A PROFILE OF LONG TERM DEGENERATIVE HIP DISEASE PATIENTS

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This thesis has been prepared
under my supervision
and the candidate has complied
with the Master's regulations.

Signature of Supervisor

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Abstract

The purpose of this study was to profile and determine the relationships among activity level, age, health status, quality of life, walking capacity and severity of degeneration in 54 (mean age 54.91 ± 16.97, range 26 to 86) long term degenerative hip disease (DHD) patients. The relationships of these variables with respect to five classifications of DHD (derived from a medical assessment as to the origin of the disease) were also examined, and various coping strategies utilized to manage the disease were documented. Radiological and historical data, the Short Form 36 (SF-36) Health Status Questionnaire, the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC), a set of interview questions, a six-minute walk test, and a seven day diary were used to obtain the data on each variable. Six correlations ($p < 0.05$; $r \geq \pm 0.50$) were produced, the strongest of which ($r = -0.73$) was between health status (SF-36) and physical functioning (SF-36). Physical functioning also best predicted walking capacity. Three of the seven variables (age, general health (SF-36), and severity of degeneration) were significantly different among the groups. Analgesics were the coping strategy most recorded for both one-time usage and over a seven day period. Long-term DHD sufferers must survive with the daily limitations of their disease until surgery is warranted. Pain, stiffness and physical dysfunction associated with DHD, which are intermittent by nature, require the use of coping strategies to manage the symptoms, and help patients survive on a day to day basis. It would appear that, in this preliminary study, the DHD patients are surviving with this disease on a long term basis. Further longitudinal research is required to examine how these patients function over time. The results from this study give concrete evidence to physicians and DHD sufferers themselves on how other, similar long term patients have managed on a day to day basis.

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CHAPTER 1

Introduction

Background to the Problem

Degenerative hip disease (DHD) is a breakdown in the normal function of the hip joint (Mitchell & Cruess, 1977). It is a heterogeneous condition with a variable presentation and an assortment of patterns of expression. This disease is focal, progressive (Michet, 1993) and there is currently no known non-surgical therapy that will halt, or even reverse, the progression of DHD (Brandt, 1989). Among the risk factors for DHD are (1) age, (2) obesity, (3) family history, (4) previous (or childhood) trauma to the joint area, (5) secondary osteoarthritis (OA), (6) congenital disease, (7) acquired disease, (8) avascular necrosis, and (9) previous surgery, all of which may facilitate the onset of DHD (Oka & Hatanpaa, 1976; Ball, 1986; Mankin & Brandt, 1989; Burke & Flaherty, 1992; Croft, Cooper, Wickham & Coggon, 1992; Bullough, 1993; Klippel & Dieppe, 1994). Although many systems exist for classifying the origin of this disease (Mitchell & Cruess), the present study utilized five classifications; (1) abnormal concentrations of force on normal articular cartilage, (2) normal concentrations of force on abnormal articular cartilage, (3) normal concentrations of force on normal articular cartilage supported by weakened subchondral bone, (4) idiopathic arthritis and, (5) failed previous surgery (Mitchell & Cruess; H. Hamilton, personal communication, Feb. 26, 1996).

In most patients with DHD, the clinical onset of the condition consists of an intermittent increase in the frequency and severity of joint pain or stiffness (Wigley, 1984). Due to the interrupted nature of the disease, presentation to a doctor or therapist is often delayed by months or even years after the onset of DHD (Mitchell & Cruess, 1977). By this time, the signs and symptoms of DHD are usually well established (Wigley; Mankin & Brandt, 1989). As DHD progresses, involvement in activity lessens, movement of the joint decreases, and most severely, the patient becomes disabled (Ike, Lampman & Castor, 1989; Boulware & Byrd, 1993). Pain and stiffness in the degenerative joint can lead to a decreased quality of life in many of the patients (Wiklund & Romanus, 1991). This decrease is due to a loss of independence in performing daily activities (Schon & Zuckerman, 1988). Rorabeck et al. (1994) report that DHD not only causes extreme pain, but also affects the individual's physical activity, social interactions and overall health. Pain is a subjective experience, and literature (Ike et al., 1989; Pierron et al., 1990; Noreau, Martineau, Roy & Belzile, 1995) supports the belief that pain affects, to varying degrees, both the mental status of the patient and his/her physical functioning.

The patient's history, radiological data and physical examination will aid a physician in deciding the proper course of action (Schon & Zuckerman, 1988). Often, the first steps in therapy for DHD patients are non-surgical treatments such as medications, walking aids and physical therapy (Poss & Sledge, 1989). When a patient meets the criteria for surgery, a total hip replacement (THR) is recommended. This surgery is performed to replace the diseased joint, and hopefully rid the patient of the pain while returning an acceptable range of motion to the affected area (Haworth, Hopkins, Ells, Ackroyd & Mowat, 1981; Hamilton & Joyce, 1985; Weissman, 1989). A limitation to the surgery option for DHD sufferers, however, is the life span of a prosthesis (Harrison, 1996). Older (1995) reported that THRs in patients aged 40 years or younger at the time of their operation had a survivorship of only 66% after 20 years. The older group, aged 70-80 at time of surgery, had a survivorship after 20 years of 92%. Joint replacements usually last up to twenty years before wear and tear have their effects on the prosthesis (H. Hamilton, personal communication, Feb 26, 1996). Younger candidates are often urged to forgo, or postpone, surgery, despite pain and degeneration states, until they reach a more suitable age.

Statement of the Problem

The primary purpose of this study was to profile and determine the relationships among activity level (in units of metabolic energy expenditure, or METS), age (yrs), health status (Western Ontario and McMaster Universities Osteoarthritis Index), quality of life (Short-Form 36 Health Status Questionnaire), walking capacity (six-minute walk test in metres), and severity of degeneration (minimal cartilage space in millimetres), in long term DHD patients. These variables were also examined in relationship to the five classifications of DHD. In addition, the study was used to document the various coping strategies utilized by long-term DHD patients.

Significance of the Study

The prevalence of DHD and the limited literature on the long term functioning of DHD patients pointed to the necessity for research in this area. The estimated prevalence of DHD between the ages of 45-64 years is 30% and over the age of 65 it is nearly 70% (Brandt, 1989). In Britain, Croft et al. (1990) estimated that DHD is the major factor in the 35,000 THRs performed annually, while Malchau, Herberts and Ahnfelt (1993) reported that over 800,000 THRs are performed worldwide annually. Pierron et al. (1990) stated that DHD is the leading cause of disability in the elderly and Brandt estimated that over 100,000 people in the United States are unable to walk independently from bed to bathroom because of either knee or hip degenerative joint diseases (DJDs). Wigley (1984) reported that 90% of patients over the age of 40 present with radiological evidence of DJDs, particularly in the weight-bearing joints. Given the magnitude of the disease, there is still little known regarding etiology, natural history, and therapeutic efficacies associated with DHD (Davis, 1988).

Literature on DHD is limited, primarily due to the fact that researchers often term DHD "OA", when in fact, OA only constitutes one type of DHD (H. Hamilton, Feb. 26, 1996). Specific studies on activity levels, age, health status, quality of life, walking capacity, and severity of degeneration in DHD patients are also rare. Furthermore, Keefe et al. (1987) reported that the relationship of pain coping strategies to pain level, physical and psychological adjustment have not been systematically investigated in DHD. Most of the existing research has been targeted at what may cause the onset of the disease, often using a middle-aged, male subject pool (Oka & Hatanpaa, 1976; Marti, Knobloch, Tschopp, Jucker & Howald, 1989; Noreau et al., 1995).

The limited life-span of the hip prosthesis and the intermittent nature of this disease necessitated profiling and discovering the relationships among activity levels, age, health status, quality of life, walking capacity, and severity of degeneration in long term DHD patients. This information will be beneficial to doctors when counselling potential THR candidates, by providing concrete examples of how these variables relate to DHD. In addition, providing descriptions of the coping strategies used by a wide age range of DHD patients is an asset to present and future sufferers of DHD themselves, as these coping strategies gave, at the very least, some comfort to the patients through managing pain, stiffness and functional disability.

Delimitations

This study was delimited to only those subjects who:

1. Met the five year documentation criterion.

2. Were referred to the study by Dr. Hamilton.

3. Resided in Thunder Bay or the surrounding area.

4. Were mobile enough to perform the six-minute walk test at the testing site.

5. Could attend the interviews during a pre-arranged four-week time period.

This study was also delimited to:

6. The variables and measurement scales previously noted.

Limitations

1. The intermittent nature of this disease is such that the severity of the symptoms within the same subject is inconsistent on a day to day basis. Due to the limited time span for the interviews, this characteristic was monitored and recorded by asking how the patients felt on the particular day and time of testing.

2. Inherent limitations exist with interview and survey research, such as individual variability and biased answers on the questionnaires. These limitations were partially controlled through the use of standardized questionnaires and piloted interview questions.

3. The number of subjects who fell into each of the five diagnostic classifications did not meet the basic assumption of equal variances for the statistical procedures. Subjects were classified based on their radiological data and clinical symptoms.

4. Assigning the subjects to one of five classifications of DHD was based on Dr. Hamilton's clinical interpretation and grading system. This subjective classification eliminated possible overlap as the category that best represented that subject was chosen.

5. It is possible that disability from causes other than DHD influenced the results. This was partially controlled for by asking subjects to respond in relation to their hip problems only.

6. The time-pressure nature of the six-minute walk test may have prompted subjects to

walk with an unnatural gait, which would not have represented their normal capacity. The subjects were asked to walk at a comfortable pace; one that they could maintain without any undue pain over the six-minutes, and were guided with consistent prompting and encouragement.

7. The severity of degeneration score is assessed by the minimal cartilage space where a lower score typically represents greater degeneration. There is a possibility, however slight, that the cartilage will swell before degeneration sets in (H. Hamilton, personal communication, July 8, 1996), resulting in greater cartilage scores.

8. Only 31 of 54 subjects returned the seven-day diary.

Definitions

Activity: for this study, activity was defined as being the goal-directed use of time, energy, or attention. High activity was participation that results in a monthly metabolic energy expenditure (METS) of 6500 or greater; moderate activity produced between 3000-6499 METS; low activity produced less than 3000 METS (Ministry of Tourism and Recreation, 1984).

Cartilage: a type of opaque connective tissue consisting of chondrocytes (the primary cells of the cartilage) embedded in a dense network of fibres and a matrix (Tortora, 1989).

Comfortable Walk Pace: the suggested walking pace for the six minute test; subjects were urged to walk with their normal gait for the six minutes, without placing any undue pain on themselves. Consistent prompting and encouragement were provided.

Coping strategies: adjusting or adapting successfully to a challenge (Taber's Cyclopedic Medical Dictionary, 1989). For the purpose of this study, any strategy used to relieve pain, stiffness and functional disability was noted. Examples included the use of analgesics, walking aids, rest, ice, heat, exercise and prayer.

Degenerative hip disease: a focal, progressive breakdown in normal functioning of the hip joint, resulting from a complex interplay of factors (Mitchell & Cruess, 1977; Michet, 1993)

Health status: for the purpose of this study, the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) was used to assess health status. It is a reliable, valid tool that measures health status by assessing pain, stiffness and physical function (Bellamy, 1989).

Metabolic energy expenditure (METS): units used for defining levels of activity. Monthly METS were estimated by the charts and equations listed in Appendix F, based on the subject's subjective opinion. One MET is the energy expended by a person while sitting at rest.

Quality of life: due to the abundance of definitions and the broad nature of quality of life itself, for the purpose of this study, the Short-Form 36 Health Status Questionnaire (SF-36) provided a reliable, valid quality of life score (Brazier et al., 1992). The eight parameters in this questionnaire are; physical functioning, physical role functioning, bodily pain, general health, social functioning, vitality, emotional role functioning, and mental health.

Severity of degeneration : for the purpose of the present study, the minimal cartilage space represented severity of degeneration. Cartilage was measured on the last radiography of the subject's hip; an Engineer's caliper provided the measurements in millimetres.

Walking capacity: for the purpose of this study, walking capacity was assessed through the six minute test (Rorabeck et al., 1994). The subjects were prompted to walk up and down a pre-measured hallway at a comfortable pace, with consistent encouragement.

CHAPTER 2

Review of Literature

Degenerative Hip Disease

Description of Degenerative Hip Disease

Degenerative joint diseases (DJD) are the most common joint disease of mankind and are the leading cause of chronic disability in the elderly (Brandt, 1989; Pierron et al., 1990). Specifically, DHD, which is often used inter-changeably in the literature with OA, is a clinical term for the consequences of a breakdown in the joint's normal function (Bullough, 1993). It is a focal, progressive disease and it does not have a single etiology, but results from a complex interplay of factors ending in a final common pathway of joint damage (Mankin & Brandt, 1989; Howell, Treadwell & Trippel, 1992; Michet, 1993). Although the natural history of DHD is not well described, Klippel & Dieppe (1994) report that DHD occurs when the joint is slowly eroded due to a plethora of reasons. The eventual result is complete destruction of the joint's articulating surfaces with a subsequent loss of function.

Long before the degenerative process is complete, considerable pain and stiffness are experienced, which place stress on the muscles and other soft tissues that surround the joint (Pierron et al., 1990; Michet, 1993; Arthritis Society, 1994). This stress may also lead to an overall mental and physical deterioration (Wiklund & Romanus, 1991; Pierron et al.). The accompanying signs and symptoms of this disease are multifactorial, and without a known cause, there is no universal, non-surgical treatment that will halt or even reverse the progression of DHD (Brandt, 1989; Vingard, 1994). Furthermore, while radiographic changes of osteophytes, loss of joint space, bony sclerosis, and cysts may be present to varying degrees in

DHD patients, radiographic changes may not correlate closely with symptoms (Michet). Current treatment strategies for DHD sufferers aim to relieve pain and increase the range of motion in the joint (Poss & Sledge, 1989; Pierron et al.; Adams, 1993).

Prevalence of Degenerative Hip Disease and Total Hip Replacements

The etiology of DHD has long puzzled those interested in its management (Mitchell & Cruess, 1977). As the most common and costly form of arthritis, DJDs are most prevalent in the knee and hip joints (Adams, 1993) and are the most prevalent activity-limiting conditions among older persons (Croft et al., 1990; Hampson et al., 1993). Furthermore, the hip joint has been studied most extensively in relation to DJDs (Klippel & Dieppe, 1994). In Britain, DHD was the major factor in the 35,000 THRs carried out annually (Croft et al.), and Pierron et al. (1990) suggested that there were an estimated 75,000 THRs performed annually in the United States, and that 65% of them were performed in patients over the age of 65. Malchau et al. (1993) reported that over 800,000 THRs are performed worldwide each year.

Older (1995) obtained data from eight hospitals on 4,869 patients who had a Charnley Low Friction Arthroplasty (LFA). In the majority of these centres, the LFA was performed by one surgeon. All of the operations were prior to the 31st of December, 1980, with a minimum follow up of 15 years, and a maximum follow up of more than 20 years in 10% of the cases. Patients who were aged 70-80 at surgery time had a 92% survivorship twenty years post surgery. Patients who were less than 40 years of age at the time of surgery had only a 66% survivorship at 20 years post surgery. It must be noted, however, that these results were based on a sample of highly successful centres. Also, only 53% of the original patients were alive at time of study, so it is possible that the high percentage of survivorship in the older age category represents a small number of healthy, elderly hips. Furthermore, the condition of the hip disease prior to surgery is unknown, so it is possible that the lower age category was represented by more severe cases.

More recently, Harrison (March, 1996) wrote an article on arthritis which was supported by a panel of health care providers. In this forum style article, it was reported that when symptoms no longer respond to medication and the arthritis is beginning to seriously infringe on daily activities, surgery can help. Surgery can effectively realign joints, reduce pain and improve function. Joint replacements now last up to 15 years, but eventually wear out. For this reason, doctors tend to postpone surgery for as long as possible.

Risk Factors Associated with Degenerative Hip Disease

There is persuasive evidence that the rate of functional disability and the prevalence of DHD increases with age; the disorder is rare in persons under age 25, and most common in persons over age 60 (Wigley, 1984; Pierron et al., 1990; Michet, 1993). There are also noted differences in the prevalence of the disease between the sexes (Oka & Hatanpaa, 1976; Ball, 1986; Dieppe, 1990), although research provides contradicting trends. Articles which indicated a greater prevalence for women typically studied older subject groups. Davis (1988) discussed that in general, there is little sex difference in the prevalence of DHD; or if a sex difference exists, the tendency is for an excess in men. Dieppe, in an article examining different DJDs, reported that hips, ankles and elbows had male preponderance. Michet reported that DJDs are more common among men than women in younger age groups, likely representing the influence of occupation or trauma, whereas the rate in women exceeds that of men by middle age. Hochberg (1991) explained that DJDs are typically higher in women than in men, however, DHD is greater in men than women below age 65, while comparable between the sexes at ages 65 and older.

More recently, Klippel & Dieppe (1994) have suggested that DJDs in general are more common in women than in men over age 60.

Oka and Hatanpaa (1976) have commented that heredity is a possible risk factor in the development of the disorder. This belief was supported by Pierron et al. (1990) and Michet (1993) who also suggested that obesity may play a large role in the development of various DJDs. Other risk factors include; trauma (especially that which interferes with the mechanics and circulation of the joint and ligaments), mechanical load (both from occupations and high impact sporting activities), congenital diseases (where changes from the disease may lead to earlier and faster progression of DHD), and bone mass (Mankin & Brandt, 1989; Bullough, 1993; Michet; Klippel & Dieppe, 1994).

Classification of Degenerative Hip Disease

Altman (1991) published classification criteria for DHD derived from a group of patients with hip pain due to degeneration, as compared to patients with similar symptoms related to other diseases. Pain was the major symptom of DHD, however the distribution of pain poorly separated DHD from the control group, because the pattern of pain to physical activities was not consistent among patients with DHD (Altman). The radiograph was the most important clinical DHD classification and combining clinical evaluation and radiographic findings of the hip was not superior to the radiograph alone. Requiring more than osteophytes on the radiograph did not alter the sensitivity or specificity in classification of DHD. Clinical criteria without the radiograph were reasonably sensitive (86%) but not very specific (75%).

The osteophyte on the radiograph was the criterion that best separated those with DHD from controls when combining clinical and radiographic changes. Joint space narrowing was present in 91% of patients with DHD, but it was only 60% specific. Joint space narrowing could be on the superior, axial and/or medial aspects of the hip joint. Adams (1991) stressed that neither osteophytes nor joint-space narrowing are individually specific of DHD, however, their combination appears to be quite sensitive (89%) and specific (91%). In contrast, the American College of Rheumatology proposed classification criteria which rely heavily on radiographic osteophytes, depend less on joint-space narrowing, emphasize reduced internal rotation and hip flexion in contrast to other hip motions, do not require radiographic subchondral changes, and do not exclude secondary DHD (as cited by Altman).

Other researchers have supported the use of radiographs for DHD identification. Schon & Zuckerman (1988) suggested that radiographic findings for DHD include loss of the superior and lateral joint space, superior migration of the femoral head, sclerosis, osteophytes and cysts. Pierron et al. (1990) reported that the most commonly observed early anatomical change in DHD is cartilaginous fibrillation and erosion, which leads to the classical radiographic finding of localized joint space. Furthermore, Michet (1993) insisted that radiographically heterogeneous patterns of DHD are observed, with superior joint space loss much more common than medial or axillary femoral head migration. However, studies also indicate that the radiograph alone is not sensitive enough for DHD classification. Michet reported that radiographic changes may not correlate closely with symptoms, and Schon & Zuckerman insisted that history, physical examination and radiographs are essential to the diagnosis of DHD. These are just a few of the difficulties that hinder discovery of the origin and natural progression of DHD.

Traditionally, degenerative arthritis has been classified into two types. These types are primary and secondary to conditions that could be expected to produce abnormal concentrations of force on cartilage leading to its degeneration (Mitchell & Cruess, 1977). Now it appears that the term "primary arthritis" can no longer be entertained by the medical community and with further study it will eventually be found that all instances of this disease are secondary to some insult to the cartilage. This classification of degenerative arthritis by cause is based on the assumption that the insult, whether physical, chemical, inflammatory or otherwise, results in; abnormal concentrations of force on normal articular cartilage matrix, normal concentrations of force on abnormal articular cartilage matrix, normal concentrations of force on normal articular cartilage matrix supported by stiffened subchondral bone, and normal concentrations of force on normal articular cartilage matrix supported by weakened subchondral bone (Mitchell & Cruess).

Activity and Degenerative Hip Disease

Activity Induced Degenerative Hip Disease

Oka & Hatanpaa (1976) tested the effect of training begun at an early age on the femoral head tilt in male, adolescent, competitive athletes and physical education students. Fifty-four boys of the Finnish Sports Society who had been in training for several years acted as subjects, while the control group consisted of army recruits. The runners had a yearly training distance of approximately 2740 kilometres. The results on femoral head tilt implied that sports activities started at an early age would not contribute to epiphysiolysis and, through that, to later development of DHD. It is, of course, possible that at an early age those with injured hip joints because of epiphysiolysis or other reasons had already discontinued their sports activities.

Panush (1987) tested the prevalence for DHD in 17 healthy, middle aged runners against a control group of 18 sedentary, middle aged people matched for height, weight and age. Feet pain, swelling, cartilage thickness and the grade of cartilage degeneration were all comparable, which led to the conclusion that DHD was not initiated through running. Mokowitz (1987) supported this belief, as out of 20 long-distance runners with chronic knee pain, six reported having degeneration, but all six had had previous trauma to the affected joint. Exercise did not initiate degeneration, although previous trauma seemed to be correlated with the onset of the disease (Mokowitz; Eichner, 1989). Research by Pascale and Grana (1989) on 45 middle-aged, trained runners developed comparable results. Only eleven of the subjects had degeneration, and nine of these eleven recorded previous trauma to the knee or hip joints. Furthermore, the results from a study on the prevalence of DHD among former Finnish champion runners also failed to identify a significant relationship between habitual running and premature DHD. In 74 former runners, primary DHD was only found in 4% of the athletes, but in 9% of the controls (Puranen, Ala-Ketola, Peltokallio, & Saarela, 1975). In all of these studies, however, the subjects are predominantly male, healthy and middle-aged, not representative of the entire population. In addition, the intensities and durations of exercise are often excluded information.

Radiographical evidence of cartilage degeneration in runners has also failed at linking sports with the onset of DHD (Eichner, 1989). Even when matched for height, weight, age and occupation, comparing the sedentary control group with the active middle aged subjects revealed little differences in DHD prevalence. Subjects who exercised also noted less visits to the doctor over a five year period and had less reported disabilities than the control group. As such, it has been concluded that running is more beneficial to the body than it is costly. Again, the subject pool consisted of middle-aged males.

With respect to intensity of exercise, Marti et al. (1989) concluded that long-term, high intensity, weight-bearing, high mileage running should not be dismissed as a potential risk factor for premature DHD in a study questioning if excessive running could be predictive of DHD. The subjects consisted of 27 former long distance runners, nine former bobsleigh riders, and 23 normal, healthy untrained men (control group). Physiological and exercise characteristics of all subjects had been recorded in 1973. In 1988, these measurements were repeated, together with radiological examination of the hips. An additive radiological index of DHD on joint space narrowing, grades of subchondral sclerosis, and osteophyte formation was significantly increased among runners as compared with bobsleigh riders and untrained controls.

High impacting, weight-bearing sports such as football tend to increase injury prevalence (Marti et al., 1989; Peyron, 1993). Dorr (1991) reported that injuries occurring with athletics can increase the incidence of arthritis. Low weight bearing exercise such as cycling, swimming, or walking are the best exercises for strengthening muscles, and reducing the risk of injury (Boulware & Byrd, 1993). Swimming allows for a safe environment within which to exercise while the joints are supported. Performing water exercises is also a great way to lose weight and increase cardiovascular fitness without placing undue stress on the joints (Katz, 1991).

Physical Benefits of Activity

Persuasive scientific evidence indicates that sedentary living is associated with the onset of various diseases and conditions, while regular physical activity has an important role in preventing disease and increasing longevity (Paffenbarger, Hyde, Wing & Hsieh, 1986; Owen, Lee, Naccarella & Haag, 1987; Sarna, Sahi, Koskenvuo & Kaprio, 1993). Furthermore, a lack of activity may predispose older individuals to lose their independence (Pavlou, Steffee, Lehman & Burrows, 1985; Shephard, 1993; Blair, Wood & Sallis, 1994; Greig et al., 1994).

A longitudinal examination (1977-1985) on 11,864 college alumni supported the role of exercise adoption in optimizing all-cause mortality in a study that assessed the effects of changes in physical activity over time on risk of all-cause mortality among college alumni (Paffenbarger, Hyde, Wing, Jung, & Kampert, 1991). Activity and fitness are never defined, and the sample is all male, although the large sample size lends itself to high external validity. A similar study by Kaplan, Seeman, Cohen, Knudsen & Guralnik (1987) reported a 38% greater risk of all-cause mortality found in sedentary individuals when comparing active leisure lifestyle subjects with those adopting a sedentary lifestyle over a 17 year period. It is also likely that an increase in physical fitness enhances the quality of life throughout a person's life span, particularly shortening the terminal period of partial and total dependency seen in a sedentary older person.

Lyngberg (1988) tested the effects of exercise training on arthritis patients. He concluded that conditioning training and strength exercise training in a controlled and progressive form were beneficial to the strength and independence of acute arthritis patients. Although there was no mention of the type of exercise used, nor the frequency and weekly repetitions for the exercise, the idea is for exercise to promote health, while not increasing the prevalence of injury, or further aggravating a damaged joint.

More recently, Ettinger and Afable (1994) studied the role of exercise as an intervention for dealing with disability as a result of DJDs. They reported that physical disability from degenerative knee disease (DKD) was a complex interplay among the severity of the disease, pain, comorbid conditions, psychosocial factors, and deficits in physical capacity such as low aerobic work capacity and lower extremity muscle weakness. These deficits in physical capacity could be corrected with exercise training. Other studies have indicated that people with DHD show gains in physical capacity and report less pain and disability with exercise training

(Bunning & Materson, 1991; Afable, Bailey & Woodard, 1992; Kovar, et al., 1992).

Mental Benefits of Activity

The association between physical and mental health has been well established (Lichtman & Poser, 1983; Goldwater & Collis, 1985; Stevens, 1988; Thirlaway & Benton, 1992). Zgola (1987) proposed that among the implied psychological benefits of exercise are improved academic performance, confidence, emotional stability, intellectual function, mood, perception, self-control, sexual satisfaction, and work efficacy. These beliefs have been supported by many researchers (Dishman & Gettman, 1980; Poser and Ronthal, 1991; Carlucci, Goldfine, Ward, Taylor & Rippe, 1991). Poser and Ronthal observed that exercise can provide mental stimulation, maintain or increase functional capacity, enhance independence, improve appetite, improve sleep, and help alleviate depression. Furthermore, activity may preserve the ability to perform functionally important every day tasks and maintain physical independence, despite the progressive loss of muscle mass associated with old age (Dishman, 1985; Greig et al., 1994). Pierron et al. (1990) suggested that the care of DHD patients should not ignore the psychological aspects of the management, and the diagnosis of depression in this population is often missed.

Koss (1994) maintained that it is well accepted that intellectual function declines with advancing age, although the extent and rate of such deterioration are far from absolute. Koss suggested that factors such as education and good physical health retard the mental decline. To investigate the premise that regular physical exercise promotes healthy, emotional states, researchers (Morgan, 1985; Sinyor, Golden & Steinert, 1986) have studied the relationship between physical activity and such variables as anxiety, depression, and self-esteem. Most of this research uses vigorous aerobic exercise, such as running and stationary bicycling, to demonstrate an effect. Walking, however, may be an easier and more realistic form of exercise than running or biking because it is possible for nearly everyone. More recent data (Porcari, Ward & Morgan, 1988) suggested that 40 minutes of walking reduces state anxiety in men and women independent of exercise intensity and that this reduction persists for at least two hours after exercise. The discrepancies in research may, in part, be due to the differences in exercise duration, but also may highlight differences in past physical activity, education and current health status, as a healthy population often represents the subject pool.

Carlucci et al. (1991) postulated that in addition to reducing state anxiety, regular exercise programs have been associated with decreases in depression and with enhanced self-esteem. Possible explanations for this improvement in mental well-being include alterations in brain mono-amines (particularly norepinephrine and serotonin), exercise-induced changes in beta-endorphin activity, and distraction from stressful stimuli. Furthermore, weight reduction is a benefit that increases functional ability, enhances self-esteem and alleviates depression.

Thirlaway and Benton (1992) found that higher levels of physical activity were associated with lower values on the General Health Questionnaire, a relationship that was independent of sex, age and fitness. Although activity was not defined, activity levels were calculated using previous ratings. Active people may report better mental health either because physical activity improves mental health, or, because those in better mental health are more likely to be physically active. After citing numerous studies supporting the former statement, the conclusion was that physical activity is associated with improved psychological functioning.

Noreau et al. (1995) demonstrated that a dance-based exercise program is a safe and efficient activity to improve physical fitness and psychological state in persons with rheumatoid arthritis (RA). A group of 19 persons, mean age 49.3, participated in a 12 week exercise program twice weekly. Ten persons served as controls. No significant changes were observed in joint status, even though the count of painful joints tended to decrease in the exercise group. Positive changes in depression, anxiety, fatigue and tension were observed in the exercise group, providing some evidences in favour of aerobic exercise in individuals with RA.

In a recent commentary entitled Exercise is Medicine, Elrick (1996) stated that the health rewards of exercise extend far beyond its benefits for specific diseases. Exercise reduces blood clotting, enhances self-image, elevates mood, reduces stress, improves appearance, increases energy and gives the feeling of well-being, probably due to stimulating endorphins. Furthermore, Elrick reported that, in patients who have DJDs, exercise improves endurance, strengthens muscles, and increases joint flexibility and range of motion.

Management of Degenerative Hip Disease

Coping Strategies for Degenerative Hip Disease

Pierron et al. (1990) published a paper on the aging hip, which outlined various management practices for DHD. For patients with mild disease, typical strategies are to reduce weight (if overweight), to protect the joint where possible, to take a mild analgesic, and to use moderate heat or cold therapy to alleviate pain. Rest periods during the day are important in reducing pain and should be prescribed in the same way as a pharmacological agent. Non steroidal anti-inflammatories (NSAID) are useful alternatives to aspirin, however, these agents are particularly prone to produce reversible renal failure in older subjects. Relaxation therapy and biofeedback techniques may be useful in some patients, particularly if they have a high degree of anxiety associated with their pain. Pierron et al. also suggest range of motion exercises to keep the hip mobile, isometric exercises to strengthen all the muscles of the lower limbs, and that exercises are more easily carried out in water. Furthermore, supportive devices, such as canes or walkers, can provide important support for the patient.

Coping strategies are fundamental to an elderly person's ability to maintain independence in spite of physical and social losses. Burke and Flaherty (1993) investigated how 130 elderly women coped with the physical impairment and pain associated with degenerative joint diseases and examined the relationship between coping strategies and health status. The mean age of the sample was 83.2, and the mean number of years that the subjects reported having some form of degenerative joint disease was 18.6. Sixty percent reported taking medication for their disease on a regular basis, whereas 16% reported never having taken medication. The use of a positive reappraisal as a coping strategy furnished evidence of continued personal growth and an increasing awareness of spiritual dimension in the lives of these elderly women. As such, a major aspect of coping in the elderly is to maintain a positive attitude and sense of self-esteem.

Hampson et al. (1993) describe the self management methods for DJDs reported by 61 participants, aged 60 years or older. In addition to, or instead of, taking NSAIDs, people use a variety of activities to manage their disease. Active forms of management include low-impact exercises (walking and swimming, and range of motion exercises for specific joints); more passive management activities include the application of heat or cold to painful joints, relaxation, protecting the joints with aids such as a specialized jar opener, and massage. Sometimes people try nontraditional remedies such as liniments, but ideally, the disease is managed by a judicious balance of rest, exercise, and other activities that bring relief and yet are compatible with a person's lifestyle and level of disability. On a typical day, the most often used coping strategies, in order of prevalence, were; low impact activity, medication, rest, range of motion exercises, relaxation, and heat. On worse days, the most common coping strategies were; rest, medication, low impact exercise, relaxation, range of motion exercises, and heat. On worse days, more coping strategies were used in combination than on the typical days.

Michet (1993) states that regardless of the specific joint affected, the standard clinical management of DJDs include medications, nonpharmacalogic rehabilitative approaches, and surgical treatment, especially for the knee and hip. Furthermore, rehabilitative medical care in the form of exercise, activity modification, splints, and assistive devices is an important component of treatment. Specifically for DHD, initial nonoperative management includes the use of rehabilitative exercise which emphasizes range of motion, stretching, and abductor and extension strengthening. A cane might also help to alleviate the limping gait. When indicated, NSAID therapy is useful and should be given without concern for theoretical risks of worsening cartilage deterioration. Previous studies have failed to link an increased cartilage metabolism and hence an increase in cartilage destruction with NSAID use for DHD.

Strength, Range of Motion and Degenerative Hip Disease

Persuasive evidence has been documented which indicates that activity benefits the arthritis patient in several ways (Ike et al., 1989). Abnormal muscle strength is sometimes the primary factor that limits the walking ability or other daily functions of arthritis patients. As such, activity should target surrounding tissues to build up strength and subsequently increase joint movement capabilities (Banning & Materson, 1991; Dexter, 1992; Ettinger & Afable, 1994). Furthermore, physical activity such as walking has been linked with promoting changes in functional capacity which can result in a greater independence in overall daily living (Carlucci et al., 1991). Strength training can prevent muscle weakness and impaired gait in the elderly, which are common causes of falls, and as such lead to injury prevention (Barry, Rich & Carlson, 1993).

It appears that loss of muscle mass may be an inevitable accompaniment of healthy aging, however, the increased prevalence of chronic disease in an aging population makes it difficult to know to what extent the loss of strength and power is an inevitable accompaniment of healthy aging (Skelton, Greig, Davies & Young, 1994). It has been considered that the loss of muscle strength accelerates after the age of 70, when there appears to be a faster muscle atrophy with a reduction in the size of fast twitch fibres. Physical activity and ability, however, play an important role in maintaining the health and independence of older people (Fitzgerald, 1987).

Alexander (1985) described how various exercises and stretching can increase range of motion in the joints by simple stimulation. Likewise, McKeag (1992) concluded that physical activity has both preventative and therapeutic benefits for the frail elderly, although the ultimate goal is improved quality of life. The notion of physical benefits was supported by Steincamp, Dillingham and Markel (1993) who concluded that patients with patellofemoral joint arthritis may tolerate rehabilitation with leg press exercise and subsequently increase the range of motion in the joint. This increased range of motion will enhance the overall movement in the body. Finally, Bennett (1994) suggested that perfecting non-invasive technologies of dynamic muscle function should be a goal of future studies. The study of exercising muscle has the potential to yield important clues as to the etiology of fybromyalgia muscle pain and dysfunction.

Pain and Degenerative Hip Disease

Schon and Zuckerman (1988) describe how hip pain in the elderly can result in severe disability with compromise of independence. The causes of hip pain include many intrinsic and extrinsic disorders and the elderly patient who presents with hip pain requires the clinician's utmost concern. In addition, the symptoms of DHD may be aggravated by excessive activity. DHD patients frequently have buttock, medial thigh or greater trochanteric pain from weight bearing, and the pain often radiates to the knee. This concern is supported by Michet (1993), who adds that patients presenting with symptomatic hips may complain of pain in a variety of locations, including the groin, buttock, or distal anterior thigh. The latter presentation may mislead both the patient and the physician into believing that the symptoms originate in the knee.

Identifying the nature of the pain in DHD is particularly useful, as is the determination of factors that alleviate the pain, including the use of NSAIDs, rest, and the use of crutches or a cane (Schon & Zuckerman, 1998). Treatments for pain include salicylates, NSAIDs, and resting the joint using ambulatory aids (cane, crutches or walker) to unload the hip. When pain is reasonably well controlled, a structured physical therapy program could then be initiated; low-weight bearing activity, heat and stretching exercises can be particularly useful in alleviating pain. However, pain must be controlled first. This belief is supported by Lequesne (1991) who documented that pain is probably the main component of disability from DHD. He added that, uncommonly, limitation of movement exceeds pain as a cause of impairment.

Solomon (1991) indicated that maximal bicycle ergonometry exercise increases the natural killer cell activity in concentration and subsequently leads to noted pain loss, demonstrating that exercise has a therapeutic effect for diminishing pain. This belief was supported by Pertovaara, Huopaniemi, Virtanen and Johansson (1984) in a study examining the influence of exercise on dental pain thresholds and the release of stress hormones in six healthy middle-aged males. Four different levels of exercise were produced by a bicycle ergonometer, and heart rate, blood pressure, and blood samples were taken before the exercise, at each work load, and 30 minutes after the exercise. Physical exercise at sub-maximal work loads was enough to produce a pain threshold elevation in some subjects, with a minor co-activation of stress mechanisms.

Droste, Greenlee, Schreck and Roskamm (1991) tested experimental pain thresholds and plasma beta-endorphin levels during exercise in ten healthy, sportive men. The subjects were tested before, during and after progressively more strenuous physical exercise. Pain threshold elevation was most pronounced during maximal exertion, at which time the subjects reported the greatest subjective fatigue. Thresholds remained elevated 10-15 minutes after the end of exercise, and, 60 minutes after exercise, thresholds returned to baseline values. Droste et al. (1991) documented that physical exercise can evoke a transient elevation in pain thresholds. Similarly, Dexter (1992) concluded that exercise can decrease pain and improve function in middle aged men with DJDs. Furthermore, 64% of people who received exercise advice from a physician to exercise did so, which lead to the conclusion that a physician must prescribe an exercise program that helps the affected joints and builds fitness, while education and encouragement are equally important.

Boulware and Byrd (1993) produced a descriptive article describing optimizing exercise programs for arthritis patients. As part of a comprehensive treatment plan, exercise can decrease pain and improve function in people who have DJDs. No firm data exist to confirm the benefit of exercise on the long-term outcomes of DJDs, however, the authors stated that the lack of a demonstratable benefit may be due to the methods of outcome measurement, because patients clearly enjoy a global improvement and enhanced sense of well-being when exercise is part of their therapy. The lack of demonstratable findings in pain research may, however, be answered by Lequesne (1991), who wrote a report on indices of severity and disease activity for OA. He documented that, among the difficulties of quantifying pain in DJD sufferers is the variable intensity of pain. Pain levels can be altered by different factors, such as rest or activity, and researchers should be aware that pain perception is higher during the evenings and weekends. Studies on pain and DHD must control for these pain variations, and researchers must be aware of such assessment problems when discussing the existing literature.

Quantifying Activity Levels

Definitions of Activity Levels

There are questions regarding the activity type, frequency, and duration that should be addressed in order to maintain a healthy lifestyle. Unfortunately, a definition for activity is rarely provided in the literature. Furthermore, "activity", "fitness" and "physical health" are often used interchangeably, but again, never truly defined. Advice has typically varied on activity types, frequencies and durations, however, a recent trend has emerged connecting activity and overall health. Researchers have concluded that the emphasis should be on performing physical activity rather than improving physical fitness (Thirlaway & Benton, 1992). Stevens (1988), and Moses, Steptoe, Mathews and Edwards (1989) suggested that the greatest psychological benefits accrue to those who exercise moderately. It has also been implied that the greatest physical benefits accrue to those exercising moderately (La Porte et al., 1984). Although there is an abundance of research on physical activity, future research is necessary in order to put definitions to the words "exercise", "fitness", and "activity", and define how much is enough to promote optimal health.

Owen et al. (1987) indicated that a mediated behaviour-change program for aerobic exercise called for the classification of self-reported exercise levels. Following guidelines set by the American College of Sports Medicine's (1978) criterion for aerobic level, the "physically active" were those who performed three sessions of vigorous exercise per week for an overall total of at least 45 minutes. "Activity" itself was never defined, nor was "vigorous" (Blair, Jacobs & Powell, 1985). Furthermore, Moses et al. (1989) stated that positive psychological responses were reported by subjects in a moderate exercise group, but not by those who exercised more, suggesting that participants in the high exercise group found the training too demanding.

Thirlaway and Benton (1992) concluded that participation in physical activity has a positive effect on mental health and mood. Two hundred and eight subjects completed a physical activity habits questionnaire concerning their physical activity over the last month. A list of activities were presented; the subjects noted which ones they had engaged in, how many times and the duration. Each type of exercise was assigned a value that reflected the amount of oxygen consumed by the body per minute. The total time spent in a month on each activity was multiplied by its value per minute and the scores for each activity performed were added to give a total. This study indicated that higher levels of physical fitness are associated with a tendency to report a positive mood, although the "highest" level in this study may be low compared to an elite group of athletes. Furthermore, the subject group was a middle-aged, healthy population.

White, Croce, Loureiro and Vroman (1991) tested the effects of frequency and duration of exercise sessions on physical activity levels and adherence for 33 male and female sedentary university students. Analysis indicated that frequency and duration of the exercise program did not significantly affect adherence, however, frequency and duration of the exercise sessions did significantly increase leisure activity once the structured exercise program terminated. It is possible, however, that the resources for leisure activity were made readily available to this group of educated university subjects.

Gordon and Scott (1991) studied the role of exercise in the primary and secondary prevention of coronary artery disease, and suggested that an exercise prescription should take into consideration safety aspects, the type or types of exercise performed, and the frequency, duration, intensity, and the rate of progression of exercise training. Further studies have strongly suggested that moderate levels of leisure time physical activity may be sufficient for reducing coronary heart disease (CAD) mortality rates (Blair, Goodyear & Gibbons, 1984; Leon, Connett & Jacobs, 1987). Regular participation in light-to-moderate intensity activities, which are unlikely to substantially impact maximal oxygen uptake, is beneficial for reducing CAD risk; more vigorous exercise does not offer significantly greater protection. Naturally, weekly energy expenditure during exercise training is dependent on the type, frequency, intensity, and duration.

Activity Levels in Metabolic Energy Expenditure Units

Quantifying activity levels is difficult, primarily due to the barriers that the lack of a universal definition has provided. A number of research studies have assessed activity levels based on the metabolic energy expenditure (METS) associated with different types, frequencies, and intensities of physical, recreational, and occupational activities in which a person engages (Ministry of Tourism and Recreation, 1984, 1986; Sallis et al., 1985).

Studies in 1984 and 1986 by the Ministry of Tourism and Recreation on Physical Activity Patterns in Ontario noted that there is a substantial seasonal effect to people's activity patterns. For example, walking is the most popular activity in spring and fall, while summer and winter sports show more variations. Also noted are; participation rates drop in the late fall; the number of active women is equal to men; and recent trends suggest that women are more frequently active, but fewer women expend high levels of energy. Although "activity" is not defined, this report utilizes a physical activity index of METS to classify participants into activity categories. One MET is the energy expended by a person while sitting at rest.

The Ministry of Tourism and Recreation (1984) reported that low activity groups were active once a week, medium groups were active once or twice a week, and high activity groups were active three or more times a week. In order to estimate the participants' energy expenditure in all the activities they have participated in, a physical activity index was constructed. This index takes into account the type of activity, intensity of participation, and frequency and duration of participation, and is based on one used in the Canada Health Survey. Energy expenditure is measured in METS, a value of the metabolic energy cost expressed as a multiple of the resting metabolic rate. Individuals were classified as low actives if they scored less than 3000 METS per month, medium actives if they scored between 3000 and 6499 METS per month, or high actives if they scored 6500 METS or more per month.

Sallis et al. (1985) reported on the physical activity assessment methodology in the five-city project. Previous measures of physical activity for epidemiologic studies were considered inadequate to meet the needs of a community-based health education trial. Therefore, new methods of quantifying the physical activity habits of communities were developed. Moderate activities were defined as activities requiring an energy expenditure in the range of 3-5 METS, and participation in vigorous leisure time activities required an estimated 6 METS or above. This study was based on a one-day interview session on over 2,000 participants. The METS were assigned from a ranking system and a list of commonly occurring physical activities.

Instruments and Procedures

The Short-Form 36 Health Status Questionnaire (SF-36)

The terms "functional status", "health status"' and "quality of life" are used interchangeably in the literature, and have been used in a variety of different ways (Kaplan, Coons, & Anderson, 1992). Some authors emphasize that quality of life is similar to functional status, typically defined in terms of abilities to perform activities of daily living (ADL). Others suggest that the basic dimensions of quality of life revolve around the performance of ADL or the experience of symptoms (Patrick & Dayo, 1989; Kaplan & Anderson, 1990). Recently promoted as a promising quality of life measure is the Short-Form 36 Health Status Questionnaire (SF-36), developed for use in the Medical Outcomes Study (MOS) in America (Brazier et al., 1992). The SF-36 is a multi-item scale that assesses eight different health concepts; physical functioning (10 items), role limitations - physical (4 items), bodily pain (2 items), social functioning (2 items), general mental health (5 items), role limitations - emotional (3 items), vitality (4 items), and general health perceptions (5 items) (Ware & Sherbourne, 1992). The importance of distinct aspects of physical functioning and the necessity of sampling a range of severe and minor physical limitations, necessitates the full ten items for the physical functioning concept.

Brazier et al. (1992) tested the acceptability, validity and reliability of the SF-36 and compared it with the Nottingham health profile (NHP), using 1980 subjects aged 16-74 years. The response rate for the SF-36 was high (83%) and the rate of completion for each dimension was over 95%. Considerable evidence was found for the reliability of the SF-36 (reliability coefficient >0.75 for all dimensions except social functioning) and for construct validity in terms of distinguishing between groups with expected health differences. The SF-36 was able to detect low levels of ill health in patients who had scored 0 (good health) on the NHP, and was considered a promising new instrument for measuring health perception in a general population. It is easy to use, acceptable to patients, and fulfils stringent criteria of reliability and validity. Rockwood (1995) supports this and reports that the SF-36 is being advocated as a quality of life measure that could be used as a routine outcome measure in health care.

To gain population norms for the SF-36 in a large community sample and to explore the questionnaire's internal consistency and validity, Jenkinson, Coulter and Wright (1993) sent out a postal survey by using a booklet containing the SF-36 to 13,042 randomly selected subjects aged 18-64 years. The survey achieved a response rate of 72%, and internal consistency of the different dimensions of the questionnaire was high. The Cronbach's alpha statistic was 0.76 or higher for each of the eight dimensions. The authors concluded that the SF-36 is a potentially valuable tool in medical research.

Garratt, Ruta and Abdalla (1993) assessed the validity, reliability and acceptability of the SF-36 as a measure of patient outcome in a broad sample of patients suffering from four common clinical problems; low back pain, menorrhagia, suspected peptic ulcer, or varicose veins. Based on 1700 patients, aged 16-86 years, and a comparison group of 900 general population members, support was provided for the SF-36 as a potential measure of patient outcome. Furthermore, the response rate exceeded 75% in the patient population.

Lyons, Perry and Littlepage (1994) reported on the suitability of the SF-36 for use in an elderly population through interviewing a sample of 827 adults by interview. Evidence for high degree of internal consistency was good with Cronbach's alpha statistic exceeding 0.80 for each parameter. The evidence for construct validity was also good with the SF-36 distinguishing between those with and without markers of poor health. The SF-36 is suitable for an elderly population when used in an interview setting, and is thus a reliable measure.

McHorney, Kosinsky and Ware (1994) provided national norms for the scoring of the SF-36 Health survey upon conducting a collection of the survey by mail versus a telephone interview. Norms for both the telephone and mail versions were provided specifically for use in interpreting individual and group scores. These scores were supported by the 1990 National Survey of Functional Health Status (NSFSH), from which the SF-36 was derived.

McHorney, Ware, Rachel and Sherbourne (1994) obtained data from the MOS to evaluate data completeness and quality, test scaling assumptions, and estimate internal-consistency reliability for the eight scales constructed from the MOS SF-36 Health Survey. Analyses were conducted among 3,445 patients and were replicated across 24 subgroups differing in sociodemographic characteristics, diagnosis and disease severity. For each scale, item completion rates were high across all groups (88% to 95%), but tended to be somewhat lower among the elderly, those with less than a high school education, and those in poverty. On average, surveys were complete enough to compute scale scores for more than 96% of the sample. Across patient groups, all scales passed tests for item-internal consistency (97% passed) and item-discriminant validity (92% passed). Reliability coefficients ranged from a low of 0.65 to a high of 0.94 across scales and varied somewhat across patient subgroups. These findings support the use of the SF-36 survey across the diverse populations studied (Appendix C).

Most recently, a combination of the WOMAC and the SF-36 was used in a study determining differences between pre-operative DHD and DKD patients in Canada versus the

United States (June 18, 1996). The anonymous article indicated that the combination of these two questionnaires provided an excellent measurement tool for this population. The preliminary findings on 88 subjects (no age range or gender mentioned) suggested that Canadians 'suffer more' than Americans before surgery, and it was implied that either Canadian doctors wait too long for surgery, or American doctor's perform surgery too early. Other implications from these preliminary findings were; patients who wait longer for surgery end up with fewer surgical revisions in the long term, whether subjects wait long term or short term equal benefits from surgery are indicated, and there are also possibilities of competition, less strict criteria for pain and function, and better financial remunerations which may prompt earlier surgery in the U.S.

The Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC)

The WOMAC was designed to probe clinically important, patient relevant symptoms in the areas of pain, stiffness and physical function in patients with DHD or DKD (Bellamy, 1989). The WOMAC is a new tri-dimensional, disease specific, self-administered, health status measure consisting of 24 questions (5 pain, 2 stiffness, 17 physical function), the importance of physical functioning being emphasized. These parameters were deemed clinically important by studying 100 patients with symptomatic DJDs and assigning scores of importance to the prospective WOMAC items (Lequesne, 1991).

A quasi-experimental validation study of the WOMAC was run by Bellamy, Buchanen, Goldsmith, Campbell and Stitt (1988). Thirty patients were evaluated the day before undergoing hip or knee replacement surgery, and they were evaluated again at 6 weeks, 3 months and 6 months post-operatively. Validity testing was based on construct validity determined using Pearson's correlation coefficients; the WOMAC index items showed higher levels of correlation with indices probing the same dimension than with indices probing other dimensions. Reliability was determined by Cronbach's alpha pre-operatively and at 6 weeks and 6 months post-operatively. Reliability values for the three subscales at the aforementioned times were as follows: Pain; 0.80, 0.78, 0.93; Stiffness; 0.88, 0.75, 0.88; and Physical Function; 0.93, 0.92, 0.97.

Within the context of a double blind randomized controlled parallel trial of 2 NSAIDs (Isoxicam and Piroxicam) Bellamy et al. (1988) ran a validation study on the WOMAC. Fifty seven patients were evaluated at enrollment and again one week later without any change in therapy in order to obtain test-retest estimates in a steady state. Thereafter, patients underwent a one-week NSAID-free washout period. Finally, they were evaluated after 2, 4 and 6 weeks of active treatment. Test-retest reliability by Kendall's tau c statistic using a one-week retest interval was as follows: Pain (combined groups), 0.68; Stiffness (combined groups), 0.48, and; Physical Function (combined groups); 0.68. Test-retest coefficients are in the mid range due to interval change occurring in health status of participating patients over the one-week interval. Internal consistency by Cronbach's alpha was as follows: Pain; 0.86-Isoxicam, 0.89-Piroxicam, Stiffness; 0.90-Isoxicam, 0.91-Piroxicam and, Physical function; 0.95-Isoxicam, 0.95-Piroxicam. These data suggest excellent reliability

The pain, stiffness, and physical function subscales of the WOMAC fulfil conventional criteria for face, content and construct validity, reliability, responsiveness and relative efficiency. Rorabeck et al. (1994) consider the WOMAC a disease-specific, purpose-built, reproducible, high-performance instrument for evaluative research in DHD clinical trials. Furthermore, the WOMAC has been shown to be responsive to change in clinical trials.

Six-Minute Walk Test

The six-minute walk test is used to examine functional exercise capacity (Rorabeck et al., 1994). With the same individual administering the test in order to maximize control, Guyatt et al. (1985) used the six-minute walk test as a new measure of exercise capacity in patients with chronic heart failure. They concluded that the six-minute walk test is a useful measure of functional exercise capacity and a suitable measure of heart failure. Similar support for the test came from Peterson et al. (1993) who used the six-minute walk test as a measurement of functional status. It tests the distance walked in six-minutes, and was used to support the hypothesis that a walking and educational program were effective in improving gait function in patients with degenerative knee disease. This study also provides baseline measurements for the six-minute walk results, which are characteristic in arthritis patients.

Kovar et al. (1992) ran a supervised fitness walking program in patients with degenerative knee disease (DKD). One hundred and two patients with a documented diagnosis of primary degeneration of one or both knees participated in the study. Patients were evaluated and outcomes assessed before and after the intervention using a six-minute test of walking distance. Patients randomly assigned to the walking program had a 70-metre increase in walking distance relative to their baseline assessment, which represents an improvement of 18.4%. In contrast, controls showed a 17-metre decrease in walking distance relative to their baseline assessment. At baseline, the mean scores for the control group and intervention group on the 6-minute walk test were 356 metres and 381 metres respectively.

Peterson et al. (1993) tested the effect of a walking program on gait characteristics in patients with DKD. One hundred and two patients were randomly assigned to an 8-week educational and walking program (the intervention group) or to a weekly telephone survey (the control group). Functional status was measured by a six-minute test of walking distance. The intervention group had a 15% increase in walking distance as compared to the control group. At baseline, the intervention group and the control group had walk test scores of 390m and 357m respectively, whereas post-intervention scores were 449m and 338m respectively. The walking and educational program was effective in improving gait function in patients with DKD.

Use of Diaries and Physical Activity Recall

Diaries have been administered for reporting several precise measures, such as leisure activity expenditure information, which is not accessible from simple surveys. Diaries allow for detailed analysis of daily events, and have been used to reveal the nature and range of activities undertaken by various populations. They are accurate and reliable indications of activity (Shelby & Colvin, 1982; McInnis & Glyptis, 1986; Hopkins, 1991). Diaries have been used extensively in social and business research, but less often in health and related studies (Freer, 1980).

Brooks (1987) utilized time diaries collected from a sample of American adults in 1981 in order to calculate a possible baseline measure of adult physical activity. Results indicate that time diaries are a viable method for assessing physical activity behaviour of large populations. Ideally, a physical activity assessment tool should be reliable and valid, sensitive to change in individual activity patterns, applicable to diverse groups, administratively feasible, and not cause alteration of physical activity patterns (Blair, Haskell et al., 1985).

Kohl, Blair, Paffenbarger, Macera and Kronenfeld (1988) utilized 375 subjects to investigate the associations of self-reported measures of physical activity from a mail survey with an objective measure of physical fitness. The questionnaire included a section of inquiries concerning leisure time physical activity participation and subjects were asked to recall exercise participation quantitatively for varying periods of time. Results were that exercise behaviour can be accurately estimated in large populations by using questions in a mail survey.

Romsa and Blenman (1989) compared the participation rates of retirees obtained from questionnaires (medium term recall) with those derived from time budget diaries recorded on a daily basis (immediate recall). Questionnaires tended to provide higher estimates of participation than diaries in this elderly population. These results, however, might reflect the invalid use of the diary format for this particular age group, even though reliable data may be provided.

Ashworth, Reuben and Benton (1994) used 24-hour real-time diaries from healthy younger and older volunteers in order to begin a study on whether healthy aging is associated with changes in function. Such use of real-time diaries has been employed in community-based studies of older persons in many countries (Altergott, 1988). Diaries have also been used to validate physical activity questionnaires in older persons (Cartmel & Moon, 1992).

CHAPTER 3

Methodology

Subjects

The subjects recruited for this research project were 54 DHD patients referred to the study by Dr. Henry Hamilton at the Port Arthur Clinic in Thunder Bay, Ontario. The subjects ranged in age from age 26-86, with a mean age of 54.91 ± 16.97 yrs, and consisted of 25 males and 29 females. The subjects resided in Thunder Bay or the surrounding area and had been on file for at least five years. Furthermore, none of the subjects had currently undergone a THR. The patients were assigned to one of five classifications of DHD according to the origin of the disease, assessed radiologically and historically by Dr. Hamilton. The five classifications were; normal concentrations of force on abnormal articular cartilage, n = 20 (37.0%), abnormal concentrations of force on normal articular cartilage, n = 6 (11.11%), normal concentrations of force on normal articular cartilage supported by weak subchondral bone, n = 6 (11.11%), idiopathic arthritis, n = 15 (27.8%), and previous surgery, n = 7 (13.0%) (Mitchell & Cruess, 1977; H. Hamilton, Feb. 26, 1996). The most recent radiological data was used to assign a severity of degeneration score (Appendix H) from a measurement of the existing minimal cartilage space in the hip joint. Another radiographical sign, the formation of osteophytes, which may or not be present for any given subject, was also noted.

An initial authorization form was sent to the potential candidates with a self-addressed stamped envelope enclosed (Appendix A). The return of this form, and later completion of a consent form (Lakehead University's Ethics Review Committee) indicated the subject's interest in the study, and permitted access to the patient's medical files in the Port Arthur Clinic. From these files, historical and radiological data were used to classify the subjects into the five DHD groups, and assess age (yrs) and the severity of degeneration (mm) in the hip.

Instruments and Procedures

The Questionnaires

Two standardized questionnaires were used to determine the subject's quality of life and health status; the Short-Form 36 Questionnaire (SF-36) (Appendix C) and the Western Ontario and McMaster Universities (WOMAC) Osteoarthritis Index (Appendix D) respectively. Both questionnaires are reliable and valid (Brazier et al, 1992; Bellamy, 1995) and have documented scoring mechanisms with published norms for various populations (Jenkinson, Coulter & Wright, 1993; Garratt et al, 1993; Rorabeck et al, 1994; Bellamy).

The SF-36 measures eight parameters of health status in order to assess quality of life. These eight parameters are; physical functioning (10 items), role limitations due to emotional problems (3 items), role limitations due to physical problems (4 items), social functioning (2 items), mental health (5 items), bodily pain (2 items), vitality (4 items), and general health perceptions (5 items). For each parameter, the scores were coded, summed, and transformed to a scale from 0-100. These scores were compared as eight separate parameters to other various published norms, where a higher score indicated better quality of life (Brazier et al., 1992; Ware & Sherbourne, 1992; Lyons, Perry & Littlepage, 1994).

The WOMAC is a tri-dimensional, disease-specific, self-administered, health status measure. It probes clinically-important, patient-relevant symptoms in the areas of pain, stiffness and physical function in patients with DJDs. It consists of 24 questions which examine three parameters; 5 on pain, 2 on stiffness, and 17 on physical function (Bellamy et al., 1988; Bellamy, 1989). Similar to the SF-36, the parameters were summed together and scored from 0-100, but were weighted and aggregated to form one score representing health status. These scores were also compared to various published norms where a lower score represented greater health.

The Interview Questions

After the subjects completed the two standardized questionnaires, they were asked seven additional questions, which were piloted by ten university students (Appendix E). The questions were asked in the same order for each subject. The first two questions were qualitative in nature and dealt with whether the subject thought a THR existed for them in the future, coupled with the reasons why the subject had not yet undergone a THR. The next few questions targeted activity levels. This information was used to assign the candidates an activity level in METS, according to a combination of the number, the frequency and the duration of the seasonal activities in which they participated (Appendix F). Along with activity levels, the interview questions also targeted the use of various coping strategies. Anything that the subjects used to manage the disease was documented. The last question targeted the current health status of the patients, and whether on that particular day they were having a typical day, worse day, or better day in relation to their DHD. In order to add control to the study it was important to understand if items such as a cold, over-use or under-use of the affected joint during the day, the time of day the interview took place, and even perfect health conditions could have influenced the results.

The Six-Minute Walk Test

The six-minute walk test is a measure of walking capacity (Rorabeck et al., 1994) and was the final test item that the subjects underwent. With the same hallway to walk along and the same verbal prompting, the subjects were asked to walk at a comfortable, normal pace for six minutes. The total distance covered was measured in metres and represented the subject's walking capacity. None of the subjects had a warm-up, and the walk test was the final test item for each subject. If a subject felt that he/she was not able to perform the walk test that day, arrangements were made to meet him/her on another day.

The One Week Diary

The subjects, upon completion of the interview session, were given a diary (Appendix G) which required a daily detailed account of the activities the subject performed during that day, for seven consecutive days. It did not matter what time of the day, how often the subject was active, or the duration or intensity of the activity, as long as every detail was written down. The subjects were also asked to rank their daily pain on a 1-5 scale identical to one used in the standardized questionnaires, and were asked to document the use of daily coping strategies. It was asked that this diary be returned to the investigators upon completion, where it would be used to identify the frequencies and patterns of coping strategies, as well as variations in pain levels and activities. The detailed nature of the interview questions on activity and coping strategies provided a guideline for reporting in the diary.

Radiological and Historical Data

Access to the patients' medical files allowed for pertinent radiological and historical data to be extracted. For the primary purpose of this study (to profile and determine the relationships among activity level, age, health status, quality of life, walking capacity, and severity of degeneration in long term DHD sufferers), the subjects existed as one pooled group. The latest radiography (within the last year) was used to assess the severity of degeneration in the joint, which consisted of a minimal cartilage space score (millimetres), obtained from the use of an Engineer's caliper. Also documented was the existence of radiographical signs of osteophyte formation, which may or may not have been present in any given subject. Due to the fact that not every DHD patient would present with osteophyte formation, only the cartilage space was analyzed. Finally, the radiological and historical data was used by Dr. Hamilton to assign the subjects to one of the five classifications of DHD. This, along with information on all of the variables, accommodated the second purpose of this paper; to examine the relationships among the five classifications of DHD.

Study Design

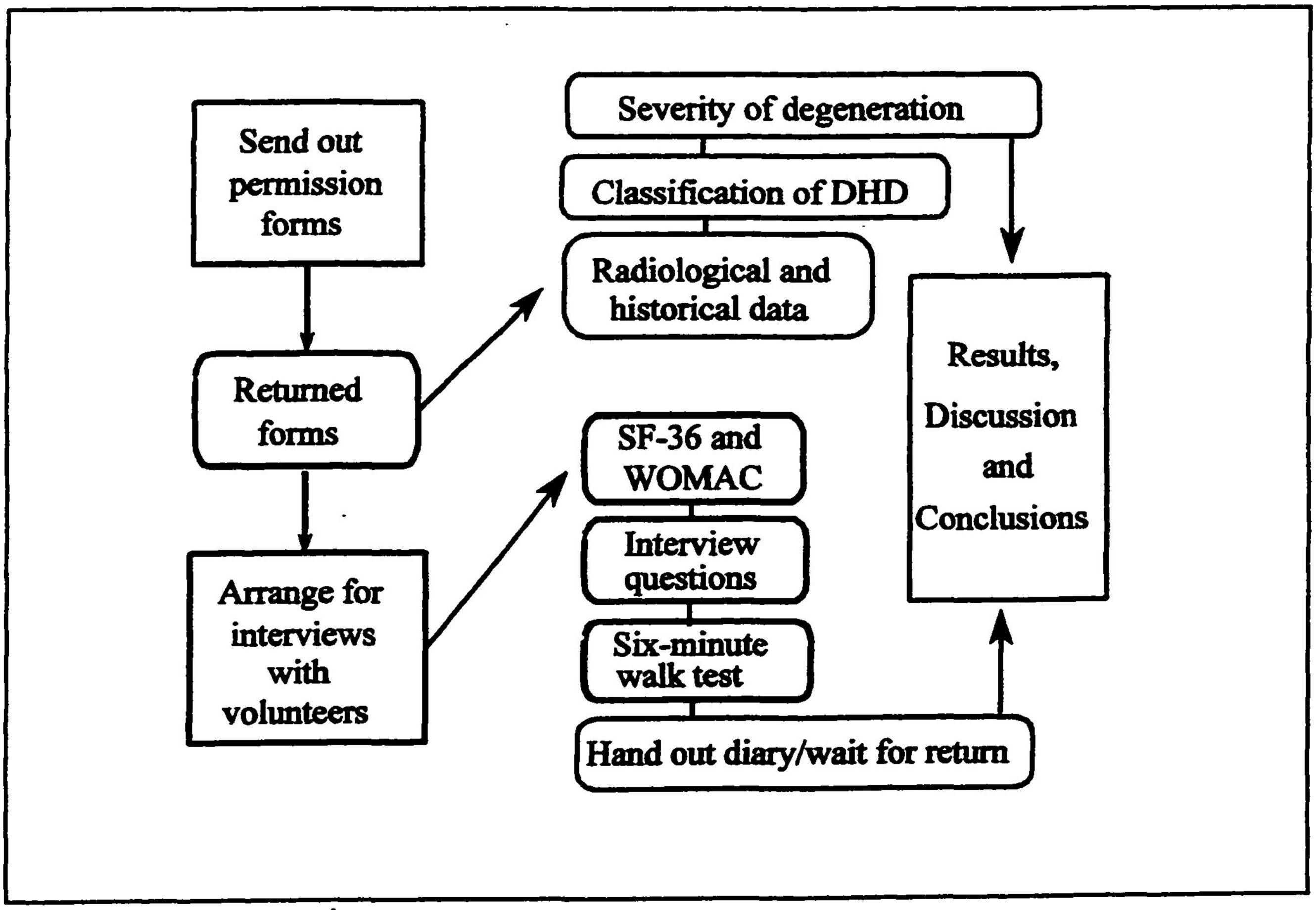

Figure 1. Chronology of the study design.

Figure 1 displays the chronology of this quasi experimental study. Once recruited, interviews were arranged with the subjects where they signed the consent form, completed the two standardized questionnaires (SF-36 and WOMAC), a set of interview questions, the six-minute walk test, and were given the one week diary, which was returned to the investigators after it's completion. Radiological and historical data were used to assign the subjects to one of the five classifications of DHD, as well as assess age and severity of degeneration in the articular cartilage.

Analysis of Data

This study had six major variables, although the quality of life variable (SF-36) had eight separate measurements of its own. The six major variables were; activity level (METS), age (yrs), health status (WOMAC (%)), quality of life (eight parameters from the SF-36 %)), walking capacity (six-minute walk test (m)), and severity of degeneration (minimal cartilage space (mm)). In order to profile the subjects with respect to the variables, descriptive statistics (means, standard deviations (SDs), and ranges) were reported for the pooled group of subjects and for the five classifications of DHD. Furthermore, chi-square analyses were used to indicate joint distributions among the categorical variables, such as gender (male or female), the classifications of DHD (groups 1 to 5), and the presence of osteophytes in the population. Level of significance for all statistical tests was set at an alpha level of 0.05.

For the purpose of examining the relationships among activity level, age, health status, quality of life, walking capacity, and severity of degeneration, multiple correlations and regressions were used. The Pearson product-moment correlations significant at $p < 0.05$ were only reported if $r \geq \pm 0.50$. Forward regression analyses were used with four criteria variables, activity level, health status, walking capacity and severity of degeneration. The predictor variables were all other variables not representing the criterion variable for that particular analysis. The following question was addressed using this procedure; what predictor variable, or combination of variables, best explained the variance in the criterion variable (activity level, health status, walking capacity, or severity of degeneration) ?

Discriminant analysis was conducted to analyze the relationship of the variables among the five classifications of DHD, and to determine differences between the five classifications. The dependent variables used in the discriminant analysis were; activity level, age, health status, quality of life (all eight parameters), walking capacity, and severity of degeneration. Significant results were analyzed with analyses of variance (ANOVAs), and Tukey post hoc tests.

Descriptions and profiles on the qualitative answers from the interview questions and diary were also provided. Themes were created for the various questions, including the subject's perceived attitudes towards THRs, why they had not yet required a THR, their thoughts on physical activity, and their use of coping strategies. The number of coping strategies used by the subjects for one-time usage was provided, as well as the frequency of use over a seven day period. The profile addressed some of the subject's attitudes towards the disease, and how these long-term sufferers use strategies for coping with the pain, stiffness and functional disability of DHD. A repeated measures one-way ANOVA was run on the seven day diary pain scales in order to determine whether pain levels fluctuated from Monday to Sunday. All data were analyzed using the Statistical Package for the Social Science (SPSS).

CHAPTER 4

Results and Discussion

Profiles of the Variables

Fifty-four subjects, 25 males and 29 females (mean age 54.91 ± 16.97 yrs), were eligible for participation in the present study. The mean activity level of the subjects was 5,115 ± 2,798.7 METS, which represents the upper end of a moderately active population. High activity results in monthly METS or 6500 or greater, moderate activity results in 3000-6499 METS, and low activity results in less than 3000 METS (Ministry of Tourism and Recreation, 1986). The WOMAC tri-dimensional Index (measuring pain, stiffness and physical functioning) was used to indicate health status in this population. A lower score represented better overall functioning (Bellamy, 1989). The mean score for this population was 32.48 ± 15.59 %, which has been compared to such values for similar pre-surgery populations as 35.74 % and 32.67 % (Bellamy et al., 1994; Takeda & Wessel, 1994). The SF-36 Questionnaire was used to measure quality of life in this population, and consisted of eight parameters; physical functioning, physical role functioning, bodily pain, general health perception, vitality, social functioning, emotional role functioning and mental health. A higher percentage represented a better quality of life (Brazier et al., 1992). The eight mean scores for this population were; 53.06 ± 27.58 %, 49.07 ± 40.33 %, 55.63 ± 21.15 %, 62.89 ± 18.50 %, 53.52 ± 20.57 % 73.15 ± 26.53 %, 68.52 ± 36.87 %, and 71.11 ± 16.46 %. Garratt et al. (1993) published the following general population norms for the eight SF-36 parameters respectively; 79.2%, 76.5%, 76.9%, 68.7%, 61.2%, 78.6%, 75.0%, and 73.7%. The mean walking capacity score from the six-minute walk test for this population was 406.87 ± 129.52 m. Previous walking capacity scores have been reported at 356 m to 451 m for similar DHD patients (Kovar et al., 1992; Peterson et al., 1993). Although not used as a single measurement in the past for severity of degeneration, the minimal cartilage space in millimetres is an objective and quantifiable measure that is commonly used in a clinical setting to assess the presence of DHD. The mean score for the present population was 1.17 ± 1.77 mm. A "normal" hip typically has greater than 4 mm of articular cartilage (H. Hamilton, July 8, 1996). The lower the score in millimetres the greater the severity of degeneration. Table 1 presents the descriptions of each measured variable in the analyses.

Table 1
Means, Standard Deviations, Minimum and Maximum Values of the Variables, N = 54.

Variable labels	M ± SD	Min.	Max.
Age of subjects (yrs)	54.91 ± 16.97	26	86
Activity level of subjects (†METS)	5115.00 ± 2798.70	540	10620
Health status score on WOMAC (%)	32.48 ± 15.59	2.63	73.2
Physical functioning score on SF-36 (%)	53.06 ± 27.58	0	100
Role functioning- physical on SF-36 (%)	49.07 ± 40.33	0	100
Bodily pain score on SF-36 (%)	55.63 ± 21.15	20	100
General health score on SF-36 (%)	62.89 ± 18.50	15	100
Vitality score on SF-36 (%)	53.52 ± 20.57	0	90
Social functioning score on SF-36 (%)	73.15 ± 26.53	0	100
Role functioning- emotional on SF-36 (%)	68.52 ± 36.87	0	100
Mental health score on SF-36 (%)	71.11± 16.46	20	100
*Walking capacity of subjects (m)	406.87 ± 129.52	47.8	702.7
**Severity of degeneration (mm)	1.71 ± 1.77	0	8.2

Note: †METS = units of metabolic energy expenditure. *N= 53. **N = 50.

Discussion

Age.

Most of the studies on profiles of DHD subjects have been conducted with higher mean ages for their subject pool (Kovar et al., 1992; Peterson et al., 1993; Ettinger & Afable, 1994). Furthermore, few authors have reported such an extended age range (26 to 86) in their studies. The purpose of the present age range was to include all potential candidates. Age was left as a continuous variable primarily to examine age as a predictor.

Activity level.

Persuasive evidence exists on the physical and mental benefits of exercise for DHD patients (Lyngberg, 1988; Ike et al., 1989; Noreau et al., 1995). It has also been documented that, in counselling patients on the management of DHD, physicians advise the patients to maintain active lifestyles by performing specific exercises (Schon & Zuckerman, 1990; Pierron et al., 1990, Hampson et al., 1993). Patients in the present study were counselled as such (H. Hamilton, July 8, 1996), which might account for the moderately high levels of activity suggested by the findings. Furthermore, asking participants to record their activities is subjective (Ministry of Tourism & Recreation, 1986), which may lead to exaggerated levels of activity. Nonetheless, this population was participating in a vast range of activities, and maintaining a moderately active lifestyle on the whole. While two of the subjects were relatively inactive (recorded levels below 1,000 METS), there was a greater number of highly active subjects (13 subjects recorded levels above 7,500 METS).

Health status.

The WOMAC health status score for the present population was 32.48%. In a study by

Bellamy et al. (1994) a baseline mean WOMAC score of 35.74 % (before treatment) in a population of 54 patients (aged 55 to 85) suffering from either DHD or DKD was indicated. Another study that used the WOMAC Index as a test measure was conducted by Takeda and Wessel (1994) in a population of 40 subjects with radiographic DKD. The mean age of the control group (20 of the 40 subjects) was 60.20 ± 9.75 yrs, and the mean age of the intervention group (the remaining 20 subjects) was 63.00 ± 8.78 yrs. The respective WOMAC scores before any treatments were initiated were 40.39 % and 32.67 %. Due to the intermittent nature of this disease with respect to pain, stiffness and physical functioning (Brandt, 1988; Schon & Zuckerman, 1988; Lequesne, 1991; Michet, 1993) it is difficult to capture a one-time "health status" score for this population. Nonetheless, the similar findings in the present study to other studies with DHD or DKD populations places confidence in the use of this measurement tool in assessing pre-surgery health status of the population. Furthermore, in light of the limitations imposed by questionnaire research, as well as the day to day variability in the symptoms of DHD (Bellamy et al., 1988; Pierron et al., 1990; Lequesne, 1991), the present study indicates values for a fairly healthy group.

Quality of life.

The findings for the present study were compared to a survey of the general population where scores were divided into two groups; a population which reported having chronic physical problems as diagnosed by a general practitioner, (N= 77), and a population which reported no physical chronic problems (N=77) (Brazier et al., 1992). The age range in the Brazier et al. study was similar to that of the present study (17 to 74 as compared to 26 to 86 respectively). A comparison of these three populations is presented in Table 2.

Table 2
Comparison of SF-36 Scores (%) from the Andersen Study, and Two Groups from the Brazier et al. (1992) study, p.161.

SF-36 questions	Present study (DHD patients)	General population with chronic ailments	General population with no chronic ailments
Physical functioning	53	66	78
Role functioning-physical	49	58	77
Bodily pain	56	59	76
General health perception	63	53	66
Vitality	54	50	57
Social functioning	73	74	86
Role functioning-emotional	69	74	74
Mental health	71	69	71

When compared to a population not reporting chronic physical problems, the DHD population is much less able to function physically and in physical roles, and suffer greater amounts of bodily pain. These findings are explained by the belief that pain, stiffness and physical dysfunction are the primary symptoms of DHD. The general health of the two groups, the ability to function mentally, and feelings of vitality were very similar, suggesting that the DHD population can cope with the disease and stay mentally active.

When compared to a population reporting chronic physical problems, the DHD population is less able to function physically and in a physical role (again signifying the importance of physical dysfunction as a primary symptom of DHD). Conversly, the DHD population was much more able to function mentally, perhaps as a result of positive attitudes and ways of coping with long-term DHD. A better general health perception score may indicate that the DHD population does not, in general, consider their health worse due to their disease, which is a belief reported by Rorabeck et al. (1994).

Two other studies with published norms for various populations are presented in Table 3.

Table 3
Comparison of SF-36 Scores (%) from the Andersen Study, a Group from the Garratt et al. (1993) Study, p. 1442, and Two Groups from the McHorney et al. (1993) Study, p. 255.

SF-36 questions	Present study (DHD patients)	General population	Serious medical	Psychiatric problems
Physical functioning	53.1	79.2	57.4	80.6
Role functioning-physical	49.1	76.5	43.9	55.6
Bodily pain	55.6	76.9	65.1	63.3
General health perception	62.9	68.7	49.13	57.9
Vitality	53.5	61.2	47.8	45.3
Social functioning	73.2	78.6	80	64.5
Role functioning-emotional	68.5	75	76.2	40.7
Mental health	71.1	73.7	77.6	52.8

Garratt et al. (1993) published norms for the general population (age 16-86; N=542) based on a random sample postal survey. McHorney et al. (1993) published scores of two groups of patients based on a sample of the population aged 18 and older; serious medical conditions (N= 144), as defined through subject and physician completed questionnaires which identified the presence of diabetes, hypertension, recent myocardial infarction and congestive heart failure, and psychiatric conditions (N= 153), which were defined using well-established psychiatric diagnostic criteria.

The DHD population was less able to function physically than any other population, again representing the importance of the physical dysfunction associated with this particular disease. Next to the general population, the DHD population perceived themselves to be in the best general health, again suggesting that DHD subjects do not necessarily consider themselves "unhealthy" on the whole. A greater ability to function mentally than the psychiatric population suggests that DHD patients incorporate positive mental functioning into their daily lives, and thus have higher mental health scores. Although depression and anxiety have been associated with DHD populations (Schon & Zuckerman, 1988; Noreau et al., 1995) the present long-term DHD population is maintaining fairly high levels of mental health, as well as moderately active lifestyles. It is possible that these two findings support the belief that exercise reduces depression and anxiety, and increases feelings of well-being (Thirlaway & Benton, 1992; Shephard, 1994; Noreau et al., 1995; Elrick, 1996).

Walking capacity.

In a study examining the effects of a supervised walking program on 102 patients with DKD, age 40 years or older, Kovar et al. (1992) reported control group and intervention group scores at baseline and after intervention. Scores of 356 m and 381 m, and, 339 m and 451 m were reported respectively. In another study, the effect of an eight week walking program on 102 subjects suffering from DKD, age 40 years or older, was tested (Peterson et al., 1993). The authors reported control group and intervention group scores at baseline, and post-intervention of 357 m and 390 m, and 338 m and 449 m respectively. When comparing the six-minute walk test results from the present study to other populations with DKD, the DHD population records scores between the baseline and intervention post-test scores, which might suggest inherent differences between knee disease and hip disease. The value may also suggest, however, that the DHD patients of the present study already engage in some walking or activity programs themselves. This belief is supported by the high number of activities that the subjects reported engaging in during the interviews. It is difficult to comment with confidence, however, on the actual mean walking score from the present study, due to the broad range of subjects, and due to the fact that the present subjects are not necessarily in as advanced a stage of disease as subjects from previous studies.

Severity of degeneration.

No other DHD studies have used minimal cartilage space as a single measurement, although such measurements have been incorporated into radiological findings for the classifications of DHD (Adams, 1991; Altman, 1991; Bullough, 1993). Pierron et al. (1990) supported the belief that cartilage erosion is the first commonly observed early anatomical change in DJDs, leading to a classical radiographical finding of localized loss of joint space. As the subjects in the present study have been diagnosed for a minimum of five years, using this measurement was justified, and a score was obtained for every subject. The degeneration level in this population is high (16 subjects recorded scores of 0.0 mm), although a large SD and positively skewed severity of degeneration data make conclusions weak. A healthy cartilage space is noted as being above 4 mm of thickness (Dr. H. Hamilton, July 8, 1996). While four subjects recorded levels between 4.0 and 5.0 mm, and one subject recorded a level above 8.0 mm, it is possible for the cartilage to swell in certain unique cases before the actual degeneration sets in (Dr. H. Hamilton, July 8, 1996).

Profiles of the Variables by Classification of DHD

The mean scores ± SDs for the five classifications of DHD with respect to age, severity of degeneration, activity levels, walking capacity and health status are presented in Table 4.

Table 4
Mean Age, Severity of Degeneration (Sev. Degen), Activity Level, Walking Capacity and Health Status Scores, ± SDs, for the Five Classifications of DHD.

†DHD group	Age (yrs)	Sev. degen. (mm)	Activity level (METS)	Walking capacity (m)	Health status (%)
1	52.85 ± 15.66	*2.02 ± 1.75	5059.50 ± 2782.76	**422.15 ± 128.08	29.92 ± 17.46
2	48.50 ± 16.75	0.25 ± 0.42	3958.33 ± 2544.70	433.22 ± 57.23	34.60 ± 11.98
3	57.00 ± 18.86	1.15 ± 1.41	3764.17 ± 3079.55	379.18 ± 205.06	31.81 ± 11.35
4	65.13 ± 15.63	1.47 ± 1.07	5690.67 ± 2791.33	391.34 ± 139.04	33.73 ± 19.05
5	42.57 ± 13.01	3.21 ± 2.83	6189.29 ± 2799.96	399.34 ± 102.16	35.85 ± 8.02

Note. † Group 1 = abnormal concentrations of force on normal articular cartilage, n = 20, Group 2 = normal concentrations of force on abnormal articular cartilage n = 6, Group 3 = normal concentrations of force on normal articular cartilage supported by weakened subchondral bone, n = 6, Group 4 = idiopathic arthritis, n = 15, and Group 5 = failed previous surgery, n = 7. *n = 16, **n = 19.

Chi-square analysis did not result in a significant relationship between gender and the five classifications of DHD, suggesting independence between the two variables; $\chi^2(4, N = 54) = 3.80$, $p = 0.43$. The number of coping strategies used by each subject and the five classifications were independent as well; $\chi^2(20, N = 54) = 10.98$, $p = 0.95$. Chi square analysis also did not result in a significant relationship between subject's perception of the necessity of a future THR and the five classifications; $\chi^2(16, N = 54) = 17.80, p = 0.34$.

Mean scores ± SDs for the eight quality of life parameters (SF-36) with respect to the five classifications of DHD are displayed in Table 5.

Table 5
Mean Scores ± SDs on the Eight Quality of Life (QoL) Measurements (SF-36) for the Five Classifications of DHD.

DHD Group	†QoL1 (%)	†QoL2 (%)	†QoL3 (%)	†QoL4 (%)	†QoL5 (%)	†QoL6 (%)	†QoL7 (%)	†QoL8 (%)
1	55.75 ± 26.57	52.50 ± 42.07	60.75 ± 29.95	66.75 ± 16.03	55.25 ± 21.06	79.38 ± 24.43	76.67 ± 34.37	73.60 ± 14.47
2	50.83 ± 16.56	54.17 ± 40.05	49.83 ± 11.96	42.67 ± 17.49	44.17 ± 4.92	66.67 ± 27.00	44.44 ± 45.54	63.33 ± 19.50
3	42.50 ± 29.45	37.50 ± 37.91	53.17 ± 12.12	63.83 ± 21.32	55.83 ± 21.08	62.50 ± 30.62	55.56 ± 40.37	69.33 ± 16.13
4	57.67 ± 32.62	51.67 ± 40.61	54.60 ± 23.82	66.13 ± 17.80	58.67 ± 22.00	79.17 ± 24.40	75.56 ± 29.46	76.00 ± 12.28
5	46.43 ± 28.39	39.29 ± 45.32	50.29 ± 15.82	61.43 ± 18.65	43.57 ± 23.04	57.14 ± 29.63	61.91 ± 44.84	61.71 ± 24.32

Note. † QoL1 = physical functioning; QoL2 = role functioning-physical; QoL3 = bodily pain; QoL4 = general health; QoL5 = vitality; QoL6 = social functioning; QoL7 = role functioning-emotional; QoL8 = mental health.

Discussion

The gender of the subjects in the present study was not a predictor of the origin of DHD (by classification). Over representation of males with abnormal concentrations of force on normal articular cartilage (Group 1) due to occupational or mechanical stress, or early childhood trauma has been reported (Dieppe, 1990; Croft et al., 1992). That finding did not occur in the present study, although the unequal and small sample sizes of the classifications (n = 20, 6, 6, 15, and 7 respectively), make comparisons tenuous. A male predominance in lower age categories (due to occupational or mechanical stress), and a female predominance in older age categories (due to biological reasons) have been reported in studies on DJDs (Oka & Hatanpaa, 1976; Ball, 1986; Pierron et al., 1990; Dieppe, 1990). The low numbers and vast age range in the present study do not typify studies that have been performed in the past.

Subjects in Group 2 (normal concentrations of force on abnormal articular cartilage) can expect high levels of degeneration in the cartilage (mean score 0.25mm), which infers an appropriate classification for subjects with "abnormal" cartilage (Mitchell & Cruess, 1977). Subjects in Group 5 (failed previous operation) typically have higher levels of cartilage, which might suggest that this classification of DHD does not initiate cartilage degeneration in the same manner as other classifications. A value of 8.2 mm was noted for a subject in Group 5, which creates an outlier in the data, and may suggest a unique case where swelling of the cartilage is reported before degeneration (Dr. H. Hamilton, July 8, 1996). The high SD values support an individualistic nature for this disease, and as such, conclusions regarding these values must be made with caution.

Subjects in Group 3 (normal concentrations of force on normal articular cartilage supported by weakened subchondral bone) are the least active and have the lowest capacity to walk of the five classifications, which implies a condition that interferes with physical functioning. Mitchell and Cruess (1977) stated that a collapse of the underlying bone causes a deficient shock-absorbing mechanism in the hip, which may also preclude activity. It is also possible that the types of subjects with a Group 3 membership simply do not typify an active population (Mitchell & Cruess). It is avascular necrosis from such causes as alcoholism, systemic steroid use and fracture that lead to weakened subchondral bone, and hence a Group 3 membership. With no such profiles of these classifications in the literature, comparisons with previous studies are impossible. Furthermore, a low sample size and large SDs do not provide a solid basis for making conclusions.

Analyzing the results with respect to quality of life and health status is also complex, especially if radiographic and clinical symptoms do not coincide in the subjects. Michet (1993) reported that confirmatory radiographic changes are present to varying degrees, but radiographic changes may not correlate closely with symptoms. Nonetheless, with respect to the quality of life scores, subjects in Group 1 (abnormal concentrations of force on normal articular cartilage) have the lowest levels of bodily pain. Pain levels, therefore, may be dependent on the original state of the cartilage, as subjects in Group 2 (normal concentrations of force on abnormal articular cartilage) report the highest levels of bodily pain, while also perceiving themselves to be of low general health. Subjects in Group 1 (abnormal concentrations of force on normal articular cartilage) together with Group 4 subjects (idiopathic arthritis), function the best socially, mentally and emotionally, although these values may be enhanced by the large subject numbers in these two groups. Subjects in Group 3 (normal concentrations of force on normal articular cartilage supported by weakened subchondral bone) function poorly physically, suggesting that weakened bone may play the biggest role in precluding physical functioning. Subjects in Group 5 (failed previous operation) report low levels of vitality and poor mental and social functioning. These are some of the issues that could be addressed for subjects in these five classifications.

Implications For the Presence of Osteophytes

Forty subjects (74.1 %) presented with at least one osteophyte on their latest radiography, while only 14 subjects (25.9 %) did not. Chi-square analysis between the presence of osteophytes and the five classifications of DHD did not result in a significant relationship; $\chi^2(4, N = 54) = 6.54$ $p = 0.16$. The mean ages of the subjects presenting and not presenting with osteophyte formation were 57.03 ± 16.74 yrs and 48.86 ± 16.76 yrs respectively. Mean scores for activity level (METS) and walking capacity (m) are presented in Table 6.

Table 6
Mean Activity Level and Walking Capacity Scores for the Formation of Osteophytes.

Osteophyte formation	Number of subjects	Mean activity level (METS)	Mean walking capacity (m)
Yes	40	5202.13	392.55
No	14	4886.07	*450.94

Note. Due to missing data, * $n = 13$.

Discussion

Radiographic findings of osteophytes have been used to classify the origin of DHD (Altman, 1991; Adams, 1991). In the present study, however, the presence of osteophytes did not predict group membership. Literature has not identified the consequence of osteophyte formation on the activity levels or walking capacity in subjects suffering from long-term DHD. In the present study, although significance analysis was not performed, subjects who presented with osteophytes were more active than subjects who did not present with osteophytes, and yet subjects with osteophytes were less capable when it came to walking. Osteophyte formation may play an inhibitory role in walking, which has forced the subjects in the present study to be active in other ways (such as swimming, bicycling or yard work). It is also feasible, however, that walking has inhibited the formation of osteophytes (hence the higher mean walking capacity score for the group without osteophyte formation).

Pierron et al. (1990) also documented the possibility that osteophytes occur with advancing age, which is supported by the findings in the present study. The subjects who presented with osteophyte formation were, on average, older than the subjects who did not present with osteophytes, although the unequal group sizes again lend themselves to tenuous comparisons. In order to determine plausible answers, further investigation is required.

Relationships Among the Variables

Multiple Correlations

Table 7
Significant Correlations and Interacting Variables ($p < 0.05$, $r \geq \pm 0.50$).

Correlations	* r	** P
†Walking capacity with physical functioning (SF-36)	0.66	< 0.001
†Walking capacity with vitality (SF-36)	0.57	< 0.001
†Walking capacity with activity level	0.54	< 0.001
†Health status with physical functioning (SF-36)	-0.73	< 0.001
†Health status with bodily pain (SF-36)	-0.68	< 0.001
†Health status with vitality (SF-36)	-0.55	< 0.001
Activity level with vitality	0.41	0.003
Activity level with physical functioning	0.44	0.001

Note. * r = correlation coefficient; ** P = probability; † $p < 0.001$, $r \geq \pm 0.50$.

Table 7 displays significant correlations and interacting variables. Six significant correlations ($p < 0.05$, $r \geq \pm 0.5$) were produced. Three of these correlations involved walking capacity, which was correlated with activity level, physical functioning (SF-36) and vitality (SF-36). The other three correlations involved health status (WOMAC), which was correlated with three SF-36 Questionnaire parameters; physical functioning, bodily pain and vitality.

Discussion.

The three dimensions of health status (WOMAC) are pain, physical functioning and stiffness. The correlations of this health status measure with physical functioning and bodily pain from the SF-36 Questionnaire give confidence to the use of these measurement tools. The relationship of health status with vitality (SF-36) suggests that energy levels and fatigue, which are subjective measures of well-being (Ware & Sherbourne, 1992) relate to the pain, stiffness and physical functioning of this DHD group. As subjects fatigue, pain, stiffness and physical dysfunction increase; similarly, increases in pain, stiffness and physical dysfunction decrease energy levels.

As "activity" encompasses walking, the relationship between these two is based on the more active subjects having a greater capacity to walk. This does not mean that subjects who are more active necessarily walk more, but perhaps subjects with a greater capacity to walk are more active on the whole. Furthermore, subjects with greater walking capacities will function better physically. Physical functioning on the SF-36 stresses the importance of distinct aspects of physical functioning (Ware & Sherbourne, 1992), and many of the listed items under the physical functioning category required walking. Moreover, keeping physically active, whether it be through walking or other activities, is going to allow the DHD patient to maintain a certain level of physical functioning. Maintaining this level of physical functioning will also affect the energy levels of the patient. Vitality, which is characterized by levels of energy and fatigue, will be easier to control for active subjects. Literature supports the belief that subjects suffering from DJDs are more susceptible to fatigue and lower levels of energy than the general population (Pierron, 1990; Hampson et al., 1993). It is possible that being active may aid in maintaining a certain level of vitality, which in turn enhances the DHD patient's capacity to walk.

Finally, it should be mentioned that age was the variable with the greatest number of highly unrelated, non-significant correlations (r values close to zero). Age was left as a continuous variable in order to determine its importance in various relationships. Nine of the possible 12 correlations with "age" reported values less than $r = \pm 0.278$.

Multiple Regressions

Four forward multiple regressions were conducted with the following critera variables; activity level, health status, walking capacity and severity of degeneration. In the first regression with "activity level" as the criterion variable, walking capacity was the greatest predictor of variability, although the relationship was of very low strength; $R^2adj = 0.24$, and $F(1, 46) = 16.18$, $p < 0.001$. In the next step, significant predictive accuracy was added through the addition of the general health score (SF-36) to the equation. With this variable, a significant increase in R^2adj was indicated ($R^2adj = 0.29$), and $F(2, 45) = 10.73$, $p < 0.001$. No other variables significantly contributed to the predictive accuracy of the activity level of the subjects. The regression equation follows:

$$Y' = -1389.94 + (10.03)\text{walking capacity} + (40.31)\text{general health score}.$$

In the second forward regression, with "health status" as the criterion variable, physical functioning (SF-36) provided the greatest correlation, although it was only of moderate strength; R^2adj = 0.52, $F(1, 48) = 54.14$, $p < 0.001$. In the next step, greater strength was added with bodily pain (SF-36) joining the equation, contributing to a significant increase in predictive accuracy, where $R^2adj = 0.63$, $F(2,47) = 43.43$, $p < 0.001$. No other additions resulted in significant increases. The regression equation follows:

$$Y' = 64.17 + (-0.29)\text{physical functioning score} + (-0.30)\text{bodily pain score.}$$

In the third multiple regression with "walking capacity" as the criterion variable, five variables significantly contributed to the variance. Physical functioning (SF-36) indicated the highest correlation, and contributed the greatest predictive accuracy with moderate strength; $R^2adj = 0.43$, $F(1,48) = 37.24$, $p < 0.001$. Activity level, age, and vitality (SF-36) also significantly added to the predictive accuracy of walking capacity. The final variable added to the regression equation which significantly explained the variance in walking capacity was general health (SF-36). A fairly strong relationship is indicated with $R^2adj = 0.63$, $F(5,44) = 18.85$, $p < 0.001$. The regression equation follows:

$$Y' = 378.66 + (1.45)\text{physical functioning score} + (0.01)\text{activity level} + (-2.48)\text{age} + (3.11)\text{vitality score} + (-2.23)\text{general health score.}$$

Finally, with "severity of degeneration" as the criterion variable, age was identified as the greatest predictor, although the relationship was of very little strength; $R^2adj = 0.13$, and $F(1,48) = 6.16$, $p < 0.001$. The only other variable to significantly contribute to explaining the variance in severity of degeneration was bodily pain (SF-36), which increased the adjusted correlation coefficient to 0.20. The regression equation follows:

$$Y' = 2.26 + (-0.03)\text{age} + (0.02)\text{bodily pain score.}$$

Discussion.

Activity level and walking capacity have been discussed as related variables in the correlations section, where a moderate strength relationship was identified. In the present analysis, the low regression value indicates a weak linear relationship between the two variables. Although the capacity to walk best predicted the activity levels out of all of the variables, a trend as such is not supported with confidence. As activity levels increase for the subjects, it is possible that walking capacities do not increase. Active subjects are, in fact, participating in several activities, only one of which may be walking for any active participant.

The relationship between physical functioning and health status, as well as between physical functioning and walking capacity also support earlier identified correlations. Physical functioning, which involves several different movements (Ware & Sherbourne, 1992), health status, which involves a section on physical functioning (Bellamy, 1989), and walking capacity, are indicative of this population's ability, or inability, to act in a physically functional manner. The implications for this population are that remaining physically functional will permit a greater walking capacity, while also promoting health status. The intermittent nature of the symptoms of DHD, coupled with the subject's individualistic approach to coping with this disease, may aid in explaining the low correlational and predictive values reported here.

Severity of degeneration was best predicted by age, but the relationship was very weak. There is little confidence in stating that as a subject ages, the severity of degeneration naturally gets worse. The implications are that age does not necessarily determine the lifestyle and functioning of DHD patients, rather the connection can be explained simply by the natural process of aging. Natural wear and tear increases with age (Wigley, 1984; Greig et al., 1994, Ashworth et al., 1994).

Relationships Among the Variables With Respect to the Five Classifications of DHD

Discriminant analysis was conducted in order to examine the relationships among the five classifications of DHD. While four discriminant functions were produced, only the first discriminant function was significant in over all separation between the groups. The first discriminant function accounted for 68% of all the between group variance, and the squared canonical correlation value indicated that the group membership explained 53% of the variance. The overall separation of groups after no discriminant functions were removed indicated excellent separation with a high x^2 of 52.01, and a low λ of 0.30, $p < 0.01$.

Seven variables significantly contributed to the maximum over all separation between groups. The order of inclusion of the variables through the stepwise procedure was; severity of degeneration, $p = 0.033$; the general health score on the SF-36, $p = 0.008$; age, $p = 0.003$, the physical functioning score on the SF-36, $p = 0.003$; the emotional role functioning score on the SF-36, $p = 0.003$; health status (WOMAC), $p = 0.004$, and the physical role functioning score on the SF-36, $p = 0.004$. The discriminant function equation follows:

$$D_1 = a + 0.89(\text{severity of degeneration}) + 0.89(\text{general health}) + 0.37(\text{age}) + 0.35(\text{physical functioning}) + 0.73(\text{emotional role functioning}) + 0.62(\text{health status}) + (-)0.75(\text{physical role functioning}).$$

Significant differences among the groups were identified with ANOVAs for three of the variables; age ($F(4,49) = 2.98$, $p = 0.028$), general health (SF-36) ($F(4,49) = 2.36$, $p = 0.041$), and severity of degeneration ($F(4,45) = 3.06$, $p = 0.026$). Health status, and three SF-36 parameters; physical functioning, emotional role functioning and physical role functioning, were not significantly different among the groups; $F(4,49) = 0.26$, $p = 0.91$, $F(4,49) = 0.46$, $p = 0.762$,

$F(4,49) = 1.29$, $p = 0.29$, and $F(4,49) = 0.29$, $p = 0.886$ respectively.

The Tukey post hoc test was conducted to determine which of the groups contributed to the significant findings. The results were as follows; significance was found between Group 4 (idiopathic arthritis) and Group 5 (previous failed surgery) for age, between Group 1 (abnormal concentrations of force on normal articular cartilage) and Group 2 (normal concentrations of force on abnormal articular cartilage) for general health status; and between Group 2, normal concentrations of force on abnormal articular cartilage, and Group 5, failed previous surgery for severity of degeneration. For the five classifications of DHD, the mean scores for age, general health status, and severity of degeneration are presented in Figures 2, 3, and 4 respectively.

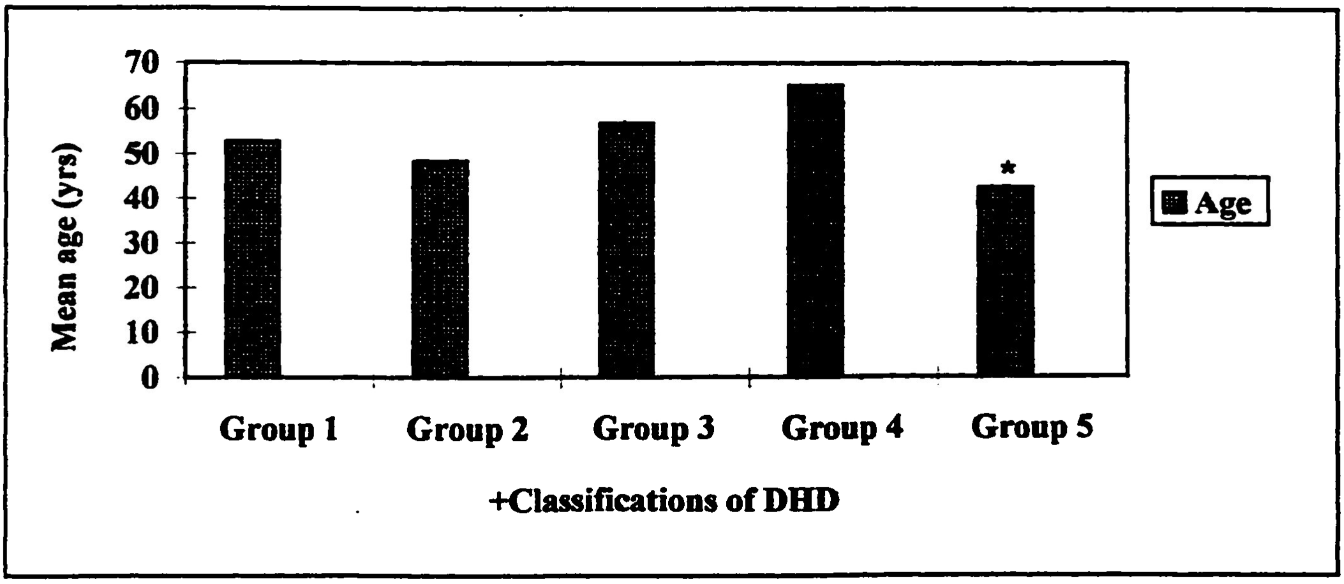

Figure 2. Mean age scores for the five classifications of DHD. Note. * Significantly different from Group 4, $p < 0.05$. †Group 1 = abnormal concentrations of force on normal articular cartilage, $n = 20$, Group 2 = normal concentrations of force on abnormal articular cartilage, $n = 6$, Group 3 = normal concentrations of force on normal articular cartilage supported by weakened subchondral bone, $n = 6$, Group 4 = idiopathic arthritis, $n = 15$, and Group 5 = failed previous surgery, $n = 7$.

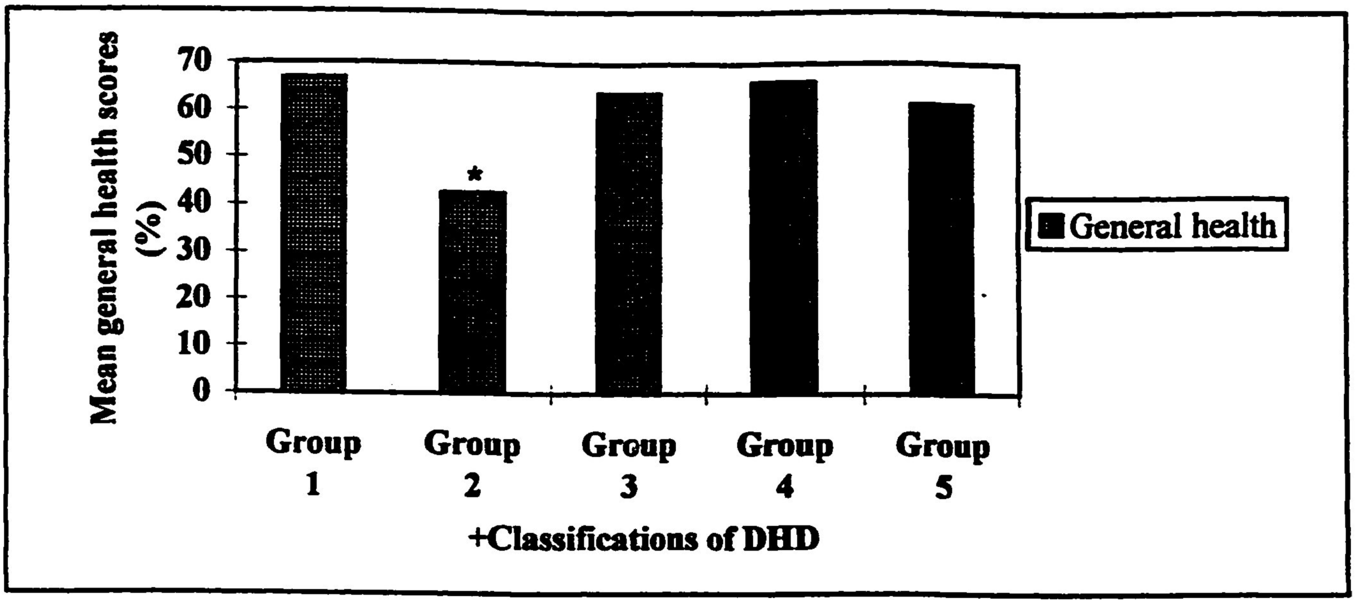

Figure 3. Mean general health scores for the five classifications of DHD. Note. *Significantly different from Group 1, $p < 0.05$. †Group 1 = abnormal concentrations of force on normal articular cartilage, $n = 20$, Group 2 = normal concentrations of force on abnormal articular cartilage, $n = 6$, Group 3 = normal concentrations of force on normal articular cartilage supported by weakened subchondral bone, $n = 6$, Group 4 = idiopathic arthritis, $n = 15$, and Group 5 = failed previous surgery, $n = 7$.

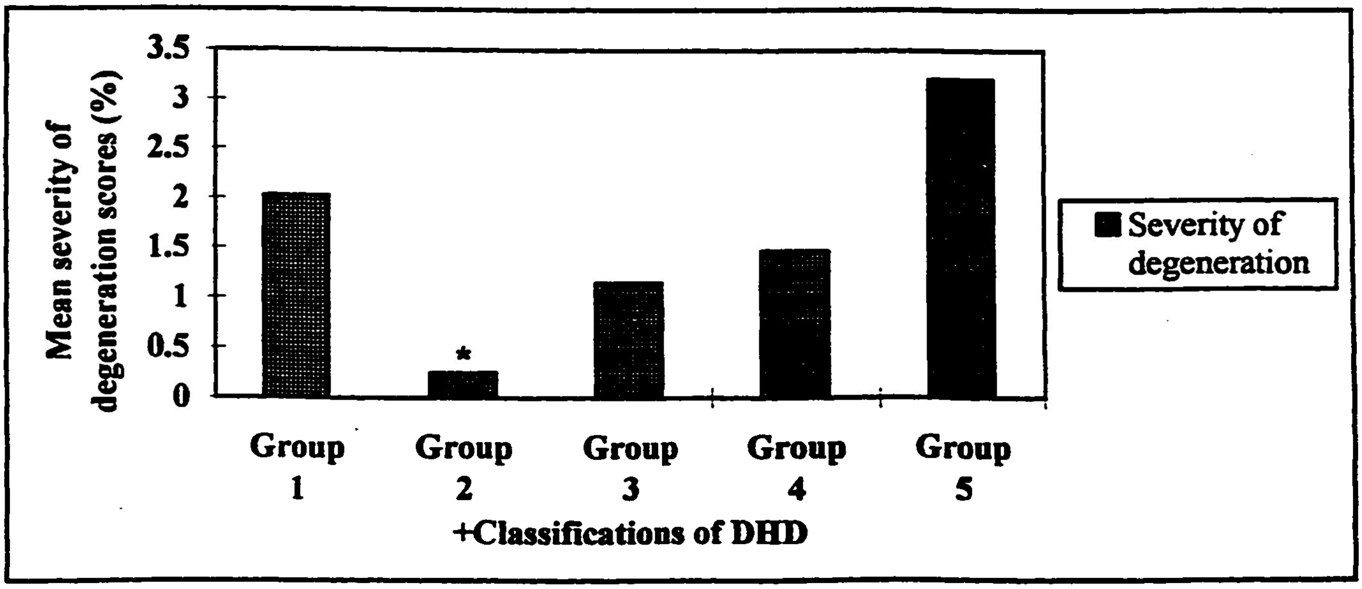

Figure 4. Mean severity of degeneration scores for the five classifications of DHD. Note. *Significantly different from Group 5, $p < 0.05$. †Group 1 = abnormal concentrations of force on normal articular cartilage, $n = 20$, Group 2 = normal concentrations of force on abnormal articular cartilage, $n = 6$, Group 3 = normal concentrations of force on normal articular cartilage supported by weakened subchondral bone, $n = 6$, Group 4 = idiopathic arthritis, $n = 15$, and Group 5 = failed previous surgery, $n = 7$

Discussion

Subjects who suffer from idiopathic arthritis are most likely older than subjects in any of the other classifications, while subjects who are classified with failed previous surgery tend to be younger. As reported in the literature, there is a belief that arthritis becomes more prevalent with age (Wigley, 1984; Michet, 1993). This is especially true of OA, which is a subset of idiopathic arthritis. Conclusions regarding age patterns are tenuous, however, as the relatively low subject numbers and unequal group sizes over the five classifications, as well as the bimodal representation of the age data, do not provide a solid working sample for analysis purposes.

Subjects in Group 1 (abnormal concentrations of force on normal articular cartilage) tend to perceive themselves as having the highest general health out of the five classifications. Subjects in Group 2 (normal concentrations of force on abnormal articular cartilage) tend to rate their general health the worst. The general health perception question asks subjects to consider such issues as; how their health relates to the general public, if subjects expect their health to get worse; and in general, how they would rate their health (Ware & Sherbourne, 1992). It is possible that the subjects in Group 2 perceive their health to be worse than subjects in Group 1 due to differing levels of pain and disability which may be associated with the classifications.

Subjects in Group 2 (normal concentrations of force on abnormal articular cartilage) have the greatest amount of cartilage degeneration of all five groups, while subjects in Group 5 (failed previous surgery) have the highest levels of existing cartilage. The implications are that subjects who have DHD originating with abnormal articular cartilage may possibly have faster rates of degeneration in the cartilage, and the cartilage is probably the part of the joint most affected by the DHD. Furthermore, subjects who acquired DHD from failed previous surgery do not necessarily suffer because of low levels of articular cartilage. It is possible that the rate of degeneration in the cartilage is, at least in the first stages of the disease, very slow. The DHD for these subjects is probably initiated in areas other than the articular cartilage.

Interview Questions and Diary Analyses

Qualitative Interview Question Analysis

The first of four qualitative questions asked of the subjects during the interview session was whether the subjects thought they would require a THR in the future. The mean ages ± SDs, number and percent of subjects for each of the responses are displayed in Table 8.

Table 8
Responses to the Question, "Do You Foresee Yourself Requiring A THR in the Future?".

Responses to the question	Mean age of subjects (yrs)	Number of subjects	Percent of subjects (%)
Yes	49.00 ± 16.45	26	48.15
Probably	48.44 ± 17.40	9	16.65
I do not know	72.00 ± 0	1	1.9
I hope not	60.63 ± 10.60	9	14.8
No	69.80 ± 11.72	9	18.5

The subjects were then asked to give the reason(s) why they had not yet undergone a THR for their DHD. Twenty-three of the subjects (42.59 %) gave only one reason for not having a THR so far. Fifteen of these 23 subjects commented that the disease was not bad enough yet. Twenty-five subjects (46.3 %) responded with two answers. Of the possible responses, 19 subjects recalled that the pain, stiffness and functional disability associated with the disease was not bad enough yet, or they simply coped with the disease. With these 19 responses, eight subjects added that they wanted to put the surgery off as long as possible. Six subjects (11.11 %) responded with three reasons for not having had a THR so far. Of these six subjects, three reported that youth, not a bad enough disease state, and the doctor's advice were the reasons, in combination, for not yet having undergone a THR. Table 9 outlines the responses to this question, the number of responses, and total percentage of responses.

Table 9

Responses to the Question, "Why Have You Not Undergone a THR So Far?".

Responses to the question	Number of responses	Percent of total responses (%)
Disease is not bad enough yet	23	26.14
Too young	14	15.91
Can manage (cope with) the disease	13	14.77
Want to put it off as long as possible	11	12.5
Other bigger problems right now	9	10.23
Doctor's advice	9	10.23
Too scared	5	5.68
Too old	4	4.54

Note. Total responses = 88.

The next question that was asked regarded whether or not the subjects considered themselves to be physically active. 55.6 % of the subjects responded "yes", 13% responded "moderately", and 31.4% responded "no". Possible responses, mean age ± SDs, number and percent of subjects who correspond with each of these responses, are presented in Table 10.

Table 10
Responses and Mean Ages, ± SDs for the Question, "Do You Consider Yourself to Be Physically Active?".

Responses to the question	Number of subjects	Percent (%)	Mean age of subjects (yrs)
Yes	30	55.6	54.91 ± 16.97
Moderately	7	13	48.71 ± 15.55
No	17	31.4	58.41 ± 18.36

The final qualitative question that was asked in the interview session regarded how the subject was feeling on the particular day, and at the particular time of the interview with respect to all aspects of their DHD, including pain, stiffness and physical dysfunction. The responses to the question, and the number and percentage of subjects reporting each response, are outlined in Table 11.

Table 11
Responses to the Question, "Do You Consider This a Typical Day, Worse Day, or Better Day with Respect to Your DHD?"

Responses to the question	Number of subjects	Percent (%)
Better than usual	9	16.67
A typical day	39	72.22
A worse than usual day	6	11.11

Discussion.

Interview questions were designed to gather pertinent qualitative information on DHD, the option of surgery, and what attitudes the subjects themselves may have towards their disease. Over half of this population believe that surgery is in their future, which means that coping with this disease is not an option, rather it is a necessity. Although many subjects reported that their disease was not in a bad enough state to warrant surgery, it is difficult to determine whether the physician's advice sparked this response, or whether the subjects actually know the degrees of severity associated with DHD. Similarly, reporting that a subject is too young for surgery also raises questions. Would greater numbers of THRs be performed if the life span of the prosthesis was not an issue? Furthermore, along the lines of a recent report published in The Medical Post (June, 1996), do Canadian physicians just wait for the pain levels and stage of disease to be greater than U.S. physicians before considering the THR option? The fact remains that, for whatever reason, these subjects are living active, daily lives and surving with DHD. They are coping with a long term disease, even though surgery exists as a future possibility.

On the whole, the subjects mentioned that they were having a typical day with respect to all aspects of their hip disease. As such, within the limitations of the present study, the data gathered on the day of the interview would be fairly consistent with a typical day of the pain, stiffness and physical dysfunction associated with DHD. This adds confidence when making generalizations about the representation of the findings reported here to the general population of long term DHD sufferers.

Descriptions of Coping Strategies

The number of one-time coping strategies used by each patient was derived from the interview questions, where the subjects simply responded to the question regarding the coping strategies that they used to combat problems with their DHD. No mention of frequency was made. The use of coping strategies over a seven day period, and combinations of particular coping strategies were derived from the diaries. From the interview questions, the number of one-time coping strategies used by this population ranged from one to six, however, 83.3 % of the subjects used three or less coping strategies. Figure 5 illustrates the reported number of one-time usages of each mentioned coping strategy (N = 117) during the interview questions.

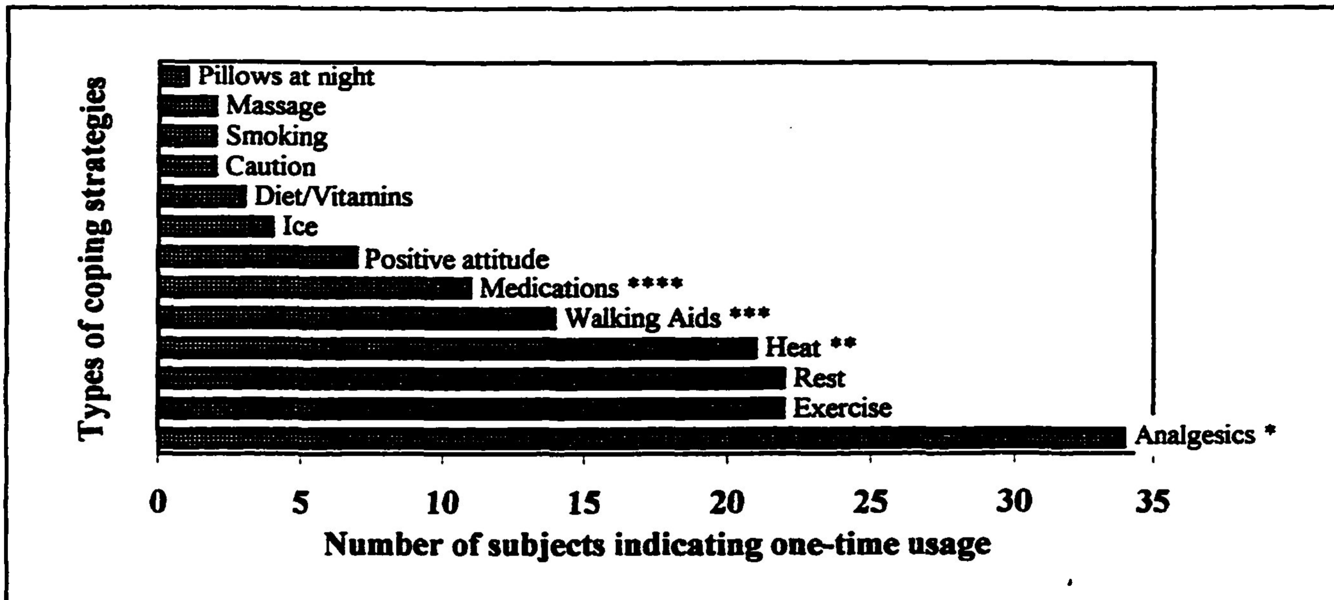

Figure 5. Reported number of one-time usage of coping strategies; N = 117. Note. * Includes tylenol, entrophen, advil, aspirin. **Includes saunas, baths, heating pads. ***Includes canes, walkers, wheelchairs. ****Prescribed medications for DHD.

Four of the five subjects who recorded only one coping strategy used an analgesic. Of the subjects who recorded two coping strategies, the two most common combinations of coping strategies were; rest with analgesics, and heat with antiinflammatories (prescribed medication). Analgesic use and prescribed medications were the most highly reported coping strategies used in combination. Subjects who reported using three coping strategies most often (eight times) used heat or rest in combination with both exercise and analgesics.

In the seven day diary, which had a 57.14 % return rate (n = 31), the subjects were asked to record any daily uses of coping strategies. The use of an analgesic was, again, the most highly reported coping strategy. Information on the frequency of coping strategy use (sum of seven days) for this population is presented in Figure 6, where the total number of coping strategies recorded was 268.

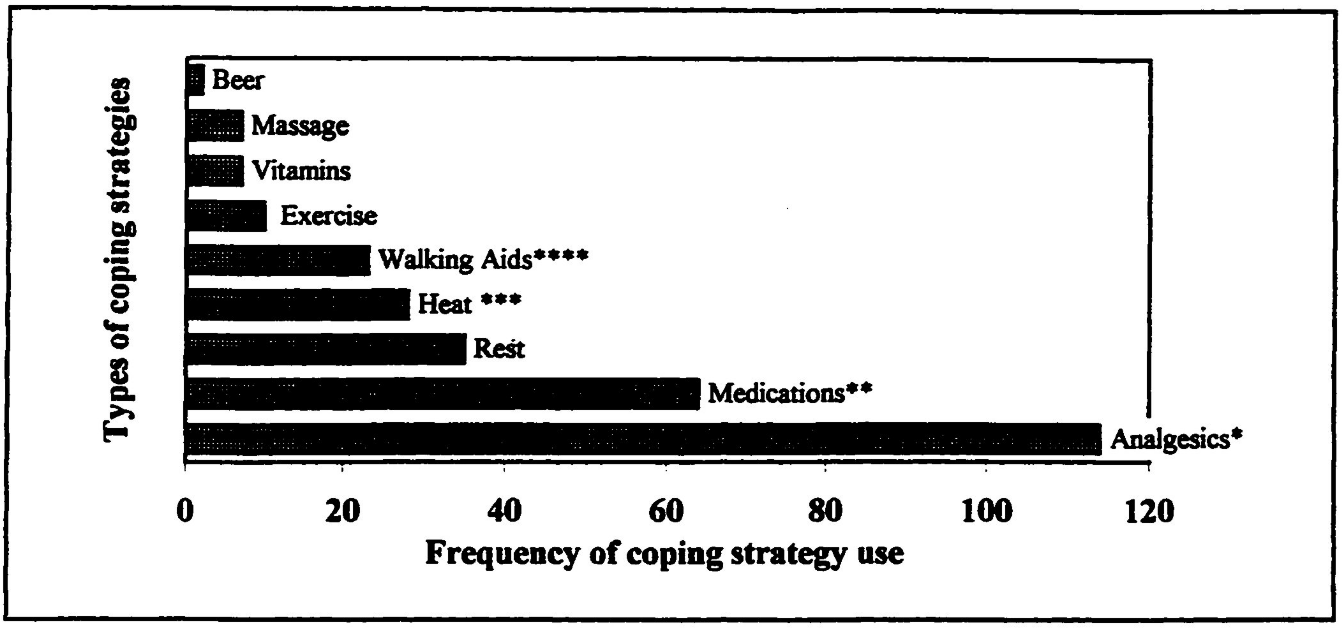

Figure 6. Frequency of coping strategy use. N =268. Note. *Includes tylenol, entrophen, advil, aspirin. **Prescribed medications for DHD. ***Includes saunas, baths, showers, heating pads. ****Includes canes, walkers, wheelchairs.

Discussion.

Coping strategies are necessary for long-term survival with DJDs (Pierron et al., 1990; Hampson et al., 1993; Burke & Flaherty, 1993). Pierron et al. also described that, at the outset of diagnosis, patients should be given instructions on joint protection, weight reduction (if overweight), and prescribed appropriate analgesics. These suggestions were provided to the present population by Dr. Hamilton. The use of heat modalities (mentioned to be especially useful for DHD), rest, supportive devices (canes, walkers) and pain reducing drugs, such as salicylates (aspirin), NSAIDs, and acetominophens (tylenol) were all documented in the present study.

Hampson et al. (1993) reported on the use of self-management for DJDs. They suggested that medications and pain-relieving drugs are often the only "prescribed" aids described in detail to the patient. This explanation might account for the high number of one-time usages and high frequency of analgesic use in the present study, and may also be representative of the levels of pain which are characteristic of DHD (Pierron et al., 1990). Hampson et al. also suggested that self-management should include both medically recommended methods and activities which individuals initiate on their own behalf. Many of the subjects in the present study mentioned using exercise, heat and rest as coping strategies which helped them get through each day. Also, the number of active subjects and the activities performed support the belief that swimming, walking and range of motion exercises are the most useful forms of active self-management.

The present study contradicts findings by Burke and Flaherty (1993) who studied the coping strategies of older women suffering from some form of arthritis. Burke and Flaherty reported that positive reappraisal (mental attitude) was the highest recorded coping strategy used. The selective use of women, the higher mean age of the subjects (83.2 yrs), or the use of a written prompt, probably account for the differences between the two populations. Although a positive mental attitude was mentioned as a coping strategy in the present study, the frequency was low. Similar to the present study, however, Burke and Flaherty support the finding of a broad range of coping strategy use. They stated that the results from their own study suggest that older women are no different from other age groups in that they use a wide range of coping strategies to respond to the stress that they encounter during the life course of a chronic illness.

A standardized coping strategy questionnaire was not used in the present study. The subjects were able to respond to the question as they understood it, and could mention anything used as a coping aid, not just strategies that had been put into a list. A list of common strategies adapted from various questionnaires, however, was used as a verbal prompt. This methodology might also help explain the broad range of reported strategies, such as putting a pillow between the legs at night, smoking, drinking a beer, taking a sauna, or having a massage, all of which cannot be found in other studies dealing with coping strategy use for DHD populations. From these results, it can be inferred that the use of coping strategies are both standardized (the high use of pain-medications), and very personalized. For long-term DHD sufferers, coping strategies are necessary to daily living, and this population does appear to be coping with its disease.

Activity and Pain Analyses From the Seven Day Diary

The activities performed in seven days were monitored by record of the type, duration and intensity of exercise in the diary. Subjects who were active participated in a number of activities ranging from swimming, walking, bicycling, gardening, yard work, looking after children and grandchildren, and hunting. Seasonal activities that were mentioned in the interview questions but not reported in the diary included cross-country skiing, down hill skiing, fishing, weight training and bowling. The most common activity reported was swimming, and this activity was responded to favourably. Walking was also a frequent activity, although there were differing opinions on the effectiveness of this activity. Some subjects walked because it made them, or their hips, feel better, as evidenced by comments such as, "Hip pain is much worse in the winter when weather, ice and cold preclude walks", "I walked two and a half miles before I began to warm up...it was great", "When I am on breaks or at lunch, I race walk to every destination... to get the hips moving", and, "My daily one mile walks make me feel great". Others did not respond in favour of walking. Although these subjects did walk, the durations and intensities were much less. Comments noted were, "I can walk about 1,000 feet before I get tired and my hips burn", and, "After walking for 15 minutes my hips start to get sore so I stop".

The diary also provided an opportunity for subjects to record and comment on their pain levels over the seven days. The pain levels were, "none", "mild", "moderate", "severe" and "extreme". Only five of the subjects reported pain levels of "severe" or "extreme" for any given day, and some comments were made about the high levels of pain. One subject wrote that he/she didn't listen to the pain that day, and pushed too hard to get everything done. "Tonight I am paying for it...". Similarly, another subject reported, "On days where the pain isn't too bad, I do too much and the pain returns". One subject remarked that the pain was severe after sitting in a hard chair at work all day long. The two subjects who reported "extreme" pain were dependent on walkers. A repeated measures one-way ANOVA, conducted to examine if pain levels recorded by each subject in a seven day period differed significantly among the days, indicated significance; $F(1,30) = 10.17$, $p < 0.001$. Although the exact day to day variances were not examined, in general the pain levels associated with DHD vary significantly from day to day.

Some subjects used the opportunity to comment on days when they had little pain. One subject wrote, "Stationary biking is the only thing that loosens up my hip....and ten minutes is all that it takes". Others made more personal comments such as, "Today I feel great, probably because I am not at work", and, " I can't believe how good I feel... must be due to the fact that it's nice and it's payday".

Discussion.

The activities reported in this study have been recorded in other DHD research (Kovar et al., 1992; Ettinger & Afable, 1994), specifically as low or non-weight bearing activities, such as swimming, walking and bicycling. The present population generally considered themselves to be physically active, and the documentation of activity types and levels supported these considerations. As such, the subjects were able to work around the pain, stiffness and physical dysfunction associated with DHD, often using exercise and activity as a coping strategy.

Pain levels vary in intensity for DHD patients (Brandt, 1988; Schon & Zuckerman, 1988; Lequesne, 1991; Michet, 1993). Pain levels in the present study also fluctuated. It is these daily variances which make analyzing the day to day lives of DHD patients difficult, and the subjects themselves are the first to admit that. Many of the subjects acknowledged these pain variances in the diary, often documenting a take-home message of "listening to the disease". A few subjects reported that it is important not to push the body too hard on days when the pain is non-existent because "...the body would pay for over-usage the next day". Subjects also commented on "doing too much" or "not stopping when the pain started to move in". In fact, if pain level variances can be acknowledged by the patients, day to day living might be a lot easier. This requires being sensible about the amounts of activity performed, and doing things in moderation.

Finally, many subjects took the opportunity to comment on weather patterns affecting their pain. Documented remarks included, "Today is a bad hip day....it is cloudy and humid", "My hips ache when it rains", "I woke up four times during the night...attributable to the dramatic shift in weather conditions", and, "Weather caused my hip to pulse with pain". This is another limited area of study for DHD sufferers which would benefit from further investigation.

CHAPTER 5

Summary, Conclusions and Recommendations

Summary

The purpose of this study was to determine the relationships among age (yrs), activity level (METS), health status (WOMAC in %), quality of life (SF-36 in %), walking capacity (six minute walk test in metres), and severity of degeneration (cartilage space in millimetres), in a group of 54 subjects (mean age 54. 91 ± 16.97) who presented with DHD. Other purposes of this study included; examining these relationships with respect to five classifications of DHD, and documenting the use of coping strategies. The five classifications were; abnormal concentrations of force on normal articular cartilage, normal concentrations of force on abnormal articular cartilage, normal concentrations of force on normal articular cartilage supported by weakened subchondral bone, idiopathic arthritis, and failed previous surgery.

Twenty five males and 29 females, aged 26 to 86, qualified for the study. Missing data for subjects resulted in $\underline{N}$=53 for walking capacity, and $\underline{N}$ = 50 for severity of degeneration. When separated into five classifications, for Groups 1 - 5, $\underline{n}$ = 20, $\underline{n}$ = 6, $\underline{n}$ = 6, $\underline{n}$ = 15 and $\underline{n}$ = 7 respectively. The present population represented the upper end of a moderately active population, and recorded similar walking capacity and WOMAC scores to other pre-surgery DHD populations. Compared to the general population, these DHD sufferers reported less physical functioning and greater bodily pain. Although 74.1 % of the subjects presented with osteophyte formation, the mean activity level was greater for this group than that recorded for the no- osteophyte formation group (5202.13 METS and 4886.07 METS respectively), but the walking capacity score was lower (392.55 m and 450.94 m respectively).

Correlations between all possible combinations of variables indicated six significant relationships ($p < 0.05$; $r \geq \pm 0.5$); walking capacity correlated with physical functioning (SF-36), vitality (SF-36) and activity level, and health status correlated with physical functioning, vitality and bodily pain (SF-36). Regression analyses indicated that walking capacity was the greatest predictor of activity level, physical functioning was the greatest predictor of both health status and walking capacity, and age was the greatest predictor of severity of degeneration ($p < 0.001$). Discriminant analyses indicated that seven variables contributed to the maximum overall separation of the five classifications of DHD ($p < 0.05$). Three of these variables, age, general health (SF-36), and severity of degeneration differed significantly when analyzed with ANOVAs. Age differed between Groups 4 and 5, general health status differed between Groups 1 and 2, and severity of degeneration differed between Groups 2 and 5.

Analyses of the interview questions and diary suggested that analgesics were both the most recorded one-time and frequently used coping strategy. Sixty-five percent of the subjects reported that they would definitely, or at least probably, require a THR in the future, while only 19% said they would definitely not require a THR. The top three recorded reasons for why the subjects have not undergone a THR were as follows; 26% stated that the disease was not yet bad enough, 16% stated that they were too young, and 15% stated that they manage with the disease as it is. Sixty-nine percent of the subjects considered themselves at least moderately physically active; the most highly recorded activities were swimming, walking, bicycling, yard work and gardening. The severity of pain varied significantly on a day to day basis as indicated by a repeated measures one-way ANOVA ($p < 0.05$). High pain levels were subjectively attributed to such things as overuse during the day and the weather, while low levels were subjectively attributed to such things as a day of moderate activity and a day off work. At the time of testing, 72% of the subjects were having a typical day with respect to all symptoms of their DHD.

Conclusions

Within the limitations of the study, the relationships among age, activity level, health status, quality of life, walking capacity and severity of degeneration are not well defined. The low numbers in this study, the uneven group sizes, and the often high standard deviation values led to several tenuous conclusions. As well, the mean may not have been the best indicator of central tendency for variables with non-normally distributed data. For the three variables with such data (severity of degeneration and two of the eight quality of life parameters presented with outliers), looking at the median as the measure of central tendency did not provide a more justified working measure for statistical purposes.

The six significant correlations were mostly of moderate strength; only one relationship, health status and the physical functioning score (SF-36), was fairly strong ($r = -0.73$). Significant regression analyses also indicated, at best, moderately correlated variables. Nonetheless, the implications are that people living with this disease must remain involved and active, and keep mentally stimulated in order to cope with the day to day variations and limitations of DHD.

The pain, stiffness and physical dysfunction associated with DHD can often be managed with the use of both standard coping strategies, such as analgesic use, or individualistic strategies such as saunas, exercise, or placing a pillow between the legs at night, all of which help patients survive on day to day basis. In general, patients can expect daily variations in the severity of symptoms, which can be dealt with in advance by listening to the signs and symptoms of DHD, and reacting accordingly. The results from this study indicate that a population of DHD sufferers need not become inactive and disengaged from the social world, rather the opposite has been revealed. Keeping physically, socially and mentally active appears to be the norm for daily survival with DHD, although moderation has been reiterated. It is understood that with DHD comes some basic limitations to daily living, however, in general, this population has indicated that making minor adjustments and remaining involved makes management of DHD possible.

Recommendations

In order to make any generalizations with respect to the origin of DHD, larger and more equal groups in number are required to meet statistical assumptions. Furthermore, a standardized method of classifying the origin of DHD needs to be established. One such method might utilize radiographic evidence of the disease, such as complete details on osteophyte formation, migration of the centre of rotation of the femoral head, changes in sphericity of the femoral head, and deterioration of the articular cartilage. This more accurate measurement of severity of degeneration might provide a foundation for classifying DHD patients, as well as provide some insight into the natural history of this disease. As well, monitoring DHD patients over time might give a more useful measurement of their lifestyles and coping strategies. A longitudinal examination would definitely further science in this area.

Other recommendations follow: Firstly, a better documentation of health problems is needed in future studies to infer that the health status and quality of life scores are directly related to DHD. As well, the six minute walk test provides only a crude estimate of walking capacity. In order to accurately assess physical walking capacity, more appropriate tests, such as standardized treadmill or work capacity tests, should be conducted.

References

Adams, M.E. (1991). Quantitative imaging of osteoarthritis. Seminars in Arthritis and Rheumatism, 20 (6), 26-39.

Adams, M.E. (1993). A use of cross-linked hyaluronic acid in the treatment of osteoarthritis. Journal of Rheumatology, 20 (39), 16-23.

Afable, R., Bailey, E., & Woodard, M. (1992). Comparison of aerobic and strength training in persons with OA of the knee. Journal of the American Geriatrics Society, 40, 17.

Alexander, D. (1985). Fitness in a chair: A complete well rounded alternative for the lazy, the busy, and the movement impaired. London: Dorleac-Macleish.

Altergott, K. (Ed.). (1988). Daily Life in Later Life: Comparative Perspectives. Newbury Park: Sage Publications.

Altman, R. (1991). Criteria for classification of clinical osteoarthritis. Journal of Rheumatology, 18 (S27), 10-12.

American College of Sports Medicine; Position Stand. (1990). The recommended quantity and quality of exercise for developing and maintaining cardiorespiratory and muscular fitness in healthy adults. Medicine and Science in Sports and Exercise, 22, (2), 265-274.

Arthritis Society. (1994). Arthritis Wise-Health Watch Canada [Brochure]. Guelph: McNeil Consumer Products Company.

Ashworth, J., Reuben, D., & Benton, L. (1994). Functional profiles of healthy older persons. Age and Aging, 23, 24-39.

Ball, G. (1986). Clinical Rheumatology. Philadelphia: W.B. Saunders Company.

Barry, H., Rich, B., & Carlson, T. (1993). How exercise can benefit older patients. Physician and Sports Medicine, 21 (2), 137-140.

Banning, R., & Materson, R. (1991). A rational program of exercise for patients with osteoarthritis. Seminars in Arthritis and Rheumatism, 18 (2), 33-43.

Bellamy, N., Buchanan, W., Goldsmith, C., Campbell, J., & Stitt, L. (1988). Validation study of WOMAC: A health status instrument for measuring clinically important patient relevant outcomes to anti-rheumatic drug therapy in patients with osteoarthritis of the hip or knee. Journal of Rheumatology, 15, 1833-1840.

Bellamy, N. (1989). Pain assessment in osteoarthritis: Experience in the WOMAC osteoarthritis index. Seminars in Arthritis and Rheumatism, 18, (4), 14-17.

Bennett, R. (1994). Exercise and exercising testing in fibromyalgia patients: Lessons learned and suggestions for future studies. Journal of Musculoskeletal Pain, 2 (3), 143-152.

Blair, S.., Goodyear, N., & Gibbons, L. (1984). Physical fitness and incidence of hypertension in healthy normotensive men and women. Journal of the American Medical Association, 252, 487-490.

Blair, S.N., Haskell, W.L., Ho, P., Paffenbarger, R.S., Vranizan, K.M., Farquar, J.W., & Wood, P.D. (1985). Assessment of habitual physical activity by a seven-day recall in a community survey and controlled experiments. American Journal of Epidemiology, 122 (5), 794-804.

Blair, S.N., Jacobs, D.R., & Powell, K.E. (1985) Relationships between exercise or physical activity and other health behaviours. Public Health Reports, 100 (2), 172-180.

Blair, S., Wood, P., & Sallis. (1994). Workshop E: Physical activity and health. Preventative Medicine, 23, 558-559..

Boulware, D., & Byrd, S. (1993). Optimizing exercise programs for arthritis patients. Physician and Sports Medicine, 2 (4), 104-106.

Brandt, K. (1989). Management of osteoarthritis. In W. Kelley, E. Harris, S. Ruddy, & C. Sledge (Eds.), Textbook of Rheumatology (pp. 1501-1510). Philadelphia: W.B. Saunders Co.

Brazier, J., Harper, R., Jones, N., O'Cathain, A., Thomas, K., & Usherwood, T. (1992). Validating the SF-36 health survey questionnaire: A new outcome measure for primary care. British Medical Journal, 305, 160-164.

Brooks, C. (1987). Leisure time physical activity assessment of American adults through an analysis of time diaries collected in 1981. American Journal of Public Health, 77 (4), 455-460.

Bullough, P. (1993). The pathology of osteoarthritis. Journal of Rheumatology, 17 (2), 110-117.

Bunning, R., & Materson, R. (1991). A rational program of exercise for patients with osteoarthritis. Arthritis Rheumatism, 21, 33-43.

Burke, M., & Flaherty, M. (1992). Coping strategies and health status of elderly arthritic women. Advances-in-Nursing-Science, 15 (1), 77-86.

Canadian hip and knee patients 'suffer more'. (June 18, 1996). Orthopedics Update. Medical Post, p. 11.

Carlucci, D., Goldfine, H., Ward, A., Taylor, P., & Rippe, J. (1991). Exercise: Not just for the healthy. The Physician and Sportsmedicine, 19 (7), 46-52.

Cartmel, B., & Moon, T. (1992). Comparison of two physical activity questionnaires with a dairy for assessing physical activity in an elderly population. Journal of Clinical Epidemiology, 45, 877-883.

Croft, P., Cooper, C., Wickham, C., & Coggon, D. (1990). Osteoarthritis of the hip and occupational activity. Scandinavian Journal of Work, Environment and Health, 18, 59-63.

Davis, M. (1988). Epidemiology of osteoarthritis. Clinics in Geriatric Medicine, 4 (2), 241-255.

Dexter, P. (1992). Joint exercises in elderly persons with symptomatic osteoarthritis of the hip or knee. Arthritis-care-and -research, 5 (1), 36-42.

Dieppe, P. (1990). Some recent clinical approaches to osteoarthritis research. Seminars in Arthritis and Rheumatism, 20 (Suppl. 3), 2-11.

Dishman, R. (1985). Medical psychology in exercise and sport. The Medical Clinics of North America, 69 (1), 123-144.

Dishman, R., & Gettman, L. R. (1980). Psychobiological influences in exercise adherence. Journal of Sports Psychology, 2, 295-310.

Dorr, L. (1991). Arthritis and athletics. Clinics-in-Sports-Medicine, 10 (2), 343-357.

Droste, C., Greenlee, M., Schreck, M., & Roskamm, H. (1991). Experimental pain thresholds and plasma beta-endorphin levels during exercise. Medicine and Science in Sports and Exercise, 23 (1), 334-342.

Eichner, E. (1989). Does running cause osteoarthritis? Physician and Sports Medicine, 17 (3), 153-154.

Elrick, H. (1996). Exercise is medicine. The Physician and Sportsmedicine, 24 (4), 72-78.

Ettinger, W., & Afable, R. (1994). Physical disability from knee osteoarthritis : The role of exercise as an intervention. Medicine and Science in Sports and Exercise, 26 (12), 1435-1450.

Fitzgerald, P. (1987). Exercise for the elderly. The Medical Clinics of North America, 69 (1), 189-196.

Freer, C.B. (1980). Health diaries: A method of collecting health information. Journal of Royal College of General Practitioners, 30, 279-282.

Garratt, A., Ruta, D., & Abdalla, M. (1993). The SF-36 health-survey questionnaire. An outcome measure suitable for routine use within the NHS. British Medical Journal, 306, 1440-1441.

Goldwater, B., & Collis, M. (1985). Psychological effects of cardiovascular conditioning. A controlled experiment. Psychosomatic Medicine, 47, 174-181.

Gordon, N., & Scott, C. (1991). The role of exercise in the primary and secondary prevention of coronary artery disease. Clinics in Sports Medicine, 10 (1), 87-103.

Greig, C., Young, A., Skelton, D., Pippet, E., Butler, F., & Mahmud, S. (1994). Exercise studies with elderly volunteers. Age and Ageing, 23, 185-189.

Guyatt, G., Sullivan, M., Thompson, P., Fallen, E., Pugsley, S., & Taylor, D. (1985). The six-minute walk: A new measure of exercise capacity in patients with chronic heart failure. Canadian Medical Association Journal, 132, 919-925.

Hamilton, H., & Joyce, M. (1985). Long-term results of low-friction arthroplasty performed in a community hospital, including a radiological review. Clinical Orthopaedics and Related Research, 211, 55-64.

Hampson, S., Glasgow, R., Zeiss, A., Birskovich, S., Foster, L., & Lines, A. (1993). Self-management of osteoarthritis. Arthritis Care and Research, 6 (1), 17-22.

Harrison, P. (March, 1996). Being your best with arthritis. The Health Journal, 1 (2), 14-19.

Haworth, R.J. (1983). Use of aids during the first three months after total hip replacement. British Journal of Rheumatology, 22, 29-35.

Hochberg, M.C. (1991). Epidemiology and genetics of osteoarthritis. Current Opinion in Rheumatology, 3, 662-668.

Hopkins, W. (1991). Quantification of training in competitive sports: methods and applications. Sports Medicine, 12 (3), 161-183.

Howell, D., Treadwell, B., & Trippel, F. (1992). Etiopathogenesis of osteoarthritis.

Osteoarthritis: Diagnosis and Management (2nd ed., 233-254). Philadelphia: W. B. Saunders Company.

Ike, R., Lampman, R., & Castor, C. (1989). Arthritis and aerobic exercise: A review. Physician and Sports Medicine, 17 (2), 132-139.

Jenkinson, C., Coulter, A., & Wright, L. (1993). Short form 36 (SF-36) health survey questionnaire: Normative data for adults of working age. British Medical Journal, 306, 1437-1443

Kaplan, R.M., & Anderson, J.P. (1990). An integrated approach to quality of life assessment: The general health policy model. In B. Spilker (Ed.), Quality of Life in Clinical Studies (pp. 131-149). New-York: Raven press.

Kaplan, R.M., Coons, S.J., & Anderson, J.P. (1992). Quality of life and policy analysis in arthritis. Arthritis Care and Research, 5 (3), 173-183.

Kaplan, G., Seeman, T., Cohen, R., Knudsen, L., & Guralnik, J. (1987). Mortality among the elderly in the Alameda county study: behavioral and demographic risk factors. American Journal of Public Health, 77, 307-312.

Katz, J. (1991). Swimming for total fitness: the water exercise technique for better swimming. Coach Education: Proceedings, 141-147.

Keefe, F.J., Caldwell, D.S., Queen, K.T., Gil, K.M., Martinez, S., Crisson, J.E., Ogden, W., & Nunley, J. (1987). Pain coping strategies in osteoarthritis patients. Journal of Consulting and Clinical Psychology, 55 (2), 208-212.

Klippel, J., & Dieppe, P. (Eds.). (1994). Rheumatology. London: Mosby Year Book Europe Limited.

Kohl, H.W., Blair, S.N., Paffenbarger, R.S., Macera, C.A., & Kronenfeld, J.J. (1988). A mail survey of physical activity habits as related to measured physical fitness. American Journal of Epidemiology, 127 (6), 1228-1239.

Koss, E. (1994). Neuropsychology. In Friedland, Clinics in Geriatric Medicine (pp 299-309). Philadelphia: WB Saunders Co.

Kovar, P., Allegrante, J., MacKenzie, R., Peterson, M., Gutin, B., & Charlson, M. (1992). Supervised fitness walking in patients with osteoarthritis of the knee. Annuals of International medicine, 116, 529-534.

La Porte, R., Adams, L., Savage, D., Brenes, G., Deerwater, S., & Cook, T. (1984). The spectrum of physical activity, cardiovascular disease and health: an epidemiological perspective. American Journal of Epidemiology, 120, 507-517.

Leon, A., Connett, J., & Jacobs, D. (1987). Leisure-time physical activity levels and risk of coronary heart disease. Journal of the American Medical Association, 258, 2388-2395.

Lequesne, M. (1991). Indices of severity and disease activity for osteoarthritis. Seminars in Arthritis and Rheumatism, 20 (Suppl. 2, 6), 48-54.

Lichtman, S., & Poser, E. (1983). The effects of exercise on mood and cognitive functioning. Journal of Psychosomatic Research, 27, 3-24.

Lyngberg, K. (1988). Exercise training in arthritis. Scandinavian Journal of Sports Sciences, 10(2), 83-90.

Lyons, R., Perry, H., & Littlepage, B. (1994). Evidence for the validity of the SF-36 in an elderly population. Age and Aging, 23, 182-184.

Malchau, H., Herberts, P., Ahnfelt, L. (1993). Prognosis of total hip replacement in Sweden. Acta Orthopedica Scandinavica, 64 (5), 497-506.

Mankin, J. (1989). Clinical features of osteoarthritis. In W. Kelley, E. Harris, S. Ruddy, & C. Sledge (Eds.), Textbook of Rheumatology (pp. 1480-1492). Philadelphia: W.B. Saunders Co.

Mankin, J., & Brandt, K. (1989). Pathogenesis of osteoarthritis. In W. Kelley, E. Harris, S. Ruddy, & C. Sledge (Eds.), Textbook of Rheumatology (pp. 1469-1471). Philadelphia: W.B. Saunders Company.

Marti, B., Knobloch, M., Tschopp, A, Jucker, A., & Howald, H. (1989). Is excessive running predictive of degenerative hip disease? Controlled study of former elite athletes. British Medical Journal, 299, 91-93.

McHorney, C., Kosinsky, M., & Ware, J. (1994). Comparisons of the costs and quality of norms for the SF-36 Health Survey collected by mail versus telephone interview: results from a national survey. Medical Care, 32, (6), 551-567.

McHorney, C., Ware, J., Rachel, J., & Sherbourne, C. (1994). The MOS 36-item short-form health survey: Tests of data quality, scaling assumptions, and reliability across diverse patient groups. Medical Care, 32 (1), 40-66.

McInnes, H., & Glyptis, S. (1986). The use of leisure time. In Managan and Small (Eds.), Sport, Culture and Society of Education (pp. 226-233).

McKeag, D. (1992). The relationship of osteoarthritis and exercise. Clinics in Sports Medicine, 11 (2), 471-488.

Michet, C.J. (1993). Osteoarthritis. Arthritis, 20 (4), 815-826.

Ministry of Tourism and Recreation. (1984). Physical Activity Patterns in Ontario- II. Ontario: Author.

Ministry of Tourism and Recreation. (1986). Physical Activity Patterns in Ontario- III. Ontario: Author.

Mitchell, N., & Cruess, R. (1977). Classification of degenerative arthritis. Canadian Medical Association Journal, 117, 763-765.

Mokowitz, R. (1987). Primary osteoarthritis: epidemiology, clinical aspects, and general management. American Journal of Sports Medicine, 83, 5-10.

Morgan, W.P. (1985). Affective beneficence of vigorous physical activity. Medicine and Science in Sports and Exercise, 17 (1), 94-100.

Moses, J., Steptoe, A., Mathews, A. & Edwards, S. (1989). The effects of exercise training on the mental well-being in the normal population: A controlled trial. Journal of Psychosomatic Research, 33, 47-61.

Noreau, L., Martineau, H., Roy, L., & Belzile, M. (1995). Effects of a modified dance-based exercise on cardiorespiratory fitness, psychological state and health status of persons with rheumatoid arthritis. American Journal of Physical Medicine & Rehabilitation, 74 (1), 19-27.

Oka, M., & Hatanpaa, S. (1976). Degenerative hip disease in adolescent athletes. Medicine and Science in Sports, 8 (2), 77-80.

Older, J. (1995, December 7-9). Worldwide Charnley LFA Retrospective Study. Symposium conducted in Lyon, England.

Owen, N., Lee, C., Naccarella, L., & Haag, K. (1987). Exercise by mail: a mediated behaviour-change program for aerobic exercise. Journal of Sport Psychology, 9, 346-357.

Paffenbarger, R. (1988). Contributions of epidemiology to exercise science and cardiovascular health. Medicine and Science in Sports and Exercise, 20, 426-438.

Paffenbarger, R., Blair, S., Lee, I., & Hyde, I. (1993). Measurement of physical activity to assess health effects in free-living populations. Medicine and Science in Sports and Exercise, 25 (1), 60-70.

Paffenbarger, R., Hyde, R., Wing, A., & Hsieh, C. (1986). Physical activity, all-cause mortality and longevity of college alumni. New England Journal of Medicine, 314, 605-613.

Paffenbarger, R., Hyde, R., Wing, A., Jung, D., & Kampert, J. (1991). Influences of change in physical activity and other characteristics on all-cause mortality. Medicine and Science in Sports and Exercise, 23, (Suppl. 2), 492.

Panush, R. (1987). Exercise and arthritis. Sports Medicine, 4, 54-64.

Pascale, M., & Grana, W. (1989). Does running cause osteoarthritis? Physician and Sports Medicine, 17 (3), 163-166.

Patrick, D.L., & Dayo, R.A. (1989). Generic and disease-specific measures in assessing health status and quality of life. Medical Care, 27, 217-232.

Pavlou, K., Steffee, Lehman, R., & Burrows, B. (1985). Effects of dieting and exercise on lean body mass, oxygen uptake, and strength. Medicine and Science in Sports and Exercise, 17, 466-471.

Petrovarra, A., Huopaniemi, T., Virtanen, A., & Johansson, G. (1984). The influence of exercise on dental pain thresholds and the release of stress hormones. Physiology & Behaviour, 33 (6), 923-926.

Peterson, M., Kovar-Toledano, P., Otis, J., Allegrante, J., Mackenzie, C., Gutin, B., & Kroll, M. (1993). Effect of a walking program on gait characteristics in patients with osteoarthritis. Arthritis Care and Research, 6 (1), 11-16.

Peyron, J. (1993). Osteoarthritis and cartilage. Osteoarthritis Research Society, 85.

Pierron, R.L., Perry, H.M., Grossberg, J.E., Morley, J.E., Mahon, G., & Stewart, T. (1990). The aging hip. The American Geriatrics Society, 38, 1229-1352.

Porcari, J.P., Ward, A., & Morgan, W. (1988). Effect of walking on state anxiety and blood pressure (abstract). Medicine and Science in Sports and Exercise, 20 (Suppl. 2), S85.

Poser, C., & Ronthal, M. (1991). Exercise and Alzheimer's disease, Parkinson's disease and multiple sclerosis. The Physician and Sportsmedicine, 19 (12), 85-92.

Poss, R., & Sledge, C. (1989). The hip. In W. Kelley, E. Harris, S. Ruddy, & C. Sledge (Eds.), Textbook of Rheumatology (pp. 2027-2040). Philadelphia: W.B. Saunders Company.

Puranen, J., Ala-Ketola, L., Peltokallio, P., & Saarela, J. (1975). Running and primary osteoarthritis of the hip. British Medical Journal, 2, 424-425.

Rockwood, K. (1995). Integration of research methods and outcome measures: Comprehensive care for the frail elderly. Canadian Journal on Aging, 14 (Suppl. 2), 151-164.

Romsa, G., & Blenman, M. (1989). Recording activity patterns: some comments from a Southwestern Ontario study of retirees. Journal of Applied Recreation Research, 15 (1), 41-50.

Rorabeck, C. Bourne, R. Laupacis, A., Feeny, D., Wong, C., Tugwell, P., Leslie, K., & Bullas, R. (1994). A double-blind study of 250 cases comparing cemented with cementless total hip arthroplasty. Clinical Orthopaedics and Related Research, 298, 156-164.

Sallis, J.F., Haskell, W.L., Wood, P.D., Fortmann, S.P., Rogers, T., Blair, S.N,. & Paffenbarger, R.S. (1985). Physical activity assessment methodology in the five-city project. American Journal of Epidemiology, 121 (1), 91-106.

Sarna, S., Sahi, T., Koskenvuo, M., & Kaprio, J. (1993). Increased life expectancy of world class male athletes. Medicine and Science in Sports and Exercise 237-244.

Schon, L., & Zuckerman, J. (1988). Hip pain in the elderly: evaluation and diagnosis. Geriatrics, 43 (1), 48-62.

Shelby, B., & Colvin, R. (1982). Encounter measures in carrying capacity research: actual, reported, and diary contacts. Journal of Leisure Research, 14 (4), 350-360.

Shephard, R. (1993). A critical analysis of work-site fitness programs and their postulated economic benefits. Medicine and Science in Sports and Exercise, 24, 354-370.

Shephard, R. (1994). Physical activity and reduction of health risks: how far are the benefits independent of fat loss? The Journal of Sports Medicine and Physical Fitness, 34 (1), 91-98.

Sinyor, D., Golden, M., & Steinert, Y. (1986). Experimental manipulation of aerobic fitness and the response to psychosocial stress: Heart rate and self-report measures. Psychosomatic Medicine, 48 (5), 324-337.

Skelton, D., Greig, C., Davies, J., & Young, A. (1994). Strength, power and related functional ability of healthy people aged 65-89 years. Age and Aging, 23, 371-377.

Solomon, G. (1991). Psychosocial factors, exercise and immunity: athletes, elderly persons, and AIDS patients. International Journal of Sports Medicine, 12 (1), 50-53.

Steincamp, L., Dillingham, M,. & Markel, M. (1993). Biomechanical considerations in patellofemoral joint rehabilitation. American Journal of Sports Medicine, 21 (3), 438-444.

Stevens, T. (1988). Physical activity and mental health in the United States and Canada: Evidence from four population surveys. Preventative Medicine, 17, 35-47.

Street, R., Gold, W., & McDowell, T. (1994). Using health status surveys in medical consultations. Medical Care, 32 (7), 732-744.

Taber's Cyclopedic Medical Dictionary. 16th Ed. (1989). Philadelphia: F.A Davis Company.

Takeda, W. & Wessel, J. (1994). Acupuncture for the treatment of pain of osteoarthritic knees. Arthritis Care & Research, 7 (3), 118-124.

Thirlaway, K., & Benton, D. (1992). Participation in physical activity and cardiovascular fitness have different effects on mental health and mood. Journal of Psychosomatic Research, 36, 657-665.

Tortora, G. (1989). Principles of Human Anatomy. New York: Harper Collins Publishers.

Vingard, E. (1994). Sport and the development of osteoarthritis of the hip. Sports Medicine, 18 (1), 1-4.

Ware, J., & Sherbourne, C. (1992). The MOS 36-item short-form health survey: Conceptual framework and item selection. Medical Care, 30 (6), 473-483.

Weissman, B. (1989). Radiographical evaluation of total joint replacement. In W. Kelley, E. Harris, S. Ruddy, & C. Sledge (Eds.), Textbook of Rheumatology (pp. 2091 -2122). Philadelphia: W.B. Saunders Company.

White, S., Croce, R., Loureiro, E., & Vroman, N. (1991). Effects of frequency and duration of exercise sessions on physical activity levels and adherence. Perceptual Motor Skills, 73, 172-174.

Wigley, F.M. (1984). Osteoarthritis: practical management in older patients. Geriatrics, 39 (3), 101-114.

Wiklund, I., & Romanus, B. (1991). A comparison of quality of life before and after arthroplasty in patients who had arthrosis of the hip. Journal of Bone and Joint Surgery, 73-A (5), 765-769.

Zgola, J. (1987). Doing Things: A Guide to Programming Activities for Persons with Alzheimer's Disease and Related Diseases. Baltimore: John's Hopkins University Press.

Appendixes

Appendix A

*Letter of Request for Participation

_______________, 1995

The Port Arthur Clinic

194 N. COURT STREET
THUNDER BAY, ONTARIO
P7A 4V7

(807) 345-2332
FAX (807) 345-2675

Dear _______________:

I have long had an interest in the natural history of arthritis of the hip. Some years ago I started keeping a list of those patients whom I had followed for several years, either without surgical intervention, or before an eventual operation.

Shannon Andersen, H. B. Sc., a graduate Kinesiology student, has agreed to help me study this group as part of her masters thesis. Shannon would like to interview all the patients in this group, probably twice over a six month period, to determine such factors as quality of life, activity level, and the reasons for not seeking or delaying a surgical solution.

If you would be prepared to take part in this study, please sign the consent slip below and return it to me in the enclosed stamped envelope.

Yours sincerely,

H. W. HAMILTON, M.B., Ch.B., F.R.C.S. (Ed), F.R.C.S. (C)

I _______________ agree to be interviewed by Shannon Andersen, H. B. Sc.,
(Please Print)
at The Port Arthur Clinic, and to allow Shannon Andersen to review those medical records relating to my hip problems.

Signature _______________

Date _______________

*Printed with permission from Dr. H. Hamilton, 1996.

Appendix B

Consent Form

1. This study is aimed to profile and determine the relationship between activity levels, physical functioning, quality of life, health status, and severity of degeneration in long-term degenerative hip disease patients.

2. I, ____________________ consent to take part in a study which will examine these variables, as well as the coping skills I use to manage the pain, stiffness and functional disability in my hip(s).

3. Dr. Henry Hamilton, the doctor in charge of the examinations, and Shannon Andersen, the principle investigator, have explained to me that I will be asked to participate in an interview session where I will be asked to fill out two questionnaires, answer some interview questions, perform a six-minute walk test, and maintain a one month"activity" diary which has been created specifically for this study. In this diary I will indicate my daily activities as specifically as I can, as well as the use of walking aids and medication.

4. I understand that there will be no direct benefit to me from participating in this study. I also understand that I may withdraw from the study at any time, even after signing this form, and this will in no way affect the regular care that I will receive. Any information that is collected about me during this study will be kept confidential, and if the results are published, I will not be identified in any way. However, the results will be available to me, and I may receive a copy of the written document upon completion of the study.

____

Signature of Participant Date

5. We have explained the nature of the study to the patient and believe he/she has understood it.

____

Signature of Researcher Date

____

Signature of Doctor Date

Appendix C

***Short Form 36 (SF-36) Health Status Questionnaire**

ENGLISH (CANADA)

SF-36

IQOLA SF-36 English (Canada)
Acute Version

The Port Arthur Clinic
194 N. Court Street
Thunder Bay, Ontario
P7A 4V7

*Printed with permission from the Medical Outcomes Trust, 1995.

SF-36 HEALTH SURVEY

INSTRUCTIONS: This survey asks for your views about your health. This information will help keep track of how you feel and how well you are able to do your usual activities.

Answer every question by marking the answer as indicated. If you are unsure about how to answer a question, please give the best answer you can.

1. In general, would you say your health is:

(circle one)

Excellent	1
Very good	2
Good	3
Fair	4
Poor	5

2. Compared to one week ago, how would you rate your health in general now?

(circle one)

Much better now than one week ago	1
Somewhat better now than one week ago	2
About the same as one week ago	3
Somewhat worse now than one week ago	4
Much worse now than one week ago	5

3. The following items are about activities you might do during a typical day. Does your health now limit you in these activities? If so, how much?

(circle one number on each line)

ACTIVITIES	Yes, Limited A Lot	Yes, Limited A Little	No, Not Limited At All
a. **Vigorous activities**, such as running, lifting heavy objects, participating in strenuous sports	1	2	3
b. **Moderate activities**, such as moving a table, pushing a vacuum cleaner, bowling, or playing golf	1	2	3
c. Lifting or carrying groceries	1	2	3
d. Climbing **several** flights of stairs	1	2	3
e. Climbing **one** flight of stairs	1	2	3
f. Bending, kneeling, or stooping	1	2	3
g. Walking **more than a kilometre**	1	2	3
h. Walking **several blocks**	1	2	3
i. Walking **one block**	1	2	3
j. Bathing or dressing yourself	1	2	3

4. During the past week, have you had any of the following problems with your work or other regular daily activities as a result of your physical health?

(circle one number on each line)

	YES	NO
a. Cut down on the **amount of time** you spent on work or other activities	1	2
b. **Accomplished less** than you would like	1	2
c. Were limited in the **kind** of work or other activities	1	2
d. Had **difficulty** performing the work or other activities (for example, it took extra effort)	1	2

5. During the past week, have you had any of the following problems with your work or other regular daily activities as a result of any emotional problems (such as feeling depressed or anxious)?

(circle one number on each line)

	YES	NO
a. Cut down the **amount of time** you spent on work or other activities	1	2
b. **Accomplished less** than you would like	1	2
c. Didn't do work or other activities as **carefully** as usual	1	2

6. During the past week, to what extent has your physical health or emotional problems interfered with your normal social activities with family, friends, neighbors, or groups?

(circle one)

Not at all 1

Slightly 2

Moderately 3

Quite a bit 4

Extremely 5

7. How much bodily pain have you had during the past week?

(circle one)

None 1

Very mild 2

Mild 3

Moderate 4

Severe 5

Very severe 6

8. During the past week, how much did pain interfere with your normal work (including both work outside the home and housework)?

(circle one)

Not at all 1

A little bit 2

Moderately 3

Quite a bit 4

Extremely 5

9. These questions are about how you feel and how things have been with you during the past week. For each question, please give the one answer that comes closest to the way you have been feeling. How much of the time during the past week -

(circle one number on each line)

	All of the Time	Most of the Time	A Good Bit of the Time	Some of the Time	A Little of the Time	None of the Time
a. Did you feel full of pep?	1	2	3	4	5	6
b. Have you been a very nervous person?	1	2	3	4	5	6
c. Have you felt so down in the dumps that nothing could cheer you up?	1	2	3	4	5	6
d. Have you felt calm and peaceful?	1	2	3	4	5	6
e. Did you have a lot of energy?	1	2	3	4	5	6
f. Have you felt downhearted and blue?	1	2	3	4	5	6
g. Did you feel worn out?	1	2	3	4	5	6
h. Have you been a happy person?	1	2	3	4	5	6
i. Did you feel tired?	1	2	3	4	5	6

10. **During the past week, how much of the time has your physical health or emotional problems interfered with your social activities (like visiting with friends, relatives, etc.)?**

(circle one)

All of the time 1

Most of the time 2

Some of the time 3

A little of the time 4

None of the time 5

11. How TRUE or FALSE is each of the following statements for you?

(circle one number on each line)

	Definitely True	Mostly True	Don't Know	Mostly False	Definitely False
a. I seem to get sick a little easier than other people	1	2	3	4	5
b. I am as healthy as anybody I know	1	2	3	4	5
c. I expect my health to get worse	1	2	3	4	5
d. My health is excellent	1	2	3	4	5

Appendix D

*Western Ontario and McMaster Universities (WOMAC) Osteoarthritis Index

Patient ID

Date

WOMAC

OSTEOARTHRITIS

INDEX

The Port Arthur Clinic
194 N. Court Street
Thunder Bay, Ontario
P7A 4V7

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Section A

INSTRUCTIONS TO PATIENTS

The following questions concern the amount of pain you have experienced due to arthritis in your study joint(s). For each situation please enter the amount of pain experienced in the last 48 hours. (Please mark your answers with an "X".)

QUESTION: How much pain do you have?

1. Walking on a flat surface.

None	Mild	Moderate	Severe	Extreme
☐	☐	☐	☐	☐

2. Going up or down stairs.

None	Mild	Moderate	Severe	Extreme
☐	☐	☐	☐	☐

3. At night while in bed.

None	Mild	Moderate	Severe	Extreme
☐	☐	☐	☐	☐

4. Sitting or lying.

None	Mild	Moderate	Severe	Extreme
☐	☐	☐	☐	☐

5. Standing upright.

None	Mild	Moderate	Severe	Extreme
☐	☐	☐	☐	☐

PAIN1 ______

PAIN2 ______

PAIN3 ______

PAIN4 ______

PAIN5 ______

Section B

INSTRUCTIONS TO PATIENTS

The following questions concern the amount of joint stiffness (not pain) you have experienced in the last 48 hours in your study joint(s). Stiffness is a sensation of restriction or slowness in the ease with which you move your joints. (Please mark your answers with an "X".)

6. How **severe** is your stiffness **after first wakening** in the morning?

None	Mild	Moderate	Severe	Extreme
☐	☐	☐	☐	☐

7. How **severe** is your stiffness after sitting, lying or resting **later in the day?**

None	Mild	Moderate	Severe	Extreme
☐	☐	☐	☐	☐

STIFF6 ______

STIFF7 ______

16. Putting on socks/stockings.

None	Mild	Moderate	Severe	Extreme
☐	☐	☐	☐	☐

17. Rising from bed.

None	Mild	Moderate	Severe	Extreme
☐	☐	☐	☐	☐

18. Taking off socks/stockings.

None	Mild	Moderate	Severe	Extreme
☐	☐	☐	☐	☐

19. Lying in bed.

None	Mild	Moderate	Severe	Extreme
☐	☐	☐	☐	☐

20. Getting in/out of bath.

None	Mild	Moderate	Severe	Extreme
☐	☐	☐	☐	☐

21. Sitting.

None	Mild	Moderate	Severe	Extreme
☐	☐	☐	☐	☐

22. Getting on/off toilet.

None	Mild	Moderate	Severe	Extreme
☐	☐	☐	☐	☐

23. Heavy domestic duties.

None	Mild	Moderate	Severe	Extreme
☐	☐	☐	☐	☐

24. Light domestic duties.

None	Mild	Moderate	Severe	Extreme
☐	☐	☐	☐	☐

PFTN16 _____

PFTN17 _____

PFTN18 _____

PFTN19 _____

PFTN20 _____

PFTN21 _____

PFTN22 _____

PFTN23 _____

PFTN24 _____

THANK YOU FOR COMPLETING THE QUESTIONNAIRE

Section C

INSTRUCTIONS TO PATIENTS

The following questions concern your physical function. By this we mean your ability to move around and to look after yourself. For each of the following activities, please indicate the degree of difficulty you have experienced in the last 48 hours due to arthritis in your study joint(s). (Please mark your answers with an "X".)

QUESTION: What degree of difficulty do you have?

8. Descending stairs.

None	Mild	Moderate	Severe	Extreme
☐	☐	☐	☐	☐

PFTN8 ______

9. Ascending stairs.

None	Mild	Moderate	Severe	Extreme
☐	☐	☐	☐	☐

PFTN9 ______

10. Rising from sitting.

None	Mild	Moderate	Severe	Extreme
☐	☐	☐	☐	☐

PFTN10 ______

11. Standing.

None	Mild	Moderate	Severe	Extreme
☐	☐	☐	☐	☐

PFTN11 ______

12. Bending to floor.

None	Mild	Moderate	Severe	Extreme
☐	☐	☐	☐	☐

PFTN12 ______

13. Walking on flat.

None	Mild	Moderate	Severe	Extreme
☐	☐	☐	☐	☐

PFTN13 ______

14. Getting in/out of car.

None	Mild	Moderate	Severe	Extreme
☐	☐	☐	☐	☐

PFTN14 ______

15. Going shopping.

None	Mild	Moderate	Severe	Extreme
☐	☐	☐	☐	☐

PFTN15 ______

Appendix E

Activity Levels and Coping Strategies Interview Questions

1. Do you foresee yourself having to have a hip replacement in the future____________

2. What factors has stopped you from having one this far? (doctor, $, scared, age, other...)

3. Do you consider yourself to be a physically active person? ___________________

4. What types of activities do you do? (frequencies/intensities/durations/types....)?

   Walking

   Bicycling

   Fishing/Hunting

   Yard work/Gardening

   Skiing

   Cards/Bingo/Knitting

   Swimming

   Other sports or activities

   Grocery shopping/house work/ cooking

5. How does activity make you feel generally, and how does your hip feel?; are you better or worse afterwards, does this differ with the activity (pain, stiffness, emotions, fatigue...)

6. What coping skills do you use to combat the pain and stiffness in your hip? Examples of rest, ice, heat, saunas, whirlpools, medications, walking aids, exercise, stretching....

7. Is this a typical day with respect to all aspects of your DHD? Is there anything unusual today about you that might affect your results? i.e. colds, flu, current health, amount of activity performed today (too much, too little) other etc.....

Six Minute Walk test results.__________________

Appendix F

*Quantification of Activity Levels

ACTIVITY/ EXERCISE	Lo METS	Med. METS	High METS
Walking	2	4	7
Jogging/Running	7	10	13
Swimming/Scuba	3	6	10
Hockey/Skating/Skiing	6	8	12
Bicycling	3	6	9
Tennis/Badminton/Table Tennis	4	6	8
Basketball/Volleyball	4	8	12
Bowling/Lawn	2	3	4
Calisthenics	7	9	12
Squash/Racquetball/Handball	8	10	12
Dancing	4	5	6
Weightlifting	4	6	8
Yoga	2	4	6
Rugby/Football	6	8	12
Soccer	8	10	12
Golf	2	3	4
Curling	3	4	5
Baseball	3	4	5
Gardening	2	4	6
Boating/Fishing	2	3	4
Horseback Riding	3	4	6
Other (Average)	4	6	8

Note. *Adapted from the Ministry of Tourism and Recreation (1986), p. 23.

The chart above indicates the MET values assigned to reported activities, at various levels of intensity. The physical activity index is calculated according to the following formula:

Total times active per month X ***METS value for activity*** X ***average time per session (mins)***

Appendix G

Sample Page From a One Week Diary

Dear ___________________

I would like to take this opportunity to thank you for participating in this study. The following are instructions on the workings of this diary. It is a 7 day diary, and must be filled out each day. Please be as specific as possible when completing each page.

Section 1 is labelled ACTIVITY. In this section please indicate any activities which you may have performed that day, and how long you were active for. For example, did you go for a walk? How far did you go, and how long did it take you? Did you go for a swim today? What type of swimming did you perform (lengths, or aquabics...), and how long did you swim for? Did you go for a bicycle ride today? For how long? Did you play golf? How many holes? Did you go shopping? Did you work in the yard/garden? These are just examples of possible activities you might have performed today. Please be as specific as possible.

Section 2 is labelled WALKING AIDS. In this section, I would like you to write down if you required the used of a walking aid during your activity today. Did you use a cane? Two canes? A walker? Crutches? A wheelchair? Any other walking aid?

Section 3 is labelled PAIN MEASUREMENT. Much like with the questionnaire you filled out during the interview, please mark an "X" in the box that best describes how you generally felt that day. Please be as honest as possible. In this section, also indicate any activity that you may have done that made your hip(s) feel better. Did you take a hot bath? Use ice therapy? Go for a sauna? Rest? Exercise?

Section 4 is labelled MEDICATION. In this section, please indicate if you took any pain medication OR any anti-inflammatory drugs that day. Also indicate what type (brand name) of medication it was, and the dosage you took.

Please fill out sections 1-4 every day. When you have completed this diary, please return it to Dr. Hamilton at the Port Arthur Clinic. The address can be located on the first page of this diary. Again, thank you for your participation in this study.

Shannon Andersen, H.B.Sc.

DATE: ____________________

SECTION 1: ACTIVITY	**SECTION 3: PAIN MEASUREMENT** PLACE AN "X" IN THE SQUARE THAT BEST DESCRIBES HOW YOU FEEL TODAY. PLEASE ADD ANY ADDITIONAL COMMENTS ON THINGS THAT MADE YOU, AND YOUR HIP(S) FEEL BETTER, OR WORSE TODAY. 1 : NO PAIN .... ☐ 2 : MILD PAIN .... ☐ 3 : MODERATE PAIN .... ☐ 4 : SEVERE PAIN .... ☐ 5 : EXTREME PAIN .... ☐ ADDITIONAL INFORMATION: ____________________ ____________________
SECTION 2: WALKING AIDS	**SECTION 4: MEDICATION**

Appendix H

***Classification and Assessment of Degeneration Severity**

NAME: Date of film:

PATHOLOGICAL DIAGNOSIS:

RADIOLOGICAL DIAGNOSIS:

Upper CARTILAGE SPACE: mm.
Medial CARTILAGE SPACE: mm.
MINIMAL CARTILAGE SPACE: mm.

OSTEOPHYTES,
Head/neck, length superior: mm.
length inferior: mm.
Acetabulum, length superior: mm.
thickness medial: mm.
length inferior: mm.

SCLEROSIS, Head, maximum thickness: mm.
Acetabulum, maximum thickness: mm.

CYSTS, Head: 1 mm, 2 mm, 3 mm, X.
Acetabulum: 1 mm, 2 mm, 3 mm, X.

SPHERICITY OF HEAD (height/width):

MIGRATION OF CENTRE OF ROTATION:
mm, degrees, lateral/medial.

OTHER FEATURES:

Defining O.A. of the hip for epidemiological studies. Croft, Cooper, Wickham & Coggon. American J. of Epidemiology. Vol 132, No 3, p 514-522, 1990.

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IMAGE EVALUATION TEST TARGET (QA-3)

150mm

6"

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Fax: 716/288-5989