Factors associated with physical therapy treatments of patients with knee osteoarthritis in Thailand

ปัจจัยที่สัมพันธ์กับการรักษาทางกายภาพบำบัดของผู้ป่วยข้อเข่าเสื่อมในประเทศไทย

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ABSTRACT

Background: Most physical therapists (PTs) in developed countries use evidence-based physical therapy for patients with knee osteoarthritis (OA). Conversely, little is known concerning treatment used by Thai PTs in such patients.

Objective: To examine the relationship among characteristics of PTs, patients with knee OA, and type of physical therapy treatments.

Methods: This survey applied three sets of questionnaires to collect data. Questionnaire Set-A collected PTs' information and experience in treating knee OA. Questionnaires Set-B collected patients' information regarding history of knee OA, pain severity, disability, and function of knee (assessed by the modified Western Ontario and McMaster Universities Arthritis (WOMAC) Index). Questionnaire Set-C collected data on the physical therapy methods. Each PT was required to collect the data of at least three consecutive patients with knee OA in the out-patient unit. Logistic regression models were used to determine the relationship among PTs' and patients' characteristics and actual use of treatments including exercise, and patient education.

Result: Exercise (93.63%) was the most used treatment. Most PTs applied a combination of techniques to relieve pain and improve knee function. Exercise was associated with the total modified WOMAC score and patient's BMI ($p<0.05$). Patient education was associated with the PTs' short-course training of OA, patients with age less than 60 years, and abnormal BMI ($p<0.05$).

Conclusion: Most Thai PTs used exercise for treating knee OA which was in line with the clinical guidelines. Some patient characteristics influenced the PTs' selection of treatment including patient's age, BMI, pain, stiffness, and functions.

Keywords: knee osteoarthritis, physical therapy, exercise, pain, education

บทคัดย่อ

ที่มาและความสำคัญ: นักกายภาพบำบัดส่วนใหญ่ในประเทศพัฒนาแล้วให้การรักษาทางกายภาพบำบัดด้วยหลักฐานเชิงประจักษ์แก่ผู้ป่วยโรคข้อเข่าเสื่อม ในทางตรงกันข้ามข้อมูลเกี่ยวกับการเลือกใช้วิธีรักษาโดยนักกายภาพบำบัดไทยในผู้ป่วยกลุ่มนี้ยังมีอยู่น้อยมาก

วัตถุประสงค์: เพื่อศึกษาความสัมพันธ์ระหว่างคุณลักษณะของนักกายภาพบำบัด ผู้ป่วยข้อเข่าเสื่อม และชนิดของวิธีการรักษาทางกายภาพบำบัด

วิธีการวิจัย: การสำรวจนี้ใช้แบบสอบถามสามชุดในการรวบรวมข้อมูล แบบสอบถาม ชุด A ใช้รวบรวมข้อมูล

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และประสบการณ์ของนักกายภาพบำบัดในการรักษาผู้ป่วยข้อเข่าเสื่อม แบบสอบถาม ชุด B รวบรวมข้อมูลของผู้ป่วยเกี่ยวกับประวัติข้อเข่าเสื่อม ความเจ็บปวด ความทุพพลภาพ และการทำงาน (โดยใช้แบบประเมิน Western Ontario McMaster Universities Arthritis (WOMAC) Index) และ แบบสอบถามชุด C รวบรวมข้อมูลเกี่ยวกับวิธีการรักษาของนักกายภาพบำบัด นักกายภาพบำบัดแต่ละรายจะเก็บข้อมูลผู้ป่วยข้อเข่าเสื่อมที่มารับการรักษาที่คลินิกผู้ป่วยนอก จำนวนอย่างน้อย 3 ราย ต่อเนื่องกัน ในการวิเคราะห์ผลใช้สถิติการวิเคราะห์พหุตัวแปรถดถอยโลจิสติกเพื่อหาความสัมพันธ์ระหว่างคุณลักษณะของนักกายภาพบำบัดและผู้ป่วยกับการรักษาทางกายภาพบำบัดด้วยวิธีออกกำลังกายและการให้คำแนะนำแก่ผู้ป่วย

ผลการวิจัย: นักกายภาพบำบัดส่วนใหญ่นิยมให้การรักษาด้วยวิธีการออกกำลังกาย (93.63%) และนิยมให้การรักษาแบบผสมผสานหลายเทคนิค เพื่อบรรเทาอาการปวดและปรับปรุงการทำงานของข้อเข่า การออกกำลังกายมีความสัมพันธ์กับคะแนน total WOMAC และค่าดัชนีมวลกายของผู้ป่วย ($p<0.05$) การให้ความรู้แก่ผู้ป่วยมีความสัมพันธ์กับ การฝึกอบรมระยะสั้นของนักกายภาพบำบัดที่เกี่ยวข้องกับเรื่องข้อเข่าเสื่อม ผู้ป่วยที่มีอายุน้อยกว่า 60 ปี และ ค่าดัชนีมวลกายของผู้ป่วยที่เกินค่าปกติ ($p<0.05$)

สรุปผล: นักกายภาพบำบัดส่วนใหญ่ใช้การออกกำลังกายเพื่อรักษาข้อเข่าเสื่อมสอดคล้องกับคู่มือให้คำแนะนำทางคลินิก ลักษณะของผู้ป่วยบางประการมีอิทธิพลต่อการเลือกการรักษาของนักกายภาพบำบัด ได้แก่ อายุ ดัชนีมวลกาย ความเจ็บปวด ความยืดตึงและการทำงานของข้อเข่า

คำสำคัญ: ข้อเข่าเสื่อม กายภาพบำบัด ออกกำลังกาย ความปวด การให้ความรู้

Introduction

Osteoarthritis (OA) is one of the most common musculoskeletal problems across the world. Clinically, knee OA is characterized by pain during weight bearing, tenderness, decreased range of motion, crepitus, and occasional effusion. The consequences of OA have the greatest impact on physical activity, leading to disability, and decreased quality of life.[1-2] In 2020, OA was the fourth leading cause of disability worldwide.[3] The prevalence of knee OA in the world was 2.5 billion people or 3.64% of the population of the world in 2012.[4] Its prevalence is rising due to the sharp increase in the elderly population in developed and developing countries. In people aged 60 years and above, approximately 13 percent of females, and 10 percent of males had symptomatic knee OA.[5] In Thailand, Thai people living in Bangkok province were affected by knee OA at a rate ranging from 34.5% to 45.6 %. [6] and the high cost of health care for them has been reported. [7]

Knee OA problem is a long-term chronic disorder involving biopsychosocial factors, the effectiveness of treatment is crucial. Various medical and rehabilitation treatment methods and equipment have been developed to reduce symptoms of patients with knee OA. Physical therapy is one of the most common conservative treatments used for relieving pain and improving knee functions. Various physical therapy treatments are recommended by clinical guidelines, including exercise and patient education. [8-12] Reasonably, high-quality evidence can be used for directing clinician's decision making. Evidence-Based Practice (EBP) consisting of the best research evidence, individual

practitioner's clinical expertise, and patients' preference or values has been currently used worldwide.

Recently, three surveys investigated physical therapy treatments for patients with knee OA in three countries, including the United States of America (USA)[13], United Kingdom (UK)[14] and Nigeria.[15] The result of Costa et al. and Walsh et al. reported that physical therapists (PTs) were more likely to use exercise (96-100%) than use other modalities (TENS 16%, ice 24%) for treating knee OA symptoms.[13,14] On the other hand, PTs in Nigeria more often used thermotherapy than exercises.[15] However, various combinations of treatments were also found in PTs' management in the three countries. Moreover, Costa et al. reported that the characteristics of physical therapists were related to their decision making on treatment options, and the use of exercise intervention and patient education for knee OA were associated with PTs who used EBP.[13]

Although the previous three studies may present a snapshot of how PTs in current practices treat patients with knee OA, there are some limitations in those studied. Firstly, the findings of the retrospective self-reported survey of treatment may be affected by recall bias. Secondly, the previous studies had low response rates. Moreover, those studies did not focus on the relationship between treatment options and the characteristics of patients. Therefore, the relationship between PT management in current practice, and the recommendations of clinical practice guidelines or systematic review is still uncertain.

In Thailand, physical therapy is one of healthcare occupations that is available at the government-owned healthcare facilities across the country, and patients with knee OA is one of the main groups of patients with musculoskeletal problems that visit physical therapy settings. However, a cross- sectional survey examining information on the physical therapy management of patients with knee OA has not been conducted. Therefore, the objectives of this study were to investigate the features of commonly used physical therapy for the management of knee OA in Thailand; and to determine associations among factors relating to the characteristics of PTs, patients with knee OA, and physical therapy treatments.

Methods

Participants

This cross-sectional survey was carried out from June 2020 to November 2020 in the 51 secondary care hospitals in the eastern part of Thailand. It was designed to collect information on PTs, patients with knee OA, and treatment interventions that were used for individual patient. Initially, the target population (N) of this survey was 135 PTs who were working at secondary care hospitals in Eastern Thailand.[16] The sample size of potential PTs to participate in this study was calculated using $n = N/1 + Ne^2$ based on Taro Yamane's formula with a 95% confidence interval [17], resulting in a calculated sample size (n) of 101 participants. A dropout rate about 20% were additionally included (n = 27). Therefore, the minimum sample size requirement was 128 PTs. The inclusion criteria of PTs were having at least

two years of experience in treating knee OA, and currently treating patients with knee OA during the data collection period. They were excluded if they were unable to prescribe physical therapy treatment to their patients with knee OA. After the screening process, a total of 135 PTs met the criteria. Therefore, the researcher planned to collect data from all 135 PTs. Each PT was primarily required to collect data from at least three patients with knee OA consecutively. According to the formula of estimated participants for sample size calculation using multivariable logistic regression analysis, Peduzzi et al suggested that the events per variable in logistic regression analysis should have 10 events or greater such as 10, 15, 20, and 25 per variable to avoid major problems to occur.[18] Since, this study had 14 independent variables to be examined in the logistic analysis model, therefore, the sample size of patients could be varied between 140-350 patients. Therefore, it was initially expected to recruit approximately 405 patients with knee OA into the study (135*3). A convenience sampling method was used for patient selection.

The inclusion criteria of patients with knee OA were having knee OA by the criteria of the American College of Rheumatology or radiographic, having baseline knee pain intensity at rest more than 2 out of 10 evaluated by the visual analog pain scale (VAS). They were excluded if they were unable to communicate in Thai. Ethical approval for this study was obtained from the Research Ethics Review Committee for Research Involving Human Participants, Health Science Group (Blinded) University (COA No.18.1/2020).

Instruments

Three sets of questionnaires including Set-A, Set-B, and Set-C were used for data collection. All PTs were required to complete the questionnaire Set-A collecting data on their individual information and clinical experience including age, gender, experience of practice, experience of knee OA training, type of evidence used for decision making on knee OA treatment, and the number of patient workload per day. The PT then gave the questionnaire Set-B to their patients with knee OA, who agreed to participate in the present study. The questionnaire Set-B required patients to provide details about age, gender, body mass index (BMI), comorbidity, duration of diagnosed knee OA, and symptoms of knee OA. The patient reported knee pain intensity using the Visual Analog Scale (VAS) and reported the feeling of joint stiffness and functional ability with a modified 22-item Western Ontario and McMaster Universities Arthritis (WOMAC) Index. The VAS consisted of a line, 10-cm long with two anchors at the ends of the line. The scale anchors were defined as 'no pain at all' with a score of 0 and 'worst pain ever' with a score of 10. Kuptniratsaikul and Rattanachaiyanont (2007) had modified an original 24-item WOMAC index developed by Bellamy et al [19] into a modified 22-item WOMAC Thai version.[20] A modified WOMAC Thai version questionnaire consists of 22 items for measuring 3 domains including pain (5 items), stiffness (2 items), and function (15 items). A response to each item is in a form of a 10-cm VAS. The score of each domain is an average of all item-scores in that domain. The total WOMAC score is calculated by averaging the scores of all

domains.[20] Thus, a maximum total WOMAC score can be 10. The lower score means less pain, less stiffness, and better physical function. The modified 22-item Thai-WOMAC index had good test-retest reliability with the intra-class correlation coefficients ranging from 0.65 to 0.71, and the internal consistency of the index had an alpha ranging from 0.85 to 0.97.[20] The main researcher obtained a permission for using the modified 22-item Thai-WOMAC for data collection from Kuptniratsaikul V.[20] The questionnaire Set-C required the PT to provide data on treatment methods specific to each patient, including the goal of treatments, physical therapy treatments, and time spent per visit.

Procedures

Prior to the data collection period, the main researcher visited a total of 51 secondary care hospitals in Eastern Thailand to explain the objectives and methodology of the research project to the working PTs, and to invite them to participate in the study. At the beginning of the data collection period, 101 out of 135 potential PTs agreed to participate in the survey and gave informed consent. All 101 PTs completed the questionnaire Set-A. Then, each PT was required to collect data of at least three consecutive patients with knee OA in the out-patient unit. On the day of data collection for each patient, the PT asked the patient to complete the questionnaire Set-B. On the same day, the PT performed physical examination and used clinical decision-making approach to select treatment methods appropriate to the patient. Subsequently, the PT recorded the treatments provided to a specific patient using the questionnaire Set-C. Figure 1 shows the procedures of data collection.

Statistical analysis

The data was analyzed using IBM SPSS version 21. The demographic data of all participants were interpreted as mean and standard deviations for numerical data, and percentages for categorical data. The binary logistic regression was used for the bivariate analysis

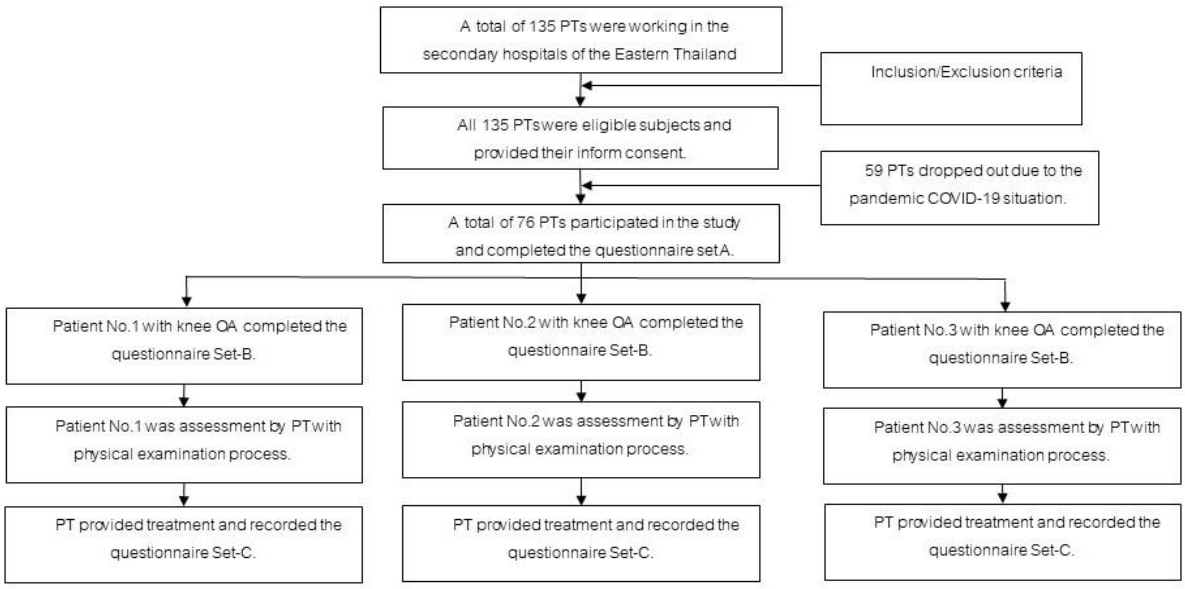

Figure 1 The procedures of data collection

to determine the association between variables of interest i.e., the association of PTs' characteristics and types of used treatments, as well as the association of patients' characteristics and types of used treatment as crude odds ratio with 95% confidence interval (CI). Then, the factors with bivariate association ($p<0.25$) were entered into multivariable logistic regression (backward step-wise (Wald) method) to select variables into the equation. Procedures for stepwise method included entry: 0.05 and removal: 0.10 to explore association between various factors and used treatments that were recommended by the guidelines including exercise and education, as adjusted odds ratio with 95% CI. The researcher adjusted some independent factors that were continuous data into category data before calculating the bivariate or multivariate associations between factors. Additionally, we compared the patient's BMI and the total WOMAC score among 5 types of exercise approach including stretching, strengthening, aerobic, balance, and proprioception exercise, using the One-way ANOVA test. A p-value of less than 0.05 was considered as statistically significant.

Results

Due to the COVID-19 pandemic in 2020, the population of Thailand were required to stay home, maintain social distance, and work from home for several months. Only patients with serious medical conditions went to the hospital to receive medical treatments, while most patients with less severity tried to stay away from hospitals to avoid contact with COVID-19. With such an unexpected situation, some participating PTs could not get any patients with knee OA, so they dropped out of the study. At the end of the data collection period, there were 76 PTs who were working across 40 secondary care hospitals in seven provinces of Eastern Thailand that completed collecting data on 267 patients with knee OA. A response rate of participating PTs in this study was 56.30%.

The demographic characteristics of participants in both groups (PT group, and patients with knee OA group) are presented in Tables 1. The average age of PTs group was 32.12 ± 5.40 years. Most of the PTs were older than 30 years (55.26%). The average age of the patient group was 63 ± 8.99 years. Most of the patients had a BMI of more than 23 kg/m^2 (79.4%) as shown in Table 1. Most PTs used therapeutic exercise (93.63%), ultrasound therapy (86.52%), heat therapy (76.03%), and patient education (62.17%) to treat patients with knee OA. When we examined the specific types of treatments as suggested by clinical practice guidelines including using exercise and patient education, we discovered that strengthening exercise was the most common type of exercise to treat knee OA (89.88%). Moreover, 62.17% of patients in this study received patient education from their PTs. The common types of patient education included details on exercise (54.68%) (Table 2).

To determine the extent to patient symptoms affected a PT's selection of exercise and patient education for each patient, this study classified patients into two groups including "treatment not given" and "treatment given groups", and then examined the average WOMAC

Table 1 Characteristics of physical therapists (n=76) and patients with knee OA (n=267)

Characteristics of PTs	Mean ±SD	Percent	Characteristics of patients with knee OA	Mean ±SD	Percent
Age (yrs.)	32.12±5.40		Age (yrs.)	63±8.99	
- 21-30		44.74	- 40-60		32.95
- >30		55.26	- >60		67.05
Gender			Gender		
- Female		82.89	- Female		70.79
- Male		17.11	- Male		29.21
Short course training in knee OA			BMI (kg/m^2)		
- No		56.58	- 18.5-23		20.60
- Yes		43.42	- >23		79.40
Using EBP			Pain at rest (VAS)	4.85±1.67	
- No		17.11	-0-3		32.96
- Yes		82.89	->3		67.04
Using Clinical guideline			Comorbidity		
- No		18.42	- No		22.10
- Yes		81.58	- Yes		77.90
Clinical experience (yrs.)	7.57±4.65		Duration of knee OA (yrs.)	2.13±0.13	
- 0-5		38.16	- 0-2.0		63.30
- >5		61.84	- >2		36.70
Patient workload per day (persons)	10.41±4.69		Total modified WOMAC score	4.39±1.53	
- 1-10		67.11	- Pain	4.67±1.62	
- > 10		32.89	- Stiffness	4.27±1.99	
			- Physical function	4.31±1.75	

Note: EBP= evidence based-practice, VAS= visual analogue scale, BMI= body mass index, yrs.=years

score of pain, stiffness, function, and total score of each group. We used this classified treatment groups and other PT variables and patient variables for binary regression analysis. Using binary logistic regression analysis for examining the use of therapeutic exercise, 9 factors that had a *p*-value of less than 0.25, and they were not found in collinearity, as seen in Table 3. Additionally, 6 factors were associated with using patient education for patients with knee OA (Table 4). For the final model calculated by multivariate logistic regression analysis (backward stepwise (Wald) method), The Hosmer-Lemeshow test for used exercise (χ^2=6.195, 8 degree of freedom, p-value=0.625)

indicated that the goodness of fit of this model was satisfactory. The significant factors associated with using exercise in knee OA were the total modified WOMAC score (adjusted OR; 0.628 95% CI: 0.442, 0.893) and patient's BMI (adjusted OR; 3.326 95% CI: 1.149, 9.631), as seen in Table 5. The model provided evidence that patients with lower total WOMAC score and BMI of more than 23 kg/m^2 were more likely to receive exercise program. Besides, the Hosmer-Lemeshow test for used education (χ^2=8.841, 5 degree of freedom, p-value=0.116) indicated that the goodness of fit of this model was satisfactory. It was found that the factors associated with using patient education included PT's participation in short course (adjusted OR; 2.337 95% CI: 1.367, 3.995), age of patient (adjusted OR; 0.286 95% CI: 0.279, 0.847), and BMI of patients (adjusted OR; 2.002 95% CI: 1.085, 3.693) (Table 5).

Table 2 Details of physical therapy treatments

Physical therapy treatments	Number	Percent (%)
Therapeutic exercise	250	93.63
- Stretching exercise	149	55.80
- Strengthening exercise	240	89.88
- Aerobic exercise	38	14.23
- Balance training	8	2.99
- Proprioceptive exercise	8	2.99
Patient education	166	62.17
- Exercise education	146	54.68
- Weight loss education	78	29.21
- Using gait aid education	23	8.61
Heat therapy	203	76.03
Ultrasound therapy	231	86.52
Manual therapy	80	29.96
TENS	63	23.60
SWD	38	14.23
Cold therapy	26	9.74
Common combination of 2 treatments		
- Exercise combined with ultrasound therapy	220	82.40
- Exercise combined with heat therapy	195	73.03
- Exercise combined with patient education	158	59.18
Common combination of more than 2 treatments		
- Exercise combined with heat therapy and ultrasound	174	65.17

Note: All physical therapists used more than 2 treatments per case

Table 3 Univariate analysis for factors associated with used exercise[a]

Variables	B	SE	df	Crude OR	Used exercise 95%CI		*p*-value
					Lower	Upper	
Characteristic of physical therapists							
Gender	-0.91	0.56	1	0.404	0.134	1.215	0.107*
Age	0.36	0.50	1	1.432	0.535	3.832	0.475
Clinical experience	-0.45	0.55	1	0.636	0.217	1.860	0.408
Used clinical guideline	0.91	0.78	1	0.404	0.09	1.818	0.238*
Used evidence- base practice	0.53	0.77	1	0.591	0.131	2.67	0.495
Short course training of OA	0.41	0.50	1	0.665	0.248	1.781	0.417
Patient workload per day	-0.01	0.52	1	1.013	0.363	2.833	0.980
Gender	1.19	0.77	1	3.276	0.731	14.679	0.121*
Age	-0.1	0.51	1	1.104	0.407	2.998	0.846
BMI (kg/m^2)	1.01	0.52	1	2.731	0.991	7.527	0.052*
Pain (VAS)	-1.05	0.55	1	0.416	0.116	1.487	0.177*
Comorbidity	-0.30	0.65	1	0.742	0.206	2.675	0.649
Duration of knee OA (years)	-0.67	0.59	1	1.958	0.62	6.182	0.252
Total WOMAC score(No exe/Exe)	-0.38	0.17	1	0.656	0.466	0.924	0.016*
Pain domain (No exe/Exe)	-0.30	0.15	1	0.722	0.538	0.970	0.03*
Stiffness (No exe/Exe)	-0.22	0.12	1	0.789	0.614	1.014	0.064*
Physical function (No exe/Exe)	-0.30	0.15	1	0.722	0.537	2.967	0.032*

Note: [a] Binary regression analysis was used to calculate univariate analysis, *p-value < 0.25, B=Coefficient, SE=standard error, df = degrees of freedom, OR = odds ratio, No exe = No exercise given, Exe = Exercise given

The model demonstrated that PTs who previously studied in short course program were more likely to deliver patient education than PTs who had never participated in short course. Patients with knee OA who had BMI of more than 23 kg/ m^2 were more likely to receive patient education from their PTs.

Furthermore, the present study found that the patients who had lower BMI (Figure 2A) or lower total WOMAC score (Figure 2B) were likely to receive complicated exercise programs that included proprioceptive exercise or balance training exercise. While those with higher BMI or higher total WOMAC score were likely to receive general exercise program such as strengthening, stretching, or aerobic exercise. However, the one-way ANOVA test revealed that the BMI values of patients among the five groups were not statistically different ($F(4,438) = 8.26$, p-value = 0.509). Also, the average total modified Thai-WOMAC score of patients among the five groups were not statistically different ($F(4,438) = 2.35$, p-

value = 0.053). However, the p-value of the average total WOMAC scores of patients among five groups almost reached the significant level, it was possible that the WOMAC score measured at the first visit might influence the PT's selection of type of exercise. A further study with a larger sample size of patients is needed to clarify this issue.

Discussion

The response rate of this study was 56.30 percent. We found that our response rate was acceptable as it was close to the response rate of the Anyanniyi et al study (66%)[15], whereas the response rate of the Walsh et al study was 28%[14], and the response rate of the Costa et al study (3.1%).[13]

The average age of the Thai PTs in this study was 32.12 ± 5.40 years. The age of most PTs was more than 30 years old (55.26%). Most of them were females, had clinical experience for more than 5 years (61.84%), used EBP (82.89%), and followed the recommendations of clinical guidelines (81.58%).

Table 4 Univariate analysis for factors associated with used patient education[a]

Variables	B	SE	df	Crude OR	Used patient education 95%CI		p-value
					Lower	Upper	
Characteristic of physical therapists							
Gender	0.45	0.37	1	1.570	0.761	3.237	0.222*
Age	-0.26	0.26	1	0.771	0.467	1.272	0.308
Clinical experience	-0.02	0.26	1	0.997	0.558	1.624	0.930
Used clinical guideline	0.29	0.30	1	0.751	0.415	1.358	0.344
Used evidence- base practice	0.02	0.33	1	0.983	0.516	1.814	0.959
Short course training of OA	0.79	0.26	1	0.453	0.270	0.760	0.003*
Patient workload per day	0.48	0.26	1	0.615	0.368	1.028	0.063*
Gender	0.20	0.28	1	1.215	0.701	2.107	0.487
Age	-0.50	0.27	1	0.605	0.360	1.018	0.058*
BMI (kg/m2)	0.64	0.30	1	1.903	1.056	3.427	0.032*
Pain (VAS)	-0.28	0.25	1	0.730	0.428	1.248	0.250*
Comorbidity	0.06	0.30	1	1.065	0.588	1.928	0.836
Duration of knee OA (years)	-0.13	0.26	1	0.877	0.526	1.462	0.614
Total WOMAC score (No edu/Edu)	0.02	0.08	1	1.011	0.858	1.191	0.898
Pain domain (No edu/Edu)	-0.06	0.08	1	0.938	0.804	1.094	0.414
Stiffness (No edu/Edu)	-0.07	0.06	1	0.93	0.820	1.054	0.257
Physical function (No edu/Edu)	-0.05	0.07	1	1.044	0.905	1.205	0.557

Note: a Binary regression analysis was used to calculate univariate analysis *p-value < 0.25, B=Coefficient, SE=standard error, df = degrees of freedom, OR = odds ratio, No edu = No education given, Edu = Education given

Table 5 Stepwise multivariate logistic regression models associated with used exercise and used patient education

Factor related to used treatments	Coefficient (B)	SE	Wald	df	Adjust OR	95%CI of adjust OR		*p*-value
						Lower	Upper	
Used exercise								
BMI								
- 18.5-23 kg/m^2	-				1.00	-	-	-
>23 k - >23kg/m^2	1.202	0.542	4.908	1	3.326	1.149	9.631	0.027*
Gender of PTs								
- Female	-				1.00	-	-	-
- Male	-1.152	0.59	3.815	1	0.316	0.099	1.004	0.051
Total WOMAC score								
- No exercise	-	-	-		1.00	-	-	-
- Exercise given	-0.465	0.179	6.718	1	0.628	0.442	0.893	0.01*
Constant	4.334	-	-	-	-	-	-	-
Used patient education								
PT's training								
- Never	-	-	-	-	1.00	-	-	-
- Ever	0.849	0.271	9.598	1	2.337	1.367	3.995	0.002*
Age of patient								
- 40-60 years	-	-	-	-	1.00	-	-	-
- >60 years	-0.721	0.277	5.389	1	0.486	0.279	0.847	0.011*
BMI of patient								
- 18.5-23 kg/m^2	-	-	-	-	1.00	-	-	-
- >23 kg/m^2	0.694	0.31	4.703	1	2.002	1.085	3.693	0.026*
Constant	0.566				-	-	-	-

Note: * p-value < 0.05, SE=standard error, df = degrees of freedom, OR = odds ratio, The Hosmer-Lemeshow test for used exercise (χ^2=6.195, 8 degree of freedom, p-value=0.625). The Hosmer-Lemeshow test for used education (χ^2=8.841, 5 degree of freedom, p-value=0.116)

However, more than half of them have never participated in short course regarding knee OA (56.58%). Consistent with the study of Ayanniyi et al., they surveyed 267 PTs in Nigeria and reported that the age of PTs ranged from 31-40 years (40.40%). Their clinical experience was less than 10 years (67.8%).[15] However, most Nigerian PTs were males. Costa et al. surveyed 413 PTs who were working in Florida, USA and treating patients with knee OA. The USA study reported that the average age of PTs was 43.8 ± 11.8 years, and the female gender was dominant. Most PTs had more

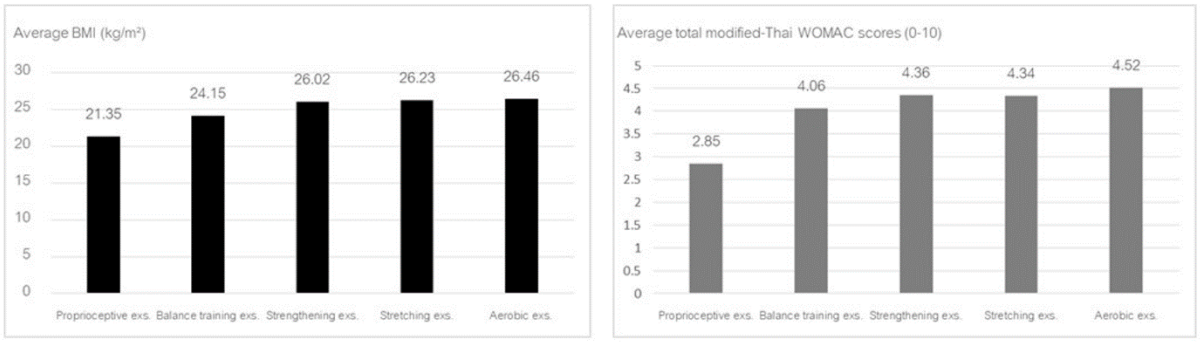

Figure 2A: Association of types of therapeutic exercise with average patients' BMI

Figure 2B: Association of types of therapeutic exercise with average total modified Thai-WOMAC scores

Figure 2 Tyoes of therapeutic exercise program used for patients with knee OA, averange patients' BMI, and average total modified Thai-WOMAC scores

clinical experience than 10 years (65.6%). Furthermore, they used EBP (69.20%) and adhered to clinical guidelines for knee OA management (76.80%).[13]

The results of 267 patients with knee OA showed that the most commonly used physical therapy treatments to treat patients with knee OA were therapeutic exercise, ultrasound therapy, heat therapy, and patient education, respectively. While cold therapy was the least commonly used. Furthermore, all PTs reported using a combination of two or more treatments; the combination of therapeutic exercise, ultrasound therapy, and heat therapy was the most frequently used. Our findings are in line with the previous surveys undertaken in three countries where therapeutic exercise was the most frequently used treatment for knee OA. In 2017, Costa et al. reported that most PTs in Florida, USA, usually used exercise (96%), self-management (94%), manual therapy (50%), and heat therapy (33%). Moreover, PTs who used EBP or clinical guidelines were likely to use exercise, education, and manual therapy.[13] Walsh et al. surveyed 83 PTs in the UK in 2009 and found that the PTs often used exercise (100%), electrotherapy (66%), manual therapy (mobilization, manipulation) (60%), and less frequently used heat therapy (4%).[14] While, Ayanniyi et al., reported that most PTs in Nigeria used heat or ice therapy (86.1%), followed by exercise (81.3%). They also used less advice on bed rest (39%).[15] PTs in Nigeria and Eastern Thailand frequently used heat therapy, even though there has been little evidence to support its effectiveness.[21]

Generally, PTs commonly used more than one type of treatments per one patient visit. A previous study showed that combined treatments (exercise, TENS, and hot pack) could reduce significant pain and improve physical function in patients with knee OA.[22] Similarly, Certin et al. reported that physical therapy treatment (hot pack, ultrasound therapy, SWD, and TENS) combined with isokinetic strengthening exercise could significantly reduce pain in patients with knee OA when compared within the group.[23] Our results showed high popularity in using ultrasound therapy and heat therapy combined with exercise. In Florida, USA, PTs commonly combined therapeutic exercise, and patient education with mobilization treatment.[14] It was possible that PTs used various

types of treatments to tailor each patient's symptoms and preference. MacKay et al. found that the treatment decision making of PTs in Canada was influenced by several factors, including PTs' belief and use of EBP, patient characteristics such as conditional patients, and health care system support such as treatment options.[24] Accordingly, PTs in different countries may select options for their treatment combination differently based on many factors such as the treatment popularity, research evidence, culture, accessible technology and knowledge, healthcare policy, as well as patient value and preferences.

There have been several available clinical practice guidelines for the management of knee OA. Most guidelines are constantly being reviewed and updated in light of new findings from research on the effectiveness of various modalities.[8-12] Recently, the American College of Rheumatology/Arthritis Foundation (ACR) guide-lines, Dutch clinical guidelines, and the Thai rheumatism association guidelines have recommended clinicians to use exercise and patient education for knee OA management.[10-12] Many randomized controlled trials that were summarized in these guidelines demonstrated that exercise therapy effectively reduced pain and improved physical function. Accordingly, PTs who are using evidence-based practice should use exercise, self-management, or patient education as the core treatments for patients with knee OA. Knee OA is an incurable disease due to a gradual deterioration of the cartilage surface of the knee joint. The rate of knee degeneration depends on the bodyweight, age, and physical activity of patients. Therefore, increasing knee muscle strength and losing weight are essential for helping patients to live a better life. Excessive weight and advancing age were discovered to be contributing factors to knee pain intensity and decreased joint functions. Most patients with knee OA had comorbidity with musculoskeletal problems such as upper limb sprain, swelling and pain in the leg, impaired balance, and fractures from falling.[5, 25-26] Further healthcare actions are required to address and treat these complications. Clinically, PTs apply several types of therapeutic exercise for relieving musculoskeletal pain, including strengthening exercise, aerobic exercise, proprioception, and mind-body training. However, PTs should choose the type of exercise based on the patients' abilities.[27-28] Our findings showed that the majority of PTs preferred to use therapeutic exercise (93.63%), which was related to the recommendations from clinical guidelines; and they commonly used strengthening exercise (89.88%) over aerobic exercise (14.23%). The multivariate analysis showed that Thai PTs used symptoms including pain, stiffness, and physical function for decision making on the design of exercise program. Patients who had less pain, less stiffness and better function were more likely to receive more complicated exercise program such as proprioceptive exercise. The reason of the decision making on using the proprioceptive exercise might be due to patients with knee OA had impaired proprioception in the knee joint. This impairment resulted in impaired balance and increased risk of fall. Therefore, PT might use proprioceptive exercise for the improvement of

proprioceptive sensation of patients. However, PTs might apply type of exercise based on ability of the patients. For example, a maneuver of proprioceptive exercise such as one leg standing with open eyes or closed eyes was more suitable to patients with less total modified Thai-WOMAC score than those with higher WOMAC scores. A previous systematic review of the effectiveness of proprioceptive training has suggested that this type of exercise can generate significant improvements in somatosensory and sensorimotor function of body.[29] Whereas, strengthening exercise are more commonly used by PTs for patients with knee OA because some maneuvers of strengthening knee exercise can be performed during sitting or lying position, and thus not placing overload to the weight-bearing knee joint.

Furthermore, this study showed that therapeutic exercise had a tendency to be associated with the BMI of patients with knee OA. The current Dutch clinical guidelines and the current ACR guidelines have recommended clinicians to use therapeutic exercise and patient education on weight loss or exercise in-home programs for patients with knee OA.[12] Spitaels et al., surveyed PTs in Belgium and found that more than 80% of patients received patient education on exercise and less than 50% received patient education on weight loss self-management strategies.[30] Our results reported that 54.68 percent of patients received advice on exercise and 29.21 percent received advice on weight loss. Thai PTs often provided advice on self-management for the patients who had an age of less than 60 years and a BMI of less than 23 kg/m^2. Previous studies reported that obesity was associated with higher levels of pain and stiffness domain of the WOMAC index. [31] Similarly, higher BMI was associated with a greater risk of knee pain.[32] Kroon et al. reported that the effect of patient education programs could mildly reduce pain in patients with knee OA when compared with usual care.[33] PTs can provide a tailored therapeutic exercise and weight loss programs to suit individual patients for decreasing their knee pain as well as improving joint function and quality of life. It was noteworthy to find that the other factor associated with using patient education by Thai PTs was their additional knowledge from attending some short courses relating to OA management. This specific finding may indicate the lack of sufficient knowledge or clinical skill related to OA management taught in undergraduate level. Information about the disease and the benefits of exercise should be incorporated into the constructs of self-knowledge to improve self-efficacy and changes in the behavior of individuals with knee OA in the long term.[34]

Our results showed that PTs in Eastern Thailand used physical therapy treatments to treat patients with knee OA in line with the recommendations of the Thai rheumatism association clinical guideline and international guidelines.[8-12] Our study is the first in Thailand to investigate the relationship between the characteristics of PTs, the characteristics of patients with knee OA, and physical therapy treatments. The strength of this study is that it collected data from each PT's actual treatment, as opposed to previous studies that collected

treatment data from physical therapists through memory recall. However, this study has some limitations that should be addressed and interpreted the findings with caution. Firstly, this was the first study that surveyed PTs in one area of Thailand, therefore the results may not be generalizable to all PTs throughout Thailand. Secondly, due to the pandemic situation of COVID-19 during the survey, there had been fewer patients with knee OA visiting the surveyed hospitals than in a normal situation, resulting in some PTs had no patients with knee OA during the survey time. Moreover, the number of PTs who participated in this study was smaller than expected. If larger sample sizes of PTs and patients were obtained, the validity of this study would be increased. Thirdly, there might be patient selection bias from physical therapists that might reduce the representative of the participating patients. Fourthly, the current study did not collect data on physical examination. However, physical examination is the important part of clinical decision-making process. Findings from physical examination might influence the actual used of physical therapy treatment. Moreover, this study collected the treatments used in patients only once on the day of treatment. The used treatment might be relevant to a short-term goal. If patients would continuously receive treatment program, types of treatments used in the following visits might be different from the first visit, depending on their clinical symptom.

As a result, the benefits of this study contribute to raising awareness of PT characteristics such as studying in short course relating to knee OA, as well as characteristics of patients with knee OA such as BMI, pain severity and functional ability. These are important factors in designing appropriate exercise and patient education programs. Consequently, physical therapists' decision making about using effective treatment and using the best evidence will help improve patients' quality of life. Future studies should examine the effectiveness of evidence-based treatment program compared with routine practice program for patients with knee OA.

Conclusion

This study demonstrated that most Thai PTs used exercise and patient education programs that were in line with clinical guidelines for treating knee OA. Conversely, most PTs still used ultrasound and heat therapy although there has been lack of strong evidence to support their effectiveness. Using therapeutic exercise by PTs was associated with an abnormal BMI of patients with knee OA and their symptoms assessed by the modified Thai-WOMAC score, whereas using patient education was associated with PTs previously attending in short course and patients with knee OA who were less than 60 years old with an abnormal BMI.

Conflict of interest

The authors declare no conflict of interest.

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