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Effects of a Feldenkrais-Based Mobility Program on Function of a Healthy, Elderly Sample

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EFFECTS OF A FELDENKRAIS-BASED MOBILITY PROGRAM
ON FUNCTION OF A HEALTHY, ELDERLY SAMPLE

By

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THESIS

Submitted to the Department of Physical Therapy
at Grand Valley State University
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MASTER OF SCIENCE IN PHYSICAL THERAPY

1996
EFFECTS OF A FELDENKRAIS-BASED MOBILITY PROGRAM ON FUNCTION OF A HEALTHY, ELDERLY SAMPLE

ABSTRACT

The purpose of this study was to explore whether a program of mobility exercises, based on the Feldenkrais Method, would result in an increase in range of motion and function, as measured by the Functional Reach (FR), modified Functional Reach (modified FR), and Timed "Up and Go" tests. Twenty-eight healthy elderly volunteers participated in the study. The experimental group participated in the program three times a week for six weeks. Measurements were taken before and after the six week program.

The Timed "Up and Go" test improved significantly (p<.05) in the experimental group when age was accounted for. Right ankle dorsiflexion also increased significantly (p<.05). The FR and modified FR measurements did not demonstrate a significant change. As measured by the Timed "Up and Go" test, a Feldenkrais based program may improve function in healthy elderly individuals. Further research, with healthy and disabled subjects, is needed to understand the benefits of the Feldenkrais Method.

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The United States' population is aging significantly. In the late 1800s, 3% of the population was age 65 or older; today's elderly population is approximately 12%. By the year 2000 the elderly will comprise an estimated 13% of the total population, and will increase to as much as 20% by the year 2030 (Statistical Abstract of the U.S., 1994).

Along with this increase in the elderly population, there is an accompanying increase in health care costs. In 1992, 24.7% of total health care expenditures were for the elderly (Statistical Abstract of the U.S., 1994). This segment of society is quickly becoming a major consumer of health care.

Aging is characterized by changes, including sensory, neurologic, and musculoskeletal decline. These changes may have an impact on independence in daily living, and can lead to disability and dependence in the elderly. Modification or avoidance of these disabling factors will hopefully not only increase the functional independence of the elderly, but also lower the overall cost of care. Physical therapists, along with many other health care professionals, are in a position to address these changes and possibly avoid ensuing disability. These professionals must possess an understanding of normal physiological changes, and realize the impact they have on functional ability.

Musculoskeletal changes that occur as a natural process of aging include: loss of
Flexibility, loss of strength, poor posture, changes in gait, and pain (Lewis & Bottomley, 1990). Flexibility changes that occur include a decrease in spinal, pelvic, shoulder, hip, and ankle mobility. Biologic aging factors that decrease flexibility include collagen changes, dietary deficits, and arthritic effects (Lewis & Bottomley, 1990). Decreased physical activity also contributes to lower level of function (Rikli, 1986).

Limited data is available comparing loss of mobility in the elderly with function, and the full effect of decreased mobility on function is unknown. There are no known studies correlating increased flexibility with an increase in function. Many studies investigating exercise among the elderly do show increased range of motion, increased strength, and improved cardiovascular fitness, but improved quality of life is not generally addressed (Yerg, Seals, Hagberg, & Holloszy, 1985; Seals, Hagberg, Hurley, Ehsani, & Holloszy, 1984; Morey et al., 1989; Hopkins, Murrah, Hoeger, & Rhodes, 1990; Raab, Agre, McAdam, & Smith, 1988).

Feldenkrais Method is a way of becoming aware of one's own mind and body, especially the way they work together to create movement (Casey, 1991). Feldenkrais movement therapies are being taught to many populations, including the elderly, but minimal data is available to reflect the functional changes that may take place as a result of the therapy. The purpose of this study was to explore whether a six week program of spinal, pelvic, shoulder, hip, and ankle mobility exercises, based on the Feldenkrais Method, would result in a significant increase in function as measured by the Functional Reach, modified Functional Reach, and Timed "Up and Go" tests.
CHAPTER 2
LITERATURE REVIEW

Age Related Body System Changes

Many physiological systems show a decline in functional capacity with aging (Smith, 1981). These include the musculoskeletal, pulmonary, cardiovascular, integumentary, and nervous systems (Harper & Lyles, 1988; Payton & Poland, 1983). The following is a review of these changes.

A loss of both muscle mass and skeletal mass are associated with aging. The loss of skeletal mass begins during the fourth to fifth decades of life and occurs at varying rates throughout the skeleton (Burrage, 1991). According to Wilmore, bone mass increases circumferentially until about the age of 30 (Wilmore, 1991). There is then a transient plateau after which bone mass declines with age (Riggs & Melton, 1986).

Muscle strength decreases from 30-50% between the ages of 20 and 60 years (DeMarchena & Brooke, 1983). A decrease in the size of the individual muscles occurs with aging, particularly beyond 60 years of age (Wilmore, 1991). An assumption is made that this decrease in muscle mass is accompanied by a decrease in general strength (Wilmore, 1991). Structural changes that occur include: loss of both number and size of muscle fibers, atrophy with fibrous tissue replacing muscle, and increased atrophy of lower extremity proximal muscles with neuropathic changes of the distal leg (Harper &
Changes that occur in the pulmonary system include: loss of elastic recoil of the lungs, reduced vital capacity, decreased chest wall compliance, reduction in maximal voluntary ventilation, and decreased gas exchange (Harper & Lyles, 1988; Payton & Poland, 1983). A normal result of increased mechanical resistance to breathing is a diminished maximum lung capacity (Blocker, 1992). This can be diminished up to 50% from age 30 to age 70 years (Blocker, 1992).

With aging, there are multiple changes that occur in the cardiovascular system. These include: increased blood pressure, decreased stroke volume, decreased cardiac reserve, and decreased perspiration capability, leading to a decline in compensatory response to physical and emotional stress (Harper & Lyles, 1988; Payton & Poland, 1983). As a result of changes in the cardiovascular system, the resting heart at age 70 pumps 30% less blood than is expected of a heart at rest at age 30 (Blocker, 1992).

Integumentary changes that occur include: decreased subcutaneous adipose tissue, decreased elasticity of connective tissue, and loss of sweat and sebaceous glands (Harper & Lyles, 1988; Payton & Poland, 1983). There is also a decrease in the skin’s immune response, which causes it to become more susceptible to infection (Blocker, 1992).

Nervous system changes that occur include decreases in weight of the brain, cerebral blood flow, nerve conduction velocity, rate and magnitude of the reflex response, alpha waves per second, sensory activity, perceptual motor response, myoneural transmission, and speed of muscle contraction. Nervous system changes that increase are postural sway and arousal threshold (Harper & Lyles, 1988; Payton &
Poland, 1983). As a result of the above changes, intellectual performance is decreased (Blocker, 1992). This is manifested by the inability to perform complex learning, recent memory loss, and behavioral changes (Blocker, 1992). The normal physiological changes associated with aging are important to understand when designing any type of exercise program for the elderly.

Changes in Flexibility

Flexibility, as defined by Anderson & Burke, is "the range of motion available in a joint or a group of joints that is influenced by muscles, tendons, ligaments, and bones" (Anderson & Burke, 1991). Flexibility is affected internally by biologic aging and disease (Lewis & Bottomley, 1990). In addition, functional changes in lifestyle can also influence flexibility (Lewis & Bottomley, 1990). Biologic aging factors include collagen changes, dietary deficits, and arthritic effects.

Collagen is defined as "a fibrous insoluble protein found in the connective tissue, including skin, bone, ligaments, and cartilage" (Thomas, 1985). With aging, these fibers become irregular in shape due to cross-linking. This closer meshing and non-linear alignment results in decreased mobility in the body's tissues (Bick, 1971). Vitamin C deficiency, which is possible with a compromised diet, can result in decreased collagen formation (Robertson, 1975). Decreased collagen formation can interfere with normal tissue integrity and therefore affect muscle functioning and collagen elasticity (Lewis & Bottomley, 1990).
Arthritis can frequently cause flexibility limitations in the elderly. Acute synovitis, muscle spasm, pain, osteophyte presence, and muscle weakness all contribute to limitations in motion (Lewis & Bottomley, 1990). Hypokinesia, or decreased activity, also contributes to decreased flexibility. Increased sitting in the elderly can cause muscle shortening and tightness of the body's flexor muscles (Lewis & Bottomley, 1990).

Flexibility changes that occur with age include a decrease in spinal, pelvic, shoulder, hip, and ankle mobility. The loss of flexibility can compound mobility problems in the elderly (Lewis & Bottomley, 1990).

Past studies support a significant decrease in spinal range of motion with advancing age (Biering-Sorensen, 1984; Tanz, 1953; Moll & Wright 1971; Troup, Hood, and Chapman, 1968), with spinal extension having the greatest decrease (Einauf, Gohdes, Jensen, & Jewell, 1987). Specifically, both cervical and lumbar spinal mobility are documented as decreasing with age (Kuhlman, 1993; Penning, 1968; Schoening & Hannan, 1964; Moll & Wright, 1976; Fitzgerald, Wynveen, Rheault, & Rothschild, 1983). Adaptive shortening of soft tissue, reduced periarticular tissue length and elasticity, and loss of mobility, all contribute to decreased spinal range of motion (McKenzie, 1979, 1981).

Restricted spinal movement has been associated with low back pain (Lankhorst, Stadt, & Korst, 1985; Biering-Sorensen, 1984). Back pain may be a complaint of the elderly, and can limit function. Qualitative and quantitative collagen changes in the annulus and decreased water content of the nucleus pulposa result in decreased disk size and decreased flexibility in the spine (Lewis & Bottomley, 1990). Numerous studies
have concluded that lumbar extension exercises, when done by the elderly, may increase spinal range of motion and reduce the potential for low back pain (Smith & Mell, 1987; Dimaggio & Mooney, 1987; Davies, Gibson, & Tester, 1979; White & Panjabi, 1978).

Accurate data demonstrating the normal flexibility of the human spine at different ages is important. Physical therapists must be able to distinguish between age related decreases in spinal mobility and pathological limitations. Comparing the clinical measurement of spinal mobility to an existing established range of values rather than just to an average of values allows a more accurate spinal assessment (Einkauf et al., 1987). This range of values will increase knowledge of normal flexibility of the spine.

Decreased spinal flexibility begins during the fourth decade of life (Lind. Sihlbom, Nordwall, & Malchau, 1989). McKenzie states, "from my own observations it appears that few adults reach thirty years of age and maintain normal extension movements” (McKenzie, 1981). An investigation by Battie, Bigos, Sheehy, and Wortley (1987) determined that spinal range of motion covers a wide spectrum of values and is affected by many individual factors. They found age, sex, height, obesity, and the ratio of standing height to sitting height all figured significantly in determining spinal flexibility (Battie et al., 1987). Studies look at two different areas of spinal mobility: cervical spine and thoracolumbar spine.

Studies of cervical spine flexibility have consistently shown that as age increases, cervical spine flexibility decreases (Ferlie, 1962; O'Driscoll & Tomenson, 1982; Hayashi, Okada, Hamada, Tada, & Ueno, 1987; Lind et al., 1989). Originally, young adult cervical range of motion values were established, but normative values for the elderly
were not included (Hoppenfeld, 1976; Kapandji, 1970; Buck, Dameron, Dow, &
Skowlund, 1959; Alund & Larsson, 1990). Later, Kuhlman (1993) designed a study to
determine normative cervical range of motion values in the elderly and compared these
to standard young adult cervical range of motion values. He also assessed the differences
in range of motion between men and women. Kuhlman's investigation showed the
elderly group had significantly less range of motion than the younger group for all six
motions assessed (Kuhlman, 1993). The elderly group demonstrated 12% less flexion,
32% less extension, 22% less lateral flexion, and 25% less rotation than the young adult
group. Overall, the elderly group demonstrated a larger loss of extension compared to a
smaller loss of flexion.

There are noted inconsistencies in studies involving the relationship between age
and range of motion in the thoracic and lumbar spine. The studies of Allbrook (1957),
Batti'e et al. (1987), Einkauf et al. (1987), Fitzgerald et al. (1983), Macrae and Wright
(1969), and Loebl (1967), showed a decrease in thoracic and lumbar range of motion
with advancing age, though trends differed somewhat. Einkauf et al. found the greatest
differences in all four movements (anterior flexion, right lateral flexion, left lateral
flexion, and extension) occurred only between the two youngest and two oldest age
groups, with the middle group showing no significant differences (Einkauf et al., 1987).
Fitzgerald et al. found a different trend. They found that spinal range of motion differed
significantly between all of the age groups and that the amount of range decreased in 20-
year intervals (Fitzgerald et al., 1987). These conflicting results may have resulted from
the use of different samples. Fitzgerald et al. predominantly used male patients from a
Veteran's Administration hospital, whereas, the Einkauf et al. subjects were healthy women.

Moll and Wright's 1971 study showed an initial increase in both thoracic and lumbar range of motion between the ages of 15-34, which was then followed by a progressive decline. In his 1953 study of the lumbar spine, Tanz demonstrated a significant decrease of motion between the ages of 13-35 years, but no significant changes after the age of 35. In their 1959 study of cadaveric lumbar spine and pelvis specimens, Evans and Lissner (1959) found no relationship between age and vertebral motion. These studies show the variability that still exists regarding age, spinal mobility changes, and range of motion values.

Studies of pelvic mobility, as it relates to function, are virtually nonexistent. Of the studies that do exist, most assess pelvic mobility in relation to low back pain and relative to lumbar and hip mobility. A study by Mayer, Tabor, Bovasso, and Gatchel (1994) found that patients who suffer from chronic low back pain almost invariably have some disturbance of pelvic mobility. At completion of a comprehensive functional restoration treatment program, pelvic motion returned to near normal levels (Mayer et al., 1994). Another study found that increased lumbar and hip mobility was more important than increased trunk strength for progression of low back pain patients (Mellin, Hurri, Harkapaa, & Jarvikoski, 1989). However, in women, increased trunk extension strength correlated significantly with subjective progress (Mellin et al., 1989). Another study demonstrated significant low back pain resolution correlated with increased spinal lateral flexion and rotation, along with other factors (Mellin, 1986).
Numerous studies have been done involving shoulder flexibility. In 1979, Boone and Azen found a significant loss of shoulder flexibility with age for shoulder flexion, but no significant loss of shoulder abduction. An age related loss of shoulder flexibility was reported by Germain and Blair (1983). They showed a negative correlation between age and shoulder flexion (Germain & Blair, 1983). In 1989, Bassey, Ebrahim, Dallosso, and Morgan found a significantly lower value for shoulder abduction in women than men. However, for both sexes, values were an average of 30 degrees lower than those found in younger adults (Bassey et al., 1989).

Munns (1981) worked with adults aged 65 to 88 years in a twelve week exercise and dance program that put each body joint through a full range of motion. Results showed the experimental group exhibited a significant increase over the control group in range of motion at six pre-selected body sites, which included the neck, hip, shoulder, wrist, knee, and ankle (Munns, 1981). Results of a study by Raab, Agre, McAdam and Smith (1988) implied that exercise may partially reverse age related losses in flexibility at the shoulder. Their study involved the use of weights versus no weights, and they concluded "if flexibility is the primary goal of an exercise program for an older population, it may be advisable to concentrate on flexibility exercises without weights, especially for the shoulder" (Raab et al., 1988). A study by Cunningham, Paterson, Himann, and Rechnitzer (1993) showed that independent individuals showed a significantly greater flexibility in shoulder abduction and adduction compared to dependent individuals.
Studies have shown decreased hip range of motion in the elderly (Ahlback & Lindahl, 1964; Boone, Walker, & Perry, 1981). Hip flexion and medial rotation were decreased significantly (Ahlback & Lindahl, 1964; Boone et al., 1981). When hip flexion contractures were present, they averaged 2-11 degrees (Ahlback & Lindahl, 1964; Boone et al., 1981). A study by Walker, Sue, Miles-Elkousy, Ford, and Trevelyan (1984) concurred with these findings. A study by Cunningham et al. (1993) showed a significantly greater range of motion in hip flexion and extension for independent men and women than for dependent men and women. A study by Gehlsen and Whaley (1990) found that flexibility of the hip and ankle joints may be related to falls in the elderly when extreme joint excursion situations are required. These results support Shephard's observation that decreased joint flexibility is accompanied by declines in stability and mobility, and by an increase in deformity (Shephard, 1984).

As a person ages, changes that compromise mobility may occur in the ankles and feet (Osterman & Stuck, 1990). With degenerative joint disease, range of motion can be reduced at the involved joints. Rheumatoid arthritis produces degenerative changes in cartilage leading to deformity and limited mobility (King, 1980). Deformities are often accompanied by contracture and rigidity (Helfand, 1982). Occurrence of bunions can be extremely painful, leading to decreased mobility and unstable gait (Osterman & Stuck, 1990). Neglect or inadequate foot care can lead to structural deformity with eventual immobility (Haviland & Garlinghouse, 1983). Reduced ankle mobility impairs the efficiency of the venous muscle pump, which is postulated to increase the incidence of venous leg ulcers (Gaylarde, Dodd, & Sarkany, 1990).
Decreased ankle and foot mobility can reduce independence and lessen quality of life by causing physical discomfort, social isolation, and sometimes by exacerbating preexisting chronic conditions (Haviland & Garlinghouse, 1985). Numerous studies recommend exercise to improve existing levels of flexibility and prevent future problems (Stamford, Fallice, & Hambacher, 1974; Frekany & Leslie, 1975; Helfand, 1982; Haviland & Garlinghouse, 1985; Osterman & Stuck, 1990; Munns, 1981; Raab et al., 1988). Types of exercise include: walking (the best choice), ankle and toe exercises, and basically to be as active as possible (King, 1980). Perhaps the greatest advantage of increased range of motion in the elderly lies in the attainment of an increased level of self-sufficiency in the performance of normal everyday tasks (Frekany & Leslie, 1975).

Age Related Changes in Balance

An age related decline occurs in the ability to maintain balance (Hill, Vandervoort, & Kramer, 1990). One aspect of balance, postural control, can be defined as the ability to maintain the body's center of mass over its base of support (Horak, 1987; Lee, 1989; McCollum & Leen, 1989). The ability to maintain postural control is essential for the performance of daily activities. Decreased strength and range of motion in the elderly may lead to impaired postural control (Alexander, 1994). Impaired postural control can lead to falls (Alexander, 1994; Patla, Frank, & Winter, 1992).

By 80 years of age, one third of the elderly will have experienced an injurious fall (Isaacs, 1978). In 1987, the death rate from falls and fall-related injuries for persons
aged 65-84 was 18 per 100,000, and for those 85 years and older, 131.2 per 100,000 (U.S. Department of Health and Human Service, 1992).

In community-dwelling elderly, 6% of falls result in fractures and 12% result in soft tissue injuries (Tinetti, Speechley, & Ginter, 1988). The number of elderly people who suffer fractures is high and this places a great demand on the health care system (Christiansen & Juhl, 1987). Even falls which do not result in injury often have serious social and psychological consequences for the elderly (Christiansen & Juhl, 1987). These include loss of confidence, reduced mobility, and loss of independence (Vandervoort, Hill, Sandrin, & Vyse, 1990; Christiansen & Juhl, 1987).

Poor health status, especially chronic illness, impaired mobility, postural instability, and a history of prior falls have all been associated with the risk of falling (Christiansen & Juhl, 1987). Falls by the elderly can lead to permanent disability, loss of independence, and a decrease in quality of life.

Functional Reach

The Functional Reach (FR) test was created in 1990 by Duncan, Weiner, Chandler, and Studenski in response to a need for an assessment method to describe and comprehend balance impairments in older persons. Some existing balance measures, like the one-footed standing and tandem walking tests, possess limitations because they are even difficult for healthy elderly individuals to perform (Duncan, Weiner, Chandler, & Studenski, 1990). Generally the dynamic balance assessments like the Wolfson's
postural stress test, center of pressure excursion, and the platform perturbation test are more widely accepted methods to assess an individual's ability to maintain equilibrium during self-motivated or external perturbation. However, "these tests assess postural responses to artificially created external stimuli rather than voluntary movement performed during routine activities" (Duncan et al., 1990). Therefore, Duncan et al. (1990) created the FR test, a dynamic balance measure that uses a continuous scoring system. The FR test is simple to perform and is accessible in the clinic.

Functional reach is defined as the maximum distance a subject can reach forward, past arm's length, while still maintaining a stable base of support in standing (Duncan et al., 1990). FR was found to have criterion validity and clinical reliability in a healthy elderly population (Duncan et al., 1990). In addition, it demonstrated concurrent validity in its ability to discriminate levels of physical frailty and also demonstrated sensitivity to change over time (Weiner, Duncan, Chandler, & Studenski, 1992; Weiner, Bongiorni, Studenski, Duncan, & Kochersberger, 1993). FR was also found to be age sensitive, although only modestly (Pearson r = -0.45) (Duncan et al., 1990). The FR test has been presented as a "new dynamic measure of postural control that is inexpensive, precise, stable, age-sensitive, and clinically assessable" (Duncan et al., 1990).

Modified Functional Reach

The modified Functional Reach test (modified FR), created by Lynch in 1995, is a sitting version of the FR test. Lynch (1995) conducted a study to establish reliability and
validity of the modified FR test for a population that cannot stand. The study found the test to be a valid and reliable way to measure sitting balance in men with spinal cord injury (Lynch, 1995). The set up and performance of the modified FR test is similar to that of the FR test described by Duncan et al. (1990), except that each subject is seated. The modified FR was used in this study as a functional assessment because all the Feldenkrais based exercises were done in a seated position.

Timed "Up and Go" Test

The Timed "Up and Go" test is a mobility test created by Podsiadlo and Richardson (1991) as a modified timed version of the "Get Up and Go" test (Mathias & Isaacs, 1986). The "Get Up and Go" test quantifies most of the basic mobility maneuvers and is also quick and practical, but the scoring system can lack objectivity (Podsiadlo & Richardson, 1991). The participants of the "Get Up and Go" test were rated on their performance and assigned a number from one to five, which represented the observers perception of the patient's risk of falling (Podsiadlo & Richardson, 1991). The intermediate numbers, two to four, were less clear than the first and last numbers and variation in scores from different observers could occur (Podsiadlo & Richardson, 1991). Therefore, a modified timed version was developed as a test of basic mobility skills. During the test the subject is timed, in seconds, the length of time required to stand up from a standard arm chair (approximate seat height of 46 cm), walk a distance of 3 meters, turn, walk back to the chair, and sit down again (Podsiadlo & Richardson, 1991).
The Timed "Up and Go" test proved to be a reliable tool for assessing physical mobility in the frail elderly (Podsiadlo & Richardson, 1991). In the clinic it requires little equipment, is inexpensive, and can be performed quickly (Podsiadlo & Richardson, 1991). It also was shown to have content validity in that it evaluated a sequence of movements that are performed in everyday life (Podsiadlo & Richardson, 1991). The test has also been shown to have concurrent validity as it correlated well with more extensive measures of gait speed, balance, and functional ability (Podsiadlo & Richardson, 1991).

The Dartmouth COOP Measures of Functional Status

The Dartmouth COOP Measures of Functional Status is a concise method for measuring perceived function and health, which may be useful in studies that cannot afford extensive data collection (Beaufait et al., 1992). The system consists of nine charts which measure the following: physical functioning, social functioning, role functioning, emotional status, overall health, pain, change in health, social support, and quality of life (Beaufait et al., 1992).

The COOP charts can be administered via two methods: provider-administered or self-administered. If the charts are provider administered they take about 15 minutes to complete and if they are self-administered they take less than 5 minutes to complete (Beaufait et al., 1992). A high score indicates a poor level of health (Beaufait et al., 1992).
The COOP charts show a strong test-retest reliability under the same method of administration in different settings (Beaufait et al., 1992). Interrater reliability was found to be good overall (Beaufait et al., 1992). The average convergent validity between different measures of the same concept was .60 in a study which involved 592 patients (Beaufait et al., 1992). This result indicated good discriminate validity (Beaufait et al., 1992). Another study by Nelson, Landgraph, Hays, Wasson, and Kirk (1990) showed the COOP charts were practical, reliable, valid, and useful for quickly measuring patient function.

Feldenkrais Method

Feldenkrais Method is a way of becoming aware of one's own mind and body, especially the way they work together to create movement (Casey, 1991). The goal of the Feldenkrais Method is to achieve poise, grace, and efficient movement (Casey, 1991). The Feldenkrais Method has two approaches: Awareness Through Movement (ATM) and Functional Integration (FI). Both involve integration of mind and body, which may enhance education and self-inquiry (Leri, 1993). Both approaches yield the same result, which is for the participant to experience a keener sense of his body which allows him to be relieved of pain, to enjoy greater flexibility and to move more freely in different ways (Reichley, 1994). McIntyre, a physical therapist and Feldenkrais practitioner cited by Reichley (1994), states that Feldenkrais takes a great deal of training to do well. She feels that it works because of the way the practitioner pays attention to the person he or
she is working with. Some stated benefits of the Feldenkrais Method include: more restful sleep, improved mood and mental alertness, increased flexibility, and fewer headaches and backaches (Williams, 1991).

ATM is composed of structured sequences of movement (Casey, 1991). It consists of verbally directed movement sequences presented to groups. The goal of ATM is to increase awareness of one's own body (Casey, 1991). Wildman (1995), a certified Feldenkrais practitioner, states that the purpose of the ATM lessons is to enable a person to experience how the whole body cooperates in motion. He believes that people learn new patterns of awareness and enhance their neuromuscular self-image, which allows more efficient and comfortable movement.

FI involves a teacher and an individual student (Casey, 1991). It is more individualized than ATM, and can be used by people with health problems which prevent them from participating in ATM classes. In FI, the teacher uses his or her hands to guide the student through movements (Casey, 1991). The goal of FI is to increase awareness through non-verbal communication, and to create new pathways in the nervous system (Casey, 1991). Gentle movements are used and there is no attempt to use force to extend the range of motion beyond the person's current capabilities (Casey, 1991).

The Feldenkrais Method was developed by Moshe Feldenkrais (1904-1984) (Casey, 1991; Leri, 1993). Feldenkrais experienced a knee injury in the 1940's and following surgery was given only a 50 percent chance of full recovery (Casey, 1991; Leri, 1993). Combining the principles of engineering and cybernetics with his knowledge of body mechanics, he focused on improving his own knee (Casey, 1991). Feldenkrais
thought that people did not use all of the mind's and body's capabilities, and thus fell far short of their potential (Casey, 1991). He thought that specific exercises could develop these unused resources, which would open new pathways for the flow of sensory and motor signals between the body and the brain (Casey, 1991).

A study concluded that a Feldenkrais ATM sequence for neck flexion resulted in improvements in the excursion of neck flexion and perception of decreased effort required to perform the movement (Ruth & Kegerreis, 1992). The subjects of the study were between the ages of 11 and 36 and denied any history of cervical pathology (Ruth & Kegerreis, 1992).

A study published in 1977 concluded that after participating in Feldenkrais classes that emphasized slow therapeutic movement, three times a week for six weeks, the group responded in a positive way to the program (Gutman, Herbert, & Brown, 1977). The researchers stated that the participants verbalized some perceived benefits which included, "improved knees-removed stiffness", "now have some feeling in my fingers", "the program improved general health", and "the program gave a sense of well-being." The study's measurements included height, weight, blood pressure, heart rate, balance, flexibility, morale, perceived health, and activities of daily living performance, but the results were not statistically significant. Rotational flexibility was the only type of flexibility measured (Gutman et al., 1977). A literature review revealed no other studies of the Feldenkrais ATM sequences.

The neuromuscular exercise program entitled Relaxercise is based on Feldenkrais' Awareness Through Movement (ATM) sequences (Zemach-Bersin, Zemach-Bersin, &
Reese, 1990). The authors state it is "a step-by-step program which utilizes the extraordinary natural abilities of your brain to improve the health of your body. Relaxercise shows participants how to achieve a state of fitness and well-being that will afford greater enjoyment of living" (Zemach-Bersin et al., 1990). Participants learn how to increase flexibility, coordination, and grace of movement, as well as improve posture (Zemach-Bersin et al., 1990).

Summary

Relevant literature supports age related body system changes in the musculoskeletal, pulmonary, cardiovascular, integumentary, and nervous systems (Harper & Lyles, 1988; Payton & Poland, 1983). One musculoskeletal change that can lead to problems in the elderly is a decrease in flexibility. Flexibility changes include decreased spinal, pelvic, shoulder, hip, and ankle range of motion. These changes may have an impact on independence in daily living, and can lead to disability and dependence in the elderly. Limited data is available comparing loss of flexibility in the elderly with function and the full effect of decreased mobility on function is unknown. The Feldenkrais Method is proposed to be a way of integrating mind and body which allows the participant to be relieved of pain, to enjoy greater flexibility, and to move more fully in different ways. However, few studies exist substantiating these claims. The investigators in this study hypothesized that participation by elderly individuals in a six week program of spinal, shoulder, pelvic, hip, and ankle mobility exercises, based on the
Feldenkrais Method, would result in an increase in function as measured by the FR, modified FR, and Timed "Up and Go" tests.

Our three hypotheses were as follows:

1. Participation in a six week program of spinal, pelvic, shoulder, hip, and ankle mobility exercises, based on the Feldenkrais Method, will result in a significant change in function as measured by the FR test.

2. Participation in a six week program of spinal, pelvic, shoulder, hip, and ankle mobility exercises, based on the Feldenkrais Method, will result in a significant change in function as measured by the modified FR test.

3. Participation in a six week program of spinal, pelvic, shoulder, hip, and ankle mobility exercises, based on the Feldenkrais Method, will result in a significant change in function as measured by the Timed "Up and Go" test.
CHAPTER 3
METHODOLOGY

Design

This study had a Non-Equivalent Pretest-Posttest Control Group design in which two groups (one experimental and one control) were compared. Subjects were recruited through flyers and verbal solicitation from the Wyoming and Kentwood Senior Centers in Wyoming and Kentwood, Michigan, and an advertisement was placed in a local newspaper. Volunteers signed up for either the experimental or control group. Because of the six week, three times a week time commitment for the experimental group, random assignment into the experimental group was not feasible. To encourage volunteers to participate in the control group, control subjects were offered the opportunity to participate in a similar exercise program after completion of the study, if results were successful.

Pretest measurements of the experimental and control groups were taken one week prior to the commencement of the exercise classes. The experimental group then participated in a sitting exercise program entitled Relaxercise (Zemach-Bersin, Zemach-Bersin, & Reese, 1990) three times a week for six weeks. The exercise program was taught by a certified Feldenkrais practitioner and participants were disqualified from the study if they missed four or more exercise classes. The control group did not participate
in any structured sitting exercise program for that duration. All participants were asked to maintain their current activity level.

Sample

The sample chosen was independently living, healthy elderly individuals. A healthy elderly subject was defined as a male or female age 55 years or above who was independent in ambulation with or without an assistive device. Exclusion criteria included history of neurological impairment or a progressive neurological disease, pain that would limit their ability to stand or reach, or any surgical (orthopedic) procedure within the past one year. Twenty eight volunteers who met these criteria, based on a subjective questionnaire (Appendix A), were chosen to be a part of either the experimental or control group. The control group initially consisted of twelve individuals and the experimental group consisted of sixteen individuals. Subjects were then asked to read and sign a consent form which had been approved by the Human Research Review Committee at Grand Valley State University (Appendix B).

All individuals were then assessed through a physical screen. The screen was performed by a licensed physical therapist, and involved gross assessments of active shoulder flexion, static standing balance (unsupported standing for 30 seconds), and dynamic standing balance (unsupported standing while flexing shoulder to 90 degrees) (Appendix C). Failing to complete any of the three activities resulted in exclusion of the subject.
By the completion of the six week program the experimental group consisted of twelve subjects and the control group consisted of eleven subjects. Four individuals dropped out of the experimental group, two as a result of health problems and two for unknown reasons. One individual dropped out of the control group because of a scheduling conflict.

Instrumentation

The Relaxercise exercise program used in this study is based on the work of Dr. Moshe Feldenkrais (Zemach-Bersin et al., 1990). Relaxercise contains ten basic exercises proposed to improve an individual’s health and well-being. For this study six of the ten exercises were chosen because they addressed some aspect of pelvic and spinal mobility or addressed better alignment of extremity segments. Lesson one is entitled "Easy Flexibility" and focuses on rotary movements of the pelvis and spine (Appendix D). Lesson three is entitled "A Healthy Spine" and focuses on flexion and extension of the pelvis and spine (Appendix E). Lesson four is entitled "Relaxed Shoulders" and focuses on restoring flexibility to the neck, chest, and back (Appendix F). Lesson five is entitled "Your Power Center" and focuses on restoring flexibility in the hip joints and lower back (Appendix G). Lesson six is entitled "Aligning Your Body" and focuses on lateral movement of the spine (Appendix H). Lesson eight is entitled "Flexible Feet" and focuses on restoring the natural flexibility of the feet, thus improving posture and stability (Appendix I). Lessons two, seven, nine, and ten were omitted because they are
The exercise program was performed in sitting three times a week (at least one day of rest between each session) for a duration of six weeks. Lessons one, three, and four were taught on the first, third, and fifth week of the study. Lesson one was taught during the first session of the week, lesson three during the second session, and lesson four during the third session of the week. Lessons five, six, and eight were taught on the second, fourth, and sixth week of the study. Lesson five was taught during the first session of the week, lesson six during the second session, and lesson eight during the third session of the week. The exercise sessions were held at the Wyoming Senior Center in Wyoming, Michigan.

FR, modified FR, and Timed "Up and Go" tests, were the three functional measurement tools used to assess the participants during pretesting and posttesting (Appendix K). An additional subjective measurement tool called the Dartmouth COOP Measures of Functional Status was completed by the subject to rate perceived health and function pretest and posttest (Appendix L). Active range of motion measurements of trunk flexion and extension, shoulder flexion, hip flexion, ankle dorsiflexion, and ankle plantarflexion were also obtained pretest and posttest (Appendix M). These joint motions were selected because the specific Relaxercise exercises used in this study focused on these areas.

The FR test is a balance instrument created by Duncan, Weiner, Chandler, and Studenski in 1990. The test measures the maximum distance an individual can reach.
forward, past arm's length, while still maintaining a stable base of support in standing. A leveled 48-inch yardstick was mounted horizontally on a wall at shoulder height. The subject then stood with their side close to the wall with feet flat on the floor, shoulder width apart with no socks or shoes on. His or her shoulder was flexed to 90 degrees with the elbow and wrist at neutral and the hand listed. The subject was then asked to reach as far forward as they could, with the arm staying parallel to the measuring device. The verbal command of, "Reach as far forward as you can without taking a step" was given. Losses of balance resulting in taking a step or touching the wall by the subject resulted in discarded measurements with the trial repeated. All subjects were given two practice trials to begin and had a research assistant guarding them during their reaching. The distal end of the third metacarpal on the reaching arm was the point of reference for obtaining the measurement. Three measured trials were gathered and the mean of the scores was calculated (Weiner et al., 1992). Pretest and posttest measurements were taken in the same way. A gait belt was worn by each subject and was used by the research assistant if balance loss occurred. Prior to the beginning of the study interrater reliability was established for FR. Four elderly subjects who met our criteria performed the FR while our designated investigator recorded results simultaneously with an experienced physical therapy clinician who frequently uses the FR as an assessment tool. Accuracy of measurements were assessed and found to be within .25 inches.

The modified FR was the second measurement tool used. The set up and performance of the modified FR was similar to that of the FR test described by Duncan et al. (1990), except that each subject was seated. All subjects were placed in the same
straight back chair, with hips and knees flexed to 90 degrees, which was determined through observation. A padded cushion was placed behind the subject and/or floor mats were stacked underneath the feet of the subject to obtain the above criteria. The modified FR was then performed as outlined in the FR test above. Both pretest and posttest measurements were taken in the same fashion. A gait belt was again worn by each subject to assist with guarding against losses of balance.

The third functional tool being used was the Timed "Up and Go" test. The subjects were asked to get up out of a standard arm chair (approximate seat height of 46 cm), walk a distance of 3-meters, turn around, return, and sit down. During this test the subject was timed in seconds. The subject began with his or her back against the back of the chair and arms on the armrests of the chair. Everyday footwear was worn and no assistance was given by the evaluator during the process. The subject was allowed to perform the test once before beginning the timed trial. The subject was instructed to start the test on the verbal command of "Go" and was told to walk a comfortable and safe pace to the destination and back (Podsiadlo & Richardson, 1991). A stop-watch was used by the tester to obtain the duration of the activity. Only one timed trial was allowed.

The fourth assessment tool was the Dartmouth COOP Measures of Functional Status, which was used in both the experimental and control groups to assess the subjects' perceived health and function before and after the six week study. The Dartmouth COOP consists of nine charts which are designed to measure perceived function and health (Beaufait et al., 1990). Most subjects can complete this self-administered tool in less than five minutes (Beaufait et al., 1990).
Active range of motion measurements were obtained from each subject both pretest and posttest. Trunk flexion and extension, left and right shoulder flexion, left and right hip flexion, and left and right ankle dorsiflexion and plantarflexion were measured. All extremity motions were obtained using a goniometer and trunk motions were obtained using an inclinometer. Goniometric measurements were based on the book, Measurement of Joint Motion: A Guide to Goniometry (Norkin & White, 1985).

Inclinometer measurements, including inclinometer placement and landmarks, were based on work by Loeb (1967), who described a method of measuring spinal movement.

For shoulder flexion the subject assumed a supine position with knees flexed to flatten the lumbar spine. The shoulder was positioned at zero degrees of abduction, adduction, and rotation. The forearm was positioned at zero degrees of supination and pronation with the palm facing the body. The tester stabilized the thorax to prevent extension of the spine. The tester centered the fulcrum of the goniometer close to the acromion process. The proximal arm was aligned with the mid-axillary line of the thorax, and the distal arm was aligned with the lateral midline of the humerus, using the lateral epicondyle of the humerus for reference. The patient was told, "Raise your arm up over your head as far as you can and hold that position."

For hip flexion measurements, the subject was positioned in supine with the hip at zero degrees of abduction, adduction, and rotation. Initially, the knee was extended, but as the hip moved through the motion, the knee was allowed to flex. The pelvis was stabilized by the tester to prevent rotation or posterior tilting. The fulcrum of the goniometer was centered over the lateral aspect of the hip using the greater trochanter of
the femur for reference. The proximal arm of the goniometer was aligned with the lateral midline of the pelvis and the distal arm was aligned with the lateral midline of the femur using the lateral epicondyle for reference. The subject was told, "Bring your knee up to your chest as far as you can and hold."

Both ankle dorsiflexion and plantarflexion were measured in sitting with the knee flexed at 90 degrees. The foot was positioned at zero degrees of inversion and eversion. The tester stabilized the tibia and fibula to prevent knee motion and hip rotation. The fulcrum of the goniometer was centered over the lateral aspect of the lateral malleolus. The proximal arm was aligned with the lateral midline of the fibula, using the head of the fibula for reference. The distal arm was aligned parallel to the lateral aspect of the fifth metatarsal. For ankle dorsiflexion the subject was told, "Pull your foot up and towards your head as far as you can and hold." For ankle plantarflexion the subject was told, "Point your foot as far down as you can and hold."

Trunk flexion and extension was measured using a commercially available engineer's inclinometer (a pendular goniometer). The inclinometer reading was taken from a point which was 15 cm above the first sacral vertebrae. This area was marked while the subject was standing erect but relaxed. For trunk flexion the subject was seated with hips and knees flexed to 90 degrees. The subject was then asked to, "Reach down to the floor between your knees and hold that position." Hip motion was not prevented during this movement. For trunk extension the subject was in the prone position. The subject was then asked to come up to the prone-on-elbows position and then to the prone-on-hands position. The subject was asked to, "Arch back as much as possible into
extension and hold that position." Hip motion was prevented by verbally instructing the patient to keep the anterior aspect of the hips on the mat.

Procedure

After a subject volunteered for the experimental or control group he or she filled out a subjective health questionnaire that screened for exclusion criteria. One week before the start of the exercise program, all volunteers that met the inclusion criteria were scheduled to come to the Wyoming Senior Center for pretest screening and assessment. On the day of pretest the participants had the consent form read to them. They signed the consent form after all participant questions were answered. Information obtained from each subject was kept strictly confidential and the data was coded so that identification of individual participants was not possible. The subject then underwent a gross physical screen. All subjects meeting the criteria of the physical screen then filled out the Dartmouth COOP Measures of Functional Status questionnaire. All active range of motion measurements were then taken in the order of shoulder flexion, hip flexion, ankle dorsiflexion, ankle plantarflexion, trunk flexion, and trunk extension. The three functional tests were randomly assigned and performed in that order. This sequence was noted for posttest data collection and performed in the same order. The subjects participating in the exercise group attended three sessions weekly for six weeks. No more than four absences were allowed. The control group received no intervention and were asked to maintain their current level of activity. Within seven days following the
six week program, the subjects returned and again underwent all testing procedures except for the gross physical screen.

Data analysis

Pretest and posttest measurements of the experimental and control groups were obtained from the Dartmouth COOP Measures of Functional Status questionnaire, the FR, the modified FR, the Timed "Up an Go" test, and active range of motion of the trunk, shoulder, hip, and ankle. Pretest measurements were subtracted from posttest measurements to obtain the change in measurements. These differences between pretest and posttest measurements were compared for the experimental and control groups. Initially a parametric t-test was run, but because of problems with the assumption of normality and the small sample size of convenience, the results of this test were not used. The nonparametric Wilcoxon rank-sum test was used because it allowed for uneven distribution of measurements and a small sample size of convenience. A Chi-square test of Independence was run to investigate the difference in gender distribution between groups and a Wilcoxon rank-sum test was run to investigate the difference in age distribution. A multiple regression analysis was run for all variables to adjust for significant age differences between the two groups.
CHAPTER 4
RESULTS / DATA ANALYSIS

The purpose of this study was to explore whether a six week program of spinal, pelvic, shoulder, hip, and ankle mobility exercises, based on the Feldenkrais Method, would result in a significant change in function as measured by the FR, modified FR, and Timed "Up and Go" tests. The Dartmouth COOP Measures of Functional Status was also used to explore whether participation in the program altered the participants perceived health status. Goniometric measurements of shoulder flexion, hip flexion, ankle dorsiflexion, ankle plantarflexion, spinal flexion, and spinal extension were taken to assess changes in ranges of motion.

The control group consisted of ten females and one male. The mean age was 71.55 with a standard deviation of 4.97. The mean age of the exercise group was slightly higher at 75.92 years with a standard deviation of 2.61. The exercise group was comprised of ten females and two males. Descriptive statistics of the data are summarized in Table 1.

Table 1  Age Characteristics

<table>
<thead>
<tr>
<th></th>
<th>Range</th>
<th>Mean</th>
<th>Std dev</th>
<th>p-value (Wilcoxon rank-sum test)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control Group (n = 11)</td>
<td>64-77</td>
<td>71.54</td>
<td>4.967</td>
<td>.0220</td>
</tr>
<tr>
<td>Experimental Group (n = 12)</td>
<td>72-80</td>
<td>75.92</td>
<td>2.610</td>
<td></td>
</tr>
</tbody>
</table>

32
The Wilcoxon rank-sum test was initially used to compare groups for all data. No significant difference in pretest and posttest values was found between the experimental and control groups except for right ankle dorsiflexion (Table 2). Right ankle dorsiflexion increased significantly in the experimental group as compared to the control group (p<.05). A t-test was used to compare the scores on the pretest Dartmouth COOP Measures of Functional Status between groups. This was run to determine whether our two groups were significantly different prior to the beginning of the program. The two groups showed no significance between pretest scores.

Two factors that needed to be considered in this experiment were the age and gender distribution in each group. We were concerned that age or gender may have affected mobility measurements. For example, if one group was significantly older or predominantly of a different gender than the other group, this could be a source of possible confounding in our results. The gender distribution between groups was analyzed using the Chi-square test of Independence. A p-value of .5899 was computed indicating that gender and group were not significantly related. To determine if there was a difference in mean age between groups, a Wilcoxon rank-sum test was used. The results of the analysis indicated that there was a significant difference in age between the two groups, with the exercise group significantly older (p = .0220) (Table 1).

In order to account for the difference in age between the two groups, a multiple regression model was constructed, which included the variables in question as the dependent variables, and age and group as the independent variables. The results of this regression analysis (Table 2) indicated that when age was accounted for in the model, the mean change in right ankle dorsiflexion remained significant (p<.05). The change in the Timed "Up and Go" test from pretest to posttest also showed significance between groups when age was accounted for (p<.05). Multiple regression analysis predicted an average improvement of .5982 seconds in the control group as compared to the improvement of
1.260 seconds for the experimental group. This regression model for the Timed “Up and Go” variable also showed that as a person ages the time to complete the test increases. Every one year increase in age increased a person’s time by 0.187 seconds. The results of the regression analysis indicated no significant difference between groups for the FR, modified FR, Dartmouth COOP Measures of Functional Status, or range of motion measurements other than right ankle dorsiflexion. Range of motion and functional test data are summarized in Tables 3 and 4 respectively.

### Table 2  Group p-values

<table>
<thead>
<tr>
<th>Variable</th>
<th>Wilcoxon rank-sum test</th>
<th>Multiple regression analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dartmouth COOP Questionnaire</td>
<td>.2351</td>
<td>.6557</td>
</tr>
<tr>
<td>Right Hip Flexion</td>
<td>.8801</td>
<td>.9080</td>
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<tr>
<td>Left Hip Flexion</td>
<td>.9279</td>
<td>.9947</td>
</tr>
<tr>
<td>Right Shoulder Flexion</td>
<td>.6947</td>
<td>.9332</td>
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<tr>
<td>Left Shoulder Flexion</td>
<td>.9759</td>
<td>.8803</td>
</tr>
<tr>
<td>Right Ankle Dorsiflexion</td>
<td>.0374</td>
<td>.0310</td>
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<td>Left Ankle Dorsiflexion</td>
<td>.5254</td>
<td>.5660</td>
</tr>
<tr>
<td>Right Ankle Plantarflexion</td>
<td>.7850</td>
<td>.6181</td>
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<td>Trunk Flexion</td>
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<td>Trunk Extension</td>
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<tr>
<td>Timed &quot;Up and Go&quot; Test</td>
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<td>.0266</td>
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<tr>
<td>FR: Dominant hand</td>
<td>.1693</td>
<td>.2076</td>
</tr>
<tr>
<td>FR: Non-dominant hand</td>
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<td>.6855</td>
</tr>
<tr>
<td>Modified FR: Dominant hand</td>
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<td>.8072</td>
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<tr>
<td>Modified FR: Non-dominant hand</td>
<td>.6505</td>
<td>.8049</td>
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Table 3  Range of Motion Data

<table>
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<th>Range of change</th>
<th>Mean change</th>
<th>Std dev</th>
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<td><strong>Right Hip Flexion</strong></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>control</td>
<td>-12 to 8</td>
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<td>6.074</td>
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<tr>
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<td><strong>Left Hip Flexion</strong></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>control</td>
<td>-11 to 10</td>
<td>1.0000</td>
<td>6.812</td>
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<tr>
<td>experimental</td>
<td>-13 to 16</td>
<td>1.0000</td>
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<tr>
<td>Flexion</td>
<td>-8 to 12</td>
<td>4.5455</td>
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<td>Dorsiflexion</td>
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<tr>
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<tr>
<td>Plantarflexion</td>
<td>5 to 14</td>
<td>3.0000</td>
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<td>Plantarflexion</td>
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<td></td>
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<td>experimental</td>
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<td><strong>Trunk Extension</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>control</td>
<td>-12 to 25</td>
<td>8.2727</td>
<td>13.138</td>
</tr>
<tr>
<td>experimental</td>
<td>-11 to 16</td>
<td>1.7500</td>
<td>7.300</td>
</tr>
</tbody>
</table>

Note: A negative value represents a decrease in range of motion measurement.
Table 4  Functional Test Data

<table>
<thead>
<tr>
<th>Variable</th>
<th>Range of change</th>
<th>Mean change</th>
<th>Std dev</th>
</tr>
</thead>
<tbody>
<tr>
<td>Timed &quot;Up and Go&quot; Test (secs)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>control</td>
<td>-1.64 to 3.87</td>
<td>-0.5982</td>
<td>1.480</td>
</tr>
<tr>
<td>experimental</td>
<td>-0.62 to 4.24</td>
<td>-1.2600</td>
<td>1.417</td>
</tr>
<tr>
<td>FR: Dominant hand (inches)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>control</td>
<td>-2.96 to 2.25</td>
<td>-0.5182</td>
<td>1.624</td>
</tr>
<tr>
<td>experimental</td>
<td>-2.33 to 4.75</td>
<td>0.8558</td>
<td>2.252</td>
</tr>
<tr>
<td>FR: Non-dominant hand (inches)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>control</td>
<td>-3.08 to 2.33</td>
<td>-0.2455</td>
<td>1.659</td>
</tr>
<tr>
<td>experimental</td>
<td>-2.42 to 4.75</td>
<td>0.6333</td>
<td>2.155</td>
</tr>
<tr>
<td>Modified FR: Dominant hand (inches)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>control</td>
<td>-5.96 to 7.00</td>
<td>-0.4400</td>
<td>3.808</td>
</tr>
<tr>
<td>experimental</td>
<td>-4.16 to 5.00</td>
<td>-0.2508</td>
<td>2.412</td>
</tr>
<tr>
<td>Modified FR: Non-dominant hand (inches)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>control</td>
<td>-0.59 to 7.45</td>
<td>-0.3855</td>
<td>4.007</td>
</tr>
<tr>
<td>experimental</td>
<td>-3.00 to 3.75</td>
<td>0.0992</td>
<td>2.045</td>
</tr>
<tr>
<td>Dartmouth COOP Questionnaire</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>control</td>
<td>-12.00 to 8.00</td>
<td>-0.8182</td>
<td>5.250</td>
</tr>
<tr>
<td>experimental</td>
<td>-1.00 to 14.00</td>
<td>-3.9167</td>
<td>4.990</td>
</tr>
</tbody>
</table>

Note. A negative value for the Timed "Up and Go" test and the Dartmouth COOP questionnaire represents a decrease in score, which indicates an improvement. A negative value for the FR and modified FR represents a decrease in reaching distance.
CHAPTER 5
DISCUSSION

After analyzing the data using multiple regression analysis to account for age, it was discovered that participation in a six week program of spinal, pelvic, shoulder, hip, and ankle mobility exercises, based on the Feldenkrais Method, resulted in significant improvements in right ankle dorsiflexion and the Timed "Up and Go" test. Multiple regression analysis was used because subjects in the exercise group were significantly older than subjects in the control group. A smaller measurement change between pretest and posttest scores could be more significant for an older person. Participation in the Feldenkrais-based program did not significantly improve FR, modified FR, goniometric measurements (except right ankle dorsiflexion), and the Dartmouth COOP Measures of Functional Status questionnaire, between the experimental and control group.

We believe that, of the measurements we used, the Timed "Up and Go" test was the greatest indicator of level of function because this test has been shown to be a reliable tool for measuring functional ability (Podsiadlo & Richardson, 1991). It also has been shown to evaluate a sequence of movements performed in everyday activity (Podsiadlo & Richardson, 1991). The Feldenkrais Method encourages new patterns of awareness which allows more efficient and comfortable movement (Wildman, 1995). We believe the significant improvements seen in the Timed "Up and Go" test may have occurred due to participants having an increased awareness of movement, which allowed them to move more efficiently.

No significant improvements were seen in the FR, modified FR, or range of motion measurements except right ankle dorsiflexion. The FR test requires flexibility of the spine, hip, and ankle joints, and the modified FR requires flexibility of the spine and hip joints. We initially believed if we improved flexibility, it would positively affect
balance and the range of motion possible, which would result in significant improvements in the two reaching tests. The lack of significant improvement in range of motion measurements may have resulted from the limited duration of the exercise program. During the course of the program each ATM lesson was performed only three times, and the specific mobility exercise for each anatomical area, for example the shoulder, was performed only once every two weeks. Perhaps an exercise program of longer duration and additional lesson repetition would have resulted in significant improvements. We believe the significant change in right ankle dorsiflexion may be attributable to one subject's change in ankle range of motion, which possibly skewed the data. A control group subject showed a large decrease in right ankle dorsiflexion from pretest to posttest. This change may have contributed to the appearance of significant improvement in the experimental group.

No significant improvements were seen in the Dartmouth COOP Measures of Functional Status questionnaire. We initially believed that participation in this program would affect perceived function and health in a positive way. We believed this because exercise programs for older people have been found to affect flexibility, and have social and psychological benefits (Christiansen & Juhl, 1987). The Dartmouth COOP Measures of Functional Status questionnaire may not have been a sensitive enough tool to show a significant improvement in scores with the small number of participants. Even though the improvement was not significant, ten out of twelve subjects in the experimental group showed improvement in their scores from pre-exercise to post-exercise. Also in the experimental group, one subject showed no change and one subject showed a slight decrease in their Dartmouth Coop Measures of Functional Status score from pre-exercise to post-exercise. In the control group six out of eleven subjects showed improved scores after the six week period. One subject maintained the same score and four subjects showed decline in their scores.
The subjective, verbal feedback from the exercise participants during and after the six week program was very positive. A female subject claimed that she could now rise to standing from a chair without using her arms, which she was unable to do before the program. One male subject stated that he could now comb the back of his hair, which he had been unable to do prior to the beginning of the program. Another woman claimed that her golf game had improved as a result of the six week exercise program. All exercise participants reported that they enjoyed the program and would like to see the class offered in the future.

Our hypothesis was that healthy, elderly individuals would demonstrate significant improvements in function after participating in the ATM, Feldenkrais based, program. The significant improvement in the Timed "Up and Go" test supports the idea that regular participation in a mobility program may improve function. Improvements in function may help to maintain functional independence and avoid ensuing disability in the elderly. Increased activity level in the healthy elderly may prolong an independent functional level.

Limitations of the Study

All subjects who met the initial inclusion criteria volunteered for the study. Subjects were recruited from area senior centers and through the media. There was not a large sample population available to randomly choose participants. Those who volunteered were not randomly assigned to the experimental or control group. This was not feasible because of the time commitment required for participation in the experimental group. The time commitment may have contributed to the small sample size and lack of volunteers.
The sample chosen was a healthy, elderly population, thus results may not represent other geriatric groups. The small sample size also does not allow generalization to the elderly population as a whole. The small number of subjects may have contributed to the non-significance of functional measurements.

The Feldenkrais-based program lasted only six weeks. The short duration of the program may have contributed to the lack of significant changes seen in FR, modified FR, goniometric measurements (except right ankle dorsiflexion), and the Dartmouth COOP Measures of Functional Status questionnaire.

Modified FR was initially studied using male subjects with spinal cord injury. Validity and reliability have not been established for the elderly. Another limitation was that intrarater reliability was not established for goniometric measurements or the Timed "Up and Go" test. Because these were the areas which showed significance for the experimental group, results may not be reliable. Also, it was not possible for the investigators to be blinded to the experimental or control groups. Investigator assistance was required during the exercise sessions which allowed participants of the exercise group to be identified. There were variables which were uncontrollable during the study. These include extracurricular activities of the participants and participant motivation during testing.

Suggestions for Future Research

For future research, we suggest a larger sample size, random assignment, and blind data collection. Conducting similar research on other populations would allow greater generalization of results.

We also suggest an exercise program of longer duration to maximize possible benefits. Also, if the goals of further studies are to increase flexibility, then the
researcher should concentrate on a specific area of the body. For example, if increasing spinal flexibility is a program goal, then concentration of movement therapy should be on spinal segments.

Further research is needed both in the Awareness Through Movement and Functional Integration areas of the Feldenkrais approach, as they affect function. It was our intent that the results of this study would assist health care professionals in aiding healthy elderly individuals to improve function through regular exercise sessions. Because our investigation demonstrated an improvement in function as measured by the Timed "Up and Go" test, a Feldenkrais based ATM program may affect function in a healthy, elderly individual in a positive way. As stated earlier, further research is needed to understand the benefits of the Feldenkrais Method.
Reference List


APPENDIX A
SUBJECTIVE HEALTH QUESTIONNAIRE

All the information in this form will be kept confidential. Please make it as accurate and complete as possible.

Purpose: The information on this form is necessary to evaluate the physical condition of each subject.

A. PERSONAL DATA

Name ___________________________ Date: _______________

Address ____________________________________________

City/State/Zip_____________________

Date of Birth __________ Age ________ Gender ___ M ___ F

Telephone #____________________ ID #___________________

B. HEALTH AND MEDICAL INFORMATION

1. Do you have or have you experienced any of the following?
   a. Diabetes yes___ no____
   b. Shortness of breath yes___ no____
   c. Heart murmurs yes___ no____
   d. Chest pressure yes___ no____
e. Chest pain              yes___no__
f. Dizziness/fainting      yes___no__
g. Heart problems/surgery yes___no__
h. Hypertension           yes___no__

If you answered yes to any of the above question, please explain.

2. Skeletal/muscular history:
   a. Have you had any bone or joint surgery within the last year?
      yes___no__
      If yes, explain___________________________________

3. Neurological:
   a. Please check if you have been diagnosed with any of the following neurological disorders?
      _____Stroke
      _____Multiple sclerosis
      _____Brain or spinal tumors
      _____Parkinson's disease
      _____Mysthenia Gravis
      _____Muscular Dystrophy
      If you checked any of the above, please explain.
         ____________________________________________________________
         ____________________________________________________________
4. Are you taking any medication?

   yes____ no____

   If yes, please list_________________

                            

C. LIFESTYLE INVENTORY

1. What physical and recreational activities do you participate in and how often?

   **ACTIVITY** (golf, walking, etc) | **FREQUENCY** (daily, weekly etc)

   _____________________________ | _____________________________

   _____________________________ | _____________________________

   _____________________________ | _____________________________

   _____________________________ | _____________________________

   _____________________________ | _____________________________
Consent Form

I understand that this is a study comparing two groups of subjects, one which participates in an exercise program and one which does not. The exercises include spinal, shoulder, pelvic, hip, and ankle movements. I also understand that the results from this exercise program will be assessed by measuring functional activities which include reaching and getting up from a chair and walking. I understand that the knowledge gained in this study is expected to help physical therapists and all caregivers in keeping the elderly as active and independent as possible.

I also understand that:
1. participation for the exercise group will involve 18 exercise classes of one hour each, 3 times a week for 6 weeks, with an additional hour each for functional screening and testing before and after the exercise program. For the second group, participation will involve two one hour functional screening and testing periods.
2. I have been selected for participation because I have passed all of the screening procedures for this study through my completion of a written questionnaire.
3. it is not anticipated that this study will lead to physical or emotional risk to myself. During all functional tests a gait belt will be worn for guarding purposes. It is not anticipated that exercise soreness will occur.
4. benefits will include a free health screening and functional evaluation. Benefits may also include increased flexibility, coordination, grace of movement, and postural improvements.
5. the information I provide will be kept strictly confidential and the data will be coded so that identification of individual participants will not be possible.
6. a summary of the results will be made available to me upon my request.

I acknowledge that:
"I have been given an opportunity to ask questions regarding this research study, and that these questions have been answered to my satisfaction."

"In giving my consent, I understand that my participation in this study is voluntary and that I may withdraw at any time during the procedures."

"I hereby authorize the investigator to release the information obtained in this study to scientific literature. I understand that I will not be identified by my name."

"I have read the above information and I release Wyoming Senior Center and the investigators (Sister Mario, Carolyn Sarantakis, Susan Finney, Barbara Brown, and Jolene Bennett) from any liability in the unlikely event physical injury to myself should occur during the research."
"I acknowledge that I have read and understand the above information, and that I agree to participate in the study."

Participants Signature  Witness

Date  Date

If you have any questions or concerns please contact Carolyn Sarantakis at (616) 669-4397.

I am interested in receiving a summary of the study results.
APPENDIX C

57
Name______________________________

ID #______________________________

A. RANGE OF MOTION

Yes  No

Active shoulder flexion to 90 degrees  _____  _____

B. BALANCE

Yes  No

Static standing
(unsupported standing for 30 sec)  _____  _____

Dynamic Standing
(unsupported standing while flexing shoulder to 90 degrees)  _____  _____
PLEASE NOTE

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Appendix D-I
pages 59-128

UMI
April 4, 1995

Harper & Row, Publishers, Inc.
10 East 53rd Street
New York, NY 10022

Regarding: Permission to copy pages from the following book:
Relaxercise.

Dear Permissions Department:

We are graduate Physical Therapy Students from Grand Valley State University working on our masters thesis and would like to incorporate Relaxercise lessons into our research study. We are seeking permission to copy lessons 1, 3, 4, 5, 6, and 8 for inclusion in our thesis appendix.

Thank you.

Sincerely,

Barb Brown SPT, Sue Finney SPT, and Carolyn Sarantakis SPT

Please send correspondence to:

Sue Finney
2737 Carla SW
Grandville, MI 49418

(616) 534-3997
APPENDIX K
DATA COLLECTION FORM: PRETEST

SELF ASSESSMENT

1. Dartmouth COOP Measures of Functional Status

FUNCTIONAL TESTS

Dominant Hand: R____  L____

<table>
<thead>
<tr>
<th>Trial</th>
<th>Trial 2</th>
<th>Trial 3</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. FUNCTIONAL REACH</td>
<td>R____</td>
<td>_____</td>
<td>_____=</td>
</tr>
<tr>
<td></td>
<td>L_____</td>
<td>_____</td>
<td>_____=</td>
</tr>
<tr>
<td>2. MODIFIED FR</td>
<td>R_____</td>
<td>_____</td>
<td>_____=</td>
</tr>
<tr>
<td></td>
<td>L_____</td>
<td>_____</td>
<td>_____=</td>
</tr>
<tr>
<td>3. TIMED &quot;UP AND GO&quot;</td>
<td>_____</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
DATA COLLECTION FORM: POSTTEST

SELF ASSESSMENT

1. Dartmouth COOP Measures of Functional Status ________

FUNCTIONAL TESTS

   Dominant Hand:  R_____  L_____  

<table>
<thead>
<tr>
<th>Trial 1</th>
<th>Trial 2</th>
<th>Trial 3</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>FUNCTIONAL REACH</td>
<td>R_____</td>
<td>_____</td>
<td>_____</td>
</tr>
<tr>
<td></td>
<td>L______</td>
<td>_____</td>
<td>_____</td>
</tr>
<tr>
<td>MODIFIED FR</td>
<td>R_____</td>
<td>_____</td>
<td>_____</td>
</tr>
<tr>
<td></td>
<td>L______</td>
<td>_____</td>
<td>_____</td>
</tr>
</tbody>
</table>

   | TIMED "UP AND GO" | ________ |
COOP MEASURES OF FUNCTIONAL STATUS

PHYSICAL FITNESS
During the past four weeks...
What was the hardest physical activity you could do for at least two minutes?

<table>
<thead>
<tr>
<th>Very Heavy</th>
<th>Not at all</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heavy</td>
<td>Slightly</td>
<td>2</td>
</tr>
<tr>
<td>Moderate</td>
<td>Moderately</td>
<td>3</td>
</tr>
<tr>
<td>Light</td>
<td>Quite a bit</td>
<td>4</td>
</tr>
<tr>
<td>Very Light</td>
<td>Extensively</td>
<td>5</td>
</tr>
</tbody>
</table>

SOCIAL ACTIVITIES
During the past four weeks...
Has your physical and emotional health limited your social activities with family, friends, neighbors or groups?

| No difficulty at all | 1 |
| A little bit of difficulty | 2 |
| Some difficulty | 3 |
| Much difficulty | 4 |
| Could not do | 5 |

DAILY ACTIVITIES
During the past four weeks...
How much difficulty have you had doing your usual activities or tasks, both inside and outside the house because of your physical and emotional health?

FEELINGS
During the past four weeks...
How much have you been bothered by emotional problems such as feeling anxious, depressed, irritable or downhearted and blue?

| Not at all | 1 |
| Slightly | 2 |
| Moderately | 3 |
| Quite a bit | 4 |
| Extensively | 5 |

OVERALL HEALTH
During the past four weeks...
How would you rate your health in general?

| Excellent | 1 |
| Very Good | 2 |
| Good | 3 |
| Fair | 4 |
| Poor | 5 |
**PAIN**

During the past four weeks...
How much bodily pain have you generally had?

<table>
<thead>
<tr>
<th>Pain Level</th>
<th>Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>No pain</td>
<td>1</td>
</tr>
<tr>
<td>Very mild pain</td>
<td>2</td>
</tr>
<tr>
<td>Mild pain</td>
<td>3</td>
</tr>
<tr>
<td>Moderate pain</td>
<td>4</td>
</tr>
<tr>
<td>Severe pain</td>
<td>5</td>
</tr>
</tbody>
</table>

**CHANGE IN HEALTH**

How would you rate your overall health now compared to four weeks ago?

<table>
<thead>
<tr>
<th>Health Change</th>
<th>Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Much better</td>
<td>1</td>
</tr>
<tr>
<td>A little better</td>
<td>2</td>
</tr>
<tr>
<td>About the same</td>
<td>3</td>
</tr>
<tr>
<td>A little worse</td>
<td>4</td>
</tr>
<tr>
<td>Much worse</td>
<td>5</td>
</tr>
</tbody>
</table>

**SOCIAL SUPPORT**

During the past four weeks...
Was someone available to help you if you needed and wanted help? For example if you:
- felt very nervous, lonely or blue
- got sick and had to stay in bed
- needed someone to talk to
- needed help with daily chores
- needed help just taking care of yourself

<table>
<thead>
<tr>
<th>Support Level</th>
<th>Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes, as much as I wanted</td>
<td>1</td>
</tr>
<tr>
<td>Yes, quite a bit</td>
<td>2</td>
</tr>
<tr>
<td>Yes, some</td>
<td>3</td>
</tr>
<tr>
<td>Yes, a little</td>
<td>4</td>
</tr>
<tr>
<td>No, not at all</td>
<td>5</td>
</tr>
</tbody>
</table>

**QUALITY OF LIFE**

How have things been going for you during the past four weeks?

<table>
<thead>
<tr>
<th>Quality Level</th>
<th>Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very good</td>
<td>1</td>
</tr>
<tr>
<td>Pretty good</td>
<td>2</td>
</tr>
<tr>
<td>Good &amp; bad parts</td>
<td>3</td>
</tr>
<tr>
<td>Pretty bad</td>
<td>4</td>
</tr>
<tr>
<td>Very bad</td>
<td>5</td>
</tr>
</tbody>
</table>
DATA COLLECTION FORM: PRETEST

ACTIVE RANGE OF MOTION

1. TRUNK FLEXION

2. TRUNK EXTENSION

3. SHOULDER FLEXION
   R______ L______

4. HIP FLEXION
   R______ L______

5. ANKLE DORSIFLEXION
   R______ L______

6. ANKLE PLANTARFLEXION
   R______ L______
DATA COLLECTION FORM: POSTTEST

ACTIVE RANGE OF MOTION

1. TRUNK FLEXION

2. TRUNK EXTENSION

3. SHOULDER FLEXION   R______   L______

4. HIP FLEXION        R______   L______

5. ANKLE DORSIFLEXION R______   L______

6. ANKLE PLANTARFLEXION R______   L______