spinal cord injuries (Latime, Martin, Craven, & Hicks, 2006). These studies examine tools used to measure recall, such as surveys, questionnaires, and assessment tests; however, they neglect to include exercise technique as a part of their criteria.

Given the potential negative cognitive impact of chemo brain, it is possible that cancer patients who have received chemotherapy may be more compromised in their ability to recall appropriate exercise technique than those that have not received this treatment. This potential negative impact of chemotherapy treatment could have a potentially adverse effect on the safety and effectiveness of exercise programs that cancer patients engage in on their own. Information regarding exercise recall could potentially allow fitness professionals to determine if certain aspects of an intervention need to be emphasized to a greater degree to maximize safety and effectiveness. Such information would also potentially increase the degree to which individuals would be self-sufficient exercisers following program participation.

Statement of Purpose

The purpose of this study was to determine the level of exercise technique recall in cancer survivors who had participated in a 12-week exercise and nutrition course. This study examined exercise technique recall in general, but more specifically, it compared individuals who had received chemotherapy to individuals who had not received chemotherapy to investigate the effects of chemo brain on exercise technique recall. In addition, the study examined the impact of consistent exercise on recall following the

exercise and nutrition course. Finally, the study examined the impact of length of time since cessation of treatment on technique recall.

Hypotheses

- Mean recall for all participants combined will be less than 75% (little research exists in the area of exercise technique recall, so an arbitrary average number was selected to signify sufficient recall)
- Participants who did not receive chemotherapy will have a greater recall of the exercise techniques than those who did receive chemotherapy.
- Participants who received chemotherapy within the past five years will have significantly diminished recall when compared to participants whose chemotherapy treatments ceased more than five years prior to the study.
- Consistent exercisers who received chemotherapy will have greater recall of the exercise techniques than inconsistent exercisers.

CHAPTER 2

METHODS

Participants

Participants had all been members of the Strong Survivors program in a prior semester. Strong Survivors is a free 12-week exercise and nutrition course conducted at John A. Logan College for individuals who are either currently being treated for cancer or who have experienced cancer treatment in the past (cancer caregivers are welcome to participate). During the twelve weeks, participants learned proper exercise technique and healthy diet habits. Participants were instructed on the proper use of several different types of resistance exercise equipment including: dumbbells (1-25 lbs), a variety of variable resistance machine exercises, and resistance tubes of varying intensity. They also learned dynamic and slow/static stretches associated with warm-up and cool down procedures, respectively. Following their initial participation in Strong Survivors, a segment of these participants joined a post-Strong Survivors group called Survivors Forever and have participated in that program during at least one semester subsequent to their initial semester of participation. Survivors Forever are allowed to continue exercising during the scheduled Strong Survivors sessions, but are responsible for writing and executing their own exercise program. Participation in Survivors Forever features a significantly lower level of supervision from the Strong Survivors staff.

All participants in the Strong Survivor program have a medical history kept on file that was updated at the time of recruitment and then used to confirm that potential participants were free of any major disease that would inhibit their participation in the testing protocol. Exclusion criteria included the existence of any major chronic disease

beyond their cancer (cardiovascular, respiratory, metabolic or musculoskeletal). The severity of disease symptoms was evaluated on an individual basis and a determination was made on whether the symptomology would interfere significantly with study participation. No participants had any evidence of cognitive disorder independent of cancer treatment. Eighteen individuals qualified for study inclusion (16 female, 2 male; mean age 62.6) (more information on participant demographics can be found in appendix A).

Participant Groups

Participants were separated into 6 different groups for the purposes of data analysis. Group1 consisted of participants who underwent chemotherapy (11 female, 1 male; mean age 61.2). Group 2 consisted of participants who have not received chemotherapy (5 female, 1 male; mean age 58.3). Group 3 consisted of participants who had chemotherapy within the last 5 years (7 female, 0 male; mean age 63.5). Group 4 consisted of individuals who had received chemotherapy, but more than 5 years prior to participation in this study (4 female, 1 male; mean age 62.8). Group 5 was made up of participants who had exercised at least one day per week in the Survivors Forever program since their initial semester of participation in Strong Survivors (6 female, 2 male; mean age 63.0). Group 6 consisted of individuals who did not meet the criteria for Group 5 inclusion (10 female, 0 male; mean age 66.9) (Group 5 and 6 were made up of chemo and non-chemo subjects combined).

Data Collection Procedures

Participants initially received a letter or email describing the study. Follow-up calls or emails were made within two-three days of letter or email receipt. When participants arrived for testing, they were asked to sign an informed consent and were re-briefed on the testing procedures. The primary location for data collection was the Aerobics and Weight Training Center at John A. Logan College (where the majority of the exercise session took place during the Strong Survivors Program). A small portion (23%) of participants found the SIUC Cancer Rehabilitation Laboratory to be a more convenient location for testing. Participants were familiar with this location due to the pre and post assessments that took place there during initial Strong Survivors participation, so the impact on data collection was minimal.

All participants were asked to demonstrate basic exercise techniques they learned during the Strong Survivors course (see the Data Collection Form section below for a description of technique evaluation). All exercise techniques were commonly used during Strong Survivors workout sessions and should have been reasonably familiar to the participants. Participants were first asked to demonstrate a series of dynamic stretches. Next, the performance of six different resistance exercises was evaluated. These exercises included: incline bench press, wall ball squats, lat pull down, front raise, triceps press down, and bicep curl. Participants performed the resistance exercises with light resistance. Finally, the participants were asked to demonstrate a series of slow and static stretches. Once testing was complete, the researcher reviewed each exercise/stretch with the participant and made corrections on their technique, if necessary.

Data Collection Form

The data collection form was developed by the researcher for use in this study. Each exercise and stretch was evaluated on a variety of criteria. All criteria for each exercise and stretch were rated on a zero to six, Likert scale. A score of zero indicated that the participant did not meet that particular criteria properly or at all and a score of six indicated that the participant completed the criteria perfectly. To ensure consistency from test to test and participant to participant, a single researcher rated exercise technique in all participants. The data collection form can be found in Appendix B, but an example of the criteria and rating scale for the torso twist dynamic stretch is listed below.

Torso Twists

1.) Feet shoulder width apart

0 1 2 3 4 5 6

1.) Arms raised to chest level with elbows bent at 90 degree and upper arms parallel with floor

0 1 2 3 4 5 6

1.) Rotate side to side while back remains straight throughout motion

0 1 2 3 4 5 6

1.) Appropriate pace maintained

0 1 2 3 4 5 6

Data Analysis

A statistical software package (SPSS, Version 16 for windows, SPSS, Chicago,IL) was used to summarize data and to perform statistical procedures. Means and standard deviations were calculated and two tailed t-tests were used to determine if there were any significant differences between the group means. An alpha level of .05 was used to evaluate significance

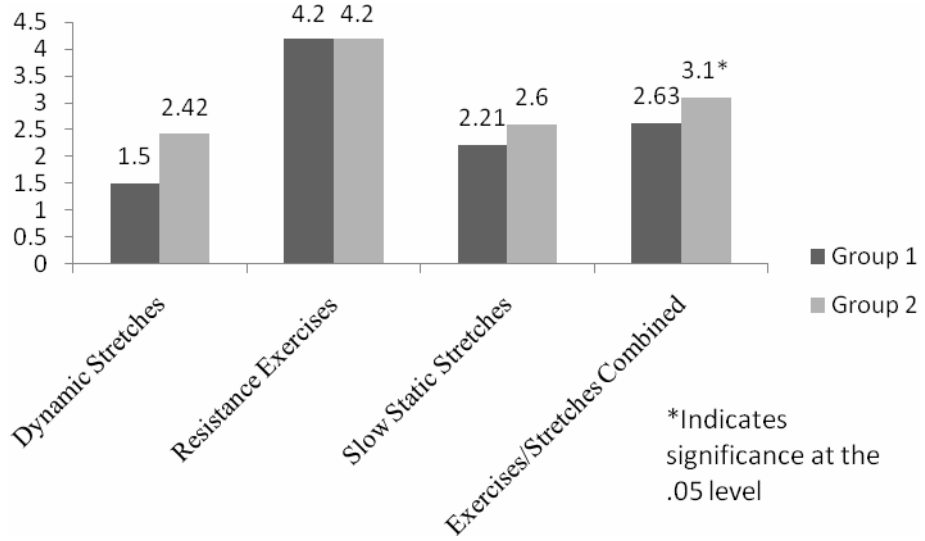
CHAPTER 3

RESULTS

For each figure below, group mean values were calculated for all of the dynamic stretches, resistance exercise and slow/static stretches combined. Total group mean values were then computed for all of the stretches and exercises combined. These values were then used in t-tests to evaluate significant differences between groups. The t-tests tables can be found in Appendix C. Individual values for each stretch and exercise for the individual groups and all of the groups combined can be found in Appendices D-F.

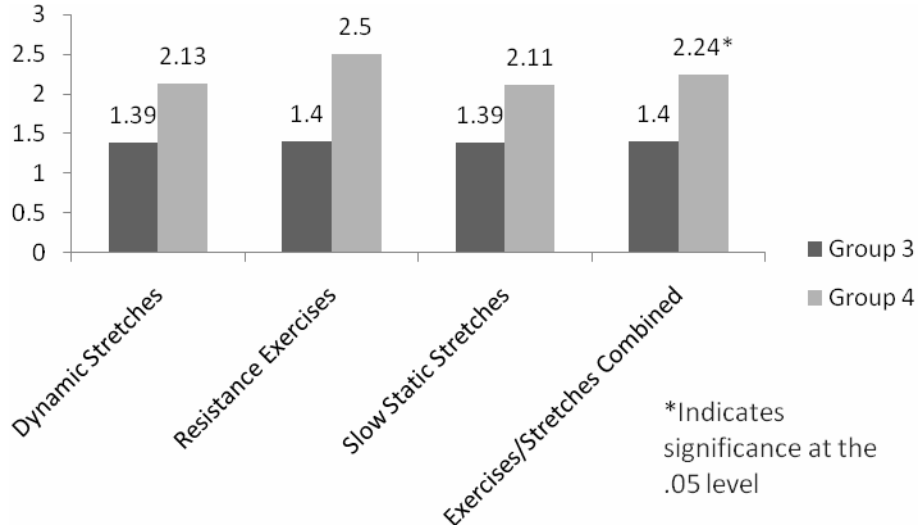
Participants who received chemotherapy (Group 1) had a total mean recall score of 2.63 out of six for the dynamic, resistance and slow static stretches combined. This is compared to Group 2 (no chemotherapy), who had a total mean recall score of 3.15 out of six (.45 difference). When analyzed with a t-test (Appendix C), the level of recall for individuals in Group 1 was considered to be significantly lower than Group 2 (p = .041).

Figure 1. **Mean Recall Values for Group 1 and 2 (Chemo & No Chemo)**



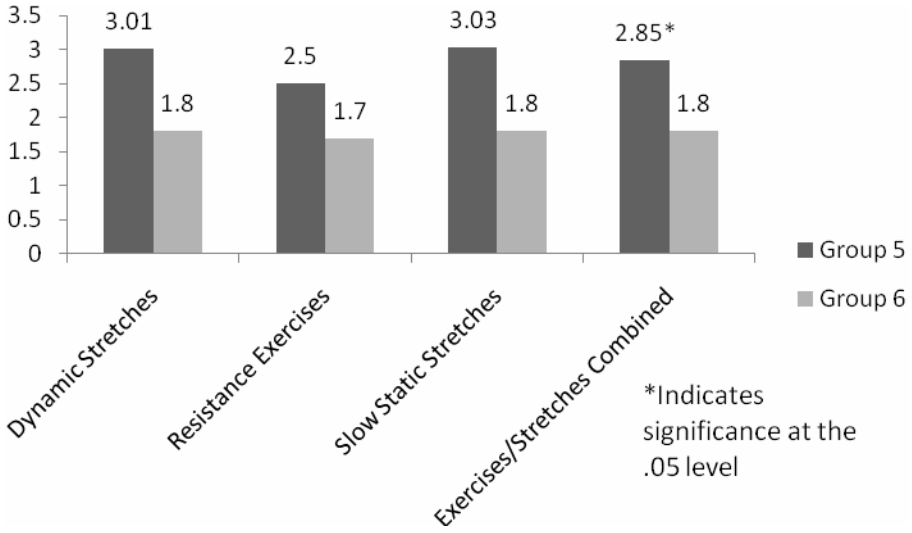
Individuals who had chemotherapy over five years ago (Group 4) had a total mean recall score of 2.23 out of six. Participants who received chemotherapy within the last five years (Group 3) had a total mean recall score of 1.40 out of six (.840 difference). When analyzed with a t-test (Appendix C), the level of recall for individuals in Group 4 was considered to be significantly greater than Group 3 (p = .001).

Figure 2. **Mean Recall Values for Group 3 and 4 (Recent Chemo & Non-Recent Chemo)**



Participants who continued to exercise consistently in the Survivors Forever program (Group 5) had a total mean recall score of 2.85 out of six. Participants who were not consistent exercisers (Group 6) after completion of the Strong Survivor program had a total mean recall score of 1.80 out of six (1.10 difference). When analyzed with a t-test (Appendix C), the level of recall for individuals in Group 6 was considered to be significantly lower than Group 5 (p = .03).

Figure 3. **Mean Recall Values for Group 5 and 6 (Consistent & Inconsistent Exercisers)**



CHAPTER 4

DISCUSSION

Technique Recall of All Participants Combined

The overall mean recall for all of the exercises and stretches combined for the entire group of participants was 2.01 out of six. This value computes to a 33.5% recall rate which is well below the 75% recall rate suggested in the first hypothesis. Without values from prior research in the field of exercise technique recall to compare to, it is difficult to interpret conclusions from this number; however, from a practical standpoint, this value seems to represent insufficient recall and seems to support the first hypothesis. From an exercise technique recall perspective, it seems apparent that a greater emphasis needs to be placed on proper exercise technique in the Strong Survivors program, regardless of chemotherapy treatment history.

There are a number of possible explanations for the apparent low overall recall. First, there may have been a lack of cognitive involvement during the warm up and cool down stretching period during the Strong Survivors exercise sessions. This part of the program is generally led by a Strong Survivor staff member and many of the participants simply mimic the actions of the stretching leader. It is possible that the participants may not feel that it is necessary to remember the warm up or cool down stretch procedures on their own.

Second, the average age of the participants in this study was 62. As discussed in Chapter 1, cognitive ability is known to decline with increasing age. The older age of this study population may have contributed to the lower level of recall independent of all other factors. It is possible that a younger group may have an increased level of recall. It

is important to note that the mean age of all of the sub-groups (1-6) were well matched, decreasing the likelihood that age contributed to any group differences in the sub-group analyses.

Third, the average amount of time that elapsed between participation in this study and graduation from the Strong Survivor program was 31 months. As stated in Chapter 2, a segment of the participants continued to exercise in the Survivors Forever program; however, this participation features a lower level of supervision from the Strong Survivors staff. In general, time away from the program may have caused individuals to forget exercise techniques. This may have been due, at least in part, to the fact that they may not receive the same level of feedback while exercising from the Strong Survivors staff compared to what they received during their initial participation.

Technique Recall of Group 1 and 2

The results of the Group 1 vs. 2 t-test analysis suggest that individuals who received chemotherapy may have slightly impaired exercise technique recall when compared with individuals who have not and this finding seems to support the second hypothesis. As stated in Chapter 1, individuals who have received chemotherapy treatment are prone to decreased executive function and information-processing speed, impaired spatial and language skills, diminished learning ability and memory capacity, and decreased motor function (Jansen, Miaskowsmki, Dodd, Sowling, & Kramer, 2005). Incidence of any of the issues, either individually or in concert, could have contributed significantly to the exercise recall issue in Group 1.

Technique Recall of Group 3 and 4

The results of the Group 3 vs. 4 t-test analysis suggest that individuals who received chemotherapy less than five years ago may not be able to recall everything learned while in the program in as much detail as participants who underwent chemotherapy at a time further in their past and this finding seems to support the third hypothesis. As stated in Chapter 1, the severity of chemo brain varies based on a number of factors including the elapsed time from treatment cessation (Cancer Treatment Centers of America, 2008). Chemo brain symptoms have also been shown decrease in severity over time (Cimprich, et al., 2010; Hampton, 2008). This phenomenon is consistent with severity reduction over time in a number of other side effects and may be due to gradual repair of nervous tissue damage. This factor may have contributed to the difference in recall between group 3 and 4.

Technique Recall of Group 5 and 6

The results of the Group 5 vs. 6 t-test analysis suggest consistent physical activity may aid recall in individuals regardless of chemotherapy status. This finding seems to support the fourth hypothesis. This finding is likely due, at least in part, to the benefit of continued exercise technique repetition, but also may point to general cognitive benefits resulting from improved physical fitness. As stated in Chapter 1, consistent physical activity in cancer survivors has been shown to indirectly affect cognitive function by influencing sleep quality, nutrition, disease states, anxiety, and depression (Hayes, et al., 2009).

Qualitative Observations/Suggestions Gathered During Data Collection

As data collection proceeded, many general qualitative observations were made by the researcher in reference to the participant's performance. It was observed that participants did not know the difference or the purpose for the warm up and cool down stretches. Participants would often complete both warm up and cool down stretches at the same time. When prompted to perform the cool down stretches learned while in the Strong Survivors program, most individuals adopted a blank expression, and stated that they "already did the stretches during the warm up" and asked if there was a difference between the two. In many cases, participants were asked to perform both warm up and cool down stretches at the same time. This was done to streamline the procedures and to decrease participant's anxiety when unable to differentiate between the two protocols. These observations, combined with the data regarding dynamic and slow/static stretch recall, seems to indicate that more attention should be paid to these aspects of program instruction.

After the participants completed all of the data collection procedures (warm up/cool down stretches and six resistance exercises), they were asked to give suggestions to help other individuals remember the warm up and cool down procedures. Suggestions included; making a song, limerick, rhymes, having participants in the class lead warm up and cool down stretches, creating a list of top 5 stretches for cool down and warm up and, emphasizing the importance of the different stretches during the class.

During the resistance exercise recall portion of the study, participants were handed a clipboard and asked to perform the different exercises listed on it. Many

participants were unable to find the proper exercise equipment. To ease the anxiety of the participants and to streamline the data collection process, participants were led to the exercise equipment that they would be using. After being shown the proper exercise equipment, the majority of the participants were then able to complete the six exercises with varying levels of success.

Suggestions from the participants were also recorded for the six different resistance exercises. Participants suggested that they be allowed to make up their own names for the exercise equipment. As one participant said "I don't know the difference between the biceps and the triceps, but I know how to use this machine." If allowed to make up their own names for exercise equipment when prompted, participants may be able to find the exercise equipment more quickly, but may not know the proper muscle group being used.

Potential Limitations

There are a number of other possible limitations that may have influenced the results of this study. First, the small sample size in the study groups limits the ability to generalize the results to the general population of cancer patients. The group size may have also limited the ability to see a greater significant difference between the groups.

Second, the participant numbers in each group were less balanced than ideal. For example, Group 1 contained twelve participants whereas Group 2 contained six. This discrepancy is reflective of the overall chemo vs. no-chemo breakdown of the Strong Survivors participant population, but it may have contributed further to the decreased ability to find a larger significant difference between groups. Also, it increases the chance that moderate outliers may impact the group mean.

Third, it is possible that participants may not have had improper exercise technique corrected on a regular basis during their Strong Survivors participation. The Strong Survivors staff is instructed on consistent technique for exercise instruction, but variation remains from trainer to trainer and this could affect the overall consistency of instruction from participant to participant. Also, there is a significant age difference between the participants and the trainers (~60 vs. ~20) and this may cause some trainers to be somewhat reticent about correcting the technique of the participants. Regardless of reason, a lack of correction on technique could have significantly impacted the ability of the participants to recall technique accurately. It is also possible that the degree of emphasis placed on each exercise and stretch may have varied from trainer to trainer as well.

Fourth, the wide range of time that elapsed from initial chemotherapy treatment to participation in this study may have been a factor as stated earlier it is thought that chemo brain symptoms lessen over time (Cimprich, et al., 2010; Hampton, 2008). In the "time from chemotherapy" analysis, the range of ≤ 5 years from chemo treatment in Group 3 is fairly wide and the range in Group 4 (> 5 years) is even wider. Although a significant difference between Group 3 and 4 was detected, utilizing groups with elapsed time from chemo treatment ranges that are lower would allow researchers to draw more concrete conclusions about the impact of this factor on exercise technique recall.

Finally, the type and dosage of chemotherapy treatment received was widely varied. Treatments included alkylating agents, antitumor antibiotics, topoisomerase inhibitors and antimetabolites. All of these treatments control the growth of cancer but do so in different ways. Although it has not been studied specifically, it is possible that these

treatments elicit varying effects on cognitive ability. Larger treatment dosages are likely to trigger a greater cognitive impact and the wide range of dosage observed in this study makes it more difficult to draw definitive conclusions regarding the chemotherapy-related analyses.

CHAPTER 5

SUMMARY, CONCLUSION, RECOMMENDATION

Within the field of cancer treatment there is a growing interest in the role of exercise in enhancing the quality of life of cancer survivors. Studies have looked at the effects of exercise on biomarkers of disease and cancer recurrence, as well as other chronic diseases in cancer survivors (Courneya et al., 1997). Until recently many people undergoing cancer treatment have been told to get plenty of rest and "take it easy" (Cancer Treatment Centers of America, 2008). Recent studies on exercise and cancer treatment suggest that this is not an effective strategy. Consistent exercise has been shown to increase cancer survivor's quality of life and well being as well as decrease their risk of other chronic diseases (Barella, et al., 2010). Despite this information, many cancer survivors are limited in their ability to participate in exercise programs. This may be due partly to the cost of gym memberships and trainers as well as exercise therapy for cancer survivors is not covered by major insurance companies. Cancer survivors have to pay for treatment as well as any exercise therapy themselves which is a financial burden that many people cannot afford.

Although, the initial aim of this study was to look at the effects of chemo brain in cancer survivors, this investigation also gives insight to what could be changed within the Strong Survivors instructional practices. The overall scores for all participants were as follows: dynamic stretches: 1.79/6 (29.9%); resistance exercises: 4.15/6 (69.2%); slow/static stretches: 2.36/6 (39.2%) procedures. It is important that all of the techniques tested receive more attention during instruction, but the warm-up and cool down procedures are of particular concern. A greater emphasis on proper exercise technique

instruction needs to be imposed to increase the quality of the program from both a safety and effectiveness standpoint. Follow-up re-training during Survivors Forever participation could be incorporated to help strengthen recall of proper exercise technique.

Although this study was small in scope, the significant differences noted indicate that this study should be repeated on a larger population. To strengthen the results of future investigations, care should be taken to decrease the limitations noted earlier. Future research could contribute a greater depth of knowledge and help cancer survivors cope better with the cognitive issues that accompany chemo brain.

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APPENDICES

Appendix A

Participant demographics

Sex		Mean	N	Maximum	Minimum
Female	Age	62.8750	16	81.00	53.00
	Time elapsed (months) since graduation from the Strong Survivors Program	30.5000	16	61.00	3.00
Male	Age	60.5000	2	66.00	55.00
	Time elapsed (months) since graduation from the Strong Survivors Program	35.0000	2	59.00	11.00
Total	Age	62.6111	18	81.00	53.00
	Time elapsed (months) since graduation from the Strong Survivors Program	31.0000	18	61.00	3.00

Appendix B

Warm UP

Arms above head

1.) Arms start in "touchdown" formation
0 1 2 3 4 5 6

1.) Feet shoulder width apart
0 1 2 3 4 5 6

1.) Back remains straight throughout motion
0 1 2 3 4 5 6

1.) Arms remain over head throughout upward motion until straightened
0 1 2 3 4 5 6

1.) Return arms to starting "touchdown" position
0 1 2 3 4 5 6

1.) Minimal body movement other than arms
0 1 2 3 4 5 6

1.) Appropriate pace maintained
0 1 2 3 4 5 6

Front Push

1.) Hands at chest level with elbows at 90 degree angle with lower arms parallel with floor
0 1 2 3 4 5 6

1.) Feet shoulder width apart
0 1 2 3 4 5 6

1.) Hands/arms push away at same time until elbows are straight
0 1 2 3 4 5 6

1.) Return hands to chest with elbows at 90 degree angle with lower arms parallel with floor
0 1 2 3 4 5 6

1.) Minimal body movement apart from arms
0 1 2 3 4 5 6

1.) Appropriate pace maintained
0 1 2 3 4 5 6

Windmill

1.) Arms start at sides
0 1 2 3 4 5 6

1.) Feet shoulder width apart
0 1 2 3 4 5 6

1.) Raise arms in opposite directions (forward and backward) until parallel with floor
0 1 2 3 4 5 6

1.) As motion continues don't stop arms in start position, but continue to swing until parallel with floor on opposite side
0 1 2 3 4 5 6

1.) Minimal body movement other than arms
0 1 2 3 4 5 6

1.) Appropriate pace maintained
0 1 2 3 4 5 6

Knee Lift

1.) Feet shoulder width apart

0 1 2 3 4 5 6

1.) Use of stable object for balance maintenance

0 1 2 3 4 5 6

1.) Raise knee up as high as possible

0 1 2 3 4 5 6

1.) Return leg to starting position

0 1 2 3 4 5 6

1.) Back remains straight throughout motion

0 1 2 3 4 5 6

1.) Appropriate pace maintained

0 1 2 3 4 5 6

Leg Pendulum

1.) Use of stable object for balance maintenance

0 1 2 3 4 5 6

1.) Weight shifted to plant foot

0 1 2 3 4 5 6

1.) Leg opposite of plant foot swings back and forth with knee remaining straight throughout motion

0 1 2 3 4 5 6

1.) Leg swings as far forward & backwards as possible

0 1 2 3 4 5 6

1.) Back remains straight throughout motion

0 1 2 3 4 5 6

1.) Appropriate pace maintained

0 1 2 3 4 5 6

Torso Twists

1.) Feet shoulder width apart

0 1 2 3 4 5 6

1.) Arms raised to chest level with elbows bent at 90 degree and upper arms parallel with floor

0 1 2 3 4 5 6

1.) Rotate side to side while back remains straight throughout motion

0 1 2 3 4 5 6

1.) Appropriate pace maintained

0 1 2 3 4 5 6

Calf Raises

1.) Use of stable object for balance maintenance

0 1 2 3 4 5 6

1.) Feet shoulder width apart

0 1 2 3 4 5 6

1.) Rise up onto toes with heels off the ground

0 1 2 3 4 5 6

1.) Heels return to the floor

0 1 2 3 4 5 6

1.) Appropriate pace maintained

0 1 2 3 4 5 6

Half Squats

1.) Use of stable object for balance maintenance

0 1 2 3 4 5 6

1.) Feet shoulder width apart

0 1 2 3 4 5 6

1.) Lower buttocks half way to full squat position with weight on heels

0 1 2 3 4 5 6

1.) Knees don't extend past shoe laces during squatting motion

0 1 2 3 4 5 6

1.) Stick buttocks out during squatting motion

0 1 2 3 4 5 6

1.) Appropriate pace maintained

0 1 2 3 4 5 6

Total Points out of 300

_____

Resistance Exercises

Incline Bench

1.) Feet flat on floor with no arch in the back throughout motion

0 1 2 3 4 5 6

1.) Dumbbells at chest level initially with elbows at 90 degree angle and upper arms parallel with floor

0 1 2 3 4 5 6

1.) Weights moved straight away from chest during motion

0 1 2 3 4 5 6

1.) Focus straight above, not at chest (no tucking of chin)

0 1 2 3 4 5 6

1.) Appropriate pace maintained

0 1 2 3 4 5 6

1.) Appropriate breathing maintained

0 1 2 3 4 5 6

Wall Ball Squats

1.) Feet slightly wider than shoulder width and 3-4 feet away from wall (depending on height)

0 1 2 3 4 5 6

1.) Body angled slightly against the wall with ball behind the lower back

0 1 2 3 4 5 6

1.) Body lowered to squat position

0 1 2 3 4 5 6

1.) Knees do not go over shoe laces when going down to squat position

0 1 2 3 4 5 6

1.) Back remains straight throughout motion

0 1 2 3 4 5 6

1.) Focus straight ahead and not on feet

0 1 2 3 4 5 6

1.) Appropriate pace maintained

0 1 2 3 4 5 6

1.) Appropriate breathing maintained

0 1 2 3 4 5 6

Triceps Press down Machine

1.) Feet shoulder width apart or staggered

0 1 2 3 4 5 6

1.) Elbows snug to the body at all times throughout motion

0 1 2 3 4 5 6

1.) Arms are straightened at end of concentric phase

0 1 2 3 4 5 6

1.) Straight back maintained throughout motion (no leaning over the weight)

0 1 2 3 4 5 6

1.) Eccentric motion stops when lower arms are parallel to the floor

0 1 2 3 4 5 6

1.) Focus straight ahead and not on hands

0 1 2 3 4 5 6

1.) Appropriate pace maintained

0 1 2 3 4 5 6

1.) Appropriate breathing maintained

0 1 2 3 4 5 6

Bicep Curl with Resistance Tube

1.) Standing with feet shoulder width apart

0 1 2 3 4 5 6

1.) Elbows snug to side throughout motion

0 1 2 3 4 5 6

1.) Band hooked under feet appropriately

0 1 2 3 4 5 6

1.) Palms facing toward body

0 1 2 3 4 5 6

1.) Hands raised to chest level and returned to starting position

0 1 2 3 4 5 6

1.) Back remains straight throughout motion

0 1 2 3 4 5 6

1.) Focused straight ahead not at waist or weights

0 1 2 3 4 5 6

1.) Appropriate pace maintained

0 1 2 3 4 5 6

1.) Appropriate breathing maintained

0 1 2 3 4 5 6

Lat Pull down Machine

1.) Seat adjusted so no vertical movement is seen in the legs when raising or lowering weight
0 1 2 3 4 5 6
1.) Weight lowered to starting position with arms extended
0 1 2 3 4 5 6
1.) Bar pulled down to middle of the chest at end of concentric phase
0 1 2 3 4 5 6
1.) Shoulder blades squeezed together at end of concentric phase
0 1 2 3 4 5 6
1.) Weight returned though eccentric phase back to start position with no vertical movement of the buttocks or legs
0 1 2 3 4 5 6
1.) Appropriate pace maintained
0 1 2 3 4 5 6
1.) Appropriate breathing maintained
0 1 2 3 4 5 6

Front raise

1.) Feet shoulder width apart
0 1 2 3 4 5 6
1.) Arms at sides in start position
0 1 2 3 4 5 6
1.) Palms face toward body
0 1 2 3 4 5 6
1.) Raise dumbbells though concentric phase until arms are parallel with ground
0 1 2 3 4 5 6
1.) Elbows remain straight during both concentric and eccentric phase
0 1 2 3 4 5 6
1.) Back remains straight throughout motion
0 1 2 3 4 5 6
1.) Appropriate pace maintained
0 1 2 3 4 5 6
1.) Appropriate breathing maintained
0 1 2 3 4 5 6

Total Points out of 282

_____

Cool Down

Hand Cuffs

1.) Feet shoulder width apart
0 1 2 3 4 5 6
1.) Grab wrist with opposite hand behind back
0 1 2 3 4 5 6
1.) Slowly moves arm up as far back as possible while elbows remain straight
0 1 2 3 4 5 6
1.) Stretch slowly for 10 seconds
0 1 2 3 4 5 6
1.) Hold for 10 seconds
0 1 2 3 4 5 6
1.) Appropriate breathing maintained
0 1 2 3 4 5 6

Side lean

1.) Feet shoulder width apart
0 1 2 3 4 5 6
1.) Hands on elbows while arms are above head
0 1 2 3 4 5 6
1.) Lean laterally
0 1 2 3 4 5 6
1.) Stretch slowly for 10 seconds
0 1 2 3 4 5 6
1.) Hold for 10 seconds
0 1 2 3 4 5 6
1.) Complete stretch on both sides of the body
0 1 2 3 4 5 6
1.) Appropriate breathing maintained
0 1 2 3 4 5 6

Wall-Chest

1.) Feet shoulder width apart

0 1 2 3 4 5 6

1.) Palm & elbow touching the wall

0 1 2 3 4 5 6

1.) Straight back maintained throughout motion

0 1 2 3 4 5 6

1) Turn body away from hand/elbow

0 1 2 3 4 5 6

1.) Stretch for 10 seconds

0 1 2 3 4 5 6

1.) Hold for 10 seconds

0 1 2 3 4 5 6

1.) Complete stretch on both sides of the body

0 1 2 3 4 5 6

1.) Appropriate breathing maintained

0 1 2 3 4 5 6

Wall-Arm

1.) Feet shoulder width apart

0 1 2 3 4 5 6

1.) Palm placed against the wall with arm straight

0 1 2 3 4 5 6

1.) Straight back maintained throughout motion

0 1 2 3 4 5 6

1) Turn body away from hand

0 1 2 3 4 5 6

1.) Stretch for 10 seconds

0 1 2 3 4 5 6

1.) Hold for 10 seconds

0 1 2 3 4 5 6

1.) Complete stretch on both sides of the body

0 1 2 3 4 5 6

1.) Appropriate breathing maintained

0 1 2 3 4 5 6

Arm Across

1.) Feet shoulder width apart

0 1 2 3 4 5 6

1.) With one hand, grab and pull wrist of opposite arm so opposite arm reaches across the body

0 1 2 3 4 5 6

1.) Stretch for 10 seconds

0 1 2 3 4 5 6

1.) Hold for 10 seconds

0 1 2 3 4 5 6

1.) Complete stretch on both sides of the body

0 1 2 3 4 5 6

1.) Appropriate breathing maintained

0 1 2 3 4 5 6

Calf

1.) Palms flat against the wall

0 1 2 3 4 5 6

1.) Staggered foot placement with forward leg bent and back leg straight

0 1 2 3 4 5 6

1.) Both heels flat on floor initially (front heel may come off the floor during the stretch)

0 1 2 3 4 5 6

1.) Reach/lean in to push wall

0 1 2 3 4 5 6

1.) Stretch for 10 seconds

0 1 2 3 4 5 6

1.) Hold for 10 seconds

0 1 2 3 4 5 6

1.) Complete stretch on both sides of the body

0 1 2 3 4 5 6

1.) Appropriate breathing maintained

0 1 2 3 4 5 6

Quad

1.) Use of stable object for balance maintenance

0 1 2 3 4 5 6

1.) Grab ankle, shoe, sock of leg being stretched

0 1 2 3 4 5 6

1.) Back remains straight throughout motion

0 1 2 3 4 5 6

1.) Stretch for 10 seconds

0 1 2 3 4 5 6

1.) Hold for 10 seconds

0 1 2 3 4 5 6

1.) Complete stretch on both sides of the body

0 1 2 3 4 5 6

1.) Appropriate breathing maintained

0 1 2 3 4 5 6

Seated Hamstring stretch

1.) Sit on front edge of chair or bench

0 1 2 3 4 5 6

1.) One knee bent with opposite leg straight, resting on heel (toes pointed upward)

0 1 2 3 4 5 6

1.) Slowly bend forward at hips trying to touch toe or go beyond toe with fingers

0 1 2 3 4 5 6

1.) Stretch for 10 seconds

0 1 2 3 4 5 6

1.) Hold for 10 seconds

0 1 2 3 4 5 6

1.) Complete stretch on both sides of the body

0 1 2 3 4 5 6

1.) Appropriate breathing maintained

0 1 2 3 4 5 6

Total Points out of 236

_____

Appendix C

Table 1

One-Sample t-test Comparing Group 1 and 2 Total Exercise/Stretch Means

	Test Value = 0.4148					
					95% Confidence Interval of the Difference	
	t	df	Sig. (2-tailed)	Mean Difference	Lower	Upper
Group 1	2.725	2	.112	2.21697	-1.2830	5.7170
Group 2	4.790	2	.041	2.67100	.2716	5.0704

Table 2

One-Sample t-test Comparing Group 3 and 4 Total Exercise/Stretch Means

	Test Value = 0.7389					
					95% Confidence Interval of the Difference	
	t	df	Sig. (2-tailed)	Mean Difference	Lower	Upper
Group 3	40.510	2	.001	.65897	.5890	.7290
Group 4	12.773	2	.006	1.50037	.9949	2.0058

Table 3

One-Sample t-test Comparing Group 5 and 6

	Test Value = 1.0422					
					95% Confidence Interval of the Difference	
	t	df	Sig. (2-tailed)	Mean Difference	Lower	Upper
Group 5	9.804	2	.010	1.80727	1.0141	2.6004
Group 6	18.313	2	.003	.73373	.5613	.9061

Appendix D

Technique Recall Results For Group 1 and 2

	Group 2 (No Chemo)			Group 1 (Chemo)		
	Mean	Std. Deviation	N	Mean	Std. Deviation	N
Arms Above Head	2.6883	3.00593	6	2.6000	2.45220	12
Front Push	3.8600	3.00759	6	1.8542	2.36998	12
Windmill	1.8883	2.93306	6	1.1717	2.18266	12
Knee Lift	2.4717	2.70829	6	1.0275	2.03537	12
Leg Pendulum	3.8333	2.99444	6	1.9433	2.87141	12
Torso Twist	1.4583	2.26062	6	1.3958	2.11987	12
Calf Raises	1.4000	2.29783	6	1.4167	2.23925	12
Half Squats	1.7483	2.05205	6	.4300	1.48956	12
Incline Bench	4.7500	2.33987	6	4.9292	1.68690	12
Wall Squats	3.6233	2.84930	6	4.0517	2.13174	12
Triceps Press Down	4.8733	1.20395	6	4.6550	1.17801	12
Bicep Curl	4.7750	1.00079	6	5.1842	1.67722	12
LatPull Down	4.0700	2.20267	6	3.6517	2.36114	12
Front Raise	2.4983	2.76048	6	2.5933	2.76249	12
Hand Cuffs	1.5267	2.36564	6	1.5958	2.06133	12
Side Lean	.3567	.87365	6	1.1775	2.13633	12
Wall Chest	2.4350	2.67209	6	1.4258	2.23179	12
Wall Arm	3.3117	2.58279	6	2.7800	2.50957	12
Arm Across	3.2200	2.55111	6	1.7900	2.27212	12
Calf Stretch	4.2067	2.20488	6	2.1050	2.36472	12
Quad Stretch	2.6633	2.91798	6	3.1642	2.44324	12
Seated Hamstring	3.4500	2.71554	6	3.6633	1.97987	12

Appendix E
Technique Recall Results for Group 3 and 4

	Group 3 (Chemo > 5 Yrs. Ago)			Group 4 (Chemo ≤ 5 Yrs. Ago)		
	Mean	N	Std. Deviation	Mean	N	Std. Deviation
Arms Above Head	2.8250	7	2.64104	2.3850	5	2.61094
Front Push	2.6490	7	2.89717	2.3650	5	2.59685
Windmill	2.0560	7	2.74239	.6038	5	1.70766
Knee Lift	2.2660	7	2.58135	.5625	5	1.59099
Leg Pendulum	3.4490	7	2.98270	1.4788	5	2.73849
Torso Twist	1.6000	7	2.08899	1.1875	5	2.23507
Calf Raises	1.0800	7	1.89315	1.8250	5	2.58664
Half Squats	1.0490	7	1.77609	.6450	5	1.82434
Incline Bench	5.0990	7	1.81923	4.5825	5	1.99404
Wall Squats	3.8240	7	2.20502	4.0150	5	2.60199
Triceps Press Down	4.6240	7	1.18697	4.8575	5	1.18205
Bicep Curl	5.0310	7	.84638	5.0688	5	2.07598
LatPull Down	3.8840	7	2.27380	3.6750	5	2.37720
Front Raise	2.9490	7	2.59990	2.0775	5	2.87530
Hand Cuffs	2.6150	7	2.26612	.2700	5	.76368
Side Lean	.6990	7	1.60610	1.1600	5	2.15651
Wall Chest	2.5230	7	2.68669	.8112	5	1.53884
Wall Arm	3.3240	7	2.35712	2.4988	5	2.69209
Arm Across	2.3480	7	2.51497	2.1650	5	2.40337
Calf Stretch	3.0610	7	2.70028	2.4862	5	2.28019
Quad Stretch	2.6540	7	2.79865	3.4262	5	2.27086
Seated Hamstring	3.5690	7	2.55061	3.6212	5	1.75698

A

Appendix F
Technique Recall Results For Group 5 and 6

	Group 5 (Inconsistent Exerciser)			Group 6 (Consistent Exerciser)		
	Mean	N	Std. Deviation	Mean	N	Std. Deviation
Arms Above Head	2.0630	10	2.30511	3.3375	8	2.83636
Front Push	1.6650	10	2.21002	3.5950	8	2.99030
Windmill	.3400	10	1.07517	2.7488	8	2.95880
Knee Lift	1.2830	10	2.27371	1.7913	8	2.47589
Leg Pendulum	1.1660	10	2.45945	4.3325	8	2.69426
Torso Twist	1.5500	10	2.01660	1.2500	8	2.32993
Calf Raises	.7200	10	1.61988	2.2750	8	2.59656
Half Squats	.0000	10	.00000	1.9562	8	2.24896
Incline Bench	4.4820	10	2.38188	5.3538	8	.78992
Wall Squats	3.1990	10	2.40775	4.7962	8	1.99284
Triceps Press Down	4.4490	10	1.34682	5.0762	8	.81321
Bicep Curl	4.8210	10	1.89631	5.3312	8	.66551
LatPull Down	3.6400	10	2.06093	3.9800	8	2.60611
Front Raise	2.9990	10	2.64536	2.0150	8	2.79790
Hand Cuffs	1.9310	10	2.14678	1.1250	8	2.08310
Side Lean	1.1270	10	1.93561	.6250	8	1.76777
Wall Chest	1.3360	10	2.16511	2.2950	8	2.62643
Wall Arm	2.2750	10	2.44509	3.8100	8	2.37498
Arm Across	1.1820	10	1.94508	3.6225	8	2.29866
Calf Stretch	2.3240	10	2.50941	3.4075	8	2.43764
Quad Stretch	2.0130	10	2.62342	4.2275	8	1.90877
Seated Hamstring	2.3400	10	2.15525	5.1575	8	.66381

Appendix G

Technique Recall Results For All Participants Combined

	N	Minimum	Maximum	Mean	Std. Deviation
Arms Above Head	18	.00	6.00	2.6294	2.55936
Front Push	18	.00	6.00	2.5228	2.69101
Windmill	18	.00	6.00	1.4106	2.39451
Knee Lift	18	.00	5.83	1.5089	2.30838
Leg Pendulum	18	.00	6.00	2.5733	2.96863
Torso Twist	18	.00	5.50	1.4167	2.10042
Calf Raises	18	.00	6.00	1.4111	2.19032
Half Squats	18	.00	5.16	.8694	1.75589
Incline Bench	18	.00	6.00	4.8694	1.85988
Wall Squats	18	.00	6.00	3.9089	2.31763
Triceps Pres Down	18	2.62	6.00	4.7278	1.15563
Bicep Curl	18	.00	6.00	5.0478	1.46772
LatPull Down	18	.00	6.00	3.7911	2.25289
Front Raise	18	.00	6.00	2.5617	2.67980
Hand Cuffs	18	.00	4.66	1.5728	2.09678
Side Lean	18	.00	5.00	.9039	1.82651
Wall Chest	18	.00	6.00	1.7622	2.35851
Wall Arm	18	.00	5.50	2.9572	2.47056
Arm Across	18	.00	5.66	2.2667	2.39495
Calf Stretch	18	.00	5.62	2.8056	2.46727
Quad Stretch	18	.00	5.57	2.9972	2.53493
Seated Hamstring	18	.00	6.00	3.5922	2.17163
Valid N	18				

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