MOBILITY AND FUNCTIONAL LOWER EXTREMITY STRENGTH SCREENING BY 30 SECOND CHAIR STAND TEST IN PATIENTS WITH KNEE OSTEOARTHRITIS

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2023

การคัดกรองการเคลื่อนไหวและความแข็งแรงของกล้ามเนื้อรยางค์ขาด้วยการทดสอบ 30 SECOND CHAIR STAND ในผู้ป่วยข้อเข่าเสื่อม

ภัทร์ธิรา วิริยธรรมเจริญ

ปริญญานิพนธ์นี้เป็นส่วนหนึ่งของการศึกษาตามหลักสูตร
วิทยาศาสตรมหาบัณฑิต สาขาวิชากายภาพบำบัด
คณะกายภาพบำบัด มหาวิทยาลัยศรีนครินทรวิโรฒ
ปีการศึกษา 2566

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A Thesis Submitted in Partial Fulfillment of the Requirements

for the Degree of MASTER OF SCIENCE

(Physical Therapy)

Faculty of Physical Therapy, Srinakharinwirot University

2023

THE THESIS TITLED

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BY

PATTIRA WIRIYATUMJAROEN

HAS BEEN APPROVED BY THE GRADUATE SCHOOL IN PARTIAL FULFILLMENT
OF THE REQUIREMENTS FOR THE MASTER OF SCIENCE
IN PHYSICAL THERAPY AT SRINAKHARINWIROT UNIVERSITY

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Title	MOBILITY AND FUNCTIONAL LOWER EXTREMITY STRENGTH SCREENING BY 30 SECOND CHAIR STAND TEST IN PATIENTS WITH KNEE OSTEOARTHRITIS
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Degree	MASTER OF SCIENCE
Academic Year	2023
Thesis Advisor	Assistant Professor Dr. Chatchada Chinkulprasert

According to the estimation of the WHO, 80% of the population with knee OA had mobility limitations, and 25% of individuals with knee OA were unable to perform daily activities. However, there is no data to determine how much the proportion of knee OA patients with mobility limitations and decreased functional lower extremity strength based on physical performance test screening. The aim of this study was to define the number and percentage of knee OA patients with mobility limitations and decreased functional lower extremity strength by a 30-second chair stand test (30s-CST). The population consisted of 40 knee OA patients, aged 50–69 years, were recruited by following the criteria of the American College of Rheumatology (ACR). The numeric rating scale of all patients were greater than four. They were assessed for physical performance by 30s-CST. If they performed 30s-CST less than 12 repetitions, it means that knee OA patients had mobility limitations and decreased functional lower extremity strength. Descriptive statistics were used to determine the number and percent of knee OA patients with mobility limitations and decreased functional lower extremity strength. The results of knee OA patients who were recruited in this study performed 30s-CST less than 12 repetitions. One hundred percent of knee OA patients showed mobility limitations and decreased functional lower extremity strength. The mean repetitions of 30sCST in knee OA patients, aged 50-69 years, were 7.95±1.78 repetitions. In conclusion, all patients with knee OA exhibited mobility limitations and decreased functional lower extremity strength. They were able to perform a full stand for approximately eight repetitions in 30 seconds, which was less than the mean number of full stands for the elderly. It was inferred that all knee OA patients showed greater mobility limitations and decreased functional lower extremity strength when compared to the elderly. The 30s CST can be used to clinically screen mobility and functional lower extremity strength in knee OA patients. Further studies may also apply the other performance tests to assess functional mobility in knee OA patients.

Keyword : Knee Osteoarthritis, 30-second Chair Stand Test (30s-CST), Mobility limitation, Decreased functional lower extremity strength.

ACKNOWLEDGEMENTS

Foremost, I am deeply thankful to the Faculty of Physical Therapy, Srinakharinwirot University, for supporting the research fund. I would like to express my sincere gratitude to my advisor, Asst. Prof. Chatchada Chinkulprasert, for the continuous support of my master's degree study and research and for her patience, motivation, enthusiasm, and immense knowledge. Her guidance helped me with all my research and thesis writing. I could not have imagined having a better advisor and mentor for my master's degree study. Besides my advisor, I would like to thank my thesis committee for their encouragement, insightful comments, and challenging questions. I would like to thank the physical therapy department at Sena Hospital for allowing the use of the facility to collect research data, and all physical therapists who assisted in collecting research data provided various information and recommended patients participate in this research. I would like to thank my parents for supporting, understanding, and encouraging me to continue my master's degree study.

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CHAPTER 1
INTRODUCTION

Background

Osteoarthritis is the most common joint condition and is predicted to rise the fourth leading cause of disability worldwide. (1) Global knee OA prevalence in 2020 was 22.9% in individuals aged 40 and over. (2) The symptoms persisted for an average of 5.9±5.7 years. (3) As the increased age, the number of people with knee OA increased from 13.9% in adults to 33.6% in older adults. (4) In Asia, the age of knee OA was older than 65 years. (5) The prevalence was high, accounting for 38.1% to 50% of the elderly population. (1) The prevalence increased by approximately 7% in 2008 and is forecast to increase by 16% in 2040. (5) In Thailand, knee OA was one of the 10 most common diseases that cause disability in the elderly. The disability affected knee OA patients' and their families' quality of life. (6) The prevalence of the people who have knee OA was very high, 34.5% to 45.6% in the population over 50 years old, (7) 33.3% of people in the 60-69 age range and 37.8% of people over 70 years old. (8) In 2017, Bosittipichet T studied the prevalence of the community with knee OA in Phra Nakhon Si Ayutthaya province. He found that the knee OA prevalence was 13.10% in elderly, and 17.3% in age ranges 60-69 years. (9)

The International Classification of Functioning, Disability, and Health framework has described the definition of osteoarthritis that is a chronic joint disorder in which there is progressive softening and disintegration of articulate cartilage accompanied by the new growth of cartilage and bone at the joint margins (osteophytes) and capsular fibrosis. Common clinical features included pain, swelling, long-standing bow leg deformity, joint stiffness after rest, quadriceps muscle weakness, impaired movement, and patellofemoral crepitus. (10, 11) The anatomical changes caused by OA lead to joint pain, reduction in muscle function, and activities daily living restriction (12) Primary problem of patient with knee OA is pain and mobility limitation. (13) From worldwide estimation 80% of knee OA population had mobility limitation and 25% of patients were

not able to perform activities daily living, especially movements with weight bearing. (14) The patients with knee OA will have difficulty in performing weight-bearing activities such as standing up and sitting down, standing, short and long walking, up and down stairs, turning, etc. (15) Moreover, the decreased muscle strength of the lower extremity and knee joint degeneration have affected changes in functional performance and balance of patients with knee OA such as walking, up and down stairs, rising to stand, and balance increased risk of fall. (16) The maintenance of lower extremity muscle strength is crucial to postpone and prevent the onset of disability, physical frailty, and dependency in later years. (17, 18)

The performance-based test was used to objectively measure the functional ability of the patient in performing ADL activities. A previous study found that the functional limitation was detected by performance-based tests more than self-reported questionnaires. (19) Osteoarthritis Research Society International (OARSI) has advised performance-based tests to assess physical function in knee OA patients. (20) The recommended set of performance-based assessment of physical function consisted of five tests; a 30-second chair stand test (30sCST), a 40-meter fast-pace walk test (40mFPWT), a stair climb test (SCT), a timed up and go test and 6- minute walk test (6MWT). The first three examinations were established as a minimum core set of performance-based tests. OARSI recommended these tests to be frequently utilized in clinical practice and research. All 5 measurement were intended to be a supplement to self-reported measures and consistent with prospective outcomes. (21)

The 30s-CST is a simple test that is a fundamental movement of all activities. It represented a functional activity which was similar to this test sit to stand activity. it was also utilized to evaluate functional lower extremity strength in older adults by performing as numerous complete stands as feasible in 30 seconds. If the number of repetitions in the 30s-CST was higher, it generally indicates better functional lower extremity strength.(21) The chair stand performance was used to estimate knee extensor strength. (22) This examination was often utilized to evaluate the performance of person diagnosed with knee OA, as well as persons treated with total knee arthroplasty (TKA).

(23) The inter- and intra-rater reliability of 30s-CST were excellent ($ICC_{(1,1)}$ and $ICC_{(2,1)}$) =0.84 and 0.92, respectively). (23) The 30s-CST was highly correlated with the maximal weight-adjusted leg-press performance for both males and females (r=0.78 and r=0.71, p<0.01, respectively). (24) Also, this test had a moderately high correlation with both the 50-foot timed walk and WOMAC function scale (r=-0.64, p<0.01 and r=-0.62, p<0.01, respectively). The 30s-CST score in persons without a gait aid was significantly higher than those with a gait aid. (25)

The 30s-CST was utilized to evaluate the physical function in older adults. The previous study showed a significant decrease in 30s-CST when increasing the age of participants. The overall mean of 30sCST in the age groups 60's, 70's, 80's, 90's was 12.1, 10.3, 9.4, and 7.2, respectively. (25) WHO mentioned that 80% knee OA patients had decreased muscle strength, limited mobility, and 25% could not perform major daily activity of life. (14) The previous studies only explored the prevalence of patients with knee OA in Thailand. However, there is no data regarding the proportion of knee OA patients who have mobility limitation and decreased functional lower extremity strength from physical function assessment by using 30s-CST.

Research question

What is the proportion of knee OA patients who have mobility limitation and decreased functional lower extremity strength?

Research objectives

To define the number and percentage of knee OA patients with mobility limitation and decreased functional lower extremity strength

Benefit of research

The information in the current study will be the fundamental data regarding knee OA patients with mobility limitation and decreased functional lower extremity strength by using 30sCST.

Conceptual framework

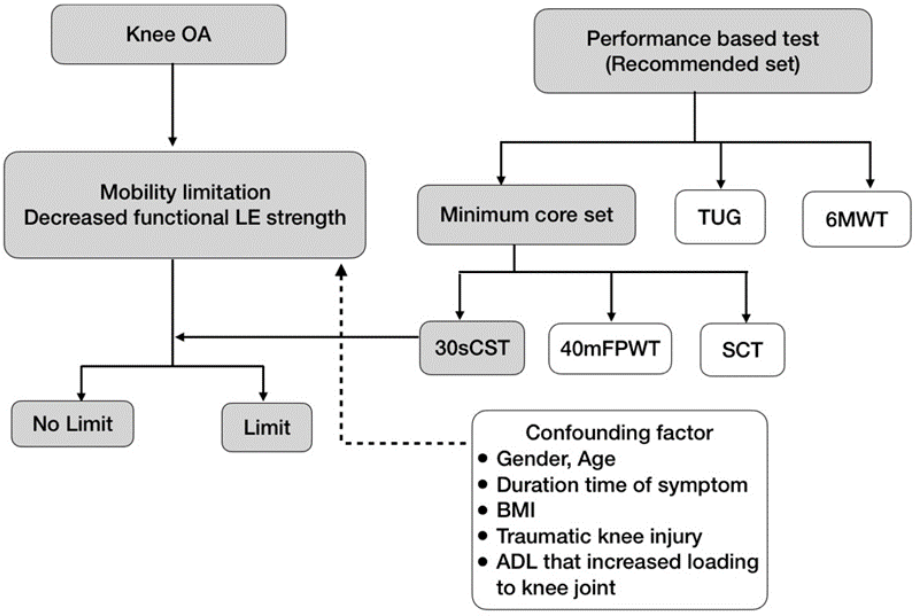

Figure 1 Conceptual framework in this study

CHAPTER 2
LITERATURE REVIEW

Epidemiology and Prevalence of knee Osteoarthritis

Osteoarthritis (OA) is the most prevalent joint condition and is predicted to rise the fourth largest cause of disability globally. (1) In England, the survey and report regarding osteoarthritis reported that disabled osteoarthritis was 22 % and knee osteoarthritis was commonly one-fourth of the joint region (hand, hip, foot, knee). In the Framingham study, radiographic and symptomatic hip OA were found in 19.6% and 4.2%, respectively. The prevalence of radiographic hip OA in males was higher than in females. Radiographic and symptomatic knee OA were found 25.4% and 15.4%, of people in Sweden, respectively. Other studies found the prevalence of radiographic OA in midfoot and forefoot. (26)

In the Asian region, the prevalence of hip discomfort or symptomatic hip OA was less prevalent but the prevalence of knee pain or symptomatic knee OA was more common in older adults. Some activities of daily living, intensive manual labor activity, or prolonged kneeling or squatting, risk factors for increased OA were studied in the Asian population. (1)

Global knee OA prevalence in 2020 was 16.0% (14.3%-17.8%,95%CI) in people over the age of fifty and 22.9% (95%CI, 19.8%-26.1%) in those over the age of forty. The prevalence rate for knee OA would peak at the age range of 70-79 years. (2) The symptoms persisted for an average of 5.9±5.7 years. (3) As the increased age, the number of people with knee OA increased from 13.9% in adults to 33.6% in older adults. (4) In Asia, the age of knee OA was older than 65 years. (5) The prevalence was high, accounting for 38.1% to 50% of the elderly population. (1) The prevalence was increased by approximately 7% in 2008 and was forecast to increase by 16% in 2040. (5) In Thailand, knee OA was one of the top ten most common condition that cause impairment in the older adults. The disability has affected knee OA patients' and their families' quality of life. (6) The prevalence of the people with knee OA was very high,

34.5% to 45.6% in the population over 50 years old (7), 33.3% of people in the 60-69 age group , as well as 37.8% of people over 70 years old. (8) In 2017, Bosittipichet T studied the prevalence of the community with knee OA in Phra Nakhon Si Ayutthaya province. He found that the knee OA prevalence was 13.10% in elderly, 17.3% in ages ranging from 60-69 years, 15.58% in women, 16.49% in obesity, and 28.57% in persons with a history of an accidental knee injury. (9)

The definition of knee Osteoarthritis

Osteoarthritis Research Society International (OARSI) and Outcome Measures in Rheumatoid Arthritis Clinical Trials (OMERACT) decided to form a task force to develop a set of guidelines for treating patients with knee OA. It was expected that these criteria would represent the three domains: pain, functional impairment, and structural damage. Consequently, the task force was subdivided split into three sub-tasks: sub-task to suggest a tool for assessing pain, sub-task force to propose a tool to assessing the function, and sub-task force to suggest a tool to assessing structure. OARSI-OMERACT initiated the change in joint space width (JSW) which was measured from a plain X-ray and defined in millimeters to measure the severity of structural damage in knee OA. However, the change in JSW was not able to categorized patients as “progressors” or “non-progressors” of knee OA. (27)

Both OARSI and OMERACT supported the use of core outcome measures that evaluated the categories of pain and function. Physical function was defined as the capacity to shuffle around and carry out everyday activities. It can be categorized as activities using the World Health Organization (WHO). The International Classification of Functioning, Disability, and Health (ICF) framework has described the definition of osteoarthritis that is a chronic joint disorder marked by is progressive disintegration and softening of articulate cartilage along with the emergence of new bone and cartilage at the joint margins (osteophytes) and capsular fibrosis. Common clinical features included pain, swelling, long-term abnormality of the bow legs, stiff joint after resting, quadriceps muscle weakness, movement impairment, and patellofemoral crepitus. (10, 11) The

anatomical changes caused by OA lead to joint pain, reduction in muscle function, and limitation in the daily living activities. (12) The primary problem of patients with knee OA was pain and mobility restriction. (13) The knee OA patients have experienced double knee discomfort during walking, up as well as down stairs when compared to the healthy control group. (28)

From worldwide estimation, 80% of the knee OA population had mobility limitation and 25% of patients were not able to perform daily living activities, especially movements with weight bearing. (14) The patients with knee OA will have difficulty in performing weight-bearing activities such as standing up and sitting down, standing, short and long walking, up and down stairs, turning, etc. (15) Bean et al, 2003 found that alters in the muscle strength of the lower extremity may predict the reduction of functional activities. (29) Moreover, the decreased muscle strength of the lower extremity and knee joint degeneration have affected changes in functional performance and balance of patients with knee OA such as walking, up and down stairs, and rising to stand. (16) In addition, knee OA patients have shown impaired standing balance in both static and dynamic balance, and if the severity of knee OA increases, the ability to balance will decrease. (30) The maintenance of lower extremity muscle strength is crucial to delay and prevent the progression of physical frailty, dependency and disability in later life. (17, 18)

Clinical criteria of knee Osteoarthritis

American College of Rheumatology (ACR) created three clinical standards for the categorization of knee OA. First, the classification criteria involving the physical assessment only was a common technique for clinicians to diagnose knee OA. These criteria were the presence of knee pain plus three of the six clinical finds: age more than 50 years, morning stiffness less than 30 minutes, crepitus, during knee movement, bony tenderness, bony enlargement, as well as the absence of palpable synovium warmth. This classification criteria using physical examination only had 95% sensitivity and 69% specificity. Secondly, the categorization criteria utilizing the physical assessment and

radiography, criteria were the existence of knee pain with one of the three clinical findings: age more than 50 years, morning stiffness less than 30 minutes, crepitus during knee movement, combined with osteophytes diagnosed by radiography of the knee. This categorization criteria using the physical examination and radiography had 91% sensitivity and 86% specificity. Lastly, the categorization criteria using the physical assessment and laboratory examination, criteria were the presence of knee pain with having five of the nine clinical findings: age more than 50 years, morning stiffness less than 30 minutes, crepitus during knee movement, bony tenderness, bony enlargement, absence of apparent synovium warmness, erythrocyte sedimentation rate (ESR) fewer than 40mm/hour, rheumatoid factor (RF) fewer than 1/40, and synovial fluid compatible with OA, can classify the knee OA in the patient. This classification criteria using laboratory findings had 92% sensitivity and 75% specificity. (31) These three classification clinical criteria are shown in Table1. The ACR clinical criteria seem to reflect moderate to severe knee OA. (32)

Table 1 The American College of Rheumatology is clinical creteria (ACR) for classifying idiopathic osteoarthritis (OA) of the knee(31)

Clinical classification criteria	Clinical/radiographic classification	Clinical/Laboratory classification
Knee pain + 1. Age> 50 years old 2. Morning stiffness< 30 minutes 3. Crepitus on knee movement 4. Bony tenderness 5. Bony enlargement 6. No apparent warmness	Knee pain + 1. Age> 50 years old 2. Morning stiffness < 30 minutes 3. Crepitus on knee movement + Osteophytes	Knee pain + 1. Age> 50 years old 2. Morning stiffness< 30 minutes 3. Crepitus on knee movement 4. Bony tenderness 5. Bony enlargement 6. No apparent warmness 7. ESR < 40mm/hour 8. RF < 1/40 9. synovial fluid compatible with OA
95% sensitive 69% specific	91% sensitive 86% specific	92% sensitive 75% specific

The severity of knee Osteoarthritis

The radiography was the common method to evaluate the severity of knee OA. The most common technique for determine the degree of knee OA was radiographic classification scheme of OA. The aim of KL was to establish a classification system and a corresponding set of standard radiography images for OA of diarthrodial joints. The KL classification was initially defined using anteroposterior (AP) knee radiography images. From 0 to 4, a grade was given to each radiograph (i.e., grade 0 indicated no radiographic evidence of OA, grade 1 indicated minimal osteophytes of uncertain clinical significance, grade 2 indicated obvious osteophytes with intact joint space, grade 3 indicated obvious osteophytes with substantial joint space narrowing, grade 4 indicated obvious osteophytes with serious constriction of the joint space and subchondral sclerosis. (33) The KL score had a significantly negative correlation with KOOS scores for pain, activity daily living, sports/recreation function, and quality of life. (34) From previous study showed that higher KL scores were associated with the less scores of KOOS in all subscales. (35) The mean values of KOOS, pain, symptom, and ADL subscale, KL severity are shown in Table 2. However, the higher KL scores were associated with lower scores of KOOS in all subscales

Table 2 Kellgren and Lawrence (KL) of knee OA and Mean of KOOS pain, symptom, and ADL subscales

Researches	KL Severity of Knee OA	Mean KOOS pain subscale	Mean KOOS symptom subscale	Mean KOOS ADL subscale
Englund et al, 2003 (36)	Symptomatic Knee	≤86.1	≤85.7	≤86.8
Sivachidambaram et al, 2014 (37)	Primary Knee OA	<62.90	<69.15	<67.27
Sabirli et al, 2013 (38)	>K/L2	<37.35	<49.39	<37.21
Ateef et al, 2017 (39)	>K/L2	<55.71	<59.93	<59.07
Naili et al, 2019 (40)	>K/L1-2	<62.1	<68.3	<69.1

Self-reported questionnaire for knee Osteoarthritis

Mostly, physical therapy assessment in patients with knee OA was focused in pain and functional limitation which have come from the subjective and objective examination. Self-reported questionnaires were typically administered as part of a subjective examination which involved asking a participant about the disease process, pain, and functional limitation without examiner bias such as Western Ontario and McMaster University Osteoarthritis Index (WOMAC), Knee injury and Osteoarthritis Outcome Score (KOOS), Lower Extremity Functional Scale (LEFS) etc. They may not be sufficient for determining an individual's specific diagnosis.

The Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) was developed by Bellamy N., et al., 1997. The knee OA patients first started experiencing symptoms and physical disability, WOMAC was frequently used to measure these factors. It was used to evaluate 3 domains: 5 questions for pain, 2 questions for stiffness, and 17 questions for physical function. A lower score on the Likert version of the WOMAC indicated a lower level of symptoms or physical disability. The total score was commonly calculated by summating the scores for the 3 subscales. For the Likert version the test-retest reliability ($ICC_{2,1}$) on the subscale measuring pain, stiffness, and physical function subscales were 0.68, 0.48, and 0.68, respectively. (41)

The Knee injury and Osteoarthritis Outcome Score (KOOS) was developed version of the WOMAC for used to assess pain, symptoms, including swelling and limited range of motion, daily living activities, sport and recreation function, and quality of life related to the knee in adolescent and adult subjects with ACL injury, meniscus injury, or post-traumatic osteoarthritis. The KOOS included five dimensions: pain, symptoms, daily living activities, sport and recreation function, and quality of life related to the knee. The five KOOS dimensions were scored independently as follows: pain (9 items), symptoms (7 items), daily living activities (17 items), sport and recreation function (5 items), and quality of life related to the knee (4 items). Every item had a score between 0 and 4, and the scores of each subscale were calculated by the formula of KOOS. The formula of each subscale consisted of the observed items mean value share

equally by 4, times by 100, and finally equal to 100. Extreme knee problems were represented by a score of 0, no knee problem by a value of 100. Achieved value ranged from 0 to 100, signifying the proportion of the total possible score. The separate scores of the five dimensions are able to be visualized as a portrait. The test-retest reliability in the English version had good to excellent intraclass correlation coefficients of each dimension, 0.85 for pain, 0.93 for symptoms, 0.75 for activities of daily living, 0.81 for sport and recreation function, and 0.86 for quality of life related to the knee. This questionnaire had a high correlation with SF-36 scales with a high capacity to assess physical wellness. (35) KOOS was an instrument that there was high validity and reliability (ICC = 0.78-0.97) in patients with knee OA. (42) KOOS Thai version, the Cronbach's alpha for the reliability of internal consistency across all domains was 0.9. The test-retest reliability value was high, 0.78 - 0.82 for pain and ADL subscale. (43) Previous studies reported that KL scores were significantly negatively associated (fair to good) with self-reported KOOS pain and ADL subscales. (r=-0.49 and r=-0.52, p=0.01 in pain and ADL subscales, respectively)(34)

The World Health Organization's model of disability and handicap served as the basis for development of Lower Extremity Functional Scale (LEFS) in 1999. LEFS was widely applied in various orthopedic disorders affecting the lower extremities, including those with varying degrees of disability. The purposes of LEFS were used for clinical research and the evaluation of clinical outcome. The basic questions in LEFS were about the functional limitations of patients. The LEFS consisted of 22 items. On a 5-point rating system, the rating ranged from 0 (high difficulty/unable to perform activities) to 4 (no perform difficulty activities). The test-retest reliability of LEFS scores was excellent ($ICC_{(2,1)}$ =0.94, 95%CI=0.89). The correlation between LEFS score and SF-36 physical component score and physical function score was moderate to high (r= 0.64; 95% lower limit CI=0.54, r = 0.80; 95% lower limit CI=0.73), respectively. Regrading clinical effectiveness and responsiveness to modification for the recording of physical function in patients with lower-extremity dysfunction the LEFs outperformed the SF-36. (44)

Performance-based measures of physical function for knee Osteoarthritis

The performance-based test was used to objectively measure the functional ability of the patient in performing ADL activities. A previous study found that the functional limitation was detected by performance-based tests more than self-reported questionnaires.(19) Osteoarthritis Research Society International (OARSI) has advised performance-based tests to evaluate physical function in patients suffering from knee OA.(20) Performance-based tests were measured as the duration of time spent or the number of repetitions or distance to perform these activities. The recommended set of performance-based assessments of physical function consisted of five tests; a 30-second chair stand Test (30sCST), a 40-meter fast pace walk test (40mFPWT), a stair climb test (SCT), a timed up and go test and 6 minutes-walk test (6MWT). The first three examinations were suggested as a minimum core set of performance-based tests as shown in Figure 2. OARSI recommended these tests to be widely utilized in clinical research and clinical practice. All tests had good to excellent inter-rater and intra-rater reliability, as shown in Table 3. (23)

Figure 2 The minimum core set of performance-based measures comprised of three tests; a 30-second chair stand test (30sCST), a 40-meter fast-pace walk test (40mFPWT), and a stair climb test (SCT). The recommended set comprised three core tests and two additional

Table 3 Intra- and inter-rater reliability of performance-based tests

Performance-based tests	Within-rater reliability $ICC_{2,1}$ with 95%CI	Between-rater reliability $ICC_{1,1}$ with 95%CI
OARSI minimum core set		
- 30sCST	0.85(0.67-0.93)	0.86(0.77-0.92)
- 40mFPWT	0.92(0.82-0.96)	0.96(0.93-0.98)
- 11-step SCT	0.78(0.50-0.89)	0.78(0.65-0.87)
TUG	0.81(0.65-0.89)	0.78(0.63-0.87)
6MWT	0.93(0.77-0.97)	0.94(0.90-0.96)

The 30-second Chair Stand Test (30sCST) was a simple assessment to symbolize the sit-to-stand task that is a fundamental movement of activity daily living. Before knee OA patients can perform their major daily activities of life, they should be successful in sit-to-stand activity. The 30sCST was also used to evaluate functional lower extremity strength in elderly by performing as numerous complete stands as feasible in 30 seconds. To ensure a consistent comparison of test results over time across sites, studies, or individuals, it is essential to standardize chair heights during assessment. For this test, the most measurement property evidence suggested an armless chair and having a seat elevation of roughly 43 cm (17 inches). It could be recognized that getting up and sitting down from a chair requires a strong and vigorous effort.(23) Jones et al, 1999 found that maintaining lower body strength was a necessity part of independent daily living activities like walking, climbing stairs, and getting out of a seated position. (18) This test was often utilized to evaluate the performance of patients diagnosed with knee OA, and individuals receiving total knee arthroplasty (TKA). (21) The 30sCST was highly correlated with the maximal weight-adjusted leg-press performance for both males and females ($r=0.78$, $p<0.01$ and $r=0.71$, $p<0.01$, respectively). Six physical function measures were compared for validity in patients prior to hip or knee joint replacement surgery by Gill et al, 2012. They found that the 30sCST had a moderately high correlation with both the 50-foot timed walk and WOMAC function scale ($r=-0.64$, $p<0.01$, and $r=-0.62$, $p<0.01$, respectively). The 30sCST score in

persons without a gait aid was significantly higher than those with a gait aid. (24) McCarthy et al, 2004, studied the relationship between the 5-chair sit-to-stand test and 30sCST in sexagenarians. They found that the mean and Standard deviation value of 30sCST was 13.97±3.07. (45) Macfarlane et al, 2006 showed a significant decrease in 30sCST when increasing the age of participants. The overall mean of 30sCST in the age groups 60's, 70's, 80's, 90's was 12.1, 10.3, 9.4, and 7.2, respectively. They also found that there was no significant difference in 30sCST score between the 80's and 90's age groups. (25) Rikli et al, 2013 studied the reliable and valid criterion of functional fitness test. They found that the mean and standard deviation value of 30sCST in the age groups 60-64 years as well as 65-69 years for men and women (46), as shown in Table 4.

Table 4 Mean and standard deviation value of 30sCST (25, 45, 46)

	30sCST Mean ± SD	Age (yrs.)	Population	
McCarthy et al, 2004	13.97 ± 3.07	60-69	Sexagenarian women (n=47)	
Rikli et al, 2013	13.8 ± 3.6	60-64	Women	n=144
	14.8 ± 4.7	60-64	Men	
	13.7±3.5	65-69	Women	n=369
	14.0 ± 4.5	65-69	Men	
Macfarlane et al, 2006	12.1 (overall mean)	60-69	Hong Kong Chinese (n=1038)	

The 40-meter (4x10m) fast-paced walk test (40mFPWT) was determined to the best test for short-distance walking activity based on available measurement-property evidence. The advisory group concluded that fast-paced tests were preferable over self-paced tests because they were more effective at indicating the range of abilities across the distribution of OA. Every short-distance walking exercise had a predetermined distance and time component.

The Stair Climb Test (SCT) was an important measurement for researchers and medical perrsonnel to evaluate a stair climbing activity. The SCT was a precise measurement to identify mobility limitations in the early phase of knee OA. Stair climbing was also a prevalent activity restriction and recuperation purpose in patients with knee or hip OA. (21) Lijima et al, 2019 found 11-SCT had excellent test-retest reliability, ICC $_{(1,1)}$ = 0.952; 95%CI 0.56 – 0.985. (47)

Timed Up-and-Go test and 6-min walk test (6MWT) were also selected for the recommended set as because they had strong measurement qualities in OA as well as various people and were frequently applied in clinical practice and clinical research. The timed up-and-go test typically included sit-to-stand activity, a short walking distances, and a turning component assessing mobility and functional ability in individuals. The 6MWT was thought to be the appropriate exam to incorporate for specific purposes and to concentrate on physical function, such as the domain of aerobic capacity or long-distance walking.

Previous research (48) showed that the TUG test can be used to measure dynamic balance and the risk of falls in patients with knee OA. They found that if the severity of knee OA is different, the time obtained from the test will be different. For example, the patients with mild knee OA spent time on the TUG test less than moderate knee OA. (48) TUG showed good inter-rater reliability ($ICC_{(1,1)}$=0.78) and excellent intra-rater reliability ($ICC_{(2,1)}$=0.81). (23) Other studies found the TUG test and KL radiological stages had positive correlation (r=0.628, p<0.01), and a moderate relationship between TUG and every KOOS subscales (r=0.521-0.694, p=0.0001) in knee OA. (38)

Pain severity in knee osteoarthritis

Pain severity was a primary measurement used to assess the worsening of knee OA over time. Pain scales including the verbal rating scale (VRS), numerical rating scale (NRS), and visual analog scale (VAS) were commonly used to assess pain intensity in clinical practice. The VAS frequently was used to measure pain outcomes. It was made up of a both directional 10 cm parallel line with the labels, “no pain” and “most severe

possible pain", at either end to indicate the degree of pain. The NRS was an 11-point rating system with 0 representing "no pain" and 10 representing the "most severe imaginable pain" conceivable pain. The patients were asked to select one number on the pain scale representing their degree of discomfort. The VRS, which included a list of descriptors to indicate different levels of pain such as none, mild, moderate, and severe, was a valid scale. Excellent test-retest reliability was demonstrated by all three test, the VAS, NRS, and VRS each had ICC(2,1) value of 0.97, 0.95, and 0.93, respectively. For VAS, NRS, and VRS, the corresponding SEMS were 0.03, 0.48, and 0.21, respectively. The MDC for the VAS, NRS, and VRS were 0.08, 1.33, and 0.58, respectively. The NRS had excellent correlation with K/L grade and VRS, $r=0.817$ and $r=0.925$, $p < 0.001$, respectively. (49) The NRS was easier to understand and administer in the elderly population when compared to the VAS.

CHAPTER 3
METHOD

Research Design

This study was a cross-sectional study.

Setting

Data collection set at Sena Hospital in Sena District, Phra Nakhon Si Ayutthaya Province, Thailand

Sample size

A sample size was determined by the estimation in a finite population proportion formula as shown in the equation below.

$$n = \frac{Np(1-p)z^2_{1-\frac{\alpha}{2}}}{d^2(N-1)+p(1-p)z^2_{1-\frac{\alpha}{2}}}$$

The sample size required the confidence level (1-α) at 95%. A maximum tolerated error (d) was at 5%. The proportion of event (p) in an outcome from a previous study was 25%. (14) A population size(N) of knee OA patients aged 60 to 69 years in the previous study was 44 patients. (8) Total sample size calculation (n) was approximately 40 participants.

Participants

Forty participants diagnosed with knee OA, aged 50-69 years old, were recruited in this study. This study was authorized by the human research ethics committee of Sena Hospital, Phra Nakhon Si Ayutthaya Province (AY.0032.202.2/028). The inclusion criteria of knee OA patients were determined base on as the clinical classification criteria of the American College of Rheumatology (ACR) by using either the physical assessment and radiography or the physical assessment alone. For classification criteria involving results of the physical assessment and radiography (Table 5), the patient exhibited knee pain plus at least 1 of the remaining 3 clinical

findings: age older than 50 years, morning stiffness lasting less than 30 minutes, or crepitus on active knee movement (i.e., with weight-bearing, such as squatting) including osteophytes from radiographic finding. For classification criteria involving results of the physical assessment alone (Table 5), the patient exhibited knee pain plus at least 3 of the remaining 6 clinical findings: age older than 50 years, morning stiffness lasting less than 30 minutes, or crepitus on active knee movement, tenderness of the bony margins of the joint, bony enlargement, and no palpable synovium warmth. (31) The numeric rating scale (NRS) for knee pain was 4 or greater. (50)

Table 5 The clinical criteria for the classification of idiopathic osteoarthritis (OA) of the knee developed by the American College of Rheumatology (ACR)(31)

Clinical examination and radiographic	Clinical examination alone
Knee pain + at least 1 of 3:	Knee pain + at least 3 of 6:
Age> 50 years old	Age> 50 years old
Morning stiffness < 30 minutes	Morning stiffness< 30 minutes
Crepitus on knee movement	Crepitus on knee movement
+	Bony tenderness
Osteophytes	Bony enlargement
	No apparent warmness

The participants were excluded if they had a previous diagnosis of cardiopulmonary disorder that exacerbated symptoms during testing, neurological problems such as cerebrovascular accident, Parkinson's disease, etc. They have experience in lower extremity joint replacements, vertebral or lower limb surgery, and vertebral or lower limb fractures.

For the discontinuation criteria, when a participants reported experiencing provocative pain, the testing was stopped. (i.e. NRS rises at the minimum 3 scales)(51)

Variables and Instrumentation

Number of stands in 30sCST

The 30sCST was applied utilizing an armless chair, having a seat elevation of 43.2 cm (17 inches), the chair, with rubber tips on the legs was positioned against a wall to keep it from replacing during the test. The rater takes thirty seconds using a stopwatch. The participants are encouraged to finish as numerous complete stands feasible in 30 seconds. As the participant's performance is being observed to check for proper sit-to-stand, the rater quietly records the completion of every successful stand. The repetitions are the total successfully completed stand in 30 seconds (a full stand is considered when the timer reaches over midway up after 30 seconds). Unsuccessfully stands and sits are not recorded. (18)

Pain severity evaluation

The NRS is a tool for self-reported pain assessment. It is used to evaluate pain severity before and after the test.

Scores in self-reported knee pain, symptoms, and ADL

The Knee injury and Osteoarthritis Outcome Score (KOOS) pain, KOOS symptoms, and KOOS ADL subscales were used to assess knee pain, knee symptoms, and daily living activities in the knee OA group. The KOOS score is between 0 and 100. The higher KOOS score indicated better health or fewer impairments, whereas the lower KOOS score indicated extreme problems or more impairments.

Procedures

Participants were informed regarding their demographic data (i.e. age, gender, weight, height, body mass index (BMI), and history of medical conditions (Appendix A). The participants with knee OA were identified following ACR criteria (Appendix B). The anthropometric data in participants with knee OA (i.e. bony alignment, pain, and ADL subscales of KOOS, and NRS (Appendix C) was measured.

Prior to testing, the one rater (physiotherapist over 10 years of clinical expertise) was examined for intra-rater reliability of 30sCST. The reliability testing assessed for on the same patient condition at two distinct time points by using the video recording. The

same rater will count the number of 30sCST based on the same video recording within one-week intervals. Intra-class correlation coefficients ($ICC_{(3,1)}$) was utilized to explore the intra-rater reliability. Analyze intra-class correlation coefficients ($ICC_{(3,1)}$) was 0.954, excellent intra-rater reliability.

Before data collection, the rater will instruct the protocol of the 30s-CST examination. The participants were given the chance to rehearse prior to they perform this test accurately. The video recording was used to observe the movement strategy and verify the counting number of 30s-CST. The participants' front and side views have been captured on camera. The pain severity was evaluated by NRS before and after exam. The instructions for 30s-CST, the participants will sit half-buttocks in the chair, back straight, feet placed on the floor, approximately shoulder width apart, slightly knee flexion, arms crossed, and hold hands on the shoulders. They stood on the word 'go' and then return to the first sitting position. They finish repetitions of full stand and full seat repetitions within 30 seconds. During standing up, if they are unable to maintain their arms cross-body and their hands move away from their shoulders, they were reminded by the rater, and this stand was disregarded. (Figure 3) The protocol of testing are demonstrated in Figure 4.

Figure 3 30-second Chair Stand Test

Interpretation of 30s-CST for mobility limitation and decreased functional lower extremity strength

The normative data of 30sCST in older adult aged group 60-69 years was 12 times. (25) If participants complete 30sCST fewer than 12 times, they have mobility limitation and decreased functional lower extremity strength. If they complete 30sCST with 12 times or more than, they do not have any mobility restrictions.

The cutoff-point of 30s-CST for physical performance of older adults admitted in the hospital was 8 repetitions.(52) If participants perform 8 repetitions or less than on the 30sCST, they will be categorized as having low physical performance. If participants can complete 30sCST with over 8 times, they will be categorized as having high physical performance.

Statistical analyses

Descriptive statistics (i.e., mean, standard deviation (SD)) was utilized to describe the demographic characteristics of knee OA patients and baseline measurements. The proportion of knee OA patients with mobility limitation and decreased functional lower extremity strength were described as the percentage (%). The numbers of 30sCST, pain-, symptoms-, ADL-subscales of KOOS, and pain intensity of NRS were presented as mean, standard deviation (SD).

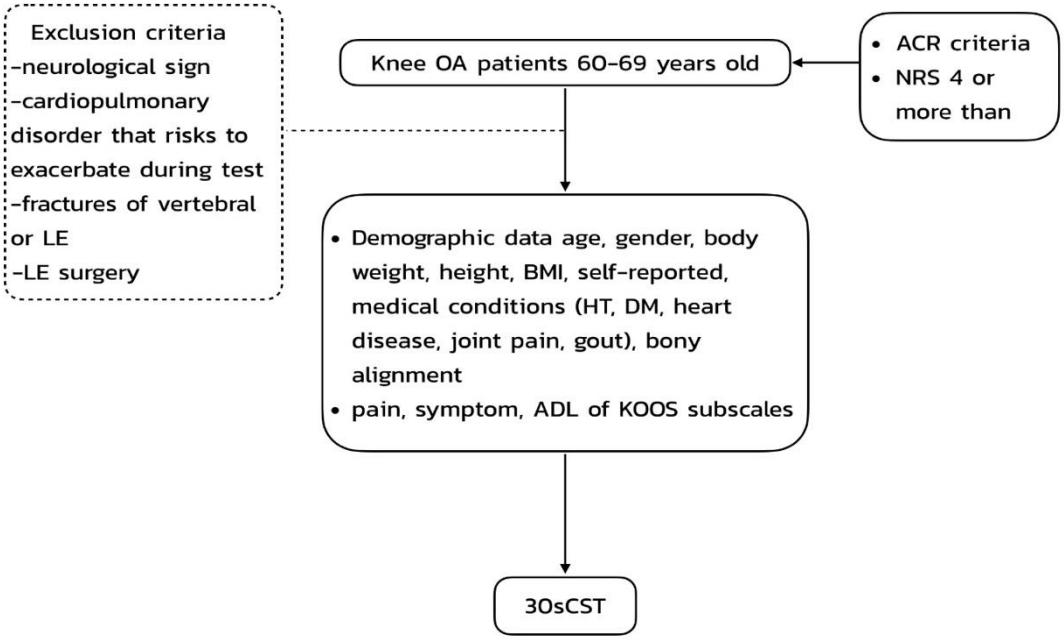

Figure 4 The procedures for testing

CHAPTER 4
RESULT

The objective of this research was to define the number and percentage of knee OA patients with mobility limitation and decreased functional lower extremity strength.

Demographic and clinical characteristics

Forty patients diagnosed with knee OA were enrolled in this study. All knee OA patients could walk independently without assistive devices. Baseline demographic and clinical characteristics of knee OA patients were presented in Table 6. The mean age of patients was 61.98±4.23 years. Seventy-five percent of knee OA patients were between the ages of 60 and 69. Eighty percent of knee OA patients were female and 20% was male. The mean body mass index (BMI) of patients was 27.53±4.61 kg/m^2. Over half of individuals with knee OA were obese and had a BMI greater than 24.9 kg/m^2 (67.5%). The mean pain intensity of patients was 5.9±1.53. 57.5% of knee OA patients experienced moderate pain, whereas 42.5% reported severe pain. In 70% of knee OA patients underlying diseases (i.e., hypertension, dyslipidemia, and diabetes mellitus) were discovered (55%,17.5%, and 10%, respectively). Patients typically (75%) had genu varum or bowlegs alignment in their knees. There were 10% of cases involving genu valgus or knocked knees. Genu recurvatum or hyperextension was present in 15% of patients with knee OA.

Table 6 Demographic and clinical characteristics of knee OA patients.

Characteristics	Number (n=40)	Percent	Mean±SD	range
Age (years)			61.98±4.23	53-69
- 50-59	10	25%	-	-
- 60-69	30	75%	-	-
Gender				
- Female	32	80%	-	-
- male	8	20%	-	-
BMI (kg/m^2)			27.53±4.61	18.94-40.44
- Normal (18.5-22.9)	4	10%		
- Overweight (23-24.9)	9	22.5%		
- Obese1 (25-29.9)	16	40%		
- Obese2 ($\geq$30)	11	27.5%		
Pain intensity (NRS)			5.9±1.53	4-9
- Moderate (4-6)	23	57.5%	-	-
- Severe (7-10)	17	42.5%	-	-
Underlying diseases	28	70%	-	-
- Hypertension	22	55%	-	-
- Dyslipidaemia	7	17.5%	-	-
- Diabetes mellitus	4	10%	-	-
No underlying	12	30%	-	-
Knee alignment				
- Genu varum	30	75%	-	-
- Genu valgus	4	10%	-	-
- Genu recurvatum	6	15%	-	-

30-second chair stand (30s-CST)

All knee OA patients performed 30s-CST less than 12 repetitions, as shown in Table 7. This finding indicated that all individuals with knee OA had mobility limitations and decreased functional lower extremity strength. The percentage of knee OA patients

who performed 8 repetitions or less than on the 30s-CST was 57.5%. The finding indicated that mostly knee OA patients had low physical performance.

Table 7 The percentage of knee OA patients with mobility limitation and decreased functional lower extremity strength

Number of 30sCST	Knee OA patients(n)	percent
≥12 repetitions	0	0%
<12 repetitions	40	100%
• > 8 repetitions	17	42.5%
• ≤ 8 repetitions	23	57.5%

According to Table 8, the mean repetitions of 30s-CST in all knee OA patients were 7.95±1.78 repetitions. The mean repetitions of 30s-CST for each age group showed no significant difference between 50-59, 60-64, and 65-69 years (8.40±1.71, 8.00±1.85, and 7.50±1.78, respectively, p=0.504). There was no significant difference in the mean repetitions of 30s-CST between female and male knee OA patients. (7.97±1.84 and 7.88±1.64, respectively, p=0.896). For each BMI classification, there was no significant difference in repetitions of 30s-CST revealed between normal BMI, overweight, obese1, and obese2 (8.25±1.71, 8.44±1.13, 7.50±2.03, and 8.09±1.92 respectively, p=0.749) For pain intensity, there was no significant difference in the mean repetitions of 30s-CST between moderate and severe knee pain. (8.17±1.64 and 7.65±1.91, respectively, p=0.362).

Table 8 The mean±SD of 30s-CST (repetitions) of knee OA patients.

Characteristics	Number (n=40)	Median	Mean of 30s-CST (repetitions)	p-value
Age 50-69 (years)	40	8	7.95±1.78	
- 50-59	10	8.5	8.40±1.71	0.504[a]
- 60-69	30	8	7.80±1.81	
- 60-64	18	8	8.00±1.85	
- 65-69	12	8	7.50±1.78	
Gender				0.896[b]
- Female	32	8	7.97±1.84	
- Male	8	7.5	7.88±1.64	
BMI (kg/m^2)				0.749[c]
- Normal (18.5-22.9)	4	8.5	8.25±1.71	
- Overweight (23-24.9)	9	8	8.44±1.13	
- Obese1 (25-29.9)	16	8	7.50±2.03	
- Obese2 (≥30)	11	7	8.09±1.92	
Pain intensity (NRS)				0.362[b]
- Moderate (4-6)	23	8	8.17±1.64	
- Severe (7-10)	17	8	7.65±1.91	

*Significance at p-value <0.05 [a]=ANOVA, [b]=Independent t-test, [c]= Kruskal Wallis Test

Knee osteoarthritis outcome score (KOOS)

The mean KOOS subscale scores were pain 57.42±14.82, symptom 61.58±12.04, and ADL 65.58±20. To compare between each age group, there was no significant difference in the mean KOOS pain, symptom, and ADL subscales (pain; p=0.125, symptoms; p=0.626, and ADL; p=0.052). The mean difference in KOOS subscale score between the aged groups 50-59 and 60-69 was pain 3.4, symptoms 2.66, and ADL 2.28. For gender, there was no significant difference in the mean KOOS pain, symptom, and ADL subscale between females and males (KOOS pain; p=0.837, KOOS symptom; p=0.744, and KOOS ADL; p=0.490, respectively). The mean

differences in KOOS subscales between men and women were pain 1.22, symptom 2.22, and ADL 5.02. For each BMI classification, there was no significant difference in the average of all KOOS subscale scores between normal BMI, overweight, obese level 1, and obese level 2 ($p>0.05$). The mean differences in KOOS subscales between obese level 1 and obese level 2 were pain (4.31), symptoms (0.54), and ADL (7.18). KOOS scores in the pain subscale agreed with pain intensity from the NRS. As compared to the moderate pain group, the severe pain group had significantly lower KOOS scores in the pain subscale (62.32±12.49 and 52.26±15.90, $p=0.03$). Additionally, KOOS scores in the symptom subscale were significantly lower in the severe pain group when compared to the moderate pain group (66.47±13.32 and 55.00±19.25, $p=0.032$). However, there was no significant difference in KOOS scores on the ADL subscale between the moderate and severe pain groups (66.42±16.09 and 55.70±19.08, $p=0.64$), as shown in Table 9.

Table 9 The mean±SD, median of three subscales of KOOS scores; pain, symptom, and ADL subscales of knee OA patients.

Characteristics	Number (n=40)	Pain subscales	Symptom subscales	ADL subscales
Age 50-69 (year)	40	57.42±14.82	61.58±12.04	65.58±20.23
median		58	62.5	63.5
- 50-59	10	55.50±13.47	59.60±12.07	63.60±14.92
median		60.94	64.14	65.38
- 60-69	30	58.90±15.23	62.26±18.31	61.32±19.07
median		58	61	63.5
Mean difference		3.4	2.66	2.28
p-value		0.45	0.79	0.82
Gender				
- Female	32	57.78±15.62	61.16±16.75	62.88±19.10
median		58	62.5	69

Table 10 The mean±SD, median of three subscales of KOOS scores; pain, symptom, and ADL subscales of knee OA patients. (Continued)

Characteristics	Number (n=40)	Pain subscales	Symptom subscales	ADL subscales
- Male	8	59.00±11.09	63.38±18.46	57.86±12.97
median		59.50	66	57
Mean difference		1.22	2.22	5.02
p-value		0.837[b]	0.744[b]	0.490[b]
BMI (kg/m^2)				
- Normal (18.5-22.9)	4	59.50±9.47	62.50±8.54	70.25±11.18
median		61	66	68.50
- Overweight (23-24.9)	9	56.33±17.01	61.22±13.75	63.56±23.55
median		58	61	69
- Obese1 (25-29.9)	16	60.13±13.22	61.81±15.03	63.00±13.41
median		57	62.50	65.5
- Obese2 (≥30)	11	55.82±17.53	61.27±24.48	55.82±21.00
median		50	57	54
Mean difference between obese1and obese2		4.31	0.54	7.18
p-value		0.875[a]	0.999[a]	0.538[a]
Pain intensity (NRS)				
- Moderate (4-6)	23	62.32±12.49	66.47±13.32	66.42±16.09
median		61	67.86	65
- Severe (7-10)	17	52.26±15.90	55.00±19.25	55.70±19.08
median		50	53.57	54
Mean difference		10.06	11.47	10.72
p-value		0.03[b]*	0.03[b]*	0.64[b]

*Significance at p-value <0.05 [a]=ANOVA, [b]=Independent t-test, [c]= Mann-Whitney Test

CHAPTER 5
DISCUSSION

The objective of this study was to determine the number and percentage of OA knee patients with mobility limitation and decreased functional lower extremity strength by 30s-CST. As a result, it was found that all participants with OA Knee, in the age range of 50-69 years, performed 30s-CST less than twelve repetitions. Consequently, the patients with OA knee had mobility limitations and decreased lower extremity strength.

Demographic and clinical characteristics

In this study, knee OA patients increased with age. In Table 6, 75% of knee OA patients were between the ages of 60 and 69. Only 25% of individuals with knee OA were between the (1)indicated an age-related increase in the prevalence of knee OA. (2) In Thailand, the knee OA prevalence among community-based elderly also increased with age. (7) The current study found that 80% of knee OA patients were female and 20% were male. Consistent with the previous study in Asia, the prevalence of knee OA patients was higher in females than males. (1) Moreover, in the epidemiological studies of knee OA patients in Bangkok and Samut Songkhram, knee OA patients were found to be more females than males (78.1%, 21.9%, and 83.7%, 16.3%). (7, 8) For BMI as a risk factor of knee OA, most knee OA patients (90%) in the current study had a BMI above 22.9 kg/m2, of which 22.5% were overweight and 67.5% were obese. In agreement with the study by Losina et al 2013, the patients with knee OA were often obese. (53)

30-second chair stand Test (30s-CST)

The findings of the current study showed that 100% of knee OA patients performed less than 12 repetitions of the 30s-CST. In the current study, knee OA patients had mean of 30sCST were approximately 8 repetitions. Bruun et al, 2017 they examined construct validity by comparing patients with low physical performance

(defined as 30sCST≤ 8) with patients with high physical performance (defined as 30sCST>8). The result showed that the proportion of patients with low physical performance who needed help with everyday activities was higher than the proportion of patients with high physical performance ($p<0.01$). (52) This study reflected that the patients who performed 30sCST less than 8 repetitions were the patients who needed help with ADL. According to the current study, all knee OA patients who had mean of 30sCST were approximately 8 repetitions were likely to have mobility limitations and decreased functional lower extremity strength. The major problem may result from osteoarthritis of the knee joint. Osteoarthritis is a chronic joint disorder in which there is progressive softening and disintegration of articulate cartilage, accompanied by the new growth of cartilage and bone at the joint margins (osteophytes) and capsular fibrosis. Common clinical features included pain, swelling, long-standing bow leg deformity, joint stiffness after rest, quadriceps muscle weakness, movement impairment, and patellofemoral crepitus. (10, 11) The anatomical changes caused by OA lead to joint pain, a reduction in muscle function, and limitations in the activities of daily living. (12) The primary problem of patients with knee OA was pain and mobility restriction. (13)

As classified by age groups, the current study showed that the aged group 60-69 years of knee OA patients performed 30s-CST less than 12 repetitions. Consistent with the study of Macfarlane et al, 2006 measured lower body muscle strength in the Hong Kong elderly by 30s-CST. They reported that the overall mean of 30s-CST in the Hong Kong older adult aged group 60-69 years was 12.1 times. (25) For the age group 50-59 years, the current study found that the average of 30s-CST was 8.40 repetitions, which agreed with the previous study of Keerthana et al 2022. They discovered that the persons with knee OA, aged 56.63 years, had an average of 30s-CST of 8.58 repetitions, whereas the persons without knee OA, aged 57.08 years, had an average of 30s-CST of 17.08 repetitions. According to the findings of the study by Keerthana et al, 2022 the average of 30s-CST of the persons with knee OA was less than that of the persons without knee OA. (54) It indicated that mobility limitation may result from the knee OA aged less than 60 years. Moreover, the average of 30s-CST of knee OA

patients in the aged group 50-59 years was less than the mean of 30s-CST in the Hong Kong older adult aged group 60-69 years (8.40, 12 repetitions). (25) It suggested that knee OA may have an impact on functional lower extremity strength and mobility limitations more than increased age. In addition, the study of Macfarlane et al 2006 reported the normative values of the 30-sCST in 1038 Hong Kong elderly people in 5-year age ranges indicating that the mean of 30s-CST was higher in the 60-64 age group than the 65-69 age group, approximately 1 repetition in both female and male. Contrary to the current study, there was a mean difference of 30s-CST between the age group of 60-64 and 65-69 that did not exceed 1 repetition. Moreover, older adults with low levels of habitual physical activity had a mean of 30s-CST that was greater than knee OA patients of the current study (9.7, 7.95 repetitions, respectively). (25) It implied that knee OA may affect functional lower extremity strength more than age or levels of regular physical activity.

As considered to gender, the current study found that there was no difference in mean repetitions of 30s-CST between males and females (7.88 and 7.97 times, respectively). In agreement with Zasadzka et al, 2015, they found no statistically significant differences in mean of 30s-CST between gender (7.1 and 5.7 repetitions, respectively). (55) Controversy, MacKay et al, 2017 established a reference dataset of normative values of 30s-CST stratified for age and gender (age>60 years). They found a significant difference in mean of 30sCST between males and females (18.3 and 15.9 times, respectively) in the elderly. (56) Consequently, the mobility limitation in patients with knee OA may not be affected by gender.

As divided by BMI, the current study found that there was no difference in mean repetitions of 30s-CST between normal, overweight, obese level 1, and obese level 2 groups (8.25, 8.44, 7.50, and 8.09 times, respectively). The previous study by Bennell et al, 2020 found that obese level 2 with knee OA patients, aged 62.4 years, had a mean repetition of 30s-CST greater than obese level 2 with knee OA patients in the current study approximately 2 repetitions (10.0 and 8.09 times, respectively). (57) The study by Keerthana et al, 2022 found that the mean repetitions of 30sCST in obese without knee

OA patients were twice greater than those in obese with knee OA patients in the current study (17.08 and 8.09 times, respectively). (54) Additionally However, Keerthana et al, 2022 found that the mean repetitions of 30sCST in obese with knee OA patients were similar to those in the current study (8.58 and 8.09 times, respectively), although the age of obese knee OA patients in Keerthana's study was less than the age in the current study (56.83 and 62.15 years, respectively). (54) According to the results, knee OA factors were more likely to cause mobility restriction than age and BMI factors in comparison to the previous study.

Regarding pain intensity, the current study found that there was no difference in mean repetitions of 30s-CST between moderate pain and severe pain (8.17, and 7.65 times, respectively). Although the mean pain intensity of lower extremity OA patients in the study of Zasadzka et al, 2015 was similar to the current study (pain scale 5.0 and 5.9, respectively), the mean of 30s-CST in Zasadzka's study was lower than those in the current study (5.9 and 7.95 times, respectively) However, the mean age of OA patients in Zasadzka's study was higher than that in the current study (73.1 and 61.98 years, respectively). (55) As mentioned above, the finding of the current study implied that age-related factors had a greater effect on functional lower extremity strength than pain intensity.

Knee osteoarthritis outcome score (KOOS)

The KOOS score is between 0 and 100. The higher KOOS score indicated better health or fewer impairments, whereas the lower KOOS score indicated extreme problems or more impairments. Larsen et al, 2023 established national record-based reference values for the KOOS in Denmark. This study revealed that mean KOOS subscale scores were pain 84.2, symptoms 83.7, and ADL 85.9 in the 50-59 age range and pain 83.3, symptoms 83.6, and ADL 84.8 in the 60-69 age range. (58) In the current study, the three subscale scores of KOOS in knee OA patients were lower than the reference values in all age ranges (pain 55.50, symptom 59.60, ADL 63.60 in the 50-59 age range and pain 58.90, symptom 62.26, ADL 61.32 in the 60-69 age range).

Additionally, Larsen et al, 2023 used mean differences in the KOOS score of 10 points as the cut-off for clinical relevance. They found small differences (<10 points) in KOOS all subscale scores between age groups (pain 0.9, symptom 0.1, ADL 1.1). (58) In agreement with the current study, the mean differences in KOOS all subscale scores between the 50-59 and 60-69 age groups did not exceed 10 points (pain 3.4, symptoms 2.66, and ADL 2.28).

As considered to gender, the current study found that there was no significant difference in mean KOOS subscale scores between males and females (pain 59.00 and 57.78, p=0.837; symptom 63.38 and 61.16, p=0.744; ADL 57.86 and 62.88, p=0.49, respectively). The mean difference in KOOS all subscale scores between males and females was less than 10 points, which agreed with the finding of Larsen et al, 2023. (58) However, two previous studies found significant differences in KOOS scores between males and females. Paradowski et al, 2006 established population-based reference data for KOOS. They discovered significant differences in all KOOS subscales (pain 87.7 and 78.6, p=0.027, symptom 88.4 and 71.1, p=0.003, and ADL 86.3 and 77.4, p=0.046, respectively) between women and men in the age group 55-74. (59) Tonelli et al, 2011 reported that females had significantly worse scores of on the KOOS pain and ADL subscales than males (p=0.02, 0.007, respectively) Additionally, females reported higher pain intensity than males (8.40 and 5.93, respectively). (60) Contrary to the current study, both females and males were in the moderate pain group (6.16 and 4.88, respectively).

As divided by BMI, the current study found that there was no difference in KOOS subscale scores between the normal, overweight, obese level 1, and obese level 2 groups. The result also showed the difference in all KOOS subscale scores between obese level 1 and level 2 did not exceed 10 points (pain 4.31, symptoms 0.54, and ADL 7.18). According to Larsen et al, 2023 exhibited a small difference in all KOOS subscale scores between obese level 1 and obese level 2 (pain 4, symptoms 3.6, and ADL 3.5), which was less than a cutoff (<10 points) for clinical relevance. (58)

The NRS was used to measure pain intensity and pain distress in patients with knee OA. In the previous study, there was a negative correlation between the KOOS score in all subscales and the NRS. (61) The NRS scale was higher, but the KOOS score was lower. According to the current study, knee OA patients in the severe pain group had significantly lower KOOS pain and symptom scores than those in the moderate pain group (p=0.03). Bennell et al, 2022 compared the effectiveness of exercise programs in people with medial knee OA and co-morbid obesity. They found the NRS scale, KOOS pain, and symptom subscales that agreed with the current study (NRS: 5.9 and 5.9, KOOS pain: 52.9 and 57.42, KOOS symptom: 55.1 and 61.58, respectively). (57) However, the KOOS ADL subscale in the current study showed no significant difference between the moderate and severe pain groups. This finding discovered that 50% of knee OA patients in the severe pain group (NRS>6) had a KOOS ADL score higher than patients in the moderate pain group. It is possible that although they had a greater NRS, they perceived they could perform ADL well.

Limitation

The 30s-CST test, one of the minimum core sets of performance-based tests, was employed in the current investigation to represent the functional mobility in standing up of the patients with OA knees. Other performance-based assessments included the 40-meter fast pace walk test (40mFPWT), stairs climbing (SCT), timed up and go test, and six-minute walk test (6MWT). Therefore, these performance-based tests may be utilized to assess the functional mobility of the patients with OA knees in further study.

Conclusion

This study concluded that 100% patients with knee OA had mobility limitations and decreased functional lower extremity strength. The mean repetitions of 30sCST in patients with knee OA aged 50–69 was approximately 8 repetitions. Moreover, the knee OA patients' scores on all KOOS subscales (pain, symptom, and ADL) decreased, which was associated with the lower number of stands in 30sCST.

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Appendix

Appendix A: Demographic data

Name: _____ Surname: _____

Age: _____ years Gender: female ☐ male ☐

Weight: _____ Kg. Height: _____ cm. BMI: _____ kg/m2

Medical condition: ☐ Hypertension ☐ Diabetes

☐ Heart disease ☐ joint pain ☐ Gout

Surgery history: ☐ Yes ☐ Lower extremity ☐ Spine

☐ No

Fracture history: ☐ Yes ☐ Lower extremity ☐ Spine

☐ No

Appendix B: ACR criteria

The clinical criteria for classification of idiopathic osteoarthritis (OA) of the knee developed by

American College of Rheumatology (ACR)(31)

☐ Clinical examination and radiographic
☐ Knee pain + at least 1 of 3: ☐ Age> 50 years old ☐ Morning stiffness < 30 minutes ☐ Crepitus on knee motion+Osteophytes

☐ Clinical examination alone
☐ Knee pain + at least 3 of 6: ☐ Age> 50 years old ☐ Morning stiffness< 30 minutes ☐ Crepitus on knee motion ☐ Bony tenderness ☐ Bony enlargement No palpable warmth

Appendix C: OA knee group

Bony alignment: ☐ Genu valgus

☐ Genu varus

☐ Hyperextension of knee

Numerical Rating Scale (NRS)(50)

ไม่มีอาการปวด ปวดมากที่สุด

0	1	2	3	4	5	6	7	8	9	10

Knee injury and Osteoarthritis Score (KOOS): pain, symptom and ADL subscales (43)

Symptom Subscales:

อาการ: คำถามต่อไปนี้เกี่ยวกับอาการที่เกิดขึ้นกับท่านในช่วงสัปดาห์ที่ผ่านมา

S1 ข้อเข่าของท่านมีอาการบวมหรือไม่

ไม่มี ☐ ไม่ค่อยมี ☐ บางครั้ง ☐ มีอาการบ่อยๆ ☐ บวมตลอดเวลา ☐

S2 ท่านรู้สึกว่าข้อเข่ามีการเสียดสีกัน หรือมีเสียงเกิดขึ้นในข้อขณะเคลื่อนไหวหรือไม่

ไม่มี ☐ ไม่ค่อยมี ☐ บางครั้ง ☐ เป็นบ่อยๆ ☐ เป็นตลอดเวลา ☐

S3 ข้อเข่าของท่านมีอาการติด หรือยึดในขณะเคลื่อนไหวหรือไม่

ไม่มี ☐ ไม่ค่อยมี ☐ บางครั้ง ☐ เป็นบ่อยๆ ☐ เป็นตลอดเวลา ☐

S4 ท่านสามารถเหยียดเข่าได้สุดหรือไม่

ทำได้ทุกครั้ง ☐ ทำได้เป็นส่วนใหญ่ ☐ ทำได้บางครั้ง ☐ ทำไม่ค่อยได้ ☐ ทำไม่ได้เลย ☐

S5 ท่านสามารถงอเข่าได้สุดหรือไม่

ทำได้ทุกครั้ง ☐ ทำได้เป็นส่วนใหญ่ ☐ ทำได้บางครั้ง ☐ ทำไม่ค่อยได้ ☐ ทำไม่ได้เลย ☐

การฝืดขัดของข้อ: คำถามต่อไปนี้เกี่ยวข้องกับการฝืดขัดของข้อเข่าที่ท่านรู้สึกในช่วงสัปดาห์ที่ผ่านมานี้ การฝืดขัดของข้อเข่าเป็นความรู้สึกถึงการจำกัดการเคลื่อนไหวของข้อเข่า หรือเคลื่อนไหวข้อเข่าในทิศทางต่างๆได้ช้าลง

S6 เมื่อท่านตื่นนอนตอนเช้า ระดับความรุนแรงของการฝืดขัดของข้อเข่าเป็นอย่างไร

ไม่มีอาการ ☐ มีอาการเล็กน้อย ☐ มีอาการปานกลาง ☐ มีอาการรุนแรง ☐ มีอาการรุนแรงมาก ☐

S7 ระดับความรุนแรงของการฝืดขัดของข้อเข่าหลังจากนั่ง นอน หรือพักการใช้ขาในช่วงระหว่างวันเป็นอย่างไร

ไม่มีอาการ ☐ มีอาการเล็กน้อย ☐ มีอาการปานกลาง ☐ มีอาการรุนแรง ☐ มีอาการรุนแรงมาก ☐

Pain Subscales

P1 ท่านรู้สึกว่ามีอาการปวดข้อเข่าบ่อยครั้งเพียงใด

ไม่มีอาการ ☐ ทุกเดือน ☐ ทุกสัปดาห์ ☐ ทุกวัน ☐ ตลอดเวลา ☐

โปรดระบุระดับความปวดข้อเข่าที่เกิดขึ้นในช่วงสัปดาห์ที่ผ่านมานี้
ในขณะที่เคลื่อนไหวข้อเข่าในลักษณะต่อไปนี้

P2 หมุนบิดขาขนเข่าข้างที่ปวดขณะยืน

ไม่มีอาการ	มีอาการเล็กน้อย	มีอาการปานกลาง	มีอาการรุนแรง	มีอาการรุนแรงมาก
☐	☐	☐	☐	☐

P3 เหยียดเข่าจนสุด

ไม่มีอาการ	มีอาการเล็กน้อย	มีอาการปานกลาง	มีอาการรุนแรง	มีอาการรุนแรงมาก
☐	☐	☐	☐	☐

P4 งอเข่าจนสุด

ไม่มีอาการ	มีอาการเล็กน้อย	มีอาการปานกลาง	มีอาการรุนแรง	มีอาการรุนแรงมาก
☐	☐	☐	☐	☐

P5 เดินบนพื้นราบ

ไม่มีอาการ	มีอาการเล็กน้อย	มีอาการปานกลาง	มีอาการรุนแรง	มีอาการรุนแรงมาก
☐	☐	☐	☐	☐

P6 เดินขึ้น หรือลงบันได

ไม่มีอาการ	มีอาการเล็กน้อย	มีอาการปานกลาง	มีอาการรุนแรง	มีอาการรุนแรงมาก
☐	☐	☐	☐	☐

P7 ขณะนอนอยู่บนเตียงตอนกลางคืน

ไม่มีอาการ	มีอาการเล็กน้อย	มีอาการปานกลาง	มีอาการรุนแรง	มีอาการรุนแรงมาก
☐	☐	☐	☐	☐

P8 นั่งหรือนอน

ไม่มีอาการ	มีอาการเล็กน้อย	มีอาการปานกลาง	มีอาการรุนแรง	มีอาการรุนแรงมาก
☐	☐	☐	☐	☐

P9 ยืนตรง

ไม่มีอาการ	มีอาการเล็กน้อย	มีอาการปานกลาง	มีอาการรุนแรง	มีอาการรุนแรงมาก
☐	☐	☐	☐	☐

ADL Subscales: การเคลื่อนไหวในกิจวัตรประจำวัน คำถามต่อไปนี้เกี่ยวข้องกับความสามารถในการเคลื่อนไหวที่เป็นส่วนประกอบของการทำกิจวัตรประจำวัน ซึ่งหมายถึงการเคลื่อนไหวและดูแลตนเอง

โปรดเลือกคำตอบที่แสดงระดับความยากลำบากของการเคลื่อนไหวต่อไปนี้ ที่ท่านรู้สึกในช่วงสัปดาห์ที่ผ่านมา

A1 เดินลงบันได

ไม่ลำบากเลย	ลำบากเล็กน้อย	ลำบากปานกลาง	ลำบากมาก	ลำบากมากที่สุด
☐	☐	☐	☐	☐

A2 เดินขึ้นบันได

ไม่ลำบากเลย	ลำบากเล็กน้อย	ลำบากปานกลาง	ลำบากมาก	ลำบากมากที่สุด
☐	☐	☐	☐	☐

A3 ลุกขึ้นจากเก้าอี้

ไม่ลำบากเลย	ลำบากเล็กน้อย	ลำบากปานกลาง	ลำบากมาก	ลำบากมากที่สุด
☐	☐	☐	☐	☐

A4 ยืนตรง

ไม่ลำบากเลย	ลำบากเล็กน้อย	ลำบากปานกลาง	ลำบากมาก	ลำบากมากที่สุด
☐	☐	☐	☐	☐

A5 ก้มหยิบของจากพื้น

ไม่ลำบากเลย ☐ ลำบากเล็กน้อย ☐ ลำบากปานกลาง ☐ ลำบากมาก ☐ ลำบากมากที่สุด ☐

A6 เดินบนพื้นราบ

ไม่ลำบากเลย ☐ ลำบากเล็กน้อย ☐ ลำบากปานกลาง ☐ ลำบากมาก ☐ ลำบากมากที่สุด ☐

A7 ก้าวขึ้นหรือลงจากรถ

ไม่ลำบากเลย ☐ ลำบากเล็กน้อย ☐ ลำบากปานกลาง ☐ ลำบากมาก ☐ ลำบากมากที่สุด ☐

A8 เดินไปซื้อของระยะใกล้ๆ

ไม่ลำบากเลย ☐ ลำบากเล็กน้อย ☐ ลำบากปานกลาง ☐ ลำบากมาก ☐ ลำบากมากที่สุด ☐

A9 สวมถุงน่องหรือถุงเท้า

ไม่ลำบากเลย ☐ ลำบากเล็กน้อย ☐ ลำบากปานกลาง ☐ ลำบากมาก ☐ ลำบากมากที่สุด ☐

A10 ลุกขึ้นจากเตียง

ไม่ลำบากเลย ☐ ลำบากเล็กน้อย ☐ ลำบากปานกลาง ☐ ลำบากมาก ☐ ลำบากมากที่สุด ☐

A11 ถอดถุงน่องหรือถุงเท้า

ไม่ลำบากเลย ☐ ลำบากเล็กน้อย ☐ ลำบากปานกลาง ☐ ลำบากมาก ☐ ลำบากมากที่สุด ☐

A12 นอนพลิกตัวบนเตียงโดยไม่ขยับเข่าก่อน

ไม่ลำบากเลย	ลำบากเล็กน้อย	ลำบากปานกลาง	ลำบากมาก	ลำบากมากที่สุด
☐	☐	☐	☐	☐

A13 ก้าวขาเข้าและออกจากห้องน้ำ

ไม่ลำบากเลย	ลำบากเล็กน้อย	ลำบากปานกลาง	ลำบากมาก	ลำบากมากที่สุด
☐	☐	☐	☐	☐

A14 นั่ง

ไม่ลำบากเลย	ลำบากเล็กน้อย	ลำบากปานกลาง	ลำบากมาก	ลำบากมากที่สุด
☐	☐	☐	☐	☐

A15 นั่งลง และลุกจากโถส้วม (โปรดระบุหากเป็นส้วมแบบนั่งยองๆไม่ใช้แบบโถนั่ง)

ไม่ลำบากเลย	ลำบากเล็กน้อย	ลำบากปานกลาง	ลำบากมาก	ลำบากมากที่สุด
☐	☐	☐	☐	☐

A16 ทำงานบ้านหนักๆ เช่น เคลื่อนย้ายสิ่งของ ขัดพื้น

ไม่ลำบากเลย	ลำบากเล็กน้อย	ลำบากปานกลาง	ลำบากมาก	ลำบากมากที่สุด
☐	☐	☐	☐	☐

A17 ทำงานบ้านเบาๆ เช่น ทำกับข้าว กวาดบ้าน

ไม่ลำบากเลย	ลำบากเล็กน้อย	ลำบากปานกลาง	ลำบากมาก	ลำบากมากที่สุด
☐	☐	☐	☐	☐

แบบบันทึกการทดสอบ 30-sCST

จำนวนครั้งที่ผู้เข้าร่วมวิจัยทำได้_____ครั้ง

Appendix D: The certificate of ethical approval

เอกสารรับรองโครงการวิจัย
โดยคณะกรรมการจริยธรรมในมนุษย์
คณะกายภาพบำบัด มหาวิทยาลัยศรีนครินทรวิโรฒ

เอกสารรับรองเลขที่	PTPT2021-007
ชื่อโครงการ :	การคัดกรองการเคลื่อนไหว, ความแข็งแรงของกล้ามเนื้อรยางค์ขา, และความเสี่ยงในการล้มด้วยการทดสอบ 30 second Chair Stand Test และ timed up and go ในผู้ป่วยข้อเข่าเสื่อม
ชื่อหัวหน้าโครงการ :	นางสาวภัทร์ธิรา วิริยธรรมเจริญ
หน่วยงานที่สังกัด :	สาขากายภาพบำบัด
เอกสารที่รับรอง :	1. แบบเสนอโครงการวิจัย
	2. เอกสารชี้แจงผู้เข้าร่วมการวิจัย
	3. หนังสืออินยอมตนให้ทำการวิจัย
	4. แบบการเก็บรวบรวมข้อมูล/โปรแกรมหรือกิจกรรม
วันที่รับรอง :	30 สิงหาคม 2564
วันที่หมดอายุ :	29 สิงหาคม 2565

ขอรับรองว่าโครงการดังกล่าวข้างต้นได้ผ่านการพิจารณาเห็นชอบโดยสอดคล้องกับคำประกาศเฮลซิงกิ จากคณะกรรมการจริยธรรมในมนุษย์ คณะกายภาพบำบัด มหาวิทยาลัยศรีนครินทรวิโรฒ **ออกให้ ณ วันที่** 13 กันยายน 2564

ลงนาม.....
(ผู้ช่วยศาสตราจารย์ ดร.ชัชฎา ชินกุลประเสริฐ)
ประธานคณะกรรมการจริยธรรมในมนุษย์

ลงนาม.....
(รองศาสตราจารย์ ดร.รัมภา บุญสินสุข)
คณบดีคณะกายภาพบำบัด

วันที่ ๑๙ สิงหาคม ๒๕๖๔
เลขที่หนังสือรับรอง อย.๐๐๓๒.๒๐๒.๒/...๐๒๘.....

หนังสือรับรองโครงการวิจัย

คณะกรรมการจริยธรรมการวิจัยในมนุษย์โรงพยาบาลเสนา อำเภอเสนา จังหวัดพระนครศรีอยุธยา ได้ทำการตรวจสอบและรับรองโครงการวิจัยตามที่ระบุไว้ด้านล่าง ทั้งนี้โดยพิจารณาตามหลักเกณฑ์ของคณะกรรมการฯ

ชื่อโครงการ:
การคัดกรองการเคลื่อนไหว, ความแข็งแรงของกล้ามเนื้อรยางค์ขา, และความเสี่ยงในการล้มด้วยการทดสอบ 30 second Chair Stand Test และ Timed up and go ในผู้ป่วยข้อเข่าเสื่อม

หัวหน้าโครงการ:
นางสาวภัทร์ธิรา วิริยธรรมเจริญ

สถานที่ทำวิจัย:
แผนกกายภาพบำบัด โรงพยาบาลเสนา จังหวัดพระนครศรีอยุธยา

เอกสารที่รับรอง:
โครงร่างการวิจัย
แบบสอบถาม/เครื่องมือ
หนังสือยินยอมตนให้ทำการวิจัย (Informed Consent Form)
เอกสารชี้แจงผู้เข้าร่วมการวิจัย (Information Sheet)
ประวัติหัวหน้าโครงการวิจัย

วันที่ออกเอกสารรับรอง:
๑๙ ตุลาคม ๒๕๖๔

วันหมดอายุ:
๑๘ ตุลาคม ๒๕๖๕

จริยธรรมการวิจัยในมนุษย์
โรงพยาบาลเสนา

(ทันตแพทย์หญิงผดาศิริ ศรพรหมมาศ)
ประธานคณะกรรมการจริยธรรมการวิจัยในมนุษย์โรงพยาบาลเสนา

Appendix E: Concrete benefits shown in research results

เอกสารรับรอง การนำผลงานวิจัยไปใช้ประโยชน์อย่างเป็นรูปธรรม

คำชี้แจง : เอกสารชุดนี้มีวัตถุประสงค์เพื่อประเมินคุณภาพผลงานวิจัยของนิสิตระดับบัณฑิตศึกษา มหาวิทยาลัยศรีนครินทรวิโรฒ ที่สามารถนำไปใช้ประโยชน์อย่างเป็นรูปธรรม

ชื่อ-นามสกุล.....นางสายสมร บุญรอด.....

ตำแหน่ง.....นักกายภาพบำบัดชำนาญการ.....

ชื่อบริษัท/องค์กร..งานกายภาพบำบัด กลุ่มงานเวชกรรมฟื้นฟู โรงพยาบาลเสนา.....

ได้ใช้ประโยชน์จากปริญญานิพนธ์/สารนิพนธ์ เรื่อง Mobility Limitation and Functional Lower Extremity Strength Screening by 30 second Chair Stand Test in Patients with Knee Osteoarthritis

ชื่อนิสิต....นางสาวภัทร์ธิรา วิริยธรรมเจริญ.....**หลักสูตร**.....วิทยาศาสตรมหาบัณฑิต สาขากายภาพบำบัด

การนำผลงานไปใช้ประโยชน์อย่างเป็นรูปธรรม : **กรุณากรอกการนำผลงานวิจัยไปใช้ประโยชน์โดยละเอียด ได้แก่ ระบุ วัน เวลา สถานที่ที่นำไปใช้ประโยชน์ ผู้นำไปใช้ประโยชน์ พร้อมแนบหลักฐาน เช่น รูปถ่ายหนังสือเชิญ หนังสือขอนำผลไปใช้ ฯลฯ (ถ้ามี)**

1. **ใช้ประโยชน์ในเชิงพาณิชย์** ระบุ.....

   [ ] บริษัทเจรจาขอตัวอย่างผลิตภัณฑ์ / ถ่ายทอดงานวิจัย [ ] อยู่ระหว่างทำสัญญากับบริษัท

   [ ] อื่นๆ.....

2. **ใช้ประโยชน์ทางสังคมและชุมชน เช่น การถ่ายทอดงานวิจัยสู่ชุมชนในรูปแบบต่างๆ**

   [ ] การฝึกอบรม [ ] การติดโปสเตอร์งานวิจัยในชุมชน / วัด / โรงเรียน

   [ ] การจัดทำคู่มือให้กลุ่มเป้าหมาย [ ] การจัดประชุมให้ความรู้กลุ่มเป้าหมายเฉพาะ

   [ ] อื่นๆ

3. **ใช้ประโยชน์ในเชิงนโยบายเพื่อใช้ประโยชน์ประกอบการตัดสินใจในการบริหาร หรือกำหนดนโยบาย**

[√] การนำเสนอข้อมูลที่เป็นประโยชน์ต่อหน่วยงาน

[ ] อื่นๆ.....

4. **การจดสิทธิบัตร, อนุสิทธิบัตร, ฉลากการค้า และอื่นๆ ที่เกี่ยวข้องกับทรัพย์สินทางปัญญา**

[ ] ไม่ได้จด [ ] อยู่ระหว่างการยื่นจด

[ ] ยื่นจด [ ] สิทธิบัตร ระบุ.....

[ ] อนุสิทธิบัตร ระบุ.....

[ ] ฉลากการค้า ระบุ.....

[ ] อื่นๆ.....

เมื่อปี พ.ศ. .....เลขที่.....

5. **การนำผลงานเผยแพร่ในเว็ปไซต์ ระบุเว็บไซต์.....**

ชื่อผลงาน.....

ผู้นำขึ้นโพสต์.....

ลงชื่อ.....

(.....นางสายสมร บุญรอด.....)

บริษัท/องค์กร....โรงพยาบาลเสนา.....

หมายเหตุ: ผู้มีอำนาจโปรดลงนามพร้อมประทับตรางค์กร

VITA

NAME	Pattira Wiriyatumjaroen
DATE OF BIRTH	19 January 1988
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