Challenges in Fibromyalgia Management: A study of anxiety, depression, and motivation using distance learning and social networking

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An Applied Dissertation Submitted to the
School of Health Management
In Partial Fulfillment of the Requirements for the
Degree of Doctor of Health Education

A. T. Still University
February 7, 2010

School of Health Management Approval of the Applied Dissertation

Approval Page

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Acknowledgements

I thank my dissertation committee and readers for their insight, assistance, critical review, and guidance. I thank Dr. Patricia Sexton, my dissertation chairperson, who has been a significant mentor during this process.

I thank my fellow classmates for their willingness to provide critical peer-reviews and a sense of community. My dissertation journey has been enriched with their support.

I thank my parents, Lawrence and Tina, and my partner, Matthew, who sacrificed much to allow this pursuit. Without their understanding, love, and support, I could not have been successful.

This work is dedicated to those living with fibromyalgia, who live each and every day feeling pain or fatigue.

Abstract

Patients with fibromyalgia have difficulty managing symptoms (e.g., fatigue, chronic pain). The challenges in fibromyalgia management may vary from patient to patient, from painful physical exercise to pharmaceutical side-effects. Since the management of fibromyalgia greatly varies, there seems to be an individualist or personal component to symptom management in this patient population.

Perhaps, the riddle of fibromyalgia management may be solved by realizing that a golden method for the patient population does not exist. Health professionals have had a marginal effect on fibromyalgia management with participants in health education programs (Alvarez, et al., 2009), even when using a multimodal curriculum. The struggle for finding a golden method for fibromyalgia management may be a result of cost and population dynamics (e.g., pain disrupting schedule). It is important for health educators to devise cost-effective and practical tools for the fibromyalgia population.

This study details a solution for fibromyalgia symptom management health education. In this study, a distance learning environment was used to deliver a health education course using social networking. The distance learning model resolves issues related to population dynamics. A free social networking site was used for discussion boards, course material distribution, and communication (e.g., email, chat). Therefore, this study used a no-cost solution for health educators assisting fibromyalgia patients.

This approach to the health education of fibromyalgia patients enables the patient population to learn asynchronously (e.g., discussion boards) or synchronously (e.g., chat) without cancelling participation due to pain or fatigue. The Beck Anxiety Inventory was administered before and after the health education course. The results of this study showed that distance learning correlates with improved anxiety levels, demonstrating that a clinical outcome may be obtained via distance learning. The Beck Depression Inventory was administered before and after the health education course. Results were inconclusive. In order to assess the various population dynamics, intensive interviews were conducted upon completion of the course. The qualitative data was analyzed using the grounded theory methodology.

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Chapter One: Introduction

Humankind has searched for methods to extend life for thousands of years. The famous story of Juan Ponce de León and the fountain of youth have mystified the masses with the possibility of eternal youth. Centuries later, the pursuit of reversing the ageing process continues to be sought by millions.

According to the Cosmetic Surgery National Data Bank, approximately 11.7 million cosmetic procedures were performed in the United States during 2007 (The American Society for Aesthetic Plastic Surgery, 2008). The Cosmetic Surgery National Data Bank states that about two million cosmetic procedures were performed in 1997 (The American Society for Aesthetic Plastic Surgery, 2008). Facial procedures were among the top five cosmetic surgical procedures in both men and women in 2007(The American Society for Aesthetic Plastic Surgery, 2008). This data suggests that the quest for a youthful appearance is evermore prevalent and continuing to rise.

The goal of becoming young is not obtained through cosmetic procedures, because physiological ageing and chronological ageing remain separate. This concept is best captured by the story of the Greek mythological figure Tithonus, who asked the Godess Aurora for eternal life, but not eternal youth (Tennyson, 1963). As a consequence to a lexical error, Tithonus becomes immortal, but ages forever. While some cosmetic procedures provide an aesthetically youthful appearance, these procedures fall short of capturing youth.

Ageing is defined a multitude of ways. Chronological age, biological age, and psychological age are the three major concepts of ageing (Merck Medical Library,

2000). Chronological age refers to the number of years since birth. Psychological age refers to how old one feels. Biological age is a more complex concept of ageing.

Biological age, or physiological age, assesses ageing in terms of the standard changes that take place as a result of the ageing process (Merck Medical Library, 2004) using measures of physiological function. These physiological indicators, or biomarkers, involve biological parameters that are related to and may provide information on the ageing process (Nakamura & Miyao, 2007). Some physiological changes include the following: bones becoming less dense due to decreased calcium absorption (Gerdhem, Ringsberg, Magnusson, Obrant, & Akesson, 2003), the heart walls becoming stiff and filling with blood more slowly (Merck Medical Library, 2004), and the decrease in muscle mass (i.e., sarcopenia).

Many of these physiological changes can be slowed or prevented using diet and exercise (Gupta, 2007). Vitamin D assists with calcium absorption; cardiovascular exercise improves heart function; and strength training slows or delays the loss of muscle mass. Diet and exercise have shown to play a crucial role in biological age. For instance, a sedentary lifestyle compounded by overeating could lead to an increase in body fat percentage, an increase body mass index (BMI), a decrease in cardiovascular function, and a decrease in muscle strength (Centers for Disease Control and Prevention, 2008).

Caloric restrictive diets indicate the role of glucose in the ageing process (Cerami, 1985; Masoro, Katz, & McMahan, 1989; Mobbs, 1990), such that increase in glucose accelerates the ageing process. Lifestyle has been shown to have a major impact on general health. Therefore, the environment has an impact on physiological function to a certain degree.

Certain environmental components may be manipulated in order to impact biological ageing (i.e., physiological functioning). Notwithstanding, there are environmental variables that may or may not affect the ageing process. In the early development stages of the biological age concept, it was believed that manipulation of biological age was an unattainable goal (Hayflick, 1994). This was arguably due to defining the biomarkers associated with biological ageing. Even though there is a better understanding of the relationship between biomarkers and biological ageing, this relationship is being continually redefined and interpreted. Today, health professionals advocate lifestyle change for preventive medicine measures in order to slow the decline in physiological function.

Senescence refers to the decline in physiological function which results in death (Hayflick & Moorhead, 1961). This decline in function may be accelerated through environmental components. Long-term smoking, sedentary lifestyle, and poor nutrition are just a few environmental components associated with senescence. If the ageing process can be accelerated, is it possible to be decelerated? In the proposed study, the management of biological age deceleration will be assessed. The manipulation of biological age is defined by two components: (a) decreasing the disease burden or disease risk and (b) delaying onset or progress of the ageing process (Sayer & Cooper, 2004).

There may be barriers to biological age deceleration. These barriers inhibit the ability to control environmental forces (e.g., exercise). Chronic pain is an exemplar barrier to biological age deceleration. It has a complex—and cascading—relationship with the ageing process. In terms of exercise, chronic pain may deter patients when

movement becomes uncomfortable or painful. The decrease in exercise contributes to a change in energy level, a change in mood (i.e., decrease in endorphins), a decrease in muscle strength, among other factors. There are associations among chronic pain and psychological factors, such as depression (Rabins, 1998). Therefore, the barriers of biological age may also impact psychological factors.

Psychological age, how old one feels, has not been studied as extensively as biological age. For the most part, psychological age is assessed in patients by asking, "Do you feel younger or older than your age? Do you feel your age?" (Merck Medical Library, 2004).

A more intensive assessment of psychological ageing is warranted. Since there is a relationship between depression and biological age (Gupta, 2007), the associations among psychological variables and biological ageing are known. However, there is minimal contextualization of psychogical variables in terms of psycholocal ageing. In the proposed study, psychological ageing will be evaluated in terms of the management of biological ageing.

Biological age deceleration is important to the study of ageing. One important implication of biological age deceleration research is the possibility to extend human life through the maintenance of physiological function—the slowing or delaying of senescence. Chronic pain patients incur pain as a symptom of a disease (e.g., multiple sclerosis). Consequently, these chronic diseases contribute to senescence. The proposed study intends to: (a) expand the understanding of biological age in chronic pain patients; (b) identify a model of biological ageing in chronic pain patients; and (c) propose a method to evaluate psychological age.

Problem Statement

Over a one-year period, the researcher will design, implement, and evaluate a chronic pain management distance learning course, using the biological ageing concept, for adults with fibromyalgia and experiencing chronic pain in Pennsylvania Pain Management Centers.

Subproblems.

How do depression and anxiety relate to fibromyalgia management?

How does distance learning relate to fibromyalgia patient education?

Impact of the Problem

From 1996 to 2025, the percentage of people 60 years old and over is expected to multiple by 133 percent—a one third increase (Merck Medical Library, 2004). Similar statistics indicate that the global life expectancy will significantly increase by the year 2020 (Lancet, 1997). This raises a concern about the quality of life for the ageing population.

Advances in medical technology, medical treatment, and public health interventions have certainly contributed to the increase in life expectancy and improvement of quality of life (Wright & Weinstein, 1998). The current understanding of quality of life is based on psychological variables: patients report the quality of life based on how they feel. This type of response may be unreliable and invalid. When patients are asked to report the quality of life of someone else, they are unable to make concrete responses (Ziller, 1974).

Biological age deceleration suggests that the maintenance of physiological function could improve the quality of life. It is common medical knowledge and practice

that improving the quality of life and life expectancy in patients by improving environmental factors will improve general health and wellbeing. Environmental factors were shown to increase life expectancy from 30 years in 1800 to approximately 67 years in 2000 (Riley, 2001). Factors that resulted in this increase included: medical and public health interventions (e.g., germ theory), income and economic impacts, famine and malnutrition levels; and educational level.

The proposed study will offer a potential model for chronic pain patients to slow or delay the deterioration of physiological function by using biological age deceleration concepts. Chronic pain patients incur pain as a symptom of a disease (e.g., multiple sclerosis). These diseases can accelerate biological ageing. In other words, chronic pain patients are not as healthy as their non-chronic pain counterparts. The condition of chronic pain forms a barrier for patients to improve health and wellbeing. The next section explores this barrier and associated implications.

Evidence of the Problem

Ageing and disease have an abstruse relationship. The immune system uses a diverse method of defensive and offensive protection to maintain an organism's health. As ageing progresses, the immune system function declines in a process called immune senescence (Weksler, 2004). Immune senescence generally manifests upon some physiological stress, such as malnutrition, organ failure, and dehydration. Immune senescence is compounded by chronic disease. Therefore, it has been shown that immune system dysfunction is related to environmental and psychological factors.

Biological ageing is a complex concept with various physiological implications. Although the specific biomarkers of biological ageing are currently being researched, the

relationship between biological age and psychological variables has not been researched as rigorously. In order to evaluate this complex issue, the research environment must be constructed in a certain way. The following section describes an overview of the research environment.

Overview of the Research Environment

The proposed research on the management of chronic pain will use distance-learning environments for course implementation and grounded theory research design for data collection and analysis. Distance learning or e-learning environments use discussion board forums to an extent. This course will use the social networking site Facebook, more specifically Facebook Groups, in order to utilize free sophisticated discussion board forums. The collection of data will be conducted using intensive interviews and questionnaires (i.e., Beck Depression Inventory and Beck Anxiety Inventory). The following sections detail the proposed research environment.

History. Distance education has been in existence since the 1700s (Holmberg, 2005). In 1728, students learning shorthand had completed lessons via postal mail. In the mid-1800s, the demand for correspondence courses increased and there was a change in the philosophy of education, which focused more on the transfer of knowledge rather than face-to-face interaction. By the 1900s, distance learning had become a prominent method of instruction throughout several universities. During the 20th Century, some colleges were entirely devoted to the distance learning methodology (Reiser, 2002). Today, technology has catapulted distance learning into modern culture, using internet course modules (e.g., discussion boards, blogs, etc.), videoconferencing, teleconferencing, and chat rooms. Students are able to learn at anytime, participate in

asynchronous and/or synchronous discussions, and devote more time to active learning processes using modern distance learning designs.

Community. Distance learning environments are typically referred to as e-learning (i.e., electronic learning) (Laurillard, 1993). The term e-learning is attributed to this design because the internet is the mainstay method of distance learning (e.g., chat, discussion boards, web-conferencing, online modules, etc.). Laurillard (1993) suggests there are four types of interaction, which may be used in e-learning environments to build community, called the Laurillard Conversational Model. These interactions include: (a) learning via acquisition, where the instructor plays storyteller; (b) learning via discussion, where instructor and student negotiate solutions; (c) learning via discovery, where student guides research; and (d) learning via guided discovery, where instructor and student collaborate with research.

The Laurillard Conversational Model comprises the major student and teacher interactions of the e-learning community (Laurillard, 1993). When the instructor plays storyteller, conceptual knowledge is transferred directly from instructor to student. When the instructor and student operate as negotiators, conceptual knowledge is discussed. When the student guides research, the student applies knowledge to situations and learns from experiences. When the instructor and student collaborate, conceptual knowledge is applied and expanded; the events thereto are interpreted and discussed.

Background. E-learning provides students with increased access to the learning environment (Holmberg, 2005). Often times, the online course integrates learning modules or sessions. These sessions are broken into topics or focus areas. During each module, a student will devote time to understanding, mastering, and applying new

information based on a specific topic. This format is similar to a lecture or lesson plan. However, the difference among the lecture/lesson format and online module design is dedicated time parameters. For instance, a student may not be required to master or apply material presented in lecture until an exam is given. This may not occur until several weeks later. In the e-learning system, it is thought that students immediately apply new information, whereby the learning process occurs earlier.

Resources. The proposed study will contain biological, psychological, and social resources. The biological resources will include: (a) a fitness editorial that advises chronic pain patients on best exercise practices and (b) a nutritional editorial that provides current dietetic information on healthy eating for patients with fibromyalgia. The psychological resources will include: (a) an editorial from the Department of Health and Human Services on basic meditation methods; (b) the Beck Depression Inventory questionnaire; and (c) the Beck Anxiety Inventory questionnaire. The social resources will include: (a) the online learning environment (i.e., Facebook and Facebook Groups) and (b) intensive interviews.

Context. The online learning environment will play an integral role in the proposed research in health education. Facebook Groups will provide: (a) chat rooms or email, which may be used for communication between instructor and student; (b) a centralized course website to establish the online classroom; (c) ability to provide students with resource files that will enhance the learning experience (e.g., editorials).

Although data may be obtained online, some information will be collected using intensive interviews. When collecting data from fitness, flexibility, and balance tests, an

interview appointment with participants will be established. The intensive interview will occur via teleconference. In addition, questionnaire data collection will occur via mail.

Role of the Researcher. The researcher's role will involve coordination of students, lesson modules, and data collection; the researcher would have a significant role in the creation and monitoring of the learning environment (see Figure 1). Several instruments will be used to collect data in the proposed study. Instrumentation will include intensive interviews and questionnaires. The biological ageing course may require the use of expert information. Professional publications in nutrition, pain management, fitness, and meditation will be used. The researcher will be responsible for providing students with the professional publications and monitoring the online learning environment (see Figure 1).

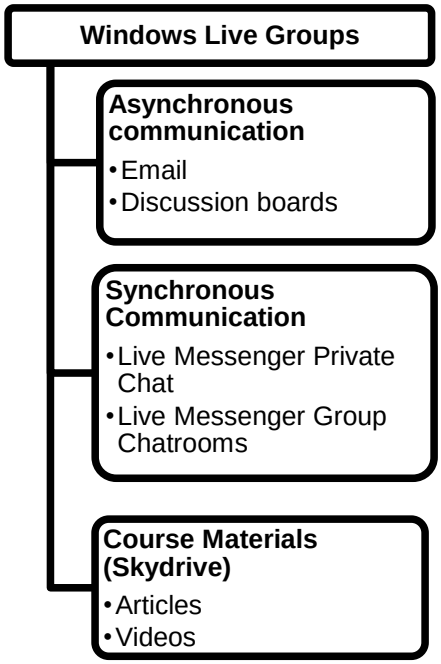

Figure 1. Organizational chart for proposed learning environment.

The researcher will use the research design of grounded theory to evaluate the phenomena and derive a model of chronic pain management. Grounded theory is a qualitative research design which generates theory from interacting with participants and observing the phenomena (Glaser & Strauss, 1967). The grounded theory design uses the constant comparison method to form an emerging theory, which is then substantiated with a focused literature review. Table 1 depicts the phases and processes involved in the grounded theory design.

Table 1

Overview of the Grounded Theory phases and processes.

Phase	Process
Intensive interview	Data is collected from participants using questionnaires and probing
Coding	Data from questionnaire is coded into categories or meaningful units
Memo-writing	Categories or meaning units are compared and analyzed using data from the intensive interview
Theoretical sampling	Generates an emerging theory
Reconstructing theory	Parameters of the emerging theory are derived
Draft writing	Emerging theory is substantiated using all previous data analyses and a focused literature review

Note. Adapted from "Constructing Grounded Theory" by K. Charmaz (2007).

Theory is generated from the data in grounded theory (Charmaz, 2007). This type of theorizing establishes a bona fide theory. First, data will be collected using intensive interviews, a particular interview style that probes for specific information. The intensive interview will be coded by the researcher. In order to analyze the data, the research will conduct memo-writing in order to generate a theory.

The sample (e.g., size) determines the ability to generalize the theory to a larger population. Grounded theory may be applicable to the cohort or the general population.

Purpose of the Applied Dissertation

The School of Health Management at A. T. Still University has certain requirements in completing the Doctor in Health Education (D.H.Ed.) degree. The D.H.Ed. candidate must research a health related issue, in which the outcome has a positive impact on the student's profession. The D.H.Ed. candidate must identify a problem, design a solution, implement best practices for resolution, and evaluate the outcome. To fulfill this requirement, chronic pain patients would participate in a health education program focused on overcoming the barriers to biological age deceleration. In addition, biological age concepts (e.g., caloric restriction) will be a part of the health education program.

Biological age deceleration has the potential to be a method for preventive medical therapy for patients with chronic pain. The proposed research will use the biopsychosocial model of pain management, which contains biological, psychological, and social components associated with senescence. In the proposed project, the purpose is related to the investigation of the psychological and social variables associated with

biological age deceleration. However, the goals and objectives are concerned with senescence.

The purpose of the proposed study is to examine the relationship among chronic pain, biological age, psychological age, and social components. In this study, chronic pain will be considered a barrier to biological age deceleration, because it makes the management of environmental factors more difficult. Biological age refers to the common changes that take place as a result of the ageing process. Psychological and social variables are known to have an effect on chronic pain, thereby impacting the ageing process. For instance, depression and pessimistic perspectives have been related to the acceleration of senescence (Gupta, 2007).

Goals. There are several goals associated with the proposed research project.

- The first goal is to educate the patients with fibromyalgia on the best methods for managing chronic pain.
- The second goal is to inform patients on the biological ageing concepts that relate to chronic pain management.
- The third goal is for patients to decreased depression and anxiety after the intervention.

Objectives. There are objectives associated with the proposed research project. The first objective is to inform patients with fibromyalgia on the best methods for exercise managing chronic pain. The second objective is to educate patients with fibromyalgia on the best methods for reducing stress through use of meditation. The third objective is to promote collaborative learning through social networking.

The purpose of the proposed research is clarified through defining the goals and objectives. The parameters of the health education course and intervention, as well as the parameters of the data collection and analysis are reflected throughout the goals and objectives.

Definition of Terms

Biological Age. Biological age is the age based on physiological status or general health status.

Biological Age Deceleration. Biological age deceleration is the slowing or delaying of the ageing process.

Biomarkers. Biomarkers are biological parameters that correlate with chronological age.

Biopsychosocial Model of Pain Management. The biopsychosocial model of pain management is a method to manage chronic pain through biological components, psychological components, and social components.

Chronic Pain. Chronic pain is the persistent pain related to another disease—characteristics include gradual development, lengthy duration, and indefinite beginning and end.

Chronological Age. Chronological age is the age based on years since birth.

Preventive Medicine. Preventive medicine is a health field that concentrates on improving health status through decreasing health risks, co-morbidities, health disparities, etc.

Seminar Series. The seminar series will be administered by the researcher and consists of workshops on preventive medicine, pain management, and tools to reverse biological age.

Senescence. Senescence describes the processes that are associated with physiological deterioration associated with the ageing process.

Psychological Age. Psychological age is the age range that is based on the perception of how young one feels.

Summary

Biological age, or physiological age, is a model by which to assess general health. Psychological age is a model by which to assess a patient's subjective experience. The proposed study involves a health education course that entails the instruction of chronic pain management in patients with fibromyalgia using biological ageing concepts. This study will have biological, psychological, and social components. These components will be present in course materials, learning environment, or data collection and analysis.

In the proposed study, a social networking site (i.e., Windows Live Groups) will be used to implement the distance-learning environment. Windows Live Groups will provide a discussion board forum, course email, and a download function for course materials.

The next chapter will detail the review of literature for this study.

Chapter Two: Literature Review

Biological age provides a context to implement general health education strategies for chronic pain patients. Biomarkers offer a method for assessing biological age deceleration. In patients with chronic illness, there are notable barriers for biological age deceleration. These barriers are related to chronic pain. In addition, psychological age—how old one feels—may play a role in biological age deceleration.

The present review is limited to investigations of adults. Studies were excluded if any of the following components were present: (a) the study used traditional medical treatment (e.g., pharmacological therapies) to treat chronic pain; and (b) the study focused on reversing the ageing process in terms of youthful appearance (e.g., minimizing wrinkles via cosmetic surgery). This literature review will focus on four areas of interest: ageing, biological age, chronic pain management, and psychological age.

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Subproblems.

How do depression and anxiety relate to fibromyalgia management?

How does distance learning relate to fibromyalgia patient education?

Ageing

From 1996 to 2025, the percentage of people 60 years old and over is expected to multiple by 133 percent—a one third increase (Merck Medical Library, 2004). Similar statistics indicate that the global life expectancy will significantly increase by the year 2020 (Murray & Lopez, 1997). This raises a concern about the quality of life for the ageing population. Approximately 80 percent of community-dwelling people who are 65 years and over have at least one chronic disorder (Merck Medical Library, 2000).

Advances in medical technology, medical treatment, and public health interventions have certainly contributed to the increase in life expectancy and improvement of quality of life (Wright & Weinstein, 1998). Patients may report the quality of life based on their experiences, which is a subjective response. However, when patients are asked to report the quality of life of someone else they are unable to make concrete responses (Ziller, 1974). This indicates that the assessment for quality of life does not offer health information, but rather self-other perception. For instance, an 80-year-old woman who has several comorbidities and is at high risk for falling may indicate that her life is "good," when asked. Quality of life in its current form does not objectively indicate quality of health. Rather, quality of life presents a measure of the patient's perception of self-health or health of others.

In order to present the connection between health status and psychological functioning, this literature review will first explore ageing. The following topics on ageing will be discussed: (a) Tithonus error, (b) senescence; (c) ageing theories; and (d) longevity. Examination of these ageing topics establishes the foundation for biological age deceleration.

Tithonus Error. Alfred Lord Tennyson describes the Tithonus' lexical error and the ramifications of his wording (Tennyson, 1963). Tithonus is a character described in Greek mythology. When he asks Aurora to grant him eternal life, he becomes immortal. What was thought of as a gift from Aurora turns out to be a curse. Since Tithonus did not ask for eternal youth, he appears to grow older, and continually ages forever without the resolution of death.

The Tithonus error can be linked with biological age deceleration. There have been several postulates detailing the paradigm of slowing the aging process. If diseases in the elderly are postponed, retarded, or prevented, there would more than likely be an improvement of general health (Gupta, 2007). The Tithonus error is analogous with the biological ageing concept because both hypothesize enhanced health and longevity.

Even if biological ageing and the Tithonus error describe an actual phenomenon, cellular ageing would continue (Bond, Haughton, Blaydes, Gire, Wynford-Thomas, & Wyllie, 1996). In order to have a drastic improvement in biological age, the ageing process would need to change at the cellular and molecular levels. To this end, Williams (1999) suggests gerontologists should focus on senescence, rather than immortality.

Critique of Tithonus Error. The Tithonus error relates to life expectancy and health status on some level. For instance, the notion that one may delay the occurrence of death is a direct result of expanding life expectancy. In addition, the Tithonus error seems to suggest that it is possible to expand life expectancy without improving health status. Since the historical record indicates that life expectancy was improved only through health education, prevention and/or medical technology, there is no evidence to suggest that one can increase life expectancy without improving health status (Riley

2001). Therefore, this is a fallible model and should not warrant further investigation with the proposed study parameters.

Senescence. Senescence refers to the decline in function that results in death (Comfort, 1964). Compared to ageing, senescence is the process by which cell division and functional capacities are lost over time and ageing is the process of incremental maturation (Dumont, Burton, Chen, Gonos, Frippiat, Mazarati, Eliaers, Remacle, & Toussaint, 2000). The life of a noncancerous cell is mortal; cells die after a certain number of divisions. (Hayflick & Moorhead, 1961), which is called replicative senescence or Hayflick's Limit (Hayflick & Moorhead, 1961; Hayflick, 1985; Hayflick, 1994). The immortalization of cellular functioning is a hallmark of senescence (Campisi, 1999).

Critique of Senescence. Senescence refers to a decline in function as a result of the ageing process. This model coincides with biological age deceleration because this decline in function may be reversed. With a reversal of senescence, biological age deceleration exists. Therefore, senescence relates to the proposed study rather than the Tithonus error.

Theories of Ageing. There are several existing models that attempt to explain the ageing process (See Figure 2). Even though many models have been able to produce testable results, ageing largely remains a mysterious process. Researchers do not accede on one acceptable model. For example, some researchers believe ageing occurs at the tissue level (Mattison, et al., 2002; Kowald & Kirkwood, 1994) and other researchers believe ageing occurs at the cellular level (Van Zant & Liang, 2003; Geiger & Van Zant, 2002). Ageing may also be explained via endocrine system and hormones (Gosden,

1996). Since there are a multitude of models that could explain ageing, it is necessary to detail the main theories of ageing (see Figure 2).

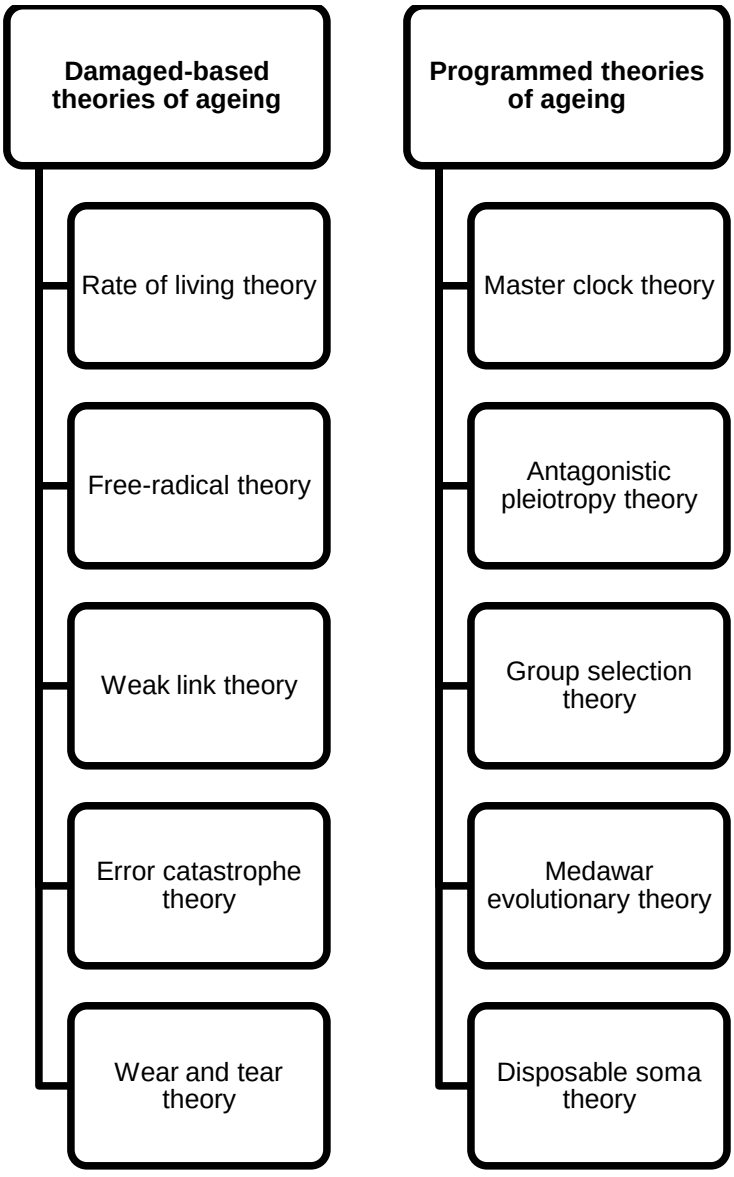

Figure 2. Damaged-based and programmed theories of ageing.

Magalhaes (2005) has posited two categories for ageing theories: damage-based theories of ageing and programmed theories of ageing. Damage-based theories of ageing posit that ageing is due to the accumulation of the byproducts involved in cellular metabolism. Furthermore, this accumulation of damaging byproducts is thought to interrupt normal cellular processes. Alternatively, the programmed theories of ageing posit that ageing is due to a genetic control. In other words, gene regulation is thought to induce ageing in programmed theories of ageing (Bond, Haughton, Blaydes, Gire, Wynford-Thomas, & Wyllie, 1996).

Kirkwood and Austad (2000) stated that each ageing theory provides one piece of the puzzle in terms of the ageing process. In other words, there is no one theory to explain the ageing process. In the sections below, damage-based and programmed theories of ageing will be detailed.

Damage-Based Theories of Ageing. The following section details the damaged-based theories of ageing.

Rate of living theory. Max Rubner hypothesized a relationship between body size, metabolism, and longevity in 1908: animals with longer lifespans have smaller bodies and slower metabolisms (Lautz, 1961). Hayflick (1994) added that organisms are born with some potential energy substance and the faster it is used the quicker the organism ages. The energy consumption hypothesis of Rubner was later named the rate of living theory of ageing. The rate of living theory of ageing states that ageing hastens due to increased biological activity due to increased metabolic rate.

Free-radical theory of ageing. The free-radical theory of ageing involves a highly reactive oxygen species that may cause damage to cellular components during

propogation of the radical atom (Berneburg, Grether-Beck, Kurten, Ruzicka, Briviba, Sies, & Krutmann, 1999). The oxygen radical intiates in the presence of ultraviolet light from a diatomic oxygen atom. Since oxygen is associated with the electron transport chain as the final electron acceptor, forming water as a byproduct, human cells need oxygen to thrive. The accumulative damage caused by reactive oxygen species is posited as the cause to the ageing process in the free-radical theory of ageing (Beckman & Ames, 1998). In addition, this theory provides considerable evidence that suggests that oxidative damage increases with ageing. In older organisms, the amino acids build oxidized residues which decrease protein activity.

Weak link theory. The weak link theory of ageing posits that during senescence a particular physiologic system is vulnerable to damage (Csermely & Soti, 2006). For instance, the immune system and neuroendocrine system are thought to be vulnerable due to entropic processes. Furthermore, this theory suggests that random damage influences the low affinity, transient interactions (i.e., weak links) within cellular networks (Soti & Csermely, 2007). The damage accumulation results in increased destabilization and diversity in cellular processes—creating noise. This noise is thought to contribute to the ageing process.

Error catastrophe theory. First proposed by the physicist Leo Szilard (Szilard, 1959), the error catastrophe theory posits that the accumulation of DNA transcription or RNA translation errors lead to genetic errors and these errors promote the ageing process (i.e., senescence). Progeria, the genetic disorders that results in an accelerated ageing process (e.g., Werner's, Hutchinson-Gilford's, and Cockayne syndromes), originates in a recessive mutation in a gene, WRN, encoding a RecQ helicase (Yu et al., 1996; Gray et

al., 1997). Furthermore, the WRN gene may be involved in DNA repair (Huang et al., 1998). The study of progeroid syndromes is a major field of study in the error catastrophe theory of ageing.

Wear and tear theory. The wear and tear theory of ageing posits that cells, tissues, and body systems are damaged through mere activity and thus wear out over time (Olshansky, 1991). A hallmark of this theory is that damage begins at the level of the molecule, and then through accumulation of damage there is malfunction of the cell. The accumulation of damaged cells leads to malfunction of a tissue, then organ, then system, and et cetera.

The wear & tear and error catastrophe theories of ageing would not pertain to the proposed study parameters. First, the wear and tear theory of ageing posits that a decline in function occurs through day-to-day activities performed over time. The proposed study will demonstrate that activity improves function (e.g., muscle endurance exercise improves fitness and perception of chronic pain). The error catastrophe theory of ageing does not pertain to the proposed study because there is no evidence to suggest fibromyalgia is a genetic disorder.

The rate of living, free-radical, and weak link theories of ageing may apply to the proposed study. First, the rate of living may be linked to restrictive caloric diets to improve general health-a concept that would be used in the proposed study. Second, the free-radical theory of ageing may also be linked to diet by foods that decrease free-radicals. Third, the weak link theory of ageing may relate to fibromyalgia patients who do not seek regular exercise—improving systemic functioning (e.g., respiratory or muscular systems).

Programmed Theories of Ageing. The following section details the programmed theories of ageing.

Master clock theory. The master clock theory in ageing research has two interpretations. The first interpretation of the master clock theory of ageing suggests that ageing is under direct genetic control and is species specific (Spiegel, Nowacki, & Hsiao, 2001). Variation from normal ageing is due to exposure, maladaptation, and lifestyle, usually resulting in a shortened lifespan. In this first interpretation of the master clock, it is not stated what controls the rate of ageing. The second interpretation of the master clock theory of ageing states that gene silencing contributes to the ageing process. Since this interpretation is more recent, there is little known about this model.

Antagonistic pleiotropy theory. The phenomenon where more than one phenotypic trait is controlled by one gene is called pleiotropy (Cheverud, 1996). Posited in 1957 by George Williams, an evolutionary biologist, the antagonistic pleiotropy theory of ageing proposes the existence of genes that produce harmful effects later in life, but beneficial effects early in life (Kirkwood, 2002). It is throught that some genes that are involved in normal functioning during youth are the same genes that cause senescence. For instance, in human females, genes that cause regular menstrual cycles in early life are the same genes that cause follicular depletion via menopause (Wood, O'Conner, Holman, Bringle, Barsom, & Grimes, 2001).

Group selection theory. The group selection theory of ageing is a concept that formed from the Darwinian evolutionary theory and its opponants. When Darwin proposed evolution in the "Origin of Species," opponants argued against evolution by citing colonies of bees, ants, and other insects (Weismann, 1891). In colonies, such as

bee colonies, there contains a large proportion of sterile organisms. The opponants to evolution argued that natural selection for sterility does not fit with evolution. However, evolutionary biologists countered with the idea of group selection: characteristics that favor the species are passed on to the next generation. In the case of bee colonies, worker bees are favorable because they orchestrate the hive, but are sterile. Thus, the genes to produce sterile worker bees are favored by natural selection. The concept of group selection pertains to ageing when shorter life cycles are favorable in populations or species (e.g., mosquito seasons). In terms of humans, group selection theory may explain why our species cannot live past a certain age: genes were selected by evolution that favored shorter lifespans.

Medawar evolutionary theory. The Medawar evolutionary theory of ageing was posited by Peter Medawar in 1952 (Medawar, 1952). This concept of ageing from the Darwinian evolutionary theory and group selection. The premise of this theory states that genes that are beneficial in old age does not pass onto the next generation because females cannot bear children in old age. Thus, genes that deselect for diseases (e.g., Alzheimers or Parkinson's Disease) do not participate in natural selection.

Disposable soma theory. The disposable soma theory of ageing posits that evolution favors cellular processes that maintain the cell until procreation (Kirkwood, 1988). More specifically, cellular maintenance (e.g., protein turnover, DNA repair, defenses against antioxidants, etc.) were favored by natural selection, but these processes decline with age. Since older females lose the ability to reproduce during the ageing process, the cellular maintenance in older adults are not involved in natural selection.

The programmed theories of ageing would not apply to the proposed study for two main reasons. First, the programmed theories of ageing suggest a genetic component to senescence. Genetics will not be evaluated in the proposed research. In addition, the proposed study will assess environmental conditions (e.g., exercise, diet, lifestyle, etc.). Second, certain programmed theories of ageing involve evolutionary processes, which would be outside the study parameters: not evaluated in the proposed research. Therefore, the programmed theories of ageing do not coincide with the proposed research.

Life Expectancy. Life expectancy is a measure of the average length of survival or lifespan of a certain population (Galor & Moav, 2005). In addition, life expectancy is thought of in terms of number of years before death. Although the human life expectancy has varied over the span of history, there has been a spike in the average human lifespan in most recent history. For instance, in Classical Rome or Greece, the life expectancy was from 20-30 years old (Central Intelligence Agency, 2008). In the beginning of the 1900s, the life expectancy was from 30-40 years old. However, the current life expectancy for humans is approximately 66 years old.

There are several factors that affect life expectancy. First, life expectancy could be affected by heredity (Yokote & Saito, 2008) or natural selection (Perlman, 2008). Genes that are favorable in old age do not participate in natural selection, because older females lose the ability to reproduce. In addition, genes predispose a person to certain diseases (e.g., hypercholesterolemia) and may result in death.

Second, advancements in science and medical interventions have been able to eliminate or diminish many conditions that result in death (Wright & Weinstein, 1998).

For instance, the germ theory and radiation therapy for cancer has diminished or eliminated conditions that resulted in early death. Third, lifestyle is thought to have great impacts on life expectancy (Cockerham, 1997). For instance, diet and exercise is linked to BMI, blood pressure, atherosclerosis, rickets, kwashiorkor, etc. Lifestyle choices are thought to play a major role in ageing.

Lifestyle and preventive medicine are two methods for improving life expectancy that directly relate to the study parameters. However, genetic components do not relate to the study parameters, because genetics will not be evaluated in the proposed research.

Biological Age. Since research in biological age depends on how it is defined, a definition of biological age is a necessary step in every research project. There exists a controversy in the research community about the implications of anti-ageing techniques (Hayflick, 1994), among researchers of anti-ageing and cellular senescence. However, this controversy only exists because there are two contrasting concepts about biological age and its implications.

The first concept suggests that biological age is a rate that is dynamic (Magalhaes, Cabral, & Magalhaes, 2005). This rate changes in an individual over a period of time. The second concept suggests that biological age refers to the physiological health and mental health that are compared and contrasted to the statuses of health from different age groups to determine if one is older or younger than their chronological age (Gavrilov & Gavrilova, 2003). This paradigm conceptualizes biological age in more general (i.e., higher level) terms, which may be assessed over a shorter period of time and with measures of general health.

For biological age research, the concept relating to ageing as a rate could not be assessed inside the proposed research parameters, therefore, it does not fit. In the proposed study, the concept that relates biological age to physiological and mental health would apply, because these variables would be accessed directly in the research.

Biomarkers. The ageing process has certain indicators that allow researchers to study biological age. Ageing is thought to be associated with five physiological variables (Nakamura & Miyao, 2007):

- Systolic blood pressure
- Forced expiratory volume in one second
- Hematocrit
- Albumin
- Blood urea nitrogen.

Alternatively, fitness and self-management skills have been shown to correlate to the improved physiological function, whereby reversing biological ageing (Rooks, Gautam, Romeling, Cross, Stratigakis, Evans, Goldenberg, Iversen, & Katz, 2007).

There are several reasons that indicate the importance of these physiological variables in terms of biomarkers for ageing.

- These biomarkers are biological parameters that correlate with chronological age using a cross-sectional analysis. Since cross-sectional data only indicates a relationship for a specific point in time, longitudinal designs provide a more complete clarification about the ageing phenomenon.

- Nakamura and Miyao (2007) stated these biomarkers were the only physiological variables that seemed to reflect an underlying ageing process during their adaptation of a longitudinal analysis of ageing — previously used in rhesus monkeys.

In Nakamura and Miyao (2007), there were additional physiological variables associated with ageing, these five biomarkers move in tandem indicating covariance, which leads to the third underlying principle for the biomarkers of ageing: these biomarkers are essential for an underlying component of ageing (i.e., global ageing process) and they indicate the existence of a general ageing factor.

Nakamura and Miyao (2007) showed some potential biomarkers for ageing. However, there are several others that exist. For instance, abdominal obesity has been shown to accelerate biological ageing (Nordfjall, Eliasson, Stegmayr, Lundin, Roos, & Nilsson, 2008). In addition, Nordfjall et al. (2008) had shown associations among perceived early ageing, poor self-rated health, and shorter telomere length. Furthermore, telomeres lengths are an important characteristic of the ageing process and have great implications in biological age research (Huzen, van Veldhuisen, van Gilst, & van der Harst, 2008).

Biomarkers as stated by Nakamura & Miyao (2007) would relate to cellular senescence. However, these biomarkers do not directly assess the outcomes of the health education course (i.e., improved fitness, balance, and flexibility). Rooks et al. (2007) biomarkers directly relate to the proposed study parameters and health education course outcomes.

Frailty. Frailty is another characteristic of the ageing process. There are two main models for frailty: (a) phenotypic frailty and (b) frailty index (Rockwood, Andrew, & Mitnitski, 2007). Phenotypic frailty is based on five specific phenotypes characteristics (i.e., weight loss, exhaustion, low energy expenditure, slowness, & weakness), which may mark a person as robust, pre-frail, or frail, and may relate to a deficiency in balance (Rossiter-Fornoff, Wolf, Wolfson, & Buchner, 1995). In a study by Fried, Tangen, Walston, Newman, Hirsch, Gottiener, Seeman, Tracy, Kop, and Burke (2001), an intermediate stage for frailty was described as the presence of one or two criteria. The intermediate stage for frailty was a high risk status indicating that one may become frail in three to four years. If there is a critical stage for frailty, an indicator of the ageing process, and this critical stage may be managed (e.g., physical exercise), then it is plausible that one may control biological age.

The second model is the frailty index, which quantifies a person's deficits by counting the number of signs, symptoms, abnormal laboratory values, and functional impairments (Mitnitski, Song, & Rockwood, 2004). Goggins, Woo, Sham, and Ho (2005) stated that the delay in onset or prevention of frailty has implications for public health care systems—improving the public's general health.

The frailty index by Mitnitski, Song, and Rockwood (2004) does not directly relate to balance, a biomarker used by the proposed study, but it does relate to cellular senescence. Phenotypic frailty as described by Rossiter-Fornoff et al. (1995) does directly relate to balance and would apply to the study parameters, because balance is one biomarker used in the proposed research.

Flexibility. The MacArthur Studies of Successful Ageing provide a method to assess the ageing process (Seeman, Berkman, Charpentier, Blazer, Albert, & Tinetti, 1995; National Institute on Ageing, 2008). The MacArthur Studies assessed men and women 70-79 years of age. Physical, psychological, and social components of ageing were assessed. Physical performance measurements were based on upper and lower body function. The upper body function tests included strength and dexterity assessments and the lower body function tests included balance and gait assessments. In addition, biomedical measurements were collected: postural and seated blood pressure, pulmonary function, and waist/hip ratio.

In a study by de Araújo (2008), flexibility was assessed across the human lifespan. Participants were ages 5 to 91 years and consisted of both males and females. This study used flexitest to assess flexibility and flexindex to examine results. The study showed that flexibility decreases after adolescence and considerably in old age. In addition, males showed decreased flexibility when compared to females. Since the trend was amplified as chronological age progressed and indicates a decline in physical health, flexibility is thought to be a reliable biomarker for biological age.

Ayan, Alvarez, Alonso-Cortes, Barrientos, Valencia, and Martin (2009) studied the affect of a home-based health education course for fibromyalgia patients, which entailed stretching exercises, breathing techniques, and physiotherapy sessions. In this study, flexibility was assessed over a 12-week period; improved flexibility was found to have a relationship with improved fibromyalgia symptoms.

Flexibility would be an ideal biomarker for the proposed study for two main reasons. First, flexibility tends to diminish with age. Second, flexibility has been linked

with a decline in physical health. For these reasons, an improvement in flexibility would indicate biological age deceleration. Therefore, flexibility relates to the study parameters.

Chronic Pain Management

Chronic pain is an ongoing symptom that is related to some underlying disease or condition (e.g., arthritis) (McMahon & Koltzenburg, 2005). The core characteristics of chronic pain include: gradual development, lengthy duration, and indefinite beginning and end. Chronic pain characteristics are generally the antithesis of acute pain—a pain that is sudden, short, and has a distinct onset and cessation. Models of pain provide conceptualization of the complexities of pain perception. According to Lewandowski (2006), there are three significant chronic pain models:

- The Cartesian (i.e., biological, nociceptive) model
- The Gate-control model
- The Biopsychosocial model

In addition, the multidimensional model has been found to be significant (Otis-Green, Sherman, Perez, & Baird, 2002).

Models of Chronic Pain. The following section will detail the Cartesian model of pain, gate-control model of pain, biopsychosocial model of pain, and multidimensional model of pain.

Cartesian model of pain. In the seventeenth century, Rene Descartes posited the first major pain concept (Melzack, 1993) called the Cartesian model of pain. Under the Cartesian model, pain is associated with tissue damage, such that an increase in tissue damage increases pain sensation (Lewandowski, 2006). The pathway of pain originates at the site of tissue damage or injury and propagates a direct signal to the brain. Although

this model pioneered pain concepts, this model was overarching in terms of pain type and the individual pain perception.

Chronic pain is less mechanical than the "dial control" concept that the Cartesian model sets forth — turn up the tissue damage, turn up the pain. Even though this model does not provide a solid interpretation of the chronic pain experience, it is useful to understand chronic pain as having some underlying cause.

Gate-control model of pain. Melzack and Wall proposed the gate-control model of pain in 1965 (McMahon & Koltzenburg, 2005). The gate-control model of pain postulates that there are transmission and inhibitory cells at the site of the dorsal horn. At this location, a critical excitatory impulse must be reached in order for pain perception to begin. The critical excitatory impulse may vary from person to person. In terms of fibromyalgia, the critical excitatory impulse may be lower than the normal population.

The foremost concept to the gate-control model is the relationship between the mind and the body. The biological component of the gate-control model states pain signals are subjected to a gating mechanism located in the spine (Lewandowski, 2006), which can be opened and closed. In other words, the gating mechanism of the gate-control model facilitates or impedes pain perception.

The psychological component of the gate-control model states the gating mechanism is under the control of the mind (i.e., emotions, mood, thoughts, memories, etc.). The gate-control model explains the perception of pain without injury (e.g., phantom limb) and the decreased pain perception when injury is present. A practical application of the gate-control model of pain is pain management—controlling pain perception or sensation.

Biopsychosocial model of pain. Engle proposed the biopsychosocial model of pain in 1977 (Lewandowski, 2006). The biopsychosocial model builds upon the Cartesian and gate-control models of pain by including social components. For instance, the blush phenomenon involves a biological component (i.e., the face becoming flushed), a psychological component (i.e., an emotional trigger), and a social component (i.e., interpretation of a situation). With the biopsychosocial model, there are various phenomena that can affect, maintain, and exacerbate chronic pain (see Figure 3).

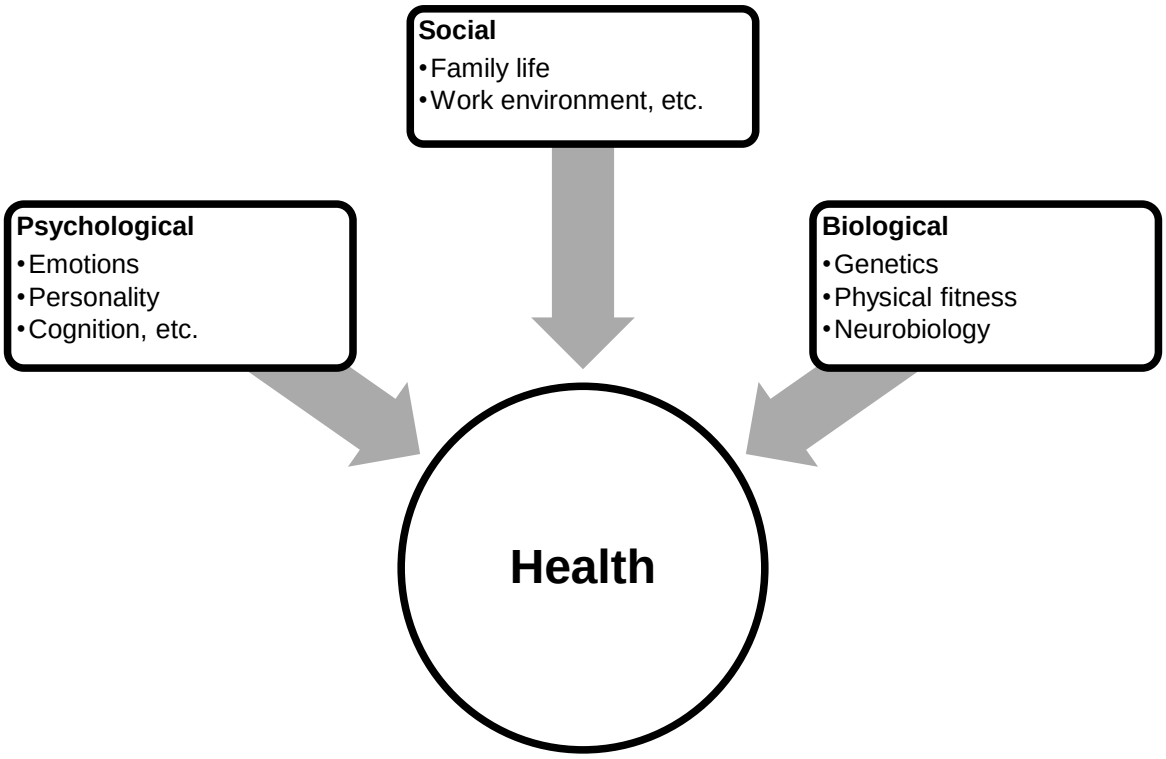

Figure 3. The biopsychosocial model in relationship to health.

Biological phenomena include fatigue; sleep disturbance; medications; inflammation; body mechanics (i.e., use of the body for physical tasks); posture; physical arousal; muscle tension; tissue damage; scarring; and degenerative changes. Psychological phenomena include boredom; personal pain concepts; frustration; depression; anxiety; focus on pain; and feelings of helplessness. Social phenomena include cultural influences; religious influences; pain concepts learned in childhood; interaction with physicians and the health care system; health insurance; and legal and disability systems.

It is important to note that the extent by which biological, psychological, and social phenomena affects, maintains, or exacerbates chronic pain is dependent upon the individual. Lewandowski (2006) states chronic pain patients could benefit from forming chronic pain circles — a process for identifying the biological, psychological, and social phenomena in the individual pain experience.

Multidimensional model of pain. The multidimensional model of pain has emerged as the more recent model of pain (Otis-Green, Sherman, Perez, & Baird, 2002). This model is identical to the biopsychosocial model of pain with the exception of one additional component: spirituality. The spiritual component includes a gamut of alternative medicine therapies: energy medicine, reiki, acupuncture, and prayer (McMahon & Koltzenburg, 2005).

This pain model is broad—encompassing biological, psychological, social, and spiritual components of pain management. However, the spiritual component remains a dubious treatment because of two reasons: (a) the placebo effect plays a greater role in

outcome than in other components; and (b) mechanism of action is unclear. Until future research counters criticism, the multidimensional model of pain is a controversial model for health interventions. Since the biopsychosocial and the multidimensional models of pain are identical, with the exception of spirituality, both models may be used in the proposed study simultaneously without conflicts. This would allow for participants to discuss spirituality, if needed.

Critique of Chronic Pain Management Model. The chronic pain management models do not differ from each other based on concept, but rather differ based on perspective. While the Cartesian and gate-control models link pain to perspective or the mind, the biopsychosocial and multidimensional models include this linkage as well as linkages with social components. The multidimensional model is the all-encompassing model which includes all linkages with pain that other models propose, as well as a link to spirituality.

The biopsychosocial or multidimensional model of chronic pain would be useful in the proposed study for one main reason: the proposed study will use the qualitative design called grounded theory, in which a theory is constructed from observations, interviews, among other qualitative data collection. The biopsychosocial model and the multidimensional model are identical in concept, but differ on one component. That varying component is spirituality. Spirituality may or may not be indicated by the participants. However, it is possible participants may indicate spirituality during an intensive interview. Therefore, the biopsychosocial and multidimensional model of pain will be used in the proposed study.

Causes of Chronic Pain. There are various causes to the presence of chronic pain. Chronic pain may involve pain signals that continue to fire in the nervous system (McMahon & Koltzenburg, 2005). McMahon and Koltzenburg (2005) stated that pain signals may continue to fire for weeks, months, and in some cases years. This cause of chronic pain complements the gate-control model of pain, since the critical excitatory impulse is reached continuously.

In many cases, chronic pain is a result of physical complications, such as:

- Cancer
- Infection
- Arthritis
- Inflammation, etc.

Common chronic pain ailments include:

- Back pain
- Headache
- Cancer pain
- Neurogenic pain
- Arthritis pain (McMahon & Koltzenburg, 2005)

In addition, some chronic pain ailments have psychogenic components — no physical explanation for the pain event. Psychogenic components are of interest to the proposed study because fibromyalgia causes have no certain explanations. Since cancer and arthritis tend to be common causes of chronic pain, participants will be questioned on their other chronic diseases.

Chronic Pain Treatment. Chronic pain may be treated pharmacologically, non-pharmacologically, or a mixture of the two. The treatment of chronic pain with pharmaceuticals depends on the cause and origination. For chronic pain associated with inflammation or musculoskeletal origin, analgesics (e.g., nonsteroidal anti-inflammatory drugs or NSAIDs) may be used (McMahon & Koltzenburg, 2005). For neuropathic pain, tricyclic antidepressants, antiseizure drugs, or opioids may be used.

The treatment of chronic pain with non-pharmaceuticals may also provide relief of chronic pain. Regular exercise is considered the most effective non-pharmaceutical treatment and could decrease depression, improve sleep, and maintain endurance, muscle strength, and flexibility (McMahon & Koltzenburg, 2005). Another effective non-pharmaceutical treatment is hot and cold applications. However, chronic pain patients with diabetes mellitus comorbidity cannot use cold compresses on feet, because of the risk of an injury (McMahon & Koltzenburg, 2005).

Chronic pain may also be treated with the following nontraditional therapies:

- Chiropractic manipulation (Brodin, 1985)
- Relaxation techniques (Grzesiak, 1977)
- Transcutaneous electrical stimulation (Carroll, Moore, McQuay, Fairman, Tramer, & Leijon, 2001)
- Biofeedback (Turk, Swanson, & Tunks, 2008)
- Acupuncture (Musial, Michalsen, & Dobos, 2008)
- Cognitive and behavioral therapy/group counseling (Turk, Swanson, & Tunks, 2008)

These therapies were found to have a significant affect on chronic pain. In addition, osteopathic manipulation has been used to treat chronic pain (Kuchera, 2007). In the proposed study, nontraditional therapies for chronic pain would be explored, because these therapies involve a linkage between pain and the mind (e.g., cognitive therapies).

Psychological Ageing

Psychological age differs from the psychology of ageing. Psychological age in medical practice is a measure of how old the patient "feels," a subjective response (Byrd & Breuss, 1992). The psychology of ageing depicts the idiosyncrasies of the ageing process in terms of mental health. Psychological age assessment in medical practice does not go beyond asking the patient for a subjective response. Objective assessments of psychological age may provide information about a patient's general health. The World Health Organization (WHO) defines health as the, "state of complete physical, mental, and social wellbeing and not merely the absense of disease or infirmary" (WHO, 2008).

Since WHO places mental health on the same level as physical health, psychological age assessments would enrich the patient's general health status information. However, psychological ageing has not been developed into an objective assessment. The psychological age assessment that is currently used is more an indicator of quality of life rather than an assessment of psychological wellbeing. Therefore, psychological age will be investigated within the study parameters.

Summary

From damaged-based to programmed, there are several theories of ageing. The proposed study would use a damaged-based theory of ageing, because in order to change the ageing process, the cause of ageing must be thought of as environmental. There are

several models of chonic pain. The health education course will use a multimodal approach to fibromyalgia symptom management (e.g., chronic pain, fatigue). Therefore, the biopsychosocial model of pain will be used. In the next section, a method to examine the problem and subproblems of this proposed research will be detailed.

Chapter Three: Methodology

As demonstrated from the review of literature in chapter two, much evidence suggests that flexibility, balance, and fitness are indicators for general health status. In addition, these indicators, known as biomarkers, are used to determine biological age. However, how are biomarkers managed in the patient population? In terms of preventive medicine, health education must go beyond superficial instruction of knowledge and empower patients with the skills to make a difference in their daily lives. Therefore, patient education must be tailored to this population administering practical skills training in order to make a potential impact.

This chapter will detail the proposed intervention (i.e., health education course), the theoretical basis for the intervention, methodology of grounded theory analysis, and statistical analysis of collected data (i.e., Wilcoxon signed-rank test).

Problem Statement

Over a one-year period, the researcher will design, implement, and evaluate a chronic pain management distance learning course, using the biological ageing concept, for adults with fibromyalgia and experiencing chronic pain in Pennsylvania Pain Management Centers.

Subproblems.

How do depression and anxiety relate to fibromyalgia management?

How does distance learning relate to fibromyalgia patient education?

The Proposal

Biological age provides a context to implement general health education strategies for chronic pain patients. Biomarkers offer a method for assessing biological age

deceleration. In patients diagnosed with a chronic illness, there are notable barriers for biological age deceleration. These barriers are related to chronic pain. In addition, psychological age—how old one feels—may play a role in biological age deceleration. The proposed research project will investigate the interrelationships among (a) the management of chronic pain and (b) the biological, psychological, and social components to biological ageing.

Sample. The proposed research study will use a qualitative & quantitative design. More specifically, a grounded theory study design will be used. Therefore, participants are contained in one group, in which interviews and any additional data sources are used to analyze interrelationships.

Number of Subjects. In a grounded theory study, the number of participants increases until no new data are presented (Charmez, 2006). Since the point of theoretical saturation is determined by sample size (Glaser & Strauss, 1967; Goulding, 2002; Locke, 2001; Strauss & Corbin, 2007), sample size cannot be determined until data collection and analysis occur (Corbin & Strauss, 1998; Glaser & Strauss, 1967). Thomson (n.d.) conducted a literature review saturation to clarify sample size in grounded theory; this review states that the common sample size in grounded theory is between ten to thirty participants. Thompson (n.d.) also indicated that interview parameters, interviewing skills, and target population may influence sample size. The proposed study will have approximately fifteen participants.

Inclusion Criteria. The following inclusion criteria have been set for this research study: (a) subject has been diagnosed with fibromyalgia and has experienced chronic pain within the last six months, (b) subject experiences the chronic pain

symptoms associated with fibromyalgia, (c) subject is a male or female age 40 years or older, and (d) subject has the ability to operate a computer and is able to perform basic functions related to internet activity (e.g., email, web-surfing, chat, blogging).

Exclusion Criteria. The following exclusion criteria have been set for this research study: (a) subject has been diagnosed with a chronic pain condition other than fibromyalgia, (b) subject has used an illegal substance, defined by any or all state(s) in the United States, to cope with chronic pain within the last thirty days, (c) subject has engaged in aerobic or strength training exercises of moderate intensity at least three times per week in the last month, and (d) subject has a severe depression score on the Beck Depression Inventory (i.e., >30) within the last month.

Subject Recruitment. Subjects will be recruited through the private practice of a pain management specialist in Philadelphia, Pennsylvania. The private pain management practice will deliver contact information to qualified participants. Interested participants will contact the researcher. Participants will be provided with an information packet for initial recruitment. There are approximately fifteen participants expected to enroll in the health education course and the research study.

Subject Assignment. This study will use a single group of about fifteen participants and the qualitative design of grounded theory research will be employed. Participants do not need to be assigned into an experimental group or control group for grounded theory research. Quantitative research attempts to control subjective, contextual, and interpretive data through use of experimental design, but these types of data is the foundation of quantitative research (Auerbach & Silverstein, 2003; Charmaz, 2007; Glaser & Strauss, 1967; Maxwell, 1992; Strauss & Corbin, 2007). In addition,

pretest and posttest data from the Beck Depression Inventory and the Beck Anxiety Inventory will be analyzed using the Wilcoxon signed ranks test.

Role of Subjects. Subjects will participate in pretest and posttest assessments. The pretest assessments will occur within thirty days prior to the health education course, whereas the posttest assessments will occur within thirty days after the health education course. The pretest assessments will include the Beck Depression Inventory and Beck Anxiety Inventory, while the posttest assessments will include the Beck Depression Inventory, Beck Anxiety Inventory, and grounded theory data procurement via intensive interviews.

If during the pretest assessments, it is found that a participant has severe depression or anxiety, he or she will be removed from the study and not permitted to participate in the health education course. Additional recruitment may be required if there is a significant loss of participants due to the pretest assessment scores. Additional participants, then, would be recruited from the same private practice.

Approval and Consent. The proposed study has been approved by the Institutional Review Board (IRB) at A. T. Still University. A letter indicating IRB approval is on file at A. T. Still University's School of Health Management.

Figure 4 details the informed consent form.

KIRKSVILLE COLLEGE OF OSTEOPATHIC MEDICINE

A. T. STILL UNIVERSITY, SCHOOL OF HEALTH MANAGEMENT

CENTER FOR GROWTH, PHILADELPHIA, PA

CONSENT FOR PARTICIPATION IN RESEARCH ACTIVITIES

Investigator: Matthew J. Caines, M.P.H., D.H.Ed. Candidate

(760) 282-4531

Participant Informed Consent Information: Review the following information and initial or provide a signature to acknowledge your understanding and acceptance of the following terms and conditions.

1. You voluntarily agree to participate in a research study at this institution. The title of the research is *Biological Age Deceleration in Fibromyalgia Patients Experiencing Chronic Pain.*
2. You understand that the purpose of the research is to evaluate the barriers that fibromyalgia patients may have when improving general health. This study is based on improving balance, flexibility, and fitness. Fibromyalgia therapy uses biological, psychological, and social components to pain management. This study will focus on biological and psychological components. This research is important for developing a standard fibromyalgia therapy.
3. Your participation will involve: An “at-home” health education course, in which you will participate on a regular basis over a 6-week period. Fitness, balance, and flexibility assessments which will be conducted by a physician before and after the health education course in person.

4. Psychological and cognitive tests which will be conducted by a health professional before and after the health education course in person. Surveys, questionnaires, and interviews which will be conducted over the telephone or in person.
5. You understand there are possible risks to you if you agree to participate in the study. They include any foreseeable and unforeseeable risks or discomforts, including the consequences of ineffective treatment. You understand that if side effects or discomforts do occur, *Matthew Caines* will try to minimize and treat these by limiting or eliminating your participation in this study and/or requesting that you follow-up under the care of a physician. You understand that the treatment or procedure described may involve risks to you which are currently unforeseeable. You understand that the researcher may terminate your participation without regard to your consent under certain circumstances or when, in the investigator's judgment, it is in your interest to do so.
6. You understand that the results of the research study may be published but that your name or identity will not be revealed and that your records will remain confidential. In order that confidentiality can be maintained, *Matthew Caines* will not use your name or any other identifiable information when collecting data for this study.
7. You understand that the possible benefits of your participation include: Improved flexibility, balance, and/or fitness; and a method to manage pain
8. You understand that there are alternatives to this health education course. You understand that the alternative is non-participation. Other alternatives may be suggested by your general medicine physician.
9. You also understand that your participation is voluntary and that refusal to participate will involve no penalty to you or loss of benefits to which you are otherwise entitled. You also understand that you may withdraw from the research study at any time without penalty or prejudice. If you withdraw from the study, you will notify *Matthew Caines (760) 282-4531.* You will be informed of any significant (major) new findings developed during the course

of your participation in this research which may have a bearing on your continuation of the study.

10. You agree to volunteer for this study and will not be paid for participation in the research study. If you should decide to terminate your participation prior to completion, you may do so at any time by notifying *Matthew Caines*.
11. You understand that there may be harm to an embryo or fetus if you should become pregnant. To the best of your knowledge, you are not pregnant, and if you do become pregnant, you will notify the researcher of your pregnancy, and immediately stop the health education course.
12. To the best of your knowledge, you are not participating in any other medical research study.
13. Any questions that you may have concerning your participation in the research study will be answered by *Matthew Caines*, who can be reached at (760) 282-4531 or mcaines@atsu.edu.
14. You understand that *Matthew Caines* may evaluate and refer you for treatment in the event that an injury results because of your participation in this project. The College has not set aside funds to provide financial compensation. The College assumes no liability for any injury that results from your participation in this project. In addition, Matthew Caines assumes no liability for any injury that results from your participation in this project.
15. If you have any questions about your rights as a research subject or in the event your believe you have suffered any injury as a result of participation in the research project, you may contact, Robert Theobald, Ph.D., the Chairman of KCOM Institutional Review Board (660-626-2316), who will discuss your questions or will be able to refer you to the individual who will review the matter with you, identify other resources that may be available, and provide further information as to how to proceed.

16. “I have read the above statement and have been able to ask questions and express concerns, which have been satisfactorily responded to by the investigator. I believe I understand the purpose of the study as well as the potential benefits and risks that are involved. I hereby give my informed and free consent to be a participant in this study."
    Participant’s signature _____
    Date: _____
17. "I certify that I have explained to the above individual the nature and purpose, the potential benefits and possible risks associated with participation in this research study, have answered any questions that have been raised, and have witnessed the above signature."
    Investigator’s signature _____
    Date _____
18. These elements of Informed Consent conform to the assurance given by KCOM to the DHHS to protect the rights of human subjects.
19. "I have provided the subject/patient a copy of this signed consent document."
    Investigator’s signature _____
    Date _____

Figure 4. Informed consent form.

Summary. The parameters of the proposed study are defined by the research design. The qualitative research design of grounded theory will be used in this study. Grounded theory research determines sample size through theoretical saturation, the number of research groups, and the role of the subject during data procurement. The Wilcoxon signed ranks test will be used to analyze pretest and posttest data. The methodology of grounded theory, how data is gathered, analyzed, and interpreted, must

be detailed with respect to this study. Furthermore, it is necessary to describe the selection and use of the Wilcoxon signed-rank test, as well as the Wilcoxon signed-rank test calculations. The next section will describe the grounded theory research and the Wilcoxon signed ranks test statistical analysis.

Data Collection and Analysis of Grounded Theory. Grounded theory emerged in the 1960s from the work of sociologists Barney G. Glaser and Anselm L. Strauss (Glaser & Strauss, 1967). Glaser and Strauss (1967) investigated dying patients in hospitals in the United States by collecting qualitative data. After analyzing the data, they constructed theoretical analyses of the social organization and temporal order of dying. Glaser and Strauss (1967) were able to develop theory based on data rather than through the deductive testing of hypotheses. This became known as grounded theory.

There are several components to grounded theory (see Figure 5): (a) gathering and analyzing data, (b) forming categories or analytical codes based on the data (i.e., omitting previous logically derived hypotheses), (c) implementing a constant comparative method, which compares the codes and categories during each stage of analysis, (d) theory formulation, (e) category elaboration through memo writing, (f) theory construction through sampling, and (g) literature review after developing an independent analysis (Charmaz, 2007). Glaser and Strauss (1967) demonstrated that grounded theory provided theoretical models that could not be diminished, since these models was derived from the data itself, rather than through logic or rationale with subsequent experimentation to support the logic/rationale. In essence, grounded theory works backward from that of quantitative research. Instead of discussing results in terms of the hypothesis, the results become the hypothesis (Charmez, 2006).

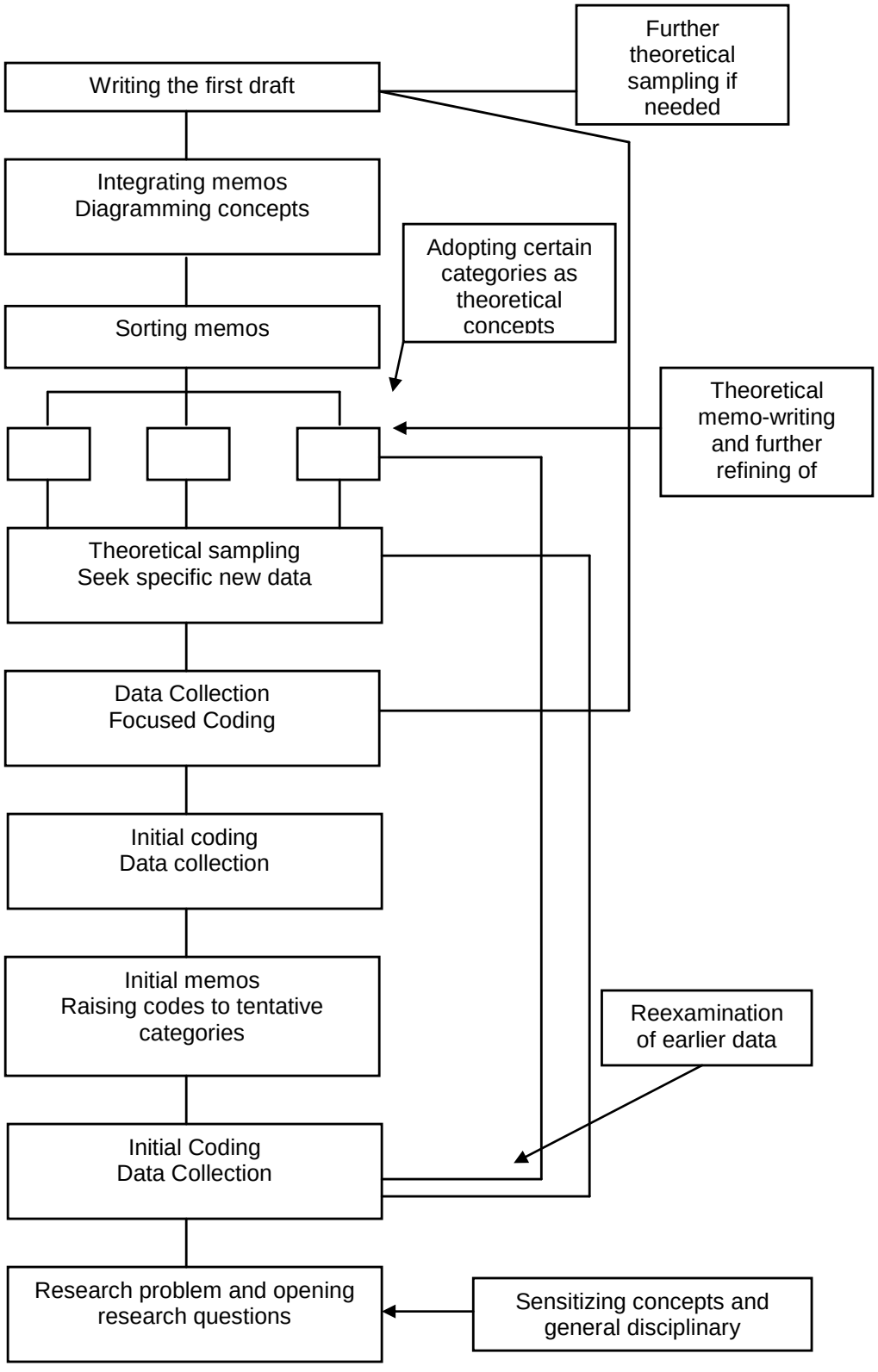

Figure 5. Grounded theory process (Charmaz, 2007).

Grounded theory research has similarities to ethnography (Coffey & Atkinson, 1996). Ethnography and grounded theory research provides information on a population without experimental design. Grounded theory research differs from ethnography on the basis of methodology, whereas ethnography involves description of human society (i.e., no interaction with researcher) and grounded theory research interacts with a population (e.g., intensive interviews). In the proposed study, a chronic pain management health education program will be implemented. Interaction with this population presents the opportunity to study a particular group via ethnography. Grounded theory would provide the option of probing particular areas of interest in order to record the life of the study participants. Furthermore, grounded theory ethnography attributes priority to the examination of a phenomenon or process, rather than assessing the setting itself.

Data Collection. Intensive interviewing allows for the collection of rich data and has been the mainstay method of data-gathering in qualitative research (Charmez, 2006). In intensive interviewing, a particular topic or issue may be explored in great detail, providing the researcher with a complete depiction of the participant's interpretation of his or her experience. Intensive interviewing allows the researcher to: (a) probe participants for in-depth information; (b) go on a tangent to gather more information based on a particular statement or topic; (c) seek additional information or clarify an explanation; (d) gather information on a participant's feelings, thoughts, or actions; (e) bring the participant back to a topic; (f) shift to a different topic; (g) provide validation to the participant in terms of humanity, action, or perspective; (h) use social skills to investigate; and (i) express respect and appreciation for the participant. Furthermore, intensive interviews allow participants to: (a) express their views; (b) tell their stories in

a coherent way; (c) reflect on previous events; (d) be experts; (e) choose the way in which to share their experience; and (f) receive understanding and affirmation. In the proposed study intensive interviews will be used to collect data.

This study will collect data using the Beck Depression Inventory, Beck Anxiety Inventory and intensive interviews. The Beck Depression Inventory and Beck Anxiety Inventory (i.e., the pretest and posttest assessments) are detailed in following section (See Psychological Assessment). For the intensive interview, the following questions will be used to collect data after the chronic pain management health education program.

Initial Questions. Figure 6 depicts the initial questions that will be used during the intensive interview.

Tell me about what happened during the health education program.
When, if at all, did you first experience or notice a change in managing your fibromyalgia?
[If so,] what was it like? What did you think when it happened? How did you happen to manage your fibromyalgia? Who, if anyone, influenced your actions? Tell me about how he/she or they influenced you.
Could you describe the events that led up to your management of fibromyalgia?
What contributed to this change?
What was going on in your life at that time? How would you describe how you viewed managing fibromyalgia before this health education program? How, if at all, as your view of managing fibromyalgia changed?
How would you describe the person you were then?
(additional questions if needed)

Figure 6. Initial questions for intensive interviews.

Intermediate Questions. Figure 7 depicts the intermediate questions that will be used during the intensive interview.

What, if anything, did you know about managing fibromyalgia?

Tell me about your thoughts and feelings when you learned about biological ageing.

What happened next?

Who, if anyone, was involved? When was that? How were they involved?

Tell me about how you learned to handle the management techniques within this program.

How, if at all, have your thoughts and feelings about chronic pain management changed since beginning this program?

What positive changes have occurred in your life since beginning this program?

What negative changes have occurred, if any, since beginning this program?

Tell me how you go about managing your fibromyalgia. What do you do?

Could you describe a typical day for you when you are managing your fibromyalgia? [Probe for different times.] Now tell me about a typical day when you are not managing your fibromyalgia.

Tell me how you would describe the person you are now. What most contributed to this change [or continuity]?

As you look back on your life before this program, are there any other events that stand out in your mind? Could you describe [each one] it? How did this event affect what happened? How did you respond to [event]?

Could you describe the most important lessons you learned through experiencing this program?

Where do you see yourself in two years [five years, ten years as appropriate]? Describe the person you hope to be then. How would you compare the person you hope to be and the person you see yourself now?

What helps you to manage fibromyalgia in the future? What problems might you encounter? Tell me the sources of these problems.

Who has been the most helpful to you during this time? How has she/he been helpful?

Has any organization been helpful? What did [the organization] help you with? How has it been helpful?

Additional questions (if necessary)

Figure 7. Intermediate questions for intensive interviews.

Ending Questions. Figure 8 depicts the ending questions that will be used during the intensive interview.

What do you think are the most important ways to manage fibromyalgia? How did you discover [or create] them? How has your experience before this program affected how you manage fibromyalgia?

Tell me about your views [and/or actions depending on the preceding responses] may have changed since you began this program.

How have you grown as a person since this program? Tell me about your strengths that you discovered or developed through completing this program. [If appropriate] What do you most value about yourself now? What do others most value in you?

After having these experiences, what advice would you give to someone who has just been diagnosed with fibromyalgia?

Is there anything that you might not have thought about before that occurred to you during this interview?

Is there anything else you think I should know to understand fibromyalgia better?

Is there anything you would like to ask me?

Additional questions (if necessary).

Figure 8. Ending questions for intensive interviews.

Intensive interviewing requires the researcher to probe any topic of issue that is deemed appropriate or important to the study parameters. Therefore, follow-up questions that are not listed above may be used in the proposed study.

Data Analysis: Coding. The first phase of data analysis is initiated upon collection of qualitative data using intensive interviewing. This phase of data analysis in grounded theory is coding and is the first step in transforming concrete statements into analytical interpretations (Charmaz, 2007). Qualitative coding has been described as the process by which data are labeled or summarized into categories, accounting for the collective procured data (Bowker & Star, 1999). More specifically, qualitative codes distinguish data into segments, summarize them by a meaningful term, and provide a handle for developing abstract ideas for data interpretation.

There are different types of coding used in grounded theory. Grounded theory research begins with initial coding. In initial coding, the codes fit the data rather than the data fitting the codes. Furthermore, the meaningful units must summarize, be simple and precise, preserve actions, compare data with other data, and move quickly through the data (Charmaz, 2007). Initial coding generates data generates data that is categorized either word-by-word or line-by-line. Word-by-word coding is used in ephemera documents (e.g., Internet data), whereas line-by-line coding is used in interviews. Therefore, the proposed study will use line-by-line coding for the initial coding data analysis. Table 2 details an example of line-by-line coding.

Table 2

Example of line by line coding.

Coding	Patient Response
Daughter found out second-hand Daughter contacted Patient X Daughter confronted Patient X Daughter was upset The patient links event with pain Specific pain trigger / Pain increased Patient concept of dealing w/pain Patient attempts to manage pain Time when pain escalated Pain increased with breathing Foresees breathing crisis Scared about more pain Contacted Daughter Physician appointment	…She found out from Linda that I was, had been in bed for days and she called me up, "You never tell me, and I have to find out from Linda," and "Why don't you tell me who you are and what's going on and …" Well, I don't know how long after that, but Saturday the pain started right here and it, throughout the day it got worse and worse and worse. And she—I kept thinking that, well, I can deal with this, so I took some kind of pain pill and nothing helped. And that was about one in the afternoon. Well, it got worse and worse so that every time I took a breath the pain was horrible, so by seven, eight o'clock that night, I was scared because I knew that if it got any worse I wasn't going to be able to breathe. So I called her and then I told her what was going on, that I was going to be driven to the doctor….

Note. From "Constructing Grounded Theory" by K. Charmaz (2007).

Initial coding assists with distinguishing data into categories and to observe processes (Glaser & Strauss, 1967). Through line-by-line coding, grounded theory researchers are able to understand the types of data needed (i.e., identify gaps or holes in a theory) (Charmez, 2006). Additionally, coding can become more global when major themes are identified. Therefore, line-by-line coding leads to coding via segment-by-

segment or incident-by-incident. Using codes, analytical distinctions are made using the process of constant comparative methods (Glaser & Strauss, 1967). In terms of coding, this analytical method involves comparing and contrasting data. The comparison can be made among participants in a cohort or within several different interviews over time by the same participant.

The second major phase in coding is focused coding. These codes are more conceptual than word-by-word or line-by-line (Charmez, 2006). In focused coding, early codes are used to distinguish significant categories. In the proposed study, focused coding will be used after initial coding to derive higher level concepts for grounded theory analysis. Table 3 details an example of focused coding.

Table 3

Example of focused coding.

Coding	Patient Response
Receiving second-hand news Being left out; Accusing mother of repeated not telling; (questioning ethical stance?) Being confronted Facing self and identify questions; Demanding self-disclosure and information Experiencing escalating pain Expecting to manage pain Inability to control pain Rapid worsening of pain Having excruciating pain Becoming frightened; Foreseeing breathing crisis Breaking the news; Informing daughter of plan	…She found out from Linda that I was, had been in bed for days and she called me up, "You never tell me, and I have to find out from Linda," and "Why don't you tell me who you are and what's going on and …" Well, I don't know how long after that, but Saturday the pain started right here and it, throughout the day it got worse and worse and worse. And she—I kept thinking that, well, I can deal with this, so I took some kind of pain pill and nothing helped. And that was about one in the afternoon. Well, it got worse and worse so that every time I took a breath the pain was horrible, so by seven, eight o'clock that night, I was scared because I knew that if it got any worse I wasn't going to be able to breathe. So I called her and then I told her what was going on, that I was going to be driven to the doctor….

Note. From "Constructing Grounded Theory" by K. Charmaz (2007).

The third type of coding in grounded theory is axial coding. In axial coding, the dimensions and properties of a category are specified (Charmez, 2006). Strauss and Corbin (2007) attribute three components to organizing data via axial coding. These components are: (a) the condition, which is a set of situations or circumstances pertaining to the studied phenomena; (b) the action or interaction, which is the participant response (e.g., strategic or routine) to events, problems, or issues; and (c) the consequence, which is the outcome of the action or interaction.

The fourth type of coding is theoretical coding and uses the data generated using focused coding (Charmez, 2006). Theoretical coding establishes relationships between the categories developed during focused coding and/or axial coding. Since axial coding assists with defining the category, Glaser (1992) states that axial coding assists with putting the fragmented segments back together in a more sophisticated manner.

Glaser (1978, 1998) identified several theoretical coding families: (a) causes, (b) contexts, (c) contingencies, (d) consequences, (e) covariances, (f) conditions, (g) degree, (h) dimension, (i) interactive, (j) theoretical, (k) type, (l) identify-self, (m) means-goals, (n) cultural, (o) consensus, (p) paired opposite, (q) representation, (r) scale, (s) random walk, (t) structural-functional, and (u) unit identity.

Coding in grounded theory generates the data used in further analyses. In other words, qualitative coding methods provide the necessary data used in memo-writing, theoretical sampling, reconstructing theory, and writing the draft.

Data Analysis: Memo-Writing. Memo-writing is an integral phase in grounded theory research that allows the researcher to pause and analyze data early in the research process (Charmaz, 2007). Memos capture the connections, comparisons, and thoughts of

the researcher and allows for the direction of research to be clarified (See Figure 9). During the memo-writing process, analytical notes provide the opportunity to expound the categories derived from the previous grounded theory phases. Using the meaningful units from focused coding and/or axial coding, a narrative is developed. Each narrative compares one of the following: (a) data with data, (b) data and codes, (c) codes and category, or (d) category and concept.

Suffering is a profoundly moral status as well as a physical experience. Stories of suffering reflect and redefine that moral status. With suffering come moral rights and entitlements as well as moral definitions—when suffering is deemed legitimate. Thus, the person can make certain moral claims and have certain moral judgments conferred upon him or her. (a) Deserving; (b) Dependent; (c) In need

Suffering can bring a person an elevated moral status. Here, suffering takes on a sacred status. This is a person who has been in sacred places, who has seen, known what ordinary people have not. Their stories are greeted with awe and wonder. The self also has elevated status. This person is special; the compelling story casts an aura of compelling qualities on the story-teller

Example: Bessie and her daughter. When Bessie spoke about the pain increase, her daughter was in the background intently listening. It is possible that the story of suffering presents the opportunity for one to play out the role of the hero myth. This is evident when Bessie explained about her experience with painful breathing. Something about this story sparked interest and her daughter began to ask questions and ultimately empathize with Bessie. Even though her daughter seemed engaged in the story, Bessie spoke as if detached from the situation. This loss of self was also evident in the recreation of events in other participants…

Figure 9. Example of memo-writing (Charmaz, 2007).

The purpose of a memo is to generate ideas and begin a discussion of collected and partially analyzed data. In the above memo, the category (i.e., suffering as a moral status) can be theoretically analyzed. For instance, the word "status" indicates a certain type of structure. More specifically, "status" suggests a hierarchical stratification of social value. Therefore, the researcher may explore this by creating a hierarchy of moral status in suffering.

Memo writing has a more detailed process than comparison. There are two types of memo-writing: early memo-writing and advanced memo-writing (Charmaz, 2007). In early memo-writing, the researcher explores qualitative codes and charts processes. Early memos are used to focus further collection of data, providing research with direction. Advanced memos involve: (a) additional categorization, (b) category description and category lifecycle; (c) detailing assumptions and beliefs, (d) opportunity to expound different perspectives, (e) contextualize data within an argument, and (f) establish interrelationships. Using memo-writing allows the researcher to form preliminary models by using the following techniques: clustering, free-writing, and flow charts. Memos form the foundation for grounded theory and provide the necessary data analysis for theoretical sampling.

Data Analysis: Theoretical Sampling. At this point in the proposed study using grounded theory research, the researcher will have emerging, but incomplete, ideas and tentative categories. The next phase uses all previous analyses to elaborate and refine the categories that constitute the theoretical outcome (Charmaz, 2007). Theoretical sampling is used to develop the properties of each category until there are no new properties. This saturation of categories is subsequently followed by sorting and/or diagramming into an

emerging theory. In theoretical sampling, logic supersedes sample size. A study may have a very small cohort, but unless the researcher is making inferences about human nature, larger cohorts are not necessary (Charmaz, 2007).

Theoretical sampling is unique compared to other types of sampling, such that it requires elaboration and refinement, rather than providing a point of departure. It is important to note that saturation does not occur when the researcher sees the same pattern over and over again (Charmaz, 2007). Instead, saturation occurs when no new properties emerge and conceptual density is generated. The use of theoretical sorting provides the researcher with the methodology of creating and refining theoretical links. These links may be solidified using diagramming. Diagrams offer the visual summary of data analysis.

Generating Theory: Reconstructing theory. Reconstructing theory (Charmaz, 2007), also called delimiting the theory (Glaser & Strauss, 1967), is the phase in grounded theory research in which the data analyses of previous phases are transformed into a bona fide theory (Charmaz, 2007). Although grounded theory could produce a positivist theory, in which theory defines causes and has universal application, this study will take an interpretive definition of theory, which uses creative understanding to assess phenomena and has a processual perspective. There are several goals in interpretive theory: (a) use conceptualization to understand phenomena in abstract terms, (b) detail scope, depth, power, and relevance in the articulation of theoretical claims, (c) recognize subjectivity in reconstructing theory, thereby acknowledging negotiation, understanding, and dialogue roles, and (d) generate creative interpretation. This study will use a constructivist grounded theory perspective. The constructivist grounded theory approach

prioritizes data and analysis, as well as the participant experiences and relationships (Charmaz, 1990, 1995, 2000, 2001; Charmaz & Mitchell, 1996). The constructivist grounded theory perspective is integral to this study since the participant experiences, recorded using intensive interviews, will be analyzed into the formation of a theoretical model.

In reconstructing theory, the categories and thereby the theory itself is delimited (Glaser & Strauss, 1967). Delimiting involves reduction and saturation throughout the constant comparison method of qualitative analysis. As the researcher analyzes data through coding and memo-writing, theoretical saturation occurs when the coding or comparisons become repetitive. At the point of saturation, data reduction may be implemented. Data reduction involves the collapsing of overlapping concepts into a higher level concept. Glaser & Strauss (1967) details an example of data reduction in which categories of social loss, physical loss, or productivity loss could be collapsed into "loss rationales." The higher level concept of loss rationales were linked to age in dying patients in hospitals, whereby loss rationale was stronger when a younger patient was in crisis. It is through this process that the researcher achieves two main requirements of theory: the scope and the parsimony of variables / formulation.

Reconstructing theory reduces the original list of categories derived from coding and provides more focus for the information contained in memos (Glaser & Strauss, 1967). Grounded theory research develops theoretical sensitivity by first analyzing the fundamental units of the participant experience, probing through the condition, action, and consequences of the phenomena, and fostering possibilities, establishing relationships, and asking questions. In essence, grounded theory generates simplistic

conclusions from convoluted data. At the end of reconstructing theory, the researcher has focused parameters related to the theory, but the theory has yet to be established. The final process is to generate a framework for systematic substantive theory, which is completed during the writing the draft phase.

Generating Theory: Writing the draft. Writing the draft (Charmaz, 2007), or theory writing (Glaser & Strauss, 1967), is the ending phase of grounded theory. In writing the draft, a focused literature review is conducted to compare and contrast the emerging theory, which was developed in the reconstructing theory phase, with theoretical models that are similar. If the theories are similar, that aspect of the emerging theory has been substantiated. However, if the theories are different, the researcher must examine the data (i.e., coding and memos) to explain the discrepancy. Once the variations are explained, the researcher has developed a systematic substantive theory. At this point, the researcher may commit to theory composition.

In theory composition, the researcher uses the delimited data, as well as memos and coding, to document the processual experience of the phenomena (Charmaz, 2007). The research will use the delimited categories and relationships to form a theoretical model. In order to form a theoretical model, the researcher uses the systematic substantive theory, memos, and coding to sketch a visual representation of the phenomena. It is at this point in grounded theory research that the researcher has established conclusions and generated theory, through the data itself. This is the point at which the researcher has met the demands of grounded theory and completed all responsibilities to this process.

Summary. Grounded theory generates theory beginning with data collection and ending with data analyses and theory formation. In the proposed research project, intensive interviews will be used to obtain qualitative data. These data will be coded and analyzed using memos. The data analyses herein will generate an emerging theory. This emerging theory will be compared with similar theoretical models and systematically substantiated. The process of grounded theory research ends with composition of a theoretical model, which may involve the formation a visual representation of the theoretical concept.

Psychological Assessment.

Psychological assessment is important in this patient group because of the relationship with fibromyalgia and psychological function (Salt & Season, 2000). More specifically, there is a known relationship between depression and anxiety, and fibromyalgia. The proposed health intervention may impact psychological function. Therefore, it is necessary to measure psychological function pre-hoc and post-hoc. This study will use the Beck Depression Inventory and the Beck Anxiety Inventory to assess depression and anxiety levels in this study. The two questionnaires will be administered before and after the health education course. Since there will be one measureable variable (i.e., the questionnaire score), each questionnaire will be administered at two different times, and the distribution will be non-normally distributed, the Wilcoxon signed ranks test, a non-parametric test, will be used to analyze the scores for each questionnaire, before and after the health intervention. This study cannot assume a normal distribution since the Central Limit Theorem cannot be satisfied because this study will not have thirty or more participants.

Beck Depression Inventory. The Beck Depression Inventory is a questionnaire featuring twenty-one multiple choice questions used to measure the severity of depression (Beck, et al., 1961). The Beck Depression Inventory uses a Likert scale to assess level of depression. A higher score on the Beck Depression Inventory is interpreted as a greater level of depression compared to a lower score. Figure 10 details the Beck Depression Inventory questionnaire.

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1. Mood

- ☐ I do not feel sad
- ☐ I feel blue or sad
- ☐ I am blue or sad all the time and I can't snap out of it
- ☐ I am so sad or unhappy that it is very painful
- ☐ I am so sad or unhappy that I can't stand it

2. Pessimism

- ☐ I am not particularly pessimistic or discouraged about the future
- ☐ I feel discouraged about the future
- ☐ I feel I have nothing to look forward to
- ☐ I feel that I won't ever get over my troubles
- ☐ I feel that the future is hopeless and that things cannot improve

3. Sense of Failure

- ☐ I do not feel like a failure
- ☐ I feel I have failed more than the average person
- ☐ I feel I have accomplished very little that is worthwhile or that means anything
- ☐ As I look back on my life all I can see is a lot of failures
- ☐ I feel I am a complete failure as a person (parent, husband, wife)

4. Lack of Satisfaction

- ☐ I am not particularly dissatisfied
- ☐ I feel bored most of the time
- ☐ I don't enjoy things the way I used to
- ☐ I don't get satisfaction out of anything any more
- ☐ I am dissatisfied with everything

5. Guilty Feeling

- ☐ I don't feel particularly guilty
- ☐ I feel bad or unworthy a good part of the time
- ☐ I feel quite guilty
- ☐ I feel bad or unworthy practically all the time now
- ☐ I feel as though I am very bad or worthless

6. Sense of punishment

- ☐ I don't feel I am being punished
- ☐ I have a feeling that something bad may happen to me
- ☐ I feel I am being punished or will be punished
- ☐ I feel I deserve to be punished
- ☐ I want to be punished

7. Self Hate

- ☐ I don't feel disappointed in myself
- ☐ I am disappointed in myself
- ☐ I don't like myself
- ☐ I am disgusted with myself
- ☐ I hate myself

8. Self Accusations

- ☐ I don't feel I am any worse than anybody else
- ☐ I am very critical of myself for weaknesses or mistakes
- ☐ I blame myself for everything that goes wrong
- ☐ I feel I have many bad faults

9. Self-punitive Wishes

- ☐ I don't have any thoughts of harming myself
- ☐ I have thoughts of harming myself but I would not carry them out
- ☐ I feel I would be better off dead
- ☐ I have definite plans about committing suicide
- ☐ I feel my family would be better off if were dead
- ☐ I would kill myself if I could

10. Crying Spells

- ☐ I don’t cry any more than usual.
- ☐ I cry more now than I used to.
- ☐ I cry all the time now. I can’t stop it.
- ☐ I used to be able to cry but now I can’t cry at all even though I want to

11. Irritability

- ☐ I am no more irritated now than I ever am.
- ☐ I get annoyed or irritated more easily than I used to.
- ☐ I feel irritated all the time
- ☐ I don’t get irritated at all at the things that used to irritate me

12. Social Withdrawal

- ☐ I have not lost interest in other people.
- ☐ I am less interested in other people now than I used to be.
- ☐ I have lost most of my interest in other people.
- ☐ I have lost all my interest in other people and don’t care about them at all.

13. Indecisiveness

- ☐ I make decisions about as well as ever.
- ☐ I try to put off making decisions.
- ☐ I have great difficulty in making decisions.
- ☐ I can’t make decisions at all anymore

14. Body Image

- ☐ I don't feel I look any worse than I used to
- ☐ I am worried that I am looking old or unattractive
- ☐ I feel that there are permanent changes in my appearance and they make me look unattractive
- ☐ I feel that I am ugly or repulsive looking

15. Work Inhibition

- ☐ I can work about as well as before
- ☐ It takes extra effort to get started at doing something.
- ☐ I don't work as well as I used to
- ☐ I have to push myself very hard to do anything
- ☐ I can’t do any work at all

16. Sleep Disturbance

- ☐ I can sleep as well as usual
- ☐ I wake up more tired in the morning than I used to
- ☐ I wake up 1-2 hours earlier than usual and find it hard to get back to sleep
- ☐ I wake up early every clay and can't get more than 5 hours sleep

17. Fatigability

- ☐ I don’t get any more tired than usual.
- ☐ I get tired more easily that I used to.
- ☐ I get tired from doing anything.
- ☐ I get too tired to do anything

18. Loss of Appetite

- ☐ My appetite is no worse than usual
- ☐ My appetite is not as good as it used to be
- ☐ My appetite is much worse now
- ☐ I have no appetite at all any more

19. Weight Loss

- ☐ I haven't lost much weight, if any, lately
- ☐ I have lost more than *5* pounds
- ☐ I have lost more than 10 pounds
- ☐ I have lost more than 15 pounds

20. Somatic Preoccupation

- ☐ I am no more concerned about my health than usual
- ☐ I am concerned about aches and pains or upset stomach or constipation or other unpleasant feelings in my body
- ☐ I am so concerned with how I feel or what I feel that it's hard to think of much else
- ☐ I am completely absorbed in what I feel

21. Loss of Libido

- ☐ I have not noticed any recent change in my interest in sex
- ☐ I am less interested in sex than I used to be
- ☐ I am much less interested in sex now
- ☐ I have lost interest in sex completely

Figure 10. Beck Depression Inventory questionnaire (Beck, Ward, Mendelson, Mock, & Erbaugh, 1961).

Beck Anxiety Inventory. The Beck Anxiety Inventory is a 21 multiple choice test that assesses severity of anxiety conditions (Leyfer, Ruberg, & Woodruff-Borden, 2006). This questionnaire uses a Likert scale for data procurement. A greater score on

the Beck Anxiety Inventory is interpreted as greater anxiety than a lower score. Table 4 details the Beck Anxiety Inventory questionnaire.

Table 4

Beck Anxiety Inventory questionnaire.

	Not at all	Mildly, but it didn't bother me much	Moderately, it wasn't pleasant at times	Severely, it bothered me a lot
Numbness or tingling	0	1	2	3
Feeling hot	0	1	2	3
Wobbliness in legs	0	1	2	3
Unable to relax	0	1	2	3
Fear of worst happening	0	1	2	3
Dizzy or lightheaded	0	1	2	3
Heart pounding or racing	0	1	2	3
Unsteady	0	1	2	3
Terrified or afraid	0	1	2	3
Nervous	0	1	2	3
Feeling of choking	0	1	2	3
Hands trembling	0	1	2	3
Shaky or unsteady	0	1	2	3
Fear of losing control	0	1	2	3
Difficulty in breathing	0	1	2	3
Fear of dying	0	1	2	3
Scared	0	1	2	3
Indigestion	0	1	2	3
Faint / lightheaded	0	1	2	3
Face flushed	0	1	2	3
Hot or cold sweats	0	1	2	3

Wilcoxon Signed-Ranks Test. In this study, the Beck Depression Inventory and the Beck Anxiety Inventory will be analyzed using the Wilcoxon signed-rank test. This assessment is appropriate because there is a single cohort, data are interval/ratio, and the sample will be tested twice (Le, 2001). The questionnaire responses will be reduced to numbers using the Likert scale. For example, the following question from the Beck Depression Inventory can be reduced to numerical values, using the Likert scale (see Table 5).

Table 5

Likert scaling of mood question in the Beck Depression Inventory.

Question response	Likert Scale
I do not feel sad.	0
I feel blue or sad	1
I am blue or sad all the time and I can't snap out of it.	2
I am so sad or unhappy that it is very painful	3
I am so sad or unhappy that I can't stand it.	4

The Wilcoxon signed-rank test will be performed on both questionnaires as a whole, but in the Beck Depression Inventory, the questions will also be analyzed in two groups. These two groups are mental manifestations of depression (i.e., questions that deal with sadness, pessimism, past failure, guilty feelings, punishment feelings, self-dislike, self-criticalness, suicidal thoughts or wishes, and worthlessness) and physical manifestations of depression (i.e., questions that deal with crying, agitation, loss of interest, indecisiveness, loss of energy, changes in sleeping pattern, irritability, changes in appetite, concentration difficulty, tiredness or fatigue, and loss of interest in sex).

The Wilcoxon signed-ranks test will be conducted using Microsoft Excel. The data collected from the questionnaires will be paired with the participant identification number. The data obtained from the Wilcoxon signed-rank test will be compared to the qualitative data obtained through grounded theory analysis in order to validate findings. Since the Wilcoxon signed-rank test will be calculated in a spreadsheet (e.g., Microsoft Excel), it is necessary to detail the calculation method. Table 6 details the method for calculating the Wilcoxon signed-rank test using a spreadsheet.

Table 6

Example Wilcoxon signed-rank test data.

ID	Pretest	Posttest	Difference	Abs. Diff.	Rank	Signed Rank
A	1	3	+2	2	3.5	+3.5
B	8	2	-6	6	10.0	-10.0
C	6	14	+8	8	12.0	+12.0
D	9	10	+1	1	1.5	+1.5
E	5	12	+7	7	11.0	+11.0
F	20	17	-3	3	6.0	-6.0
G	7	26	+19	19	15.0	+15.0
H	4	13	+9	9	13.0	+13.0
I	11	15	+4	4	8.0	+8.0
J	22	27	+5	5	9.0	+9.0
K	25	23	-2	2	3.5	-3.5
L	24	21	-3	3	6.0	-6.0
M	16	19	+3	3	6.0	-6.0
N	18	30	+12	12	14.0	+14.0
O	29	28	-1	1	1.5	-1.5

The purpose of Wilcoxon signed-rank test is to examine if there is a difference among the positive and negative ranks. If there is a difference, then there was an effect after treatment and the null hypothesis is rejected (Le, 2001). In addition to the Wilcoxon signed-rank test, a Spearman rho and/or Kendall's Tau may be calculated. The Spearman rho and Kendall's Tau are additional non-parametric tests that complement and support findings of the Wilcoxon signed-ranks test. These non-parametric tests will be calculated if the Wilcoxon signed-rank test demonstrates a difference in ranks.

Course Implementation

Budget. The proposed research project has a small budget due to donations and free services. The total cost for this project will be $130.00 and is covered by the researcher. The budget is broken down into: course workbook & journal, psychological tests, and a web-hosting site for the distance learning platform. The budget is itemized in Table 7.

Table 7

Budget for the proposed study.

Item	Quantity	Cost/Unit	Total
Course workbook & Journal	15	$2.00	$30.00
Psychological tests packet (i.e., Beck Inventories)	2	$50.00	$100.00
Online Learning Environment (i.e., Facebook Groups)	1	$0.00	$0.00
Total			$130.00

Timeline. The proposed research will occur over a three month period. Participants will be evaluated before and after the health education course. More specifically, the implementation timeline, including recruitment, intervention, and data analysis is detailed in Table 8.

Table 8

Timeline for the proposed study.

Date	Activity	Duration
April 2009	Participant Recruitment	8 weeks
August 2009	Pre-intervention assessment	1 week
September 2009	Health education Course	6 weeks
November 2009	Post-intervention assessment	1 week
December 2009	Data analysis	3 weeks

Audience Affected. Fibromyalgia patients experience chronic pain and fatigue. These symptoms may indicate a barrier to biological age deceleration. Recently, it has been shown that fibromyalgia patients who complete a fitness course improve management of disease symptoms. The proposed study will investigate fibromyalgia patients by studying the management of fitness, flexibility, and balance, as well as the impact of psychological components.

Summary. The proposed study has a limited budget of $130, due to the use of donations and offer of free services. The timeline for this study from recruitment to data analysis is approximately five months. During this time, participants will be evaluated before and after completion of the health education course, as well as a complete analysis of collected data will be performed. In the following section, the health education course is detailed.

Curriculum

Syllabus. The following sections detail the implementation of the course curriculum in syllabus format.

Audience. This course is designed for patients with fibromyalgia who experience chronic pain. In addition, patients who are 40 years or older will be used in this project.

Course Description. This course explores the philosophy of biological age deceleration and the techniques used to manage the following biomarkers: fitness, flexibility, and balance. The course begins with patient evaluations to identify specific barriers for improving biomarkers. After issues with improving the biomarkers are identified, patients will be presented with solutions. In addition, patients will be trained to specifically overcome barriers that are a result of chronic pain rendered by fibromyalgia.

Outcomes. By successfully completing this course, patients/subjects will be able to: (a) describe biological age deceleration, (b) describe biomarkers and manage flexibility, balance, and fitness in each patient, (c) identify and discuss barriers to biological age deceleration in terms of chronic pain, and (d) monitor and modify behaviors that improve biomarkers.

Format. This course will use a combination of small group live-classroom and distance learning activities. In live-classroom activities, patients will be trained on specific techniques to overcome barriers to biological age deceleration. In distance learning activities, patients will hone skills presented in live-classroom activities.

Course Outline. Table 9 details the outcomes and objectives of the health education course, as well as how these variables relate to learning activities and student assessments.

Table 9

Health education course outline.

Outcome	Objective	Activity	Assessment
Module 1: Describe biological age deceleration	Define and discuss the "body as a whole" concept	Article A	Discussion Board 1
	Discuss biological ageing	Article A	Discussion Board 2
Module 2: Describe biomarkers and manage flexibility, fitness, and balance	Discuss the use of meditation in daily life	Article B	Discussion Board 3
	Describe the event of meditation	Article B	Discussion Board 4
Module 3: Identify and discuss barriers to biological age deceleration in terms of chronic pain.	Identify and discuss flexibility in terms of chronic pain and techniques used to overcome barriers	Article C	Discussion Board 5
		Article C	Discussion Board 6
		Article C	Discussion Board 7
Module 4: Monitor behaviors that improve biomarkers	Discuss the benefits of adhering to a healthy lifestyle	Article D	Discussion Board 8
Module 5: Describe biomarkers and manage flexibility, fitness, and balance	Identify methods for managing biomarkers	Article D	Discussion Board 9

Learning Activities. The learning activities will consist of four articles (i.e., articles A, B, C, and D). The topics of these articles are listed below.

Article A. This is a peer-reviewed journal article from the European Journal of Public Health. In Adams and White (2004), the concept of biological ageing is described, explaining how biological ageing occurs, the outcomes, and how to change the outcomes. Since this article may be beyond the average reading level of the general public, a one-page summary will accompany this article when delivered to the students.

Article B. This is a meditation primer document developed by the U.S. Department of Health and Human Services, National Institutes of Health, and National Center for Complementary and Alternative Medicine (2009). The intent of this document is to inform the public about meditation, its health-related purposes, and an introduction on how to meditate.

Article C. This is a document written by the VA War Related Illness & Injury Study Center of New Jersey on the management of chronic pain and/or fatigue through physical exercise (WRIISC, 2008). This document details the benefits of regular physical activities and educates the public on practical methods to increase physical activity. More specifically, this document provides information on the frequency, intensity, duration, and type of exercise to complete in order to manage chronic pain in fibromyalgia patients.

Article D. This is a printout from the National Fibromyalgia Association archive (2007). This article discusses information on how nutrition affects chronic pain in fibromyalgia patients. In addition, this article provides practical advice for adhering to a healthy diet.

Discussion Board Forums. There will be nine discussion board forums (i.e., discussion boards one through nine). The topics of these forums are listed below.

Discussion Board One. This discussion board is an introduction to the biological ageing concept. Therefore, the discussion board topic is, "Post to this discussion board your interpretation of biological ageing. Do you believe you are ageing "quicker" because you were diagnosed with fibromyalgia? Explain."

Discussion Board Two. This discussion board forum topic will be centered on the application of biological ageing to the individual. Therefore, the discussion board topic is, "Post to this discussion board a list of things that you believe affect your biological ageing process. You may be as specific as possible. In the same post, describe ways in which you could overcome the items of your list."

Discussion Board Three. This discussion board forum introduces the use of meditation in day-to-day life. Therefore, the discussion board topic is, "Post to this discussion board ways in which meditation can be used in your daily life. How would you use the "four elements" of meditation to establish proper technique?"

Discussion Board Four. This discussion board forum discusses the use of meditation. Therefore, the discussion board topic is, "After completing one meditation session, post to this discussion board a description of the experience. Did you feel differently after the experience? Explain."

Discussion Board Five. This discussion board forum is focused on the biomarker flexibility. Therefore, the discussion board topic is, "Do you believe that your fibromyalgia has affected your flexibility? Explain. After reading the article on exercise,

how would you use exercise to improve flexibility? Post to this discussion board your responses."

Discussion Board Six. This discussion board forum is focused on the biomarker fitness. Therefore, the discussion board topic is, "Do you believe that your fibromyalgia has affected your fitness? Explain. After reading the article on exercise, how would you use exercise to improve fitness? Post to this discussion board your responses."

Discussion Board Seven. This discussion board forum is focused on the biomarker balance. Therefore, the discussion board topic is, "Do you believe that your fibromyalgia has affected your balance? Explain. After reading the article on exercise, how would you use exercise to improve balance? Post to this discussion board your responses."

Discussion Board Eight. This discussion board forum introduces current concepts on nutrition and fibromyalgia. Therefore, this discussion board topic is, "Post to this discussion board your top three most common meals. Name specific things about these meals that are considered unhealthy. What would you change about these meals to make them healthier?"

Discussion Board Nine. This discussion board forum is aimed at empowering the students with adhering to healthy nutritional standards. Therefore, this discussion board topic is, "Pick one of your top three meals and make that meal with healthy changes. Post to this discussion board forum your experience on creating and eating this meal."

Learning environment. This course implores a cooperative learning environment. Cooperative learning is a learner-centered environment that engages students in active learning processes. Students will use an online discussion forum to

communicate with each other during the program, creating a support network during the health education course. There are multiple online environments that allow for discussion board forums (e.g., WebCT, Blackboard, and WebStudy) (Faulkner Information Systems, 2001). However, discussion boards are not unique to learning management systems.

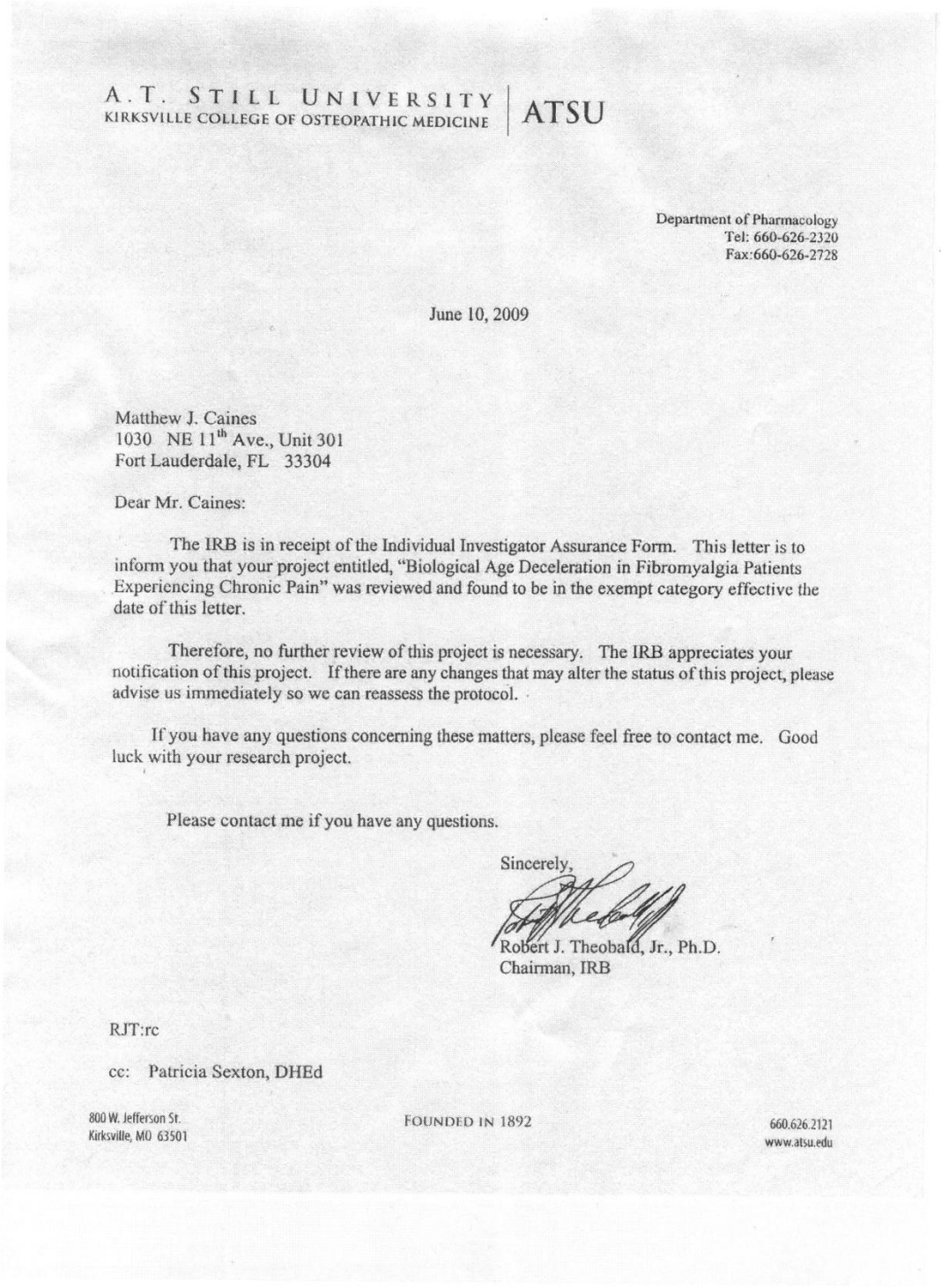
Windows Live Groups is an online community in which members create profiles, communicate with others, and have the opportunity to join groups (Windows Live, 2009). In Windows Live groups, members may engage synchronously (e.g., chat) or asynchronously by participating in discussion board topics. Windows Live groups is an ideal learning environment for this study for several reasons: (a) Windows Live Groups is free, which will keep production costs to a minimum, (b) Windows Live Groups can be set to confidential settings, allowing for participation in the group to be kept private, and (c) Windows Live Groups is known for having a reliable social networking community that will have minimal technical issues during implementation.

The implementation of this course using Windows Live Groups will occur over a thirty day period. The first few days patients/subjects will be provided an overview of the course and an orientation in the use of Windows Live Groups (e.g., practice discussion board). The course itself will be implemented as follows: (a) participants are provided access to all learning activities in the beginning of the study; (b) participants are given specific deadlines for posting the initial post in a discussion board; (c) participants are asked to reply to at least five other participants within five days after the initial post deadline.

Summary. The health education course will be approximately six weeks in length. During this time, students will learn how to manage fibromyalgia through understanding biomarkers. Data will be gathered before and after this health education course. In the following section, the standard operating procedure is detailed.

Standard Operating Procedure

Institutional Review Board. The Institutional Review Board at A. T. Still University approved the study on June 10, 2009 (see Figure 11).



A.T. STILL UNIVERSITY
KIRKSVILLE COLLEGE OF OSTEOPATHIC MEDICINE | ATSU

Department of Pharmacology
Tel: 660-626-2320
Fax:660-626-2728

June 10, 2009

Matthew J. Caines
1030 NE 11th Ave., Unit 301
Fort Lauderdale, FL 33304

Dear Mr. Caines:

The IRB is in receipt of the Individual Investigator Assurance Form. This letter is to inform you that your project entitled, "Biological Age Deceleration in Fibromyalgia Patients Experiencing Chronic Pain" was reviewed and found to be in the exempt category effective the date of this letter.

Therefore, no further review of this project is necessary. The IRB appreciates your notification of this project. If there are any changes that may alter the status of this project, please advise us immediately so we can reassess the protocol.

If you have any questions concerning these matters, please feel free to contact me. Good luck with your research project.

Please contact me if you have any questions.

Sincerely,

Robert J. Theobald, Jr., Ph.D.
Chairman, IRB

RJT:rc

cc: Patricia Sexton, DHEd

800 W. Jefferson St.
Kirksville, MO 63501

FOUNDED IN 1892

660.626.2121
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Figure 11. IRB approval from A. T. Still University.

Limitations. There are several limitations and delimitations associated with the proposed project. The first limitation involves biomarkers. Namely, biomarkers may need a lengthier period of time to demonstrate an effect. The biomarkers will be assessed over six weeks, but an effect may not be forthcoming. In addition, some biomarkers may show little effect within the six weeks time frame, but substantial effects over a longer time span.

The second limitation is associated with participation. The proposed seminar will implement a program using biological, psychological, and social components—a method of pain management referred to as the biopsychosocial model. Since diverse didactics would be involved, participants may not fully adhere to health program.

The third limitation also involves participation. In the proposed project, the target audience will be patients with chronic pain ages forty and older. Since pain perception may hinder ability to complete fitness aspects of the program, this population will have variable ability to complete an exercise regimen. Pain perception located in the hand may preclude participants from effectively using the online learning environment.

The fourth limitation is associated with epidemiology. There are many diseases associated with chronic pain. Since the participant pool is limited to those with chronic pain, there will be participants in the program that have varying comorbidities. Since the project would not focus on the disparities among these comorbidities, the proposed study will not investigate the diseases associated with chronic pain (e.g., fibromyalgia, multiple sclerosis, etc.) in terms of biological age deceleration.

Delimitations. In addition to the above limitations, the proposed project also has delimitations. The first delimitation involves the length of time in data collection. More specifically, data collection will not occur after three months from program commencement. The proposed study will not use a longitudinal design and does not investigate long-term effects

The second delimitation involves varying methods to achieve biological age deceleration. The program involves diverse didactics in the management of health and wellbeing, using several techniques to achieve course objectives. Since several concepts to improve general health will be used, the proposed study will not examine methods for optimal biological age deceleration. In other words, the proposed study will present an array of methods to participants and not evaluate which method used provided optimal biological age deceleration.

The third delimitation involves the direct measurement of biomarkers. In the proposed study, biomarkers are assessed using intense interviews. Participants will be asked about the impact the health education course has had on their health and wellbeing. However, the biomarkers (i.e., balance, flexibility, and fitness) will not be directly assessed. Therefore, the study cannot demonstrate a change in general health; the study may only assess the perception of health.

Policies and Procedures. The following sections detail the policies and procedures for the proposed study.

Subject recruitment. Participants will be recruited using the fibromyalgia support groups located in or nearby Philadelphia, Pennsylvania. The researcher will obtain contact information from participants via email. After the patient has delivered

participant contact information to the researcher, the researcher will send a packet to the participant containing enrollment documents and study information.

Enrollment. Participants will be considered enrolled in the research project once the informed consent form has been received. The informed consent form will be sent to the participant's address along with a self addressed, postage paid envelope for return. If patient would like to cease participation in this study, the patient may do so at any time and for any reason. If a patient ceases participation before the health education course begins (i.e., during pretest assessments), a replacement will be recruited. If a patient ceases participation during or after the health education course, a replacement cannot be used.

Data collection. The researcher will contact participants via email, mail, and telephone to enroll them and schedule a time for data collection. For intensive interviews, teleconference meetings will be made and the researcher will contact the participant via telephone. For questionnaires, these documents will be mailed to the participant with a postage paid and self-addressed envelope for return. If after initial data analysis, additional information is required then the researcher will contact the participants to arrange an additional teleconference.

Health education. Participants must complete the pre-course assessment (i.e., Beck Inventories) before starting the health education course. The pre-course assessment will be mailed to the participant's address, along with a postage paid, self-addressed envelope for return. In addition, participants will be required to complete the health education course to continue with post-course assessment. Completion of the health education course will be determined as follows: (a) participant has submitted responses

to all discussion boards, and (b) participant has responded to at least two other participants on each discussion forum topic.

Participant withdrawal. Participants may withdraw from the project at any time and for any reason. Participant may or may not contact the researcher about withdrawal. Participants, who do not express withdrawal in writing or verbally, will be automatically withdrawn from the study, when the participant is not active for the previous 3 weeks. Active participation is considered the return of necessary forms, posting responses on discussion boards, asking questions either in writing or verbally, et cetera.

Study closing. The study will be considered in closing procedures after each participant has completed the intensive interviews and returned the second administrated Beck Depression Inventory and Beck Anxiety Inventory. Once all data has been gathered grounded theory analysis and the Wilcoxon signed-rank test will be applied. Upon completion of the data analysis and interpretation, the study will be considered closed. Data will be maintained for six months after data analysis, after which data will be deleted as to protect personal identifying information about the participants.

Recommendations for Further Research. This study will provide the basis for additional research involving chronic pain management in fibromyalgia patients. Although participants may manage pain using pharmaceuticals, the use of grounded theory may establish a model for the non-pharmaceutical management of pain in fibromyalgia patients, because patients are asked to not change pharmaceuticals or their dosage during the study. This model may then be tested using a quantitative research design. Since the long-term impacts of this health education course are important, further research may include a longitudinal design.

Summary. This study will investigate the barriers of managing pain in fibromyalgia patients. Management of health is assessed using grounded theory research design. Psychological function is assessed using the Beck Depression Inventory and the Beck Anxiety Inventory. Depression and anxiety may be barriers to the management of fibromyalgia pain. Using a grounded theory research design, the researcher will examine the relationship that the barriers have with chronic pain and fibromyalgia, as well as suggest methods for improving general health. In the next chapter, the data analyses for this study will be presented.

Chapter Four: Discussion

There are many methods to manage chronic pain. Patients with fibromyalgia present a unique challenge in chronic pain management. Fibromyalgia has been widely misunderstood by health professionals (Russell, 1999). In this study, a health education course was implemented using distance learning modalities. The content of the course focused on the various methods to manage chronic pain and fatigue (e.g., exercise, meditation, and nutrition). Patients engaged in discussion board forums to discuss course topics. There were several measurements of participant evaluation: (a) discussion board participation analysis; (b) Beck Depression Inventory; (c) Beck Anxiety Inventory; and (d) intensive interviews for grounded theory derivation. The following sections include a summary of the problem addressed, the value of the study, a best practices analysis, a review of methodology, the study results, and a discussion of study limitations, implications, and recommendations for future research.

Problem Statement

Over a one-year period, the researcher will design, implement, and evaluate a chronic pain management distance learning course, using the biological ageing concept, for adults with fibromyalgia and experiencing chronic pain in Pennsylvania Pain Management Centers.

Subproblems.

How do depression and anxiety relate to fibromyalgia management?

How does distance learning relate to fibromyalgia patient education?

Best Practices

Turk and Wilson (2009) stated that psychosocial factors might play a role in the cause and maintenance of fibromyalgia and that improving self-efficacy, decreasing negative thinking, and enhancing coping skills lead to successful treatment outcomes. The idea that fibromyalgia management improves through the impact of psychological components has been a major treatment paradigm for over ten years. Often misunderstood by health professionals and patients, this paradigm does not suggest that fibromyalgia should be classified as a mental illness. However, the patient's perspective has been associated with successful symptom management. This study examined the role of fibromyalgia symptoms on the patients' mental health and a modality for patient education.

There were three best practices implemented to address the issue of fibromyalgia symptom management in the patient cohort. These include a distance learning modality of education, the use of the biopsychosocial/multicomponent paradigm to manage fibromyalgia symptoms, and standard operating procedures to assist health professionals with improving psychological distress in patients with fibromyalgia. A five-week health education program was delivered to patients diagnosed with fibromyalgia using a distance-learning environment (i.e., Windows Live Groups). Fifteen patients agreed to participate in this program, eleven patients began this program, and seven patients completed the program. This program allowed patients to:

1) Describe biological age deceleration
2) Describe biomarkers and manage flexibility, balance, and fitness in each patient

3) Identify and discuss barriers to biological age deceleration in terms of chronic pain
4) Monitor and modify behaviors that improve biomarkers.

The health education course instructed patients with fibromyalgia on a method of pain management. A social networking site (i.e., Windows Live Groups) was used as the online learning environment. Participants were provided access to a confidential online group forum, which provided the vehicle for discussion boards, file distribution, and communication using chat and email.

The biopsychosocial model of pain management was used in order to address biological, psychological, and social health and wellbeing. Participants were provided the Beck Depression Inventory and Beck Anxiety Inventory before and after the health education course. Upon completion of the health education course, participants were interviewed for qualitative data collection.

Results

Qualitative data associated with the variability of non-pharmacological effectiveness, as well as quantitative data associated with the psychological components were obtained during this study. Qualitative data were analyzed using grounded theory methodology while quantitative data were analyzed using certain nonparametric statistical tests.

Grounded Theory. As detailed in chapter three, grounded theory is a method of analyzing qualitative data systematically in order to derive theoretical assumptions. This study analyzed intensive interviews by first transcribing recorded interviews into text. A

line-by-line coding methodology was implemented. Table 10 provides an example of line-by-line coding using data from this study.

Table 10

Coding of a participant's intensive interview.

Code	Transcript
Initial change Reaction from medication Undesirable outcome Seeking alternative therapies Family connection Daughter is a motivator Medication decreased awareness Does not view self as depressed Family as support system Family as motivator Desire for improvement	"I first noticed a change in my fibromyalgia when I first took my medication. All of a sudden, I was very tired from the medications. That was not the lifestyle that I wanted to lead. So, I was motivated to do research and to try different things. Around this time, I adopted a little girl. I needed to be there for her. This motivated me to be on top of things and aware. This awareness had decreased when I took drugs that made me tired. However, my child has influenced me in an extraordinary way. I am not depressed. I am future oriented...My daughter has been my inspiration and she motivates me to be better than I am."

Upon completion of the line-by-line coding, focused and axial coding were implemented in order to organize hierarchical relationships. In Figure 12, an abridged list of focused codes is detailed.

Long term usage = long term effects	Information resource	Mode of management	Effective only during therapy
Perseverance	Increased learning	Therapy program details	Effective after therapy (progress from prior experiences)
Personal issues hindered progress	Related to other participants	Sleeping habits before management	Initiated by personal connection
Therapy as a priority	Feelings of isolation	Coping	Affordability of therapy
Frequency	Impact of experience	Decrease in pain	Apprehension
Context in time	Related to other participants	Listening to the body	Important events leading to fibromyalgia management
Personal issues	Other participants had greater problems	Body signals	
Comorbidities present			

Figure 12. Abridged list of codes for an intensive interview.

The process of grounded theory derivation involved coding data for category comparison, generating memos derived from categorical data and actual data, then establishing theory from memo-writing. The outcomes of grounded theory methodology are theoretical statements. Theoretical statements based on this process have been detailed in the following sections.

Theoretical Statements. In this study, patients indicated people as motivators for improving fibromyalgia management. One patient stated, "my neighbor knew of my condition and the troubles I have gone through. It was not until my neighbor found a newspaper article about local fibromyalgia therapies that I began to realize I may have some control over my condition." There were three main motivators indicated by the patient cohort: (a) self, (b) friends and family, and (c) community.

Several motivators affected the patient cohort. The self-motivator had the greatest impact. One patient stated, "my daughter and church members have urged me to seek therapies to manage my fibromyalgia, but so many attempts, trying to get better, with no result, I do not feel compelled to do so." The other motivators for this patient cohort were friends/family and the community. However, even though the friends and family and community motivators were present in the patient cohort, without some level of self-motivation, the patient did improve.

Motivation and anxiety may have a cyclical relationship (see Figure 12). When an effort to manage fibromyalgia symptoms did not produce desirable outcomes, the patient cohort stated that the lack of control resulted in a heightened state of anxiety or worry. Additional attempts to manage fibromyalgia symptoms were only made when the patient cohort felt concern for self or others. One patient stated, "I need to think about my grandchildren. If they see that I give up, what will they think about me or themselves? I do not want them to think like a quitter."

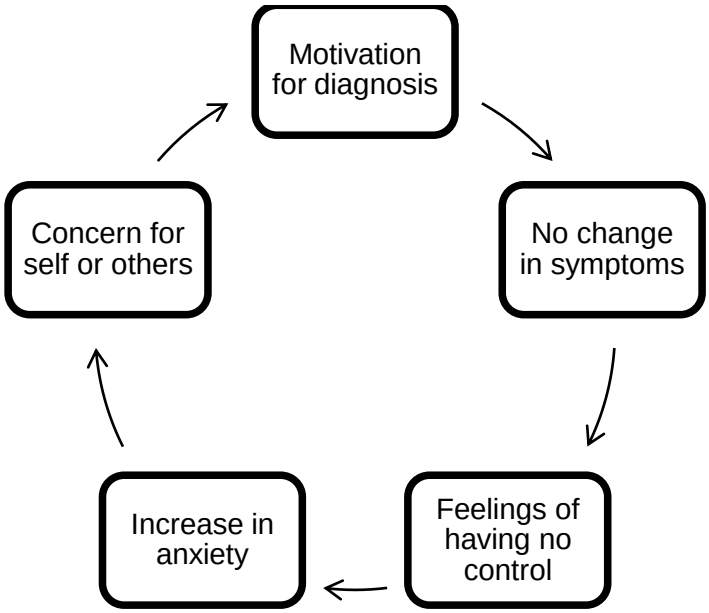

Figure 13. Cycle of motivation for this fibromyalgia patient cohort.

The patient cohort had indicated an additional motivator for improvement during intensive interviews. Social networking had become a distinct form of motivation for fibromyalgia improvement during this study. One patient stated that she "felt engaged and involved in the fibromyalgia community without having to keep an appointment—like with group therapy." Another patient "looked forward to logging into the website to discuss the next topic." Figure 14 contrasts social networking with group therapy and environment (i.e., non-controlled).

Figure 14. Comparison of environment, group therapy, and social networking.

In terms of fibromyalgia symptom management, routine was either the problem or solution for the patients in this study. The data revealed that part of the patient cohort believed routine helped them in managing daily pain and fatigue. For example, patients reported that a morning routine involving physical exercise, water therapy, yoga, and so on helped diminish pain and fatigue for at least part of the day. Other patients reported that routine was an issue, because appointments could not be kept because of pain or fatigue. One patient stated, "I cannot keep a set schedule and this really bothers me. I use to be a ballroom dancer and compete in local competitions. Since living with fibromyalgia, I can no longer dance or plan to attend a dance competition. The pain, mind-fog, and feeling tired all the time has made my schedule impossible to determine."

Fibromyalgia has been widely misunderstood by the medical community (Russell, 1999; Rau & Russell, 2000). Rau and Russell (2000) stated that health professionals are skeptical of the fibromyalgia diagnosis due to subjectivity in the assessment process. Subjectivity may have been attributed to the perception of chronic pain coupled with the lack of a defining pathogenic mechanism for pain processes. Even though urine, blood,

and spinal fluid may indicate abnormalities indicative to the fibromyalgia population (Russell, 1999), there is not a gold standard laboratory test or clinical assessment that can diagnose fibromyalgia at all times (Rau & Russell, 2000). In an industry that relies on concrete data to support conclusions, many medical practitioners have difficulty diagnosing fibromyalgia.

The challenge of diagnosis is the lesser of two challenges facing health practitioners with fibromyalgia patients. The greater challenge is the management of fibromyalgia symptoms (i.e., pain, fatigue). Turk and Wilson (2009) define treatment for fibromyalgia in pharmacological (i.e., tricyclic antidepressants, selective serotonin reuptake inhibitors, selective serotonin-norepinephrine reuptake inhibitors, and anticonvulsants) and non-pharmacological (i.e., education, exercise, and cognitive behavioral therapy) methods. Notwithstanding, Turk and Wilson (2009) stated that no one method has been shown to be highly effective in managing fibromyalgia symptoms.

The data from this study support the multicomponent treatment method for fibromyalgia patients. The following sections will detail the qualitative data obtained during participants' intensive interviews followed by the data analysis. It is important to note that the process of grounded theory requires a literature review after data collection (Charmaz, 2006). Therefore, the following sections on grounded theory analysis reflect this requirement.

Participants in this study used pharmaceuticals to control pain, assist with sleeping, increase energy, and improve psychological wellbeing. However, data obtained from the participants' interviews revealed that the effectiveness of pharmacological therapies in fibromyalgia management varied among participants. For example, one

participant stated that she "could not make it through a day" without the use of pharmaceuticals, while another participant stated that the use of pharmaceuticals "worsened her condition." The remaining participants seemed to lie between these extremities, having a variable experience with the use of pharmaceutical drug therapy.

In addition, the results showed that the patient cohort used pharmaceuticals not only for fibromyalgia management, but also for other chronic illnesses. Some participants stated that certain pharmaceuticals used to treat another chronic condition had enhanced their fibromyalgia symptoms (e.g., fatigue), while other participants stated that the pharmacotherapy used to treat another condition decreased their fibromyalgia symptoms (e.g., pain). There was variability in the outcome of pharmaceutical use in the patient cohort.

The patient cohort reported variable responses to medication consumption. As depicted in Figure 15, the outcome of the medication consumption event varied in response and outcome. Patients who received an improvement in fibromyalgia symptoms had two outcomes: (a) an increase in motivation when the patient experienced no side effects and (b) a decrease in motivation when the patient experienced side effects. In addition, patients who did not receive an improvement in fibromyalgia symptoms had decreased motivation. Therefore, health professionals must be aware of the psychological impact of successful and unsuccessful outcomes when treating fibromyalgia patients and the cyclical relationship of motivation in future fibromyalgia management attempts.

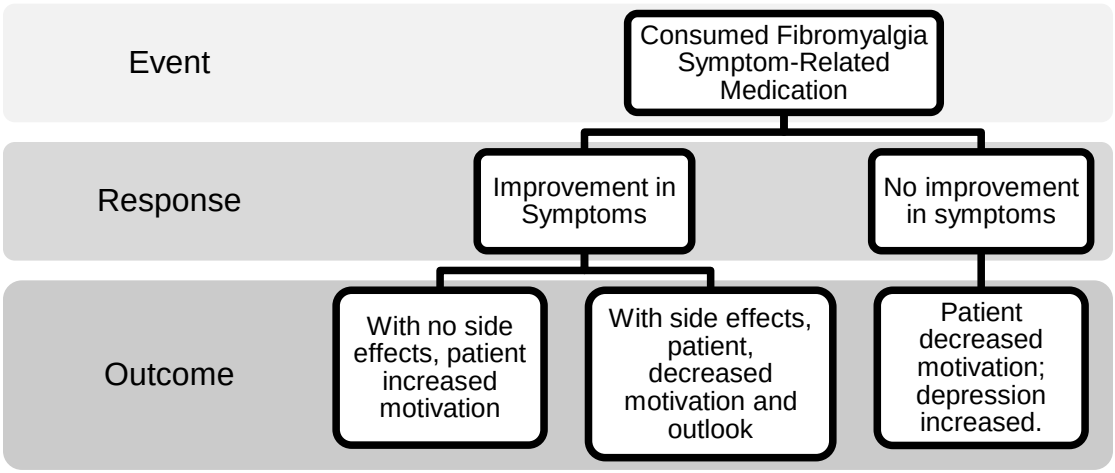

Figure 15. Response and outcome of fibromyalgia medication consumption event.

Beck Anxiety Inventory Analysis. The Beck Anxiety Inventory was administered before and after the health education course. Since the cohort was < 30, nonparametric tests were employed. The Wilcoxon Signed-Ranks Test was used to assess the difference in magnitude among paired samples. Spearman's rho was used to assess the correlation of pretest and posttest inventory scores according to rank differences. The Kendall's tau was used to confirm the Spearman's rho results; Kendall's Tau is similar to the Spearman's rho, but provides a more robust analysis.

For the Wilcoxon Signed-Ranks Test, the null and alternative hypotheses were:

H_0: Anxiety levels are not related to the health education course.

H_1: Anxiety levels had lowered after the health education course.

Data had been conceptualized as unidirectional. Therefore, a one-tailed test with α=0.025 will be used during analysis. The analysis began with assigning ranks. The signed ranks for the prehoc and posthoc tests have been detailed in Table 11.

Table 11

Signed ranks for difference in Beck Anxiety Inventory scores.

Subject	Before	After	D	|D|	R	SR
A	35	7	-28	28	7	-7
B	16	12	-4	4	5	-5
C	40	38	-2	2	3	-3
D	5	4	-1	1	1	-1
E	35	24	-11	11	6	-6
F	31	30	-1	1	1	-1
G	26	23	-3	3	4	-4

The sum of the positive signed ranks was 0 and the sum of the negative signed ranks was -27, with an *n* of 7. The test statistic *W* was 0, the lesser of the two sums. Since the *n* was 7, the critical value, $W_{cr,}$ was 2 at α=0.025 using a one-tailed test. Therefore, we reject H_0 and conclude that anxiety levels had lowered after the health education course.

Since the data revealed there was a difference in the anxiety levels for the patient cohort after the health education course, Spearman's rho, a nonparametric correlation was used to analyze the relationship of the difference of Beck Anxiety Inventory scores and participation level and writing ability. Participation level was determined in terms of character, word, sentence, paragraph, and post count, as well as characters per word, words per sentence, and sentences per paragraph. Writing ability was determined in

terms of readability statistic: Flesch reading ease, Flesch-Kincaid grade level, and automated readability index. The count data are displayed in Table 12. The count ratio averages are displayed in Table 13. The readability statistics data are displayed in Table 14.

Table 12

Counts for characters, words, sentences, paragraphs, and posts per patient.

	Count				
Patient	Character	Word	Sentence	Paragraph	Post
A	441	87	4	1	1
B[a]	0	0	0	0	0
C	11548	2640	317	102	26
D	15515	3334	265	74	9
E	1751	414	34	8	5
F	15507	3397	225	33	15
G	5826	1300	133	47	11

[a]This patient did not participate in the online health education course.

Table 13

Average sentences per paragraph, words per sentence, and characters per word per patient.

	Averages		
Patient	Sentences per Paragraph	Words per Sentence	Characters per Word
A	4	21.75	5.07
B[a]	0	0	0
C	3.11	8.33	4.37
D	3.58	12.58	4.65
E	4.25	12.18	4.23
F	6.82	15.1	4.56
G	2.83	9.77	4.48

[a]This patient did not participate in the health education course.

Table 14

Readability statistics per patient.

Patient	Readability Statistic		
	Flesch Reading Ease	Flesh-Kincaid Grade Level	Automated Readability Index
A	35.98	14	14
B[a]	0	0	0
C	77.44	5	3
D	66.68	7	7
E	74.52	6	5
F	66.67	8	8
G	74.57	5	5

[a]This patient did not participate in the health education course.

Since the Spearman's rho correlation analysis uses ranked data sets, the Beck Anxiety Inventory scores must be ranked. Even though the Beck Anxiety Inventory scores were ranked in the Wilcoxon signed-ranks test, the ranking of the Beck Anxiety Inventory scores is the exact opposite for the Spearman's rho correlation, because the Wilcoxon signed-ranks test used absolute values of the score difference. The ranking of the difference of Beck Anxiety Inventory Scores is displayed in Table 15.

Table 15

Ranking of the difference of Beck Anxiety Inventory scores.

Patient	D	Rank of D
A	-28	1
B[a]	-4	3
C	-2	5
D	-1	6
E	-11	2
F	-1	6
G	-3	4

Note. D = difference in Beck Anxiety Inventory scores.
[a]This patient did not participate in the online health education course.

Spearman's rho (r_s) was calculated for count, count ratio averages, and readability statistics. Table 7 details the results of the Spearman's rho analyses. Since the critical value for Spearman's rho at n=7 and α=0.05 was 0.786, the test revealed three significant correlations. As character, word, and sentence count increased, the difference in the Beck Anxiety Inventory increased. In other words, patients that typed more characters, words, and sentences in the distance learning course, demonstrated a greater improvement in anxiety.

Table 16

Spearman's rho for character, word, sentence, paragraph, and post count and readability statistics per Beck Anxiety Inventory score.

Measure	r_s
Count	
Character	**0.875**
Word	**0.875**
Sentence	**0.804**
Paragraph	0.732[a, b]
Post	0.732[a, b]
Averages	
Sentences per Paragraph	0.339[b]
Words per Sentence	0.089
Characters per Word	0.196
Readability Statistic	
Flesch Reading Ease	0.375[b]
Flesch-Kincaid Grade Level	-0.036
Automated Readability Index	0.071

Note. The critical value for Spearman's rho at n=7 and α=0.05 is 0.786. Significant values are shown in boldface.
[a]The critical value for Spearman's rho at n=7 and α=0.10 is 0.714.
[b]Values of Spearman's rho that indicate the need for additional analysis.

There were two borderline significant values of Spearman's rho for paragraph and post count (see Table 16). In addition, there were marginal values of Spearman's rho for sentences per paragraph and Flesch reading ease.

Kendall's tau is a nonparametric test for correlation, similar to Spearman's rho in assumptions, but is more robust in analysis. Kendall's tau analysis was administered for significant, borderline, and marginal values of the Spearman's rho for a more robust analysis (see Table 7). The results of Kendall's tau are detailed in Table 8.

Table 17

Kendall's tau for count, sentences per paragraph, and Flesch Reading Ease per difference in Beck Anxiety Inventory score.

Measure	τ
Count	
Character	**0.857**[a]
Word	**0.857**[a]
Sentence	**0.762**
Paragraph	**0.714**
Post	**0.762**
Average	
Sentences per Paragraph	0.571
Readability Statistic	
Flesh Reading Ease	**0.667**

Notes. The critical value for Kendall's tau at n=7 and α=0.05 is 0.619. Significant values are shown in boldface.
[a]The critical value for Kendall's tau at n=7 and α=0.01 is 0.8095.

The critical value for Kendall's tau at n=7 and α=0.05 was 0.619 (see Table 17). This analysis confirmed that the correlation between character, word, and sentence count and difference in Beck Anxiety Inventory scores were significant. However, Kendall's tau indicates that the borderline values of Spearman's rho were significant: paragraph and post count correlate with a difference in Beck Anxiety Inventory scores. Furthermore, one marginal value of Spearman's rho was found to be significant using Kendall's tau: Flesch reading ease correlates with a difference in Beck Anxiety Inventory scores. Therefore, the Spearman's rho and Kendall's tau indicated a correlation between patient participation and anxiety improvement, and Kendall's tau indicated a correlation between writing ability and anxiety improvement.

Beck Depression Inventory Analysis. The Beck Depression Inventory was administered before and after the health education course. Since the cohort was < 30,

nonparametric tests were employed. Before analyzing the data in terms of correlation, the Wilcoxon Signed-Ranks Test was used to assess the difference in magnitude among paired samples.

For the Wilcoxon Signed-Ranks Test, the null and alternative hypotheses were:

H_0: Depression levels had no relationship to the health education course.

H_1: Depression levels had lowered after the health education course.

Data were conceptualized as unidirectional. Therefore, a one-tailed α was used during analysis. The analysis began with assigning ranks. The signed ranks for the prehoc and posthoc test have been detailed in Table 18.

Table 18

Signed ranks for difference in Beck Depression Inventory scores.

Subject	Before	After	D	|D|	R	SR
A	6	6	0	0	1	1
B	8	12	4	4	3	3
C	20	25	5	5	6	6
D	3	7	4	4	3	3
E	39	36	-3	3	2	-2
F	24	20	-4	4	3	-3
G	17	7	-10	10	7	-7

The sum of the positive signed ranks was 13 and the sum of the negative signed ranks was -12, with an *n* of 6 (i.e., number of nonzero ranks). The test statistic *W* was the absolute value of -12 (i.e., 12), the lesser of the two sums. Since the *n* was 6, the critical value, $W_{cr,}$ was 2 at α=0.05 using a one-tailed test. Therefore, the null hypothesis (H_0)

was not rejected and it was concluded that depression levels had not lowered after the health education course.

Discussion

The results of this study revealed that the patient cohort improved Beck Anxiety Inventory scores after the health education course. A correlation between difference in Beck Anxiety Inventory scores and participation level was determined to be significant. The Kendall's tau correlation suggested that writing ability might also correlate with a difference in Beck Anxiety Inventory scores. For the Beck Depression Inventory, the data demonstrated no significant findings. However, grounded theory derivation indicated the relationship between motivation and improvement in fibromyalgia symptom management, motivating factors (e.g., social networking), and the variability in fibromyalgia management in the patient cohort. In the following sections, the limitations of the study and the factors related to fibromyalgia symptom management (i.e., motivation, anxiety, depression, and pharmacotherapy) are detailed. Recommendations for future research are stated throughout.

Limitations. Chapter three described four limitations: (a) significant results may require a longer period of time; (b) level of participation; (c) pain perception; and (d) comorbidities. Even though some patients significantly improved depression and anxiety upon completing the program, the Wilcoxon signed-ranks test stated that anxiety improved, but depression did not. Depression may require a longer time-period to show improvement.

The level of participation had greatly varied in the health education course. The difference in participation level was assessed by character, word, and sentence count and

by total number of posts. There was a correlation between difference in Beck Anxiety Inventory scores and character, word, sentence, and post count, such that an increase in count correlated with improved anxiety scores. However, a limitation in this patient cohort was typing ability. Since participation required the cohort to type responses to a social networking group website, an inability to type was a limitation in this study; some participants stated that typing caused discomfort, while other participants stated that he or she did not have typing skills.

Pain perception, or pain tolerance, may have had an impact on the study. Even though level of pain was assessed, the instrument used to assess pain is subjective in nature. Pain perception may have a significant impact on patients with fibromyalgia. In other words, some patients may tolerate higher levels of pain.

All patients in this study have at least one other chronic disease in addition to fibromyalgia. The presence of other chronic diseases was a limitation in this study because it was impossible for patients to distinguish the symptoms of fibromyalgia from that of the other disease.

In addition to the limitations detailed in chapter three, there was an additional limitation discovered while implementing the health education course. Participants had varying computer knowledge or skills. Computer skills were required to complete the distance learning course using social networking.

Motivation. As detailed in the grounded theoretical statement, motivation for improvement in fibromyalgia management was difficult to obtain for this patient cohort, when previous efforts did not meet desirable outcomes. Negative thinking became an

obstacle for some patients to overcome. Nevertheless, there were particular motivators in the patients' environment: self, friends and family, and the community.

Anxiety. Anxiety may more likely be present in patients with nonorganic somatic symptoms (Abeles, Pillinger, Solitar, & Abeles, 2007). There has not been research on whether fibromyalgia causes psychiatric distress. The results of this study indicate that the health education course had an impact on Beck Anxiety Inventory scores of the patient cohort. The health education course used a biopsychosocial (i.e., multicomponent) method for fibromyalgia management. Since patient anxiety scores improved after the health education course, investigation into the causal relationship between anxiety and fibromyalgia is warranted.

Depression. The reciprocal relationship between pain and depression has had vast analysis and exposition (Bair, Robinson, Katon, & Kroenke, 2003). The presence of pain worsens depression and vice-versa. Therefore, it is logical to assume that fibromyalgia patients are predisposed to depression, having chronic pain. From prehoc to posthoc, patients in this study did not improve scores on the Beck Depression Inventory, as indicated in the result of the Wilcoxon signed-ranks test (See Table 9). There may be a reason for this result. During this study, the seasons had changed in Pennsylvania, from summer to autumn, bringing about a colder temperature. Since all participants indicated in the intensive interview that cold, wet weather might flare up fibromyalgia symptoms, there is reason to believe that an increase in fibromyalgia symptoms may have resulted in worsened depression.

Pharmaceutical therapy. In a study by Kim, Song, Mun, and Park (2009), tramadol and milnacipran were found to have a potent antihyperalgesic effect when used

in combination. This pharmaceutical combination had an impact on chronic pain associated with fibromyalgia thirty minutes after administration using the animal model. The drug interaction created an antihyperalgesic effect (i.e., decrease the sensitivity to pain). Kim et al. (2009) injected mice to produce similar fibromyalgia trigger points. Even though there are inconsistencies between drug interactions in humans and other species, the concept of drug interactions to create the antihyperalgesic effect (i.e., decrease the sensitivity to pain) in fibromyalgia patients is worthy of investigation.

In this study, two participants noticed the presence of fatigue about one hour after taking evening medications, which included pharmaceuticals for fibromyalgia management and other chronic conditions. If an antihyperalgesic may occur, is it possible for a hyperalgesic effect to occur? There are certain pharmaceuticals that produce somnolence (e.g., antihistamine); fatigue is a common fibromyalgia symptom.

General Discussion. Patients in this study improved Beck Anxiety Inventory scores after the health education course. The improvement in anxiety scores was positively correlated with participation level (e.g., character, word, and sentence count) using Spearman's rho and positively correlated with participation level (e.g., character word, sentence, paragraph, and post count) and writing ability (i.e., Flesch reading ease readability statistic), using Kendall's tau. However, it is important to note that typing ability may have been a limitation in this study since it was not controlled. Controlling for typing ability would have strengthened the argument related to participation level and improvement in Beck Anxiety Inventory scores. Without controlling for typing ability, did patients type less due to less participation or due to not being able to type well could not be determined.

Grounded theory derivation concluded that even though a social support system may help fibromyalgia patients in symptom management, without self-motivation and positive outlook, symptom management becomes difficult to obtain. In addition, grounded theory derivation found that there is an individualistic component to fibromyalgia such that there is not one method of symptom management that is highly effective for all patients. Therefore, fibromyalgia patients should use multiple methods for managing fibromyalgia symptoms and understand that, even though a method may not produce desirable outcomes, it is important to continue seeking improved health and wellness to find the methods that having a desirable outcome. Furthermore, it is important to note that pain tolerance was not assessed in this study and may have been a limitation. Even though the relationship between pain and motivation was studied, without understanding the role of pain tolerance, a standardized model cannot be derived.

Future research

Recommendations for future research have been previously referenced. The following research proposals are suggested for future study:

Overcoming limitations. The following recommendations resolve issues related to study limitations.

- Since depression had not improved in this study, future research may analyze the length of time for depression to improve in the fibromyalgia population.
- Ability to type and typing speed was a limitation in this study. Future research may control for this limitation by using fibromyalgia patients that are able to type at approximately similar speed.

- Pain perception may have varied in the patient cohort. Therefore, future research should explore the perception of pain in fibromyalgia patients.
- An epidemiological study may be warranted to determine if other chronic diseases are present as comorbidity with fibromyalgia.
- Future research may control for computer skill level by administering a computer assessment to patients during enrollment.
- Since grounded theory derivation indicated a relationship between environment and motivation, future research may focus on this relationship.
- Since patient anxiety scores improved after the health education course, investigation into the causal relationship between anxiety and fibromyalgia is warranted.
- Some patients reported a worsening in fibromyalgia symptoms when consuming certain medications, therefore, the concept of drug interactions to create the antihyperalgesic effect (i.e., increase the sensitivity to pain) in fibromyalgia patients is worthy of investigation, as well as further research in the potential drug interactions involving fibromyalgia and the hyperalgesic effect.

Additional recommendations.

- Social networking may be useful in health education programs. This study demonstrated that a health education program administered using social networking was related to the lowering of anxiety in the patient cohort.

Therefore, further research on the role of social networking in health program implementation is recommended.

- Routine was mentioned by most participants. Some participants stated that routine was helpful in managing fibromyalgia, while other participants stated that routine was difficult to maintain due to fibromyalgia symptoms. Therefore, further research on the role of routine in fibromyalgia management is recommended.

References

Abeles, A. M., Pilinger, M. H., Solitar, B. M., & Abeles, M. (2007). Narrative Review: The pathophysiology of fibromyalgia. *Annals of Internal Medicine, 146*: 726-734.

Adams, J. M. & White, M. (2004). Biological ageing: A fundamental, biological link between socio-economic status and health? *European Journal of Public Health, 14*(3), 331-334.

Auberbach, C. F. & Silverstein, L.B. (2003). *Qualitative data: An introduction to coding and analysis.* New York, NY: New York University Press.

Ayan, C., Alvarez, M.J., Alonso-Cortes, B., Barrientos, M.J., Valencia, M., & Martin, V. (2009). *Health education home-based program in females with fibromyalgia: A pilot study, 22*(2), 99-105.

Bair, M. J., Robinson, R. L., Katon, W., & Kroenke, K. (2003). Depression and pain comorbidity: A literature review. *Archives of Internal Medicine, 163*, 2433-2445.

Beck, A. T., Ward, C. H., Mendelson, M. Mock, J., & Erbaugh, J. (1961). An inventory for measuring depression. *Archives of General Psychiatry,* 4, 53-63.

Beckman, K. B., & Ames, B. N. (1998). The free radical theory of aging matures. *Physiological Reviews , 78*, 547-581.

Berneburg, M., Grether-Beck, S., Kurten, V., Ruzicka, T., Briviba, K., Sies, H., & Krutmann, J. (1999). Singlet oxygen mediates the UVA-induced generation of the photoaging-associated mitochondrial common deletion. *The Journal of Biological Chemistry, 274*(22), 15345-15349.

Bowker, L. H. & Star, S. L. (1999). *Sorting things out: Classification and its consequences.* Cambridge, MA: MIT Press.

Brown, C. (2007). *The FM diet: Eating for a better quality of life* from the National Fibromyalgia Association archive.

de Araújo, C. G. S. (2008). Flexibility assessment: Normative values for flexitest from 5 to 91 years of age. *Arquivos brasileiros de cardiologia, 90*(4), 257-263.

Carroll, D., Moore, R. A., McQuay, H. J., Fairman, F., Tramer, M., & Leijon, G. (2001). Transcutaneous electrical nerve stimulation (TENS) for Chronic Pain. *Cochrane Database of Systemic Review, 3*, CD0f03222.

Centers for Disease Control and Prevention. (2008). *About BMI for adults.* Retrieved on August 20, 2008, from http://www.cdc.gov/nccdphp/dnpa/healthyweight/assessing/bmi/adult_BMI/about_adult_BMI.htm.

Central Intelligence Agency. (2008). *The world factbook.* Retrieved on August 20, 2008 from https://www.cia.gov/library/publications/the-world-factbook/index.html.

Cerami, A. (1985). Glucose as a mediator of aging. *Journal of the American Geriatric Society , 33*, 626-634.

Charmaz, K. (1990). Discovering chronic illness: Using grounded theory. *Social Science and Medicine, 30*, 1161-1172.

Charmaz, K. (1995). Grounded theory. In J. A. Smith, R. Harre, & L. Van Langenhove (Eds.) *Rethinking methods in Psychology* (pp. 27-49). London: Sage Publications.

Charmaz, K. (2000). Constructivist and objectivist grounded theory. In N. K. Denzin, & Y. Lincoln (Eds.*) Handbook of Qualitative Research* (pp. 509-535). Thousand Oaks, CA: Sage Publications.

Charmaz, K. (2001). Qualitative interviewing and grounded theory analysis. In J. F. Gubrium & J. A. Holstein (Eds.) *Handbook of interview research* (pp. 675-694). Thousand Oaks, CA: Sage Publications.

Charmaz, K. (2006) *Constructing grounded theory: A practical guide through qualitative analysis.* Los Angeles: Sage Publications.

Charmaz, K. & Michell, R. G. (1996) The myth of silent authorship: Self, substance and style in ethnographic writing. *Symbolic Interaction, 19*(4), 285-302.

Cheverud, J. (1996). Developmental integration and the evolution of pleiotropy. *American Zoology, 36*, 44-50.

Coffey, A. & Atkinson, P. (1996). *Making sense of qualitative data: Complementary research strategies.* Thousand Oaks, CA: Sage Publications.

Colorado Division of Workers' Compensation. (2008*). Psychological tests commonly used in the assessment of chronic pain patients.* Retrieved on August 24, 2008, from http://www.healthpsych.com/testing/psychtests.pdf.

Cooper Institute for Aerobics Research. (1994). *The prudential FITNESSGRAM test administration manual.* Dallas, TX: Cooper Institute for Aerobic Research.

Department of Health and Human Services, National Institutes of Health, and National Center for Complementary and Alternative Medicine. (2009). *Meditation: An introduction* from the National Center for Complementary and Alternative Medicine archive.

Faulkner Information Systems. (2001). *Learning management systems.* New York: FIS.

Fried, L.P., Tange, C.M., Walston, J., Newman, A.B., Hirsch, C., Gottdiener, J., Seeman, T., Tracy, R., Kop, W.J., Burke, G., & McBurnie, M.A. (2001). *Frailty in older adults: Evidence for a phenotype, 56A*(3): M146-M156.

Galor, O. & Moav, O. (2005). Natural selection and the evolution of life expectancy. *Minerva Center for Economic Growth Paper, No. 02-05.*

Gallo, J. J., Busby-Whithead, J., & Rabins, P. V. (1999). *Reichel's care of the elderly: Clinical aspects of aging* (5th ed.). Philadelphia: Lippincott, Williams, & Wilkins.

Gerdhem, P., Ringsberg, K. A., Magnusson, H., Obrant, K. J., & Akesson, K. (2003). Bone mass cannot be predicted by estimations of frailty in elderly ambulatory women. *Gerontology , 49*, 168-172.

Glaser, B. G. (1978). *Theoretical sensitivity.* Mill Valley, CA: The Sociology Press.

Glaser, B. G. (1992). *Basics of grounded theory analysis.* Mill Valley, CA: The Sociology Press.

Glaser, B. G. (1998). *Doing grounded theory: Issues and discussions.* Mill Valley, CA: The Sociology Press.

Glaser. B. G. & Strauss, A. L. (1967*). The discovery of grounded theory: Strategies for qualitative research.* New Brunswick, NJ: Aldine Transaction.

Goggins, W. B., Woo, J., Sham, A., & Ho, S. C. (2005). Frailty index as a measure of biological age in a chinese population. *Journal of Gerontology , 60A* (8), 1046-1051.

Goulding, C. (2002). *Grounded theory: A practical guide for management, business, and market researchers.* Thousand Oaks, CA: Sage Publications.

Gupta, S. (2007). *Chasing Life: New discoveries in the search for immortality to help you age less today.* New York, NY: Wellness Central.

Grzesiak, R. C. (1977). Relaxation techniques in treatment of chronic pain. *Archives of Physical Medicine and Rehabilitation, 6,* 270-272.

Brodin, H. (1985). Cervical pain and mobilization. *Manual Med, 2,* 18-22.

Hayflick, L. (1985). The cell biology of aging. *Clinical Geriatric Medicine , 1* (1), 15-27.

Hayflick, L. (1994). *How and why we age.* New York, NY: Ballantine Books.

Hayflick, L., & Moorhead, P. S. (1961). The serial cultivation of human diploid cell strains. *Experimental Cell Research , 25*, 585-621.

Hendrich, A. (2007). Predicting Patient Falls. *American Journal of Nursing, 107*(11), 50-58.

Hoeger, W. W. K. & Hoeger, S. A. (2004). *Fitness and wellness.* New York, NY: Brooks Cole.

Huzen, J., van Veldenhuisen, D. J., van Gilst, W. H., & van der Harst, P. (2008). Telomeres and biological ageing in cardiovascular disease. *Nederlands tijdschrift voor geneeskunde, 152*(22), 1265-1270.

Johns Hopkins Medical Institutions. (2005). *The Johns Hopkins Medical guide to health after 50.* (T. Dickey, S. B. Cassetty, & J. W. Brown, Eds.) New York, NY: Black Dog & Leventhal Publishers, Inc.

Kasser, E., Reinhard, S., Fox-Grage, W., Houser, A., & Accius, J. (2008, July). *A balancing act: State long-term care reform.* Retrieved July 11, 2008, from AARP Public Policy Institute: http://assets.aarp.org/rgcenter/il/2008_10_ltc.pdf.

Kendall, F. P., McCreary, E. K., Provance, P. G., Rodgers, M. M., & Romani, W. A. (2005). *Muscles: Testing and function, with posture and pain.* Philadelphia, PA: Lippincott, Williams, & Wilkins.

Kowald, A. & Kirkwood, T. B. (1994). Towards a network theory of ageing: A model combining the free radical theory and the protein error theory. *Journal of Theoretical Biology, 168*(1), 75-94.

Kim, S. H., Song, J., Mun, H., & Park, K. U. (2009). Effect of the combined use of tramadol and milnacipran on pain threshold in an animal model of fibromyalgia. *Korean Journal of Internal Medicine, 24*(2), 139-142.

Kirkwood, T. B. (1988). The nature and causes of ageing. *Ciba Foundation Symposium, 134,* 193-207.

Kirkwood, T. B. (2000). Why do we age? *Nature, 408*(6809), 233-238.

Kirkwood, T. B. (2001). Evolution of ageing. *Mechanisms of Ageing and Development, 123*, 737-745.

Kuchera, M. L. (2007). Applying osteopathic principles to formulate treatment for patients with chronic pain. *Journal of the American Osteopathic Association, 107*(10), ES28-ES38.

Lautz, A. (1961). Max Rubner on Aging. *Geriatrics, 16*, 44-51.

Le, C. T. (2001). *Health and numbers: A problem based introduction to biostatistics*. New York: Wiley-Liss.

Lewandowski, M. J. (2006). *The chronic pain care workbook: A self-treatment approach to pain relief using the behavioral assessment of pain questionnaire.* Oakland, CA: New Harbinger Publications, Inc.

Leyfer, O. T., Ruberg, J. L., & Woodruff-Borden, J. (2006). Examination of the utility of the Beck Anxiety Inventory and its factors as a screener for anxiety disorders. *Journal for Anxiety Disorders, 20*(4): 444-458.

Littlejohn, G. O. (2002). A realistic approach to managing patients with fibromyalgia. *Current Rheumatology Reports, 4*: 286-292.

Locke, K. (2001). *Grounded theory in management research.* Thousand Oaks, CA: Sage Publications.

Magalhães, J.P. (2004). From cells to ageing: a review of models and mechanisms of cellular senescence and their impact on human ageing. *Experimental Cell Research, 300,* 1-10.

Mattson, M.P., Duan, W., & Maswood, N. (2002). How does the brain control lifespan? *Ageing Research Review, 1*(2), 155-165..

Masoro, E. J., Katz, M. S., & McMahan, C. A. (1989). Evidence for the glycation hypothesis of aging from the food-restricted rodent model. *Journal of Gerontology , 44*, B20-B22.

Maxwell, J. A. (1992). Understanding and validity in qualitative research. In A. M. Huberman & M. B. Miles (Ed.), *The qualitative researcher's companion* (pp. 37-64). Thousand Oaks, CA: Sage Publications.

McMahon, S., & Koltzenburg, M. (2005). *Wall and Melzack's textbook of pain* (5th Edition ed.). New York, NY: Churchill Livingstone.

Medawar, P. (1952). *An unsolved problem of biology.* London: H.K. Lewis.

Melzack, R. (1993). Pain: Past, present, and future. *Canadian Journal of Experimental Psychology , 47* (4), 615-715.

Merck Medical Library. (2000). *The Merck manual for geriatrics* (3rd Edition ed.). (M. H. Beers, T. V. Jones, M. Berkwitz, J. L. Kaplan, & R. Porter, Eds.) New York, NY: Merck Research Laboratories.

Merck Medical Library. (2004). *The Merck manual of health & aging.* (M. H. Beers, T. V. Jones, M. Berkwitz, J. L. Kaplan, & R. Porter, Eds.) New York, NY: Merck Research Laboratories.

Mitnitski, A. B., Song, X., & Rockwood, K. (2004). The estimation of relative fitness and frailty in community-dwelling older adults using self-report data. *Journal of Gerontology , 59A* (6), 627-632.

Mobbs, C. V. (1990). Neurotoxic effects of estrogen, glucose, and glucocorticoids: Neurohumoral hysteresis and its pathological consequences during aging. *Review of Biological Research in Aging , 4*, 201-228.

Morse, J. M. (2006). The safety of safety research: The case of patient fall research. *Canadian Journal of Nursing Research, 38*(2), 73-88.

Musial, F., Michalsen, A., & Dobos, G. (2008). Functional chronic pain syndromes and naturopathic treatments: Neurobiological foundations. *Forschende Komplementarmedizin, 15*(2), 97-103.

National Institute of Neurological Disorders and Stroke. (2008). *NINDS chronic pain information page.* Retrieved on August 9, 2008, from http://www.ninds.nih.gov/disorders/chronic_pain/chronic_pain.htm.

National Institute on Aging. (2008). *Macarthur study of successful aging.* Retrieved on August 10, 2008, from http://www.nia.nih.gov/NR/rdonlyres/2F0C4BF5-905D-44EA-82D0-0C0840E97C2A/0/McArthurStudySuccessfulAging.pdf.

Nakamura, E., & Miyao, K. (2007). A method for identifying biomarkers of aging and constructing an index of biological age in humans. *Journals of Gerontology Series A: Biological Sciences & Medical Sciences , 62A* (10), 1096-1105.

Nordfjall, K., Eliasson, M., Stegmayr, B., Lundin, S., Roos, G., & Nilsson, P. M. (2008). Increased abdominal obesity, adverse psychosocial factors and shorter telomere length in subjects reporting early ageing: The MONICA Northern Sweden study. *Scandinavian Journal of Public Health.* Retrieved on August 20, 2008, from PubMed ahead of print.

Otis-Green, S., Sherman, R., Perez, M., & Baird, R. P. (2002). An integrated psychosocial-spiritual model for cancer pain management. *Cancer Practice, 10*, S58-65.

Rabins, P. V. (1998). Co-morbidity and mental health in later life. *Aging & Mental Health , 2* (4), 262-263.

Rau, C. L. & Russell, I. J. (2000). Is fibromyalgia a distinct clinical syndrome? *Current Review of Pain, 4*(4), 287-294.

Rockwood, K., Andrew, M., & Mitnitski, A. (2007). A comparison of two approaches to measure frailty in elderly people. *Journal of Gerontology , 62A* (7), 738-743.

Roizen, M. F., & Oz, M. C. (2007). *You staying young: The owner's manual for extending your warranty.* New York, NY: Simon & Schuster, Inc.

Russell, I. J. (1999). Is fibromyalgia a distinct clinical entity? The clinical investigator's evidence. *Baillieres Best Pract Res Clin Rheumatology, 13*(3), 445-454.

Salt, W. B. & Season, E. H. (2000). Fibromyalgia and the mind/body/spirit connection. Chicago: Parkview Publishing.

Sayer, A. A., & Cooper, C. (2004). A life course approach to biological ageing. In D. Kuh, & Y. Ben-Shlomo (Eds.), *A life course approach to chronic disease epidemiology* (pp. 306-323). London, England: Oxford University Press.

Seeman, T. E., Berkman, L. F., Charpentier, P. A., Blazer, D. G., Albert, M. S., & Tinetti, M. E. (1995). Behavioral and psychosocial predictors of physical performance: MacArthur studies of successful aging. *Medical Sciences, 50A*(4), M177-M183.

Sohal, R. S., & Weindruch, R. (1996). Oxidative stress, caloric restriction, and aging. *Science, 273*, 59-63.

Soti, C. & Csermely, P. (2007). Aging cellular networks: Chaperones as major participants. *Experimental Gerontology, 42*, 113-119.

Strauss, A. & Corbin, J. (2007). *Basics of qualitative research: Grounded theory procedures and techniques.* Thousand Oaks, CA: Sage Publications.

Thomson, S. B. (n.d.). *Qualitative research: Grounded theory – size and validity.* Retrieved on July 15, 2009, from Monash University Business and Economics Parent Directory.

Tinetti, M. E. (1986). Performance-oriented assessment of mobility problems in elderly patients. *Journal of the American Geriatric Society, 34*, 119-126.

Tennyson, A. (1963). *Selected poems.* New York, NY: Oxford University Press.

Turk, D. C., Swanson, K. S. & Tunks, E. R. (2008). Psychological approaches in the treatment of chronic pain patients—when pills, scalpels, and needles are not enough. *Canadian Journal of Psychiatry, 53*(4), 213-223.

Turk, D. C. & Wilson, H. D. (2009). Managing fibromyalgia: An update on diagnosis and treatment. *The Journal of Musculoskeletal Medicine, 10.* Retrieved on December 15, 2009, from http://jmm.consultantlive.com/display/article/1145622/1476015.

Tufts University Program in Evidence-Based Complementary and Alternative Medicine. (2006, February 9). *Pain, palliative, and supportive care: Models of pain management*. Retrieved May 9, 2008, from TUFTS ebcam: http://www.tufts.edu/med/ebcam/pain/models.html.

The American Society for Aesthetic Plastic Surgery. (n.d.). *Cosmetic surgery national data bank statistics.* Retrieved June 10, 2008, from The American Society for Aesthetic Plastic Surgery: http://www.surgery.org/download/2007stats.pdf

Van Zant, G. & Liang, Y. (2003). The role of stem cells in ageing. *Experimental Hematology, 31*(8), 659-672.

Weismann, A. (1891). *On heredity.* Oxford: Claredon Press.

Williams, G. C. (1999). The Tithonus error in modern gerontology. *The Quarterly Review of Biology , 74* (4), 405-415.

Windows Live. (2009). *Windows Live Groups.* Retrieved from http://windowslive.com/Online/Groups.

Weksler, M. E. (2004). Immune senescence. *Annals of Neurology , 35* (S1), S35-S37.

Wood, J. W., O'Conner, K. A., Holman, D. J., Bringle, E., Barsom, S. H., & Grimes, M. A. (2001). *The evolution of menopause by antagonistic pleiotropy.* Retrieved on August 16, 2008, from http://csde.washington.edu/downloads/01-04.pdf.

World Health Organization. (2008). *WHO definition of health.* Retrieved on August 24, 2008, from http://www.who.int/about/definition/en/print.html.

WRIISC of New Jersey. (2008). *Exercise to health manage chronic pain and/or fatigue* from the VA War Related Illness & Injury Study Center of New Jersey archive.