The Effect Of Exercise On Joint Mobility And Perceived Pain Of The Hand In The Elderly With Arthritis

Jane Hulett
Mississippi University for Women

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The Effect of Exercise on Joint Mobility and Perceived Pain of the Hand in the Elderly with Arthritis

by

Jane Hulett

A Thesis
Submitted to the Faculty of Mississippi University for Women in Partial Fulfillment of the Requirements for the Degree of Master of Science in Nursing in the Division of Nursing Mississippi University for Women

Summer, 1987
The Effect of Exercise on Joint Mobility and Perceived Pain of the Hand in the Elderly with Arthritis

by

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Ralph Hill
Director of the Graduate School
In memory of my sister Carolyn

Throughout your battle with cancer, in spite of pain and fear, you always encouraged me to meet my goals. Your words of encouragement and praise echo in my mind when I feel like quitting. Although your body is no longer here, your love and warmth surround and nourish me.
Acknowledgements

I wish to express my wholehearted appreciation to Mary Pat Curtis, my major research advisor, for her guidance and support during my graduate study. My gratitude is also directed to Dr. Rayma Skinner and Dr. Phyllis Werner for their assistance and much needed advice that made it possible for the completion of this thesis. In addition, I would also like to thank the research participants for their time and support that made this study possible.

My very special thanks are expressed to my husband, Bob, for his love and support at all times, and without whom this would not have been possible. To my dear sweet sons, Bobby and Bradford, who endured mother's absences, moodiness, and troubled times during school and for bearing with me throughout my college career. I would also like to acknowledge my mother, Jerry Alexander, for her continued love, encouragement and support throughout my life. My heartfelt thanks to my entire family for their patience with me in reaching this goal.
Abstract

This was a quasi-experimental study designed to compare the amount of pain perceived and degree of joint mobility in elderly arthritics who participated in a water exercise program and elderly arthritics who participated in a land exercise program. The hypotheses tested in this study were:

1. There will be no significant difference in pain experienced by elderly arthritics who participate in land exercises and elderly arthritics who participate in water exercises.

2. There will be no significant difference in joint mobility of elderly arthritics who participate in land exercises and elderly arthritics who participate in water exercises.

Twenty-three subjects participated in this study. Ten subjects in the experimental group participated in an exercise program for the hands using water. Thirteen subjects in the control group participated in an exercise program for the hands without water. The Rasmussen Pain Description Index was used to collect data about pain and the goniometer was used to collect data about joint mobility of the hands.

The t-test and .05 level of significance were used to analyze the data for the hypotheses. The results of the
statistical analysis failed to reveal a significant difference for Hypothesis I at the .05 level. Therefore, the researcher failed to reject Hypothesis I. The results of the statistical analysis revealed a significant difference for Hypothesis II at the .05 level and Hypothesis II was rejected. Based on the results of this study, the researcher concluded that exercise does lead to increased joint mobility for the elderly with arthritis of the hand.
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Chapter I

The Research Problem

The elderly population (persons 65 years of age and older) in the United States increases by 1,600 daily (McDuffie, 1985). One prediction estimates that there will be a 46% increase in persons 65 years of age or older and an 80% increase of persons 85 years of age or older during the next 15 years (Performance Technologies, 1986). As the elderly population is rapidly increasing in the United States, so, too, is the number of clients who are suffering with arthritis. Rheumatoid arthritis affects 4.5% of the population between 55 and 75 years of age (McDuffie, 1985). Osteoarthritis affects between 50 and 75% of the older population (MacLaren & Lorig, 1981). One researcher estimates that 90% of all people show some joint degeneration (osteoarthritis) by age 50 (Nowotry, 1980).

Arthritis is a chronic and painful illness ranging from mild to excruciating pain due to damaged joints, muscles, and connective tissues of the body (Skeers, 1979). The disease usually follows a progressive course with morning pain and stiffness being the first symptom. Loss of full extension of a joint is another early sign (Calin, 1986).
Arthritic patients suffer from pain, decreased joint mobility, joint deformity, and sometimes immobility. The arthritic client also suffers easy fatigability and other vague systemic complaints. These symptoms frequently lead to depression and demoralization for arthritic patients (Moore & McDonald, 1983). In the elderly, arthritis may present problems with achieving intimacy. Depending on the severity of the disease, the pain and immobility may lead to social isolation. Safety, independence, and self-esteem are threatened as a result of the arthritis process. Thus, arthritis contributes to making it difficult for the elderly to maintain a desired lifestyle (Carnevali & Patrick, 1979).

Exercise is very valuable to the treatment of arthritis. The goal is to restore the maximum degree of physical function by helping the patient make the best use of remaining abilities. Affected joints should be moved through their full range of motion (Department of Health and Human Services, 1981). Banwell (1984), a physical therapist, defines exercise as "purposeful use of the body" and states that this includes many kinds of activities and movements. Therapeutic and recreational exercise should be combined with specific goals in mind when possible. Physical therapy and exercise used in conjunction with pharmacologic agents in the treatment of osteoarthritis have many benefits to the arthritic. Active and passive range of motion exercises, isometric, and isotonic active exercises
for strengthening, and Williams flexion exercises can be performed in bed before arising in the morning. These exercises assist in strengthening and supporting osteoarthritic joints and reducing the symptoms of pain and stiffness. These exercises also are effective in the relief of muscle spasms (Altman, 1986). Passive range of motion exercises should be maintained in painful joints of those suffering with arthritis to maintain muscle strength as soon as the pain of an acute phase is controlled (Diamond, 1982).

Nordemar, Ekblom, Zachrison, and Lundqvist (1981) have conducted studies about exercise in arthritic patients. One study involved 10 patients in a 6-week physical training program 5 days a week. These patients performed 2 hours of physical activity each day in addition to activities of daily living training. Results of this study revealed a decrease in the number of tender joints, an improvement in duration of the walking and stair climbing tests, maximal physical work capacity increased on the bicycle ergometer, and an increase in quadriceps and bicep strength (Nordemar, 1981).

In a long-term study (4-8 years) conducted by Nordemar et al. (1981), 23 participants met for one hour every second week. Group training included activities/exercises such as the bicycle ergometer, swimming, skiing, cycling, dancing, gymnastics, golf, walking, jogging, and other organized sports. Participants of this organized exercise program
suffered less joint stiffness, sick leave, and days spent in the hospital, fewer intra-articular injections and oral steroids, plus less pronounced progression of joint destruction as measured by x-ray than the control group that did not exercise. This group also performed better on quadriceps torque, biceps torque, and stair tests.

Podgorski and Edmonds (1985) state that warm water combines pain relief with an ideal environment for exercise. The risk of injury to joints and muscles is minimized because water provides buoyancy and has a shock absorbing effect. Patients experience increased flexibility in water where there is reduced stress on joints and muscles, thereby leading to a lessened risk of injury. Older adults with arthritis can move more easily in the water (Weinstein, 1986).

Although exercise increases joint mobility and decreases pain, the incidence of noncompliance to exercise in the elderly arthritic is high due to pain and immobility (Simpson & Dickinson, 1983). Exercise in water may be one way of increasing compliance to an exercise program in the elderly population since water exercise helps the joints to move better with less pain (Altman, 1986; Simpson & Dickinson, 1983). Although exercise in water has been suggested as one way of increasing compliance with exercise, there is little research to support this in the elderly patient. This researcher believes the issue of whether
exercise by the elderly in water is more effective needs further study.

This researcher has been a victim of arthritis for the past 20 years and has experienced the progressive stages of this chronic, painful disease. As a nurse and Geriatric Nurse Clinician (GNC) student, the researcher has worked with numerous geriatric clients, noting the crippling and painful effects of this disease.

Since arthritis is a chronic, debilitating disease of the elderly, the GNC is in a position to make an important contribution to management of arthritis. If results from this study identify one type of exercise as more beneficial in reducing pain and increasing mobility, the GNC can incorporate these findings into practice through prescribing therapy and education. By these actions the GNC can improve the elderly's compliance to therapy, sense of well-being, and comfort, thereby contributing to the elderly's quality of life.

The purpose of this study was to determine if one type of exercise is more beneficial to the elder arthritic in reducing pain and increasing joint mobility. The researcher was seeking to answer this question: Is water exercise more beneficial than traditional land exercise in reducing pain and increasing joint mobility for the elder arthritic?
Chapter II

Theoretical Basis of Study

Johnson's behavioral system is the basis for this study of land versus water exercise for the elder arthritic. Johnson's theory originated in Nightingale's writings which viewed nursing's goal as helping individuals prevent or recover from injury or disease (Marriner, 1986). Johnson supports the open systems concept and views man as a behavioral system which functions as a whole by virtue of the interdependence of its eight subsystems (Marriner, 1986). Man attempts to achieve stability and balance in these subsystems through adjustments and adaptations. These adjustments and adaptations are necessary for efficient and effective functioning (Marriner, 1986).

The structure of each subsystem includes a goal that is based on a basic drive, a set, choices, and the ultimate action or behavior. These four factors contribute to the observable activity or action of a person in a given situation. Goals can be identified by the behavior exhibited, i.e., if the elderly arthritic is hurting, the goal is to relieve the pain. Behavior will reveal activities necessary to relieve pain, i.e., taking medication and rest painful joints (Marriner, 1986).
Johnson notes that an individual usually acts or responds to a situation in a certain way. This stable action, defined as a set, is the person's habitual response to stimuli. For instance, the usual response to the inability to accomplish some activities of daily living because of painful joints and/or decreased mobility may be frustration. The action of the individual is the observable response to stimuli or behavior. The action to the inability to accomplish some activities and frustration may be to solicit help from a family member or significant other. Alternate behaviors which may be used in a given situation are identified as choices. Choices may include obtaining and using a device to aid in activities of daily living (Marriner, 1986).

If one subsystem is out of balance, the remaining seven subsystems will also be affected resulting in disequilibrium for the whole system or individual. The goal then becomes identifying the underlying problem in the original subsystem and correcting it if possible. If the problem cannot be corrected, alternate methods of behavior need to be utilized. When the problem has been resolved or alternate behaviors adopted, the remaining subsystems will return to a state of equilibrium.

The subsystem tested by this research is achievement. The goal of achievement is to master or control man or man's environment. The subjects in this study are elderly
individuals who suffer from pain and decreased mobility due to arthritis of the hands. The achievement subsystem is out of balance for these individuals due to a loss of control over their bodies and environment. The subjects in this study may have difficulty performing activities of daily living, such as opening jars and dressing, due to pain and decreased mobility in their arthritic hands. The usual responses or set to treating this pain and decreased mobility of arthritic hands are taking medicine as prescribed by doctors, resting joints during acute stages, and applying heat in the form of heating pads or warm compresses. These behaviors have not been effective in meeting the achievement goal, reduction of pain, and increased mobility. Therefore, equilibrium has not been established. An alternative behavior to meet the achievement goal or drive of reduction in pain and increase in joint mobility is exercise. This study determines if the alternative behavior of exercise meets the achievement goal. In addition, this study determines which type of exercise, land or aquatic, is the most effective alternate behavior.

Johnson (cited in Marriner, 1986) defines nursing as an external force acting to preserve the organization of the patient's behavior while the patient is under stress by means of imposing regulatory mechanisms or by providing resources. Johnson views nursing as an art and a science, supplying external assistance both before and during system
balance disturbance. The nursing goal is to maintain and restore balance in patients by helping them to achieve a more optimal level of functioning. In this study a planned program of land or water exercises for the elder arthritic is used as an alternate behavior or choice in treatment to aid subjects in regaining control of their bodies and the environment fulfilling the achievement subsystem and restoring equilibrium.
Chapter III

Hypotheses

Theoretical Null Hypotheses

1. There will be no significant difference in pain experienced between elderly arthritics who participate in land exercises and elderly arthritics who participate in water exercises.

2. There will be no significant difference in joint mobility between elderly arthritics who participate in land exercises and elderly arthritics who participate in water exercises.

Definitions

1. No significant difference: using the t test at the .05 level of significance.

2. Pain: as measured by the Rasmussen Pain Description Index pre- and post-exercise program.

3. Joint mobility: as measured by a goniometer pre- and post-exercise program.

4. Elderly arthritics: persons between the ages of 55 and 80 years who are medically diagnosed with arthritis.

5. Participate: agree to do exercises, land or water, five times with each hand two times a day for one month.
6. **Land exercise**: a 4-week program of exercises for fingers approved by the Arthritis Foundation.

7. **Water exercise**: a 4-week program of exercises for fingers approved by the Arthritis Foundation with hands submerged to wrists in moderately warm water.

**Operational Hypotheses**

1. When persons between the ages of 55 and 80 years who participate in a 4-week land exercise program are administered the Rasmussen Pain Description Index before and after the exercise program and the scores are compared using the \( t \) test to the scores of persons between the ages of 55 and 80 years not participating in the land or water exercise program, there will be no difference at the .05 level of significance.

2. When persons between the ages of 55 and 80 years who participate in a 4-week land or water exercise program have range of motion of the fingers measured with a goniometer before and after the exercise program and the scores are compared using the \( t \)-test statistic to the scores of persons between the ages of 55 and 80 years not participating in the land or water exercise program, there will be no difference at the .05 level of significance.
Chapter IV

Review of Related Literature

A review of the literature revealed numerous articles about the contribution of exercise to elderly arthritic persons in decreasing pain and increasing joint mobility. The literature, however, is lacking in research which validates the effect of water exercise on elderly arthritic persons' joint pain and mobility. Therefore, the focus of this review is to the effects of exercise on pain reduction and joint mobility in individuals with arthritis. In addition, articles discussing the benefits of heat and/or water will be cited.

Nordemar, Edstrom, and Ekblom (cited in Kottke, Caspersen, and Hill, 1984) examined the effects of exercise on pain and activity in rheumatoid arthritis patients. Ten patients were enrolled in a 6-week physical training program for 9 hours a day, 5 days a week. The training program focused on upper and lower extremities. Two of the 9 hours consisted of physical activity, including intermittent work bouts on a cycle ergometer, quadriceps strength training, walking, and stair climbing. Each patient also participated in activities of daily living training on a daily basis. If pain occurred, activity was curtailed. Pre- and post-
evaluation included a walking test in which the patient was asked to walk a distance of 850 meters as rapidly as possible, a stair test in which the patient walked up and down stairs as quickly as possible, and a maximal exercise test on a bicycle ergometer. ECG, oxygen consumption, blood lactate, and perceived exertion were used to analyze the ergometer exercise tolerance. Both arms and legs were measured for maximal isometric muscle strength.

All 10 of the patients completed this program. Of these 10, 4 had a decrease in the number of tender joints. There was an average improvement of 6% in duration of the walking test and 11% in duration of the stair test. Other findings included an average of 25% on quadricep and bicep strength and 35% on maximal physical work capacity on the bicycle ergometer.

A similar study conducted by Nordemar, Ekblom, Zachrisson, and Lundqvist (1981) focused on individuals with classical or definite rheumatoid arthritis. Forty-six subjects selected from an outpatient clinic on three consecutive occasions between 1970 and 1974 participated in and completed the study. Subjects were evaluated using x-ray analysis, Lansbury's joint index, walking and stair tests, cycle ergometer tests, and quadriceps and biceps torque. Subjects were equally divided into control and experimental groups. The experimental group participated in a training program. The training program consisted of bicycle
ergometer, swimming, skiing, cycling, dancing, gymnastics, golf, walking, and/or jogging. Subjects exercised one half to one hour daily.

Statistical analysis included the $t$ test and Mann-Whitney test. Results revealed that the experimental group scored better on the Lansbury's joint index, x-ray analysis, and stair test than the control group. The authors concluded that half an hour of daily active exercise, such as fast walking, bicycling, or swimming, might delay the joint destruction and loss of functional capacity associated with arthritis (Nordemar et al., 1981).

Another study conducted by Harkcom, Lampman, Banwell, and Castor (1985) included 20 female patients with definite or classical arthritis. Subjects were selected from a large outpatient population of a local institution. The subjects were divided into four groups, three exercise and one control. The exercise groups participated in a 12-week program of bicycle ergometer exercise three times a week. The three exercise groups differed in the initial length of total exercise time, the rate of progression, and the final total duration of activity achieved after 6 weeks. Exercise intensity was maintained for all experimental groups at 70% of maximal heart rate measured during the baseline exercise tolerance test. Exercise sessions were divided into five bouts of exercise separated by one-minute rest periods. Each exercise session was preceded by a warmup and ended
with a cool-down period. Subjects in the control group continued their routine daily activities without knowledge of any intervention.

Pretesting and posttesting included exercise tolerance tests for aerobic capacities, muscle strength, walk time, grip strength, and a Modified Functional Status Index. The Modified Functional Status Index assessed morning stiffness, sleep patterns, self-care, ambulation, and activities of daily living. Statistical analysis included analysis of variance and the t-test.

All three exercise groups reported a decrease in pain and swelling, a reduction in morning stiffness, and an improvement in sleep patterns. No subjective improvements were noted in the control group. An increased exercise tolerance and aerobic capacity also was noted for all exercising subjects. Harkcom et al. concluded that 15 minutes of exercise performed three times per week is beneficial in the long-term treatment of rheumatoid arthritis.

While no research studies documenting the combined effects of heat, water, and exercise were found, several authors proposed that pain and joint mobility were improved by these modalities. Strodthoff (1982), Driscoll (1975) and Hudak (1977) noted that heat application in the form of warm moist towels, or a warm tub bath or shower is useful to relieve muscle spasms near arthritic joints, reduce joint stiffness and swelling, facilitate joint mobility, and
prepare joints for exercise. Moore and McDonald (1983) and Driscoll (1975) advocate the use of heat as in warm baths or paraffin dips before exercising. The Department of Health and Human Services (1981) advises that heat is relaxing and soothing and thus helps the joints to move better with less pain.

Schutt (1977) discussed the use of hydrotherapy in the treatment of the pain and stiffness of arthritis. Methods of hydrotherapy include the Hubbard tank at a temperature of 38 °C (101 °F) or whirlpool baths at 39 °C (102.2 °F). However, these two methods require hospitalization or treatment in an outpatient physical therapy department. Home remedies suggested by Schutt include the use of electric blankets in helping to decrease morning stiffness and paraffin baths at a temperature of 52 °C (125 °F).

The findings of the studies in this review of the literature showed that exercise is effective in reducing arthritics' joint pain, stiffness and swelling, as well as increasing joint mobility and exercise tolerance. Several authors recommend the use of heat and/or water to relieve muscle spasms near arthritic joints, reduce joint stiffness and swelling, facilitate joint mobility, relieve pain, and prepare joints for exercise. However, there were no studies comparing the effectiveness of exercise in water to land exercise.
Chapter V

Research Design and Methodology

Research Design

The quasi-experimental design was utilized in this study about the effects of land versus water exercise in elderly patients with arthritis. Burns and Grove (1987) note that quasi-experimental designs "facilitated the search for knowledge and examination of causality in situations in which complete control is not possible" (p. 256). According to Polit and Hungler (1983), quasi-experiments involve the manipulation of an independent variable, or the institution of a treatment. This study was designed to test the effectiveness of water exercise by exposing an experimental group to a structured program of water exercise and comparing the results to a control group who participated in the same exercise program without the modality of water.

Variables

The independent variable in this study was the treatment modality of water exercise. The dependent variables were the amount of pain experienced by the subjects as measured by the Rasmussen Pain Description Index and the degree of finger joint mobility as measured by a goniometer.
Intervening variables included compliance by the subjects to the exercise programs, weather, and the extent of the disease process in each subject. Controlled variables were the age of the subjects, the joint structure affected by arthritis, and subject's place of residence.

Setting, Population, and Sample

The setting for this study was a small town in north central rural Mississippi. The 1980 census of this town is 6,177 residents. The population is divided into 62% whites and 38% blacks. Nineteen percent of the population is over 65 years of age. Major sources of personal income for residents in this community are transfer or entitlement checks, 25.6%; manufacturing, 17.1%; government, 11.3%; services, 10.2%; and dividends, interest, and rent (property), 10.1%. The mean annual income for this area is $11,831, and all socioeconomic levels are represented in this area (Montgomery County Economic Council, personal communication, May 12, 1987).

The population was composed of elderly members of a Sunday School class and a local Senior Citizens group. The church class services elders, ages 50 to 82 years, and represents all socioeconomic levels (P. Carmack, personal communication, May 12, 1987). The Senior Citizens group services elders ages 50 to 93 years. Members of this group are in the middle and lower socioeconomic levels (J. Pinkney, personal communication, May 12, 1987). The sample
consisted of those elders who met criteria for selection, signed consent forms, and were present during the period of data collection. To participate in the study subjects had to be at least 55 years of age and have pain and limitation of movement in fingers/hands with a medical diagnosis of arthritis.

**Data Gathering Process**

The researcher contacted the President of the Sunday School class and the Director of the Senior Citizens group and obtained permission to explain the study to members. The researcher scheduled a time to meet with members at each location and obtained informed consent (see Appendices A and B). At that time subjects were assured of confidentiality and told that the researcher would be the only person to see the names of the subjects and that all materials would be destroyed after data analysis. After informed consent was obtained, subjects completed the Rasmussen Pain Description Index (RPDI) (see Appendix C) and were measured for the degree of flexion and extension of fingers using a goniometer. A printed exercise program (see Appendices D and E) was given to each subject with an explanation. The assignment of aquatic exercise to a group was accomplished by the toss of a coin. The researcher explained that each subject would be contacted on a weekly basis over a period of 4 weeks to monitor compliance and answer questions.
Each week the researcher met with both groups to monitor compliance, offer encouragement, and answer questions. At the conclusion of the 4-week period, subjects completed the RPDI and were measured for the degree of flexion and extension of their fingers using a goniometer. Data were collected from May through June 1987.

**Instrumentation**

The Rasmussen Pain Description Index (RPDI) was developed to measure "the intensity of pain as it can be verbally described" (Rasmussen, 1974). Rasmussen's instrument was developed based on the Clarke-Spear Analogue Scale, data reported by Melzack and Torgenson (cited in Rasmussen, 1974), and personal interviews by Rasmussen with those who were having pain. The tool was pilot-tested for content, language, and response alternatives and reviewed by three nursing experts (Rasmussen, 1974).

The RPDI contains items about demographic and background information (age, occupation, type of arthritis if known) and pain as experienced by respondent. The 10 items related to pain are forced choice questions designed to obtain general information related to the subject's pain. The information obtained includes when is pain most intense and how long does relief last between episodes of pain. The questionnaire can be self-administered or administered by interview. The tool is considered to be in an early stage.
of development with no information available as to its reliability or validity (Dobson, 1981).

Scoring of this instrument is accomplished by summing the answers from the 10 forced choice questions. These 10 questions have four possible responses. Each response is assigned a numeral of 1, 2, 3, or 4, and the higher the numerical value, the higher the degree of pain. Total scores may range from 10 to 40.

The second tool used in this study was the goniometer. The goniometer is an instrument used for measuring angles (New World Dictionary, 1984). Health care providers use the goniometer to measure the degree to which a client can bend a joint or raise or lower a limb. Therefore, the degree of limitation of motion can be determined with the use of a goniometer.

The procedure used by Dobson (1981) to measure joint mobility was used. The differences in the degree of angle of each of the fingers were calculated. An increase in the degree of the angle received a positive number indicating greater mobility. A decrease in the angle was given a negative number which indicated lesser mobility. The differences in each finger of each hand were totaled to obtain a score for the hands as a unit.

**Statistical Analysis**

Data from the RPDI and the goniometer were analyzed using the $t$ test. This basic parametric procedure is the
test of choice to compare sample sizes of less than 30 (Polit & Hungler, 1983). The t-test is used for analyzing the differences between two means and was appropriate to determine if a significant difference existed between elderly arthritics who participated in land exercises and those who participated in water exercises.

Assumptions
1. The subjects responded truthfully.
2. Pain can be measured.
3. Joint mobility can be measured.

Limitations
1. Limiting subjects to those over 55 years prevents generalization to those under 55 years of age.
2. Limiting the sample population to a small rural town in north central Mississippi prevents generalization to other geographical areas.
3. Limiting the period of data gathering to May/June may prevent generalizations to other months of the year.
Chapter VI

Analysis of Data

The purpose of this study was to compare pain and joint mobility in elderly arthritics who participated in a planned water exercise program with those who participated in a planned land exercise program. Data were collected using the Rasmussen Pain Description Index and goniometer.

A total of 23 subjects completed this study, 10 in the water or experimental group and 13 in the land or control group. The ages of the experimental group ranged from 58 to 80 years, with a mean age of 70.2 years. All of the subjects in this group were Caucasian females. The educational level ranged from 3 to 12 years for this group, with a mean educational level of 9.6 years. The ages of the control group ranged from 60 to 93 years, with a mean age of 75.1 years. The control group was composed of 3 Caucasian females, 2 black males, and 8 black females. The educational level for this group ranged from 3 to 12 years, with a mean educational level of 6.23 years (see Table 1).

The experimental group was composed of two subjects with rheumatoid arthritis while the remaining 8 had osteoarthritis. Eight of the subjects in the control group had osteoarthritis. The remaining 5 had been told that they had
arthritics by their physicians, but did not know the type. All subjects took arthritis medication on a daily basis.

Scores on the Rasmussen Pain Description Index can range from 10 (low pain) to 40 (high pain). Pretest scores for the experimental group ranged from 16 to 27 with a mean of 22.20. Posttest scores for the experimental group ranged from 16 to 23, with a mean score of 20.50. The pretest scores of the control group ranged from 13 to 36, with a mean of 23.23. Posttest scores for the control group ranged from 13 to 31, with a mean of 22.77. Table 1 contains subject data and raw scores of each dependent measure.

Joint mobility is measured in degrees so that the higher the numerical value, the more mobility there is. Pretest scores for the experimental group ranged from 9 to 52 degrees, with a mean of 37.9. Posttest scores for the experimental group ranged from 47 to 80 degrees, with a mean of 56.8. The control group had a pretest score range of 20 to 71 degrees, with a mean of 41.15. Posttest scores for the control group ranged between 25 and 75 degrees, with a mean of 45.92.

Hypothesis I

The researcher hypothesized that there would be no significant difference in the amount of pain reduction by elderly arthritics who participated in the planned water exercise program and elderly arthritics who participated in the planned land exercise program. To test this hypothesis,
Table 1
Experimental and Control Group Raw Data

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<td>93</td>
<td>Osteo</td>
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</table>
the \( t \) test was employed. The comparison of the experimental and control groups on pain pre-exercise program resulted in a \( t(21) = -.44, p = .662 \). A comparison of the two groups post-exercise revealed a \( t(21) = -1.18, p = .252 \). The result of these analyses can be found in Table 2.

Table 2

A \( t \)-Test Comparison of Pre- and Post-Pain Reduction

<table>
<thead>
<tr>
<th>Variable</th>
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<th>M</th>
<th>SD</th>
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<tbody>
<tr>
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<tr>
<td>Pretest</td>
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<td></td>
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<tr>
<td>Group I</td>
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<td>22.20</td>
<td>3.521</td>
<td>-.44</td>
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<td>23.23</td>
<td>6.635</td>
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</tr>
<tr>
<td>Posttest</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Group I</td>
<td>10</td>
<td>20.50</td>
<td>2.600</td>
<td>-1.18</td>
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<tr>
<td>Group II</td>
<td>13</td>
<td>22.76</td>
<td>5.630</td>
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</tbody>
</table>

*\( p \leq .05 \).

The comparison of the groups using change in pain scores from pretest to posttest resulted in \( t(21) = 1.04, p = .312 \). The result of this analysis can be found in Table 3. Since the \( t \) values were not significant at .05 level, the researcher failed to reject Hypothesis I.
Table 3
Analysis of Change Scores of Rasmussen Pain Reduction Index for Land and Water Exercises Using t Test

<table>
<thead>
<tr>
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<th>SD</th>
<th>t</th>
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</thead>
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<td>Group I</td>
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<td>1.7000</td>
<td>1.703</td>
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<td>Group II</td>
<td>13</td>
<td>.4615</td>
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</tbody>
</table>

*p < .05.

Hypothesis II

The researcher hypothesized that there would be no significant differences in the degree of joint movement experienced by elderly arthritics who participated in a planned water exercise program and elderly arthritics who participated in a planned land exercise program. To test this hypothesis, the t test was employed. The comparison of the experimental and control groups on joint mobility pre-exercise program revealed a t(21) = -.47, p = .653. A comparison of the two groups post-exercise resulted in a t(21) = 2.02, p = .056. The results of these analyses can be found in Table 4. The comparison of the groups using change in mobility scores from pretest to posttest resulted in a t(21) = 2.30, p = .032. The results of this analysis can be found in Table 5. Since the t test was significant at the .05 level, the researcher rejected Hypothesis II.
Table 4
A t-Test Comparison of Pre- and Post-Joint Mobility Change

<table>
<thead>
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<tr>
<td><strong>Pretest</strong></td>
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<td>41.1538</td>
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<td><strong>Posttest</strong></td>
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</table>

*p < .05.

Table 5
Analysis of Change Scores in Joint Mobility Measured With Goniometer for Land and Water Exercises Using t Test

<table>
<thead>
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<tr>
<td>Group I</td>
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<td>18.9000</td>
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<td>4.7692</td>
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*p < .05.
Additional Findings

During this experimental study, the weather was unreasonably rainy. Weather was warm and sunny prior to and on the day of pretest data collection. However, during the 4-week exercise program and posttest data collection, the weather was overcast and/or rainy.

Demographic data, the Rasmussen Pain Index Scores, and the degree of joint mobility were submitted to Pearson product moment correlation analysis. The results of this analysis were a significant negative correlation between age and joint mobility ($r = -.3558, p = .048$), a significant positive correlation between education and pain reduction ($r = .3544, p = .948$) and a significant positive correlation between education and joint mobility ($r = .6086, p = .001$).
Summary

This was a quasi-experimental study designed to compare the amount of pain perceived and degree of joint mobility in elderly arthritics who participated in a water exercise program and elderly arthritics who participated in a land exercise program. The hypotheses tested in this study were:

1. There will be no significant difference in pain experienced by elderly arthritics who participate in land exercises and elderly arthritics who participate in water exercises.

2. There will be no significant difference in joint mobility of elderly arthritics who participate in land exercises and elderly arthritics who participate in water exercises.

Twenty-three subjects participated in this study. Ten subjects in the experimental group participated in an exercise program for the hands using water. Thirteen subjects in the control group participated in an exercise program for the hands without water. The Rasmussen Pain Description
Index was used to collect data about pain and the goniometer was used to collect data about joint mobility of the hands.

The t test and .05 level of significance were used to analyze the data for the hypotheses. The results of the statistical analysis failed to reveal a significant difference for Hypothesis I at the .05 level. Therefore, the researcher failed to reject Hypothesis I. The results of the statistical analysis revealed a significant difference for Hypothesis II at the .05 level and Hypothesis II was rejected. Based on the results of this study, the researcher concluded that exercise does lead to increased joint mobility for the elderly with arthritis of the hand.

Conclusions and Implications

Subjects from the experimental group reported an average 60% reduction in pain, while the control group had an average 46% reduction in pain. While this reduction was not significant, pain reduction did occur. One reason for nonsignificant findings may have been the weather. Carnevali and Patrick (1986) note that arthritis patients report changes in joint discomfort related to weather changes. This researcher believes the rainy weather which occurred during this study had a negative effect on the outcome of this study. The study should be repeated during various seasons to determine if there are seasonal differences in pain and joint mobility with exercise.
The finding of reduced pain from both land and water exercise supports the findings of other studies on exercise and pain reduction. Harkcom, Lampman, Banwell, and Castor (1985) and Nordemar, Ekblom, Zachrisson, and Lundqvist (1981) found that exercise reduces pain in joints.

Results of this study revealed increased joint mobility for both groups. However, those participating in water exercise had significantly greater changes in joint mobility than those participating in land exercise. A review of the literature revealed no comparative studies about the benefits of water exercise and land exercise on joint mobility for the arthritic. The finding of increased joint mobility with water exercise needs to be substantiated by further research.

There was a significant correlation between age and changes in joint mobility due to exercise. As age increased there were fewer benefits from exercise in joint mobility. One reason for this relationship may be that the disease process has been present longer causing greater damage to joints. There were no studies in the literature which support this finding.

There was a positive correlation between education and pain reduction and joint mobility. As the level of education decreased, the less change in pain reduction and joint mobility. These findings may indicate a need for increased teaching and reinforcement to those with lower
levels of education. There were no studies in the literature which support this finding.

Results of this study support Johnson's theory of nursing. Water exercise is an effective alternative behavior for meeting the achievement subsystem goal of increased joint mobility and reduced pain. By meeting the achievement goal, the elder arthritic system may be returned to equilibrium. Johnson's theory of nursing is appropriate for the Geriatric Nurse Clinician (GNC) in caring for arthritis.

Recommendations

The following recommendations are made based on the findings of this study:

Research

1. Replication of this study using a larger, more representative sample in terms of race, age, sex, and education.

2. Conduction of a similar study with a longer treatment period.

3. Conduction of a similar study with periodic checks for pain perception and joint mobility.

4. Investigation of the positive correlation between age and decreased joint mobility.

5. Investigation of the positive correlation between education and pain reduction.
6. Investigation of the positive correlation between education and joint mobility.

**Nursing**

1. Prescription by GNC of land or water exercise to reduce pain from arthritic hand joints.

2. Prescription by GNC of water exercise as preferred treatment to increase joint mobility of arthritic hand joints.

3. Intervention with arthritis using exercise at the time of diagnosis.

4. Adaptation of teaching to level of education.
Appendix A

Informed Consent

(Water)

My name is Jane Hulett. I am a registered nurse and a graduate student at Mississippi University for Women in Columbus, Mississippi. I am conducting research on the effect of exercise on persons who have arthritis. This will include a teaching program explaining the exercises to be done two times a day for one month. The subjects will be persons who have a form of arthritis (rheumatoid, osteo, or gouty) of the fingers and who are willing to participate in the exercise program. Two questionnaires must be completed and range of motion of fingers measured on two different occasions.

This research has been explained to me and if I agree to participate I am aware that:

1. I will complete a questionnaire before and after the one-month exercise program.

2. My name will appear on the questionnaires but confidentiality will be maintained. After data collection the information will be destroyed.

3. Range of motion will be measured on my fingers before and after the one-month exercise program in water.

4. I will participate in the exercise program at home twice a day for one month as explained to me.

5. Participation in this research is voluntary. I have the right to refuse to participate at any time up until data collection.

6. If I have any other questions, I am free to contact her at any time.

________________________________________  _______________________________________
Date                                      Subject Signature

________________________________________  _______________________________________
Date                                      Researcher Signature
Appendix B

Informed Consent

Land

My name is Jane Hulett. I am a registered nurse and a graduate student at Mississippi University for Women in Columbus, Mississippi. I am conducting research on the effect of exercise on persons who have arthritis. This will include a teaching program explaining the exercises to be done two times a day for one month. The subjects will be persons who have a form of arthritis (rheumatoid, osteo, or gouty) of the fingers and who are willing to participate in the exercise program. Two questionnaires must be completed and range of motion of fingers measured on two different occasions.

This research has been explained to me and if I agree to participate I am aware that:

1. I will complete a questionnaire before and after the one-month exercise program.

2. My name will appear on the questionnaires but confidentiality will be maintained. After data collection the information will be destroyed.

3. Range of motion will be measured on my fingers before and after the one-month exercise program.

4. I will participate in the exercise program at home twice a day for one month as explained to me.

5. Participation in this research is voluntary. I have the right to refuse to participate at any time up until data collection.

6. If I have any other questions, I am free to contact her at any time.

_________________________________  ____________________________
Date                                             Subject Signature

_________________________________
Date                                             Researcher Signature
General Information

NAME: ________________________________

AGE: _______ SEX: _______

ADDRESS: __________________________________________

_________________________________________________

TYPE OF ARTHRITIS: RHEUMATOID ________

OSTEO ________

GOUTY ________

WILLING TO PARTICIPATE: _____________________________

_________________________________________ M.D.
Appendix C

PRE  POST

Rasmussen Pain Description Index

Name: ____________________________  Age: _____ yrs.

Occupation: ____________________________

Type of Arthritis (if known):
Osteoporosis_____  Rheumatoid_____  Gouty_____

On medicine regularly for arthritis?  Yes_____  No_____

What is the name of your medicine (if known)?

__________________________________________________

Marital Status (check one answer please):
Single___  Married___  Separated___  Divorced___  Widowed___

Background Data:

For the questions below, please check the correct answer, "Yes" or "No." Please do not write in the margins, but answer each question.

1. Have you completed high school?  Yes____  No____

2. Have you ever had surgery on your fingers to relieve pain?  Yes____  No____

3. Have you had more than one surgery on your fingers?  Yes____  No____

4. Have you had finger pain for more than one year?  Yes____  No____

5. Have you taken pain medication in the past 4 to 8 hours?  Yes____  No____
Pain Description Items:

For the questions below, please circle the letter of the answer that best describes the pain you have. While the answer may not exactly describe your pain, select the answer that comes closest to your own description and circle the letter. Do not write in the margin or skip questions. You will discuss your pain further with the doctor, but this questionnaire is intended only to give us a rough idea of the pain you have. Move through the questions as fast as you can, but don't skip questions.

Example: How was the temperature when you came in today?

a. Hot
b. Warm
c. Chilly
d. Frigid

1. How would you describe your pain as it was when it first occurred?

a. As bad as it could possibly be
b. Very bad
c. Moderately bad
d. Fairly bad

2. How would you describe your pain as it usually occurs?

a. Distressing
b. Intense
c. Bearable
d. Excruciating

3. After your pain becomes more intense, how long does it usually last?

a. One to 6 hours; part of the day
b. Six to 12 hours; half a day
c. Twelve to 18 hours; all day
d. Eighteen to 24 hours; all day and all night

4. When is your pain more intense?

a. All the time
b. Off and on; several times a day
c. Once or twice a day
d. Less than once a day
5. How long does relief last between episodes of pain?
   a. No relief at all
   b. Only brief period; up to 8 hours
   c. Half a day or more; up to 16 hours
   d. A day or more; 16 to 24 hours or more

6. How would you describe your pain as it occurs most of the time?
   a. As bad as it could possibly be
   b. Very bad
   c. Moderately bad
   d. Fairly bad

7. How would you evaluate your pain?
   a. Annoying
   b. Miserable
   c. Intense
   d. Unbearable

8. How has pain affected your ability to work?
   a. Maintain the same schedule as before
   b. Maintain the same work schedule as before, but tire more easily
   c. Now do another type of work which is easier
   d. Unable to work at all

9. How would you describe your family relationships since pain has been present?
   a. No change noticed
   b. Very little change for the better or the worse
   c. Definite change for the better or the worse
   d. Things are much better or much worse

10. How would you describe your pain at this moment?
    a. As bad as it could possibly be
    b. Very bad
    c. Moderately bad
    d. Fairly bad
Exercise Instructions
(Water)

FINGERS AND THUMB

A

B

C

D

E

F

EXERCISING THE FINGERS AND THUMB (Water)

These exercises are to be done with hands submerged in water to the wrist. The water temperature should be moderately warm to hot. The container should allow hands to be completely submerged and room for exercising. Suggested containers include: sink, plastic tub, dish pan, wash basin.

Stretch fingers of one hand as straight as possible. If fingers remain bent, rest palm on a table, hold other hand firmly on back of resting hand, then raise forearm of resting hand in an effort to flatten bent fingers, as shown in A.

Now make a fist, then straighten fingers, spread them apart, and bring them back together (B).

Next, touch each fingertip— one at a time— to the end of your thumb, and making an "O" (C).

Straighten fingers again, then bend them at the knuckles (D).

Straighten fingers once more, then bend thumb, place it against palm, and move it across the palm toward your little finger (E).

Finally, touch tip of thumb to tip of little finger (F).

These exercises are to be repeated five (5) times with each hand two times a day for a total of ten (10) times a day per hand.
Exercise Instructions  
(Land)

FINGERS AND THUMB

A

B

C

D

E

F

EXERCISING THE FINGERS AND THUMB (Land)

Stretch fingers of one hand as straight as possible. If fingers remain bent, rest palm on a table, hold other hand firmly on back of resting hand, then raise forearm of resting hand in an effort to flatten bent fingers, as shown in A.

Now make a fist, then straighten fingers, spread them apart, and bring them back together (B).

Next, touch each fingertip— one at a time—to the end of your thumb, and making an "0" (C).

Straighten fingers again, then bend them at the knuckles (D).

Straighten fingers once more, then bend thumb, place it against palm, and move it across the palm toward your little finger (E).

Finally, touch tip of thumb to tip of little finger (F).

These exercises are to be repeated five (5) times with each hand two times a day for a total of ten (10) times a day per hand.
Range of Motion Test for Finger

**Thumb M. P.**

<table>
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<tr>
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<th>Extension</th>
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**Limitations**

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<th>R</th>
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<tbody>
<tr>
<td>1</td>
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<td>2</td>
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</tr>
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**Thumb I. P.**

<table>
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<tbody>
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<td>90 - 0</td>
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**Limitations**

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<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
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</tbody>
</table>
RANGE OF MOTION TEST FOR FINGER AND TOES

1. Anatomical position is starting position. Range is measured with cauda as 0°, cranium as 180°. Rotating motions are from the midsagittal plane as 0° to lateral plane as 180°.

2. All ranges are expressed as passive range of motion. Check muscle chart attached for limitations caused by tightness, weakness, spasm, or contracture.

3. The scale is divided into units of 10°. Range of motion is recorded by filling in area of range directly on attached sketch with data and examiner's initial.

4. Use of same sheet for subsequent tests is recorded in same color and dated accordingly.

5. Regression is marked by diagonal lines over area of previous test and date.

6. If position is other than in sketch, indicate S for supine, P for prone.

### Fingers M. P.

<table>
<thead>
<tr>
<th>Flexion</th>
<th>0 - 90</th>
</tr>
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<td>Extension</td>
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**Limitations**

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### Fingers I. P. Prox

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**Limitations**

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### Fingers I. P. Distal

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**Limitations**

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References


