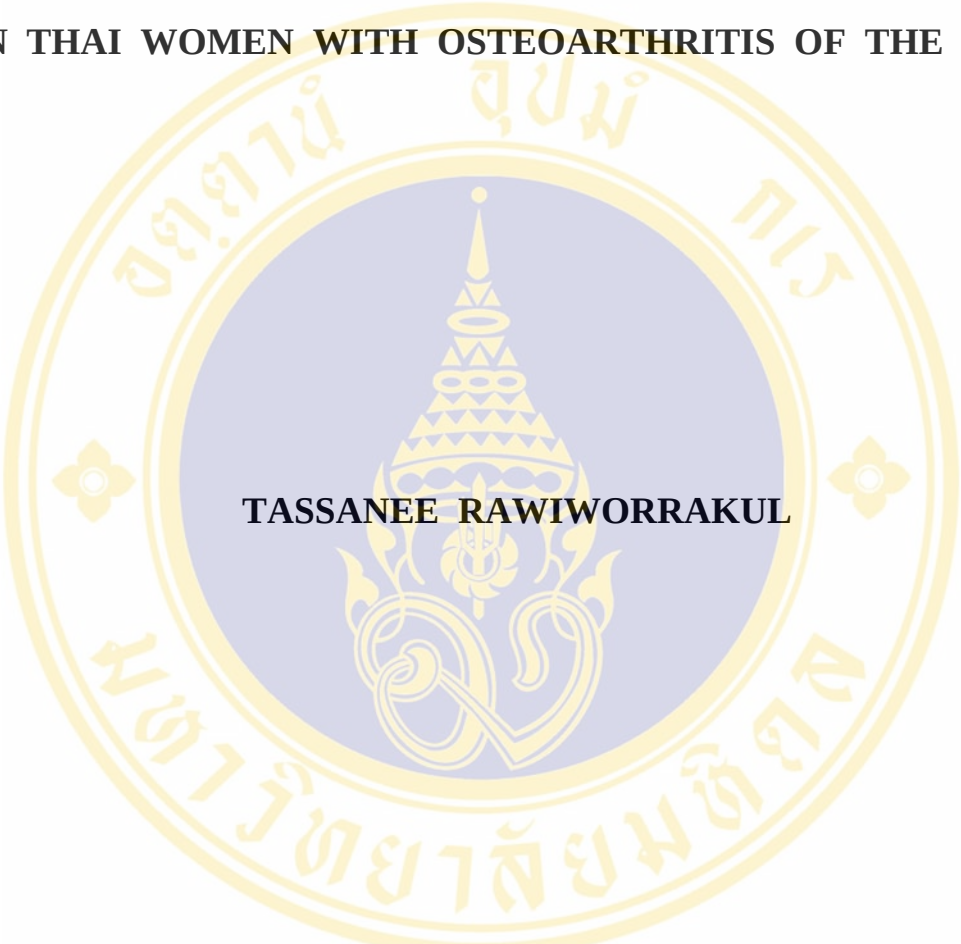


**THE EFFECTIVENESS OF A COMMUNITY-BASED
EXERCISE PROGRAM ON SELF-EFFICACY AND OUTCOME
EXPECTATIONS FOR EXERCISE, SEVERITY OF KNEE
SYMPTOMS, AND PHYSICAL PERFORMANCE
IN THAI WOMEN WITH OSTEOARTHRITIS OF THE KNEE**

The seal of Mahidol University is a large, circular emblem. It features a central blue circle containing a golden Thai stupa. Surrounding this is a yellow ring with Thai script. The outermost ring is white with a yellow border and more Thai script. The author's name is printed across the center of the seal.

TASSANEE RAWIWORRAKUL

**A THESIS SUBMITTED IN PARTIAL FULFILLMENT
OF THE REQUIREMENTS FOR
THE DEGREE OF DOCTOR OF PHILOSOPHY (NURSING)
FACULTY OF GRADUATE STUDIES
MAHIDOL UNIVERSITY**

2006

ISBN 974-04-7211-7

COPYRIGHT OF MAHIDOL UNIVERSITY

Thesis
Entitled

THE EFFECTIVENESS OF A COMMUNITY-BASED EXERCISE PROGRAM
ON SELF-EFFICACY AND OUTCOME EXPECTATIONS FOR EXERCISE,
SEVERITY OF KNEE SYMPTOMS, AND PHYSICAL PERFORMANCE
IN THAI WOMEN WITH OSTEOARTHRITIS OF THE KNEE

Tassanee Rawiworakul

Ms. Tassanee Rawiworakul
Candidate

Yupapin Sirapo-ngam

Assoc.Prof. Yupapin Sirapo-ngam,
D.S.N. (Adult Health)
Major-Advisor

Amy H. Tsang Davis

Asst.Prof. Amy H. Tsang Davis,
Ph.D. (Nursing)
Co-Advisor

Porntip Malathum

Lect. Porntip Malathum,
Ph.D. (Nursing)
Co-Advisor

T. Kulthanan

Clin.Prof. Teerawat Kulthanan,
M.D., FIMS, FICS, FRCS(T)
Co-Advisor

Thavatchai Vorapongsathorn

Assoc. Prof. Thavatchai Vorapongsathorn,
Ph.D. (Research Design & Statistics)
Co-Advisor

Salee Kiewkarnka

Asst. Prof. Salee Kiewkarnka, Ph.D
Acting Dean
Faculty of Graduate Studies

Kobkul Phancharoenworakul

Assoc. Prof. Kobkul Phancharoenworakul,
Ph.D. (Nursing)
Chair
Doctor of Philosophy Program in Nursing
Faculty of Medicine, Ramathibodi Hospital
and Faculty of Nursing

Thesis
Entitled

THE EFFECTIVENESS OF A COMMUNITY-BASED EXERCISE PROGRAM
ON SELF-EFFICACY AND OUTCOME EXPECTATIONS FOR EXERCISE,
SEVERITY OF KNEE SYMPTOMS, AND PHYSICAL PERFORMANCE
IN THAI WOMEN WITH OSTEOARTHRITIS OF THE KNEE

was submitted to the Faculty of Graduate Studies, Mahidol University
for the degree of Doctor of Philosophy (Nursing)

on
April 5, 2006

Tassanee Rawiworrakul

Ms. Tassanee Rawiworrakul
Candidate

Amy H. Tsang Davis

Asst.Prof. Amy H. Tsang Davis,
Ph.D. (Nursing)
Member

Yupapin Sirapo-ngam

Assoc.Prof. Yupapin Sirapo-ngam,
D.S.N. (Adult Health)
Chair

T. Kulthanan

Clin.Prof. Teerawat Kulthanan,
M.D., FIMS, FICS, FRCS (T)
Member

Porntip Malathum

Lect. Porntip Malathum,
Ph.D. (Nursing)
Member

Linchong Pothiban

Assoc.Prof. Linchong Pothiban,
D.S.N. (Adult Health)
Member

Thavatchai Vorapongsathorn

Assoc.Prof. Thavatchai Vorapongsathorn,
Ph.D. (Research Design & Statistics)
Member

Somchit Hanucharurnkul

Prof. Somchit Hanucharurnkul,
Ph.D. (Nursing)
Member

Rajata Rajatanavin

Prof. Rajata Rajatanavin, M.D., F.A.C.E.
Dean
Faculty of Medicine, Ramathibodi Hospital
Mahidol University

Salee Kiewkarnka

Asst. Prof. Salee Kiewkarnka, Ph.D
Acting Dean
Faculty of Graduate Studies
Mahidol University

Kobkul Phancharnworakul

Assoc. Prof. Kobkul Phancharnworakul,
Ph.D. (Nursing)
Dean
Faculty of Nursing
Mahidol University

ACKNOWLEDGEMENT

I would like to express my sincere appreciation to the dissertation committee: Associate Professor Dr. Yupapin Sirapo-ngam, the major advisor, who has worked hard and closely with wisdom, dedication and kindness; and my co-advisors, Clinical Professor Dr. Teerawat Kulthanan, Associate Professor Dr. Thawatchai Vorapongsa-thorn, Dr. Porntip Malathum, and a distinguish committee from College of Nursing University of Arizona, Assistant Professor Dr. Amy H. Tsang Davis, who have provided valuable knowledge, experiences, and suggestions to this study. The external committee, Associate Professor Dr. Linchong Pothiban, and the representative committee from the Ph.D. Program in Nursing, Professor Dr. Somchit Hanucharurnkul, also have given valuable guidance and comments for this dissertation.

My sincere thanks runs to the experts involved to this study, Dr. Chakarg Pongurgsorn, Dr. Ratre Ruangthai, and Dr. Kwanjai Amnatsatsue. They were vital in validating of the community-based exercise program protocol. Thanks also goes to Professor Barbara Resnick, Dr. Teeranut Harnirattisai, Assistant Professor Dr. Narirat Jitramontree, and Mrs. Pranee Kanjanavorawong for their valid instruments using in this study. Moreover, I am grateful to every instructor and professor in the curriculum, who were patient teaching me becoming a scholar.

In addition, I would like to thank the Thai Health Promotion Foundation for the research grant provided to this study. Many thanks are given to every technician and officer of the Division of Sport Medicine, Department of Orthopedic Surgery, Faculty of Medicine, Siriraj Hospital in conducting over two hundred times of the isokinetic muscle strength testing. Thanks to the community nurses in every study settings of Bang Kruay District, Nonthaburi Province, for providing their effort on surveying and finding potential participants. I cannot forget to thanks all of the study settings, community members, elderly club members, and all potential participants who had dedicated their effort and time during the eight months of the study.

The completion of this dissertation would not be achieved without support from my mother and elder brother. I have also appreciated the support from Associate Professor Dr. Chalermchai Chaikittiporn, Dean of Faculty of Public Health, Mahidol University, Associate Professor Dr. Sunee Lagampan - Head, and my colleagues at the Department of Public Health Nursing. I also thank to all my friends for their understanding, caring, and supports.

Lastly, I would like to give my apology and express my thankful to those whose I failed to give names on this page. I genuinely appreciate all of your helps. Thank you.

Tassanee Rawiworrakul

THE EFFECTIVENESS OF A COMMUNITY-BASED EXERCISE PROGRAM ON SELF-EFFICACY AND OUTCOME EXPECTATIONS FOR EXERCISE, SEVERITY OF KNEE SYMPTOMS, AND PHYSICAL PERFORMANCE IN THAI WOMEN WITH OSTEOARTHRITIS OF THE KNEE

TASSANEE RAWIWORRAKUL 4436648 NRNS / D

Ph.D. (NURSING)

THESIS ADVISORS: YUPAPIN SIRAPO-NGAM, D.S.N.; AMY H. TSANG DAVIS, Ph.D.; PORNTIP MALATHUM, Ph.D.; TEERAWAT KULTHANAN, M.D., FIMS, FICS, FRCS(T); THAVATCHAI VORAPONGSATHORN, Ph.D.

ABSTRACT

Osteoarthritis of the knee is one of the most common chronic conditions and most often occurs in women middle aged and older. Exercise can decrease pain related to osteoarthritis of the knee, as well as increase physical performance. However, insufficient data to provide guidelines on the optimal exercise type or dosage exists. The purpose of this study was to examine whether a bi-weekly stationary cycling exercise provided beneficial outcomes in the 4th, 8th, or 12th week of the intervention.

There were 25 experimental and 28 control participants who completed the study. Community participation involved finding an exercise facility, recruiting potential participants, and finding instruments for cycling exercise in the community. A lecture of general information regarding osteoarthritis of the knee was provided to all eligible participants. Then, a community-based exercise program based on self-efficacy enhancing strategies, was conducted twice weekly for the experimental participants. Control participants were asked to maintain their normal activities. Severity of the Disease-Modified Version (M-SEV), Self-efficacy (SEE) and Outcome Expectations for Exercise (OEE) and physical performance, including 6-Minute Walk Test-Distance (6MWD), range of motion (ROM) of the knee, and quadriceps muscle strength were assessed at baseline, the 4th, 8th, and 12th week. Multivariate analyses and non-parametric analyses were employed to detect differences between groups and changes over time.

Results revealed non-significant differences between groups, despite this, the experimental group improved the M-SEV, SEE, 6MWD, ROM in both knee and quadriceps muscle strength at the 4th week ($p < .05$). With a ceiling effect at baseline, OEE did not change in either group. Control participants improved the M-SEV, SEE, 6MWD and quadriceps muscle strength but ROM was stable.

Although the control group improved their beneficial outcomes as well, the experimental group showed more improvements. In addition, the experimental participants learned to exercise safely and did not develop knee pain despite having osteoarthritis of the knee. Therefore, establishing an exercise facility in a community may encourage some regular exercise behavior which could be maintained for a healthy lifestyle.

KEY WORDS: EXERCISE / KNEE OSTEOARTHRITIS / SELF-EFFICACY / OUTCOME EXPECTATIONS / PHYSICAL PERFORMANCE

190 P. ISBN 974-04-7211-7

ประสิทธิผลของโปรแกรมการออกกำลังกายต่อความสามารถตนเองต่อการออกกำลังกาย ความคาดหวังในผลลัพธ์ของการออกกำลังกาย ความรุนแรงของอาการปวดเข่า และสมรรถภาพทางกายของสตรีไทยที่มีอาการของโรคข้อเข่าเสื่อม (THE EFFECTIVENESS OF A COMMUNITY-BASED EXERCISE PROGRAM ON SELF-EFFICACY AND OUTCOME EXPECTATIONS FOR EXERCISE, SEVERITY OF KNEE SYMPTOMS, AND PHYSICAL PERFORMANCE IN THAI WOMEN WITH OSTEOARTHRITIS OF THE KNEE)

ทัศนีย์ รวีวรกุล 4436648 NRNS / D

ปร.ด. (การพยาบาล)

คณะกรรมการควบคุมวิทยานิพนธ์: ยูพาพิน ศิริโพธิ์งาม, D.S.N., Amy H. Tsang Davis, Ph.D., พรทิพย์ มาลาธรรม, Ph.D., ชีรวัฒน์ กุลทนันทน์, M.D., FIMS, FICS, FRCS(T), ธวัชชัย วรพงษ์พร, Ph.D.

บทคัดย่อ

โรคข้อเข่าเสื่อมเป็นโรคที่มักพบได้ในผู้หญิงวัยกลางคนถึงผู้สูงอายุ การออกกำลังกายเป็นวิธีหนึ่งที่จะช่วยบรรเทาอาการปวดเข่าจากโรคข้อเข่าเสื่อมและช่วยเพิ่มสมรรถภาพทางกาย แต่ยังไม่มีการศึกษาใดที่จะบอกได้ว่าการออกกำลังกายแบบใดและระยะเวลาเท่าใดที่จะทำให้เกิดประสิทธิภาพสูงสุดในการบำบัดอาการดังกล่าว การวิจัยครั้งนี้มีวัตถุประสงค์เพื่อศึกษาผลของโปรแกรมการออกกำลังกายต่อความสามารถตนเองต่อการออกกำลังกาย ความคาดหวังในผลลัพธ์ของการออกกำลังกาย ความรุนแรงของอาการปวดเข่า และสมรรถภาพทางกายเปรียบเทียบระหว่างสตรีในชุมชนกลุ่มทดลองจำนวน 25 คนกับสตรีในชุมชนกลุ่มเปรียบเทียบจำนวน 28 คน ในเขตอำเภอบางกรวย จังหวัดนนทบุรี ทั้งก่อนเริ่มโปรแกรม ๑ และในระยะ 4, 8, และ 12 สัปดาห์หลังจากเริ่มโปรแกรม ๑ ดังกล่าว

การวิจัยเริ่มต้นโดยอาศัยความร่วมมือจากบุคลากรสุขภาพ สมาชิกในชุมชนและสมาชิกชมรมผู้สูงอายุกลุ่มทดลองในการจัดตั้งสถานที่เพื่อออกกำลังกาย การรับสมัครผู้ร่วมวิจัย และจัดหาจักรยานออกกำลังกาย หลังจากการบรรยายเรื่องน่ารู้เกี่ยวกับข้อเข่าเสื่อมให้แก่ผู้ร่วมวิจัยทั้งสองกลุ่มแล้ว ผู้วิจัยเริ่มโปรแกรมการออกกำลังกายด้วยจักรยานออกกำลังกายแบบตั้งอยู่กับที่ให้แก่กลุ่มทดลองสัปดาห์ละ 2 ครั้งเป็นเวลา 12 สัปดาห์ ส่วนกลุ่มควบคุมสามารถดำเนินกิจวัตรประจำวันได้ตามปกติ โดยทั้งสองกลุ่มตอบแบบสอบถามความสามารถตนเองต่อการออกกำลังกาย ความคาดหวังในผลลัพธ์ของการออกกำลังกาย ความรุนแรงของอาการปวดเข่า และวัดสมรรถภาพทางกายรวม 4 ครั้ง คือ ก่อนเริ่มโปรแกรม ๑ และในระยะ 4, 8, และ 12 สัปดาห์หลังจากเริ่มโปรแกรม ๑ ดังกล่าว วิเคราะห์ข้อมูลโดยสถิติพารามตริกและนอนพารามตริกเปรียบเทียบความแตกต่างภายในกลุ่มและเปรียบเทียบระหว่างกลุ่ม

ผลการเปรียบเทียบระหว่างกลุ่มพบว่าตัวแปรที่ศึกษาแตกต่างกันอย่างไม่มีนัยสำคัญทางสถิติ อย่างไรก็ตามกลุ่มทดลองมีการเปลี่ยนแปลงของความสามารถตนเองต่อการออกกำลังกาย ความรุนแรงของอาการปวดเข่า ระยะทางที่เดินในเวลา 6 นาที องศาการงอข้อเข่า และความแข็งแรงกล้ามเนื้อต้นขา อย่างมีนัยสำคัญทางสถิติ ($p < .05$) กลุ่มควบคุมมีการเปลี่ยนแปลงของความสามารถตนเองต่อการออกกำลังกาย ความรุนแรงของอาการปวดเข่า ระยะทางที่เดินในเวลา 6 นาที และความแข็งแรงกล้ามเนื้อต้นขาเช่นเดียวกันแต่ไม่พบการเปลี่ยนแปลงขององศาการงอข้อเข่า ทั้งสองกลุ่มมีคะแนนความคาดหวังในผลลัพธ์ของการออกกำลังกายในระดับสูงและไม่มีความแตกต่างกันทางสถิติทั้งภายในกลุ่มและระหว่างกลุ่ม

อย่างไรก็ดี ผู้ร่วมวิจัยกลุ่มทดลองมีการเปลี่ยนแปลงที่ดีกว่ากลุ่มควบคุม ทั้งยังได้เรียนรู้วิธีการออกกำลังกายที่เหมาะสมและปลอดภัยกับข้อเข่า รวมถึงการริเริ่มจัดตั้งสถานที่ออกกำลังกายภายในชุมชนของตนเองเพื่อการออกกำลังกายอย่างสม่ำเสมอและเพื่อการมีสุขภาพที่ดี

190 หน้า. ISBN 974-04-7211-7

CONTENTS

	Page
ACKNOWLEDGEMENT	iii
ABSTRACT (ENGLISH)	iv
ABSTRACT (THAI)	v
LIST OF TABLES	viii
LIST OF FIGURES	xi
CHAPTER	
I INTRODUCTION	
Background and Significance of the Study	1
Purpose	6
Research Questions	7
Conceptual Framework	7
Hypotheses	11
Definition of Terms	11
II LITERATURE REVIEW	
Osteoarthritis of the Knee	14
Quadriceps Muscle Strength in Relation to Osteoarthritis of the Knee ...	20
Exercise for People with Osteoarthritis of the Knee	24
Theoretical Basis and Empirical Research Findings	29
Studies Related to Exercise and Osteoarthritis of the Knee	33
Conclusion	42
III METHODOLOGY	
Research Design	44
Population and Sample	45
Instruments	48
Protection of Human Rights	55
Community Involvement and Intervention	56
Data Collection	61
Data Analysis	62

CONTENTS (CONT.)

	Page
IV RESULTS	
Characteristics of the Experimental and the Control Groups	64
Comparisons of Study Variables between Groups at Baseline	69
Effectiveness of the Community-Based Exercise Program	70
Additional Analyses on Effect Size and Power of Test	91
V DISCUSSION	
Characteristics of the Subjects Participating in the Study	95
Effect of the Community-Based Exercise Program	97
Community Participation	105
Theoretical Aspects	107
Methodological Issues	108
VI CONCLUSION	
Summary of the Study	112
Implications and Recommendations	115
BIBLIOGRAPHY	120
APPENDIX	142
BIOGRAPHY	190

LIST OF TABLES

	Page
Table 2.1 Clinical Profiles of Osteoarthritis	16
Table 2.2 ACR Criteria for the Classification and Reporting of Osteoarthritis of the Knee	18
Table 2.3 ACR Classification Criteria for Osteoarthritis of the Knee	18
Table 2.4 Stretching Exercises for Patients with Osteoarthritis of the Knee...	22
Table 2.5 Contraindications to Exercise Testing	25
Table 2.6 Target heart rate zones for aerobic exercise	28
Table 3.1 Comparisons of The Self-Efficacy Strategies and the Community- Based Exercise Program	52
Table 3.2 Schedule of the Community-Based Exercise Program	59
Table 4.1 Means and Standard Deviations of Selected Demographic Characteristics of the Participants	66
Table 4.2 Number and Percent of Marital Status, Educational Level, and Present Occupation of the Participants	66
Table 4.3 Characteristics related to Knee Pain of the Participants	67
Table 4.4 Characteristics related to Exercise Behavior Prior to the study	68
Table 4.5 Times of Participation in the Exercise Program among the Experimental Participants	69
Table 4.6 Comparisons of Study Variables between the Experimental and Control Groups at Baseline	70
Table 4.7 Comparisons of Self-Efficacy for Exercise and Outcome Expectations for Exercise Score in the Experimental Group during the Different Time Points	71
Table 4.8 Friedman Multiple Comparisons of Self-Efficacy for Exercise Sum of Ranks between Different Time Points in the Experimental Group	72

LIST OF TABLES (CONT.)

	Page
Table 4.9 Comparisons of Severity of Knee Symptoms and Physical Performance in the Experimental Group during the Different Time Points	73
Table 4.10 Friedman Multiple Comparisons of Modified Severity of the Disease Sum of Ranks in the Experimental Group between Different Time Points	74
Table 4.11 Friedman Multiple Comparisons of 6-Minute Walk Test-Distance Sum of Ranks in the Experimental Group between Different Time Points	74
Table 4.12 Mean Difference Scores of Logarithmic Right Knee Extension Peak Torque Data in the Experimental Group between Different Time Points	75
Table 4.13 Mean Difference Scores of Left Knee Extension Peak Torque in the Experimental Group Between Different Time Points	76
Table 4.14 Friedman Multiple Comparisons of Right Knee Flexion Range of Motion Sum of Ranks in the Experimental Group between Different Time Points	76
Table 4.15 Friedman Multiple Comparisons of Left Knee Flexion Range of Motion Sum of Ranks in the Experimental Group between Different Time Points	77
Table 4.16 Mean Difference Scores of Right Knee Extension Range of Motion in the Experimental Group between Different Time Points	77
Table 4.17 Comparisons of Self-Efficacy and Outcome Expectations for Exercise Mean Rank between Groups at Each Time Point.....	79
Table 4.18 Comparisons of Modified Severity of the Disease Mean Rank between Groups at Each Time Point	80
Table 4.19 Comparisons of 6-Minute Walk Test-Distance Mean Rank between Groups at Each Time Point	81

LIST OF TABLES (CONT.)

	Page
Table 4.20 Comparisons of Transformed Right Knee Extension Peak Torque Mean Score between Different Time Points	83
Table 4.21 Mean Difference Scores of Transformed Right Knee Extension Peak Torque Data between Different Time Points	83
Table 4.22 Comparisons of Left Knee Extension Peak Torque Mean Score between Different Time Points	85
Table 4.23 Mean Difference Scores of Peak Torque Left Knee Extension between Different Time Points	85
Table 4.24 Comparisons of Knee Flexion Range of Motion Mean Rank between Groups at Each Time Point	86
Table 4.25 Comparisons of Right Knee Extension Range of Motion Mean Score between Different Time Points	88
Table 4.26 Comparisons of Left Knee Extension Range of Motion Mean Rank between Groups at Each Time Point	88
Table 4.27 Summary of the Significant Levels of Study Variables in the Experimental Group during Different Time Points	90
Table 4.28 Summary of the Significant Levels of Study Variables between Groups at Each Different Time Points	91
Table 4.29 Effect Sizes of Self-Efficacy for Exercise and Modified Severity of the Disease Mean Scores between Groups at Different Time Points	92
Table 4.30 Effect Sizes of Self-Efficacy for Exercise, Modified Severity of the Disease, 6-Minute Walk Test-Distance, and Degree of Knee Flexion Range of Motion Mean Scores within each Group between Baseline and Other Time Points	93
Table 4.31 Comparisons of Effect Sizes of Knee Extension Peak Torque Variables within each Group during Different Time Points	94

LIST OF FIGURES

	Page
Figure 1.1 Conceptual Framework of this Study	10
Figure 3.1 The Research Design	44
Figure 3.2 The Research Procedure	60
Figure 4.1 Mean Scores of Self-Efficacy for Exercise and Outcome Expectations for Exercise Scale between Groups across Different Time Points	80
Figure 4.2 Mean Scores of Modified Severity of the Disease Scale between Groups across Different Time Points	81
Figure 4.3 Mean Scores of 6-Minute Walk Test-Distance between Groups across Different Time Points	82
Figure 4.4 Mean Scores of Square Root of Right Knee Extension Peak Torque between Groups across Different Time Points	84
Figure 4.5 Mean Scores of Peak Torque Left Knee Extension between Groups across Different Time Points	86
Figure 4.6 Mean Scores of Knee Flexion Range of Motion between Groups across Different Time Points	87
Figure 4.7 Mean Scores of Knee Extension Range of Motion between Groups across Different Time Points	89

CHAPTER I

INTRODUCTION

Background and Significance of the Study

Osteoarthritis of the knee is one of the most common chronic conditions and most often occurs in older people. It typically manifests after age 60, but more than 80% of persons over 50 have radiologic evidence of osteoarthritis (National Institute of Arthritis and Musculoskeletal and Skin Diseases, 2002). In addition, some younger people get osteoarthritis from joint injuries, congenital deformities, or metabolic alterations in the cartilage (Sands, 1988). Osteoarthritis of the knee seems not to be a major public health concern as there is a weak relationship between joint pain and mortality (Donald & Foy, 2004). However, in an older population, osteoarthritis is one of the major causes of pain and physical disability that decreases functional capacity and quality of life (Bellamy & Buchman, 1986; Davis, Ettinger, Neuhaus, & Mallon, 1991; Rejeski & Shumaker, 1994; Verbrugge, Lepkowski, & Konkol, 1991).

Clinically, people with osteoarthritis of the knee have pain in and around the knee that is typically worse with weight-bearing activities (Hochberg et al., 1995). People suffering chronic conditions, such as osteoarthritis of the knee, are affected not only by the illness, but also by socioeconomic, personal, and environmental factors related to the illness (WHO, 2003). A comparisons of mobility, household activities, physical activity, social activities, activities of daily living (ADL), and problems associated to osteoarthritis of the knee indicates that pain induces highest stress and affects quality of life in elderly women with osteoarthritis of the knee (Aree-ue, 1997). Patients experiencing symptoms associated to osteoarthritis of the knee are mostly advised by health providers to rest and avoid vigorous activities. This recommendation leads to a decrease in aerobic capacity, muscular strength, and physical mobility (Minor & Lane, 1996).

Osteoarthritis of the knee is also one of the most common chronic health problems among the older Thai population both in urban and rural communities

(Malathum, 2001; Tosayanonda, Kuptniratsaikul, Nilganuwong, & Thamalikitkul, 2001). A survey of the welfare of the elderly in Thailand indicates that back pain and arthritis are two of the most common health problems among people aged 50-59 years, and tend to be more prevalent at an advanced age (Chayovan & Knodel, 1997). Additionally, in the Arthritis Day 2004 conference, it was reported that 7 million Thai people or more than 10 percent of the Thai population are suffering from some kind of arthritis and this is predicted to increase to 50 percent of the Thai population within the next 20 years (Wattana, B.E.2547). This increase of osteoarthritis could be caused by a Thai custom in which people are used to squatting, kneeling, or sitting on the floor for more than 6 hours per week, and rarely have physical activity or exercise (Ministry of Public Health, B.E. 2547a; Ngamsutikul, 2000). Public health statistics reveal that diseases of the musculoskeletal system and connective tissue are the second highest numerical cause of outpatient visits in hospitals in the Bangkok metropolitan areas and is the third most overall cause of outpatient visits in Thailand (Ministry of Public Health, B.E.2546). Recent studies also indicate that advancing age (Hootman, Macera, Helmick, & Blair, 2003), overweight (Cheng, Macera, Davis, Ainsworth, Troped, & Blair, 2000; Lachance, Sowers, Jamadar, & Hochberg, 2002), previous knee joint injury (Miranda, Viikari-Juntura, Martikainen, & Riihimäki, 2002), previous knee joint surgery (Doherty, 2001; Hootman et al., 2003), vigorous physical activity (Doherty, 2001), varus-valgus alignment of knee joint (Doherty, 2001), and sitting postures such as squatting, or kneeling (Coggon, Croft, Kellingray, Barrett, McLaren, & Cooper, 2000; Ngamsutikul, 2000) are potential causes of osteoarthritis of the knee.

In general, the goals of treatment of osteoarthritis are to reduce pain, maintain and/or improve joint mobility, and decrease physical disability or impairment (Altman, Hochberg, Moskowitz, & Schnitzer, 2000). Presently, the types of treatment of arthralgia from osteoarthritis include pharmacological agents, non-pharmacological interventions, and surgical treatments when the first two treatments are not effective. Over the past several years, exercise has been increasingly accepted as a good means of promoting and maintaining health. Quadriceps muscle exercise, as a non-pharmacological intervention, has been shown to promote muscle strength, range of motion of the knee joint, and decrease knee pain in people with

osteoarthritis of the knee (Bartlett, 2002; Hochberg et al., 1995). Moderately intense exercise either decreases or appears to not increase the risk of developing osteoarthritis (Casper & Berg, 1998; Halbert, Crotty, Weller, Ahern, & Silagy, 2001; O'Reilly, Muir, & Doherty, 1999). It can also decrease pain from arthritis, as well as increase physical performance, thereby maintaining individuals' independence and a good quality of life. Findings from several studies indicate that exercise programs provide a significant improvement in knee pain and increase physical performance in the experimental individuals as compared to the control individuals. Additionally, exercise programs designed for osteoarthritic individuals can improve their health and physical performance without exacerbation of disease (Ettinger, et al., 1997; Evcik & Sonel, 2002; Fitzgerald, Childs, Ridge, & Irrgang, 2002; Mangione et al., 1999; Petrella & Bartha, 2000; Thongsumrit, 1999; Tosayanonda et al., 2001; van Baar, Dekker, Oostendorp, Bijl, Voorn, & Bijlsma, 2001). However, it is not completely defined which type of exercise is the most beneficial treatment and which limitations should be observed for people with osteoarthritis (McKinney & Andersen, 2000). Generally, types of exercise for people with osteoarthritis of the knee should start at a light intensity and be pain-free. Therefore, encouraging them to continue their exercise behavior and develop the benefits of exercise.

It is warranted that motivation has an influence on behavior. Based on the Social Cognitive Theory (Bandura, 1997), human motivation and action are regulated by forethought. Self-efficacy is a significant determinant of the initiation and maintenance of goal-related behaviors (Resnick, 1998a). Previous studies reveal that self-efficacy has a significantly direct effect on exercise attendance (Chinuntuya, 2001; Clark, 1999; Dawson, Brawley, & Maddux, 2000). Additionally, in a prospective study examining the relationship between self-efficacy, and self-reported disability among older adults with knee pain, Rejeski and colleagues (2001) reveal a significant interaction between self-efficacy and knee strength in predicting physical performance. Participants who have lower self-efficacy and lower muscle strength at baseline also have greater decline in physical performance and greater self-reported disability at the 30-month follow-up. One meta-analysis study reported that exercise interventions had a positive effect on self-efficacy with moderate effect sizes (Kruger, 2001). Therefore, self-efficacy plays an important role in initiating and

continuing exercise behavior, which is expected to be more beneficial than deteriorative.

People with osteoarthritis of the knee are usually middle aged and older, and more frequently women (Chuprapawan, B.E.2543; Ministry of Public Health, B.E.2546). Therefore, perhaps this population does not include exercise in their priorities. One study indicates that lack of motivation and time management are causes of attrition from exercise programs in middle-aged adults (McAuley, Proag, Gleason, & Wraith, 1990). For the older population, barriers to exercise include lack of knowledge about the benefits of exercise at an advanced age (Dishman, 1994), perceived impaired health (Blair et al., 1996; Resnick, 1998a), perceived low self-efficacy (Rejeski, Ettinger, Martin, & Morgan, 1998), lack of support or poor economic status (Kuptniratsaikul, Tosayanonda, Nilganuwong, & Thamalikitkul, 2002), lack of access to appropriate facilities (Boyette, Sharon, & Brandon, 1997; King et al., 1992; Nies, Vollman, & Cook, 1997), fear of injury (Dishman, 1994), and unpleasant sensations associated with exercise (Cooper, Bilbrew, Dubbert, Kerr, & Kirchner, 2001; Resnick & Spellbring, 2000; Sharon, Hennessy, Brandon, & Boyette, 1997). Therefore, factors influencing decreasing physical activity and increasing pain include a person's feelings of motivation, fatigue, illness, and daily commitments. In addition, at long-term follow-ups, most participants report decreasing exercise behavior at 9-months and 12-months after completion of exercise programs (McAuley, Lox, & Duncan, 1993; Messier, Thompson, & Ettinger, 1997; Tosayanonda et al., 2001; van Baar et al., 2001), whereas self-efficacy declines at 4- and 6- month follow-ups (McAuley, Jerome, Marquez, Elavsky, & Blissmer, 2003). Most short-term studies, at less than 6 months duration, rarely examined factors influencing exercise participation or included motivation as a mediator to regular exercise behavior.

A gap in the knowledge on exercise interventions in people with osteoarthritis of the knee was found by reviewing publications, articles, and theses. Two issues presented themselves for further study. Firstly, the duration of exercise interventions, without follow-up assessments, varies from weeks to years. The most effective duration and intensity of intervention have not yet been concluded. One study reveals significant improvement of perceived pain, stiffness, physical function,

and general health status at the end of the first week of a 4-week quadriceps strengthening exercise intervention in patients with osteoarthritis of the knee (Tanwattana et al, 2002). However, one systematic review concluded that most exercise interventions lasted 8 weeks, and lack of standard protocols, outcome measures, and maintenance strategies have contributed to poor implementation of exercise treatments for osteoarthritis of the knee (Petrella, 2001). Another systematic review indicates that there are insufficient data to provide guidelines on the optimal exercise type or dosage for people with osteoarthritis (Fransen, McConnell, & Bell, 2003). Therefore, this study examined whether a bi-weekly stationary cycling exercise could provide beneficial outcomes in the 4th, 8th, or 12th week of the intervention.

Another issue was that many studies measured the effectiveness of exercise interventions for people with osteoarthritis of the knee using pain and physical performance. They did not examine whether participants confidently continued regular exercise after completion of the interventions. Campbell and colleagues (2001) found that motivation to continue exercising after physiotherapy intervention, for people with osteoarthritis of the knee, was explained by 4 themes. These themes are: a) attitudes towards exercise; b) perceived severity of knee symptoms; c) ideas about the cause of arthritis; and d) perceived effectiveness of the intervention (Campbell, Evans, Tucker, Quilty, Dieppe, & Donovan, 2001). Therefore, motivation plays an important role in continuing regular exercise. Within this study, self-efficacy and outcome expectations for exercise are expected to raise motivation. The main strategies for achieving this are: a) providing knowledge about osteoarthritis of the knee and how to exercise safely; b) showing example(s) of people with osteoarthritis of the knee who gained benefits after practicing exercise; c) providing verbal encouragement; and d) self-evaluating physical function regarding exercise and reevaluating symptoms during group discussion by focusing on physiological feedback such as pain, fatigue, or anxiety associated with an activity. Thus, this community-based exercise intervention included: a) information about osteoarthritis of the knee and the benefits of exercise for people with osteoarthritis of the knee, b) group stationary cycling exercise sessions in community setting(s), and c) motivation and reinforcement to perform exercise behavior focusing on enhancement of self-

efficacy and outcome expectations for exercise.

One meta-analysis study related to exercise in aging adults indicates that a facility-based exercise intervention in a physiotherapy clinic or group exercise intervention results in a greater effect than home-based exercise intervention (Conn, Valentines, & Cooper, 2002). Social persuasion is often employed as a method of facilitating efficacy cognitions. Peers, friends, family members, and instructor's influences may well take the form of another source of beliefs in personal capabilities or self-efficacy (Bandura, 1986a). Thus, group exercise, including group discussion, would be suitable to enhance self-efficacy and outcome expectations which influence regular exercise behavior. This community-based exercise program was designed to enhance self-efficacy and outcome expectations for exercise, resulting in initiation and maintenance of stationary cycling exercise behavior in Thai women with osteoarthritis of the knee. Therefore, the expected outcomes were a decreasing severity of knee symptoms, and an improving physical performance. The effectiveness of the program may be further used to develop a guideline and protocol for exercise interventions for people with osteoarthritis of the knee, in community settings. In addition, promoting exercise behavior using the campaigns "Exercise for Health," and "Healthy Thailand" have been a focus of both Thailand's Ministry of Public Health and the World Health Organization (Ministry of Public Health, B.E.2545; Thai Health Promotion Foundation, B.E.2547; WHO, 2002).

Purpose

The overall aim of this study was to determine the effect of a 12-week community-based exercise program on self-efficacy and outcome expectations for exercise, severity of knee symptoms, and physical performance, in Thai women with osteoarthritis of the knee. The intermediate expected outcomes included self-efficacy and outcome expectations for exercise, resulting in regular exercise behavior. The ultimate expected outcomes included less severity of knee symptoms and improved physical performance.

Research Questions

Because the majority of people with osteoarthritis of the knee are women in their middle age and older (Chuprapawan, B.E.2543; Ministry of Public Health, B.E.2546), this study designed a community-based exercise program for this population. Therefore, the research questions were as follows:

1. Can a community-based exercise program, based on the Self-Efficacy Theory, increase self-efficacy and outcome expectations for exercise in Thai women with osteoarthritis of the knee?
2. Does this exercise program decrease severity of knee symptoms and improve physical performance in Thai women with osteoarthritis of the knee?
3. Will Thai women with osteoarthritis of the knee develop their self-efficacy and outcome expectations for exercise at the 4th week of the exercise program?
4. When will the optimal improvement on severity of knee symptoms and physical performance be developed after performing the exercise sessions, the 4th, 8th, or 12th week?

Conceptual Framework

The conceptual framework of this study emerges from the notion that complementary and integrated approaches can improve treatment outcomes in people with chronic conditions (Marks, Allegrante, & Lorig, 2005). In addition, many studies reveal that self-efficacy affects maintenance of exercise behavior (McAuley, Jerome, Marquez, Elavsky, & Blissmer, 2003; Rejeski, Ettinger, Martin, & Morgan, 1998; Resnick, & Nigg, 2003). Self-efficacy contributes to regular exercise, which helps prevent the development of major health problems (Bandura, 1997). Different types of chronic diseases, such as osteoarthritis of the knee, present many similar problems relating to how to manage pain, overcome obstacles created by physical impairments, maintain self-sufficiency, and maintain control over medical services to achieve the best results. People with chronic health problems rarely adopt or continue their regular exercise behavior as they are recommended. Thus, an exercise program should be merged with psychosocial programs that build self-efficacy in performing

capabilities, which activate many adaptive processes beyond the particular skills taught in an intervention (Bandura, 1997).

Self-Efficacy Theory states that the stronger an individual's belief in their ability to perform a course of action, and in the positive outcomes of those actions, the more likely they will initiate and persist in a given activity (Bandura, 1997). People judge how they will be able to perform in a given situation. Then, they infer their capabilities from the imagined outcomes, which precede the actions. Perceived self-efficacy is a judgment of one's ability to perform a specific behavior, whereas an outcome expectation is a judgment of the likely consequence such behavior will produce. For example, an outcome expectation might be one's belief in the benefits of exercise, i.e., improving muscle strength, losing weight, or feeling good in general. Both self-efficacy and outcome expectations play an influential role in the adoption and maintenance of specific behavior in older adults (McAuley, Shaffer, & Rudolph, 1995; Resnick, 1998b; Resnick, Palmer, Jenkins, & Spellbring, 2000). Bandura (1997) states four major sources of self-efficacy. These include: (a) enactive mastery experience (performance accomplishment or actual performance of an activity); (b) verbal persuasion (verbal encouragement by a credible source); (c) vicarious experience (role models or seeing individuals who are similar to themselves perform the same activity); and (d) physiological and affective states (physiological feedback such as pain, fatigue, or anxiety associated with an activity) (Bandura, 1997; Resnick, 1998a). Outcome expectations also have an important influence on older adults' participation in exercise activities (Conn, 1998; Jette et al, 1998; Resnick, Palmer, Jenkins, & Spellbring, 2000; Resnick & Spellbring, 2000). Outcome expectations can take three major forms: physical effects, social effects, and self-evaluative reactions (Bandura 1986a). The types of outcomes that people anticipate generally depend on their judgments of how well they will be able to behave. Although outcome expectations result in both positive (serving as incentives) and negative expectations (serving as disincentives), people who consider themselves to be highly efficacious will expect favorable outcomes.

In this study, community participation was employed to initiate an exercise facility in a community. Community nurses, key persons, and community members were invited, discussing about benefits of exercise for people with osteoarthritis of

the knee and older people in community. Mutual goal to set up an exercise facility in their community was desired. After the exercise facility was situated, the intervention, based on the Self-Efficacy Theory (Bandura, 1997), was provided to enhance self-efficacy and outcome expectations for exercise in Thai women with osteoarthritis of the knee through four major strategies:

- a) Providing knowledge about osteoarthritis of the knee and how to exercise safely to gain “skill mastery.” People are expected to be more efficacious in managing their knee symptoms when they know “what” and “how” to do, for example, through exercise practicing. All experimental participants performed cycling exercise under researcher’s instruction. In addition, they could anticipate what the expected outcomes from exercise are, such as decreasing severity of knee symptoms and increasing physical performance;
- b) Modeling, by showing example(s) of people with osteoarthritis of the knee who successfully gained benefits from exercise. In addition, participants having efficiency in exercise may be promoted to lead the exercise sessions;
- c) Providing verbal encouragement or persuasive communication during group discussion sessions evaluating progress and benefits from exercise; and
- d) Self-evaluating physical function regarding exercise and reevaluating of symptoms during group discussion, for example, detecting physiological feedback such as pain, fatigue, or anxiety associated with an activity.

The assumption of this study was that Thai women with osteoarthritis of the knee have capabilities to perform regular exercise, resulting in improvement of severity of knee symptoms and physical performance. These capabilities require harmony between self-beliefs on one hand and possessed skills and knowledge on the other. Therefore, providing knowledge, modeling, verbal encouragement, and encouraging self-evaluating strategies are included in the community-based exercise program to develop beliefs about capability to engage in exercise behavior. These strategies acted in concert with the beliefs that exercise can lessen severity of knee symptoms and improve physical performance so that Thai women with osteoarthritis of the knee adopted and continued their exercise behavior.

As part of the community-based exercise program, a strengthening of self-efficacy and outcome expectations for exercise was encouraged. The more self-efficacy for exercise the participants perceive, the more outcome expectations (benefits) they expected. Therefore, both self-efficacy and outcome expectations have an influence on initiation and maintenance of exercise behavior. Thus, regular stationary cycling exercise would result in less severity of knee symptoms and improved physical performance in Thai women with osteoarthritis of the knee. The conceptual framework for this study is shown as follows (Figure 1.1).

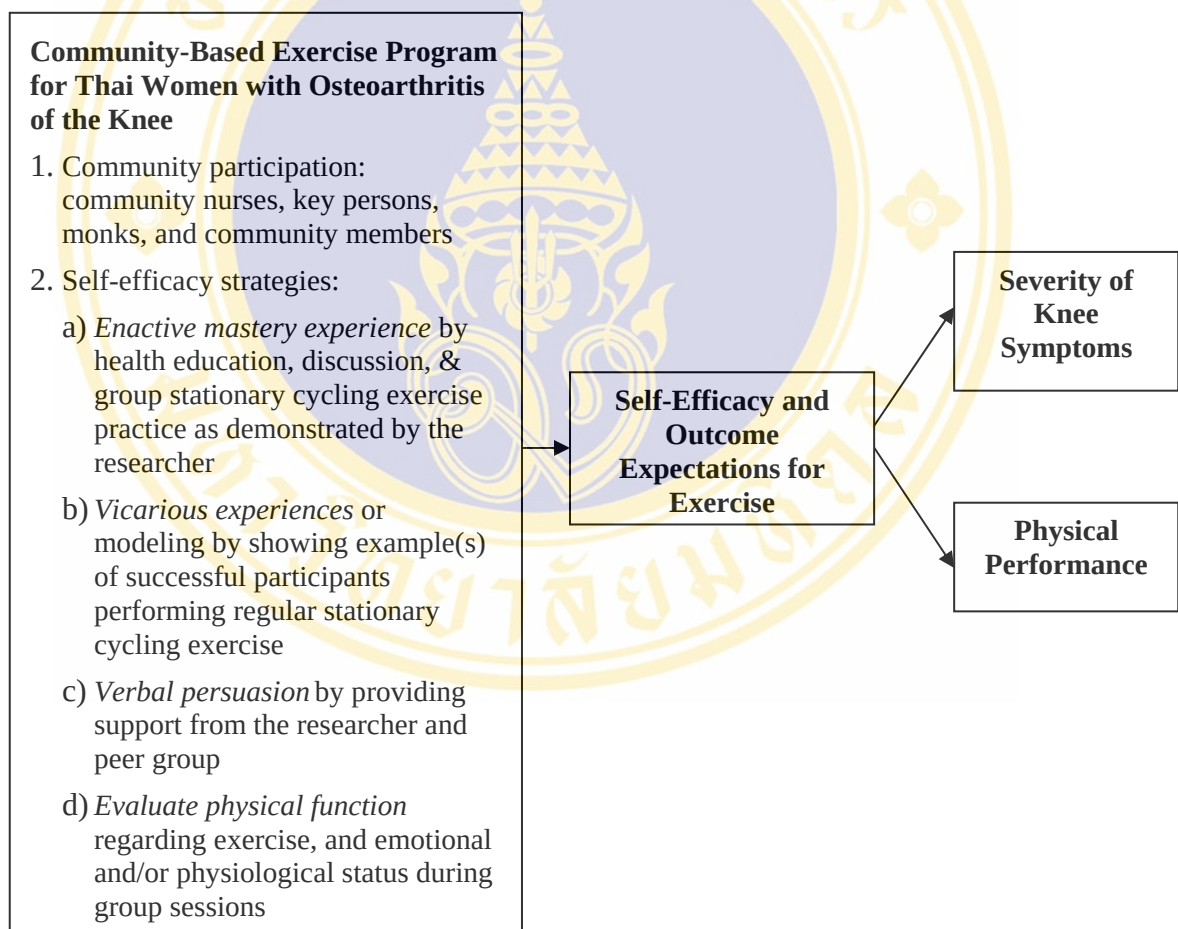


Figure 1.1 Conceptual Framework of this Study

Hypotheses

1. At the 4th, 8th, and 12th week of the community-based exercise program, Thai women with osteoarthritis of the knee participating in the experimental group will have higher perceived self-efficacy and outcome expectations for exercise than before participation in the exercise program.

2. At the 4th, 8th, and 12th week of the community-based exercise program, Thai women with osteoarthritis of the knee participating in the experimental group will experience less severity of knee symptoms and attain better physical performance than before participation in the exercise program.

3. At the 4th, 8th, and 12th week of the community-based exercise program, Thai women with osteoarthritis of the knee participating in the experimental group will have more self-efficacy and outcome expectations for exercise, experience less severity of knee symptoms, and attain better physical performance than those in the control group.

Definition of Terms

Osteoarthritis of the knee is a defect of the articular cartilage of the knee joint characterized by the gradual loss of cushioning substance, joint space narrowing and the resultant exposure of rough underlying bone ends that can cause pain and joint stiffness (Kart, Metress, & Metress, 1992: 89). In this study, criteria for specified osteoarthritis of the knee for Thai women are based on the American College of Rheumatology (ACR) clinical criteria of idiopathic osteoarthritis of the knee (Altman et al., 1986). The criteria include knee pain with at least three indicators of: a) age over 50 years, b) knee stiffness no longer than 30 minutes, c) crepitus at the knee joint(s), d) bony tenderness, e) bony enlargement, and f) no palpable warmth. However, eligible participants in this study are Thai women, age 50 to 70 years old. Therefore, inclusion criteria will be “knee pain” and 2 additional characteristics from the ACR classification scheme. These criteria will be examined by a screening questionnaire as interviewed by the researcher. Medical history or physician diagnosis is an optional confirmation method.

The community-based exercise program is a 12-week exercise program developed and proposed to the community members by the researcher. The major aim of the program is to enhance self-efficacy and outcome expectations for exercise, resulting in adoption and continuing exercise behavior. Based on Bandura's (1997) Self-Efficacy Theory, this program was conducted by the researcher through four strategies: a) enactive mastery experience; b) vicarious experiences or modeling; c) verbal persuasion; and d) evaluated physical function regarding exercise, and emotional and/or physiological status.

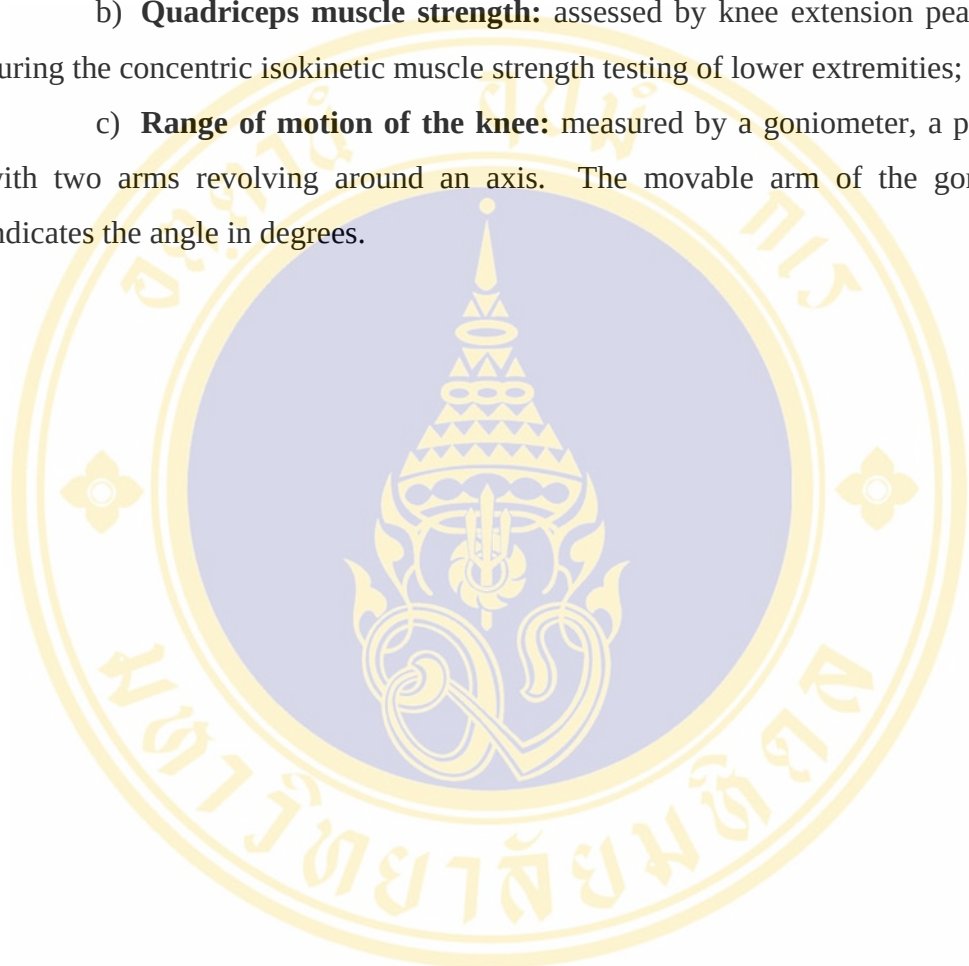
Self-efficacy for exercise is defined as an individual's confidence in his/her abilities to perform regular exercise, both group exercise and home-based individualized leg exercises. Self-efficacy for exercise was measured by the Thai-version of the Self-Efficacy for Exercise Scale (SEE) translated by Harnirattisai (2002). Because the original version was developed from Westernized culture, item number 1, 3, and 9 were modified for easier understanding in Thai culture for this study.

Outcome expectations for exercise is defined as a judgment of the likely consequences that regular exercise behavior will produce, such as less severity of knee symptoms and increased physical performance. Outcome expectations for exercise was measured by the Thai-version Outcome Expectations for Exercise Scale (OEE) translated from the original version by Harnirattisai (2002). All items in the OEE were also modified for easier understanding in Thai culture for this study.

Severity of knee symptoms is defined as symptoms and behaviors related to osteoarthritis of the knee such as joint pain, joint stiffness, and ability to perform specific postures/activities. Severity of knee symptoms was assessed by the Severity of the Disease Scale-Modified Version (M-SEV; Kanjanavorawong, 1997). In addition, a self-report of the use of non-steroid anti-inflammatory drugs (NSAIDs) and/or analgesics were recorded at baseline, and evaluated at the 4th, 8th, and 12th week of the community-based exercise program.

Physical performance is the ability to actually perform a physical task at a desired level, which is divided into three components:

- a) **Physical function:** measured by distance participants walked in the 6-Minute Walk Test;
- b) **Quadriceps muscle strength:** assessed by knee extension peak torque during the concentric isokinetic muscle strength testing of lower extremities; and
- c) **Range of motion of the knee:** measured by a goniometer, a protractor with two arms revolving around an axis. The movable arm of the goniometer indicates the angle in degrees.



CHAPTER II

LITERATURE REVIEW

Exercise research has gained considerable attention from researchers and theorists (Godin & Kok, 1996). However, the most effective existing exercise programs for people with osteoarthritis of the knee are still not suitable. In this chapter, to better understand the nature of osteoarthritis of the knee and the relationship between exercise and osteoarthritis of the knee, the topics are reviewed as follows: osteoarthritis of the knee, quadriceps muscle strength in relation to osteoarthritis of the knee, exercise for people with osteoarthritis of the knee, theoretical basis and empirical research findings, and studies related to exercise and osteoarthritis of the knee.

Osteoarthritis of the Knee

Definition, Signs, and Symptoms

Osteoarthritis is defined as a non-inflammatory degenerative joint disease characterized by loss of articular cartilage and marginal hypertrophy of bone accompanied by pain and stiffness that is aggravated by prolonged activity (Sandmeier, 1998). Osteoarthritis is the most common type of arthritis, which affects the knees in middle-aged and older people (American College of Rheumatology, 2000; Dieppe, Cushnaghan, & McAlindon, 1992; Oliveria, Felson, Klein, Reed, & Walker, 1996). Additionally, osteoarthritis is a major source of discomfort and disability for many older persons (MacLean, 2001; WHO, 1997). This is the fourth most common predictor of health problems worldwide in women and the eighth most common predictor of ill-health in males (Murray & Lopez, 1996). According to Salter (1983), the term osteoarthritis is synonymous with the following: degenerative joint disease, osteoarthrosis, degenerative arthritis, senescent arthritis, and hypertrophic arthritis. Goldberg and Kuettner (cited in Huch, Kuettner, & Dieppe, 1997) clarified the pathogenesis of osteoarthritis as “a result of both mechanical and biological events that destabilize the normal coupling of degradation and synthesis of

articular cartilage chondrocytes and extracellular matrix, and subchondral bone.” Theoretically, people who are 65 years of age and older have some evidence of radiographic osteoarthritis even if they are clinically asymptomatic (Brunk & Sands, 1988).

It is believed that factors that cause osteoarthritis are genetic, developmental, metabolic and traumatic factors, which involve all types of tissues of the joint compositions (Huch, Kuettner, & Dieppe, 1997). The disease is manifested by the changes in morphology, biochemistry, and biomechanics of both cells and matrix, which leads to “a softening, fibrillation, ulceration, loss of articular cartilage, sclerosis and aberration of subchondral bone, osteophytes, and subchondral cysts” (Huch, Kuettner, & Dieppe, 1997).

Osteoarthritis can be classified into two subgroups as follows (Altman, 1991; Altman et al., 1986):

1. Primary or idiopathic osteoarthritis, which has an unknown prior event or disease with relation to the osteoarthritis. Genetics and hormones may produce the symptom.
2. Secondary osteoarthritis is caused by associated conditions or diseases such as inflammatory joint diseases, overuse of the joint, traumatic lesions, metabolic processes that weaken the cartilage, and congenital deformities.

The disease process of osteoarthritis involves the gradual breakdown of articular cartilage and the exposure of the underlying bone. Inflammation and injury are generally two major causes of the disease process. However, some osteoarthritic individuals do not have any experience of inflammation or injury. Synovitis, an inflammation of the joint, is processed by the articular surface fissuring and splitting in the superficial layers at specific sites. These layers gradually merge and deepen through almost the entire bone surface of the affected joint. Cartilage changes usually occur by chronic or acute trauma. Once the cellular changes are initiated, simple mechanical factors appear to play a major role in ongoing cartilage destruction. In addition to the cartilaginous destruction, osteophyte spur formation occurs at the joint margins. Bone spurs and bone cyst develop in the affected joints as the disease progresses, which may cause synovitis by releasing cartilage crystals that

stimulate inflammation (Brunk & Sands, 1988). The general characteristics of osteoarthritis are summarized as the clinical features and changes in Table 2.1.

Table 2.1 Clinical Profiles of Osteoarthritis (Moskowitz & Holderbaum, 2001).

Factor	Characteristics and Occurrence
Age	Usually advanced; symptoms uncommon before age 40, unless due to secondary cause, e.g., injury, infection.
Joint involvement	Commonly: distal interphalangeal, proximal interphalangeal, first carpometacarpal, hip, knee, first metatarsophalangeal joints, and lower lumbar and cervical vertebrae. Rarely: metacarpophalangeal, wrist, elbow, or shoulder joints, except after trauma.
Joint effusion	Little or none
Onset	Usually insidious
Systemic manifestations	Rare
True bony ankylosis	Uncommon
Symptoms	Pain on motion (early); pain at rest (later); pain aggravated by prolonged activity, relieved by rest; localized stiffness of short duration (called “gelling”) relieved by exercise; possibly painful muscle spasm; limitation of motion; “flares” associated with crystal-induced synovitis
Signs	Localized tenderness; crepitus and cracking on motion; mild joint enlargement with firm consistency from proliferation of bone and cartilage; synovitis (less common), gross deformity (later)

Osteoarthritis of the knee is characterized clinically as knee pain, restriction of joint motion, crepitus, occasional effusion and non-systemic inflammation (Huch, Kuettner, & Dieppe, 1997). The symptoms include pain on walking, stiffness of the joint, and difficulty with steps and stairs climbing. Signs, such as muscle wasting, bony swelling, joint tenderness, crepitus, painful limitation of motion and, in some cases, an effusion can be seen. Valgus and varus joint deformities can be seen in advanced cases. According to Creamer and Hochberg (1997), the most important clinical symptom of osteoarthritis is pain, which is caused by inflammation of the synovial membrane, joint capsule distension, periarticular ligaments damage, periarticular muscle spasm, periosteum elevation by osteophytes, and subchondral

bone thickness.

Osteoarthritis of the knee evolves slowly, with the condition remaining relatively stable for several years. However, symptomatic "flares" with notable inflammation, lasting days or weeks may occur. Occasionally, osteoarthritis of the knee may take a more aggressive course, resulting in severe pain, rapid destruction, and gait disturbance. The signs and symptoms of osteoarthritis are usually localized to the joints. The disease does not have general systemic effects (Brunk & Sands, 1988). Radiographs can usually confirm the diagnosis of osteoarthritis, although the findings are nonspecific. The cardinal radiographic features of the disease are a loss of joint space and the presence of new bone formation or osteophytes. The association between joint pain and the radiographic features of osteoarthritis is not constant, in that many joints with pathologic or radiographic evidence of this disease remain asymptomatic because bone demineralization is not a radiographic feature of osteoarthritis (Manek & Lane, 2000). One study reveals that radiological evidence of osteoarthritis of the knee has non-significant relationship with pain, functional performance, and self-efficacy (Harrison, 2004). The American College of Rheumatology (ACR) has summarized, with excellent precision, the signs and symptoms of osteoarthritis of the knee for identification of patients with symptomatic osteoarthritis of the knee and they have revised criteria for the classification of osteoarthritis of the knee as described in Table 2.2 and 2.3 (Altman et al., 1986).

Table 2.2 ACR Criteria for the Classification and Reporting of Osteoarthritis of the Knee (Altman et al., 1986)

Clinical and Laboratory	Clinical and Radiographic	Clinical*
Knee pain plus at least five of nine: - Age > 50 - Stiffness < 30 minutes - Crepitus - Bony tenderness - Bony enlargement - No palpable warmth - ESR < 40 mm/hour - RF < 1:40 SFOA	Knee pain plus at least one of three: - Age > 50 - Stiffness < 30 minutes - Crepitus plus Osteophytes	Knee pain plus at least three of six: - Age > 50 - Stiffness < 30 minutes - Crepitus - Bony tenderness - Bony enlargement - No palpable warmth
92% sensitive 75% specific	91% sensitive 86% specific	95% sensitive 69% specific

* An alternative for the clinical category would be four of six, which is 84% sensitive and 89% specific.

RF = rheumatoid factor; SFOA = synovial fluid signs of osteoarthritis (clear, viscous, or white blood cell count <2000/mm³).

Table 2.3 ACR Classification Criteria for Osteoarthritis of the Knee (Altman et al., 1986)

Osteoarthritis of the knee	Criteria
Traditional format	Knee pain and radiographic osteophytes and at least 1 of the following 3 items: - Age > 50 years - Morning stiffness ≤ 30 minutes in duration - Crepitus on motion
Classification tree	Knee pain and radiographic osteophytes, or Knee pain and age ≥ 40 years and morning stiffness ≤ 30 minutes in duration and crepitus on motion

Risk Factors

Osteoarthritis is a chronic disease of unknown etiology that can lead to significant pain and disability, especially when the involved joints are critical to the activities of daily living. Although the causes of osteoarthritis are not completely understood, biomechanical stresses affecting the articular cartilage and subchondral bone, biochemical changes in the articular and synovial membrane, and genetic factors are all important in its pathogenesis (Holderbaum, Haqqi, & Moskowitz, 1999; Mow, Setton, Fuilak, & Ratcliffe, 1995; Poole, 1997). Previous knee injury and

being over weight are potential risk factors of osteoarthritis of the knee. One study reveals that there is a strong association between obesity and osteoarthritis of the knee (Hootman, Macera, Helmick, & Blair, 2003). Among men, age, previous injury on hip and/or knee, previous hip/knee surgery, and body mass index (BMI) were significant independent risk factors for osteoarthritis. Among women, age and BMI were independent risk factors for osteoarthritis.

Overuse of the knee joints also is a risk factor of osteoarthritis. Sutton and colleagues (2001) analyzed a secondary data set to examine whether active people developed osteoarthritis of the knee in later life. Results reveal that knee injury and BMI had a statistically significant relationship to osteoarthritis of the knee (Odd ratio = 8.0, $p = 0.003$). Accordingly, they indicate that people, who were more active or had regular long walks in the past, should be at a higher risk of developing osteoarthritis of the knee. However, the data did not support the hypothesis that increasing activity in younger life may lead to osteoarthritis of the knee in later life. One biomechanical study (Luepongsak et al., 2001) examined the relationship between type of daily activity and force/torque loading across the hip and knee joints in 132 community-dwelling elderly. Standing, chair rising, walking, bending, and stair descending were assessed. They found that walking and descending stairs create greatest force/torque load on hip and knee joints, which could be causes of pain or risk of osteoarthritis. These findings are controversial because walking exercise is one of the exercise programs recommended for elderly people in order to maintain muscle strength, balance and physical ability.

Occupational factors and genetics may also play a role in developing osteoarthritis. Occupations that require a great deal of squatting or knee bending can predispose an individual to the development of osteoarthritis, and can encourage development of abnormalities in the structure of the knee. Findings support that osteoarthritis of the knee can be caused by work that involves kneeling, squatting, climbing stairs and ladders, or heavy lifting (Coggon, Croft, Kellingray, Barrett, McLaren, & Cooper, 2000). The mechanisms that underlie joint pain are not fully understood, although there is mounting evidence that inflammation plays an important role (Marshall & Waddell, 2000). It is increasingly clear that the disorder of osteoarthritis of the knee is complex, not just in terms of its constitutional and

local risk factors but also genetics (Loughlin, 2001).

Quadriceps muscle strength is found to be associated with osteoarthritis of the knee. A relationship among knee joint pain, muscle strength, and physical activity was examined by Lamb and colleagues (2000). Seven hundred and sixty-nine community-dwelling older women were assessed by interviewing and physical examination. They found that only obesity had a significant effect to knee pain severity with the effect size (ES) of 1.34. The results showed a significant difference among walking speed, chair raise ability, muscle strength, depression, and level of inactivity among women with no knee pain, moderate knee pain, and severe knee pain. However, ESs in these knee symptom groups ranged from small to medium (ES = 0.03 to 0.24). The main findings from this study were a) only a high pain severity score was associated with an increased risk of poor mobility; b) obesity, activity, and depression interacted with moderate and severe pain to increase risk of mobility limitation; and c) knee extensor weakness did not influence the association between pain and mobility limitation. Jadelis and colleagues (2001) investigated the role of knee and ankle strength interacts to dynamic balance. Among 480 older participants, aged 65 and older, who had knee pain, they found that obesity was associated with attenuated dynamic balance performance. However, pain level is not related to balance for subjects with stronger knees. Improving ankle strength might help in maintaining balance in elders with osteoarthritis of the knee. There are also two studies indicate that reducing quadriceps muscle strength would affect the initiation and progression of osteoarthritis of the knee (Fransen, McConnell, & Bell, 2003; Sharma, Dunlop, Cahue, Song, & Hayes, 2003).

Quadriceps Muscle Strength in Relation to Osteoarthritis of the Knee

The quadriceps muscle or quadriceps femoris is situated over the front of the thigh and is composed of four muscles: rectus femoris, vastus intermedius, vastus lateralis and vastus medialis (Shier, Butler, & Lewis, 1996). They cross both the knee and hip joints and consequently produce flexion at the hip, moving the thigh towards the chest, and allowing extension or straightening at the knee. Vastus medialis is particularly important for the stability of the patella during activity. The oblique pull

of the quadriceps muscle is counteracted by vastus medialis and weakness can cause the knee to give way. Muscle wasting occurs rapidly following injury, disease or lack of use and this can lead to instability and/or pain during activity. As a result, knee joint pain is lessened with stronger quadriceps muscle strength.

It is well recognized that quadriceps muscle weakness is common in people with osteoarthritis of the knee. Quadriceps muscle weakness in these people has generally been ascribed to disuse atrophy. However, quadriceps weakness also exist in persons with osteoarthritis of the knee who have no history of joint pain and in whom quadriceps muscle mass is not diminished but is normal or even increased (because of obesity). One study indicates that people with knee pain and radiographic evidence of osteoarthritis have weaker knee-extensor muscle strength than those who are asymptomatic with normal knees (Slemenda et al., 1997). Additionally, women with a greater lower-extremity lean mass have lesser leg-extensor strength when they have symptomatic osteoarthritis. Another two studies have indicated that peak torque, total work, average power for knee flexor and extensor muscles, and balance control in Thai women with symptomatic knee osteoarthritis are significantly less than those without symptomatic knee osteoarthritis (Narongrach, 1998; Pichaiyongvongdee, 2000). However, radiographic severity indicating osteoarthritis of the knee appears to have a non-significant relationship with balance, disability, and knee pain (Creamer, Lethbridge-Cejku, & Hochberg, 2000; Jadelis, Miller, Ettinger, & Messier, 2001; Slemenda et al., 1997). Additionally, many studies reveal that people with a degenerative knee joints radiograph do not suffer with knee pain (Jadelis, Miller, Ettinger, & Messier, 2001; Lamb et al., 2000).

Recent studies revealed that quadriceps muscle weakness and decreased postural stability is associated with reduced functional performance in people with osteoarthritis of the knee (Hassan, Mockett, & Doherty, 2001; Hinman, Bennell, Metcalf, & Crossley, 2002; Hurley, Scott, Rees, & Newham, 1997; Lewek, Rudolph, & Snyder-Mackler, 2004). Among people with symptomatic osteoarthritis of the knee, there is a lower maximum knee flexion angle during stance and a shorter period of eccentric quadriceps contraction than in symptomatic individuals (Radin et al., 1991 cited in Sharma, 1999). This suggests that there is less efficient use of the quadriceps to control the rate of descent of the foot. Additionally, knee

proprioception, the perception of limb position including awareness of joint position and movement, is worse in subjects with advanced osteoarthritis than those with mild osteoarthritis (Barrett, Cobb, & Bentley, 1991; Hurley, Scott, Rees, & Newham, 1997; Sell, Zacher, & Lack, 1993). Quadriceps muscle exercise is essential for two reasons: 1) it keeps knee joints from becoming stiffer, and it strengthens the muscles surrounding the joints; and 2) strong muscles provide needed support, making movement easier and reducing pain (Petrella, 1999). Evidence studies showed that increasing quadriceps muscle strength could decrease knee pain and stiffness in people with osteoarthritis of the knee (Deyle, Henderson, Matekel, Ryder, Garber, & Allison, 2000; Mounghong, 2001; Nantavanotayan, 1996; O'Reilly, Muir, & Doherty, 1999; Tanwattana et al., 2002; Tosayanonda et al., 2001). Many types of exercise for improving quadriceps muscle strength have been developed; for example, stretching exercises for patients with osteoarthritis of the knee as recommended by Petrella (1999), which include five exercise regimens as shown in Table 2.4. It is noted that if an individual increases soreness after doing these exercises, other recommendations for relieving pain should be provided. These include compressing a cold pack or ice on the effected knee, elevating the leg on a chair, and taking acetaminophen, or non-steroid anti-inflammatory drugs (NSAIDs), or other analgesic, as prescribed before or after exercise if ice alone is inadequate. In addition, if increased soreness or pain lasts for more than 2 hours after exercise, the repetitions of the strength exercises should be lessened and then gradually build up again. However, no desired dose-response or most effective exercise intervention for improving quadriceps muscle strength for people with osteoarthritis of the knee have been established.

Table 2.4 Stretching Exercises for Patients with Osteoarthritis of the Knee (Petrella, 1999)

Topic	Procedure
1. Unloading the knee	Put a light weight (5 to 10 pounds) on one ankle and sit in a position that allows the leg to dangle (e.g., on a bench, tall stool, edge of bed). Hold for 5 to 15 minutes, 1 to 3 times a day. Repeat for the other knee.

Table 2.4 Stretching Exercises for Patients with Osteoarthritis of the Knee (Petrella, 1999) (cont.)

Topic	Procedure
2. Knee extension	Sit in a chair and rest one foot on another chair across so that the knee is slightly raised. Gently push the raised knee toward the floor using only leg muscles. Hold the stretch for 5 to 10 seconds and then rest a minute. Repeat 10 times. Do every day up to 3 times a day.
3. Knee flexion	While sitting, loop a long towel underneath one foot. Gently pull on the towel with both hands to bend the knee, raising the foot 4 or 5 inches off the floor. Hold for 5 to 10 seconds, rest a minute, and repeat 10 times. Do with both knees every day, up to 3 times a day.
4. Quadriceps setting	While sitting in a chair, straighten one leg and hold. Repeat 5 to 10 times. Do the exercises with both knees, up to 3 times each day.
5. Wall slide	Leaning back against a wall, bend both knees 30°, sliding down the wall, and then straighten up again. Move slowly and smoothly. Keep the feet and legs parallel, and center kneecap over the second toe. Repeat 5 to 10 times, 1 to 3 times a day.

In conclusion, quadriceps muscle strength plays an important role in osteoarthritis of the knee, acting on knee extension and support knee joint stability. It needs regular muscle exercise and strength training to maintain muscle strength. One systematic review indicates that increasing quadriceps muscle strength could decrease knee pain and stiffness in people with osteoarthritis of the knee (Petrella, 2001). However, at long-term follow up, most subjects had lower muscle strength and higher knee pain than at the completion of the exercise programs (Deyle, Henderson, Matekel, Ryder, Garber, & Allison, 2000; Penninx et al., 2001; Thomas, Muir, Doherty, Jones, O'Reilly, & Bassey, 2002; Tosayanonda et al., 2001; van Baar et al., 2001). Additionally, one systematic review indicated that there were insufficient data to provide useful guidelines on optimal exercise types or dosage for people with osteoarthritis (Fransen, McConnell, & Bell, 2003). Many studies found that loss of interest, a lack of belief in benefits from the intervention, and lack of time influenced regular exercise (O'Reilly, Muir, & Doherty, 1999; Penninx et al., 2001;

Thomas et al., 2002). Motivation to regularly exercise, such as self-efficacy and outcome expectations for exercise, to maintain quadriceps muscle strength, should be further examined.

Exercise for People with Osteoarthritis of the Knee

Types of exercise generally recommended for patients with osteoarthritis are: a) range of motion and flexibility exercises, b) muscle conditioning or strengthening exercises, and c) aerobic exercise (Felson et al., 2000; National Institute of Arthritis and Musculoskeletal and Skin Diseases, 2001). Aerobic exercise is physical activity that elevates the heart rate and breathing rate, thereby stimulating the cardiovascular system (Seguin, Epping, Buchner, Bloch, & Nelson, 2002). Basic physiological adaptations on aerobic exercising range from early phase training of individuals to long-term training over years. The most significant change in cardiovascular function is improving stroke volume, which relates to subsequent workout, type of exercise training, and the genetic potential for change (Baechle & Earle, 2000). Thus, the optimal physiological adaptations following aerobic exercise are: 1) increased maximal cardiac output and maximal oxygen uptake, 2) slower resting heart rate, 3) improved ventilation efficiency, and 4) increased oxygen extraction (American College of Sports Medicine, 2000; Baechle & Earle, 2000).

For older adults, advancing age is associated with a loss of muscle mass (Baechle & Earle, 2000). The observed muscle atrophy with aging appears to result from physical inactivity and a gradual and selective denervation of muscle loss, resulting in a loss of muscle strength. Factors that may contribute to the age-related decline in muscle strength and power include reduction in muscle mass, nervous system changes, poor nutrition, and physical inactivity (Fleck & Kraemer, 1997). One systematic review indicates that exercise affects both prevention and treatment of chronic diseases and disability (Singh, 2004). High intensity exercise under supervised cycle ergometry aerobic exercise for 25 minutes three times a week can improve gait, pain and aerobic capacity in older adult with osteoarthritis of the knee (Mangione et al., 1999). In addition, maintaining regular exercise can prolong ADL limitations. Brach and colleagues (2003) analyzed a data of one randomized

controlled trial, which examined the effects of walking on bone status in older women. At a mean age of 74.2 years on the 14-year follow-up, only 38% of women who were consistently active had limitations in ADL whereas those who were inconsistently active and consistently inactive had 40% and 59% of the limitations, respectively. A similar pattern was noted for the outcomes of physical performance test scores and gait speed. However, contraindications to exercise should be carefully assessed for safety implications. Exercise-induced arrhythmias are more frequent in the elderly than in other age groups (Baechle & Earle, 2000). Thus, according to the American College of Sports Medicine guidelines (ACSM, 2000), people having one or more contraindications to exercise or exercise testing should not be permitted to enter any exercise program without medical approval. The specific contraindications to vigorous exercise or exercise testing are illustrated in Table 2.5.

Table 2.5 Contraindications to Exercise or Exercise Testing (ACSM, 2000).

Absolute	Relative
1) Recent significant change in the resting ECG identifying ischemia, myocardial infarction or other acute cardiac event	1) Left main coronary stenosis
2) Unstable chest pain (angina)	2) Moderate valvular heart disease
3) Uncontrolled cardiac arrhythmias	3) Electrolyte abnormalities (e.g., hypokalemia)
4) Severe symptomatic aortic stenosis	4) Severe arterial hypertension (i.e., systolic BP over 200 mm Hg at rest)
5) Uncontrolled symptomatic heart failure	5) Tachyarrhythmias or bradyarrhythmias
6) Acute pulmonary embolus or pulmonary infarction	6) Hypertrophic cardiomyopathy and other forms of outflow disorders that are exacerbated by exercise
7) Acute myocarditis or pericarditis	7) High-degree atrioventricular block
8) Suspected or known dissecting aneurysm	8) Ventricular aneurysm
9) Acute infection	9) Uncontrolled metabolic disease (e.g., diabetes, thyrotoxicosis)
	10) Chronic infectious disease (i.e., hepatitis)

Therefore, aerobic exercise for cardiovascular fitness in older adults should be scheduled using the following guidelines (ACSM, 2000).

1. Mode of activity: Any activity that uses large muscle groups at submaximal levels continuously and rhythmically, for example, walking, jogging, bicycling, swimming, and aerobic dancing. The activity should be accessible, convenient, and enjoyable to the participant and thus should directly relate to

exercise adherence. Additionally, a group setting may provide important social reinforcement to adherence.

2. **Intensity and rate of progression:** For inactive elderly, intensity should start low and individually progress according to tolerance and preference. Exercise need not be vigorous and continuous as a conservative approach is warranted. The most significant body adaptation to the stresses from exercise or training effects are the first six to eight weeks of an exercise program. The extent of the adjustment depends on the individual involved and the performance of the individual during exercise sessions.

3. **Duration of training:** Ideally, 20 to 60 minutes of continuous aerobic activity is the gold standard. However, exercise duration for older adults need not be continuous to produce benefits. Those who prefer shorter bouts of exercise can exercise for 10-minute periods at different times throughout the day. It is better initially increase exercise duration rather than intensity, to avoid injury and ensure safety.

4. **Frequency:** Exercise should be performed at least three times per week and no exercise days altered. At moderate intensity, it is better to exercise most days of the week.

Cost-effectiveness of an exercise program is another issue for making a decision on what is the practicable exercise program for older adults with osteoarthritis of the knee in a community. One study examined by Sevick (2000) indicates that older adults who participated in group aerobic exercise used up a lower expense and gained more efficiency in improving physical function than control participants. The cost estimated at the 18th month of the intervention for the aerobic exercise and education (control) group were \$323.55 and \$343.98 per participant, respectively. The researcher also compared the incremental saving per incremental effect for the resistance group between the resistance training group and the aerobic group. The resistance group had greater incremental saving per incremental effect than the aerobic exercise group. However, resistance training requires instruments and facilities to perform such exercise whereas aerobic exercise needs only available space for exercise.

Aerobic exercise guidelines for older adults with osteoarthritis of the knee are similar to aerobic exercise guidelines for other age groups and chronic diseases. These include 5- to 10-minutes warm-up, 20- to 60-minutes exercise training, and 5- to 10-minutes cool-down. The warm-up period is the process of preparing the body for exercise with a slowly increasing activity level and intensity, whereas cool-down is the process of reducing the intensity of exercise to help the body return to resting levels. However, it is recommended that people with osteoarthritis should start exercising slowly and not hurt or not gain more pain on their joints after exercise. Exercise should not be undertaken independently. Participants should be educated about the signs of excessive exercise stress and should decrease level of activity if these signs or symptoms develop. These signs include the following: pain lasting more than one to two hours after exercise, unusual or persistent fatigue, increased weakness, increased joint swelling, and decreased range of motion (National Institute of Arthritis and Musculoskeletal and Skin Diseases, 2001; O'Grady, Fletcher, & Ortiz, 2000).

In each exercise session, range of motion and flexibility exercises should be included. These involve gentle stretching and movement of a joint and associated muscles through a range of motion that is comfortable but also is associated with some resistance to further movement (Arthritis Foundation, 2000; O'Grady, Fletcher, & Ortiz, 2000). Range of motion and flexibility exercises should be done daily when pain and stiffness are minimal and also as a warm-up before exercise (Arthritis Foundation, 2000). The movements should be performed slowly and smoothly; the terminal stretch position (i.e., the position of maximum stretch and resistance) may be held for 10 to 30 seconds before returning the joint and muscle group to the resting position (Arthritis Foundation, 2000; O'Grady, Fletcher, & Ortiz, 2000). In addition, breathing regularly should be indicated while performing each movement because there is a tendency to hold the breath while exercising which causes increased blood pressure. Intensity of exercise should not raise heart rate over 50% to 70% of maximum heart rate (HR_{max}) or stop the participant holding conversation without feeling short of breath (Arthritis Foundation, 2000). The HR_{max} is computed by 220 minus age in years. For example, HR_{max} in people aged 60 years old is 220-60

= 160 beats per minute. HR_{max} and safety target heart rates for aerobic exercise in adults with different age groups are illustrated in Table 2.6.

Table 2.6 Target Heart Rate Zones for Aerobic Exercise (National Heart, Lung, and Blood Institute, 1993, cited in American Pharmaceutical Association, 2001).

Age (years)	Target Heart Average Rate Zone (50% to 70% HR_{max})	Maximum Heart Rate (100%)
20	100 – 140	200
25	98 – 136	195
30	95 – 133	190
35	93 – 129	185
40	90 – 126	180
45	88 – 122	175
50	85 – 119	170
55	83 – 115	165
60	80 – 112	160
65	78 – 108	155
70	75 – 105	150
75	72 – 101	145

Thus, an exercise program for Thai women with osteoarthritis of the knee should include aerobic, stretching, and flexibility exercises in each group session. Knowledge required for enhancing exercise behavior among individuals with osteoarthritis of the knee should include nursing, exercise physiology, rheumatology, cardiorespiratory system, sport medicine, and motivation strategies as self-efficacy and outcome expectations for exercise. Motivation plays an important role in encouraging people to continue regular exercise. Thus, group sessions for enhancing self-efficacy and outcome expectations for exercise through mastery experience, verbal persuasion, vicarious experience, and physiological and affective states should be included in the exercise program. This may affect disability or immobility prevention, independent activity of daily lifestyle, and better quality of life in Thai women with osteoarthritis of the knee.

Stationary cycling exercise is an exercise modality for people who cannot participate in weight-bearing exercise, such as people with arthritis (Smith, 2005; Westby, 2001). This type of exercise does not put much effort on the affected knees including ankles. It offers variable resistance from slow easy cycling to explosive

sprints, which means benefits for people of all ages and fitness levels. One study reveals that either low-intensity or high-intensity cycling improves function and gait, decreases pain, and increases aerobic capacity in older adults with osteoarthritis of the knee (Mangione et al., 1999). Muscles that do the most work in cycling include: (a) the thighs (quadriceps and hamstrings muscles), which straighten the leg; (b) the buttocks (gluteal muscles), which help straighten the hip; and (c) the calves (gastrocnemius and soleus muscles), which control the movements of the foot on the pedal (Bicycle Victoria, 2005; Westby, 2001). However, proper positioning while cycling, such as saddle and handlebars height, is different for people with different heights. The knee should be slightly bent, not more than 10 degrees flexion, when putting the foot on the pedal with the lowest position or fully extended. The handlebars should be adjusted to allow for a comfortable forward-leaning position. This ergonomic posture lessens the risk of knee strain, back pain, and premature muscle fatigue (Bicycle Victoria, 2005; ACSM, 2002). It may take several cycling sessions and some additional adjustments to find an individual's perfect position. Therefore, Thai women with osteoarthritis of the knee, performing bi-weekly 12-week exercise sessions, including warm-up, stationary cycling exercise, cool-down and stretching, should benefit by improving severity of knee symptoms and physical performance.

Theoretical Basis and Empirical Research Findings

Self-efficacy identifies that individuals create and develop self-perceptions of capability that become instrumental to the goals they pursue and to the control they are able to exercise over their environments (Bandura, 1997). From the origin of the Social Learning Theory, Bandura argued that individuals possess a self-system that enables them to exercise a measure of control over their thoughts, feelings, and actions (Bandura, 1986a). Thus, Social Cognitive Theory provides great insight into the interrelationships between belief, understanding, environment, and behavior. Beliefs are seen as the fundamental driving force behind behavior. People are viewed as self-organizing, proactive, self-reflecting and self-regulating rather than as reactive organisms shaped and shepherded by environmental forces or driven by concealed

inner impulses. This is the foundation of ‘reciprocal determinism,’ the view that, a) personal factors in the form of cognition, affect, and biological events, b) behavior, and c) environmental influences create interactions that results in a ‘triadic reciprocity.’ Self-efficacy beliefs are ‘people’s judgments’ of their capabilities to organize and execute courses of action required to attain designated types of performances (Bandura, 1997). These beliefs influence individuals’ behavior in various ways. First, they influence the choices that ones make; people engage in tasks about which they feel confident and avoid those they do not. Self-efficacy beliefs also help determine how much effort people will expend on an activity and how long they will persevere – the higher the self-efficacy beliefs, the greater the effort expenditure and persistence. This helps create a type of self-fulfilling prophecy, for the perseverance associated with high self-efficacy leads to increased performance, and also increased sense of efficacy. In addition, self-efficacy beliefs affect behavior by influencing individuals’ emotional reactions. People with low self-efficacy could come to believe that things are tougher than they really are and that fosters anxiety, stress, and a narrow vision of how best to solve a problem. With high self-efficacy, on the other hand, people create feelings of serenity in approaching difficult tasks, increase optimism, lower anxiety, raise self-esteem, and foster resilience. McAuley, Talbot, and Martinez (1999) examined effects of efficacy manipulation on positive well-being, psychological distress, and fatigue among low to moderately active women. The results revealed that participants assigned to a high-efficacy (HE) feedback, good level of physical fitness, had greater positive well-being, lower psychological distress, and lower fatigue than those assigned to a low-efficacy (LE) feedback, low level of physical fitness. Effect sizes for the well-being and fatigue differences between HE and LE conditions were moderate ($ES = .42$ to $.68$) while psychological distress difference between conditions revealed a large effect size ($ES = .82$ to 1.29).

Efficacy expectations are increased through four mechanisms (Bandura, 1997). These mechanisms are as follows: a) enactive mastery experience or performance accomplishment, b) vicarious experiences or observation learning, c) verbal persuasion from expert sources and peers, and d) minimized emotional arousal (reducing anxiety) or physiological condition. In conclusion, health behavioral

change is the result of reciprocal relationships among the environment, personal factors, and, attributes of the behavior itself. Thus, self-efficacy and outcome expectations are dynamic and form the most important characteristics that determine behavioral change (Bandura, 1997).

One self-efficacy study on exercise behavior was conducted by McAuley and Jacobson (1991) to examine the relationship among the exercise participation patterns of sedentary adults females and selected biometric (body weight and percent body fat) and psychosocial (instructor influence, self-motivation, and self-efficacy) variables. Findings suggested that self-perceptions of personal efficacy might mediate regular exercise behavior in sedentary adult women. Chinuntuya (2001) also found that perceived self-efficacy for exercise had a significantly direct effect on exercise behavior in the leisure time exercise pattern while it influenced exercise behavior indirectly through a commitment to a plan of exercise in lifestyle exercise pattern in Thai older adults. Conn (1998) examined relationships among self-efficacy expectations, outcome expectancy, perceived barriers to exercise, previous exercise behavior (as lifelong exercise practice), perceived health status, age, and exercise behavior. The results supported indirect negative relationships between perceived health status, self-efficacy expectancy and exercise behavior through perceived barriers. Perceived barriers had a negative relationship with lifelong exercise, health status, self-efficacy, and exercise behavior. Additionally, it had a positive relationship with age. Perceived barriers to exercise was also a mediator between age, health, self-efficacy, and exercise behavior. However, environmental factors influencing exercise behavior should be further explored.

Self-efficacy and predictions of health behaviors are linked. The self-efficacy construct offers a research-based theoretical approach for health care professionals to utilize within both health behavior study and health-promoting behavior-change program. The perceived ability to achieve successful behavior change can be measured by assessing “self-efficacy.” Methods of assessing “self-efficacy” include how clients or patients rate their confidence to make a behavior change on a scale from 0% to 100%. The lower the rating, the less likely it is that an individual will be able to make and sustain long-term change. Ratings less than 70% are associated with a lower chance of successful change. With a low self-efficacy

rating, education needs to be directed at discovering the beliefs and/or barriers to change (ACSM, 2000). Recent studies on Thai populations indicated that application of Self-Efficacy Theory in exercise promoting programs could increase exercise behavior, physical fitness, social contact with peer groups, and perceived well-being with statistical significance (Chairat, 1999; Maikiaw, 2001; Sumpowthong, 1993; Wattanawong, 2000; Wongkaoom, 1997).

Many studies in people with osteoarthritis of the knee, using Self-Efficacy Theory as a theoretical framework, indicated that self-efficacy enhancement interventions could increase exercise behavior and physical ability, and reduce knee pain and discomfort related to osteoarthritis of the knee. Nantavanotayan (1996) studied the effectiveness of a health education program, with an application of Bandura's Self-Efficacy Theory, in relieving knee pain among 36 experimental and 36 comparison outpatients in a tertiary care hospital of Bangkok Metropolitan. The two sessions, every other week, health education program included knowledge, examples of successive exercise on osteoarthritis of the knee, exercise practice, and reminding strategies for exercising. The result showed that the experimental individuals statistically gained more perceived efficacy expectations than before the intervention. However, there was no relationship between perceived efficacy expectations and outcome expectations. Another three studies described statistically less knee pain, more self-efficacy expectations and outcome expectations among people with osteoarthritis of the knee than before the health education program and than the comparison individuals (Barlow, Turner, & Wright, 2000; Mounghong, 2001; Thongsumrit, 1999). One qualitative study examined participants' decisions to continue participating in the physiotherapy intervention including exercise sessions in people with osteoarthritis of the knee (Campbell, Evans, Tucker, Quilty, Dieppe, & Donovan, 2001). They found that motivation to continue exercising was explained by four themes: attitudes towards exercise, perceived severity of knee symptoms, ideas about the cause of arthritis, and perceived effectiveness of the intervention. These findings are congruent with a study in older women experiencing hip fracture, conducted by Resnick and colleagues (2005). Semi-structured interviews were done face-to-face or by telephone and eleven themes facilitated that participation in exercise were found. These themes include real and expected benefits, visual cues

and knowing what to do, simplicity of the exercise program, individualized care appreciation, verbal encouragement, keeping regular schedule, confidence to exercise, personal willingness, being secured and being encouraged by the exercise trainer and family members, reciprocity of kindness to and from the trainer, and goal identification of physical performance achievement. However, themes that decrease willingness to continue exercise were also examined. These themes are unpleasant sensations associated with exercise, time constraints, and getting back to normal status before hip fracture. Although beneficial adaptations to exercise are accepted to be a non-pharmacological treatment for osteoarthritis, adherence of regularly exercise affected by motivation is inconsistent. One commentary is that promoting exercise behavior should consist of a combination of clear evidence-based guidelines coupled with health professional training and behavioral programs tailored to age-specific barriers and motivational factors (Singh, 2004). Thus, self-efficacy plays a role in the motivation to perform specific behavior, as exercise, for older adults with osteoarthritis of the knee to maintain their physical ability and wellness.

Studies Related to Exercise and Osteoarthritis of the Knee

There are many kinds of exercise modality recommended for people with osteoarthritis of the knee, e.g., walking exercise, aerobic exercise, and stationary cycling exercise. However, the goals of these exercises are to strengthen muscles, increase range of motion, and, in some studies, improve cardiovascular fitness. For people with osteoarthritis of the knee, exercise is usually conducted with other interventions such as health education and physical therapy. For instance, Deyle and colleagues (2000) conducted a randomized controlled trial (RCT). The purpose was to evaluate the effectiveness of a physical therapy program for osteoarthritis of the knee in 83 outpatients in a military medical center. The physical therapy program consisted of manual therapy to the knee, hip, ankle, and lumbar spine combined with range of motion, strengthening, and cardiovascular exercises. They compared effectiveness of the physical therapy program and the placebo (ultrasound at a sub-therapeutic intensity). Patients in the physical therapy group had significant improvement in the Western Ontario McMaster Osteoarthritis Index (WOMAC)

scores and the 6-Minute Walk Test (6MWT) from the baseline compared with the placebo group at 4 weeks and 8 weeks measure. In the treatment group, effect sizes for WOMAC scores and 6MWT- distance were 1.19 and 0.44 at 4 weeks, and 1.28 and 0.47 at 8 weeks, respectively. At one-year follow up, the WOMAC scores in the treatment group were lower than the 8-week assessment, but were still greater than baseline measures. The authors indicated that a combination of manual therapy and clinical exercise provided greater improvement than only clinical exercise; the effects could not be separated from either the clinical or home exercise program. However, the effects of the intervention beyond one year were unknown. Appropriate doses of exercise and continued relief over a longer period should be further studied. Another facility-based, single blind, 12-week RCT supervised exercise program was conducted by van Barr and colleagues (2001). The purpose of this study was to examine effects of an exercise program in patients with osteoarthritis of the hip or knee and to explore relationships between patients' characteristics and effects of exercise over time. Ninety participants were randomly assigned to the exercise therapy group and 97 were controls. The 12-week intervention consisted of individualized exercise treatment provided by a physiotherapist and patient education and drug treatment provided by general physicians. It is not known whether the tailored intervention varied by the protocol or by the providers (physiotherapists and general physicians). Although usefulness of exercise on pain and disability was clearly indicated, it declined to non-significant levels at 24-weeks follow-up after completion of the program. The important finding is that the control group improved muscle strength of the hip at the 24-week assessment. Maturation may occur from several repeated measures. A lower score on pain coping strategy and greater BMI ($\text{BMI} \geq 30$) were prognostic variables for beneficial long-term outcomes that could be potential moderators.

One cycling exercise study in older adults with osteoarthritis of the knee was conducted by Mangione and colleagues (1999). Thirty-nine adults with knee pain from osteoarthritis performed either a high- or low-intensity 10-week stationary cycling exercise program. Results revealed that there were no significant differences between high- and low-intensity cycling exercise for functional status, gait, pain, and aerobic capacity. The researchers concluded that both exercise intensities provide

beneficial effects for people with osteoarthritis of the knee. However, this study did not include control participants to investigate changes among older adults who did not participate in the exercise program. In addition, although there were significant differences between pre- and post-intervention measures, effect sizes of these measures were small to moderate ($ES = .19$ to $.63$).

An 8-week isokinetic quadriceps exercise program was conducted to examine changes in pain and function in older adults with osteoarthritis of the knee (Maurer et al., 1999). Ninety-eight men and women aged 50 to 80 years old were randomly assigned to perform the 8-week exercise intervention or receive a 4-session education intervention designed as a minimal, standardized form of usual care. The exercise group underwent strength training on the knee extensor muscle groups with a dynamometer three times a week for 8 weeks. Overall outcomes, examining pain and difficulty in performing ADL, were assessed by three questionnaires. These questionnaires included the Arthritis Impact Measurement Scales, version 2 (AIMS2), the Short-Form, 36-item version of the Medical Outcome Study scales (SF-36), and the WOMAC score. Muscle strength was measured by using a dynamometer, to find isokinetic peak torque, at baseline, at the 4th, 6th, 8th week of the intervention, and at the 12th week follow-up. The results revealed that both the exercise and the education participants significantly increased their muscle strength at the 8th week ($p < .001$). In addition, no significant between-group differences on muscle strength and overall outcome were found. The researchers discussed the idea that the education participants might have improved muscle strength by familiarizing themselves with the dynamometer and performing muscle training with the machine during the tests. Pain changes and functional activity changes improved at week 8 in both groups, however, favoring the exercise group rather than the education group. These results indicate that, other than exercise, knowledge of the disease process, joint protection and self-management strategies have encouraged increased activity levels and muscle strength. Additionally, the attention and socialization paid to both groups also encouraged all participants to find information related to osteoarthritis of the knee.

Walking exercise also benefits people with osteoarthritis of the knee in reducing pain and physical function difficulties. Kovar and colleagues (1992)

conducted a randomized control trial of a supervised fitness walking and education program in 92 women and men aged 40 to 89 years. Twenty-four sessions, based on self-efficacy and education strategies, were conducted by a physical therapist three times a week. Each 90-minute session included stretching and strengthening exercise, providing knowledge, group discussion, and supportive encouragement. Results indicated a greater benefit in 6MWT-distance and physical activity assessed by the Arthritis Impact Scale (AIMS) in the walking group than in the control group. Large effect sizes were found in 6MWT-distance ($ES = .95$) and physical activity ($ES = .96$) and a medium effect size was found in improving arthritis pain ($ES = .58$). Although walking exercise seems not to increase pain or exacerbate arthritis-related symptoms, the authors reported one participant in the walking group and one in the control group fell and fractured a hip. The risk of falling and balance should be considered for all older participants.

Evcik and Sonel (1999) examined effectiveness of a home-based exercise compared to a regular walking program and no intervention group. The exercise group performed a twice-daily isometric and isotonic quadriceps exercise program at home for three months. A weekly telephone call was used to confirm whether participants were continuing the exercise. The walking group joined a walking program three times a week. Results revealed that both exercise and walking groups improved pain and physical function, assessed by the WOMAC and visual analog scale (VAS), more than the control group. Large effect size ($ES > 0.8$) on the WOMAC and VAS pain for the exercise and the walking group were examined. No significant difference between the exercise and the walking groups on pain and physical function were examined. However, the walking group gained greater improvement in quality of life, as assessed by the Nottingham Health Profile questionnaire, than the exercise group. Home-based exercise may have been less motivating than group walking exercise. In addition, 26% of participants in the group walking exercise lost weight at the end of the program. This could be a potential motivating factor to continue regular walking.

Home-based RCTs are also used to examine the effectiveness of exercise interventions. O'Reilly, Muir, and Doherty (1999) conducted a RCT to assess the effect of a home-based quadriceps exercise on knee pain and disability in 108

experimental and 72 control individuals with osteoarthritis of the knee. The research protocol included general advice, an exercise program taught at home, and home visiting. After the intervention, statistical differences between groups were found in VAS pain for walking, VAS for stairs climbing, physical functioning, quadriceps muscle strength and activation. Compliance, level of anxiety and depression, and reduction in weight were also desirably influenced. However, effect sizes and power, which could be computed from the available data, were small ($ES = 0.01$ to 0.41 ; $Power = 0.06$ to 0.29). The intervention, designed as supervised home-based exercise, should be further developed and include other variables such as motivation, value and exercise outcome expectations.

Another study of a 2-year home-based exercise program designed to reduce pain and improve physical function among 786 participants with knee pain was conducted by Thomas and colleagues (2002). The program's purpose was to maintain and improve the strength of muscle, range of motion, and locomotor function. The intervention was designed to be simple to use for all age groups and was taught individually in the participants' homes. Four groups of participants randomly received 1) exercise therapy, 2) monthly telephone contact, 3) exercise plus telephone contact, or 4) no intervention. Results showed that the exercise groups achieved significant improvement in knee pain compared with the non-exercise groups (Odds Ratio = 1.5). Additionally, exercise was consistently better at reducing pain at 6, 12, and 18 months in the exercise group than in the non-exercise group. However, at the 2-year assessment, only 46% of the participants completed the exercise program regularly. The most common reasons were health problems, lack of time, and discomfort with the exercise instrument provided (an elastic band). Large, medium, and small effect sizes for the *F*-test on means in the ANOVA suggest an effective impact of exercise on pain among high, medium, and low grade adherence to the exercise class ($ES = 0.42$, 0.34 , and 0.16 , respectively). Scores for stiffness and physical function, and isometric muscle strength also show significant improvements in the exercise groups compared with the non-exercise groups. General physical function, anxiety, and depression at the 2-year assessment were not significant. The intervention showed a small reduction in pain (12%). Additionally, some participants thought that they were unlikely to get benefits from the

intervention. This might be caused by other non-diagnosed knee problems, e.g., knee ligament deficiency. The results indicated that the home-based exercise therapy could produce only a small but significant reduction in knee pain.

One facility- and community-based intervention was conducted among 250 community-dwelling older adults with osteoarthritis of the knee (Penninx et al., 2001). The purpose was to examine whether a physical exercise program could improve and maintain ADL. Participants were randomly assigned into an attention control group, an aerobic exercise program, or a resistance exercise program. The intervention was a 3-month facility-based exercise program and a 15-month home-based exercise program. Findings indicated that both resistance and aerobic exercise had an effect on maintaining ADL, increasing physical performance, aerobic capacity, muscle strength, and improving postural sway. Although the incidence of ADL disability among elderly in the control group was higher than the exercise group, the effect size was small ($\chi^2 = 5.3$, $p = 0.02$; $ES = 0.11$). Additionally, compliance with exercise declined over time during observations, and loss of interest in exercise was the most common reason of dropout. Why older people lose interest in exercise programs is an important issue. The mechanism, relationship of exercise and ADL disability, and variables related to long-term compliance should be further examined.

One study employed a combination of home exercise with class-based exercise for people with osteoarthritis of the knee (McCarthy et al., 2004). Two hundred and fourteen participants aged 40 - 86 years old were allocated into two groups, home exercise alone and a combination of home exercise with class-based exercise. An introductory advice and education session including guidance for the home exercise program was provided to all participants. The home exercises included sitting to standing, leg stretching and range of movement, and one leg balancing exercises. The 45-minute twice-weekly class-based exercises included a circuit of exercises supervised by a physiotherapist at a physiotherapy department. Muscle stretching, balance training, isotonic and weight-bearing exercises, and isometric quadriceps exercises were performed as part of the exercise circuit. After the 8th week of exercise intervention, the class exercise group revealed greater improvement in aggregate locomotor function (ALF) score, VAS pain score, and WOMAC score,

than baseline assessments and than the home exercise group. Effect sizes at the end of the intervention for the ALF and VAS pain score were .96 and 1.03, respectively. The effect sizes for pain, stiffness, and physical function domain in the WOMAC scores were .40, .45, and .32, respectively. However, differences of the SF-36 score were found only for the physical function and pain dimensions. In addition, not all of these improvements were maintained over the 12-month follow-up. The main reason was that participants stopped their home exercising. The authors suggested that increasing compliance strategy or motivation to continue home exercise should be encouraged so that it would produce better results.

In Thailand, Thongsumrit (1999) conducted a quasi-experimental study to examine the effect of a Traditional Thai exercise program for elders with osteoarthritis of the knee. Based on the Self-Efficacy Theory and Social Support Theory, 36 elder participants (31 women and 5 men) received the intervention program while the comparison participants were asked to retain their usual lifestyle. The 6-weekly program consisted of Traditional Thai exercise practice and knowledge regarding osteoarthritis of the knee. Results showed that the experimental group gained higher mean scores in self-efficacy expectation, outcome expectation, muscle recovery and osteoarthritis of knee condition control than before the intervention and than the comparison group ($p < .05$). However, the large effect sizes for all variables measured are based on questionnaires. Differences of mean scores between groups in body weight, knee circumference, range of motion of the knee joint, and thigh circumference revealed a small to medium effect size.

A community-based intervention was conducted in urban communities of the Bangkok metropolitan area by Tosayanonda and colleagues (2001). The purpose was to determine the prevalence of osteoarthritis of the knee and to assess the efficacy of a muscle exercise program along with educational instructions on standard routines of knee care. All of the 392 participants were elderly with a mean age of 67.7 years (S.D. = 6.0), and had pain in at least one knee. The exercise program was conducted 2 times a week for 8 weeks by physical therapists, focusing on quadriceps muscle exercise. However, the authors did not give in-depth details of the exercise program. Results indicated significant differences between the experimental group and the comparison group on 6MWT-distance and degree of lack

extension range of motion (ROM) at baseline. Radiographic appearance of the knee joint tended to remain the same among the experimental participants and no statistical difference between the two groups was found. Pain score also had no statistical significant when compared with radiographic changes. A moderate effect size was found in improving pain score ($ES = 0.6$) and ROM ($ES = 0.5$). A large effect size was found in 6MWT-distance in the experimental group ($ES = 0.81$) at the 8th week of the exercise program. However, the 6MWT-distance was decreased at the 6 and 12 months follow-up in both groups. Additionally, comparing the intervention and the comparison groups, the 6MWT-distance and the functional incapacity score indicated physical performance had a moderate effect size.

A health education program for inducing osteoarthritis of the knee prevention behavior was also developed. Sumpowthong (1993) examined the effectiveness of a health education program on osteoarthritis preventive behavior among an aging population in Thammasat University Hospital Aging Club, Patumthani province, Thailand. Based on the Health Belief Model (Becker & Maiman, 1975) and Self-Efficacy Theory (Bandura, 1986a), the intervention included a lecture with videotape, a demonstration and skill training, and home visit and group discussion. The main objective of the program was to control body weight and increase thigh muscle strength. Forty participants in the experimental group and 36 as comparisons were 60 years old and over. All participants were members of the Aging Club and no osteoarthritis of the knee was previously diagnosed. Results revealed that the experimental group had more improvement than the control group on perception, expectation, osteoarthritis preventive behavior, body weight, and quadriceps muscle strength. Perception and expectation were significantly correlated with osteoarthritis preventive behavior. Additionally, only income had a relationship to perception and expectation of osteoarthritis preventive behavior.

Mounghong (2001) examined the effect of a facility-based health education program on self-care among patients with osteoarthritis of the knee attending the orthopedics outpatient department, Pramongkutklao Hospital, Bangkok, Thailand. Sixty-nine patients participated the intervention program and 72 patients were assigned as comparisons. The quasi-experimental study, based on Self-Efficacy Theory, consisted of four-weekly sessions which included: a) providing knowledge

and discussions about the causes of osteoarthritis of the knee and knee pain; b) giving advice on self-management, diet control, and handing out a quadriceps muscle exercise booklet; c) encouraging keeping diary for diet control and quadriceps exercise recording; and d) empowering and peer supporting techniques. Results revealed that perceived self-efficacy and outcome expectations concerning self-care behavior of diet control, regular quadriceps exercise, and prevention of the positions that might increase pressure on the knee joint in the experimental individuals were higher than before the intervention program and than the comparisons. Additionally, BMI and knee pain were significantly decreased. However, there was no statistical difference concerning thigh circumference and quadriceps muscle strength.

One study was conducted to compare the effectiveness of a simple isometric quadriceps exercise ($n = 22$) and a progressive resistive quadriceps exercise ($n = 20$) among patients with osteoarthritis of the knee attending a rehabilitation outpatient department (Tanwattana, Suputtitada, Aksaranugraha, Srikiatkachon, & Samorrapoom, 2002). Following a 10-minute ultrasound treatment, participants were instructed to perform one of the quadriceps exercise regimens five days per week for 2 weeks. In addition, joint protection and hamstring muscles stretching exercises were also taught by the researchers. Participants in each group were instructed to perform the quadriceps exercises at home, as they did in the facility but with no ultrasound treatment provided, for another 2 weeks. Findings revealed that both types of quadriceps exercises resulted in a significant improvement in knee pain, stiffness, and physical function, as assessed by the WOMAC after the first week of the intervention. The WOMAC score continued to improve every week from baseline to the 4th week of the intervention. Large effect sizes on WOMAC score at the 4th week were examined both in the progressive resistive quadriceps exercise and the simple isometric quadriceps exercise groups ($ES = 1.24$ and $.82$, respectively). However, the authors noted that improvement in pain score may have been from ultrasound treatment and this exercise regimen should be further studied.

In a meta-analysis (Conn, Valentine, & Cooper, 2002), studies testing interventions using self-monitoring reported larger effect sizes than studies without self-monitoring and the presence or absence of social modeling or social support was not associated with statistically significant differences in effect sizes. Additionally,

effect size was unrelated to the number of weeks of intervention. High levels of program intensity had higher effect sizes. Intensity of contact between interventionists and participants was used as a moderator instead of length of the interventions because interventions of similar length sometimes varied dramatically in intensity. Center-based exercise studies reported significantly larger effect sizes than home-based exercise studies. Studies recommending moderate- to high-intensity activity reported a significant greater effect size than low-intensity activity. Studies testing interventions targeted only activity behavior reported higher effect sizes than studies designed to change multiple health behaviors. Interventions delivered to individuals resulted in smaller effect sizes than interventions delivered to researcher-formed groups. The researchers discussed whether group exercise might be more effective than individually tailored exercise, or if effectiveness was influenced by group process or social drive.

Collectively, these studies demonstrated beneficial effects of exercise in people with osteoarthritis of the knee. However, a gap of knowledge exists. The most effective duration and intensity of intervention have not yet been concluded. Insufficient data cannot provide guidelines on the optimal exercise type or dosage for people with osteoarthritis. Many studies did not employ motivation strategies to enhance regular exercise behavior other than measuring the effect of exercise in pain and physical performance. In addition, motivation to exercise was found to decrease after completion of the exercise interventions. Whether an exercise program for people with osteoarthritis of the knee will affect their self-efficacy and outcome expectations for exercise, severity of knee symptoms, and physical performance at the 4th, 8th, or 12th week still needs to be confirmed.

Conclusion

Osteoarthritis of the knee is one of the major causes of morbidity throughout the world (Brundtland, 2002). Forty percent of individuals over 70 years old suffer from osteoarthritis of the knee. Additionally, eighty percent of people with osteoarthritis have some degree of limitation of movement, and 25% cannot perform their major daily activities (WHO, 1997). It is a chronic disease of unknown etiology

that can be mild or lead to significant pain and disability, especially when the involved joints are critical to the activities of daily living. Although the causes of osteoarthritis are not completely understood, it is well recognized that quadriceps muscle weakness is common in people with osteoarthritis of the knee. Strengthening quadriceps muscle, by exercising, has been shown to reduce pain and improve physical function for people with osteoarthritis of the knee so that development of functional limitations and consequential disability are delayed. However, doses and intensity of exercise intervention needed to meet the optimal effectiveness in people with osteoarthritis of the knee are not yet known. Additionally, motivation to exercise was found to decrease after completion of the exercise interventions. Although one systematic review suggests that both group exercise and individual exercise at home is equally effective (Roddy et al., 2005), group exercises including education and motivation strategies are also essential. A behavioral change is the result of reciprocal relationships among the environment, personal factors, and, attributes of the behavior itself. Thus, self-efficacy and outcome expectations are dynamic and taking part of the most important characteristics that determine behavioral change (Bandura, 1997). Therefore, providing knowledge from health providers and supports both from health providers and peers could promote individuals to perform and maintain their exercise behavior. This study was to promote exercise behavior by enhancing self-efficacy and outcome expectations for exercise, in which group exercise and group discussion are the main strategies. Participants were expected to initiate and maintain their exercise behavior. As a result, they could reach the beneficial outcomes, including a decrease in severity of knee symptoms and improvement in physical performance.

CHAPTER III

METHODOLOGY

This chapter describes the research methodological approaches adopted in this study. These consist of description of research design, population and sample size, construct and development of research instruments, human rights protection for research participants, data collection, data management, and data analyses.

Research Design

This study was a quasi-experimental study, which aimed to examine the effect of a community-based exercise program on self-efficacy and outcome expectations for exercise, severity of knee symptoms, and physical performance in Thai women with osteoarthritis of the knee. Data were collected at baseline, the 4th, 8th, and 12th week after the completion of the intervention (Figure 3.1).

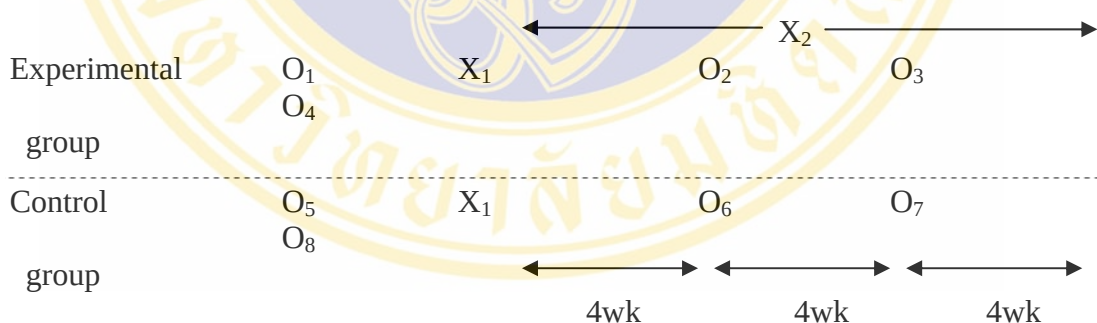


Figure 3.1 The Research Design

Experimental group : Participants received a general information regarding osteoarthritis of the knee session (X₁) and performed the 12-week community-based exercise program (X₂)

Control group : Participants received a general information regarding osteoarthritis of the knee session (X₁) and retained their normal daily life as usual during the 12 weeks of the study

X₁	: General information regarding osteoarthritis of the knee session
X₂	: The 12-week community-based exercise program
O₁ , O₅	: Baseline data collection and assessments
O₂ , O₆	: Data collection and assessments at/after the 4 th week of the study
O₃ , O₇	: Data collection and assessments at/after the 8 th week of the study
O₄ , O₈	: Data collection and assessment at/after the 12 th week of the study

Population and Sample

The target population in this study was Thai women suffering knee pain and having clinical symptoms related to osteoarthritis of the knee. After surveying to find potential participants, a convenience sampling technique was adopted for recruitment. Participants from four Elderly Clubs in Nonthaburi province were contacted during monthly meeting.

Inclusion Criteria

Eligible participants recruited into the study conformed to the following criteria.

1. Women aged 50 to 70 years old. Participants aged 60 years and over were asked to complete the Set Test for screening of moderate-to-severe cognitive impairment (Isaacs & Akhtar, 1972; Isaacs & Kennie, 1973). The cut off score was 25 or over for determining normal mental stage.

2. Presence of knee pain on one or both knees, with at least two criteria of (a) joint stiffness less than 30 minutes in duration at a time, (b) crepitus on motion, (c) bony tenderness, (d) bony enlargement, or (e) no palpable warmth (Altman et al., 1986). These criteria were included in the screening questionnaire developed by the researcher to specify clinical symptoms of osteoarthritis of the knee. Medical history was an alternative assessment when available. Various usage of medication prescribed by physician(s) to relieve knee pain was an extraneous

factor the researcher could not control for. Additionally, this is an ethical issue that all participants had their rights to received health care services and treatments for their knee pain.

3. Absence of self-reported rheumatoid arthritis or other systemic inflammatory arthritis (e.g., gout, systemic lupus erythematosus).

4. Absence of serious medical conditions that can be significant contraindications to exercise. Examples of medical conditions include:

- Unstable angina or myocardial infarction during the previous month;
- Irregular heart rate or pulse rate at rest;
- Resting heart rate over 120 per minute;
- Systolic blood pressure more than 180 mm Hg; and
- Diastolic blood pressure more than 100 mm Hg.

Medical condition information was obtained at baseline interviewing and assessments by the researcher. Participants were asked to have a physical examination or to see a physician when self-report or baseline interviewing showed any medical conditions that might preclude exercise training.

5. BMI less than 40.0 Kg/m², which determines “pathological obesity” (Ministry of Public Health, B.E. 2547b).

6. Not currently engaging in any other treatment program intervention for their arthritis, such as physical therapy.

7. Absence of major lower extremity joint reconstructive surgery.

Exclusion Criteria

Participants were excluded from the study if they experienced any of the following.

1. Severity of knee symptoms, assessed by the Severity of the Disease Scale - Modified Version (M-SEV; Kanjanavorawong, 1997), greater than moderate level (score ≥ 24).

2. Hip or ankle pain greater than 3 (moderate) out of 10 (very severe) daily, or multiple major joint osteoarthritis involvement, or subjective complaint of knee joint instability (giving way) by history.

3. Steroid injections into the effected knee within the past 3 months. The rationale was that most individuals who require articular injections to control symptoms are probably candidates for surgical intervention and possibly develop progressive damage in the knee joint (Hochberg et al., 1995).

Sample Size

The approximate sample size was determined based on statistical power analysis, at a significance level of .05, and a desired power of .80. One systematic review of forty exercise studies in people with osteoarthritis reveals that the effect sizes (d) range from 0.57 to 1.0 (Jordan et al., 2003). Therefore, the effect size on F -test on mean in the analysis of variance and covariance will be computed by using the equation:

$$N = \frac{n_{.05}}{400 f^2} + 1 \quad (\text{Cohen, 1988: 390})$$

Whereas $n_{.05}$ is the sample size needed to detect $f = .05$ (for a significant level) = .05, $u = \text{treatment} - 1 = 1$, with power = .80, the subtable Table 8.4.4 illustrates $n_{.05} = 1571$ (Cohen, 1988: 384).

f is the standard deviation of standardized means translated from d (ES index for the t -test) which is equal to $\frac{1}{2} d$ (Cohen, 1988: 276). Thus, regarding the systematic review report (Jordan et al., 2003), $f = .285$ to .500.

Substituting in the equation:

$$N = \frac{1571}{400 (.285)^2} + 1 = 49.35$$

and

$$N = \frac{1571}{400 (.500)^2} + 1 = 16.71$$

Therefore, minimum and maximum sample size for this study should be 17 and 50. Accounting for an estimated 10% attrition rate (Kovar et al., 1992; Petrella & Bartha, 2000), fifty-five participants was an adequate sample size in the experimental group and control groups to detect a significant difference between groups. However, after 6 months of recruitment, there were 30 participants from the experimental setting and 30 participants from three control settings participated in the study. The

sample size of at least 30 can draw on the central limit theorem and assume that the sampling distribution of mean scores are approximately normally distributed (Daniel, 1995). Thus, power of test for this sample size resulted between .73 and 1.0 (Cohen, 1988: 315).

After completion of the study, there were 25 experimental and 28 control participants' data employed into the analyses. Power of test in the experimental group decreased to between .65 and .99 whereas power of test in the control group might decrease to between .70 and 1.0.

Instruments

Instruments for this study were categorized into three groups as screening instruments, intervention tools, and instruments for data collection.

Screening Instruments

Based on the inclusion and exclusion criteria, the screening instruments were as follows.

1. Symptoms Related to Osteoarthritis Assessment is based on the American College of Rheumatology (ACR) clinical criteria for osteoarthritis of the knee, treatment guidelines, and inclusion criteria of this study (Altman et al., 1986; Altman, Hochberg, Moskowitz, & Schnitzer, 2000). The ACR criteria have 95% sensitivity and 69% specificity for osteoarthritis of the knee classification. The 7-item questionnaire developed for this study includes respondents' age and questions asking whether they had knee pain, knee stiffness, notice sound when moving (crepitus), knee pain when pressed, knee hypertrophy, and knee swelling, red coloration, or a warm feeling in the knee. Respondents were decided as having symptoms related to osteoarthritis of the knee when they were 50 years old or over on the response date, and reported knee pain with two or more additional symptoms of the followings: knee stiffness less than 30 minutes, crepitus, bony tenderness, bony enlargement, and no palpable warmth. This questionnaire was provided to Thai women as a contact letter and a screening questionnaire. Self-reported physician's diagnosis and medication records were additional optional confirmations.

2. The Severity of the Disease Scale-Modified Version was used to assess the level of severity of knee symptoms related to osteoarthritis of the knee. This 10-item instrument was first developed by Oupaichit (1994) to assess pain, stiffness, and difficulty with physical function related to osteoarthritis of the knee in Thai patients attending orthopedic outpatient departments. Then, the instrument was modified by reverting the score (Kanjavorawong, 1997). The modified score of each item ranges from 1 (less or no symptom) to 3 (severe symptom). Total score, which ranged from 10 to 30, was defined into three levels. A score of 10 to 16 determined slightly severe; a score of 17 to 23 refers to moderately severe; a score of 24 to 30 is considered very severe; and the Cronbach's alpha coefficient of the instrument was .94 (Kanjavorawong, 1997). Eligible participants in this study reported severity of the disease scores of 23 or lower at screening.

3. The General Health Status and Medical History Assessment Form: This screening instrument was developed for this study to examine any contraindications to exercise as described in the inclusion criteria. As a part of the screening questionnaire, this instrument included five questions asking whether the respondents had knee instability, engaged to medical-surgical treatment or physical therapy related to knee pain, one question asking whether they had hip or ankle pain, and one question asking whether they experienced chest pain. The additional three questions included resting blood pressure and pulse (heart rate) assessments. Body weight and height were also measured to compute BMI.

4. The Set Test (Isaacs & Akhtar, 1972; Isaacs & Kennie, 1973) was used to assess cognitive function of the eligible participants. This instrument is a brief objective test of mental function performed by asking participants to name as many items as they can recall in four common categories or sets as colors, animals, fruits, and towns. One point is counted on each correct item with a maximum score of 10 for each set and a maximum of 40 for the total score. The results did not appear to be materially disturbed by educational and cultural factors because it yields a simple numerical result. Isaacs and Akhtar (1972) applied the Set Test to 64 healthy elders aged 65 and over. The average score of the test was 31.23 (*SD* 7.31) and no significant difference between genders was found. However, there was a negative correlation

between age and the Set Test score, which was less with increasing age (Isaacs & Akthar, 1972). Isaacs and Kennie (1973) reported that the score of under 15 corresponded to a clinically diagnosed dementia, while a score of 25 and over revealed a normal mental function. Many Thai studies use the Set Test for screening cognitive and mental function regarding ordinary living and have changed the town set into districts or provinces which is the same set called in Thai (Nakaphonges, 1996; Lausawatchaikul, 1999; Prasertphol, 2001; Saenmanoch, 1998; Woungjunlongsin, 1999). Thus, with the applicability for the Thai population, participants aged 60 and over were asked to answer the Set Test for mental function screening. Respondents with the Set Test score of 25 or over were asked to participate in the study. The average Set Test scores of the experimental and control groups in this study were 38.08 (*SD* 3.30) and 36.71 (*SD* 3.67), respectively.

Intervention Tools

The intervention tools include a general information regarding osteoarthritis of the knee provided to all eligible participants and a community-based exercise program provided to participants in the experimental group.

1. General Information Regarding Osteoarthritis of the Knee consisted of definition of osteoarthritis of the knee, signs and symptoms, risk factors, pain management, exercise principles for osteoarthritis of the knee, and precautions regarding increasing pressure on knee joints. Content in the information was developed by the researcher and is congruent to other information advised to the public in Thailand (Seesuk, Pariwisut, & Chaipiyaporn, B.E.2537; Umpanwong, B.E. 2547; Wattana, Prasartlitha, & Samranwej, B.E.2547). After baseline assessment, the information was provided once to each elderly club participating in the study during a monthly meeting where both eligible participants and members in the elderly clubs could receive it. The information session lasted 20 minutes with a set of flipcharts and was conducted by the researcher. An additional 10 minutes was provided for any questions from the participants and a demonstration. A handbook regarding osteoarthritis of the knee written by Wattana (B.E. 2545) was given to each of the experimental and control participants after the information session. In addition, during group discussion sessions of the intervention program, general information

regarding osteoarthritis of the knee was included as health education for the experimental participants, and was given by the researcher.

2. The Community-Based Exercise Program is 24-biweekly group sessions developed by the researcher. Based on Bandura's Self-Efficacy Theory, the program included group discussion and stationary cycling exercise. Each group session lasted approximately one hour, and included:

2.1) Provision of knowledge regarding osteoarthritis of the knee:

This part included a discussion regarding participants' experiences of knee symptoms, personal behaviors related to osteoarthritis of the knee, benefits of cycling exercise, and precaution for safety issues.

2.2) Cycling exercise: The cycling exercise protocol was designed for older adults with osteoarthritis of the knee. By using stationary cycles, the exercise session began with a low intensity 5-minute warm-up, 15-minute cycling exercise, and 10-minute cool-down and stretching. Intensity was slowly progressed to a moderate level in the forthcoming weeks during the 12-week sessions. Cycling exercise includes both isometric and isotonic muscle exercise of quadriceps and hamstrings muscle groups. In addition, participants were instructed about the signs of excessive exercise stress and to decrease level of activity or stop exercise until they feel they have recovered if these signs or symptoms develop. These signs are: a) feeling shortness of breath or cannot hold a conversation; b) unusual or persistent fatigue; c) increased weakness; d) increased pain; e) increased joint swelling; and f) decreased range of motion.

2.3) Provision of verbal persuasion: During the group session, the researcher provided verbal persuasion both during the exercise and discussion sessions. Examples of successful participants practicing exercise, and social support from the researcher and peer group were also included.

2.4) Evaluation of physical function regarding exercise: Participants were asked to describe how they felt after exercise, and how improved their muscle strength, range of motion, and level of knee symptoms as pain, stiffness, and daily activities.

2.5) Goals setting: Participants were asked to set their 'goals to be achieved during the forthcoming weeks' during the group discussion sessions. Goals

were easy to achieve and participants gained confidence to perform exercise from them.

Consistency of the elements in self-efficacy strategy and the exercise program protocol is illustrated in Table 3.1.

Table 3.1 Comparisons of The Self-Efficacy Strategies and the Community-Based Exercise Program

Sources of self-efficacy information	Community-Based Exercise Program
- Enactive mastery experience	- Provide knowledge regarding osteoarthritis of the knee and perform cycling exercise under instruction
- Vicarious experiences	- Demonstrate stationary cycling exercise and modeling
- Verbal persuasion	- Provide verbal persuasion and support
- Emotional and/or physiological status	- Evaluate physical function regarding exercise and goals setting for the forthcoming weeks

Instruments for Data Collection

Instruments for data collection include both subjective and objective assessments as following.

1. The Socio-Demographic Questionnaire, developed by the researcher, included personal information, recent and past occupation, symptoms related to osteoarthritis of the knee, medical history, previous exercise practice, and current analgesic use (e.g., NSAIDs).

2. The Exercise Behavior Questionnaire, developed by Jitramontree (2003), was employed to assess participants' exercise behavior. Three questions regarding mode, frequency and duration of exercise behavior were administered to all participants at baseline to examine their exercise behavior before their participating in the intervention phase of the study.

3. Self-Efficacy for Exercise Scale (SEE) was used to assess self-efficacy for exercise. McAuley and colleagues' (1990) developed the self-efficacy barriers to exercise asking how confident the participants perceive that they could exercise under unpleasant situations; then, Resnick (2000) had revised the items and named SEE to assess confident level to exercise among older adults. The score is rated from not confident (0) to very confident (10). Total score is computed by

summing the numerical ratings for each response and dividing by the number of responses. The SEE was translated and applied in a study among Thai older persons in geriatric rehabilitation by Harnirattisai (2002), and internal consistency of the SEE revealed by Cronbach's alpha coefficients was .84 (Harnirattisai & Johnson, 2002). Because the original version was developed from Westernized culture, item number 1, 3 and 9 of the SEE were modified for easier understanding in Thai culture for this study (Appendix L) and Cronbach's alpha coefficient of this scale was .83.

4. Outcome Expectations for Exercise Scale (OEE) was translated from the original version by Harnirattisai (2002). The 9-item OEE was developed specifically to measure outcome expectations for exercise of older adults (Resnick, Zimmerman, Orwig, Furstenberg, & Magaziner, 2000). Five of the items reflect physical benefit and four items focus on mental health benefits. Rating score ranges from strongly agree (5) to strongly disagree (1) for each item identified. Total score is computed by summing the numerical ratings for each response and dividing by the number of responses. Internal consistency of OEE was revealed by Cronbach's alpha coefficients of .70 (Harnirattisai, & Johnson, 2002). Regarding cultural differences between Thai and Western cultures, all items of the OEE were modified for easier understanding for this study (Appendix L). Cronbach's alpha coefficient of OEE in this study was .82.

5. The Severity of the Disease Scale-Modified Version (M-SEV) was employed to assess severity of knee symptoms. For this study, this instrument was used both as a screening tool for recruitment and as a dependent variable examining severity of knee symptoms over time. Comparisons between the 10-item M-SEV and the 24-item Thai WOMAC (Agsaranukara, 2000) was examined among 25 community-dwelling older adults (16 women and 9 men), age 60 years and older (mean = 67.24; SD=5.8) with symptomatic osteoarthritis of the knee. Cronbach's alpha coefficients of the M-SEV and the WOMAC were 0.83 and 0.97, respectively. Because both the M-SEV and the WOMAC measure pain, stiffness, and physical function and a high correlation between the two instruments was found ($r = .886$, $p < .01$), the M-SEV was used for this study because it has fewer items and is more feasible for Thai older women. However, internal consistency of the M-SEV in

this study decreased because of the inclusion criteria. All eligible participants were determined as having mild to moderate severity of knee symptoms (M-SEV score 23 or lower). Therefore, Cronbach's alpha coefficient of the M-SEV in this study was .61. An additional questionnaire was included in socio-demographic questionnaire to examine level type and dosage of medication used related to knee pain.

6. 6-Minute Walk Test-Distance (6MWD) was used to assess 'physical function' which was the first physical performance component. The 6-Minute Walk Test (6MWT) is a validated, simple, safe, and low-cost field test, and is often used to assess functional exercise capacity and the effects of a rehabilitation program in chronic heart disease (CHF) and chronic obstructive pulmonary disease (COPD). There is evidence (Enright et al., 2003; Kervio, Carre, & Ville, 2003) demonstrating that the 6MWT can represent a submaximal exercise performance in healthy subjects (80% of the VO_{2max}) that could be safely performed for preliminary medical and cardiovascular screening in this population. Additionally, the 6MWT was revealed to be strongly associated with performance-based measures of functional limitation (Bean et al., 2002). In Thai elders, the average distance walked in 6 minutes among older adults with and without osteoarthritis of the knee was 393.6 (*SD* 41.3) and 439.4 (*SD* 66.8) meters, respectively (Tosayanonda et al, 2001). The 6MWT protocol was derived from the American Thoracic Society Guidelines for the Six-Minute Walk Test (American Thoracic Society, 2002) and translated into Thai for this study by the researcher.

7. Knee Extension Peak Torque was used to assess 'quadriceps muscle strength', the second physical performance component. Knee extension peak torque reveals highest force of the quadriceps muscle group to produce an extended rotation on the measured knee during performing a concentric isokinetic muscle strength testing. Using the CON-TREX MJ, a multi-joint module dynamometer (CMV AG, Dübendorf, Switzerland), the concentric isokinetic test was conducted by a technician at the Sport Medicine Division, Department of Orthopedic Surgery, Faculty of Medicine Siriraj Hospital, Mahidol University. Calibration was done as a routine schedule during the study in April 2005. Protocol for concentric isokinetic muscle strength testing was described in Appendix N. A study of muscle strength in

Thai women with symptomatic knee osteoarthritis reported that the average peak torque, at 60°/second, was 14.40 Newton/meter for knee flexion and 36.22 Newton/meter for knee extension (Narongrach, 1998).

8. Range of Motion (ROM) of the Knee, the last physical performance component, was measured by a goniometer and was promptly done after completion of the isokinetic muscle strength testing by the researcher. Faculty of Physical Therapy and Applied Movement Sciences, Mahidol University, designed the goniometer used in this study with a larger scale for easier examination. Calibration of the goniometer with a protractor was done prior to commencing the study. Based on the protocol described in Appendix O, knee flexion ROM was measured after knee extension ROM. A recent study revealed that Thai elders with osteoarthritis of the knee performed an average 121 degrees of knee flexion ROM and 10 to 13 degrees of knee extension ROM (Tosayanonda et al, 2001).

All physical performance components were assessed at baseline, and after the 4th, 8th, and 12th week of the experimental group sessions. The assessments were completed as soon as possible within a week after the completion of the scheduled sessions. The control participants were asked to make appointments to perform physical performance assessments at baseline, the 4th, 8th, and 12th week after baseline assessment.

Protection of Human Rights

The study proposal was submitted to the Committee on Human Rights related to Human Experimentation, Mahidol University. After proposal approval, permission letters for data collection from the Faculty of the Graduate Studies were sent to two district hospitals and a health district office in Nonthaburi Province. The nature of the study was explained to all participants by the researcher before obtaining signed (or thumb printed) consent forms. Throughout the study process, participants had the right to be protected from any possibility of discomfort, interference, or excessive burden. In addition, participants were assured that they might terminate their participation at any time or refuse to answer any specific question to which they object. Whether or not they were willing to participate in the

study, it was assured that their decision would not affect health care services that they should receive. A decision to discontinue participation in the study would not affect the relationship between the participants and health care providers or any services available. All participants' data was identified in number for their privacy and their socio-demographic information was kept separately. Participants in the control group were assured that they could receive an exercise program designed for people with osteoarthritis of the knee, as they would like to, after completion of the intervention program.

Community Involvement and Intervention

Community involvement was employed into the study. Community nurses, key persons, and community members were invited to discuss about the study and stationary cycling exercise modality for people with osteoarthritis of the knee and for older people in the community. Many elderly clubs were contacted and it was assessed whether there was one eligible setting that could set up an exercise facility for stationary cycling exercise. As being the ownership of the exercise facility, stationary cycles and other exercise instruments were donated or lent from many community members. Additionally, older people in the community, who were interested the exercise program, were invited to join cycling exercise after the intervention session. People who joined the cycling exercises were also instructed how to perform safely stationary cycling exercise by the researcher. Thus, not only the experimental participants but also people in the experimental setting could use the exercise facilities to improve and maintain their healthy lifestyle.

Target population of this study was Thai women currently living in communities of three districts in Nonthaburi Province. Co-operating with public health nurses in each setting, surveying and introduction of the study to elderly club members was conducted by the researcher. Three elderly club settings were considered control settings whereas another elderly club of over 10 kilometers distance was considered to the experimental setting. Other people interested in and who decided to join all the exercise sessions and assessments at the setting could participate in the study. Recruitment was done between the early March and mid

August 2005.

The activities and nature of the elderly clubs included in this study were almost identical. Two elderly clubs in the control group and one in the experimental group conducted their monthly meetings in the morning, from 9 am to 11 am whereas another control group's elderly club set the meeting in the afternoon, from 1 pm to 3 pm. Major activities of the meeting were providing common health services by community nurses, e.g., blood pressure measurement, providing information regarding health care for older people or health news by health personals or guests, performing a session of light to moderate exercise, and joining in an entertainment session, e.g., singing or having lunch together. In addition, all communities involved in this study have an exercise session in the evening, either aerobic exercise or exercise for the older population, at least three days per week.

The study was held as a 24-session biweekly community-based exercise intervention. The researcher contacted many potential settings to conduct the intervention. A discussion of types of exercise for people with osteoarthritis of the knee was held by the researcher many times during monthly meetings in many elderly clubs. The elderly club at Wat Boad Temple (experimental setting) was a potential setting for conducting the intervention as many members decided to participate. The exercise facility was situated in a room provided by the chief of the temple. Three stationary cycles were donated from community members and one was borrowed from a member in the experimental setting. After completion of the intervention, the donated cycles were left for continued exercising. Booklets and leaflets regarding exercise for older adults and other health concerns were also provided as information and self-study materials.

Recruitment and screening assessment used the following process. During the six months of recruitment, there were almost 100 Thai women interested the study and 62 participants met the inclusion criteria. The researcher provided information on the study and 60 women decided to participate. After baseline assessments, general information regarding osteoarthritis of the knee was provided during the monthly meeting for all eligible participants and elderly club members. Participants in the experimental group received the community-based exercise program whereas participants in the control group were asked to maintain their

normal daily life as usual. For example, they could either join any types of exercise provided in their communities or do nothing. However, participants in the control group did not get special instruction other than those provided in the general information session from the researcher.

The community-based exercise program for the experimental participants consisted of two parts: the group discussion part and the exercise part. The group discussion part focused on knowledge regarding osteoarthritis of the knee, pain management, principles of stationary cycling exercise and exercise for people with arthritis, benefits of exercise, and self-efficacy for exercise strategies. Based on the self-efficacy strategy, participants in the experimental group were provided bi-weekly group sessions. Participants could select two days of the four days set by the researcher. Tuesday, Thursday, Saturday and Sunday were optional days of the week. To get effectiveness and benefit from exercise, they were asked not to select only Saturday and Sunday. Twice a week is a minimal requirement for older adults to get benefit from exercise to improve their health-related quality of life and functional status in the short term (Stiggelbout et al., 2004).

Each session began with a group discussion which provided knowledge, management and treatments regarding osteoarthritis of the knee, exercise principles for people with osteoarthritis of the knee, and precautions regarding increasing pressure on knee joints. Then, the researcher instructed a stationary cycling exercise and stretching for 30 minutes. The exercise consisted of 5 minutes warm-up, 15 minutes stationary cycling exercise, beginning with low- and progressing to moderate-intensity of leg exercise at participants' own pace, and 10 minutes cool-down and stretching. The exercise part included a stationary cycling exercise to improve quadriceps and hamstrings muscle strength, and improve range of motion in both knees and ankles. After the exercise, the researcher continued the group discussion for 10 minutes, evaluating perceived physical function and emotional response regarding exercise. Verbal persuasion and verbal support were provided both by the researcher and peers group. Examples of successful participants practicing exercise were highlighted when available. In addition, setting goals to be achieved during the forthcoming weeks was emphasized at the end of the sessions. After completion of the intervention session at the end of the 4th, 8th and 12th week,

participants completed the questionnaires and made appointments to perform physical performance assessments. The schedule of the intervention program is presented in Table 3.2 and the Thai-version Community-Based Exercise Program protocol is presented in Appendix J.

Table 3.2 Schedule of the Community-Based Exercise Program

Sessions	Duration	Activities
Baseline	30 min	- A lecture “knee pain from osteoarthritis of the knee” consisting of definition of osteoarthritis of the knee, signs and symptoms, risk factors, pain management, exercise principles for osteoarthritis of the knee, and precautions regarding increasing pressure on knee joints. A handbook of “General information regarding osteoarthritis of the knee” was provided for each participant, both in the experimental and the control groups.
1	60 min	- Introduction to the formal classes - Discussion of symptoms and their effects on life - Discussion of personal behaviors related to osteoarthritis of the knee - Discussion of the benefits of cycling exercise in people with osteoarthritis of the knee, principle of cycling exercise, and precaution. - Introduction of participants to cycling exercise session, beginning with warm-up, cycling exercise, and cool-down and stretching - Participants practice group cycling exercise for 30 minutes
2	60 min	- Evaluation physical function, knee pain, and emotional response regarding exercise - Provision verbal persuasion and support - Discussion of “how to manage knee pain” - Participants practice group cycling exercise for 30 minutes - Identification of problem regarding exercise - Discussion of support systems - Set new goals for next week
3-24	60 min	- Clarification of questions, concerns - Evaluation physical function, knee pain, and emotional response regarding exercise - Provision of verbal persuasion and support - Participants practice group cycling exercise with progressive intensity - Set new goals for next week
8, 16, 24	60 min	- Clarification of questions, concerns - Revision of previous goals, monitoring and progress towards goals for evaluation - Provision of verbal persuasion and support - Participants practice group cycling exercise with progressive intensity - Data collection for self-efficacy and outcome expectations for exercise, and severity of knee symptoms assessments - Making an appointment for physical performance assessments

Figure 3.2 presents a summary of the process of the intervention. All eligible participants were recruited and had given signed consent. Then they completed socio-demographic data and baseline assessments. Both experimental and control participants received a lecture of information regarding osteoarthritis of the knee and a booklet from the researcher. The community-based exercise program was provided to the experimental group twice weekly by the researcher whereas the control group retained their usual daily lifestyle. During the 12-week intervention program, assessments were done every 4 weeks at the completion of the 4th, 8th, and 12th week. The researcher also made appointments with the control participants to complete assessments at the 4th, 8th, and 12th week of the study.

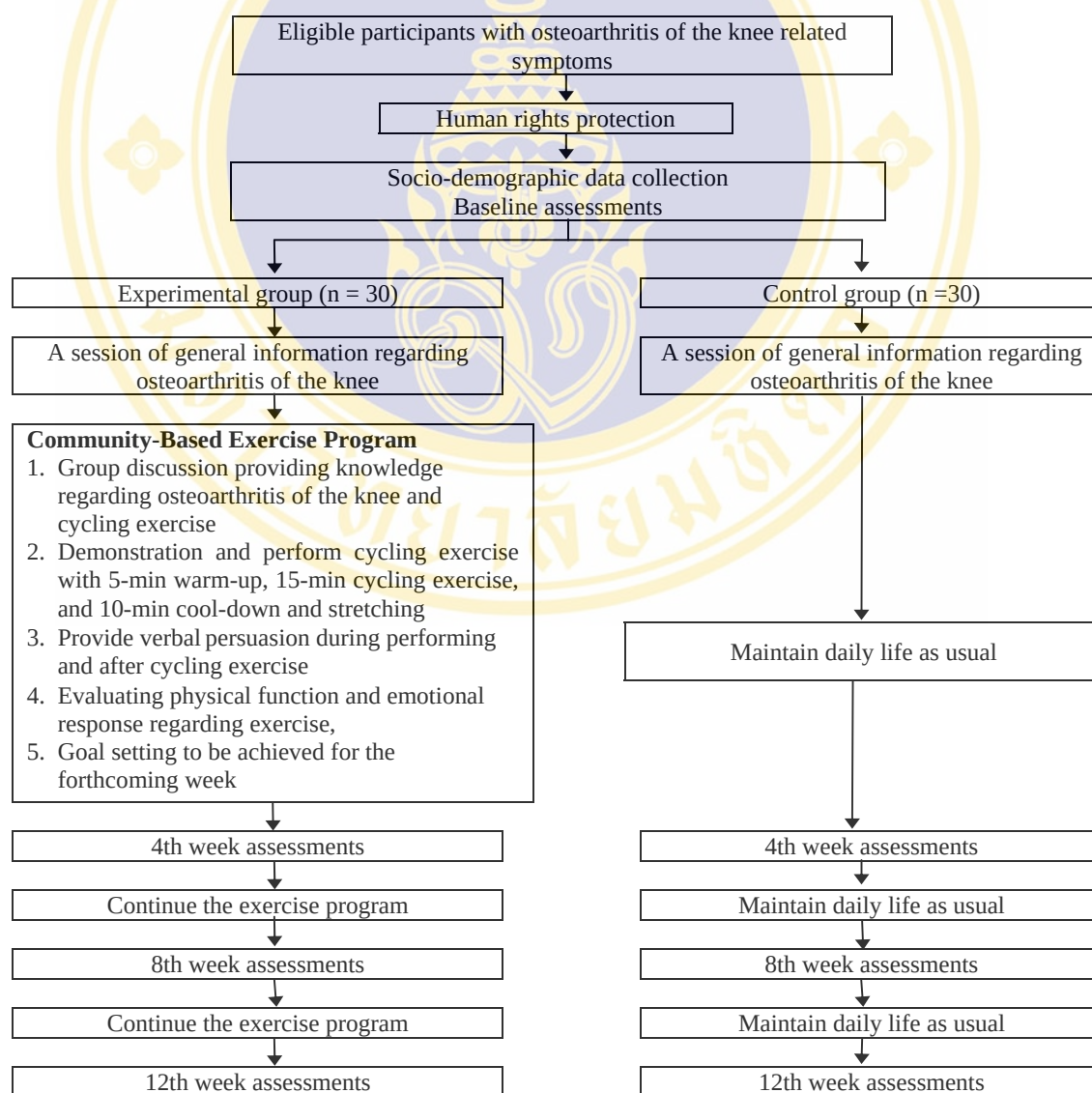


Figure 3.2 The Research Procedure

Data Collection

After obtaining permission to conduct a study from the Committee on Human Rights related to Human Experimentation, Mahidol University, the researcher contacted the eligible study settings such as community hospitals, elderly clubs, and exercise clubs in communities. A pilot survey and assessment were conducted for screening and recruitment. Five elderly clubs in three districts of Nonthaburi Province were contacted. Two elderly clubs set their monthly meeting in health centers in their settings. Another two clubs set their meeting in temples and the last one set the meeting in a district hospital. Members of the elderly clubs and people interested in the study participated for screening and recruitment during the monthly meetings. Approximately thirty percent of older Thai population cannot read or write (Chuprapawan, B.E.2543). Therefore, all participants were interviewed by the researcher or trained research assistants. Data collection procedures were conducted step by step as follows.

1. The researcher determined whether participants met the inclusion criteria by interviewing, reviewing history, assessing cognitive function, and reviewing medical records (if possible).
2. The participants were contacted individually. The researcher informed them of the purpose of the study and the rights to withdraw from the study without any effects to them. Then, the participants signed or thumb printed the consent form.
3. Baseline data collection included all questionnaires, 6MWT, concentric isokinetic muscle strength of thighs, and range of motion of the knees.
4. All eligible participants attended an education session of general information regarding osteoarthritis of the knee during the elderly clubs monthly meeting. Additional handbooks were provided to both experimental and control participants after the baseline assessment.
5. The experimental participants attended the community-based exercise program and performed stationary cycling exercise conducted by the researcher. Participants were excluded from the study if they could not continue the scheduled exercise program over two exercise sessions, which meant two weeks and over absent, or if they could not complete 18 sessions of the 12-week biweekly

intervention sessions. The control participants were asked to maintain their daily life as usual without exercise instruction other than that provided in the general information session from the researcher.

6. The experimental participants answered and performed the same assessments, except the socio-demographic data, within a week after completion of the 8th-, 16th-, and 24th-session. The researcher made appointments with the control participants for the same assessments at the 4th-, 8th- and 12th-week after baseline assessments. Participants were excluded from the study if the assessments were delayed for two weeks or over.

Data Analysis

Data was collected at baseline prior to the intervention, and after the 4th-, 8th- and 12th week of the intervention. Descriptive statistics were employed to describe participants' characteristics. Differences between groups on continuous and categorical demographic data were assessed using *t*-test and Mann-Whitney Test. Assumption of normality and homogeneity of variance on dependent variables was tested for multivariate analyses. Then, repeated-measures analysis of variance (ANOVA) was used to test the effect of the intervention on dependent variable data with normal distribution. In addition, with some degree of differences of demographic characteristics and baseline data between groups, multivariate analysis of variance (MANOVA) with covariates was applied to examine such differences on a set of dependent variables and to maintain control over the experimentalwide Type I error rate (Hair, Anderson, Tatham, & Black, 1998: 339).

As the assumption of normality and homogeneity of variance was not met, non-parametric analyses were employed instead of the originally planned parametric analyses. Thus, Friedman chi-square (χ^2) and Mann-Whitney Test were used to examine the differences between and within group means on non-normal distribution variables. Relationships of dependent variables were also assessed using bivariate Pearson's correlation coefficient, as presented in Appendix P, and a high correlation among peak torque, average power and total work of concentric isokinetic muscle strength was examined ($r > .90$, $p < .001$). Therefore, only peak torque was employed

into the analyses.

Data was analyzed using a statistical package software program. The statistical methods used were the following:

1. Descriptive statistics were conducted to describe personal characteristics of the sample, and data related to severity of knee symptoms, and physical performance.
2. Parametric analysis, two-way repeated measures analysis of variance (RMANOVA), and non-parametric analyses (Friedman χ^2 test and Mann-Whitney Z test) were applied to examine differences of dependent variables between groups at different time points.
3. The significant level of the hypothesis testing was set at .05.

CHAPTER IV

RESULTS

The results are separated into four sections. The first section covers characteristics of the sample and the second section reveals study variable comparisons between the experimental and control groups at baseline. Descriptive analysis and comparison of the characteristics of the experimental and control group are also presented. The third section reports the results regarding hypotheses of the study, which examines the effectiveness of the exercise program. Two-way repeated measures analysis of variance (RMANOVA) and non-parametric analyses were employed regarding the assumptions of normality and homogeneity of variance/covariance among study variables. The last section proposes additional analyses and the effect size of study variables in this study.

Characteristics of the Experimental and the Control Groups

Initially, there were 30 participants in three control settings and 30 participants in the experimental setting who agreed to participate the study. All participants were living in three districts of Nonthaburi Province at the time of the study. Five participants in the experimental group and two from the control group dropped out during the study. In the experimental group, one participant got severe knee pain and inflammation after baseline isokinetic muscle strength testing. The second participant was involved in an accident at home and injured her ankle at the 2nd week of the intervention. The third dropout had a gastrointestinal disturbance and absented for a rest for over 2 weeks during the exercise program. The fourth participant had cataract removal surgery at the 7th week of the exercise program and was not allowed to perform any kind of exercise for 4 weeks. The last participant complained of time constraints. She was absent for over two weeks during the exercise program and could not complete the 18 group participation sessions, which was the minimal requirement. Two control participants were excluded during the study. One participant developed vertigo and could not perform the 8th week

assessments. Another participant complained of severe shortness of breath and stopped walking after 2 min 50 second of the 6-Minute Walk Test (6MWT) at the 8th week assessment. Eventually, 25 participants in the experimental group and 28 control participants completed the study. Participants in the control group were recruited from three settings; fifteen participants were from Wat Kluay Elderly Club (setting 1), nine participants from Somchai Village Health Center (setting 2), and four participants from Bang Sri Muang sub-district Elderly Club (setting 3). Participants who met inclusion criteria were asked whether they could participate in the study and complete the same questionnaires and measurements every 4 weeks. In the experimental setting (Wat Boad community), those who met the inclusion criteria were asked to participate in group discussions and perform cycling exercises twice weekly for 12 weeks. They also agreed to complete the questionnaires and measurements every 4 weeks during the exercise program. Questionnaires and measurements were conducted by the researcher, except the isokinetic muscle strength testing which was conducted by a technician. Introduction to the study was provided to potential participants by the researcher, community nurses, and health volunteers in the settings. Recruitment and screening were performed by the researcher during several monthly meetings of the elderly clubs and by telephone call.

Demographic Characteristics of the Samples

Both the experimental and control participants' had similar ages (50-70 years old) with an average age of 59.72 years old (*SD* 6.47 years), and all were Buddhists. Thirteen experimental and 17 control participants, aged 60-70 years old, completed the Set Test with an average score of 37.30 (*SD* 3.52) ranged from 28 to 40. No statistical difference in Set Test score was examined between the experimental and control group ($p = .299$). Age and height also revealed non-significant difference between groups except body weight and BMI. The control group possessed greater body weight ($p = .049$) and greater BMI ($p = .032$) at baseline than the experimental group (Table 4.1).

Table 4.1 Means and Standard Deviations of Selected Demographic Characteristics of the Participants

Demographics	Experimental group (n = 25)		Control group (n = 28)		Total (n = 53)		<i>t</i>	<i>p</i>
	mean	SD	mean	SD	mean	SD		
Age (yrs)	58.76	6.10	60.57	6.78	59.72	6.47	-1.017	.314
Height (cm)	152.00	5.50	152.00	5.80	153.00	5.60	-.214	.831
Body weight (kg)	60.69	8.05	65.59	9.47	63.28	9.08	-2.016	.049
BMI (kg/m ²)	26.06	2.82	28.15	4.12	27.17	3.58	-2.199	.032

Significance at $p < .05$

The majority of participants in both groups was married (54.7%) and had four years of formal education (69.8%). Agricultural worker (28%) was the most common occupation in the experimental group whereas housewife (53.6%) was the most common present occupation for the controls (Table 4.2). Chi-square test revealed significant differences in marital status ($p = .002$) and educational level ($p = .004$) in both groups; but non-significant different in present occupation was found.

Table 4.2 Numbers and Percent of Marital Status, Educational Level, and Present Occupation of the Participants

Demographics	Experimental group (n = 25)		Control group (n = 28)		Total (n = 53)		χ^2	<i>p</i>
	n	%	n	%	n	%		
Marital status							12.717	.002
Single	5	20.0	3	10.7	8	15.1		
Married	13	52.0	16	57.1	29	54.7		
Widowed/separated/ divorced	7	28.0	9	32.1	16	30.2		
Educational level							8.321	.004
Primary school (4 yrs)	20	80.0	17	60.7	37	69.8		
High school (7-12 yrs)	2	8.0	4	14.3	6	11.3		
Vocational college/ Bachelor degree or higher	3	12.0	3	10.7	6	11.3		
None	0	0.0	4	14.3	4	7.5		

Table 4.2 Numbers and Percent of Marital Status, Educational Level, and Present Occupation of the Participants (cont.)

Demographics	Experimental group (n = 25)		Control group (n = 28)		Total (n = 53)		χ^2	p
	n	%	n	%	n	%		
Present occupation							5.189	.158
Agricultural work	7	28.0	1	3.6	8	15.1		
Private Business	5	20.0	6	21.4	11	20.8		
Housewife	4	16.0	15	53.6	19	35.8		
Others/ Not known	9	36.0	6	21.4	15	28.3		

Significance at $p < .05$ **Characteristics Related to Health Status and Knee Pain**

Characteristics related to health status and knee pain were not different in either the experimental or the control groups. No significant differences in osteoarthritis of the knee diagnosed and side of affected knee was found. Participants in the control group tended to use medication, as opposed to those in the experimental group who did not. However, no significant difference was found (Table 4.3). Hypertension (32.1%, $n = 17$) and diabetes (20.8%, $n = 11$) were health problems commonly found alongside osteoarthritis of the knee. All participants refrained from smoking during screening prior to the study and during the study, although some control participants had smoked in the past.

Table 4.3 Characteristics Related to Knee Pain of the Participants

Demographics	Experimental group (n = 25)		Control group (n = 28)		Total (n = 53)		χ^2	p
	n	%	n	%	n	%		
Having osteoarthritis of the knee diagnosed							.925	.336
Yes	12	48.0	11	39.3	23	43.4		
No	13	52.0	17	60.7	30	56.6		
Affected knee pain							4.113	.128
Left knee	6	24.0	6	21.4	12	22.6		
Right knee	10	40.0	7	25.0	17	32.1		
Both knees	9	36.0	15	53.6	24	45.3		

Table 4.3 Characteristics Related to Knee Pain of the Participants (cont.)

Demographics	Experimental group (n = 25)		Control group (n = 28)		Total (n = 53)		χ^2	p
	n	%	n	%	n	%		
Medication used related to knee pain							.472	.492
Not use/ not known	16	64.0	8	28.5	24	45.3		
Oral medication, external use, or both	9	36.0	20	71.4	29	54.7		

Significance at $p < .05$ **Characteristics Related to Exercise Behavior**

Both the experimental and the control groups included exercising and non-exercising participants. Although there were more non-exercise participants in the experimental group than in the control group, the data did not show any statistical difference (Table 4.4).

Table 4.4 Characteristics Related to Exercise Behavior Prior to the Study

Demographics	Experimental group		Control group		Total		χ^2	p
	n	%	n	%	n	%		
Currently exercising							.264	.876
None	12	48.0	7	25.0	19	35.8		
Aerobic exercise	8	32.0	8	28.6	16	30.2		
Others (e.g., walking, stretching)	5	20.0	13	46.4	18	34.0		
Frequency							4.887	.180
No exercise	12	48.0	7	25.0	19	35.8		
1-2 days per week	2	8.0	7	25.0	9	17.0		
3-4 days per week	1	4.0	9	32.1	10	18.9		
Everyday	10	40.0	5	17.9	15	28.3		
Duration of exercise							5.943	.114
No exercise	12	48.0	7	25.0	19	35.8		
15 minutes	1	4.0	9	32.1	10	18.9		
30 minutes	3	12.0	5	17.9	8	15.1		
45 minutes or over	9	36.0	7	25.0	16	30.2		

Significance at $p < .05$

In the experimental group, there were 24 sessions of group discussion and exercise for each participant. Eligible data employed into the analyses were collected from participants who engaged in at least 18 sessions, which was 75 percent participation. Therefore, after completion of the intervention, the average time of participation was 21.92 (*SD* 1.63), ranging from 18 to 24 (Table 4.5).

Table 4.5 Times of Participation in the Exercise Program among the Experimental Participants (*n* = 25)

Times of Participation	<i>n</i>	%
18	1	4.0
19	2	8.0
20	1	4.0
21	5	20.0
22	4	16.0
23	9	36.0
24	3	12.0

Comparisons of Study Variables between Groups at Baseline

At baseline assessments, both the experimental and the control groups reported no statistical difference in self-efficacy and outcome expectation for exercise, which was assessed by Self-Efficacy for Exercise score (SEE) and Outcome Expectations for Exercise score (OEE). Severity of knee symptoms between groups, assessed by the modified Severity of the Disease (M-SEV) score, was also not different. 6-Minute Walk Test-distance (6MWD) and range of motion (ROM) of the knee, two components of physical performance, were not different at baseline. The only significant difference was found in knee extension peak torque, which reveals quadriceps muscle strength, the other component of physical performance. Right knee extension peak torque was greater in the control group than that in the experimental group ($p = .031$). However, independent *t*-test showed no significant difference in left knee extension peak torque ($p = .241$). The results indicate that right leg quadriceps muscle strength in the control group was greater than it was in the experimental group, no difference between groups was examined in left leg quadriceps muscle strength (Table 4.6).

Table 4.6 Comparisons of Study Variables between the Experimental and Control Groups at Baseline

Variables	Experimental group (n = 25)		Control group (n = 28)		<i>t</i>	<i>P</i>
	mean	SD	mean	SD		
Self-Efficacy for Exercise	5.00	2.15	5.77	1.91	-1.386	.172
Outcome Expectations for Exercise	4.47	0.68	4.52	0.65	-.245	.807
Severity of Knee Symptoms	17.16	2.70	17.18	2.91	-.024	.981
Physical Performance						
6-Minute Walk Test-Distance (Meter)	392.22	58.28	405.37	70.26	-.737	.465
Peak Torque (Newton-meter)						
Right Knee Extension	36.8	19.6	50.8	25.5	-2.212	.031
Left Knee Extension	59.2	17.4	66.0	23.3	-1.186	.241
Range of Motion (Degree)						
Right Knee Flexion	126.6	12.3	126.1	15.2	.138	.891
Left Knee Flexion	128.7	11.3	129.1	13.7	-.113	.911
Range of Motion (Degree)						
Right Knee Extension	10.8	3.6	12.1	4.7	-1.124	.266
Left Knee Extension	9.9	4.5	11.3	3.8	-1.191	.239

Significance at $p < .05$ **Effectiveness of the Community-Based Exercise Program**

Results that reveal the effectiveness of the community-based exercise program are presented with regards to the proposed hypotheses as followings.

Hypothesis 1: At the 4th, 8th, and 12th week of the community-based exercise program, Thai women with osteoarthritis of the knee participating in the experimental group will perceive more self-efficacy and outcome expectations for exercise than before participation in the exercise program.

To answer hypothesis 1, SEE and OEE scores in the experimental group were compared during the different time points and at each time point of assessment. Both SEE and OEE data were tested for normality, homogeneity of variance, and homogeneity of variance-covariance matrices to meet the assumption for parametric

analysis (Tabachnick & Fidell, 2001). The entire SEE and OEE data including baseline, the 4th, 8th, and 12th week were analyzed by descriptive analysis to examine the Komogorov-Smirnov test of normality. Box's M test of equality of covariance matrices across groups and Levene's test of equality of error variances across groups were also examined. Since some of the data had violated the normality test, common data transformation using square root, logarithm, inverse, reflect and square root, reflect and logarithm, or reflect and inverse, was employed and re-checked. The results revealed that both the SEE and OEE did not meet the assumption of parametric analysis for repeated-measures ANOVA. Therefore, Friedman chi-square (χ^2) test was used to detect changes of SEE and OEE in the experimental group. When the Friedman chi-square (χ^2) is significant, it indicates that at least one of the measurements differs from at least one other condition, but reveals neither which one is different, nor how many of the groups are different from each other. Thus, multiple comparisons between groups were employed for further analysis. Significant difference is detected when the difference between the ranks sums exceeded the corresponding critical value, which is demonstrated in Appendix R. Comparisons of SEE and OEE across different time points by Friedman χ^2 test revealed that there was a significant difference of SEE sum of ranks over time ($p < .001$) whereas the OEE did not (Table 4.7).

Table 4.7 Comparisons of Self-Efficacy for Exercise and Outcome Expectations for Exercise Score in the Experimental Group during the Different Time Points (n = 25)

Variables	Friedman χ^2	<i>p</i>
Self-Efficacy for Exercise	29.40	<.001
Outcome Expectations for Exercise	.50	.919

Significance at $p < .05$

Multiple comparisons in SEE sum of ranks between different time points revealed significant differences between baseline and all of other repeated assessments, but no significant difference was detected between the 4th, 8th, and 12th week of the intervention (Table 4.8).

Table 4.8 Friedman Multiple Comparisons of Self-Efficacy for Exercise Sum of Ranks between Different Time Points in the Experimental Group (n = 25)

Time	Estimated Median	Sum of Ranks	Sum of Ranks Difference			
			Baseline	4 th week	8 th week	12 th week
Baseline	5.42	32.5	-	40.5 *	40.0 *	39.5 *
4th week	7.39	73.0		-	0.5	1.0
8th week	7.72	72.5			-	0.5
12thweek	7.69	72.0				-

* $p < .05$

With regards to hypothesis 1, at the 4th, 8th, and 12th week of the intervention, participants in the experimental group perceived significantly greater SEE than before participation in the exercise program. Although OEE showed little improvement over time (Appendix Q), however, it did not reveal any significant difference.

Hypothesis 2: At the 4th, 8th, and 12th week of the community-based exercise program, Thai women with osteoarthritis of the knee participating in the experimental group will experience less severity of knee symptoms and attain better physical performance than before participation in the exercise program.

Severity of knee symptoms was assessed by the M-SEV score while physical performance was assessed by three measurements: a) physical function, assessed by the 6MWD; b) quadriceps muscle strength, assessed by knee extension peak torque; and c) ROM of the knee, assessed by degree of knee flexion and extension. To answer hypothesis 2, changes of the M-SEV, 6MWD, peak torque, and ROM of the knee during the different time points and at each time point of assessment were examined. After the assumption testing and data transformation procedure for parametric analysis, there were three variables that could employ the repeated-measures ANOVA for analysis. These three variables were right knee extension peak torque (TRE)-log transformed, left knee extension peak torque (TLE), and right knee extension range of motion (ROM-RE). The rests of dependent variables were analyzed using Friedman χ^2 test. These variables include M-SEV, 6MWD, and range of motion including right knee flexion range of motion (ROM-

RF), left knee flexion range of motion (ROM-LF), and left knee extension range of motion (ROM-LE). The results show that Friedman χ^2 test and repeated-measures ANOVA F -test revealed significant differences in M-SEV, 6MWD, TRE, TLE, ROM-RF, ROM-RE, and ROM-LF over time whereas the ROM-LE did not (Table 4.9).

Table 4.9 Comparisons of Severity of Knee Symptoms and Physical Performance in the Experimental Group during the Different Time Points (n = 25)

Variables	Repeated-measures ANOVA (F -test)	Friedman Test (χ^2)	p
Severity of knee symptoms			
M-SEV		11.55	.009
Physical performance			
Physical function			
6MWD		33.67	<.001
Quadriceps muscle strength			
TRE	15.251(log transformed)		<.001
TLE	13.408		<.001
Range of motion			
ROM-RF		17.52	.001
ROM-LF		13.13	.004
ROM-RE	5.673		.002
ROM-LE		4.20	.240

Significance at $p < .05$

Note: M-SEV = Modified Severity of the Disease score; 6MWD = 6-Minute Walk Test-Distance; TRE = Right knee extension peak torque; TLE = Left knee extension peak torque; ROM-RF = Right knee flexion range of motion; ROM-LF = Left knee flexion range of motion; ROM-RE = Right knee extension range of motion; ROM-LE = Left knee extension range of motion

Friedman multiple comparisons test of M-SEV, 6MWD, ROM-RF, and ROM-LF sum of ranks between different time points in the experimental group were examined; whereas the differences of TRE-log transformed, TLE, and ROM-RE were analyzed by repeated-measures ANOVA. Multiple comparisons indicated that M-SEV sum of ranks in the experimental group showed a significant difference only between baseline and the 8th week (Table 4.10).

Table 4.10 Friedman Multiple Comparisons of Modified Severity of the Disease Sum of Ranks in the Experimental Group between Different Time Points (n=25)

Time	Estimated Median	Sum of Ranks	Sum of Ranks Difference			
			Baseline	4 th week	8 th week	12 th week
Baseline	17.25	79.0	-	19.5	27.0 *	19.5
4 th week	15.50	59.5		-	7.5	0
8 th week	15.50	52.0			-	7.5
12 th week	15.75	59.5				-

* $p < .05$

Physical performance was assessed through three components, physical function, quadriceps muscle strength, and range of motion of the knee. 6MWD was measured to assess physical function. The Friedman multiple comparisons indicate that the 6MWD sum of ranks in the experimental group revealed significant differences between baseline and the 12th week, the 4th and 12th week, and the 8th and 12th week assessment. No statistical difference of 6MWD was found among baseline, the 4th, and 8th week (Table 4.11).

Table 4.11 Friedman Multiple Comparisons of 6-Minute Walk Test-Distance Sum of Ranks in the Experimental Group between Different Time Points (n=25)

Time	Estimated Median (meter)	Sum of Ranks	Sum of Ranks Difference			
			Baseline	4 th week	8 th week	12 th week
Baseline	401.88	43.0	-	10.0	18.0	50.0*
4 th week	417.63	53.0		-	8.0	40.0*
8 th week	423.88	61.0			-	32.0*
12 th week	437.13	93.0				-

* $p < .05$

Concentric isokinetic muscle strength test was conducted to assess quadriceps muscle strength. Knee extension peak torque both knees were employed into the analysis. By transforming the non-normal distribution data, logarithm of right knee extension peak torque (TRE) data was analyzed to see if it met normal distribution and homogeneity of variance. After the assumption was met, repeated-

measures ANOVA was performed. The results show a significant difference ($F = 15.251$, $p < .001$) in changes of logarithmic TRE over time (Table 4.9). TRE mean scores at each different time points are presented in Table 4.12. However, the mean differences scores are presented by logarithmic TRE mean differences. Results indicate that the 4th, 8th, and 12th week logarithmic TRE mean different scores were significantly different from baseline ($p < .001$). No significant difference was detected between the 4th and 8th, 4th and 12th, and 8th and 12th week ($p = .893$, $.252$, and $.065$, respectively).

Table 4.12 Mean Difference Scores of Logarithmic Right Knee Extension Peak Torque Data in the Experimental Group between Different Time Points (n = 25)

Time	Mean (Newton-meter)	Pairwise Comparisons ⁺			
		Baseline	4 th week	8 th week	12 th week
Baseline	36.83	-	-.169**	-.172**	-.132**
4 th week	52.08		-	-.003	.037
8 th week	52.08			-	.040
12 th week	47.02				-

** $p < .01$

+ Least Significant Difference Method

Using repeated-measures ANOVA, left knee extension peak torque (TLE) shows a significant difference over time ($F = 13.408$, $p < .001$). Table 4.13 presents TLE mean scores at each different time points. Results indicate the significant mean difference score examined between baseline and the 4th week ($p < .001$), baseline and the 8th week ($p = .004$), the 4th and 8th week ($p = .040$), the 4th and 12th week ($p < .001$), and 8th and 12th week ($p = .005$).

Table 4.13 Mean Difference Scores of Left Knee Extension Peak Torque in the Experimental Group between Different Time Points (n = 25)

Time	Mean (Newton-meter)	Pairwise Comparisons ⁺			
		Baseline	4 th week	8 th week	12 th week
Baseline	59.20	-	14.084**	9.740**	5.196
4 th week	45.11		-	-4.344*	-8.888**
8 th week	49.46			-	-4.544**
12 th week	54.00				-

* $p < .05$; ** $p < .01$

+ Least Significant Difference Method

A significant difference across different time points in right knee flexion range of motion (ROM-RF) in the experimental group was found ($\chi^2 = 17.52$, $p = .001$). Therefore, Friedman multiple comparisons revealed the significant differences in ROM-RF sum of ranks between baseline and the 12th week, and the 4th and 12th week (Table 4.14). No statistical difference between other different time points was examined.

Table 4.14 Friedman Multiple Comparisons of Right Knee Flexion Range of Motion Sum of Ranks in the Experimental Group between Different Time Points (n = 25)

Time	Estimated Median (degree)	Sum of Ranks	Sum of Ranks Difference			
			Baseline	4 th week	8 th week	12 th week
Baseline	128.38	48.0	-	7.0	16.0	35.0*
4 th week	129.88	55.0		-	9.0	28.0*
8 th week	131.13	64.0			-	19.0
12 th week	133.13	83.0				-

* $p < .05$

A significant difference across different time points in left knee flexion range of motion (ROM-LF) in the experimental group was indicated ($\chi^2 = 13.13$, $p = .004$). Therefore, Friedman multiple comparison technique was employed and the significant differences on ROM-LF sum of ranks between baseline and the 12th week, and the 4th and 12th week were examined (Table 4.15).

Table 4.15 Friedman Multiple Comparisons of Left Knee Flexion Range of Motion Sum of Ranks in the Experimental Group between Different Time Points (n = 25)

Time	Estimated Median (degree)	Sum of Ranks	Sum of Ranks Difference			
			Baseline	4 th week	8 th week	12 th week
Baseline	130.25	54.5	-	3.0	8.5	26.5*
4 th week	130.50	51.5		-	11.5	29.5*
8 th week	132.50	63.0			-	18.0
12 th week	133.75	81.0				-

* $p < .05$

Using repeated-measures ANOVA, right knee extension range of motion (ROM-RE) revealed a significant difference across times of assessment ($F = 5.673$, $p = .002$). Comparisons of ROM-RE means scores between different time points are presented in Table 4.16. The significant mean difference score of ROM-RE were examined only between the 8th week and all other time points. The p -values of ROM-RE differences between the 8th week and baseline, the 8th and 4th week, and the 8th and 12th week are .003, .003, and .002, respectively. It is noted that ROM-RE mean score at the 8th week revealed a deteriorate degree of knee extension. However, compared to the baseline, the ROM-RE mean score reverted to non-significance at the 12th week.

Table 4.16 Mean Difference Scores of Right Knee Extension Range of Motion in the Experimental Group between Different Time points (n = 25)

Time	Mean (degree)	Pairwise Comparisons ⁺			
		Baseline	4 th week	8 th week	12 th week
Baseline	10.84	-	-1.080	-2.720**	-.280
4 th week	11.92		-	-1.640**	.800
8 th week	13.56			-	2.440**
12 th week	11.12				-

** $p < .01$

+ Least Significant Difference Method

Left knee extension range of motion (ROM-LE) in the experimental group was not significantly different over time (Friedman $\chi^2 = 4.20$, $p = .24$). Thus, the results regarding hypothesis 2 show that participants in the experimental group

perceived less severity of knee symptoms than before participation in the exercise program, but the statistical significance revealed itself only at the 8th week of the intervention. Experimental participants also attained better physical performance components than before participation in the exercise program. However, physical function presented by the 6MWD revealed a significant improvement at the 12th week. For the quadriceps muscle strength, there were significant differences on knee extension peak torque in both knees over time, and the knee flexion range of motion in both knees showed significant improvements at the 12th week, whereas ROM-LE did not. Right knee extension range of motion (ROM-RE) showed a significant difference at the 8th week; however, the change was to deteriorate degree of knee extension and reverted to non-significance at the 12th week.

Hypothesis 3: At the 4th, 8th, and 12th week of the community-based exercise program, Thai women with osteoarthritis of the knee participating in the experimental group will have more self-efficacy and outcome expectations for exercise, experience less severity of knee symptoms, and attain better physical performance than those in the control group.

Comparisons of the study variables between the experimental and control groups were examined to detect differences at the 4th, 8th, and 12th week of the study. Changes in mean values of all study variables are also presented in Appendix Q. Assumption tests and data transformation for parametric analyses were also conducted. Studied variables, which met the assumption for parametric analyses, were analyzed using two-way repeated measures ANOVA. Covariates employed into the analyses were baseline BMI and baseline right knee extension peak torque, which were significantly different between the experimental and control group. Friedman χ^2 test and Mann-Whitney test were used to analyze the non-normal distributed variables.

Self-Efficacy and Outcome Expectations for Exercise

Comparisons of the Self-Efficacy (SEE) and Outcome Expectations for Exercise (OEE) data between groups at each time point were analyzed using Mann-Whitney test (Table 4.17). Results revealed a significant difference of SEE between

groups at the 4th week ($p = .043$), but no significance was found at the 8th and 12th week. OEE difference between groups was not found in any assessments.

Table 4.17 Comparisons of Self-Efficacy and Outcome Expectations for Exercise
Mean Rank between Groups at Each Time Point

Variables	Time	Mean Rank		Mann-Whitney Z	p
		Experimental group (n = 25)	Control group (n = 28)		
Self-Efficacy for Exercise					
	Baseline	23.94	29.73	-1.363	.173
	4 th week	31.54	22.95	-2.024	.043
	8 th week	29.08	25.14	-.927	.354
	12 week	29.46	24.80	-1.096	.273
Outcome Expectations for Exercise					
	Baseline	26.16	27.75	-.384	.701
	4 th week	25.14	28.66	-.850	.395
	8 th week	24.56	29.18	-1.114	.265
	12 week	27.32	26.71	-.146	.884

Significance at $p < .05$

Changes of SEE and OEE in the experimental and control groups over time are presented in Figure 4.1. The experimental group revealed lower SEE than the control group at baseline and developed greater SEE over the control group at the 4th, 8th, and 12th week. The OEE in the experimental group was lower than the control group at baseline, the 4th, and 8th week. However, OEE in the experimental group was greater than the control group at the 12th week.

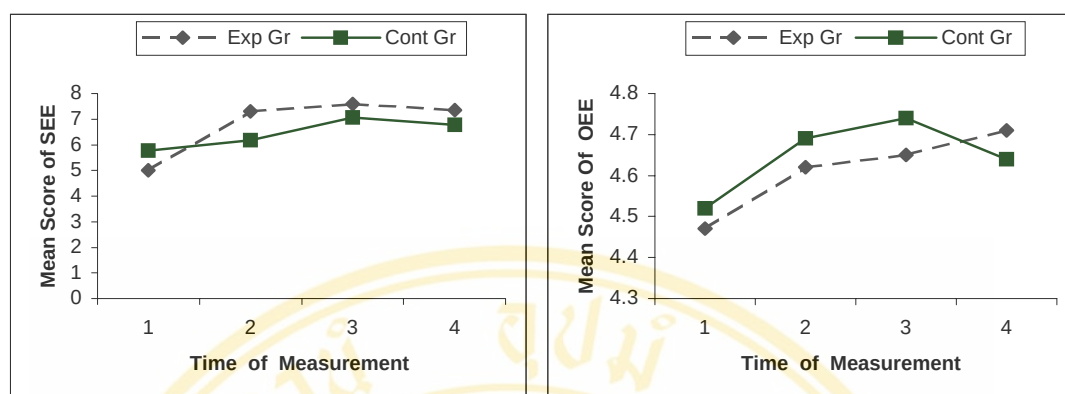


Figure 4.1 Mean Scores of Self-Efficacy for Exercise and Outcome Expectations for Exercise Scale between Groups across Different Time Points

Note: Time of Measurement: 1 = Baseline, 2 = 4th week, 3 = 8th week, 4 = 12th week
 Exp Gr = Experimental Group; Cont Gr = Control Group;
 SEE = Self-Efficacy for Exercise; OEE = Outcome Expectations for Exercise

Severity of Knee Symptoms

Severity of knee symptoms was assessed by the modified Severity of the Disease Scale (M-SEV). Comparisons of M-SEV sum of ranks at each time point were analyzed using Mann-Whitney test (Table 4.18). Results reveal a significant difference of M-SEV between groups at the 4th week ($p = .022$), but no significance was found at the 8th and 12th week.

Table 4.18 Comparisons of the Modified Severity of the Disease Mean Rank between Groups at Each Time Point

Time	Mean Rank		Mann-Whitney Z	p
	Experimental group (n=25)	Control group (n=28)		
Baseline	26.76	27.21	-.108	.914
4 th week	21.90	31.55	-2.289	.022
8 th week	25.24	28.57	-.794	.427
12 week	23.88	29.79	-1.405	.160

Significance at $p < .05$

Changes of M-SEV mean scores in the experimental and control groups at each time point are presented. Figure 4.2 demonstrates the same level of M-SEV mean scores at baseline in both groups. The experimental group revealed lower M-SEV mean scores, which was a greater improvement, than the control group at the

4th, 8th, and 12th week of the intervention.

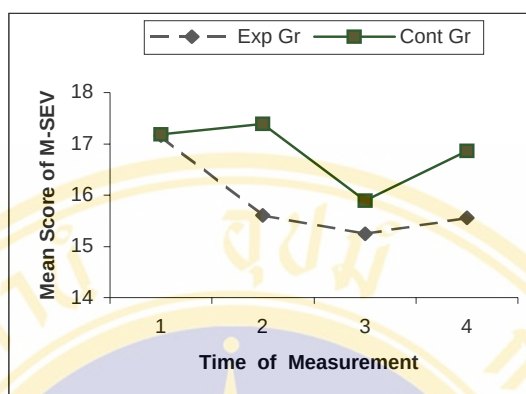


Figure 4.2 Mean Scores of Modified Severity of the Disease Scale between Groups across Different Time Points

Note: Time of Measurement: 1 = Baseline, 2 = 4th week, 3 = 8th week, 4 = 12th week
Exp Gr = Experimental Group; Cont Gr = Control Group;
M-SEV = Modified Severity of the Disease Scale

Physical Performance

Physical performance was assessed by three measurements: the 6-Minute Walk Test-distance (6MWD) for physical function assessment; knee extension peak torque for quadriceps muscle strength assessment; and range of motion of the knee, both knee flexion and extension.

1. The 6-Minute Walk Test-Distance

Comparisons of 6MWD between groups were analyzed using Mann-Whitney test (Table 4.19). Results did not show any significant difference of 6MWD between the groups at every time of assessment ($p > .05$).

Table 4.19 Comparisons of 6-Minute Walk Test-Distance Mean Rank between Groups at Each Time Point

Time	Mean Rank		Mann-Whitney Z	p
	Experimental group (n=25)	Control group (n=28)		
Baseline	24.96	28.82	-.909	.363
4 th week	24.94	28.84	-.918	.359
8 th week	25.14	28.66	-.829	.407
12 week	28.84	25.36	-.820	.412

Significance at $p < .05$

Changes of 6MWD mean scores in the experimental and control groups at each time point are presented in Figure 4.3. Although no significant difference between groups was examined at every time point, Figure 4.3 illustrates changes of 6MWD mean scores in the experimental group over the control group. The 6MWD mean scores in the experimental group are lower than those in the control group at baseline, the 4th, and 8th week, and then, the experimental group developed greater 6MWD than the control group at the 12th week.

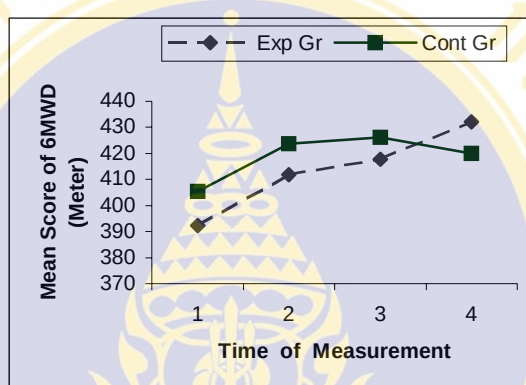


Figure 4.3 Mean Scores of 6-Minute Walk Test-Distance between Groups across Different Time Points

Note: Time of Measurement: 1 = Baseline, 2 = 4th week, 3 = 8th week, 4 = 12th week
 Exp Gr = Experimental Group; Cont Gr = Control Group;
 6MWD = 6-Minute Walk Test-distance

2. Knee Extension Peak Torque

Knee extension peak torque was examined to assess quadriceps muscle strength in this study. Two-way repeated measures ANOVA was employed to analyze differences between the experimental and control groups over time. Baseline BMI and baseline TRE were included into the analysis as covariates to examine whether they affected changes of dependent variables.

2.1) Right Knee Extension Peak Torque

As the raw right knee extension peak torque (TRE) data did not meet normal distribution and homogeneity of variance, transformation into square root of TRE data was done and further analyzed. Repeated-measures ANOVA revealed that baseline BMI had no direct effect on changes of transformed TRE ($p = .185$) whereas baseline TRE played a significant direct effect on transformed TRE

difference between groups ($p < .001$). Interaction between baseline BMI and time, and baseline TRE and time provided significant effects on changes of transformed TRE ($p = .024$ and $<.001$, respectively). Interaction of group and time also provided a significant effect ($p = .008$) on changes of transformed TRE over time (Table 4.20).

Table 4.20 Comparisons of Transformed Right Knee Extension Peak Torque Mean Score between Different Time Points

Source of Variation	SS	df	MS	F	p
Between subjects	99.647	52			
bBMI	.798	1	.798	1.805	.185
bTRE	76.189	1	76.189	172.352	<.001
Group	1.000	1	1.000	2.263	.139
Within group (error)	21.660	49	.442		
Within subjects	106.499	159			
Time	3.869	3	1.290	2.431	.067
bBMI $\times$ Time	5.151	3	1.717	3.237	.024
bTRE $\times$ Time	12.990	3	4.330	8.164	<.001
Group $\times$ Time	6.527	3	2.176	4.102	.008
Time $\times$ within group (error)	77.962	147	.530		
Total	206.146	211			

Significance at $p < .05$

Note: bBMI = Baseline BMI; bTRE = Baseline right knee extension peak torque

Transformed TRE mean scores between different time points are presented in Table 4.21. Results indicated that the 4th, 8th, and 12th week data are significantly different from baseline ($p < .001$). No significant difference was detected between the 4th and 8th, 4th and 12th, and 8th and 12th week ($p = .099$, .836, and .228, respectively).

Table 4.21 Mean Difference Scores of Transformed Right Knee Extension Peak Torque Data between Different Time Points

Time	Mean	Pairwise Comparisons ⁺			
		Baseline	4 th week	8 th week	12 th week
Baseline	6.419	-	-.835**	-.635**	-.801**
4th week	7.254		-	.200	.034
8th week	7.054			-	-.166
12th week	7.220				-

** $p < .01$

+ Least Significant Difference Method

Figure 4.4 presents changes of transformed TRE after controlling for the baseline BMI and baseline TRE. Little improvements at the 4th and 8th week were found in the experimental group over the control group. However, at the 12th week, both groups revealed transformed TRE mean score at the same level.

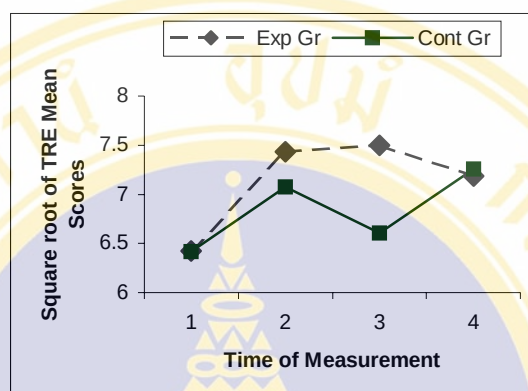


Figure 4.4 Mean Scores of Square Root of Right Knee Extension Peak Torque between Groups across Different Time Points

Note: Time of Measurement: 1 = Baseline, 2 = 4th week, 3 = 8th week, 4 = 12th week
 Exp Gr = Experimental Group; Cont Gr = Control Group
 TRE = Right knee extension peak torque

2.2) Left Knee Extension Peak Torque

Left knee extension peak torque (TLE) was analyzed using two-way repeated measures ANOVA. Covariates were not employed into the analysis because they produced heterogeneity of variances between groups, which violated the homogeneity of variance assumption. The results did not show a significant difference between groups ($p = .079$) or between interaction effect of group and time on TLE difference ($p = .054$); but direct effect revealed a significant difference ($p < .001$) in TLE changes over time (Table 4.22).

Table 4.22 Comparisons of Left Knee Extension Peak Torque Mean Score between Different Time Points

Source of Variation	SS	df	MS	F	p
Between subjects	20093.638	52			
Group	1194.465	1	1194.465	3.223	.079
Within group (error)	18899.173	51	370.572		
Within subject	16988.285	159			
Time	3218.334	3	1072.778	12.528	<.001
Group × Time	668.985	3	222.995	2.604	.054
Time × within group (error)	13100.966	153	85.627		
Total	37081.923	211			

Significance at $p < .05$

Mean difference scores of TLE are presented in Table 4.23. TLE mean scores at the 4th, 8th, and 12th week were significantly different from baseline ($p < .001$, $.005$, and $.002$, respectively). The 4th week TLE was also significantly different from the 8th week ($p = .001$) and 12th week ($p = .008$). No significant difference was found between the 8th and 12th week ($p = .662$).

Table 4.23 Mean Difference Scores of Peak Torque Left Knee Extension between Different Time Points

Time	Mean (Newton-meter)	Pairwise Comparisons ⁺			
		Baseline	4 th week	8 th week	12 th week
Baseline	62.77	-	10.958**	6.620**	5.980**
4 th week	52.00		-	-4.338**	-4.978**
8 th week	56.33			-	-.640
12 th week	56.75				-

** $p < .01$

+ Least Significant Difference Method

Figure 4.5 presents comparisons of TLE mean scores between groups. The experimental group had lower TLE than the control group at all assessments. However, independent *t*-test revealed no significant difference in TLE ($p = .241$) at baseline prior to the intervention. In addition, pattern on changes of TLE over time in both groups were almost similar.

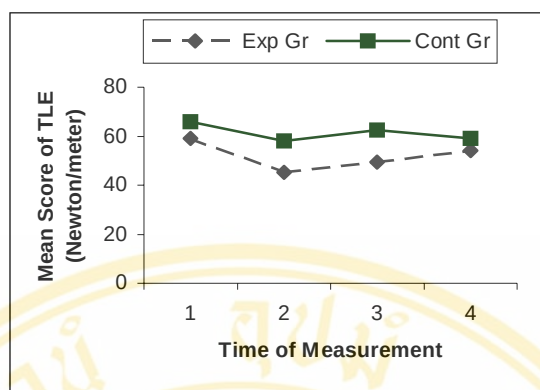


Figure 4.5 Mean Scores of Peak torque Left Knee Extension between Groups across Different Time Points

Note: Time of Measurement: 1 = Baseline, 2 = 4th week, 3 = 8th week, 4 = 12th week
 Exp Gr = Experimental Group; Cont Gr = Control Group;
 TLE = Left knee extension peak torque

3. Range of Motion

Range of motion of the knee was determined by degree of knee flexion and extension. Knee flexion range of motion in both knees revealed a significant difference over time in the experimental group ($p < .01$). However, by using Mann-Whitney test, comparisons of knee flexion range of motion between groups at each time point did not show any significant difference (Table 4.24).

Table 4.24 Comparisons of Knee Flexion Range of Motion Mean Rank between Groups at Each Time Point

Knee Flexion Range of Motion	Time	Mean Rank		Mann-Whitney Z	p
		Experimental group (n = 25)	Control group (n = 28)		
Right Knee	Baseline	26.26	27.66	-.330	.741
	4 th week	27.24	26.79	-.107	.915
	8 th week	28.14	25.98	-.508	.611
	12 week	29.62	24.66	-1.169	.243
Left Knee	Baseline	26.66	27.30	-.152	.879
	4 th week	27.88	26.21	-.393	.695
	8 th week	28.78	25.41	-.794	.427
	12 week	30.32	24.04	-1.483	.138

Significance at $p < .05$

Although no significant difference in knee flexion range of motion between groups was examined, changes in mean scores of knee flexion range of motion in the experimental group tended to improve over time whereas the control group remained similar to baseline (Figure 4.6).

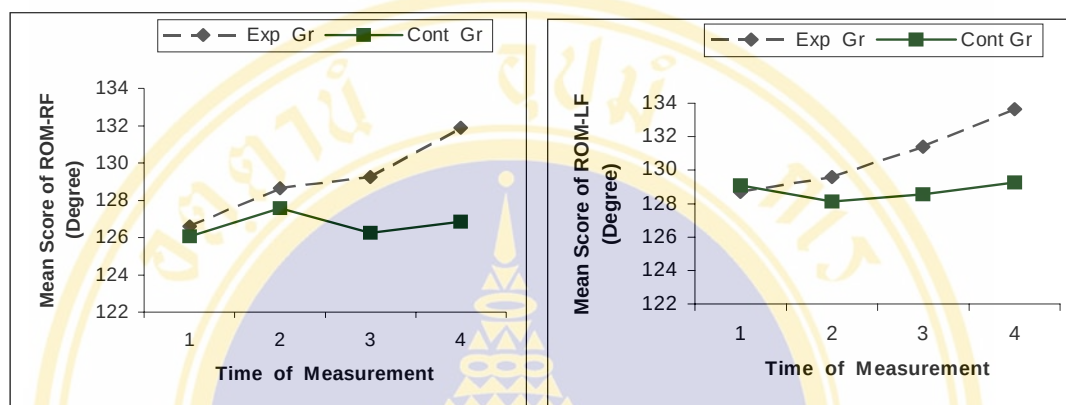


Figure 4.6 Mean Scores of Knee Flexion Range of Motion between Groups across Different Time Points

Note: Time of Measurement: 1 = Baseline, 2 = 4th week, 3 = 8th week, 4 = 12th week
 Exp Gr = Experimental Group; Cont Gr = Control Group; ROM-RF = Right Knee Flexion Range of Motion; ROM-LF = Left Knee Flexion Range of Motion

Comparisons of right knee extension range of motion (ROM-RE) between groups by two-way repeated measures ANOVA only showed a significant difference in interaction effect of baseline TRE and time on ROM-RE changes ($p = .015$). No significant difference on direct effect of ROM-RE changes between groups or interaction effect of baseline BMI and time on ROM-RE was found (Table 4.25).

Table 4.25 Comparisons of Right Knee Extension Range of Motion Mean Score between Different Time Points

Source of Variation	SS	df	MS	F	p
Between subjects	418.904	52			
bBMI	9.684	1	9.684	1.175	.284
bTRE	.142	1	.142	.017	.896
Group	5.050	1	5.050	.612	.438
Within group (error)	404.028	49			
Within subjects	1655.653	159			
Time	7.431	3	2.477	.246	.864
bBMI × Time	2.312	3	.771	.077	.972
bTRE × Time	109.036	3	36.345	3.616	.015
Group × Time	59.501	3	19.834	1.973	.121
Time × within group (error)	1477.373	147	10.050		
Total	2074.557	211			

Significance at $p < .05$

Note: BMI = Baseline BMI; bTRE = Baseline right knee extension peak torque

Comparisons of ROM-LE between groups were analyzed using Mann-Whitney test. The results revealed that ROM-LE did not show any significant difference between groups ($p > .05$) at every time point (Table 4.26).

Table 4.26 Comparisons of Left Knee Extension Range of Motion Mean Rank between Groups at Each Time Point

Time	Mean Rank		Mann-Whitney Z	p
	Experimental group (n = 25)	Control group (n = 28)		
Baseline	24.16	29.54	-.152	.879
4 th week	27.18	26.84	-.393	.695
8 th week	28.24	25.89	-.794	.427
12 week	31.26	23.20	-1.483	.138

Significance at $p < .05$

Knee extension range of motion was found to be non-significant between groups, in both knees. Most differences in mean scores of knee extension range of motion between the experimental and control groups were small. Figure 4.7 presents a greater ROM-RE in the experimental group than in the control group at the 8th

week, after which, ROM-RE reverted to the same level as the control group at the 12th week.

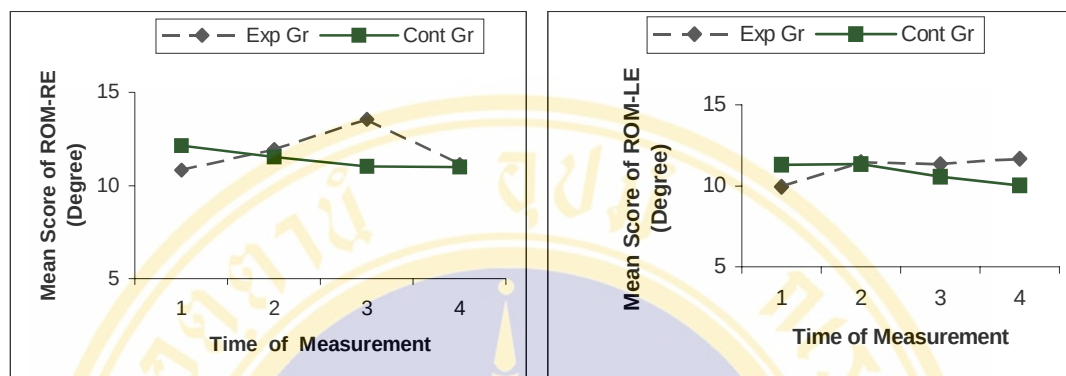


Figure 4.7 Mean Scores of Knee Extension Range of Motion between Groups across Different Time Points

Note: Time of Measurement: 1 = Baseline, 2 = 4th week, 3 = 8th week, 4 = 12th week

Exp Gr = Experimental Group; Cont Gr = Control Group; ROM-RE = Right knee extension range of motion; ROM-LE = Left knee extension range of motion

In conclusion, regarding hypothesis 3, the experimental group revealed greater improvement of M-SEV and SEE than the control group only at the 4th week of the study. OEE was not different between groups at every time of assessment. For the physical performance test, comparisons between groups in 6MWD, knee extension peak torque, and range of motion of the knee were not different. However, the experimental group illustrated significant improvement of 6MWD and knee flexion range of motion in both knees, while the control group did not. Although the control group revealed greater quadriceps muscle strength at all different time points, the experimental group also had some improvement.

Summary of the significant levels of all study variables in the experimental group is presented in Table 4.27. No exact *p*-value was presented because Friedman multiple comparisons between groups was calculated when *p* = .05 (Appendix R). SEE revealed significant differences between baseline and all repeated assessments whereas OEE did not. The M-SEV illustrated that severity of knee symptoms was significantly improved only at the 8th week, and then reverted to a non-significant level at the 12th week. Quadriceps muscle strength presents significant differences of TRE between baseline and all repeated measures. TLE had significant differences

between baseline and the 4th week, and baseline and the 8th week. No significant difference of TRE was examined between baseline and the 12th week. Significant difference in knee flexion range of motion in both knees was detected only at the 12th week. Knee extension range of motion was not significantly different in either knee although there was a difference in ROM-RE between baseline and the 8th week measures.

Table 4.27 Summary of the Significant Levels of Study Variables in the Experimental Group during Different Time Points

Variables	Significant Level between Times		
	Baseline & 4 th week	Baseline & 8 th week	Baseline & 12 th week
Self-Efficacy for Exercise⁺	*	*	*
Outcome Expectations for Exercise	ns	ns	ns
Severity of Knee Symptoms⁺	ns	*	ns
Physical Performance			
Physical Function			
6-Minute Walk Test-Distance ⁺	ns	ns	*
Quadriceps Muscle Strength			
Right Knee Extension Peak Torque	**	**	**
Left Knee Extension Peak Torque	**	**	ns
Range of Motion			
Right Knee Flexion ⁺	ns	ns	*
Left Knee Flexion ⁺	ns	ns	*
Right Knee Extension	ns	**	ns
Left Knee Extension	ns	ns	ns

* $p < .05$; ** $p < .01$

ns = No significance

+ Friedman multiple comparisons between groups was calculated when $p = .05$

A summary of the significant levels of all study variables between groups at each different time point is presented in Table 4.28. Comparisons between groups revealed that there were significant differences in SEE and M-SEV at the 4th week of the study ($p < .05$). However, at the completion of the study, no study variables were significantly different.

Table 4.28 Summary of the Significant Levels of Study Variables between Groups at Each Different Time Points

Variables	Significant Level between Groups			
	Baseline	4 th week	8 th week	12 th week
Self-Efficacy for Exercise⁺	ns	*	ns	ns
Outcome Expectations for Exercise	ns	ns	ns	ns
Severity of Knee Symptoms⁺	ns	*	ns	ns
Physical Performance				
Physical Function				
6-Minute Walk Test-Distance	ns	ns	ns	ns
Quadriceps Muscle Strength				
Right Knee Extension Peak Torque	*	ns	ns	ns
Left Knee Extension Peak Torque	ns	ns	ns	ns
Range of Motion				
Right Knee Flexion	ns	ns	ns	ns
Left Knee Flexion	ns	ns	ns	ns
Right Knee Extension	ns	ns	ns	ns
Left Knee Extension	ns	ns	ns	ns

* $p < .05$

ns = No significance

+ Friedman multiple comparisons between groups was calculated when $p = .05$ **Additional Analyses on Effect Size and Power of Test**

Effect size (ES) is a measure of the magnitude of a relationship, specific instances of the standardized mean difference statistics, the odds ratio, the correlation coefficient, the rate different, or the rate ratio in the studied population (Shadish, Cook, & Campbell, 2002). For this study, ES can be calculated by the equation:

$$ES = \frac{|m_A - m_B|}{\sigma} \quad (\text{Cohen, 1988: 20})$$

Where m_A , m_B is the experimental and the control group means expressed in raw units and σ is the standard deviation (SD) included in both groups. Assuming that SD are equal both within a group and between groups, $\sigma = \frac{1}{2} (SD_A + SD_B)$.

With regards to the equation, ESs of SEE and M-SEV, which are significantly different between groups, are presented in Table 4.29. Medium to large ESs of SEE ($ES = .616$) and M-SEV ($ES = .734$) were examined at the 4th week.

Power analysis was also examined. According to Table 8.3.14 (Cohen, 1988: 315), when $\alpha = .05$, $u = k-1 = 4-1 = 3$, and $n = \frac{1}{2} (25+28) = 26.5$, estimated power of SEE and M-SEV were .76 and .89, respectively. The M-SEV also presents a medium ES at the 12th week (ES = .500).

Table 4.29 Effect Sizes of Self-Efficacy for Exercise and Modified Severity of the Disease Mean Scores between Groups at Different Time Points

Variables	Time	Experimental group (n = 25)		Control group (n = 28)		ES	Estimated Power
		Mean	SD	Mean	SD		
SEE	Baseline	5.00	2.15	5.77	1.91	.379	.76
	4 th week	7.30	1.74	6.19	1.87	.616 [‡]	
	8 th week	7.60	1.80	7.07	1.90	.286	
	12 week	7.36	1.80	6.76	2.06	.311	
M-SEV [†]	Baseline	17.16	2.70	17.18	2.91	.007	.89
	4 th week	15.60	1.94	17.39	2.94	.734 [‡]	
	8 th week	15.24	2.35	15.89	2.79	.253	
	12 week	15.56	1.96	16.86	3.25	.500	

‡ Greatest effect size between different time points after baseline assessment

† Lesser score is better

Note: Power estimated from Table 8.3.14 (Cohen, 1988: 315)

SEE = Self-Efficacy for Exercise; M-SEV = Modified Severity of the Disease

ESs of SEE, M-SEV, 6MWD, knee extension peak torque, and knee flexion range of motion variables, which were significant within group, are presented in Table 4.30. In addition, power of test was examined for the greatest ES of each variable in each group. It is noted that the control group had greater knee extension peak torque than the experimental group. ROM-RE was not employed into the analysis because it revealed non-significant difference at the 12th week of the study. The SEE in the experimental group revealed large ESs at the 4th, 8th, and 12th week (ES = 1.186, 1.320, and 1.198, respectively) with power estimation of 1.00 at the 8th week. Medium to large ESs of SEE in the control group were found at the 8th and 12th week (ES = .679 and .502, respectively) with power estimated at the 8th week (power = .85). The M-SEV expressed medium to large ESs only in the experimental group at the 4th, 8th, and 12th week (ES = .672, .762, and .687, respectively) with power estimated at the 8th week (power = .89). ESs of M-SEV in the control group were

small to medium (ES = .072 to .453) and the power at the 8th week was lower than .80. The experimental group also illustrated medium to large ES in 6MWD at the 12th week (ES = .704), but ESs at the 4th and 8th week were small to medium (ES = .334 and .480, respectively). Power of test on 6 MWD in the experimental group at the 12th week was .84. Small to medium ESs of knee flexion range of motion in the experimental group were examined (ES = .081 to .497); only small ESs in the control group were found (ES = .012 to .103). The experimental group revealed a greater ESs in knee flexion range of motion than the control group, in both knees. However, all estimated power analyses on knee flexion range of motion were lower than .80.

Table 4.30 Effect Sizes of Self-Efficacy for Exercise, Modified Severity of the Disease, 6-Minute Walk Test-Distance, and Degree of Knee Flexion Range of Motion Mean Scores within each Group between Baseline and Other Time Points

Variables	Group	Effect Sizes between Times			Estimated Power
		Baseline & 4 th week	Baseline & 8 th week	Baseline & 12 th week	
SEE	Experimental	1.186	1.320 [‡]	1.198	1.00
	Control	.222	.679 [‡]	.502	.85
M-SEV	Experimental	.672	.762 [‡]	.687	.89
	Control	.072	.453 [‡]	.104	.50
6MWD	Experimental	.334	.480	.704 [‡]	.84
	Control	.259	.309 [‡]	.204	.23
ROM-RF	Experimental	.175	.229	.497 [‡]	.53
	Control	.103 [‡]	.012	.055	.07
ROM-LF	Experimental	.081	.251	.477 [‡]	.49
	Control	.072 [‡]	.041	.014	<.07

‡ Greatest effect size between different time points

Note: Power estimated from Table 8.3.14 (Cohen, 1988: 315)

Experimental group, n = 25; Control group, n = 28

SEE = Self-Efficacy for Exercise; M-SEV = Modified Severity of the Disease;

6MWD = 6-Minute Walk Test-distance; ROM-RF = Right knee flexion range of motion;

ROM-LF = Left knee flexion range of motion

Comparisons of ESs in TRE and TLE within each group at each time point are presented in Table 4.31. Power of the test for the greatest ES was also examined. Although TRE mean scores were greater in the control group than those in the

experimental group at every time point, medium to large ESs of TRE were found in the experimental group (largest ES = .746 at the 8th week) with an estimated power of .88. ESs in the control group were small to medium (largest ES = .409 at the 12th week). There is an inconsistency in TLE variable. At baseline, TLE were greater than the 4th, 8th, and 12th week in both groups. The lowest TLE score was found at the 4th week and slightly improved at the 8th and 12th weeks. Therefore, comparisons of TLE between baseline and other different time point were not taken into account. Designated greatest ES of TLE were found to be larger in the experimental group (largest ES = .559 at the 12th week) than in the control group (largest ES = .177 at the 8th week). All other power estimations of TRE in the control group and of TLE in both groups were lower than .80.

Table 4.31 Comparisons of Effect Sizes of Knee Extension Peak Torque Variables within each Group during Different Time Points

Variables	Group	Time	Effect Sizes between Times				Estimated Power
			Baseline	4 th week	8 th week	12 th week	
TRE [†]	Experimental (n = 25)	Baseline	-	.745	.746 [‡]	.540	.88
		4 th week	-	-	0	.256	
		8 th week	-	-	-	.256	
		12 th week	-	-	-	-	
	Control (n = 28)	Baseline	-	.266	.029	.409 [‡]	.39
		4 th week	-	-	.249	.165	
		8 th week	-	-	-	.399	
		12 th week	-	-	-	-	
TLE	Experimental (n = 25)	Baseline	-	.807 [‡]	.583	.327	.63
		4 th week	-	-	.260	.559 [#]	
		8 th week	-	-	-	.300	
		12 th week	-	-	-	-	
	Control (n = 28)	Baseline	-	.331 [‡]	.146	.283	.11
		4 th week	-	-	.177 [#]	.044	
		8 th week	-	-	-	.132	
		12 th week	-	-	-	-	

[†] Significant different score between groups at baseline

[‡] Greatest effect size between different time points

[#] Designated greatest effect size between different time points

Note: Power estimated from Table 8.3.14 (Cohen, 1988: 315)

TRE = Right knee extension peak torque; TLE = Left knee extension peak torque

CHAPTER V

DISCUSSION

This chapter presents a discussion on participants' characteristics, research findings, and theoretical aspects contributing to the study. A discussion on research methods and limitations are also presented as a contribution to nursing knowledge development.

Characteristics of the Subjects Participating in the Study

Participants of the study were women, aged 50 to 70 years old. This character resulted from inclusion criteria of this study related to a small subset of middle to old aged women with knee pain from osteoarthritis (ACR, 2000; Dieppe, Cushnaghan, & McAlindon, 1992; Ngamsutikul, 2000; Oliveria et al., 1996; Tosayanonda et al., 2001). Therefore, gender difference was excluded from the study to limit gender factor influencing dependent variables. In addition, osteoarthritis of the knee is more likely to occur among women than men (Chuprapawan, B.E.2543; Ministry of Public Health, B.E.2546; Murray & Lopez, 1996). All participants were Buddhists, reflecting the major religion of the Thai population. Almost 70% had only four years of elementary education and 7.5% had not been engaged in a formal education system. Chuprapawan (B.E.2543) also revealed that approximately 30 percent of the older Thai population could not read or write. Thus, all questionnaire collection and assessments in this study were completed by an interview method.

Present occupation was different between the experimental and control participants. The major occupation in the experimental group was agricultural work (28%) while the major occupation in the control group was housewife (53.6%). This difference might be because Nonthaburi Province is located to the northwest of Bangkok Metropolitan. Therefore, this province has both urban and suburban communities. All control settings were located very close to Bangkok Metropolitan while the experimental setting was located to the west, over 10 kilometers from the control settings. Although agriculture work was the major occupation among

participants in the experimental group, they let other family members do the hard working tasks. Participants in the experimental group were mostly staying in their house and doing household chores because of their knee pain. Thus, both experimental and control participants probably performed similar activities of housework.

Both the experimental and control groups had participants with osteoarthritis of the knee, some were diagnosed while some were not. Because osteoarthritis of the knee is not a leading cause of death and it is common for older people to have some joint pain, many people suffering only minor symptoms related to osteoarthritis of the knee do not admit themselves into a health care system (Donald & Foy, 2004). No significant difference was found between groups on 'osteoarthritis of the knee diagnosed' or on 'side of affected knee.' Severity of knee symptoms between groups was not different at baseline, however, more of the control group used medication for their knee pain than the experimental group. One possible reason is that body weight and BMI were significantly greater in the control group than those in the experimental group. There were 53.5% overweight (BMI 25.0 to 29.9 Kg/m²) and 28.6% obese (BMI 30.0 to 39.9 Kg/m²) participants in the control group compared to 64% overweight and no obese participants in the experimental group. Hootman and colleagues (2003) indicated that age and BMI were independent risk factors for osteoarthritis among women. Knee joints receive an impact of three to five times total body weight when walking or going down stairs, which increases stress on the joints (Exercise, Posture, and Weight Management, 2005). In addition, Messier and colleagues (2005) found that each pound of weight loss resulted in a 4-fold reduction loading on the knee per step during daily activities. Therefore, in this study, participants in the control group tended to load more weight on their knees, suffer more knee pain, and use more medication for their knee pain than those in the experimental group.

Comorbid conditions most found among participants in both groups were hypertension and diabetes. Hypertension was most prevalent in control participants (28.6%) whereas diabetes was most prevalent in the experimental group (20%). These two conditions are metabolic diseases common found in an older Thai population (Binhosen, 2003; Chuprapawan, B.E.2543; Ngamsutikul, 2000). In

addition, more than 50% of the participants in this study were over 60 years old, in both groups. Because diabetes can cause hypertension, these two conditions are usually found together in one person. Thus, it could be assumed that participants in both groups had no different comorbid conditions alongside osteoarthritis of the knee.

There were more participants in the control group (75%) who had been exercising prior to the study than in the experimental group (52%). Brach and colleagues (2003) revealed that women who engaged in regular physical activity had less limitations in ADL and gain a better physical performance score than those who are inactive or inconsistently active. Thus, exercise behavior might influence physical performance among participants in this study. However, no significant difference between groups in adherence to exercise, frequency, and duration was examined.

Effect of the Community-Based Exercise Program

Relationships of baseline study variables were assessed before analyzing their differences over time (Appendix P). There were weak relationships between self-efficacy for exercise (SEE) and outcome expectations for exercise (OEE), OEE and modified severity of the disease (M-SEV), and OEE and 6-Minute Walk Test-distance (6MWD). No relationship between M-SEV and other study variables was found. Most physical performance variables were found slightly to moderately correlated. These variables were 6MWD and knee extension peak torque; 6MWD and knee flexion range of motion; right and left knee extension peak torque; and right knee extension peak torque and right knee extension range of motion. Moderate to high relationships were found between right and left knee flexion range of motion, and between right and left knee extension range of motion.

Effects on Self-Efficacy and Outcome Expectations for Exercise

Based on Self-Efficacy Theory (Bandura, 1997), enhancement of self-efficacy through four mechanisms was conducted to perform stationary cycling exercise. Results revealed that the community-based exercise program, including group discussion and stationary cycling exercise, could enhance self-efficacy for

exercise (SEE) through four mechanisms. These four mechanisms were enactive mastery experience, vicarious experiences, verbal persuasion, and emotional and/or physiological status. In this study, enactive mastery experience was described by the researcher as providing knowledge regarding osteoarthritis of the knee and instructing participants to perform cycling exercise. A vicarious experience was provided by demonstrating stationary cycling exercise and showing examples of participants who gained benefits from cycling exercise. Verbal persuasion was provided from the researcher and peers by giving verbal persuasion, encouragement, and support. Finally, emotional and/or physiological status was described by evaluating physical function and pain regarding exercise, and as enhancing emotion including joyfulness, relaxation, and self-directed goal setting for the forthcoming weeks before, during, and after exercise sessions.

Participants both in the experimental and control groups gained higher SEE during the 12 weeks of the study. Although there was no significant difference in SEE between groups at the completion of the study, the experimental group gained greater SEE than the controls at the 4th week of the intervention. Effect size (ES) for the difference between groups was detected at a medium to large level at the 4th week. This result reveals the effectiveness of motivation strategy to enhance SEE among the experimental participants at the end of the 4th week of participation with a large effect size compared to baseline SEE. The results confirm the effectiveness of the intervention of this study in enhancement of self-efficacy for exercise, which may further influence regular exercise behavior. One study in Thai older adults revealed that perceived SEE had a significantly direct effect on exercise behavior and an indirect effect through commitment to a plan of exercise (Chinuntuya, 2001). However, participants in the control group also gained SEE at small to medium effect sizes (ES = .222 to .679). This might be influenced by the education session on general information regarding osteoarthritis of the knee, which could have helped participants know what to do and how to manage their knee pain. Another possible reason was the attention and socialization paid to the control participants during the 12 weeks of the study. As a placebo effect, many control participants believed that assessments they had performed every four weeks were treatments for their knee osteoarthritis so that they felt in less pain than they had been.

These findings are congruent with two qualitative studies regarding motivation to exercise in people with musculoskeletal problems (Campbell et al., 2001; Resnick et al., 2005). For the enactive mastery experience and vicarious experiences sources of self-efficacy, people will exercise when they possess ideas about the cause of arthritis and attitudes towards exercise, real and expected benefits, confidence to exercise, from visual cues and knowing what to do, simplicity of an exercise program, and keeping a regular schedule. Another motivation factor, verbal persuasion, was described by verbal encouragement, support from being secured and being encouraged by the exercise trainer and family members, and reciprocity of kindness to and from the trainer. Finally, the emotional and/or physiological status was described by individualized care appreciation, perceived severity of knee symptoms, personal willingness, perceived effectiveness of the intervention, and goal identification of physical performance achievement.

However, the largest effect size of SEE within each group in this study was detected at the 8th week of the intervention. It seems that SEE was slightly decreased at the 12th week. This may illustrate that participants with decreased knee pain or no longer suffering their knee symptoms went back to a normal status. Thus, they may have a decreased willingness to continue exercise. Resnick and colleagues (2005) also found that getting back to normal status was one of the barriers to continue exercise in older women post hip fracture.

Outcome expectations for exercise (OEE) did not differ at any assessment. Nantavanotayan (1996) also found that there was no relationship between perceived efficacy expectations and outcome expectations among outpatient participants with osteoarthritis of the knee receiving a health education intervention. In this study, both the experimental and control groups expressed a level of OEE scores at a ceiling effect. This might have been influenced by participants' high expectations that exercise could benefit health outcomes. The possible reason is that most participants in both groups were elderly clubs' members and had received health information regarding benefits of exercise from many sources including exercise practice provided in their communities.

Effect on Severity of Knee Symptoms

Severity of knee symptoms was assessed by the Modified Severity of the Disease Scale (M-SEV, Kanjanavorawong, 1997), which examined pain, stiffness, and difficulty with physical function related to osteoarthritis of the knee. The M-SEV in the experimental group revealed a significantly decreased score over time. Medium to large effect sizes were detected between baseline and all post exercise intervention assessments and the greatest effect size was found in the 8th week. Stationary cycling exercise is an exercise modality for people with osteoarthritis who cannot participate in weight-bearing exercise (Smith, 2005; Westby, 2001). One effect of stationary cycling exercise is that quadriceps muscle is strengthened (Bicycle Victoria, 2005); and then, quadriceps muscle helps keep knee joints from becoming stiffer, providing support, making knee movement easier, and reducing pain (Petrella, 1999). In addition, Mangione and colleagues (1999) also revealed that either low-intensity or high-intensity cycling could improve function and gait, decrease pain, and increase aerobic capacity in older adults with osteoarthritis of the knee. The effect of stationary cycling exercise on lessening severity of knee symptoms was identified at the 4th week of the intervention. The results were congruent to most exercise interventions for people with osteoarthritis of the knee (Deyle et al., 2000; Evcik & Sonel, 1999; Kovar et al., 1992; Mangione et al., 1999; McCarthy et al., 2004; O'Reilly, Muir, & Doherty, 1999; Tanwattana, et al., 2002; Tosayanonda et al., 2001; van Barr et al., 2001).

The control group did not show significant difference of M-SEV during the different time points. However, significant difference between groups was detected in the 4th week. One possible factor contributing to the non-significant difference in M-SEV between groups at the 8th and 12th week was that due to the inclusion criteria, all participants possessed a little to moderate severity of knee symptoms. As the general information regarding osteoarthritis of the knee and a booklet given included some quadriceps exercise regimen, participants in the control group might have independently performed exercise. Quadriceps muscle exercise helps keep knee joints from becoming stiffer, strengthening the muscles surrounding the joints, making movement easier and reducing pain (Petrella, 1999). In addition, evidence studies show that increasing quadriceps muscle strength can decrease knee pain and

stiffness in people with osteoarthritis of the knee (Deyle et al., 2000; Mounghong, 2001; Nantavanotayan, 1996; O'Reilly, Muir, & Doherty, 1999; Tanwattana et al., 2002; Tosayanonda et al., 2001). Therefore, participants in the control group may have improved quadriceps muscle strength, which lessened severity of knee symptoms related to osteoarthritis.

Effect on Physical Performance

Physical performance was assessed including physical function, quadriceps muscle strength, and range of motion (ROM) of the knee joints. Physical function was assessed by the 6-Minute Walk Test-distance (6MWD), quadriceps muscle strength was assessed by measuring knee extension peak torque during the concentric isokinetic muscle strength testing, and ROM was assessed by measuring degree of flexion and extension of the knee joints.

1. The Six-Minute Walk Test - Distance: At baseline, the average 6MWD in the experimental and control groups was 392.22 (*SD* 58.28) meters and 405.37 (*SD* 70.26) meters, respectively. These distances were congruent to a previous study in Thai older adults with osteoarthritis of the knee (Tosayanonda et al, 2001). A significant difference in 6MWD during the different time points was detected both in the experimental and control group. The experimental group increased an average of 40 meters 6MWD at the 12th week assessments compared to an average of 14 meters in the control group. Tosayanonda et al (2001) also revealed a greater 30 meters 6MWD mean score among Thai older adults with osteoarthritis of the knee after an 8-week exercise intervention. Although Luepongsak and colleagues (2001) indicated that walking could create a great force load on hip and knee joints that could cause pain or risk of osteoarthritis, in this study, participants both in the experimental and control groups increased 6MWD at the 4th week of the intervention. However, within the control group, the 6MWD became non-significant at the 8th and 12th week. Effect sizes in the experimental group were small to medium at the 4th and 8th week, and were medium to large at the 12th week. This result reveals a cumulative physical function from stationary cycling exercise in the experimental participants over time.

The effect sizes of 6MWD in this study were greater than a study (Deyle et al., 2000) providing a physical therapy program combined with range of motion,

strengthening, and cardiovascular exercises for 83 outpatients with osteoarthritis of the knee, especially at the 8th week. However, effect sizes of this study were lower than an 8-week supervised fitness walking and education program (Kovar et al., 1992) and a community-based study in Thai older adults with osteoarthritis of the knee (Tosayanonda et al., 2001). Although stationary cycling exercise in this study was different from those previous studies, this type of exercise for at least 20 minutes can also improve cardiovascular fitness and physical fitness. Thus the lower effect size of the study might be affected by a smaller sample size than the two previous studies conducted by Kovar et al. (1992) and Tosayanonda et al. (2001).

2. Quadriceps Muscle Strength: Using concentric isokinetic knee strength testing, both quadriceps and hamstrings were tested. However, quadriceps muscle strength, the knee extensor muscle group, was the major focus in this study. This muscle group is key to motions requiring elevating and lowering of the body, such as rising from a chair, climbing, jumping and walking (Bassey et al., 1988). Knee extension peak torque reveals the highest force of the quadriceps muscle group to produce an extended rotation on the measured knee. Since knee extension peak torque had been less in the experimental group than the control group at baseline, tendency of less peak torque in the experimental group was detected over time. However, right knee extension peak torque (TRE) in the experimental group was congruent to Narongrach's study (1998). Narongrach reported that TRE in women with symptomatic knee osteoarthritis aged 50 to 70 years old at 60 degree per second was 36.22 (*SD* 6.29) Newton-meters, but no left knee extension peak torque (TLE) was reported. One effect of stationary cycling exercise is strengthening muscles, which do most of the work during cycling (Bicycle Victoria, 2005; Westby, 2001). For this study, quadriceps muscle strength in the experimental group improved over time although no significant difference between groups was examined.

There were two issues of knee extension peak torque in this study. Firstly, TRE in the control group was greater than the experimental group at baseline. However, when the baseline scores (BMI and TRE) were included as covariates, two-way repeated measures ANOVA revealed no significant difference in transformed TRE between groups. With these covariates, there were interaction effects on increase of transformed TRE over time, indicating that baseline BMI and baseline

TRE influenced changes of TRE over time. In addition, both groups developed greater TRE at the 12th week although a significant level was not detected. Secondly, there was an inconsistency change of TLE in both groups. Although baseline TLE over TRE was found (Appendix Q), TRE increased but TLE decreased to the lowest peak torque at the 4th week. Then, TLE slightly increased at the 8th and 12th week, however, the 12th week TLE was still lower than baseline TLE. This phenomenon occurred both in the experimental and control groups.

There are four possible reasons to explain this. Firstly, most participants complained of muscle fatigue and knee pain after baseline concentric isokinetic testing. They might have tried performing lower force extensions of the knee during the following tests. Additionally, right leg was the dominant side most found among study participants; therefore, TLE might decrease because they fear of developing knee pain.

Secondly, before and after the isokinetic testing, all participants were instructed to perform muscle stretching. Muscle stretching was also instructed during the exercise sessions for relaxation after the stationary cycling exercise. Participants in the control group might have performed muscle stretching at home, as they were instructed during the isokinetic testing as well. Marek and colleagues (2005) revealed that a 2.8 percent decrease in concentric isokinetic peak torque for knee extension was found between prestretching and post stretching exercise among healthy young adults. They also found that stretching altered the muscle length-tension relationship and decreased muscle power during the isokinetic muscle strength testing.

Thirdly, the provision of general information regarding osteoarthritis of the knee may have encouraged participants in the control group to increase activity and independently perform exercise. This result is congruent to Maurer and colleagues' study (1999) that both the exercise and education groups improved isokinetic muscle strength after 8 weeks of the study. For this study, contamination between groups was lessened by a distance of over 10 kilometers between the experimental and the three control settings. The use of no intervention at all might have eliminated these limitations. However, studying in a community setting could not account for the attention and socialization paid to both groups. Participants in the control group might perform some types of exercise provided for all community members. In

addition, there were many women with knee pain related to osteoarthritis of the knee in the community to whom the researcher could not reach. Those women might not be elderly club members, or might still be full time workers, or be too busy. Therefore, generalization was limited to the special group of women in elderly clubs.

The other possible factor contributing to the control group's improvements might include the learning experiences during the isokinetic strength testing. All participants had to perform the same tests four times during the study period. Interaction with the machine and testing protocol may have been sufficient to produce some training effects. As van Barr and colleagues (2001) indicated in their study, maturation may occur from several repeated measures.

Although the concentric isokinetic muscle strength testing could not definitely reveal that the experimental group performed greater quadriceps muscle strength than control group, 6MWD may explain the greater improvement. Ostchega and colleagues (2004) indicated that there was a linear relationship between knee extensor strength, isokinetic muscle strength, and timed walk performance. Therefore, greater improvement of 6MWD in the experimental group may reveal greater quadriceps muscle strength than it was in the control group.

3. Range of Motion of the Knee: As significant relationships between right and left knees range of motion were found (Appendix P), changes over time in range of motion in both knees seemed to be at the same level. Knee flexion range of motion improved significantly in the experimental group while the control group retained a non-significant difference. Although there was no significant difference on degree of knee flexion between groups at each time point, degree of knee flexion range of motion in the experimental group increased over time from baseline to the 12th week, whereas the control group remained the same as the baseline measurements. The results reveal the beneficial effect of the exercise program on knee flexion range of motion. The effect sizes of right knee flexion range of motion and left knee flexion range of motion in the experimental group improved from a small to medium level at the completion of the intervention. However, knee extension range of motion did not significantly change in both groups. Baseline right knee extension range of motion and left knee extension range of motion mean scores in this study were 11.53 (*SD* 4.22) and 10.64 (*SD* 4.18) degrees and had changed less

than 2 degrees at the 12th week. These changes in knee extension range of motion indicated little difference from a normal value (Roche, no date). One possible reason was that all eligible participants in this study both in the experimental and control groups had mild to moderate severity of knee symptoms. Therefore, their knee joints would have little or no deformity (Moskowitz & Holderbaum, 2001).

Community Participation

This study was a community-based exercise intervention; therefore, participation from the community members and health professionals was needed to find eligible participants and settings, introduction to the study, and recruitment. Firstly, the researcher contacted the chief of the Health Promotion Division at Bang Kruay District Hospital to find a potential setting for the intervention. Many elderly clubs were contacted and it was assessed whether there was one eligible setting that could set up an exercise facility for stationary cycling exercise. Because the researcher was new to all settings in the district, introduction from a community health professional was very important to develop trust with elderly club members.

Three control settings and one experimental setting in two districts of Nonthaburi Province were identified. Then, with an introduction to the elderly club at the potential setting, key persons and community members were introduced to the objective, process, and expected outcomes of the study. Many people in the community had had an experience where someone had come introducing a project, which resulted in an expectation to buy some products, as a form of direct selling. Therefore, they preferred not to participate. Thus, during the 6 months of recruitment, the researcher explained many times that this study on people with osteoarthritis of the knee was a non-profit intervention. In addition, not all people suffering pain related to osteoarthritis of the knee wanted to participate. Some decided that they did not have time and some thought that exercise causes more pain. Therefore, the researcher could not recruit this group of people suffering knee pain related to osteoarthritis. However, paying attention to informing of the benefit of exercise on knee pain, conducting a safety exercise protocol, and providing a flexible schedule of exercise sessions created a better understanding. Thus, people who first decided to

participate also told and invited their friends and neighbors to come for screening and recruitment.

Key persons in each study setting, both in the experimental and control settings, had helped to introduce the objective of the study, find eligible participants, and motivate eligible participants who had decided not to participate the first time. These key persons, especially in the experimental setting, influenced the possibility of adherence to exercise of study participants during the study period. Participants dropped out from the study most had health problems. Only one participant dropped out from the study because of time constraint. Thus, key persons in the community have the potential to motivate study participants to maintain their exercise behavior and include exercise in their healthy lifestyle.

The exercise setting was located in a temple. There was a building temporarily provided to set up the stationary cycles and it has been used as a permanent exercise facility for the community ever since. Three stationary cycles were donated by community members and another one was borrowed. Community members, monks, and the elderly club's members were employed to maintain the use of the exercise facility after completion of the intervention. In addition, other exercise instruments, e.g., treadmills and dumbbells, were donated, borrowed, or funded from a civil committee to facilitate all community members to exercise. Community members who were interested in exercise were invited to perform cycling exercises after the intervention sessions. To enhance regular exercise behavior, they were asked to describe how they felt after exercise, and how they had improved in activities such as muscle strength, flexibility, and general health. There is a primary school located nearby the temple, thus, teachers and students also use these exercise instruments together with the community members. Members of the elderly club and exercise club in the experimental setting are responsible for maintaining the exercise facility. Instruction protocols for safe exercise, including indication and contraindication to exercise, were provided to enhance safe exercising, by the researcher. Handbooks, leaflets, and posters were also provided for self-studying.

Theoretical Aspects

The community-based exercise program in this study was guided by Self-Efficacy Theory. Self-efficacy, within Social Cognitive Theory, indicates that individuals create and develop self-perceptions of capability that become instrumental to the goals they pursue and to the control they are able to exercise over their environments (Bandura, 1997). The intermediate expected outcomes of the study included improved self-efficacy and outcome expectations for exercise, resulting in continuing exercise behavior. The ultimate expected outcomes include less severity of knee symptoms and improved physical performance.

With promoting self-efficacy, participants both in the experimental and control group learned about knee pain, osteoarthritis of the knee, postures and activities to alleviate knee pain as provided in the general information regarding osteoarthritis of the knee session. Participants in the experimental group also learned to safely perform stationary cycling, at their own intensity and duration, initially. With a strong emphasis on the outcomes that could be expected if exercise is done regularly, they were instructed how to warm-up, conduct cycling exercise, cool down and stretch, slowly progressing to a moderate level in the forthcoming weeks during the 12-week session. Verbal persuasion during the exercise and discussion sessions were provided by the researcher and peers to enhance confidence to exercise and as support for each other. Interaction between the researcher and participants always occurred during the intervention sessions. Participants were asked to describe how they felt after exercise, and how they had improved in activities such as muscle strength and range of motion, and level of knee pain and stiffness, every session. In addition, goals which participants could develop the confidence to perform and could easily achieve during the forthcoming weeks were set, before completion of each exercise session. In conclusion, the findings of this study support the self-efficacy strategy that a community-based exercise program motivates Thai women with osteoarthritis of the knee to initiate and perform regular stationary cycling exercise and, therefore, improve severity of knee symptoms and physical performance.

Methodological Issues

Research Design

Convenience sampling employed in this study relied on voluntary subjects. Although this study aimed to determine whether the intervention is superior to control, the control participants were active comparators because most of them joined in many activities provided by the elderly clubs including exercise. In addition, exercise behavior prior to the study was not included into the analysis. As osteoarthritis of the knee is not a leading cause of death, older people with some knee pain rather lessen their physical activity than do exercise. Therefore, with no randomization and no random treatment, a quasi-experimental and sample of convenience study was employed. This research design is the most used in health research, rather than random sample volunteers (Daniel, 1995). Threats to internal validity were found in this study. One of the threats to validity for quasi-experimental research is selection-maturation (Shadish, Cook, & Campbell, 2002). Except for demographic data, both the experimental and control groups had to complete the same assessments four times so that the repetition of tasks might improve SEE, OEE, and 6MWD in the same direction. Another threat was the difference in isokinetic test results between groups at baseline. Participants in the control group possessed greater baseline quadriceps muscle strength than those in the experimental group. The possible reason was BMI in the control group, which relates to body size and muscle mass, was greater than in the experimental group. This affects the greater quadriceps muscle strength in the control group at every time point of measurement. Settings selected for the study were also different even though they were located in the same district of Nonthaburi province. The urbanized control settings were located at health centers or near the community hospital, whereas the suburban experimental setting was located in a temple. Participants in the control settings also seemed to be more active as they performed regular exercise prior to the study (75% control versus 52% experimental participants). Another issue is sampling bias. Major participants in this study were elderly club members, so that they might more motivation and willingness to participate than other women. In addition, many people were members of more than one elderly club. This study found that at least three experimental

participants and one control participant joined two elderly clubs located near their house. Thus, the sample in this study might not well represent a statistical difference between groups and limit the representation of women aged 50-70 years with osteoarthritis of the knee in the community. Further study may employ other strategies that could motivate non-member women, e.g., providing exercise programs after office time, or setting up an exercise facility near a market.

Instrumentation

There were some limitations with the instruments used in this study. Firstly, both groups revealed a ceiling effect of the OEE scale at baseline (over 4.00 of the total 5.00). A possible reason is that the majority of participants were elderly club members. Benefits of exercise are highlighted in all elderly clubs in this study. However, the experimental groups showed a greater but not significant OEE score at the 12th week. Another possible reason is that all OEE items relate to general benefits of exercise for older adults. None of the items were related to improving knee pain or other knee symptoms related to osteoarthritis. To strengthen our understanding of specific outcome expectations for exercise related to osteoarthritis of the knee, an alternative approach may be to include an open-ended question, asking subjects to describe their perception of benefits of exercise for their knee symptoms.

The second limitation is the isokinetic testing. The participants already suffered knee pain related to osteoarthritis of the knee. Therefore, performing an isokinetic test might possibly cause more knee pain and fatigue, such as that which many participants complained of after the baseline testing. In addition, equipment and technical difficulties could reduce the optimal strength displayed by the participants. Another possible reason is that procedures of isokinetic muscle strength testing and isokinetic quadriceps exercise were very similar (Maurer et al., 1999). Thus, performing isokinetic testing every 4 weeks could improve quadriceps muscle strength, as an exercise, both in the experimental and control groups.

The third limitation is that the Set Test, which was initially considered not to be materially influenced by educational and cultural factors, had some limitations. The four common categories or sets of colors, animals, fruits, and provinces were asked to be completed. Participants who had not been engaged in a formal

educational system could response to the first three categories within 10 minutes. However, they had some difficulty naming provinces, as they might have never traveled around. A re-category from provinces to other item such as trees, or flowers, or etc., may be easier for them to recall.

Data analyses

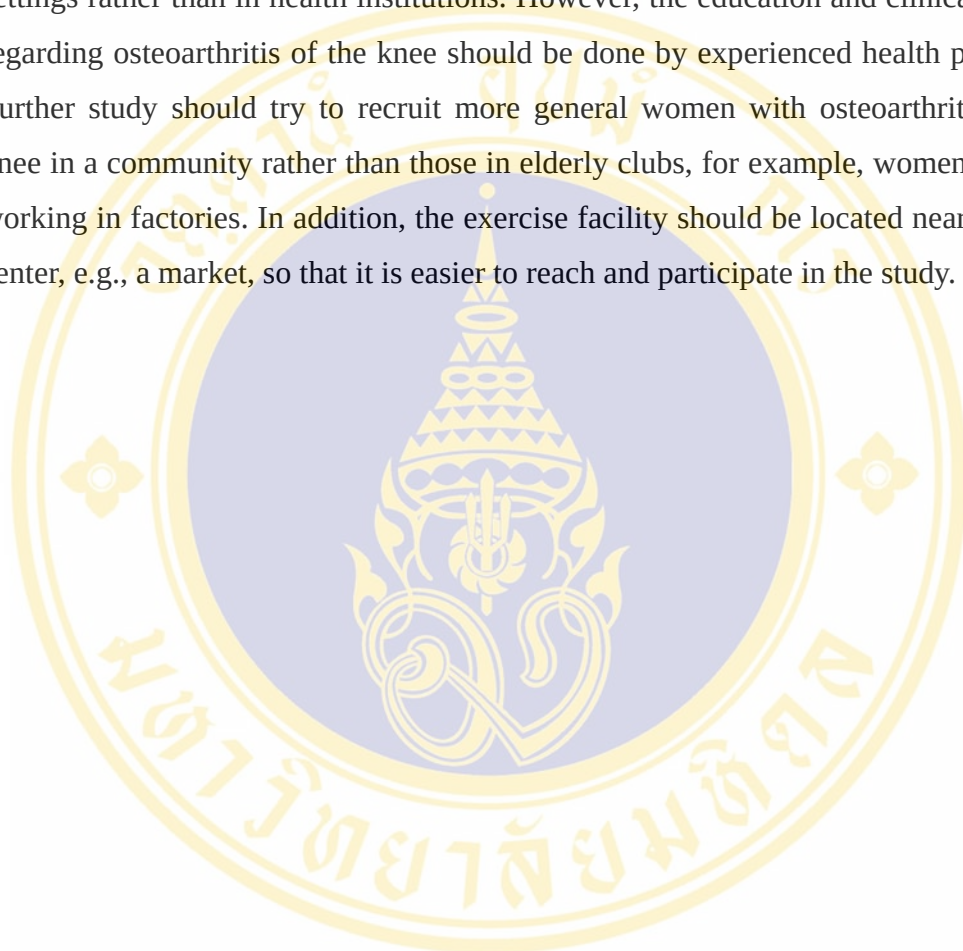
Both parametric and non-parametric analyses were employed in this study. Regarding the assumptions of multivariate analyses, as the assumptions were met, whether or not the data was transformed prior to analysis, two-way repeated measures ANOVA was used to control some variations of individual differences and to increase the power of analysis (Munro, 1997). Baseline BMI and baseline TRE were higher in the control group than the experimental group. Therefore, these two variables were employed as covariates to examine the differences of dependent variables between groups.

Non-parametric analyses were used to describe demographic characteristics and to examine differences between groups when the assumption of multivariate analysis was not met. Friedman chi-square (χ^2) and Mann-Whitney Test by ranks were alternatives to detect statistical differences between groups. Friedman two-way analysis of variance by ranks, a multiple comparisons between groups technique, was employed when the Friedman χ^2 was significant. Significant difference between different time points is detected when the difference between sums of ranks exceeded the corresponding critical value computed (Siegel & Castellan, 1988). Although non-parametric analysis has lower power of analyses than parametric analysis, these analysis procedures can reveal some degrees of differences.

Generalization

As previously mentioned, this study was designed trying to lessen heterogeneity in gender and environment. However, settings and baseline result differences were inevitable even though they are located in the same province. In addition, major participants in this study were elderly club members who possessed some level of motivation and willingness to join the study. Women were also more motivated to join the exercise program because of an organized exercise opportunity

(Damush et al., 2005). Therefore, similar to Ostchega and colleagues' study (2004), the results of this study are properly generalized only to the specific subset of people who have no health-related contraindication to exercise and isokinetic muscle strength testing. The study was trying to be feasible for conduct in community settings rather than in health institutions. However, the education and clinical criteria regarding osteoarthritis of the knee should be done by experienced health providers. Further study should try to recruit more general women with osteoarthritis of the knee in a community rather than those in elderly clubs, for example, women who are working in factories. In addition, the exercise facility should be located near a public center, e.g., a market, so that it is easier to reach and participate in the study.



CHAPTER VI

CONCLUSION

This chapter is presented in two sections. The first section is a summary of the study. The second section is focused on implications and applications of the findings to nursing and recommendations for further studies.

Summary of the Study

This quasi-experimental research was based on the Self-Efficacy Theory, examining the effectiveness of a community-based exercise program on self-efficacy and outcome expectations for exercise, severity of knee symptoms, and physical performance in Thai women with osteoarthritis of the knee.

The study was conducted in Bang Kruay District, Nonthaburi Province. Three control settings were located near each other and were over 10 kilometers from the experimental setting. Community participation included available involvement from community nurses, community members, and members of temples and elderly clubs. Three stationary cycles were donated by community members. Community members who were interested in exercise were invited to perform cycling exercises after the intervention sessions. Participants were recruited with the inclusion criteria of women aged 50-70 years old, having knee pain with at least two indications of the clinical criteria for osteoarthritis of the knee, no systemic inflammatory arthritis, no contraindication to exercise, BMI less than 40.0 Kg/m², and never having had any lower extremity joint reconstructive surgery. There were 30 participants recruited to each group. Twenty-five participants in the experimental group and 28 in the control group completed the study. The attrition rates were 16.7 % for the experimental group and 6.7% for the control group. After a session of general information regarding osteoarthritis of the knee, provided to all participants, the experimental group participated a 12-week program including a discussion group and stationary cycling exercise, whereas the control group retained their daily activities as usual. Questionnaires and assessments were done at baseline, the 4th, 8th, and 12th week of

the study.

Descriptive statistics were used to examine demographic characteristics of the sample. Both parametric and non-parametric analyses were employed due to normal distribution and homogeneity of variance assumptions. Significant difference between groups at baseline was examined on BMI and quadriceps muscle strength. The control group possessed greater baseline BMI and right knee extension peak torque scores than the experimental group.

Results in the experimental group were revealed regarding hypothesis 1 and 2. Compared to baseline assessments, the experimental group revealed significant improvement of self-efficacy for exercise (SEE) at the 4th week and severity of knee symptoms (assessed by the Modified Severity of the Disease Scale; M-SEV) at the 8th week. Therefore, only 16 stationary cycling exercise sessions (8 weeks) were sufficient to enhance SEE and improve severity of knee symptoms. Four variables of physical performance in the experimental group also showed significant improvement. These include 6-Minute Walk Test-distance (6MWD) at the 12th week; right knee extension peak torque (TRE) at the 4th week; and both right and left knee flexion range of motion (ROM-RF and ROM-LF) at the 12th week. This demonstrated that the effect of stationary cycling exercise on 6MWD and knee flexion range of motion could be seen after 3 months (12 weeks) of exercise participation. Outcome expectations for exercise (OEE) reached a ceiling effect, and were found non-significant difference over time. As the OEE asking general benefits of exercise in older adults and does not specific to osteoarthritis of the knee improvement, an additional open-ended question may provide more concerned specific outcomes in people with osteoarthritis of the knee. Large effect size (ES) was examined in SEE at every repeated assessment and the greatest ES was found at the 8th week. Medium to large ES were examined in M-SEV at the 8th week, 6MWD at the 12th week, and TRE at the 8th week. Small to medium ES were examined in right and left knee flexion range of motion (ROM-RE and ROM-LE) at the 12th week. Power of test for the greatest ES of each variable was estimated. Power of test for SEE, M-SEV, 6MWD, and TRE reached .80, but knee flexion range of motion in both knees did not. These may be resulted from mild to moderate severity of knee symptoms that little improvements over time could be examined. Therefore, larger

sample size may be able to solve this problem.

Regarding hypothesis 3, only the SEE and M-SEV were significantly improved in the experimental group than the control group. However, SEE and M-SEV reveal their significant differences between groups only at the 4th week. Therefore, it is not clear whether the improvements are due to the stationary exercise or due to attention and socialization that the researcher had paid to the participants. As previously mentioned, OEE reached a ceiling effect in both groups. Although the experimental group had improved OEE mean score over time and had greater OEE score than the control group at the 12th week, no significant difference was detected. An additional open-ended question may provide more specific concerns that may be different between the experimental and control groups. Physical performance between groups, including the 6MWD for physical function assessment, quadriceps muscle strength, and ROM, was not significantly different. This demonstrated that stationary cycling exercise performed might not be at an intensity that would be expected to produce changes in physical performance. As more than 50% of the participants in this study were over 60 years old and having knee pain, they might not be able to increase more speed and resistance during cycling exercise. Therefore, improvements in physical performance as measured in this study may not appropriate to reach the expected outcomes from a short term. Knee extension peak torque, which was used to assess quadriceps muscle strength, did not express significant difference both within each group and between groups. However, compared to the baseline results, the experimental group revealed greater improvement in 6MWD and knee flexion range of motion whereas the control group did not. Greatest ES of SEE and M-SEV at the 4th week was medium to large. Power of test for the greatest ES of SEE and M-SEV were .76 and .89, respectively.

In conclusion, the community-based exercise program provided significant improvement of self-efficacy for exercise and severity of knee symptoms in the experimental group over the control group, but physical performance did not. In the experimental group, self-efficacy for exercise had improved at the 4th week whereas severity of knee symptoms had improved at the 8th week of the study. Four physical performance components (6MWD, TRE, ROM-RF, and ROM-LF) in the experimental group reveal their improvements at the 12th week of the study but three

of them (TLE, ROM-RE, and ROM-LE) were not. SEE and M-SEV between groups were significantly different only at the 4th week. This study provides a preliminary support that stationary cycling may be used as an exercise modality for people with osteoarthritis of the knee in communities as a community-based exercise program to enhance self-efficacy for exercise, decrease severity of knee symptoms, and increase physical function.

Implications and Recommendations

Implications for Nursing Practice

Although most of the findings reveal no significant differences in physical performance, it could be concluded that the community-based exercise intervention for Thai women with osteoarthritis of the knee had begun to enhance self-efficacy and outcome expectations of exercise, improve severity of knee symptoms, and improve physical function. Participants in the experimental group had significantly decreased severity of knee symptoms, and increased self-efficacy for exercise at the 4th week of the intervention. In addition, knee flexion range of motion and 6MWD, which were physical performance components, had improved significantly at the 12th week. The exercise program was designed to be easily implemented in a community setting; however, education and general information regarding osteoarthritis of the knee, and exercise guidelines for middle-aged and older adults with osteoarthritis of the knee needs to be conducted under professional advice. Strategies to motivate those women in communities to initiate an exercise should be performed. Then, the benefits of the community-based exercise program in Thai women with osteoarthritis of the knee could be generalized and could lead to a health policy regarding exercise for people with osteoarthritis in community.

As the proportion of the Thai population aged 60 years and older is likely to escalate from 7.2% in 1990 to 11.7% in 2010 (Wibulpolprasert, 2006), the dependency ratio for the elderly will increase. Although osteoarthritis of the knee is not a leading cause of death, prevalence of joint diseases including osteoarthritis is mostly found in older populations (Institute of Geriatric Medicine, 2003). Therefore, promoting health in people with a chronic disease such as osteoarthritis of the knee

could decrease this dependency requirement. Community nurses, health professionals closely working in the community setting, can encourage people with osteoarthritis of the knee at little to moderate levels of severity to perform exercise as a formal secondary prevention and health promotion. With community participation, community nurses with advanced practice experience are needed to initiate and help performing regular exercise patterns in people with osteoarthritis of the knee. Additionally, motivation to continue exercise is needed to maintain their healthy life. Health education, both formal and informal methods, and health assessments should be performed before the implementation of an exercise program for middle-aged and older population. Assessment to measure physical function also needs professional advice. Therefore, enhanced self-efficacy and outcome expectations for exercise should be achieved.

Implications for Nursing Education

A program for an exercise intervention course for people with osteoarthritis of the knee in a community should be developed for nursing practice training. As part of advanced nursing care and health promotion for secondary level in the community, the present study could be developed into a continuing nursing education program with the following components:

a) Information on disease pathology of osteoarthritis of the knee. Types, intensity, frequency, and duration of exercise for people with osteoarthritis of the knee at different severities are different. This study was designed for participants with slight to moderate severity of knee symptoms related to osteoarthritis of the knee. Therefore, knowing the disease pathology and progress of osteoarthritis of the knee could help nurses design proper exercise intervention for each participant.

b) Treatments for people with osteoarthritis of the knee. Exercise is one of the non-pharmacological treatments for people with osteoarthritis. However, other treatments or combinations of treatments, e.g., medication or referral to other clinical treatment, could be involved during the exercise program and sometimes exercise should be stopped for a resting period after those treatments.

c) Health assessments and screening to detect contraindication to exercise. This is a safety issue for middle-aged or older people, who often have other chronic

conditions alongside osteoarthritis of the knee.

d) Exercise physiology, especially, for older populations is another safety issue for safe exercising, and

e) Motivation to initiate and continue exercise using motivation strategies based on the Self-Efficacy Theory.

Recommendations for further study

1. With the limitations of recruitment participants from elderly club members, further study should include women who are not members and who are still working in communities. The researcher could not recruit the appropriate sample size in one community. Thus, the lack of significant differences in most dependent variables may be due to insufficient power to detect differences if they existed. A larger study in many communities should be conducted with longer duration of assessments. In addition, to eliminate learning effect in the control group, repeated measures might be performed only as a pretest and posttest.

2. Further study including completely non-exercising participants should be employed, and compared to the intervention exercise program. The lack of a completely non-exercising control group in this study results an inability to conclude that cycling produces the changes in self-efficacy and outcome expectations for exercise, severity of knee symptoms, and physical performance. Most participants were elderly club members; therefore, non-exercising women were rare.

3. A larger sample size is needed to detect difference in OEE between groups. Ceiling effects of OEE revealed the belief of a high expectation on performing exercise in both the experimental and control groups, thus, difference of OEE between groups was small. Although the experimental group increased OEE scores over time, no significant difference was detected.

4. Re-categorizing components of the Set Test. Using the Set Test to detect mental disorder in this study, encountered some difficulty. The Set Test was initially considered not to be materially influenced by educational and cultural factors; however, it had some limitations. Participants who had not been engaged in a formal educational system had some difficulty recalling the provinces item. Re-categorizing from provinces to other easier naming items should be considered.

5. The application of Self-Efficacy Theory to enhance motivation to initiate and continue exercise in women with osteoarthritis of the knee was supported by this study. Enactive mastery appeared to be a possible source of efficacy information as demonstrated by the improvement in confidence to initiate and continue stationary exercise from the 1st week to the 4th week. Verbal persuasion as a source of efficacy information was supported because participants indicated that it motivated them to build their confidence to cycling. Modeling by researcher's demonstration may have ensured the safety of stationary exercise as none of the participants had difficulty in performing the bicycling after demonstration. Participants also indicated that by watching other participants' improvement after cycling exercise, their confident to continue exercise was enhanced. Finally, evaluation of emotional and/or physiological status at every exercise session allowed participants to enhance their self-observation on their improvement and served to augment their goal-setting to be achieved over time. This was evident by one participant's telling about her ability to squat and climb up a stairs which was easier than before participating in the study.

Based on the Social Cognitive Theory, triadic reciprocity between person, behavior and environment are not equal strength (Bandura, 1977). This was evident in this study in that some participants made a decision not to participate or dropped out of the study due to their perception of time constraints. Socialization between peers, as a behavior, could either enhance or deteriorate their confident to continue exercise. Environment also influenced the confident to perform exercise. The study period covered both the summer and rainy seasons where the setting was sometimes flooded. In addition, lack of transportation to the setting was another environment that influenced people's decision as to whether they exercise or participate in the study. Further studies may involve longitudinal effect of an exercise program on self-efficacy and outcome expectations to continue exercise behavior in women with osteoarthritis of the knee. Participants in the experimental group consisted of people with different levels of self-efficacy for exercise. Those participants with lower self-efficacy might be more likely to stop exercising sooner and go back to their initial state as before their participation in the study. Therefore, an additional exercise intervention might be provided to maintain regular exercise behavior for these participants.

Contribution to Knowledge Development

These findings showed some lights on knowledge regarding promoting exercise behavior and stationary cycling exercise enhancement intervention in people with osteoarthritis of the knee. Additionally, the findings suggest that the community-based exercise program based on self-efficacy theory confirms some extent of the effectiveness of the exercise program. This exercise program could increase self-efficacy for exercise, decrease severity of knee symptoms, and increase some components of physical performance in women with osteoarthritis of the knee without exacerbation of the disease. Four sources of self-efficacy enhancement as enactive mastery, verbal persuasion, modeling, and evaluating of emotional and/or physiological status were confirmed in participants' initiation to perform stationary cycling exercise. Although outcome expectations for exercise was not different between the experimental and control groups, it had influenced exercise behavior among participants in the experimental group. As they mentioned some activities which had been difficulty performed in the past, it was easier done after participating in the exercise program, e.g., squatting and climbing a stairs. Particularly, community nurses, as health professionals working in communities, can get benefit on nursing practice and innovation. They can work with community participation to promote cycling exercise for people with osteoarthritis of the knee, especially, women group. Consequently, this study offers suggestions for further study in larger populations with osteoarthritis of the knee and the use of community participation to establish and maintain a healthy lifestyle.

BIBLIOGRAPHY

- Agsaranukara, S. (2000). Modified WOMAC Scale for Knee Pain. *Journal of Thai Rehabilitation*, 9 (3), 82-85.
- Altman, R.D., et al. (1986). The American College of Rheumatology criteria for the classification and reporting of osteoarthritis of the knee. *Arthritis & Rheumatism*, 29, 1039-1049.
- Altman, R.D. (1991). Classification of disease: Osteoarthritis. *Seminar in Arthritis & Rheumatism*, 20 (suppl 2), 40-47.
- Altman, R.D., Hochberg, M.C., Moskowitz, R.W., & Schnitzer, T.J. (2000). Recommendations for the medical management of osteoarthritis of the hip and knee: American College of Rheumatology subcommittee on osteoarthritis guidelines. *Arthritis and Rheumatism*, 43 (9), 1905-1915.
- American College of Rheumatology. (2000). ACR fact sheets: Osteoarthritis. Retrieved September 10, 2002, from the web site: <http://www.arthritis.org>
- American College of Sport Medicine. (1995). *ACSM's guidelines for exercise testing and prescription*. Baltimore: Williams & Wilkins.
- American College of Sports Medicine. (2000). *ACSM's Guidelines for Exercise Testing and Prescription*. (6th Ed.). Baltimore: Lippincott Williams & Wilkins.
- American College of Sports Medicine. (2002). Stationary Bicycle brochure. Retrieved January 17, 2005, from the web site: <http://www.acsm.org>
- American Pharmaceutical Association. (2001). Partners in self-care: Supporting Patient Self-Care for Osteoarthritis. Washington: The American Pharmaceutical Association. Retrieved June 27, 2002, from the web site: <http://www.aphanet.org>
- American Thoracic Society. (2002). ATS Statement: Guidelines for the Six-Minute Walk Test. *American Journal of Respiratory Critical Care Medical*, 166, 111-117.

- Aree-ue, S. (1997). *Stress, Coping, and Quality of Life in Elderly Women with Osteoarthritis of the Knee*. M.N.S. Thesis in Adult Nursing, Faculty of Graduate Studies, Mahidol University.
- Arthritis Foundation. (2000). *The Arthritis Foundation's Guide to Good Living with Osteoarthritis*. Atlanta: Arthritis Foundation.
- Baechle, T.R., & Earle, R.W. (Eds.). (2000). *Essentials of Strength Training and Conditioning*. (2nd Ed.). Champaign: Human Kinetics.
- Bandura, A. (1986a). *Social Foundations of Thought and Action: A Social Cognitive Theory*. Englewood Cliffs: Prentice-Hall.
- Bandura, A. (1986b). The explanatory and predictive scope of self-efficacy theory. *Journal of Clinical and social Psychology*, 4, 359-373.
- Bandura, A. (1997). *Self-Efficacy: The Exercise of Control*. New York: W.H. Freeman and Company.
- Barlow, J.H., Turner, A.P., & Wright, C.C. (2000). A randomized controlled study of the arthritis self-management programme in the UK. *Health Education Research*, 15 (6), 665-680.
- Barrett, D.S., Cobb, A.G., & Bentley, G. (1991). Joint proprioception in normal, osteoarthritic and replaced knees. *Journal of Bone and Joint Surgery (British edition)*, 73, 53.
- Bartlett, S. (2002). Management role of exercise in arthritis. Retrieved April 30, 2002, from the web site: <http://www.hopkins-arthritis.som.jhml.edu/mngmnt/exercise.html>
- Bassey, E.J., Bendall, M.J., & Pearson, M. (1988). Muscle strength in the triceps surae and objectively measured customary walking activity in men and women over 65 years of age. *Clinical Sciences*, 74, 85-89.
- Bean, J.F., et al. (2002). A 6-minute walk test in mobility-limited elders: What is being measured? *Journal of Gerontology: Medical Sciences*, 57A (11), M751-M756.
- Becker, M.H., & Maiman, L.A. (1975). Sociobehavioral determinants of compliance with health and medical care recommendations. *Medical Care*, 13, 10-24.

- Bellamy, N., & Buchman, W.W. (1986). A preliminary evaluation of the dimensionality and clinical importance of pain and disability in osteoarthritis of the knee and hip. *Clinical Rheumatology*, 5, 231-241.
- Bicycle Victoria. (2005). Cycling and your health. Retrieved Jan 23, 2005, from the web site: http://www.betterhealth.vic.gov.au/bhcv2/bhcarticles.nsf/pages/cycling_and_your_health?opendocument
- Binhosen, V. (2003). *Physical activity and health related quality of life among the urban Thai elderly*. Ph.D. Dissertation in Nursing, Graduate School, Chiang Mai University.
- Blair, S., et al. (1996). Physical activity, nutrition, and chronic disease. *Medicine and Science in Sports and Exercise*, 28, 335-349.
- Boonchanaviwat, D., Saku, N., & Chaisutthi, N. (2005). *Three decades towards basic education*. Bangkok: Department of General Education, Ministry of Education. Ngamsutikul, Wipa. (2000).
- Boyette, L., Sharon, B., & Brandon, L. (1997). Exercise adherence for a strength training program in older adults. *Journal of Nutrition, Health and Aging*, 1, 93-97.
- Brach, J.S., et al. (2003). Physical activity and functional status in community-dwelling older women: A 14-year prospective study. *Archives of Internal Medicine*, 163, 2565-2571.
- Brown, L.E. (Ed.). (2000). *Isokinetics in human performance*. Champaign: Human Kinetics.
- Brundtland, G.H. (2002). The Bone and Joint Decade 2000-2010: Scientific Group Meeting on the Burden of Musculoskeletal Diseases. Retrieved Mar 5, 2004, from the web site: http://www.who.int/director-general/speeches/2000/english/20000113_bone_joint.html
- Brunk, S.E., & Sands, J.K. (1988). Arthritis and its treatment. In J.K. Sands (Ed.), *A Guide to Arthritis Home Health Care* (pp. 12-13). New York: John Wiley & Sons.

- Campbell, R., Evans, M., Tucker, M., Quilty, B., Dieppe, P., & Donovan, J.L. (2001). Why don't patients do their exercises? Understanding non-compliance with physiotherapy in patients with osteoarthritis of the knee. *Journal of Epidemiological Community Health, 55*, 132-138.
- Carter, N.D., et al. (2002). Community-based exercise program reduces risk factors for falls in 65- to 75-year-old women with osteoporosis: randomized controlled trial. *Canadian Medical Association Journals, 167* (9), 997-1004.
- Casper, J., & Berg, K. (1998). Effects of exercise on osteoarthritis: A review. *Journal of Strength and Conditioning Research, 12* (2), 120-125.
- Caspersen, C.J., Powell, K.E., & Christensen, G.M. (1985). Physical activity, exercise, and physical fitness: Definitions and distinction for health related research. *Public Health Report, 100*, 126-131.
- Chairat, N. (1999). *The Effect of Ascetic Exercise on Physical Performance and Satisfaction of the Elderly at Bangkae 2 Home for The Aged*. M.Sc. Thesis in Public health, Major in Public Health Nursing, Faculty of Graduate Studies, Mahidol University.
- Chayovan, N., & Knodel, J. (1997). *A Report on the Survey of the Welfare of the Elderly in Thailand*. Bangkok: Institute of Population Studies, Chulalongkorn University.
- Cheng, Y., Macera, C.A., Davis, D.R., Ainsworth, B.E., Troped, P.J., & Blair, S.N. (2000). Physical activity and self-reported, physician-diagnosed osteoarthritis: is physical activity a risk factor? *Journal of Clinical Epidemiology, 53*, 315-322.
- Chinuntuya, P. (2001). *A Causal Model of Exercise Behavior of the Elderly in Bangkok Metropolis*. D.N.S. Dissertation, Faculty of Graduate Studies, Mahidol University.
- Clark, D.O. (1999). Physical activity and its correlates among urban primary care patients aged 55 years or older. *Journal of Gerontology: Social Sciences, 54B* (1), S41-S48.
- CMV AG. (2002). *CON-TREX human kinetics Software Manual*. Duebendorf, Switzerland: CMV AG.

- Coggon, D., Croft, P., Kellingray, S., Barrett, D., McLaren, M., & Cooper, C. (2000). Occupational physical activities and osteoarthritis of the knee. *Arthritis & Rheumatism*, 43 (7), 1443-1449.
- Cohen, J. (1988). *Statistical Power Analysis for the Behavioral Sciences*. (2nd Ed.). Hillsdale: Lawrence Erlbaum Associates.
- Conn, V.S. (1998). Older adults and exercise: Path analysis of self-efficacy related constructs. *Nursing Research*, 47 (3), 180-189.
- Conn, V.S., Valentine, J.C., & Cooper, H.M. (2002). Interventions to increase physical activity among aging adults: A Meta-analysis. *Annals of Behavioral Medicine*, 24 (3), 190-200.
- Cooper, K.M., Bilbrew, D., Dubbert, P.M., Kerr, K., & Kirchner, K. (2001). Health barriers to walking for exercise in elderly primary care. *Geriatric Nursing*, 22 (5), 258-262.
- Creamer, P., & Hochberg, M.C. (1997). Osteoarthritis. *Lancet*, 350, 503-508.
- Creamer, P., Lethbridge-Cejku, M., & Hochberg, M.C. (2000). Factors associated with functional impairment in symptomatic knee osteoarthritis. *Rheumatology*, 39, 490-496.
- Damush, T.M., Perkins, S.M., Mikesky, A.E., Roberts, M., & O'Dea, J. (2005). Motivational factors influencing older adults diagnosed with knee osteoarthritis to join and maintain an exercise program. *Journal of Aging and Physical Activity*, 13, 45-60.
- Daniel, W.W. (1995). *Biostatistics: A Foundation for Analysis in the Health Sciences*. (6th Ed.). Singapore: John Wiley & Sons.
- Davis, M.A., Ettinger, W.H., Neuhaus, J.M., & Mallon, K.P. (1991). Knee osteoarthritis and physical functioning: Evidence from the NHANES I epidemiologic follow-up study. *Journal of Rheumatology*, 18, 591-598.
- Dawson, K.A., Brawley, L.R., & Maddux, J.E. (2000). Examining the relationships among concepts of control and exercise attendance. *Journal of Sport and Exercise Psychology*, 22, 131-134.
- Deyle, G.D., Henderson, N.E., Matekel, R.L., Ryder, M.G., Garber, M.B., & Allison, S.C. (2000). Effectiveness of Manual Physical Therapy and Exercise in Osteoarthritis of the Knee. *Annals of Internal Medicine*, 132, (3), 173-181.

- Dieppe, P., Cushnaghan, J., & McAlindon, T. (1992). Epidemiology, clinical course, and outcome of knee osteoarthritis. In K.E. Kuettner, R. Schleyerbach, J.G. Peyron, & V.C. Hascall (Eds.), *Articular Cartilage and Osteoarthritis* (pp. 617-627). New York: Raven Press.
- Dishman, R. (1994). Motivating older adults to exercise. *Southern Medical Journal*, 87, S79-S82.
- Doherty, M. (2001). Risk factors for progression of knee osteoarthritis. *The Lancet*, 358, 775-776.
- Donald, I.P., & Foy, C. (2004). A longitudinal study of joint pain in older people. *Rheumatology*, 43, 1256-1260.
- Enright, P.L., et al. (2003). The 6-min walk test: A quick measure of functional status in elderly adults. *Chest*, 123 (2), 387-398.
- Ettinger, W.H.Jr., et al. (1997). A randomized trial comparing aerobic exercise and resistance exercise with a health education program in older adults with knee osteoarthritis: The Fitness Arthritis and Seniors Trial (FAST). *Journal of American Medical Association*, 277 (1), 25-31.
- Evcik, D., & Sonel, B. (2002). Effectiveness of a home-based exercise therapy and walking program on osteoarthritis of the knee. *Rheumatology International*, 22, 103-106.
- Exercise, Posture, and Weight Management. (2005). Retrieved April 24, 2005, from the web site: <http://www.Living-with-Osteoarthritis.co.uk/Exercise, Good Posture, and Weight Management.htm>
- Felson, D.T., et al. (2000). Osteoarthritis: New Insights, Part 1: The disease and its risk factors. *Annals of Internal Medicine*, 133 (8), 635-646.
- Fitzgerald, G.K., Childs, J.D., Ridge, T.M., & Irrgang, J.J. (2002). Agility and perturbation training for a physical active individual with knee osteoarthritis. *Physical Therapy*, 82 (4), 372-382.
- Fitzgerald, G.K., Piva, S.R., Irrgang, J.J., Bouzubar, F., & Starz, T.W. (2004). Quadriceps activation failure as a moderator of the relationship between quadriceps strength and physical function in individuals with knee osteoarthritis. *Arthritis & Rheumatism*, 51 (1), 40-48.

- Fleck, S., & Kraemer, W. (1997). *Designing Resistance Training Programs*. (2nd Ed.) Champaign: Human Kinetics.
- Fransen, M., McConnell, S., & Bell, M. (2003). Cochrane Review: Exercise for osteoarthritis of the hip or knee. *The Cochrane Library, Issue 4*. Chichester, UK: John Wiley & Sons.
- Gaines, J.M., & Talbot, L.A. (1999). Isokinetic strength testing in research and practice. *Biological Research for Nursing, 1* (1), 57-64.
- Gaines, J.M., & Talbot, L.A. (1999). Isokinetic strength testing in research and practice. *Biological Research for Nursing, 1* (1), 57-64.
- Godin, G., & Kok, G. (1996). The theory of planned behavior: A review of its applications to health-related behaviors. *American Journal of Health Promotion, 11* (2), 87-98.
- Hair, J.F., Anderson, R.E., Tatham, R.L., & Black, W.C. (1998) *Multivariate Data Analysis*. (5th Ed.). New Jersey: Prentice-Hall.
- Halbert, J., Crotty, M., Weller, D., Ahern, M., & Silagy, C. (2001). Primary care-based physical programs: Effectiveness in sedentary older patients with osteoarthritis symptoms. *Arthritis care and Research, 45*, 228-234.
- Harnirattisai, T. & Johnson, R.A. (2002). *Reliability of Self-efficacy and Outcome Expectations for Exercise and Functional Activity in Thai Elders*. Poster presented at Health Science Research Day, University of Missouri-Columbia. Retrieved August 14, 2003, from the web site: <http://www.hsc.Missouri.edu/~research/srd2002/HarnirattisaiT2002.pdf>
- Harnirattisai, T. & Johnson, R.A. (2005). Effectiveness of a Behavioral Change Intervention in Thai Elders After Knee Replacement. *Nursing Research, 54*, (2), 97-107.
- Harrison, A.L. (2004). The influence of pathology, pain, balance, and self-efficacy on function in women with osteoarthritis of the knee. *Physical Therapy, 84* (9), 822-831.
- Hassan, B.S., Mockett, S., & Doherty, M. (2001). Static postural sway, proprioception, and maximal voluntary quadriceps contraction in patients with knee osteoarthritis and normal control subjects. *Annals of the Rheumatic Diseases, 60* (6), 612-618.

- Hinman, R.S., Bennell, K.L., Metcalf, B.R., & Crossley, K.M. (2002). Balance impairments in individuals with symptomatic knee osteoarthritis: a comparison with matched controls using clinical tests. *Rheumatology*, 41 (12), 1388-1394.
- Hochberg, M.C., et al. (1995). Guidelines for the medical management of osteoarthritis. *Arthritis & Rheumatism*, 38 (11), 1541-1546.
- Holderbaum, D., Haqqi, T.M., & Moskowitz, R.W. (1999). Genetics and osteoarthritis: exposing the iceberg. *Arthritis & Rheumatism*, 42, 397-405.
- Hootman, J.M., Macera, C.A., Helmick, C.G., & Blair, S.N. (2003). Influence of physical activity-related joint stress on the risk of self-reported hip/knee osteoarthritis: a new method to quantify physical activity. *Preventive Medicine*, 36, 636-644.
- Huch, K., Kuettner, K.E., & Dieppe, P. (1997). Osteoarthritis in ankle and knee joints. *Seminars in Arthritis & Rheumatism*, 26, 667-674.
- Hurley, M.V., Scott, D.L., Rees, J., & Newham, D.J. (1997). Sensorimotor changes and functional performance in patients with knee osteoarthritis. *Annals of the Rheumatic Diseases*, 56 (11), 641-648.
- Institute of Geriatric Medicine, Department of Medical Services. (2003). *A Survey on the Quality of Life of the Elderly, Thailand, 2001*. Nonthaburi: Institute of Geriatric Medicine, Department of Medical Services, Ministry of Public Health.
- Isaacs, B., & Akhtar, A.J. (1972). The set Test: a rapid test of mental function in old people. *Age and Ageing*, 1, 222-226.
- Isaacs, B., & Kennie, A.T. (1973). The set-test as an aid to the detection of dementia in old people. *British Journal of Psychiatry*, 123, 467-470.
- Jadelis, K., Miller, M.E., Ettinger, W.H., & Messier, S.P. (2001). Strength, balance, and the modifying effects of obesity and knee pain: Results from the observational arthritis study in seniors (OASIS). *Journal of American Geriatric Society*, 49, 884-891.
- Janson, S.L., Alioto, M.E., & Boushey, H.A. (2001). Attrition and retention of ethnically diverse subjects in a multicenter randomized controlled research trial. *Controlled Clinical Trials*, 22, 236S-243S.

- Jette, A., et al. (1998). Effectiveness of home-based, resistance training with disabled older persons. *Gerontologist*, 38, 412-422.
- Jitramontree, N. (2003). *Predicting exercise behavior among Thai elders: Testing the Theory of Planned Behavior*. Ph. D. Dissertation in Nursing, the Graduate College of the University of Iowa.
- Jordan, K.M., et al. (2003). EULAR Recommendations 2003: an evidence based approach to the management of knee osteoarthritis: report of a Task Force of the Standing Committee for International Clinical Studies including Therapeutic Trials (ESCISIT). *Annals of the Rheumatic Diseases*, 62, 1145-1155.
- Kanjanavorawong, P. (1997). *Quality of life in the elderly with osteoarthritis of the knee*. M.N.S. Thesis in Adult Nursing, Faculty of Graduate Studies, Mahidol University.
- Kart, C.S., Metress, E.K., & Metress, S.P. (1992). *Human Aging and Chronic Disease*. Boston, MA: Jones and Bartlett.
- Kervio, G., Carre, F., & Ville, N.S. (2003). Reliability and intensity of the six-minute walk test in healthy elderly subjects. *Medicine & Science in Sport & Exercise*, 35 (1), 169-174.
- King, A.C., Haskell, W.L., Taylor, C.B., Kraemer, H.C., & DeBusk, R.F. (1991). Group-vs-home-based exercise training in healthy older men and women: A community based clinical trial. *Journal of the American Medical Association*, 266, 1535-1542.
- King, A.C., et al. (1992). Determinants of physical activity and interventions in adults. *Medicine and Science in Sport and Exercise*, 24, 3221-3223.
- Kisner, C., & Colby, L.A. (1996). *Therapeutic exercise: Foundations and Techniques*. (3rd Ed.). Philadelphia: F.A. Davis.
- Knee exercising and testing. Retrieved April 12, 2005, from the web site: <http://www.isokinetics.net/joints/kneeessentials.htm>
- Knee Pain Clinic. (2002). What causes ongoing knee pain? Retrieved June 10, 2002, from the web site: http://my.webmd.com/special_event_article/1681.50336

- Kovar, P.A., et al. (1992) Supervised fitness walking in patients with osteoarthritis of the knee: A randomized controlled trial. *Annals of Internal Medicine*, 116 (7), 529-534.
- Kruger, J. (2001). A meta-analysis of factors related to self-efficacy for exercise in older adults. Ph.D. Dissertation, University of Illinois at Chicago, Health Sciences Center. Available: DAO database: Dissertation Abstract International [May 23, 2002].
- Kuptniratsaikul, V., Tosayanonda, O., Nilganuwong, S., & Thamalikitkul, V. (2002). The efficacy of a muscle exercise program to improve functional performance of the knee in patients with osteoarthritis. *Journal of Thai Medical Association*, 85, 33-40.
- Lachance, L, Sowers, M.F., Jamadar, D., & Hochberg, M. (2002). The natural history of emergent osteoarthritis of the knee in women. *Osteoarthritis & Cartilage*, 10 (11), 849-854.
- Lamb, S.E., et al. (2000). Factors that modify the association between knee pain and mobility limitation in older women: the Women's Health and Aging Study. *Annals of the Rheumatic Diseases*, 59, 331-337.
- Lawrence, J.S., Bremner, J.M., & Bier, F. (1966). Osteoarthrosis: Prevalence in the population and relationship between symptoms and x-ray changes. *Annals of the Rheumatic Diseases*, 25 (1), 1-24.
- Lewek, M.D., Rudolph, K.S., & Snyder-Mackler, L. (2004). Quadriceps femoris muscle weakness and activation failure in patients with symptomatic knee osteoarthritis. *Journal of Orthopaedic Research*, 22 (1), 110-115.
- Loughlin, J. (2001). Genetic epidemiology of primary osteoarthritis. *Current Opinion Rheumatology*, 13, 111-116.
- Luasawatchaikul, P. (1999). *Related factors and outcome of falls in the elderly*. M.N.S. Thesis in Adult Nursing, Faculty of Graduate Studies, Mahidol University.
- Luepongsak, N., Amin, S., Krebs, D.E., McGibbon, C.A., & Felson, D. (2002). The contribution of type of daily activity to loading across the hip and knee joints in the elderly. *Osteoarthritis & Cartilage*, 10, 353-359.

- MacLean, C.H. (2001). Quality indicators for the management of osteoarthritis in vulnerable elders. *Annals of Internal Medicine*, 135 (8) (part 2), 711-721.
- Maikiaw, C. (2001). *Effect of self-efficacy enhancement and social support on exercise behavior of the elderly*. M.N.S. Thesis in Gerontological Nursing, Graduate School, Chiang Mai University.
- Malathum, P. (2001). *A model of factors contributing to perceived abilities for health-promoting self-care of community-dwelling Thai older adults*. Ph.D. Dissertation in Nursing, Faculty of Graduate School, University of Texas at Austin.
- Manek, N.J., & Lane, N.E. (2000). Osteoarthritis: Current Concepts in Diagnosis and Management. *American Family Physician*, 61, 1795-1804.
- Mangione, K.K., McCully, K., Gloviak, A., Lefebvre, I., Hofmann, M., & Craik, R. (1999). The effect of high-intensity and low-intensity cycle ergometry in older adults with knee osteoarthritis. *Journal of Gerontology: Medical Sciences*, 54A (4), M184-M190.
- Marek, S.M., et al. (2005). Acute effects of static and proprioceptive neuromuscular facilitation stretching on muscle strength and power output. *Journal of Athletic Training*, 40 (2), 94-103.
- Marks, R., Allegrante, J.P., & Lorig, K. (2005). A review and synthesis of research evidence for self-efficacy-enhancing interventions for reducing chronic disability: Implications for health education practice (Part I). *Health Promotion Practice*, 6 (1), 37-43.
- Marshall, K.W., & Waddell, D.D. (2000). Nonoperative management of osteoarthritis of the knee. Retrieved July 14, 2003, from the web site: <http://www.physsportsmed.com/asr/knee/marshall.htm>
- Maurer, B.T., Stern, A.G., Kinossian, B., Cook, K.D., & Schumacher, H.R. (1999). Osteoarthritis of the knee: Isokinetic quadriceps exercise versus an education intervention. *Archive of Physical Medicine and Rehabilitation*, 80, 1293-1299.
- McAuley, E., Poag, K., Gleason, A., & Wraith, S. (1990). Attrition from exercise programs: Attributional and affective perspectives. *Journal of Social Behavior and Personality*, 5 (6), 591-602.

- McAuley, E., & Jacobson, L. (1991). Self-efficacy and exercise participation in sedentary adult females. *American Journal of Health Promotion*, 5 (3), 185-191.
- McAuley, E., Lox, C., & Duncan, T.E. (1993). Long-term maintenance of exercise, self-efficacy, and physiological change in older adults. *Journal of Gerontology*, 48 (4), P218-224.
- McAuley, E., Shaffer, S. M., & Rudolph, D. (1995). Affective response to acute exercise in elderly impaired males: the moderating effects of self-efficacy and age. *International Journal of Aging and Human Development*, 41, 13-27.
- McAuley, E., Talbot, H., & Martinez, S. (1999). Manipulating Self-Efficacy in the Exercise Environment in Women: Influences on Affective Responses. *Health Psychology Volume 18* (3), 288-294.
- McAuley, E., Jerome, G.L., Marquez, D.X., Elavsky, S., & Blissmer, B. (2003). Exercise self-efficacy in older adults: social, affective, and behavioral influences. *Annals of Behavioral Medicine*, 25 (1), 1-7.
- McCarthy, C.J., et al. (2004). Supplementing of a home-based exercise programme with a class-based programme for people with osteoarthritis of the knees: A randomized controlled trial and health economic analysis. *Health Technology Assessment*, 8 (46).
- McKinney, R., & Andersen, R.E. (2000). Exercise benefits patients with osteoarthritis. *The Physician and Sportsmedicine*, 28 (10). Retrieved Mar 4, 2004, from the web site: http://www.physsportmed.com/issues/2000/10_15_00/mckinney_pa.htm
- Messier, S.P., Thompson, C.D., & Ettinger, W.H.Jr. (1997). Effects of long-term aerobic or weight training regimens on gait in an older, osteoarthritic population. *Journal of Applied Biomechanics*, 13, 205-225.
- Messier, S.P., Gutekunst, D.J., Davis, C., & DeVita, P. (2005). Weight loss reduces knee-joint loads in overweight and obese older adults with knee osteoarthritis. *Arthritis & Rheumatism*, 52 (7), 2026-2032.
- Minor, M.A., & Lane, N.E. (1996). Recreational exercise in arthritis. *The Rheumatic Disease Clinics of North America*, 22 (3), 563-577.

- Miranda, H., Viikari-Juntura, E., Martikainen, R., & Riihimäki, H. (2002). A prospective study on knee pain and risk factors. *Osteoarthritis & Cartilage*, 10, 623-630.
- Moskowitz, R.W., & Holderbaum, D. (2001). Clinical and laboratory findings in osteoarthritis. In W.J. Koopman (Ed.), *Arthritis and Allied conditions: A Textbook of Rheumatology* (14th Ed.), vol. 2, pp. 2216-2239. Philadelphia: Lippincott Williams & Wilkins.
- Moungthong, B. (2001). *The effectiveness of a health education program on self-care among patients with osteoarthritis of the knee at Pramongkutklao Hospital*. M.Sc. Thesis in Public Health, Major in Health education and Behavioral sciences, Faculty of Graduate Studies, Mahidol University.
- Mow, V.C., Setton, L.A., Fuilak, F., & Ratcliffe, A. (1995). Mechanical factors in articular cartilage and their role in osteoarthritis. In K.E. Kuettner & V.M. Goldberg (Eds.), *Osteoarthritic disorders* (pp. 147-172). Rosemont: American Academy of Orthopedic Surgeons.
- Munro, B.H. (1997). *Statistical methods for health care research*. (3rd Ed.). Philadelphia: Lippincott-Raven.
- Murray, C.J.L. & Lopez, A.D. (Eds.). (1996). *The global burden of disease: a comprehensive assessment of mortality and disability from disease, injury and risk factors in 1990 and projected to 2020*. Cambridge: Harvard University Press.
- Nakaphonges, A. (1996). *Physical status, depression, nutritional self-care, and nutritional status of the community-dwelling elderly*. M.N.S. Thesis in Adult Nursing, Faculty of Graduate Studies, Mahidol University.
- Nantavanotayan, J. (1996). *An application of self-efficacy theory to relief pain among patients with osteoarthritis of the knees*. M.Sc. Thesis in Public Health, Major in Health Education, Faculty of Graduate Studies, Mahidol University.
- Narongrach, P. (1998). *Concentric isokinetic strength for knee flexor and extensor in female subjects with and without symptomatic knee osteoarthritis*. M.Sc. Thesis in Physiotherapy, Major in Physiotherapy, Faculty of Graduate Studies, Mahidol University.

- National Institute of Arthritis and Musculoskeletal and Skin Diseases. (No date). Questions and answers about arthritis and exercise. Retrieved February 17, 2001, from the web site: <http://www.nih.gov/niams/healthinfo/arthexfs.htm>
- National Institute of Arthritis and Musculoskeletal and Skin Diseases. (2002). Health Information: Handout on Health: Osteoarthritis Retrieved July 23, 2003, from the web site: <http://www.niams.nih.gov/index.htm>
- Ngamsutikul, W. (2000). *Risk factors associated with osteoarthritis of the knee and quality of life*. M.Sc. Thesis in Epidemiology, Faculty of Graduated Studies, Mahidol University.
- Nies, M., Vollman, M., & Cook, T. (1997). Facilitators, barriers, and strategies for exercise in European American women in the community. *Public Health Nursing, 15*, 263-272.
- O'Grady, M., Fletcher, J., & Ortiz, S. (2000). Therapeutic and physical fitness exercise prescription for older adults with joint disease: An evidence-based approach. *The Rheumatic Diseases Clinics of North America, 26* (3).
- O'Reilly, S.C., Muir, K.R., & Doherty, M. (1999). Effectiveness of home exercise on pain and disability from osteoarthritis of the knee: a randomized controlled trial. *Annals of the Rheumatic Diseases, 58*, 15-19.
- Oliveria, S.A., Felson, D.T., Klein, R.A., Reed, J.I., & Walker, A.M. (1996). Estrogen replacement therapy and the development of osteoarthritis. *Epidemiology, 7*, 415-419.
- Ostchega, Y., Dillon, C.F., Lindle, R., Carroll, M., & Hurley, B.F. (2004). Isokinetic leg muscle strength in older Americans and its relationship to a standardized walk test: Data from the National Health and Nutrition Examination Survey 1999-2000. *Journal of American Geriatric Society, 52*, 977-982.
- Oupaichit, B. (1994). *The effects of supportive-educative nursing system on knowledge capabilities for self-care operations and controlling disease in the elderly with osteoarthritis of the knee*. M.Sc. Thesis in Public Health, Major in Public Health Nursing, Faculty of Graduate Studies, Mahidol University.

- Penninx, B., et al. (2001). Physical exercise and the prevention of disability in activities of daily living in older person with osteoarthritis. *Archives of Internal Medicine*, 161 (19), 2309-2316.
- Petrella, R.J. (1999). Exercises for Patients with Knee Osteoarthritis. *The physician and sportmedicine*, 27 (11). Retrieved July 14, 2002, from the web site: http://www.Physsportsmed.com/issues/1999/10_15_99/petrella_pa.htm
- Petrella, R.J., & Bartha, C. (2000). Home-based exercise therapy for older patients with knee osteoarthritis: A randomized clinical trial. *Journal of Rheumatology*, 27, 2215-2221.
- Petrella, R.J. (2001). Is exercise effective treatment of osteoarthritis of the knee? *Western Journal of Medicine*, 174 (3), 191-196.
- Pichaiyongvongdee, N. (2000). *Comparison of standing balance performance, proprioception and muscle strength between women with and without symptomatic knee osteoarthritis*. M.Sc. Thesis in Physiotherapy, Faculty of Graduate Studies, Mahidol University.
- Pinto, B.M., Lynn, H., Marcus, B.H., DePue, J. & Goldstein, M.G. (2001). Physician-based activity counseling: Intervention effects on mediators of motivational readiness for physical activity. *Annals of Behavioral Medicine*, 23 (1) 2-10.
- Polit, D.F., Beck, C.T., & Hungler, B.P. (2001). *Essentials of nursing research: Methods, appraisal, and utilization*. (5th Ed.). Philadelphia: Lippincott.
- Poole, A.R. (1997). Can osteoarthritis as a disease be distinguished from ageing by skeletal and inflammation markers? Implication for 'early' diagnosis, monitoring skeletal changes and effects of therapy. In D. Hamerman (Ed.), *Osteoarthritis: Public health implications for an ageing population* (pp.187-214). Baltimore: John Hopkins University Press.
- Prasertphol, P. (2001). *Sleep quality of hospitalized elderly undergoing surgery*. M.N.S. Thesis in Adult Nursing, Faculty of Graduate Studies, Mahidol University.
- Rejeski, W.J., & Shumaker, S. (1994). Knee osteoarthritis and health related quality of life. *Medical Sciences and Sports Exercise*, 26, 1441-1445.

- Rejeski, W.J., Ettinger, W.H., Martin, K., & Morgan, T. (1998). Treating disability in Knee Osteoarthritis with exercise therapy: A central role for self-efficacy and pain. *Arthritis Care and Research*, 11 (2), 94-101.
- Rejeski, W.J., Miller, M.E., Foy, C., Messier, S., & Rapp, S. (2001). Self-efficacy and the progression of functional limitations and self-reported disability in older adults with knee pain. *The Journals of Gerontology*, 56B, S261-S265.
- Resnick, B. (1996). Motivation in geriatric rehabilitation. *Image: Journal of Nursing Scholarship*, 28, 41-47.
- Resnick, B. (1998a). Motivating older adults to perform functional activities. *Journal of Gerontological Nursing*, 24 (11), 23-30.
- Resnick, B. (1998b). Functional performance of older adults in a long-term care setting. *Clinical Nursing Research*, 7, 230-246.
- Resnick, B. (1998c). Efficacy beliefs in geriatric rehabilitation. *Journal of Gerontological Nursing*, 24 (7), 34-44.
- Resnick, B. (1999). Reliability and validity testing of the self-efficacy for functional activities scale. *Journal of Nursing Measurement*, 7 (1), 5-20.
- Resnick, B. (2000). Testing the reliability and validity of the self-efficacy for exercise scale. *Nursing Research*, 49 (3), 154-159.
- Resnick, B., & Spellbring, A.M. (2000). The factors that influence exercise behavior in older adults. *Journal of Gerontological Nursing*, 26 (3), 34-42.
- Resnick, B., Palmer, M.H., Jenkins, L.S., & Spellbring, A.M. (2000). Exercise activity in older adults: A path analysis. *Journal of Advanced Nursing*, 31, 1309-1315.
- Resnick, B., Zimmerman, S., Orwig, D., Furstenberg, A.L., & Magaziner, J. (2000). Outcome Expectations for Exercise Scale: Utility and psychometrics. *The Journals of Gerontology: Social Sciences, Series B, Psychological Sciences and Social Sciences*, 55, S352-S356.
- Resnick, B. (2001). Model testing for reliability and validity of the outcome expectaions for exercise scale. *Nursing Research*, 50 (5), 293-299.
- Resnick, B., & Nigg, C. (2003). Testing a theoretical moder of exercise behavior for older adults. *Nursing Research*, 52 (2), 80-88.

- Resnick, B., Orwig, D., Wehren, L., Zimmerman, S., Simpson, M., & Magaziner, J. (2005). The Exercise Plus Program for Older Women Post Hip Fracture: Participant Perspectives. *The Gerontologist*, 45(4), 539-544.
- Robergs, R.A., & Roberts, S.O. (2000). *Fundamental Principles of Exercise Physiology for Fitness, Performance, and Health*. Dubuque, IA: McGraw-Hill Higher Education.
- Roche, D. (no date). Guidelines for Athlete Assessment in New Zealand Sport 1: Flexibility and Muscle Balance Assessment. Retrieved November 25, 2004, from the web site: http://www.sportscience.org.nz/publications/guidelines/Section2/2.10_Flexibility_and_Muscle.pdf
- Roddy, E., et al. (2005). Evidence-based recommendations for the role of exercise in the management of osteoarthritis of the hip or knee - the MOVE consensus. *Rheumatology* 44 (1), 67-73.
- Saenmanoch, S. (1998). *Effects of promoting caregiver participation in caring of elderly fractured hip patients on postoperative recovery, caregiver anxiety, and patients' and caregiver satisfaction*. M.N.S. Thesis in Adult Nursing, Faculty of Graduate Studies, Mahidol University.
- Salter, R.B. (1983). Degenerative disorders of joint and related tissues. In Curtis, P.H. (Ed.), *Textbook of disorders and injuries of the musculoskeletal system* (2nd Ed., pp. 213-251). Baltimore: Williams & Wilkins.
- Sandmeier, R.H. (1998). Osteoarthritis and Exercise: Does Increased Activity Wear Out Joints? Retrieved August 20, 2003, from the web site: http://www.Sandmeier1998_OsteoarthritisandExercise.htm
- Sands, J.K. (Ed.). (1988). *A Guide to Arthritis Home Health Care*. New York: John Wiley & Sons.
- Seguin, R.A., Epping, J.N., Buchner, D., Bloch, R., & Nelson, M.E. (2002). *Growing stronger: Strength training for older adults*. Boston: Tufts University.
- Sell, S., Zacher, J., & Lack, S. (1993). Proprioception decline in the osteoarthritic knee. *Rheumatology*, 52, 150.
- Sevick, M.A. (2000). Cost-effectiveness of aerobic and resistance exercise in seniors with knee osteoarthritis. *Medical Science of Sports Exercise*, 32 (9), 1534-1540.

- Shadish, W.R., Cook, T.D., & Campbell, D.T. (2002). *Experimental and Quasi-Experimental Design for Generalized Causal Inference*. Boston: Houghton Mifflin.
- Sharma, L. (1999). Osteoarthritis: Proprioceptive impairment in knee osteoarthritis. *The Rheumatic Diseases Clinics of North America*, 25 (2), 299-314.
- Sharma, L., Dunlop, D.D., Cahue, S., Song, J., & Hayes, K.W. (2003). Quadriceps strength and osteoarthritis progression in malaligned and lax knees. *Annals of Internal Medicine*, 138 (8), 613-619.
- Sharon, B., Hennessy, C., Brandon, J., & Boyette, L. (1997). Older adults' expectancies of a strength training program. *Journal of Nutrition, Health and Aging*, 1, 103-108.
- Shier, D., Butler, J., & Lewis, R. (1996). *Hole's Human Anatomy & Physiology*. (7th Ed.). Dubuque: Wm. C. Brown.
- Siegel, S., & Castellan, N.J. (1988). *Nonparametric Statistics for the Behavioral Sciences*. (2nd Ed.). Singapore: McGraw-Hill.
- Singh, M.A.F. (2004) Exercise and aging. *Clinics in Geriatric Medicine*, 20 (2), 201-221.
- Slemenda, C., et al. (1997). Quadriceps weakness and osteoarthritis of the knee. *Annals of Internal Medicine*, 127, 97-104.
- Smith, J. (2005). Choosing the "Best" Exercise Modality. Retrieved Jan23, 2005, from the web site:http://www.precor.com/pdf/articles/exercise_modality.pdf
- Stiggelbout, M., Popkema, D.Y. Hopman-Rock, M., de Greef, M., & van Mechelen, W. (2004). Once a week is not enough: effects of a widely implemented group based exercise programme for older adults: a randomised controlled trial. *Journal of Epidemiological Community Health*, 58, 83-88.
- Sumpowthong, K. (1993). *The effectiveness of health education program on osteoarthritis preventive behavior of Thammasat University Hospital Aging Club Member, Patumtanee Province*. M.Sc. Thesis in Public health, Major in Health Education, Faculty of Graduate Studies, Mahidol University.

- Sutton, A.J., Muir, K.R., Mockett, S., & Fentem, P. (2001). A case-control study to investigate the relation between low and moderate levels of physical activity and osteoarthritis of the knee using data collected as part of the Allied Dunbar National Fitness Survey. *Annals of the Rheumatic Diseases*, 60, 756-764.
- Suwanraj, M. (2001). *Pain, pain management and health status in knee osteoarthritis patients*. M.N.S. Thesis in Adult Nursing, Faculty of Graduate Studies, Mahidol University.
- Tabachnick, B.G., & Fidell, L.S. (2001). *Using Multivariate Statistics*. (4th Ed.). Needham Heights: Allyn & Bacon.
- Tanwattana, C., Suputtitada, A., Aksaranugraha, S., Srikiatkachon, A., & Samorrapoom, C. (2002). Effectiveness of modified quadriceps strengthening exercise in patients with osteoarthritis of knee. *Journal of Thai Rehabilitation*, 12 (1), 32-43.
- The CON-TREX MJ multi-joint module: Biomechanical Test- and Training Systems. Dübendorf, Switzerland: CMV AG. Retrieved December 21, 2005, from the web site: www.con-trex.ch
- Thomas, K.S., Muir, K.R., Doherty, M., Jones, A.C., O'Reilly, S.C., & Bassey, E.J. (2002). Home based exercise programme for knee pain and knee osteoarthritis: randomized controlled trial. *British Medical Journal*, 325, 752-755.
- Thongsumrit, D. (1999). *The effectiveness of Thai Traditional Exercise Program for Osteoarthritis of the knee in the elderly, Amphur Watpleng, Ratchaburi Province*. M.Sc. Thesis in Public Health, Major in Public Health Nursing, Faculty of Graduate Studies, Mahidol University.
- Tosayanonda, O., Kuptniratsaikul, V., Nilganuwong, S., Thamalikitkul, V. (2001). *Health promotion and rehabilitation for knee osteoarthritic elderly*. Unpublished Research Report, Faculty of Medicine Siriraj Hospital, Mahidol University.
- Vallerand, A.H. (2003). Treating osteoarthritis pain. *The Nurse Practitioner*, 28 (4), 7-15.

- van Baar, M.E., Assendelft, W.J.J., Dekker, J., Osstendorp, R.A.B., & Bijlsma, J.W.J. (1999). Effectiveness of exercise therapy in patients with osteoarthritis of the hip or knee: A systematic review of randomized clinical trials. *Arthritis & Rheumatism*, 42 (7), 1361-1369.
- van Baar, M.E. , Dekker, J., Oostendorp, R.A.B., Bijl, D., Voorn, Th.B., & Bijlsma, J.W.J. (2001). Effectiveness of exercise in patients with osteoarthritis of hip or knee: nine months' follow up. *Annals of the Rheumatic Diseases*, 60, 1123-1130.
- Verbrugge, L.M., Lepkowski, J.M., & Konkol, L.L. (1991). Levels of disability among U.S. adults with arthritis. *Journal of Gerontology*, 46, S71-83.
- Wattanawong, O. (2000). *The application of self-efficacy theory and social support on promotion of exercise to woman laborers in wood furniture factories, Nonthaburi Province*. M.Sc. Thesis in Public Health, Major in Health education and Behavioral Sciences, Faculty of Graduate Studies, Mahidol University.
- Westby, M.D. (2001). A health professional's guide to exercise prescription for people with arthritis: A review of aerobic fitness activities. *Arthritis Care and Research*, 45, 501-511.
- Wibulpolprasert, S. (Ed.). (2006). Thailand Health Profile 2001-2004. Retrieved February 6, 2006, from the web site: http://www.moph.go.th/ops/health_48
- Wongjunlongsin, S. (1999). *Relationship among caregiving demands of cerebrovascular disease patients, self-efficacy, and stress of family caregivers*. M.N.S. Thesis in Adult Nursing, Faculty of Graduate Studies, Mahidol University.
- Wongkaoom, J. (1997). *The effect of application self-efficacy theory in exercise program on elderly exercise behavior at Elderly Bangsai Club, Chonburi Province*. M.Sc. Thesis in Public Health, Major in Public Health Nursing, Faculty of Graduate Studies, Mahidol University.
- World Health Organization. (1997). Fifty facts from the World Health Report 1997. Retrieved June 12, 2002, from the web site: <http://www.who.int.whr.2001/archieves/1997/factse.htm>

World Health Organization. (2002). World health day “Move for Health” 7 April 2002 Retrieved April 30, 2002, from the web site: http://www.who.int/world-health-day/about_whd.shtml

World Health Organization. (2003). *The burden of musculoskeletal conditions at the start of the new millennium: Report of a WHO Scientific Group*. Geneva, Switzerland: World Health Organization.

Thai Bibliography

จันทร์เพ็ญ ชูประภาวรรณ. (บก). (2543). (Chuprapawan, B.E.2543). *สถานะสุขภาพคนไทย (Thai Population Health)*. กรุงเทพมหานคร: สำนักพิมพ์หมอชาวบ้าน.

กระทรวงสาธารณสุข, กรมอนามัย, กองออกกำลังกายเพื่อสุขภาพ, กลุ่มวิทยาศาสตร์การออกกำลังกาย. (2 มีนาคม 2547). (Ministry of Public Health, B.E.2547a). ผลการสำรวจสถานการณ์การออกกำลังกายของคนไทย: กรณีศึกษาประชาชน 15-65 ปีในเขตกทม. Retrieved October 11, 2004, from the web site: <http://www.anamai.moph.go.th/dopah>

กระทรวงสาธารณสุข, กรมการแพทย์, สถาบันเวชศาสตร์ผู้สูงอายุ. (Ministry of Public Health, B.E. 2547b). *คู่มือการประเมินภาวะโภชนาการในผู้สูงอายุ*. กรุงเทพมหานคร: โรงพิมพ์ชุมนุม สหกรณ์การเกษตรแห่งประเทศไทย.

กระทรวงสาธารณสุข, กรมอนามัย, กองออกกำลังกายเพื่อสุขภาพ. (16 ตุลาคม 2545). (Ministry of Public Health, B.E.2545). นโยบายออกกำลังกายเพื่อสุขภาพ. Retrieved April 29, 2002, from the web site: <http://www.anamai.moph.go.th/dopah>

กระทรวงสาธารณสุข. (2546). (Ministry of Public Health, B.E.2546). สถิติสาธารณสุข 2545 (Health statistic B.E.2545). Retrieved February 29, 2004, from the web site: <http://www.anamai.moph.go.th/stat/index.htm>

สุรศักดิ์ ศรีสุข, เล็ก ปรีวิสุทธิ, และ นวลอนงค์ ชัยปิยะพร. (2537). (Seesuk, Pariwisut, & Chaipiyapon, B.E.2537). *ปวดเข่า*. (ฉบับแก้ไขปรับปรุงครั้งที่ 3). กรุงเทพมหานคร: สำนักพิมพ์หมอชาวบ้าน.

สำนักงานกองทุนสนับสนุนการสร้างเสริมสุขภาพ, กองบรรณาธิการ. (พฤศจิกายน 2547). (Thai Health Promotion Foundation, B.E.2547). *คำประกาศนโยบายและเป้าหมาย “เมืองไทยแข็งแรง.” จดหมายข่าวสำนักงานกองทุนสนับสนุนการสร้างเสริมสุขภาพ*, หน้า 2.

สุรพงษ์ อัมพวันวงษ์. (11 เมษายน 2547). (Umpanwong, B.E.2547). เสริมอาหารกับโรคข้อ.
เคลีนิวส์, หน้า 4.

พงษ์ศักดิ์ วัฒนา.(2545). (Wattana, B.E.2545). *เรื่อนำรู้เกี่ยวกับโรคข้อเข่าเสื่อม*. (พิมพ์ครั้งที่ 4). นนทบุรี: โครงการควบคุมโรคปวดข้อ กรมการแพทย์ กระทรวงสาธารณสุข.

พงษ์ศักดิ์ วัฒนา. (2547). (Wattana, B.E.2547). ผู้ป่วยโรคข้อควรระวังอะไรบ้าง? ใน *วันโรคข้อสากลปี พ.ศ. 2547 เรื่อง การรักษาโรคกระดูกและข้อแบบเรียบง่าย วันที่ 3 ตุลาคม 2547* (หน้า 17-19). กรุงเทพมหานคร: องค์การร่วมทศวรรษโรคกระดูกและข้อแห่งประเทศไทย (ค.ศ. 2000-2010).

พงษ์ศักดิ์ วัฒนา, ธวัช ประสาทฤทธา, และ วิมลลภ สำราญเวชย์. (2547). (Wattana, Prasartlitha, & Samranwej, B.E.2547). *เรื่อนำรู้เกี่ยวกับโรคปวดข้อ*. (พิมพ์ครั้งที่ 7). นนทบุรี: โครงการ ควบคุมโรคปวดข้อ กรมการแพทย์ กระทรวงสาธารณสุข.



APPENDIX A

Contact Letter

Dear

You can assess whether you may have symptoms related to osteoarthritis of the knee by answering these following questions:

1. Your age are years. (Your birth date is/...../.....)
2. You are currently having knee pain Yes No
3. You experience difficulty move your knee or have knee stiffness
.....Yes No
4. Can you notice any sound when you move your knee(s)?
.....Yes No
5. Do you feel pain when pressing on your knee? Yes No
6. You notice your knee joint is growing larger. Yes No
7. Your knee is swelling, red, or warm. Yes No

If you are 50 years old or older, currently having knee pain, and having additional two symptoms (on item 3 to 7), you probably have osteoarthritis of the knee. Therefore, I would like to invite you to participate in a study related to exercise behavior. For your further information, please provide your name, address, and phone number (if any), then, return to Otherwise, you can directly contact me at the phone number 01-6488124, so that we could set a time for further discussion of this study.

I am interested in the study and would like you to contact me at the following address:

Name

Address

.....

Tel:

Thank you and sincerely yours,

Tassanee Rawiworrakul, MSc,

Ph.D. candidate in Nursing,

Mahidol University

Tel: 01-6488124

เอกสารติดต่อผู้เข้าร่วมโครงการวิจัยในสตรีอายุ 50-70 ปี

เรียน ท่านผู้สนใจ

ท่านสามารถประเมินได้ด้วยตนเองว่าท่านมีอาการเกี่ยวกับโรคข้อเข่าเสื่อมหรือไม่ โดยการตอบคำถามดังต่อไปนี้

1. ปัจจุบันท่านมีอายุ ปี (เกิดวันที่ เดือน พ.ศ.)
2. ท่านมีอาการปวดข้อเข่า ใช่ ไม่ใช่
3. ท่านรู้สึกข้อเข่าเหยียด-งอไม่สะดวก (ข้อเข่าฝืด) ใช่ ไม่ใช่
4. ท่านรู้สึกว่ามีเสียงในข้อเข่าเมื่อเหยียด-งอเข่า ใช่ ไม่ใช่
5. ท่านรู้สึกเจ็บเมื่อใช้มือกดที่ข้อเข่า ใช่ ไม่ใช่
6. ท่านรู้สึกว่ากระดูกบริเวณข้อเข่าใหญ่ขึ้นกว่าเดิม ใช่ ไม่ใช่
7. ข้อเข่าของท่านบวม แดง ร้อน (มีอาการอักเสบ) ใช่ ไม่ใช่

หากท่านมีอายุตั้งแต่ 50 ปีขึ้นไป มีอาการปวดข้อเข่า และมีอาการอื่น ๆ (ที่ระบุในข้อ 3 ถึง ข้อ 7) อีกอย่างน้อย 2 อาการ ท่านอาจจะเป็นโรคข้อเข่าเสื่อม ดิฉันใคร่ขอเชิญท่านเข้าร่วมการศึกษาวิจัยเกี่ยวกับการออกกำลังกายสำหรับผู้ที่มีอาการของโรคข้อเข่าเสื่อม โดยดิฉันยินดีที่จะเสนอรายละเอียดการศึกษาเพื่อให้ท่านได้พิจารณาจนตัดสินใจร่วมโครงการวิจัยดังกล่าว

ท่านสามารถแสดงความจำนงโดยแจ้งชื่อ ที่อยู่ และหมายเลขโทรศัพท์(ถ้ามี) ในช่วงท้ายข้อความนี้ แล้วส่งที่..... หรือท่านสามารถติดต่อดิฉันได้โดยตรงที่หมายเลขโทรศัพท์ 01-6488124

ข้าพเจ้ามีความสนใจในโครงการวิจัย ฯ และต้องการข้อมูลเพิ่มเติม:

ชื่อ

ที่อยู่

โทรศัพท์:

ด้วยความนับถือ

ทัศนีย์ รวีวรกุล

นักศึกษาปริญญาเอกสาขาการพยาบาล, ผู้วิจัย

คณะแพทยศาสตร์โรงพยาบาลรามาธิบดี

มหาวิทยาลัยมหิดล

APPENDIX B

Screening Questionnaire

Name

Address Tel

-
1. Your birth date is / / Age years old
 2. Do you have knee(s) pain right now? 1. Yes 2. No
 3. Do feel pain when you press your hand on your knee (s)? 1. Yes 2. No
 4. Do you have gel phenomenon (stiffness) on your knee (s), which is less than 30 minutes at a time? 1. Yes 2. No
 5. Do you notice a sound in your knee joint when moving? 1. Yes 2. No
 6. Is your knee(s) swelling, red or warm? 1. Yes 2. No
 7. Your knee joint is larger than before (Bony enlargement)? 1. Yes 2. No
 8. Feeling of instability on your knee(s) 1. Yes 2. No
 9. You have gone to see a doctor for your knee problem 1. Yes 2. No
If 'yes,' the diagnosis is
 10. Have you had any surgery on your hip, knee, or ankle? 1. Yes 2. No
If 'yes,' please specify
 11. Have you ever had a steroid injection at your knee(s)? 1. Yes 2. No
If 'yes,' do you know what kind of medication was used?
When did you have your knee joint injection?
 12. Are you currently participating in physical therapy treatment for your knee pain? 1. Yes 2. No
 13. Have you experienced pain on your hip and/or ankle? 1. Yes 2. No
How much pain you have on your hip and/or ankle (pain score from 0 to 10)?

no pain
very severe pain

0 1 2 3 4 5 6 7 8 9 10
 14. Have you experienced chest pain in the previous month? 1. Yes 2. No
 15. Your weight is.....Kg. and your height is cm BMI = ... kg/m²
 16. Your pulse rate (at rest) is per minute; **regularity?** 1. Yes 2. No
 17. Blood pressure (at rest)/.....mmHg

แบบสัมภาษณ์ผู้ที่มีอาการปวดเข่า

ชื่อผู้ตอบแบบสอบถาม

ที่อยู่ โทรศัพท์

1. วัน เดือน ปี เกิด	อายุ ปี
2. ขณะนี้ท่านมีอาการปวดข้อเข่า	1.ใช่ 2.ไม่ใช่
3. ท่านรู้สึกเจ็บเมื่อใช้มือกดที่ข้อเข่า	1.ใช่ 2.ไม่ใช่
4. ท่านรู้สึกว่าข้อเข่าเหยียด-งอไม่สะดวก (ข้อเข่าฝืด) เป็นบางครั้ง แต่ละครั้งนานไม่เกิน 30 นาที	1.ใช่ 2.ไม่ใช่
5. ท่านรู้สึกว่ามีความเสี่ยงในข้อเข่าเมื่อเหยียด-งอเข่า	1.ใช่ 2.ไม่ใช่
6. ข้อเข่าของท่านบวม แดง ร้อน (มีอาการอักเสบ)	1.ใช่ 2.ไม่ใช่
7. ท่านรู้สึกว่ากระดูกข้อเข่าใหญ่ขึ้นกว่าเดิม	1.ใช่ 2.ไม่ใช่
8. ท่านรู้สึกว่าข้อเข่าหลวม เดินไม่มั่นคง	1.ใช่ 2.ไม่ใช่
9. ท่านเคยไปพบแพทย์ด้วยอาการปวดเข่า เมื่อใด การวินิจฉัยของแพทย์	1.ใช่ 2.ไม่ใช่
10. ท่านเคยได้รับการผ่าตัด ข้อสะโพก ข้อเข่า ข้อเท้า เมื่อใด ผ่าตัดอะไร	1.ใช่ 2.ไม่ใช่
11. ท่านเคยได้รับการฉีดยาที่ข้อเข่า เมื่อใด ยาที่ฉีด	1.ใช่ 2.ไม่ใช่
12. ท่านกำลังรับการรักษาทางกายภาพบำบัดเพื่อรักษาอาการปวดเข่า	1.ใช่ 2. ไม่ใช่
13. ท่านมีอาการปวดที่ข้อสะโพกหรือข้อเท้าด้วย	1.ใช่ 2.ไม่ใช่
ถ้ามีโปรดระบุตำแหน่ง และ สาเหตุ เท่าที่ทราบ	
อาการปวดข้อสะโพก/ข้อเท้า ของท่านมากแค่ไหน (คะแนนความปวดจาก 0 ถึง 10)	
ไม่ปวดเลย 0 1 2 3 4 5 6 7 8 9 10	ปวดมากจนทนไม่ไหว
14. ท่านเคยมีอาการเจ็บแน่นบริเวณหน้าอก ในช่วงเดือนที่ผ่านมา	1.ใช่ 2.ไม่ใช่
15. ขณะนี้น้ำหนักของท่าน กิโลกรัม ส่วนสูง เซนติเมตร	BMI = ... กก./ม. ²
16. ชีพจร (ขณะพัก) ครั้ง/นาที	ชีพจรสม่ำเสมอ 1.ใช่ 2. ไม่ใช่
17. ความดันโลหิต (ขณะพัก) /..... มม.ปรอท	

APPENDIX C

The Set Test

Instruction: This questionnaire asks you to name as many items as you can recall in each set of color, animal, fruit, and province.

Color:	Animal:
1	1
2	2
3	3
4	4
5	5
6	6
7	7
8	8
9	9
10	10

Fruit:	Province:
1	1
2	2
3	3
4	4
5	5
6	6
7	7
8	8
9	9
10	10

แบบประเมินเกี่ยวกับการนึกคิดและการจำ

คำชี้แจง: ข้อคำถามต่อไปนี้เป็นการประเมินความสามารถในการนึกคิดและการจำของท่าน

โปรดบอกชื่อของ สี สัตว์ ผลไม้ และจังหวัด ที่ท่านรู้จักให้มากที่สุดเท่าที่ท่านจำได้

สี	สัตว์
1	1
2	2
3	3
4	4
5	5
6	6
7	7
8	8
9	9
10	10
ผลไม้	จังหวัด
1	1
2	2
3	3
4	4
5	5
6	6
7	7
8	8
9	9
10	10

APPENDIX D

Severity of the Disease Scale-Modified Version

Instruction: The following items refer to severity of knee symptoms related to osteoarthritis of the knee. Please **circle** the answer that most closely **describes symptoms of your knee(s)** right now.

1. Duration of knee pain
 - a) Less than a year
 - b) 1 to 5 years
 - c) More than 5 years
2. Frequency of knee pain
 - a) Rarely having pain
 - b) Less than 3 times in the past week
 - c) All the time
3. Swelling, red, and warm palpation on the knee
 - a) None
 - b) Noticeable
 - c) Very much
4. Cracking sound palpation in the knee
 - a) None
 - b) Somewhat
 - c) Remarkably feel
5. Activity that makes more knee pain
 - a) Walking/standing for a long time
 - b) Walking up/downstairs
 - c) Even resting in bed
6. Pain killer/ analgesic/ medication use
 - a) None or sometime when having knee pain
 - b) Every time when having pain
 - c) Taking both oral medication and injection when having pain
7. Difficulty when squatting/sitting on the floor
 - a) No problem
 - b) Having difficult when getting up
 - c) Absolutely cannot perform
8. When pushing force on the knee joint
 - a) No pain
 - b) Somewhat pain
 - c) Very severe pain
9. Difficulty when performing stair climbing
 - a) No problem
 - b) Sometimes has
 - c) Absolutely cannot
10. Cane using
 - a) No
 - b) Sometimes use
 - c) Always use

การประเมินความรุนแรงของโรคข้อเข่าเสื่อม

คำชี้แจง: ข้อความต่อไปนี้กล่าวถึงความรุนแรงของโรคข้อเข่าเสื่อม

โปรด วงกลม รอบหัวข้อที่ตรงกับความเป็นจริงมากที่สุด

1. ระยะเวลาที่ปวดเข่า

ก) น้อยกว่า 1 ปี	ข) ตั้งแต่ 1 ถึง 5 ปี
ค) มากกว่า 5 ปีขึ้นไป	
2. ความถี่ของการปวดข้อเข่า

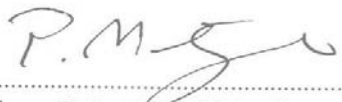
ก) ปวดนาน ๆ ครั้ง	ข) ปวดน้อยกว่า 3 ครั้ง ใน 1 สัปดาห์
ค) ปวดตลอดเวลา	
3. อาการบวม แดง ร้อน ที่ข้อเข่า

ก) ไม่มีอาการ	ข) มีอาการเล็กน้อย
ค) มีอาการมาก	
4. .
5. .
6. .
7. .
8. .
9. .
10. การใช้ไม้เท้า

ก) ไม่ได้ใช้	ข) ใช้เป็นบางครั้ง
ค) ใช้ตลอดเวลา	

APPENDIX E

Documentary Proof of Ethical Clearance

	
No. <u>32/2005</u>	
Documentary Proof of Ethical Clearance The Committee on Human Rights Related to Human Experimentation Mahidol University, Bangkok	
Title of Project.	The Effectiveness of a Community-Based Exercise Program on Self-Efficacy and Outcome Expectations for Exercise, Severity of Knee Symptoms, and Physical Performance in Thai Women with Osteoarthritis of the Knee (Thesis for Ph.D.)
Principle Investigator.	Miss Tassanee Rawiworrakul
Name of Institution.	Faculty of Medicine Ramathibodi Hospital
Approved by the Committee on Human Rights Related to Human Experimentation	
Signature of Chairman.	 (Professor Dr. Srisin Khusmith)
Signature of Head of the Institute.	 (Professor Dr. Pornchai Matangkasombut)
Date of Approval.	- 8 APR 2005

APPENDIX F

Participant Information Sheet

Project Title

The Effectiveness of a Community-based Exercise Program on Self-efficacy and Outcome Expectations for Exercise, Severity of Knee Symptoms, and Physical Performance in Thai Women with Osteoarthritis of the Knee

Project Summary

This is a research project, which is in partial fulfillment of the requirement for degree of Doctor Philosophy in Nursing. A community-based exercise intervention is developed to examine effectiveness of an exercise program on knee symptoms related to osteoarthritis of the knee, e.g., knee pain and joint stiffness, muscle strength of thighs, and physical performance in Thai women with osteoarthritis of the knee. In addition, confidence to perform exercise behavior and medication use will also be assessed.

Thai women, age of 50 to 70 years old and currently having symptoms related to osteoarthritis of the knee, are potential participants in this study. You can get the information from the investigator before making your decision whether you willingly participate. Based on your rights and confidentiality, your decision will not affect standard health care or medical service from health care professionals.

After you participate in the study, you will be asked to complete questionnaires or be interviewed by the researcher/research assistant. The questionnaires consist of health history, symptoms related to osteoarthritis of the knee, severity of knee symptoms, expectations of the benefits of exercise, and confidence to perform exercise. In addition, your personal information will be collected and will be confidentially kept by the investigator.

Your leg muscle strength, range of motion of knee joint, and physical performance will be assessed. Leg muscle strength will be measured by an isokinetic dynamometer at a hospital or health facility. Range of motion of knee joint will be measured by a simple instrument, which is safe and conducted by the investigator or trained research assistant. For the physical performance test, you will be asked to

perform hallway walking for 6 minutes. Physical examination will be done before the walk test begins, for your safety. All questionnaires and measurements, except demographic data and personal information, will be applied four times, monthly each. These assessments will be done once before the beginning of the exercise program (baseline). Then, they will be re-assessed at the 4th, the 8th, and the 12th week after baseline assessments.

After baseline assessments, the researcher will conduct a community-based exercise program for participants in the experimental community(ies). The program consists of a group discussion part and stationary cycling exercise part, which will last for approximately 1 hour, twice a week for 12 weeks. The group discussion includes health education and problem solving regarding osteoarthritis of the knee and exercise practice. Participants in the control group, who live in other community(ies), will be asked to maintain their own daily lifestyle. In addition, the control participants will be asked to complete questionnaires and physical performance tests monthly for four times as well as the experimental participants. However, after completion of the intervention, participants in the control group will be provided an exercise program designed for people with osteoarthritis of the knee by the researcher.

You could participate in this study by signing in the informed consent form attached. If you have any question or need more information, please feel free to contact the investigator at the given address and telephone number.

Thank you,

Tassanee Rawiworrakul, PhD (c), RN
(Doctoral Student & Investigator)

Address: School of Nursing, Faculty of Medicine Ramathibodi Hospital,
Mahidol University
Rama 6 Road, Rachathevi, Bangkok 10400, Thailand
Tel. 01-6488124

เอกสารชี้แจงโครงการวิจัย

ชื่อโครงการ

ประสิทธิผลของโปรแกรมการออกกำลังกายต่อความสามารถตนเองต่อการออกกำลังกาย ความคาดหวังในผลลัพธ์ของการออกกำลังกาย ความรุนแรงของอาการปวดเข่า และสมรรถภาพทางกายของสตรีไทยที่มีอาการของโรคข้อเข่าเสื่อม

การดำเนินการของโครงการ ฯ โดยสรุป

เอกสารนี้เป็นเอกสารชี้แจงโครงการศึกษาประสิทธิผลของโปรแกรมการออกกำลังกายสำหรับสตรีไทยที่มีอาการของโรคข้อเข่าเสื่อมในชุมชน ซึ่งมีวัตถุประสงค์เพื่อศึกษาผลของโปรแกรมการออกกำลังกายต่ออาการที่เกี่ยวข้องกับโรคข้อเข่าเสื่อม เช่นปวดเข่า, ข้อเข่าฝืด ความแข็งแรงของกล้ามเนื้อต้นขา และสมรรถภาพทางกายของสตรีไทยที่มีอาการของโรคข้อเข่าเสื่อม

โครงการฯนี้ เป็นส่วนหนึ่งของการศึกษาระดับปริญญาเอก สาขาการพยาบาล มหาวิทยาลัยมหิดล ดำเนินการโดย นางสาวทัศนีย์ รวีวรกุล เป็นผู้รับผิดชอบโครงการฯ

ท่านที่อายุตั้งแต่ 50 ถึง 70 ปี และมีอาการปวดข้อเข่าเนื่องจากข้อเสื่อมจะได้รับคำอธิบายจากผู้วิจัยพร้อมเอกสารชี้แจงโครงการวิจัย ก่อนการตัดสินใจเข้าร่วมโครงการดังกล่าว ซึ่งกิจกรรมนี้ไม่มีผลต่อการรักษาพยาบาล หรือ การร่วมกิจกรรมกับโรงพยาบาลหรือสถานบริการสุขภาพที่ให้การดูแลท่านแต่อย่างใด ดังนั้น การตัดสินใจนี้จึงเป็นสิทธิของท่านโดยเฉพาะ

เมื่อท่านตัดสินใจเข้าร่วมกิจกรรมของโครงการ ฯ ท่านจะได้รับแบบสอบถาม หรือได้รับการสัมภาษณ์เกี่ยวกับอาการปวดเข่า ประวัติสุขภาพ และ อาการอื่น ๆ ที่เกี่ยวข้องกับสุขภาพของท่าน เพื่อการออกกำลังกายอย่างปลอดภัย เนื่องจากการออกกำลังกายเป็นกิจกรรมสำคัญอย่างหนึ่งของโครงการ ฯ นอกจากนี้ ก่อนเริ่มกิจกรรมของโครงการ ฯ ท่านจะได้รับแบบสอบถาม หรือได้รับการสัมภาษณ์ข้อมูลส่วนตัวบางประการ อาการที่เกี่ยวข้องกับข้อเข่าเสื่อม ความสามารถตนเองและความคาดหวังผลลัพธ์ของการออกกำลังกาย รวมถึงการทดสอบสมรรถภาพทางกายประกอบด้วยการเดินทดสอบ 6 นาที และทดสอบความแข็งแรงกล้ามเนื้อต้นขาโดยการวัดความแข็งแรงของกล้ามเนื้อต้นขา และความสามารถในการเหยียด-งอข้อเข่าของท่าน

ในการวัดความแข็งแรงกล้ามเนื้อต้นขา ผู้วิจัยจะนำท่านไปรับการวัดโดยเครื่องมือพิเศษโดยผู้วิจัยรับผิดชอบค่าเดินทางและค่าใช้จ่ายในการวัดดังกล่าว ส่วนการวัดความสามารถในการเหยียด-งอข้อเข่าจะดำเนินการโดยผู้วิจัยหรือผู้ช่วยวิจัย โดยการใช้เครื่องมือวัดอย่างง่ายและมีความปลอดภัย การเดินทดสอบ 6 นาทีจะดำเนินการอย่างใกล้ชิดโดยผู้วิจัยหรือผู้ที่มีความรู้ทางการแพทย์ และมีการประเมินสภาพร่างกายก่อนการทดสอบทุกครั้ง โดยตรวจสอบประวัติอาการต่าง ๆ ที่อาจเป็นข้อห้ามสำหรับการทดสอบ การวัดชีพจร ความดันโลหิต การสังเกตและสอบถามอาการเหนื่อยหอบและอาการอ่อนเพลีย

ของท่าน ทั้งก่อนการทดสอบ ระหว่างการทดสอบ และหลังการทดสอบ

ผู้ร่วมวิจัยทุกท่านจะได้รับแบบสอบถาม วัดความแข็งแรงกล้ามเนื้อต้นขา วัดการเหยียดข้อข้อเข่า และทดสอบสมรรถภาพทางกาย ทุก 4 สัปดาห์ อีก 3 ครั้ง รวมทั้งหมด 4 ครั้ง หลังจากการทดสอบ ๑ ครั้งแรก ผู้ร่วมวิจัยที่อยู่ในชุมชนกลุ่มทดลองจะเข้าร่วมกิจกรรมของโครงการ ๑ เป็นเวลา 12 สัปดาห์ สัปดาห์ละ 2 ครั้ง โดยผู้วิจัยเป็นผู้ดำเนินการเองทั้งหมด ซึ่งประกอบด้วย กิจกรรมกลุ่มเพื่อให้ความรู้และปรึกษาปัญหาเกี่ยวกับอาการของข้อเข่าเสื่อม การปฏิบัติตัวที่เหมาะสม และการออกกำลังกายด้วยจักรยานสำหรับผู้ที่มีอาการของโรคข้อเข่าเสื่อม

สำหรับผู้ร่วมวิจัยกลุ่มควบคุม ท่านสามารถดำเนินกิจวัตรประจำวันตามปกติตลอดระยะเวลา 12 สัปดาห์ของโครงการ ๑ โดยผู้วิจัยจะติดต่อกับท่านในสัปดาห์ที่ 4 สัปดาห์ที่ 8 และ สัปดาห์ที่ 12 เพื่อเชิญท่านร่วมตอบแบบสอบถาม วัดความแข็งแรงกล้ามเนื้อต้นขา วัดการเหยียดข้อข้อเข่า และทดสอบสมรรถภาพทางกาย เช่นเดียวกันกับกลุ่มทดลอง ทั้งนี้ ผู้วิจัยจะจัดให้ท่านเข้าร่วมกิจกรรมการออกกำลังกายแบบแอโรบิกสำหรับผู้ที่มีอาการของโรคข้อเข่าเสื่อมหลังจากที่สิ้นสุดโครงการวิจัยแล้ว

หากท่านสนใจเข้าร่วมกิจกรรมของโครงการ ๑ โปรดลงนามยินยอมในแบบฟอร์มยินยอมร่วมการวิจัย ที่แนบมาพร้อมกันนี้ และหากท่านมีคำถามเพิ่มเติมเกี่ยวกับการวิจัยหรือต้องการข้อมูลเพิ่มเติม ท่านสามารถติดต่อผู้วิจัยได้ตามที่อยู่และโทรศัพท์ที่ให้ไว้ในเอกสารฉบับนี้

ด้วยความขอบคุณอย่างยิ่ง

นางสาวทัศนีย์ รวีวรกุล, วท.ม. (สาธารณสุขศาสตร์) เอกการพยาบาลสาธารณสุข

นักศึกษาปริญญาเอกสาขาการพยาบาล, ผู้วิจัย

คณะแพทยศาสตร์โรงพยาบาลรามาธิบดี มหาวิทยาลัยมหิดล

โทรศัพท์ 01-6488124

APPENDIX G

Informed Consent Form

Title: The Effectiveness of a Community-based Exercise Program on Self-efficacy and Outcome Expectations for Exercise, Severity of Knee Symptoms, and Physical Performance in Thai Women with Osteoarthritis of the Knee

Date month Year 2005

I have received all details of procedures conducted in this study as well as any potential risk and benefit for me from the investigator. I clearly understand and am willing to participate in this study. I understand and that I can ask the investigator whenever I have any question. Also, I understand that I am free to withdraw from this study at anytime without penalty. Additionally, I understand that the investigator will protect my personal identifying information against disclosure to the public. Only results reported, as a group, will be presented to the public. The disclosure of my personal identifying information to allied agencies will be permitted only for the academic purpose.

I understand that the researcher will hold her responsibility whether I have any harm or impairment from the study. In addition, the researcher will disclose any information influencing the study to me.

I have had clearly explained all of the details in this study and commit to participate with my signature in the space at the end of this consent form.

Signature (Participant)

..... (Witness)

..... (Witness)

แบบฟอร์มใบยินยอมให้ทำการวิจัยในมนุษย์

การวิจัยเรื่อง ประสิทธิภาพของโปรแกรมการออกกำลังกายต่อความสามารถตนเองต่อการออกกำลังกาย
ความคาดหวังในผลลัพธ์ของการออกกำลังกาย ความรุนแรงของอาการปวดเข่า และสมรรถภาพทางกาย
ของสตรีไทยที่มีอาการของโรคข้อเข่าเสื่อม

วันที่ทำยินยอม วันที่ เดือน พ.ศ. 2548

ก่อนที่จะลงนามในใบยินยอมให้ทำการวิจัยนี้ ข้าพเจ้าได้รับการอธิบายจากผู้วิจัยถึง
วัตถุประสงค์ของการวิจัย วิธีการวิจัย อันตราย หรืออาการที่อาจเกิดขึ้นจากการวิจัย รวมทั้งประโยชน์
ที่จะเกิดขึ้นจากการวิจัยอย่างละเอียด และมีความเข้าใจดีแล้ว

ผู้วิจัยรับรองว่าจะตอบคำถามต่าง ๆ ที่ข้าพเจ้าสงสัยด้วยความเต็มใจ ไม่ปิดบัง ซ่อนเร้น จน
ข้าพเจ้าพอใจ

ข้าพเจ้ามีสิทธิที่จะบอกเลิกการเข้าร่วมในโครงการวิจัยนี้โดยสมัครใจ และการบอกเลิกการ
เข้าร่วมวิจัยนี้ จะไม่มีผลต่อการรักษาโรคที่ข้าพเจ้าจะพึงได้รับต่อไป

ผู้วิจัยรับรองว่าจะเก็บข้อมูลเฉพาะเกี่ยวกับตัวข้าพเจ้าเป็นความลับและจะเปิดเผยได้เฉพาะใน
รูปที่เป็นผลสรุปการวิจัย การเปิดเผยข้อมูลเกี่ยวกับตัวข้าพเจ้าต่อหน่วยงานต่าง ๆ ที่เกี่ยวข้อง กระทำได้
เฉพาะกรณีที่เกิดเป็นด้วยเหตุผลทางวิชาการเท่านั้น

ผู้วิจัยรับรองว่าหากเกิดอันตรายใด ๆ อันเนื่องจากการวิจัยดังกล่าว ข้าพเจ้าจะได้รับการ
รักษาพยาบาลโดยไม่คิดมูลค่าตามมาตรฐานวิชาชีพ และจะได้รับการชดเชยรายได้ที่สูญเสียไประหว่าง
การรักษาพยาบาลดังกล่าว ตลอดจนเงินทดแทนความพิการที่อาจเกิดขึ้น

ผู้วิจัยรับรองว่าหากมีข้อมูลเพิ่มเติมที่ส่งผลกระทบต่อการศึกษา ข้าพเจ้าจะได้รับการแจ้งให้
ทราบโดยไม่ปิดบังซ่อนเร้น

ข้าพเจ้าได้อ่านข้อความข้างต้นแล้ว และมีความเข้าใจดีทุกประการ และได้ลงนามในใบ
ยินยอมนี้ด้วยความเต็มใจ

ลงนาม ผู้ยินยอม

ลงนาม พยาน

ลงนาม พยาน

ข้าพเจ้าไม่สามารถอ่านหนังสือได้ แต่ผู้วิจัยได้อ่านข้อความในใบยินยอมนี้ให้ข้าพเจ้าฟังจนเข้าใจ
ดีแล้ว และข้าพเจ้าได้ลงนามหรือประทับลายนิ้วหัวแม่มือขวาของข้าพเจ้าในใบยินยอมนี้ด้วยความเต็มใจ

ลงนาม ผู้ยินยอม

ลงนาม พยาน

ลงนาม พยาน

APPENDIX H

General Information Teaching Plan

Participants : Thai women with osteoarthritis of the knee

Duration : 30 minutes

Purpose : To provide general information regarding osteoarthritis of the knee and to provide information regarding benefits of exercise on symptoms related to osteoarthritis of the knee

Procedure

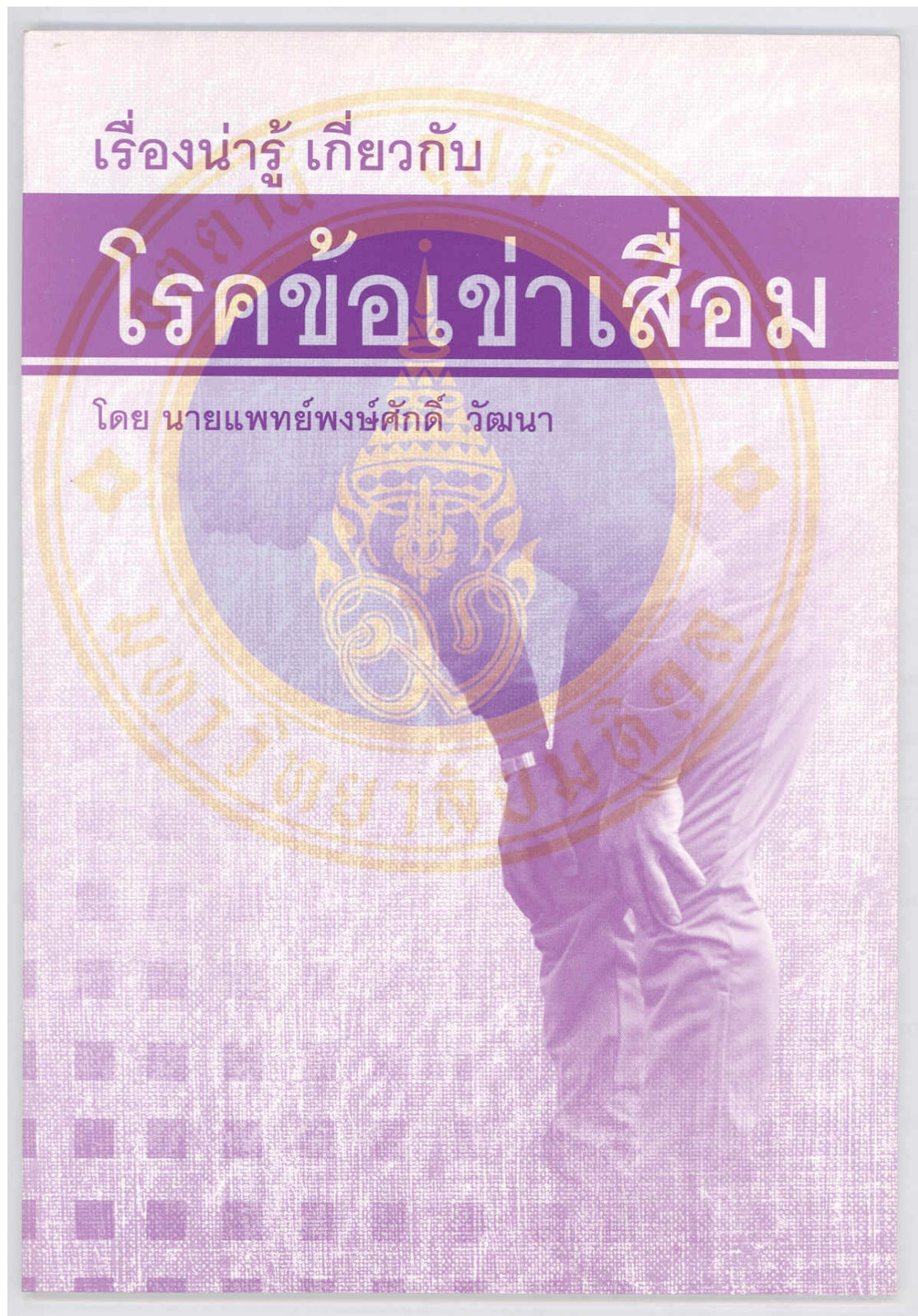
1. The researcher provides general information regarding osteoarthritis of the knee by using a set of flipchart. The information includes causes of the disease, treatments and cares when experiencing knee pain, and preventing the progress of the disease or the increase of knee pain.
2. The researcher provides a handbook of “Osteoarthritis of the knee” written by Phongsak Wattana (B.E.2545) to all participants after completion of the session.

Teaching Plan:

Objective	Content	Activity	Instruments	Evaluation
- Understand the meaning of osteoarthritis of the knee, causes, signs and symptoms, and treatments		- Lecture - Questions and answers	- Flipchart - Audio-visual aids, e.g., microphone	- Observations and questions from the participants
- Understand what and how to do when experiencing knee pain, and avoid the activities or posture which may cause knee pain		- Lecture & problem-based learning - Demonstration	- Flipchart or slide - Audio-visual aids	- Observations and return demonstration - Participants' comments and conclusion
- Understand how to perform safe exercise, role of quadriceps muscle in physical activities, and benefits of exercise when having knee osteoarthritis		- Demonstration and exercise practice	- Flipchart or slide - Audio-visual aids	- Observations and return demonstration - Participants' comments and conclusion

APPENDIX I

Handbook Regarding Osteoarthritis of the Knee



APPENDIX J

Community-Based Exercise Program Sessions Plan

(แผนการจัดกิจกรรมโปรแกรมการออกกำลังกายสำหรับผู้ที่มีอาการของโรคข้อเข่าเสื่อม)

ชื่อเรื่อง: การออกกำลังกายโดยใช้จักรยานออกกำลังกายสำหรับผู้ที่มีอาการของโรคข้อเข่าเสื่อม

การวิจัยเรื่อง: ประสิทธิภาพของโปรแกรมการออกกำลังกาย ต่อความสามารถตนเองและความคาดหวังในผลลัพธ์ของการออกกำลังกาย ความรุนแรงของอาการปวดเข่า และสมรรถภาพทางกายของสตรีไทยที่มีอาการของโรคข้อเข่าเสื่อม

ครั้งที่ 1

วัตถุประสงค์ทั่วไป : เพื่อให้ผู้ร่วมกิจกรรมมีความเข้าใจที่ถูกต้องเกี่ยวกับโรคข้อเข่าเสื่อม การออกกำลังกาย และการบริหารกล้ามเนื้อต้นขาที่เหมาะสม

วัตถุประสงค์เฉพาะ : หลังการร่วมกิจกรรม ผู้เข้าร่วมกิจกรรมสามารถ

ก)

ข)

ค)

อุปกรณ์ : จักรยานออกกำลังกายแบบอยู่กับที่, เก้าอี้มีพนักพิงสำหรับนั่ง, เครื่องขยายเสียง, เทปเพลง และเครื่องเล่นเทปเพลง, น้ำดื่ม

ระยะเวลา : 1 ชั่วโมง

วิธีการ : 1. ชี้แจงวัตถุประสงค์ของกิจกรรม

2. สร้างสัมพันธภาพ

3.

การประเมินผล:

1. ...

2. ...

3. ...

ครั้งที่ 8, 16, 24

วัตถุประสงค์ทั่วไป: ...

วัตถุประสงค์เฉพาะ: ...

อุปกรณ์: ...

ระยะเวลา: 1 ชั่วโมง

วิธีการ: ผู้วิจัย นัดผู้ร่วมกิจกรรมเพื่อตอบแบบสอบถามความสามารถตนเอง ความคาดหวังในผลของการออกกำลังกาย และความรุนแรงของโรคข้อเข่าเสื่อม โดยการสัมภาษณ์ และทดสอบสมรรถนะร่างกาย (6MWT, quadriceps muscle strength test, range of motion of the knee assessment).

การประเมินผล: และ ผลการทดสอบสมรรถนะร่างกายและแบบสอบถาม

APPENDIX K

Stationary Cycling Exercise Protocol for People with Osteoarthritis of the Knee

Duration: 30 minutes in average

Content: 1. Warm-up 5-10 minutes
2. Aerobic exercise 15-20 minutes
3. Cool down & stretching 5-10 minutes

Procedure:

1. Checking pulse rate before beginning exercise. May apply POLAR, a heart rate monitor, for heart rate monitoring during cycling exercise.

2. Getting on a stationary cycling machine. Adjust the seat height to fit each participant. Do not allow over 10 degree of knee flexion at the lowest point of the rotation of the pedal. The handlebars should be adjusted to allow for a comfortable forward-leaning position.

3. Warm-Up: Begin pedaling at a moderate pace of 40 rounds per minute (rpms) with no tension for 5 minutes.

4. Cycling exercise: Ask the participant to rate the Borg scale for her shortness of breath or fatigue. Start the stationary cycling exercise by increasing the pedaling rate to 60 rpms. Add tension, beginning with level 1, to create a smooth pedaling motion if required for the forthcoming sessions. Try to maintain this level continuously for 15 minutes. Pause and rest, if necessary.

4.1) For low aerobic capacity participants, measured by the distance of the 6-Minute Walk Test, intensity should begin at 50% of maximum heart rate and progress to 55% to 60% in the forthcoming week.

4.2) For moderate and higher aerobic capacity participants, intensity will begin at 55% and progress to 60% to 70%, but not over than 75% of maximum heart rate. Both low and high aerobic capacity participants will progressively increase intensity by adding tension on the pedal with maximum speed not over 60 rpms. In addition, each participant will not work out over 75% of her maximum heart rate.

5. Cool down: After exercise, begin to cool down by slowing the pedal rate and decreasing the tension for 2-5 minutes.

6. Stretching:

a) Getting of the cycling machine. Slightly kick out left and right leg, repeatedly 2-3 times.

b) Chest and arm stretch: At standing position with feet about shoulder-width apart, extend both arms behind and clasp hands together. Retract shoulders if possible. Hold the stretch for a slow count of 20 to 30 seconds, breathing throughout.

c) Hamstring/calf stretch: By facing a sturdy chair, stand upright and slowly bend forward at the hip. Making sure that the legs are straight without locking the knees. Rest both hand on the seat of the chair with slightly bending elbows, feeling a stretch in the back of thighs and legs if you have a straight back. Hold the stretch for a slow count of 20 to 30 seconds, breathing throughout.

d) Quadriceps stretch: By standing next to a sturdy chair, hold a chair for balance with left hand. Bend the right leg back and grab right ankle or keep the leg as close to perpendicular as possible and hold the bend, feeling a stretch in the front of the right thigh. Hold the stretch for a slow count of 20 to 30 seconds, breathing throughout. Repeat again with the left thigh.

e) Neck, upper back, and shoulder stretch: Stand (or sit) with both feet shoulder-width apart, keeping knees straight but not locked. Clasp both hands, with straight arms at the front in a waist-high position. Rotate the hands so that the palms face the ground. Then, raise both hands to about chest height. Press palms away with head slightly bend (chin close to the chest) and feel a stretch at the neck, upper back, and along the shoulders. Hold the stretch for a slow count of 20 to 30 seconds, breathing throughout.

7. Relaxation: Stand (or sit) with both feet shoulder-width apart, deep breath deeply and slowly exhale two to three times.

ข้อมูลส่วนบุคคล

ชื่อผู้ตอบแบบสอบถาม
 ที่อยู่ โทรศัพท์

ส่วนที่ 1 ข้อมูลทั่วไป

- | | | | |
|--------------------------------------|--|---------------------|-------------------------------|
| 1. สถานภาพสมรส | 1. โสด | 2. คู่ | 3. หม้าย/ หย่า/ แยก |
| 2. ศาสนา | 1. พุทธ | 2. คริสต์ | 3. อิสลาม 4. อื่นๆ ระบุ |
| 3. สถานภาพในครอบครัว | 1. หัวหน้าครอบครัว | 2. สมาชิกในครอบครัว | |
| | 3. อื่นๆ ระบุ | | |
| 4. ระดับการศึกษาสูงสุด | 1. ประถม | 2. มัธยม | 3. อนุปริญญา |
| | 4. ปริญญาตรี | 5. สูงกว่าปริญญาตรี | 6. ไม่ได้เรียน |
| 5. ปัจจุบันประกอบอาชีพ | | | |
| 6. ถ้าไม่ได้ประกอบอาชีพ | อาชีพสุดท้าย ที่ทำคือ | | |
| 7. รายได้เฉลี่ยต่อเดือน | บาท | | |
| 8. แหล่งของรายได้ | 1. การประกอบอาชีพของตนเอง 2. บำนาญ/เงินออม | | |
| | 3. สมาชิกในครอบครัว บุตรหลาน 4. อื่นๆ ระบุ | | |
| 9. ความเพียงพอของรายได้กับค่าใช้จ่าย | 1. เพียงพอ 2. ไม่เพียงพอ | | |

ส่วนที่ 2 ข้อมูลเกี่ยวกับอาการปวดเข่า

- | | | | |
|---|------------------|------------|----------------|
| 10. ท่านมีอาการปวดข้อเข่า | 1. ข้างซ้าย | 2. ข้างขวา | 3. ทั้งสองข้าง |
| 11. อาการปวดข้อเข่า ของท่านมากแค่ไหน (คะแนนความปวดจาก 0 ถึง 10) | | | |
| ไม่ปวดเลย | ปวดมากจนทนไม่ไหว | | |
| 0 | 1 | 2 | 3 |
| 4 | 5 | 6 | 7 |
| 8 | 9 | 10 | |
| 12. ปัจจุบันท่านใช้ยาเพื่อรักษาอาการปวดข้อเข่า | 1. ใช่ 2. ไม่ใช่ | | |
| โปรดระบุชนิดและขนาดที่ใช้ | | | |

ส่วนที่ 3 ข้อมูลเกี่ยวกับสุขภาพและการออกกำลังกาย

- | | | | |
|---|----------------------|-----------|--|
| 13. ปัจจุบันท่านสูบบุหรี่ | 1. ใช่ | 2. ไม่ใช่ | |
| ท่านสูบบุหรี่ วันละ มวน หรือ ซอง นาน ปี | | | |
| 14. ท่านเคยสูบบุหรี่ | 1. ใช่ | 2. ไม่ใช่ | |
| ท่านเคยสูบบุหรี่ วันละ มวน หรือ ซอง นาน ปี | | | |
| 15. ท่านมีโรคประจำตัวอื่น ๆ เช่น โรคหัวใจ โรคปอด ความดันโลหิตสูง เบาหวาน ไทรอยด์ | | | |
| เส้นเลือดสมองตีบ โรคไต หรือ โรคประจำตัวอื่น ๆ (โปรดระบุ) | | | |
| การรักษา และยาที่ใช้ประจำ | | | |
| 16. แพทย์ห้ามไม่ให้คุณออกกำลังกาย เนื่องจากท่านมีโรคประจำตัว | 1. ใช่ | 2. ไม่ใช่ | |
| 17. ท่านเคยมีอาการเวียนศีรษะ มึนงง | 1. ใช่ | 2. ไม่ใช่ | |
| 18. ท่านเคยเข้าพักรักษาตัวในโรงพยาบาล หรือ ได้รับการผ่าตัด | 1. ใช่ | 2. ไม่ใช่ | |
| ถ้าเคย โปรดระบุวันเดือนปีที่อยู่โรงพยาบาล / ผ่าตัด | | | |
| สาเหตุ | | | |
| 19. สมาชิกในครอบครัว หรือญาติพี่น้องของท่าน มีอาการปวดข้อหรือข้อเสื่อมบ้างหรือไม่ | | | |
| 1. ไม่มี | 2. มี โปรดระบุ | | |

2. Exercise Behavior Questionnaire

We would like to know about your exercise patterns last week.

For this study moderate exercise includes activities such as Tai Kek (Tai Chi), aerobic exercise, stationary bicycling, brisk walking, weight lifting, and swimming or exercise in the water.

Directions: Please circle the answer that best applies you.

1. What type of moderate exercise did you do last week?

- | | |
|-------------------------|--------------------------------------|
| a. None | e. Brisk walking |
| b. Tai Kek (Tai Chi) | f. Weight lifting |
| c. Aerobic exercise | g. Swimming or exercise in the water |
| d. Stationary bicycling | h. Other, please specify |

2. Last week, how many days did you engage in at least moderate exercise?

- | | |
|---------------|---------------------------------|
| a. None | c. Every other day (3 - 4 days) |
| b. 1 - 2 days | d. Everyday |

3. Last week, on average, how long did you exercise moderately each day?

- | | |
|------------------------------|-------------------------|
| a. I did not exercise at all | c. Half an hour |
| b. 15 minutes | d. More than 45 minutes |

แบบประเมินพฤติกรรมการออกกำลังกาย

การออกกำลังกายระดับปานกลาง หมายถึง ไทเก๊ก (ไทชิ), แอโรบิค, ปั่นจักรยานอยู่กับที่, เดินเร็ว, ยกน้ำหนัก, ว่ายน้ำหรือออกกำลังกายในน้ำ

คำชี้แจง: โปรดวงกลมรอบหัวข้อที่ตรงกับความเป็นจริงมากที่สุดเกี่ยวกับการออกกำลังกายของท่าน

1. เมื่อสัปดาห์ที่แล้ว ท่านออกกำลังกายระดับปานกลางในรูปแบบใด

.
. .
.

2. เมื่อสัปดาห์ที่แล้ว ท่านออกกำลังกายระดับปานกลางเป็นเวลากี่วัน

.
. .
.

3. เมื่อสัปดาห์ที่แล้ว โดยเฉลี่ยท่านออกกำลังกายระดับปานกลางเป็นเวลาวันละกี่นาที

.
. .
.

3. Severity of the Disease Scale-Modified Version

Instruction: The following items refer to severity of knee symptoms related to osteoarthritis of the knee. Please **circle** the answer that most closely **describes symptoms of your knee(s)** right now.

1. Duration of knee pain
 - a) Less than a year
 - b) 1 to 5 years
 - c) More than 5 years
2. Frequency of knee pain
 - a) Rarely having pain
 - b) Less than 3 times in the past week
 - c) All the time
- ...
- ...
- ...
10. Cane using
 - c) No
 - d) Sometimes use
 - c) Always use

การประเมินความรุนแรงของโรคข้อเข่าเสื่อม

คำชี้แจง: ข้อความต่อไปนี้กล่าวถึงความรุนแรงของโรคข้อเข่าเสื่อม
โปรด วงกลม รอบหัวข้อที่ตรงกับความเป็นจริงมากที่สุด

1. ระยะเวลาที่ปวดเข่า

ก) น้อยกว่า 1 ปี	ข) ตั้งแต่ 1 ถึง 5 ปี
ค) มากกว่า 5 ปีขึ้นไป	
2. ความถี่ของการปวดข้อเข่า

ก) ปวดนาน ๆ ครั้ง	ข) ปวดน้อยกว่า 3 ครั้ง ใน 1 สัปดาห์
ค) ปวดตลอดเวลา	
3. อาการบวม แดง ร้อน ที่ข้อเข่า

ก) ไม่มีอาการ	ข) มีอาการเล็กน้อย
ค) มีอาการมาก	
- ...
- ...
- ...
10. การใช้ไม้เท้า

ก) ไม่ได้ใช้	ข) ใช้เป็นบางครั้ง
ค) ใช้ตลอดเวลา	

4. Self-Efficacy for Exercise Scale

The following items are situations that causing you not to exercise.

Please identify that how confident are you to continue exercising under these situations by choosing the number from 0 to 10.

How confident are you right now that you could exercise three times per week for 20 minutes if:

	Not confident		Very confident
1. The weather was bothering your joint	0	1 2 3 4 5 6 7 8 9	10
2. You were bored by the program or activity	0	1 2 3 4 5 6 7 8 9	10
3. You felt pain when exercising	0	1 2 3 4 5 6 7 8 9	10
4. You had to exercise alone	0	1 2 3 4 5 6 7 8 9	10
5. You did not enjoy it	0	1 2 3 4 5 6 7 8 9	10
6. You were too busy with other activities	0	1 2 3 4 5 6 7 8 9	10
7. You felt tired	0	1 2 3 4 5 6 7 8 9	10
8. You felt stress	0	1 2 3 4 5 6 7 8 9	10
9. You felt depressed	0	1 2 3 4 5 6 7 8 9	10

แบบวัดความสามารถตนเองต่อการออกกำลังกาย

คำชี้แจง : ข้อความต่อไปนี้ คือสถานการณ์อันแสดงถึงเหตุผลโดยรวมที่ไม่ออกกำลังกาย

โปรดระบุว่า ปัจจุบัน ท่านมีความมั่นใจเพียงใดในการออกกำลังกาย ภายใต้สถานการณ์ต่างๆ

ดังต่อไปนี้ โดย เลือกหมายเลข จาก 0 ถึง 10

ปัจจุบัน ท่านมีความมั่นใจเพียงใดต่อการออกกำลังกาย ครั้งละ 20 นาที เป็นเวลา 3 ครั้งต่อสัปดาห์

	ไม่มั่นใจ	0	1	2	3	4	5	6	7	8	9	10	มั่นใจเต็มที่
1. หากท่านต้องเผชิญกับอากาศที่ รบกวนต่อข้อ (เช่น อากาศเย็น)		0	1	2	3	4	5	6	7	8	9	10	
2. หากท่านรู้สึกเบื่อหน่ายต่อโปรแกรม การออกกำลังกาย		0	1	2	3	4	5	6	7	8	9	10	
3. หากท่านรู้สึกเจ็บปวดขณะออกกำลังกาย (เช่น ปวดเมื่อยกล้ามเนื้อ)		0	1	2	3	4	5	6	7	8	9	10	
.													
.													
.													
9. หากท่านรู้สึกเศร้าซึม ไม่แจ่มใส		0	1	2	3	4	5	6	7	8	9	10	

5. Outcome Expectations for Exercise Scale

Instruction: These items regards to benefits of exercise

Please identify your agreement or disagreement to these benefits that exercise:

	Strongly agree					Strongly disagree
1. Makes me feel better physically	5	4	3	2	1	
2. Makes my mood better in general	5	4	3	2	1	
3. Helps me feel less tired	5	4	3	2	1	
4. Makes my muscles stronger	5	4	3	2	1	
5. Is an activity I enjoy doing	5	4	3	2	1	
6. Gives me a sense of personal accomplishment	5	4	3	2	1	
7. Makes me more alert mentally	5	4	3	2	1	
8. Improves my endurance in performing my daily activities	5	4	3	2	1	
9. Helps to strengthen my bones	5	4	3	2	1	

แบบวัดความคาดหวังในผลลัพธ์ของการออกกำลังกาย

คำชี้แจง : ข้อความต่อไปนี้กล่าวถึงประโยชน์ของการออกกำลังกาย

โปรดระบุว่าท่าน เห็นด้วย หรือ ไม่เห็นด้วย กับข้อความดังกล่าว

	เห็นด้วยอย่างยิ่ง			ไม่เห็นด้วยอย่างยิ่ง		
1. การออกกำลังกายทำให้ข้าพเจ้ารู้สึกกระฉับกระเฉงขึ้น	5	4	3	2	1	
2. การออกกำลังกายทำให้รู้สึกอารมณ์ดี	5	4	3	2	1	
3. การออกกำลังกายทำให้รู้สึกเหนื่อยน้อยกว่าเดิม	5	4	3	2	1	
9. การออกกำลังกายช่วยให้กระดูกแข็งแรง	5	4	3	2	1	

6. Six-Minute Walk Test Record Form

Before walk test

Age Years

Weight..... Kg. Height..... Cm

Pulse per min Respiratory.... per min Blood presser / mm Hg

Regularly **Yes** **No**

Medication used today.....dose time

Level of **shortness of breath**.....Level of **fatigue**.....

stop (number/duration)	lap	Number of strides	time (min: sec)	stop (number/duration)	lap	Number of strides	time (min: sec)
	1				9		
	2				10		
	3				11		
	4				12		
	5				13		
	6				14		
	7				15		
	8				16		

At the 6th min (completion of the test)

Pulse..... per minute Respiratory (RR).... per minute

Level of **shortness of breath** Level of **fatigue** Other symptoms: ...Chest pain ...Dizziness Hip pain ...Leg pain Cuff
pain

At the 7th min

Pulse..... per minute

At the 8th min

Pulse..... per minute

At the 9th min

Pulse per minute

At the 10th min

Pulse..... per minute RR per min

Total distance in 6 minutes:

Number of lap..... (x 30 meters) + distance of the last lap (.....meters) = ... meters

Number of strides

Average length meters per stride

Speed (length÷ 6) = ...meters per minute

แบบบันทึกการเดินทดสอบ 6 นาที

ก่อนเริ่มการทดสอบ

อายุ ปี น้ำหนัก กก. ส่วนสูง ซม.

ชีพจร ครั้ง/นาที (.....ส่วาเสมอ) หายใจ ครั้ง/นาที ความดันโลหิต / มม.ปรอท

ยาที่รับประทานในวันนี้ ขนาด เวลาที่รับประทานยา

อาการหอบเหนื่อยก่อนการทดสอบ อาการอ่อนเพลียก่อนการทดสอบ

หยุดเดิน (ครั้ง,วินาที)	รอบที่	จำนวนก้าว	เวลา (นาที: วินาที)	หยุดเดิน (ครั้ง,วินาที)	รอบที่	จำนวนก้าว	เวลา (นาที: วินาที)
	1				9		
	2				10		
	3				11		
	4				12		
	5				13		
	6				14		
	7				15		
	8				16		

นาทีที่ 6 (สิ้นสุดการทดสอบ)

ชีพจร ครั้ง/นาที หายใจ ครั้ง/นาที

อาการหอบเหนื่อยหลังการทดสอบ อาการอ่อนเพลียหลังการทดสอบ

อาการอื่น ๆ เจ็บแน่นหน้าอก มึนงง ปวดสะโพก ปวดขา ปวดน่อง

..... อื่น ๆ (ระบุ)

นาทีที่ 7

ชีพจร ครั้ง/นาที

นาทีที่ 8

ชีพจร ครั้ง/นาที

นาทีที่ 9

ชีพจร ครั้ง/นาที

นาทีที่ 10

ชีพจร ครั้ง/นาที หายใจ ครั้ง/นาที

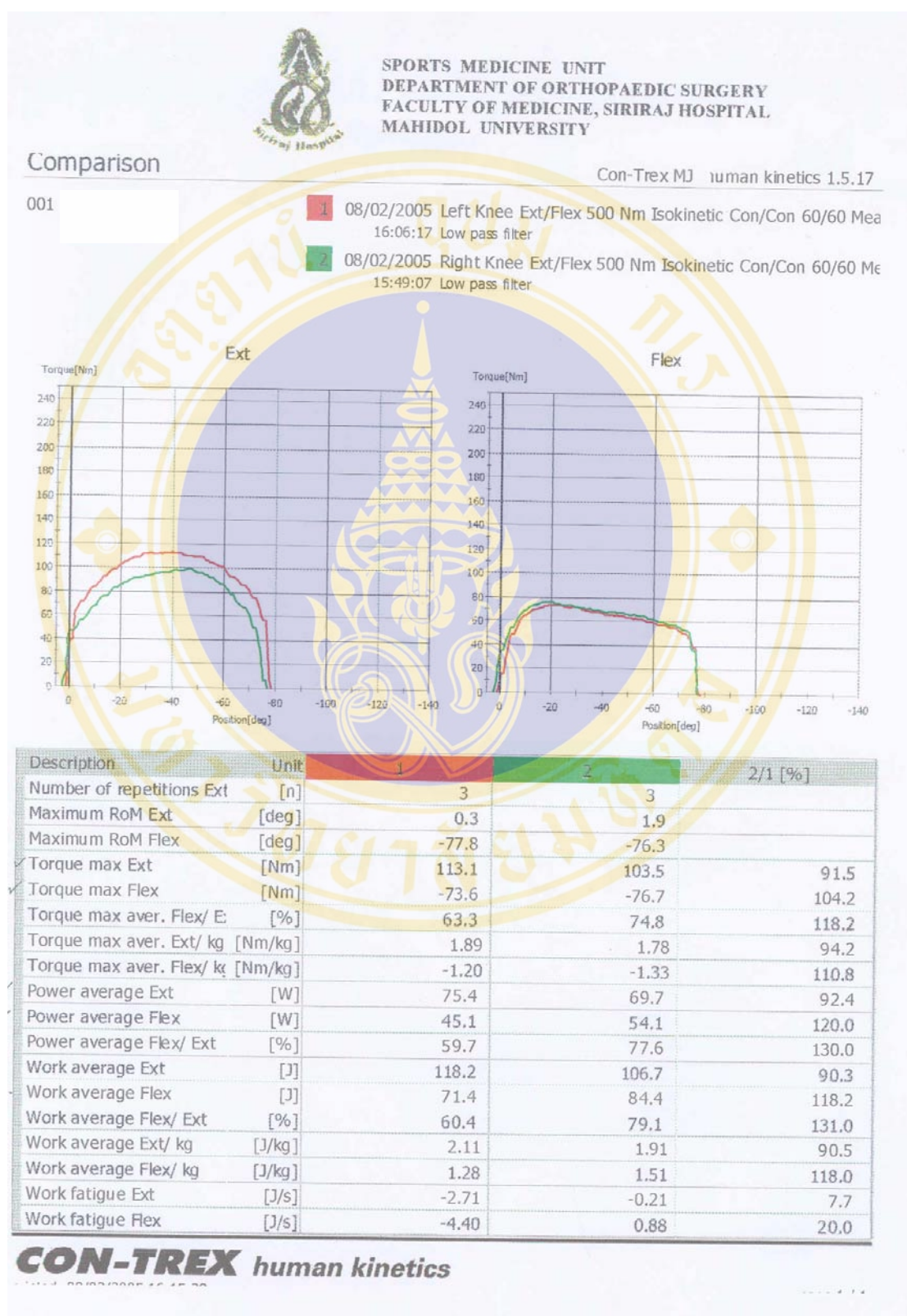
จำนวนรอบที่เดิน (x 30 ม.) + ระยะทางที่เดินในรอบสุดท้าย (.....ม.) เท่ากับ เมตร

รวมระยะทางที่เดินใน 6 นาที เมตร

จำนวนก้าว ก้าวระยะเฉลี่ย เมตร ต่อก้าว

ความเร็ว เท่ากับ (ระยะทาง.....หารด้วย 6) เมตร ต่อนาที

7. Isokinetic Muscle Strength Testing Report



8. Range of Motion Assessment Form

[illegible]

APPENDIX M

6-Minute Walk Test protocol

Objective: to assess physical performance and cardiovascular fitness

Safety issues:

- 1) Testing should be performed in a location where a rapid, appropriate response to an emergency is possible, e.g., near a hospital or a health center. A telephone or other means should be in place to enable a call for help.
- 2) Participants should be asked to bring all their medication on the day of testing.
- 3) The assessor/investigator should be certified in cardiopulmonary resuscitation with a minimum of Basic Life Support. A certified individual should be readily available to respond if needed.

Contraindication:

- Unstable angina or myocardial infarction during the previous month
- Resting heart rate over 120 per minute
- Systolic blood pressure more than 180 mm Hg
- Diastolic blood pressure more than 100 mm Hg

Reasons for immediately stopping a 6MWT include the following:

- a) Chest pain,
- b) Intolerable dyspnea,
- c) Leg cramps,
- d) Staggering,
- e) Diaphoresis, and
- f) Pale or ashen appearance.

If a test is stopped for any of these reasons, the patient should sit or lie supine as appropriate depending on the severity of the event and the technician's assessment of the severity of the event and the risk of syncope.

Do not leave the patient alone!

The following should be obtained based on the judgment of the assessor/ investigator:

- Blood pressure, pulse rate, respiratory rate, and *oxygen saturation (optional)*
- Make a telephone call for emergency and/or refer to a hospital or a health center for physician evaluation if the symptoms do not getting better.

The walking course must be 30 m in length. A 100-ft hallway is, therefore, required. The length of the corridor should be marked every 3 m. The turnaround points should be marked with a cone (such as an orange traffic cone). A starting line, which

marks the beginning and end of each 60-m lap, should be marked on the floor using brightly colored tape.

Required equipment:

- 1) Countdown timer (or stopwatch)
- 2) Two small cones to mark the turnaround point
- 3) A chair that can be easily moved along the walking course
- 4) Worksheets on a clipboard
- 5) Sphygmomanometer
- 6) Telephone

Patient preparation:

- a) Comfortable clothing should be worn.
- b) Appropriate shoes for walking should be worn.
- c) Patients should use their usual walking aids during the test (cane, walker, etc.)
- d) The patient's usual medical regimen should be continued.
- e) A light meal is acceptable before early morning or early afternoon tests.
- f) Patients should not have exercised vigorously within 2 hours of beginning the test.

Measurements:

1. Repeat testing should be performed about the same time of day to minimize intraday variability.
2. A "warm-up" period before the test should not be performed.
3. The patient should sit at rest in a chair, located near the starting position, for at least 10 minutes before the test starts. During this time, check for contraindications, measure pulse and blood pressure, and make sure that clothing and shoes are appropriate. Complete the first portion of the worksheet.
4. Have the patient stand and rate their baseline dyspnea and overall fatigue using the Borg scale
5. Instruct the patient as follows:

“The object of this test is to walk as far as possible for 6 minutes. You will walk back and forth in this hallway. Six minutes is a long time to walk, so you will be exerting yourself.

You will probably get out of breath or become exhausted. You are permitted to slow down, to stop, and to rest as necessary. You may lean against the wall while resting, but resume walking as soon as you are able. You will be walking back and forth around the cones. You should pivot briskly around the cones and continue

back the other way without hesitation. Now I'm going to show you. Please watch the way I turn without hesitation."

Demonstrate by walking one lap yourself. Walk and pivot around a cone briskly.

"When the time reaches 6 minutes completion, I would say STOP. Please just stop right where you are and I will come to you."

"Are you ready to do that? I am going to use this counter to keep track of the number of laps you complete. I will click it each time you turn around at this starting line.

Remember that the object is to walk AS FAR AS POSSIBLE for 6 minutes, but don't run or jog. Start now, or whenever you are ready."

6. Position the patient at the starting line. You should also stand near the starting line during the test. Do not walk with the patient. As soon as the patient starts to walk, start the timer.
7. Do not talk to anyone during the walk. Use an even tone of voice when using the standard phrases of encouragement.
 - Watch the patient. Do not get distracted and lose count of the laps. Each time the participant returns to the starting line, mark the lap on the worksheet. Let the participant see you do it. Exaggerate the click using body language, like using a stopwatch at a race.
 - After the first minute, tell the patient the following (in even tones): "You are doing well. You have 5 minutes to go."
 - When the timer shows 4 minutes remaining, tell the patient the following: "Keep up the good work. You have 4 minutes to go."
 - When the timer shows 3 minutes remaining, tell the patient the following: "You are doing well. You are halfway done."
 - When the timer shows 2 minutes remaining, tell the patient the following: "Keep up the good work. You have only 2 minutes left."
 - When the timer shows only 1 minute remaining, tell the patient: "You are doing well. You have only 1 minute to go."
 - Do not use other words of encouragement (or body language to speed up).
 - If the patient stops walking during the test and needs a rest, say this: "You can lean against the wall if you would like; then continue walking whenever you feel able." Do not stop the timer.
 - If the patient stops before the 6 minutes are up and refuses to continue (or you decide that they should not continue), wheel the chair over for the patient to sit on, discontinue the walk, and note on the worksheet the distance, the time

stopped, and the reason for stopping prematurely.

- When the timer reaches 6 minutes, say this: “Stop!” Walk over to the patient. Consider taking the chair if they look exhausted. Mark the spot ON THE FLOOR where they stopped. (by placing a bean bag or a piece of tape)

8. Post-test: Record the post-walk Borg dyspnea and fatigue levels and ask this: “What, if anything, kept you from walking farther?”
9. Record the number of laps and strides they did (tick marks on the worksheet)
10. Calculate the total distance walked, rounding to the nearest meter, and record it on the worksheet.
11. Congratulate the patient on good effort and offer a drink of water.

THE BORG SCALE

The Borg scale should be printed on heavy paper (11 inches high and perhaps laminated) in 20-point type size. At the beginning of the 6-minute walk test, show the scale to the subject and ask “How much do you feel shortness of breath right now?” Then ask this: “How much do you feel fatigue right now?”

At the end of the exercise, remind the patient of the breathing number that they chose before the exercise and ask the patient to grade their breathing level again. Then ask the patient to grade their level of fatigue, after reminding them of their grade before the exercise.

Example:

How much do you feel shortness of breath right now?	
How much do you feel fatigue right now?	
Using this scale from 0 (nothing at all) to 10 (very, very severe)	
0	Nothing at all
1	Very slight
2	
3	
4	Somewhat
5	
6	
7	Very severe
8	
9	
10	Very, very severe (maximal)

APPENDIX N

Isokinetic Muscle Strength Testing

Muscle strength is the maximum pull or push exerted one time by a muscle group. In physiological terms, it is the greatest number of muscle fibers that can be voluntary innervated at one time. Isokinetic strength testing is measured when the optimal muscle strength allows the leg to be lifted 90 degrees so that the specific muscle groups are then evaluated against resistance.

Instrumentation

The CON-TREX human kinetics dynamometer, CMV AG, Switzerland, will be used to assess isokinetic muscle strength in this study. All participants will perform the test at the Sport Medicine Division, Department of Orthopedic Surgery, Faculty of Medicine Siriraj Hospital, Mahidol University.

Sitting Position

The participant sits on the adjustable chair with back fully supported at 75-degree hip flexion. The posterior aspect of the knee is positioned three-fingerbreadths in front of the seat to prevent popliteal vessels compression. A pair of shoulder straps is used to stabilize across the chest for decreasing trunk movement. The tested thigh was also secured with the chair by a thigh strap to prevent extraneous hip movement. The axis of rotation of the dynamometer was visually aligned with the prominent point of the lateral femoral condyle. The shin pad of the lever arm was positioned 2 inches anterior to the tibial crest proximal to the medial malleolus. The range of motion (ROM) of the lever arm was set at 75 degrees flexion and 15 degrees extension, which yield 60 degree actual knee movement.

System Setting

- a) Test speeds = 60 degrees per second (deg/sec)
- b) Test repetitions = 2 sets of 3 maximal repetitions
- c) Rest intervals during testing 30 seconds
- d) Joint angle or range of motion (ROM) was set at 75 degrees flexion and 15 degrees extension, with additional 5 degrees cushion end-stop, to yield actual

ROM at 60 degrees knee movement. Avoid full extension or hyperextension that causes serious joint injuries.

e) Minimum and maximum force or torque limits: minimum limit = 20 Newton-meter (Nm), maximum limit = 500 Nm. These limits have been set by the system default.

f) Gravity correction before testing: This correction is calculated by the system for the effect of limb weight on torque production.

Testing Procedure

For consistency with repeated testing, the same examiner should also perform subsequent testing for each participant at each test time. A script set of instructions will be given before the test by the examiner. Flow of the testing procedure is shown in Figure A.

a) To prevent muscle sprain and pain, all participants perform muscle stretching, especially legs and thighs (quadriceps, hamstring, and gastrocnemius muscles stretching). Stretching will be performed for 5 minutes or over both before and after the test.

b) Testing the uninvolved side first: The reasons are, a) it allows the subject to understand and perform the movement that is to be completed and decreases any apprehension, and b) it provides data for a bilateral comparison.

c) Warm-up: After setting the position of knee joint, participants underwent a warm-up session before each test to familiarize the participants with the velocity and resistance. First, participants were instructed to move the tested knee with a 30-second continuous passive movement (CPM) session, and then, perform five submaximal repetitions of knee flexion and extension. Thirty-second rest period was set after each warm-up session.

d) Testing: Participants were instructed to perform two sets of 3-repetitions maximal contraction of knee extension and flexion at 60 deg/sec with 30 seconds rest period after each test. Verbal encouragement to move the knee as hard and as fast as possible against the lever arm was performed.

e) Cool-down: Then, another 30-second CPM session was performed for cool-down.

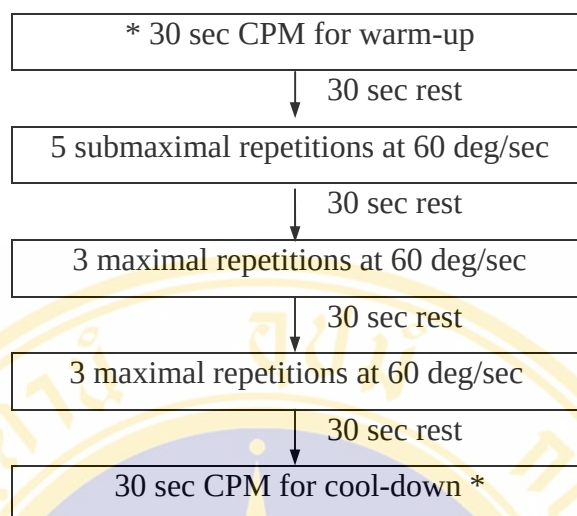


Figure A: The Isokinetic Muscle Strength Testing Procedure
* 5-minute muscle stretching

Parameters Measured

Three parameters will be recorded for isokinetic muscle strength each leg. These parameters are: (1) peak torque, (2) average power, and (3) total work.

Peak torque (PT) is the highest force that produce a rotation about a point or axis from all repetitions and all points in the ROM, usually measured in units of Newton-meters (Nm) or foot-pounds.

Average power (AP) is the total work divided by the time it takes to perform the work, usually reported in units of watts (W).

Total work (TW) is the total amount of work, force acting through a distance during the test, that is produced based on the number of repetitions. Total work is usually reported in units of Joules (J).

APPENDIX O

Range of Motion Measurement Protocol

A goniometer is a standard clear plastic 360 degree marked in one-degree against anatomical landmarks. It consists of a protractor with a moveable and a fixed arm being used as a direct measure of joint range of motion (ROM). The fulcrum of the goniometer is aligned with the axis of rotation of the joint to be measured and the arms placed parallel to the long axis of adjacent segments/external reference point. Electronic, metal and plastic goniometers are available which measure to 1 degree on the protractor. Measurement precision relies on correct location of anatomical landmarks and starting position. Intra- and inter-tester reliability may be increased by ensuring surface anatomy is accurate. Precise location of the center of rotation may be difficult in complex articulations.

The advantage of direct measurement is that it enables within and between subject comparison as segment proportions do not influence the results. The disadvantage of direct measurement is that precise location of anatomical segments and the center of joint rotation may vary between testers.

Differences in results gained from goniometer testing may be due to factors as follows: a) inconsistent placement of the goniometer; b) unfamiliarity of goniometer use; and c) low intertester reliability.

Advantages

1. The goniometer is relatively easy to use after sufficient instruction and practice.
2. The goniometer is easily calibrated against known angles.
3. The goniometer is small in size, approximately 31 x 13 cm.

In this study, a goniometer modified by the Faculty of Physical Therapy and Applied Movement Sciences, Mahidol University, was used to measure range of motion of the knee joint. This instrument consists of two arms, which measures angle in degree of range of motion on flexion and on lack of extension of the knee joint. Calibration was done by measuring a series of angles drawn using a protractor.

Knee extension range of motion measurement protocol

1. Participant is supine with upper limbs positioned by their side and foot in plantar grade.
2. The fulcrum of the goniometer is placed over the lateral epicondyle of the femur and the fixed arm aligned parallel with the leg using the tip of the lateral malleolus as a reference point. This may be used as a measurement of knee extension in participants whose knees do not hyperextend.
3. The participant is then asked to squeeze their quadriceps and push their knee down. The foot will then lift off the plinth, the moveable arm of the goniometer is aligned as above and the angle recorded.
4. Repeat for the contralateral lower limb.
5. A normal value for knee extension is 0° to 10°

Knee flexion range of motion measurement protocol

1. Participant is prone with the hip in neutral rotation and foot projecting off the end of the plinth. Upper limbs are placed by their side.
2. The fulcrum of the goniometer is placed over the lateral epicondyle of the femur and the fixed arm aligned parallel with the leg using the tip of the lateral malleolus as a reference point. This may be used as a measurement of extension in participants whose knees do not hyperextend.
3. The participants then flex their knee until maximal ROM is achieved.
4. At completion of the movement the moveable arm of the goniometer is linearly aligned as above and the angle recorded.
5. Repeat for the contralateral lower limb.
6. Normal value for knee flexion is 140°

APPENDIX P**Pearson Correlation Coefficient between Selected Variables
at Baseline (n=53)**

Variables	TRE	TLE	PRE	PLE	WRE	WLE
TRE	1					
	Sig. .					
TLE	.413	1				
	Sig. .002**	.				
PRE	.976	.388	1			
	Sig. .000**	.004**	.			
PLE	.406	.953	.386	1		
	Sig. .003**	.000**	.004**	.		
WRE	.976	.362	.995	.355	1	
	Sig. .000**	.008**	.000**	.009**	.	
WLE	.370	.974	.348	.981	.322	1
	Sig. .006**	.000**	.011*	.000**	.019*	.
* $p < .05$ ** $p < .01$						

Note: TRE = Right knee extension peak torque; TLE = Left knee extension peak torque;
 PRE = Right knee extension average power; PLE = Left knee extension average power;
 WRE = Right knee extension total work; WLE = Left knee extension total work

Variables	Age	Height	BMI	SEE	OEE	M-SEV	6MWD	TRE	TLE	ROM-RF	ROM-LF	ROM-RE	ROM-LE
Age	1												
Height	Sig. -.340	1											
BMI	Sig. .013*		1										
SEE	Sig. -.076			1									
OEE	Sig. .589				1								
M-SEV	Sig. .065					1							
6MWD	Sig. .643						1						
TRE	Sig. .123							1					
TLE	Sig. .381								1				
ROM-RF	Sig. -.099									1			
ROM-LF	Sig. .482										1		
ROM-RE	Sig. .261											1	
ROM-LE	Sig. .059												1

* $p < .05$; ** $p < .01$

Note: BMI = Body Mass Index; SEE = Self-efficacy for exercise; OEE = Outcome expectations for exercise; M-SEV = Modified severity of the disease;
 6MWD = 6-Minute Walk Test-distance; TRE = Right knee extension peak torque; TLE = Left knee extension peak torque;
 ROM-RF = Right knee flexion range of motion; ROM-LF = Left knee flexion range of motion; ROM-RE = Right knee extension range of motion;
 ROM-LE = Left knee extension range of motion

APPENDIX Q

Study Variables Mean Scores and Standard Deviation (SD)

Variables	Baseline		4 th week		8 th week		12 th week	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Self-Efficacy for Exercise Scale (SEE)								
Experiment	5.00	2.15	7.30	1.74	7.60	1.80	7.36	1.80
Control	5.77	1.91	6.19	1.87	7.06	1.90	6.77	2.07
Outcome Expectations for Exercise Scale (OEE)								
Experiment	4.47	0.68	4.62	0.39	4.65	0.37	4.71	0.38
Control	4.52	0.65	4.69	0.38	4.74	0.39	4.64	0.46
Modified Severity of the Disease Scale (M-SEV)								
Experiment	17.16	2.70	15.60	1.94	15.24	2.35	15.56	1.96
Control	17.18	2.91	17.39	2.93	15.89	2.79	16.86	3.25
6-Minute Walk-Distance (6MWD) (Meters)								
Experiment	392.22	58.28	411.76	58.70	417.76	48.05	432.04	54.81
Control	405.37	70.26	423.59	70.46	426.18	64.28	419.91	72.31
Right Knee Extension Peak Torque (TRE) (Newton-meters)								
Experiment	36.83	19.58	52.08	21.38	52.08	21.31	47.02	18.16
Control	50.77	25.48	57.26	23.22	51.47	23.36	61.34	26.14
Left Knee Extension Peak Torque (TLE) (Newton-meters)								
Experiment	59.20	17.44	45.11	17.47	49.46	15.99	54.00	14.32
Control	65.98	23.33	58.14	24.07	62.47	24.73	59.21	24.47
Right Knee Flexion Range of Motion (ROM-RF) (Degrees)								
Experiment	126.60	12.28	128.64	11.09	129.24	10.79	131.88	8.97
Control	126.07	15.25	127.57	13.94	126.25	14.11	126.85	13.24
Left Knee Flexion Range of Motion (ROM-LF) (Degrees)								
Experiment	128.68	11.28	129.60	11.28	131.40	10.37	133.64	9.53
Control	129.07	13.68	128.14	12.05	128.54	11.84	129.25	12.41
Right Knee Extension Range of Motion (ROM-RE) (Degrees)								
Experiment	10.84	3.62	11.92	3.13	13.56	3.01	11.12	3.96
Control	12.14	4.67	11.53	4.61	11.04	4.18	11.00	4.15
Left Knee Extension Range of Motion (ROM-LE) (Degrees)								
Experiment	9.92	4.53	11.48	3.96	11.32	4.22	11.68	4.08
Control	11.28	3.82	11.32	3.46	10.57	3.07	10.03	2.15

APPENDIX R

Friedman Two-way Analysis of Variance by Ranks

When the Friedman chi-square (χ^2) is significant, it indicates that at least one of the measurements differs from at least one other condition. It reveals neither which one is different, nor how many of the groups are different from each other. Multiple comparisons between groups were employed for further analysis. Significant difference is detected when the difference between the ranks sums exceeded the corresponding critical value given in the equation:

$$|R_i - R_j| \geq z \sqrt{\frac{b k (k + 1)}{6}} \quad (\text{Siegel \& Castellan, 1988: 180})$$

Where R_i and R_j are the i^{th} and j^{th} time point's sum of ranks

z is a value from Table A (Siegel & Castellan, 1988: 319) corresponding to $\alpha / k (k - 1)$.

b is number of observation/case = 53.

With the experimental error rate of $\alpha = .05$, $k =$ number of times of assessments = 4, $\alpha / k (k - 1)$ is equal to $.00417 \cong .0042$. Then, $z_{.0042}$ was 2.635.

After substitution in the equation, a significant sum of ranks difference for overall data was detected when $|R_i - R_j| \geq 35.023$.

To detect which time point was different from others in each group, $b = 25$ for the experimental group and $b = 28$ for the control group were used to substitute in the equation. A significant sum of ranks difference for the experimental group and control group was detected when $|R_i - R_j| \geq 24.054$ and 25.456, respectively. With the same different time points and samples, these critical values were used to detect significant difference for all dependent variables using the Friedman test. In addition, Mann-Whitney Test was employed to detect difference between groups at each time point on the baseline, and at the 4th, 8th, and 12th week of assessments.

APPENDIX S

Lists of Experts

Lists of Experts for Content Validating of the Community-based Exercise Program and the Stationary Cycling Exercise Protocols for Women with Osteoarthritis of the Knee

Chakarg Pongurgsorn, M.D., Ph.D. (Kinesiology)

Department of Rehabilitation Medicine, Faculty of Medicine Siriraj Hospital, Mahidol University.

Ratree Ruangthai, Ed.D. (Exercise Physiology)

Department of Sport Sciences, Faculty of Education, Kasetsart University.

Kwanjai Ammatsatsue, Ph.D. (Nursing)

Department of Public Health Nursing, Faculty of Public Health, Mahidol University.

BIOGRAPHY

NAME	Miss Tassanee Rawiworrakul
DATE OF BIRTH	31 July 1961
PLACE OF BIRTH	Bangkok, Thailand
INSTITUTIONS ATTENDED	Faculty of Nursing, Mahidol University, 1979-1983: Bachelor of Science (Nurse & Midwifery) Faculty of Public Health, Mahidol University, 1996-1999: Master of Science (Public Health) Major in Public Health Nursing School of Nursing, Faculty of Medicine Ramathibodi Hospital, and Faculty of Nursing, Mahidol University, 2001-2006: Doctor of Philosophy in Nursing
SCHOLARSHIP & FUNDING	The Commission of Higher Education, Ministry of Education
RESEARCH GRANT	Thai Health Promotion Foundation
POSITION & OFFICES	Lecturer, Department of Public Health Nursing, Faculty of Public Health, Mahidol University, 420/1 Rajavithi Road, Rachathewi, Bangkok 10400 THAILAND Tel & Fax: 66-2354-8542 E-mail: tassaneejiw@hotmail.com
HOME ADDRESS	1064/19 Paholyotin 18/2, Jomphon, Chatuchak, Bangkok 10900 THAILAND Tel: 66-2272-0694