

# Non-surgical treatment of knee osteoarthritis

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## ABSTRACT

Knee osteoarthritis is one of the most common degenerative diseases causing disability in elderly patients. Osteoarthritis is an increasing problem for ageing populations, such as that in Hong Kong. It is important for guidelines to be kept up to date with the best evidence-based osteoarthritis management practices available. The aim of this study was to review the current literature and international guidelines on non-surgical treatments for knee osteoarthritis and compared these with the current guidelines in Hong Kong, which were proposed in 2005. Internationally, exercise programmes for non-surgical management of osteoarthritis have been proven effective, and a pilot programme in Hong Kong for comprehensive non-surgical knee osteoarthritis management has been successful. Long-term studies on the effectiveness of such exercise programmes are required, to inform future changes to guidelines on osteoarthritis management.

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## Introduction

Conventionally, osteoarthritis (OA) is considered as progressive wear and tear of articular cartilage. However, recent evidence has suggested that it is an inflammatory disease of the entire synovial joint, comprising not only mechanical degeneration of articular cartilage but also concomitant structural and functional change of the entire joint, including the synovium, meniscus (in the knee), periarticular ligament, and subchondral bone.<sup>1</sup>

Knee osteoarthritis (KOA) is one of the most common degenerative diseases that causes disability in elderly people. An epidemiological study by Felson et al<sup>2</sup> showed that about 30% of all adults have radiological signs of OA; 8.9% of the adult population has clinically significant OA of the knee or hip, of which KOA was the most common type. Another study also showed that the likelihood of OA increases with age.<sup>3</sup> The Chinese population has a similar prevalence rate. A nationwide population-based study in China showed an 8.1% total incidence rate of symptomatic KOA and increasing prevalence of KOA with age.<sup>4</sup> A study in Hong Kong showed that 7% of men and 13% of women had KOA.<sup>5</sup> It is estimated that the percentage of older adults in the Hong Kong population will increase from 16.6% in 2016 to 31.1% by 2036.<sup>6</sup>

Although clinical guidelines for managing lower limb osteoarthritis (LLOA) in the primary

care setting were proposed in Hong Kong in 2004,<sup>7</sup> comparison with recently updated international guidelines shows some differences from management in Hong Kong.

In ageing populations, such as that in Hong Kong, the prevalence of OA is expected to increase. Therefore, it is of paramount importance to keep updating OA management guidelines so as to provide the best possible evidence-based management in the primary setting. This may help to delay progression into end-stage OA and thus decrease the need for arthroplasty and alleviate long waiting times (the average waiting time for arthroplasty in public hospitals in Hong Kong is 66 months).<sup>5</sup> The aim of the present study was to compare and contrast the LLOA management guidelines proposed in Hong Kong<sup>7</sup> with international guidelines, including the Osteoarthritis Research Society International (OARSI),<sup>8</sup> the American Academy of Orthopedic Surgeons (AAOS),<sup>9</sup> and the American College of Rheumatology (ACR) [Table 1].<sup>10</sup>

## Overview of treatment of knee osteoarthritis

Treatment of KOA can be divided into non-surgical or surgical treatment. Non-surgical treatment comprises non-pharmacological and pharmacological treatment, and non-pharmacological treatment comprises core first-

## 膝關節炎的非手術治療

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膝關節炎是導致老年患者致殘的最常見退化疾病之一。隨着人口老化，骨關節炎的問題日益嚴重，在香港也是如此。重要的是，應確保香港治療指南與骨關節炎治療的最佳循證實踐一致。本研究旨在回顧膝關節炎非手術治療的當前文獻和國際指南，並將之與2005年提出的香港現行指南進行比較。國際上，針對骨關節炎非手術治療的活動方案已被證實有效，香港的綜合非手術膝關節炎管理試驗計劃亦取得成功。需要對這些活動方案的有效性進行長期研究，以便為將來對骨關節炎管理指南的轉變提供參考。

line treatment for all patients with OA, including education, self-management, exercise, and weight reduction. Other primary non-pharmacological treatments for KOA include walking canes and biomechanical interventions like braces and orthosis. Pharmacological therapy may include the use of paracetamol, topical or oral non-steroidal anti-inflammatory drugs (NSAIDs), or intra-articular corticosteroids. Surgical procedures are a last resort for end-stage KOA, the most effective type of which is total knee arthroplasty with rehabilitation (Fig).

### Non-pharmacological treatment of knee osteoarthritis

#### Education

Both the Hong Kong LLOA and OARSI guidelines aim to teach patients more about OA; provide them with information about the disease process, nature, prognosis, investigation, and treatment options for OA; facilitate changes in health behaviour; and improve compliance with doctor advice. Counselling can take the form of telephone-based or group sessions or spouse-assisted training programmes, and this counselling works in combination with other treatment approaches.

#### Weight management

The Hong Kong LLOA and other international guidelines agree that weight reduction plays a key role in treating all OA patients. Obesity is strongly associated with an increased risk of developing OA, the requirement of arthroplasty, and physical disability.<sup>11</sup> A meta-analysis reported that obesity increases the risk of developing KOA five-fold, and overweight increases the risk two-fold.<sup>12</sup> The main form of weight management is lifestyle modification, which may include a low-calorie diet, increased physical activity, or anti-obesity drugs; in severe cases, surgery like gastric bypass, adjustable gastric banding, or sleeve gastrectomy should

be recommended. Recent studies have proven the significance of weight modification: evidence has shown that knee pain is reduced by over 50% after body weight reduction by around 10%,<sup>13</sup> and weight reduction may drop the risk of developing symptomatic KOA by 50%.<sup>2</sup> It is expected that weight management would also be effective in Hong Kong. A local study investigating the risk factors of KOA showed that overweight was the greatest risk factor for KOA in Hong Kong and that 64% of the investigated Hong Kong patients with KOA were overweight.<sup>5</sup>

#### Exercise

Exercise aims to reduce pain and improve general mobility and joint function; more intensive exercise can strengthen the muscle around the knee joint. Exercise is one form of first-line treatment advocated by the Hong Kong LLOA guidelines. There is no recommendation regarding the type of exercise to do, suggesting that it has lower efficacy in reduction of pain and disability compared with weight loss. Exercise is now universally recommended by the other international guidelines. Recent studies suggest the important role of exercise in OA management, and different types of exercise have different benefits in KOA treatment. Targeted strengthening exercises, aerobic exercise, stretching, and flexibility exercises are recommended by AAOS, ACR, and OARSI.

A meta-analysis found that land-based exercise (especially exercise like Tai Chi) has the strongly favourable benefits of improving pain and physical function in patients with KOA; the duration and type of exercise programme in the meta-analyses varied widely, but the general components of the programmes are strength training, active range of motion exercise, and aerobic activity. Although positive results were obtained for land-based exercise, they did not favour any specific exercise regimen or duration.<sup>14</sup>

A study in 2016 found that water-based exercise has short-term benefits for function but minor benefits for pain.<sup>15</sup> It is suggested for patients with functional or mobility limitations.

Strength training exercises include primarily resistance-based lower limb and quadriceps strengthening exercises. A meta-analysis in 2011 showed moderate benefits of reducing pain and improving physical function. However, the duration of exercise varied among these programmes.<sup>16</sup>

#### Biomechanical intervention and walking canes

Biomechanical intervention and walking canes are not included in the Hong Kong LLOA guidelines but are regarded as appropriate and effective by the OARSI guidelines. A literature review suggests that knee braces and foot orthoses could have a

TABLE 1. Summary table of comparison between the Hong Kong LLOA guidelines<sup>5</sup> and the AAOS,<sup>9</sup> the ACR,<sup>10</sup> and the OARSI<sup>8</sup> guidelines

	Guidelines			
	Hong Kong LLOA	AAOS	ACR	OARSI
Education	Recommended	Not included in recommendation	Not included in recommendation	Appropriate with moderate benefits
Weight loss	Strongly recommended, especially in overweight patients	Moderate recommendation for symptomatic KOA and BMI $\geq 25$	Strongly recommended for overweight patients	Appropriate for all patients
Exercise	Recommended for all patients, with more effects than weight loss; no recommendation on types of exercise	Strongly recommended for symptomatic KOA self-management programmes, strengthening, low-impact aerobic exercise, and neuromuscular education	Aerobic, aquatic, or resistance exercise are strongly recommended	Land-based and water-based exercises and strength training are appropriate with minor to moderate effects
Biomechanical intervention and brace	Not included	Inconclusive recommendation for symptomatic KOA	Conditionally recommended for KOA	Appropriate and effective for improving joint pain, stiffness, drug dosage, and physical function
Paracetamol	Recommended as first-line treatment	Inconclusive recommendation for symptomatic KOA	Recommended as first-line treatment	Appropriate for patients without relevant co-morbidities and uncertain for patients with relevant co-morbidities
NSAID	As alternatives to paracetamol	Strongly recommended for symptomatic KOA	Conditionally recommended for hand, knee, and hip OA	Recommended for patients with symptomatic hip or knee OA at the lowest effective dose, not appropriate for patients with relevant co-morbidities
Topical NSAID	Appropriate alternatives to oral NSAIDs	Strongly recommended for symptomatic KOA	Strongly recommended over oral NSAIDs for patients aged $\geq 75$ years	Appropriate for KOA as per scientific review, overall safer and better tolerated than oral NSAIDs
Intra-articular steroid	Only for short-term pain management	Inconclusive recommendation for symptomatic KOA	Conditionally recommended for hip and KOA	For short-term moderate-to-severe pain when oral analgesics and anti-inflammatory agents fail, but should consider alternatives for long-term treatment
Intra-articular hyaluronic acid	Recommended for both pain and functional management	Strongly not recommended	No recommendation	Uncertain for KOA and not appropriate for multiple-joint OA
Glucosamine	Appropriate as an alternative for moderate-to-severe pain	Strongly not recommended	Not recommended	Not appropriate for all patients when used for disease modification and uncertain for all patients when used for symptom relief
Opioid	Considered if both paracetamol and NSAID failed or contra-indicated	Inconclusive recommendation for symptomatic KOA	Conditionally recommended for failed initial therapy	Uncertain recommendation because of increased risk of severe side-effects
Duloxetine	Not included in recommendation	Not included in recommendation	Conditionally recommended for patients aged $\geq 75$ years	Included in the latest 2010 guideline for patients without co-morbidities nor multiple-joint involvement

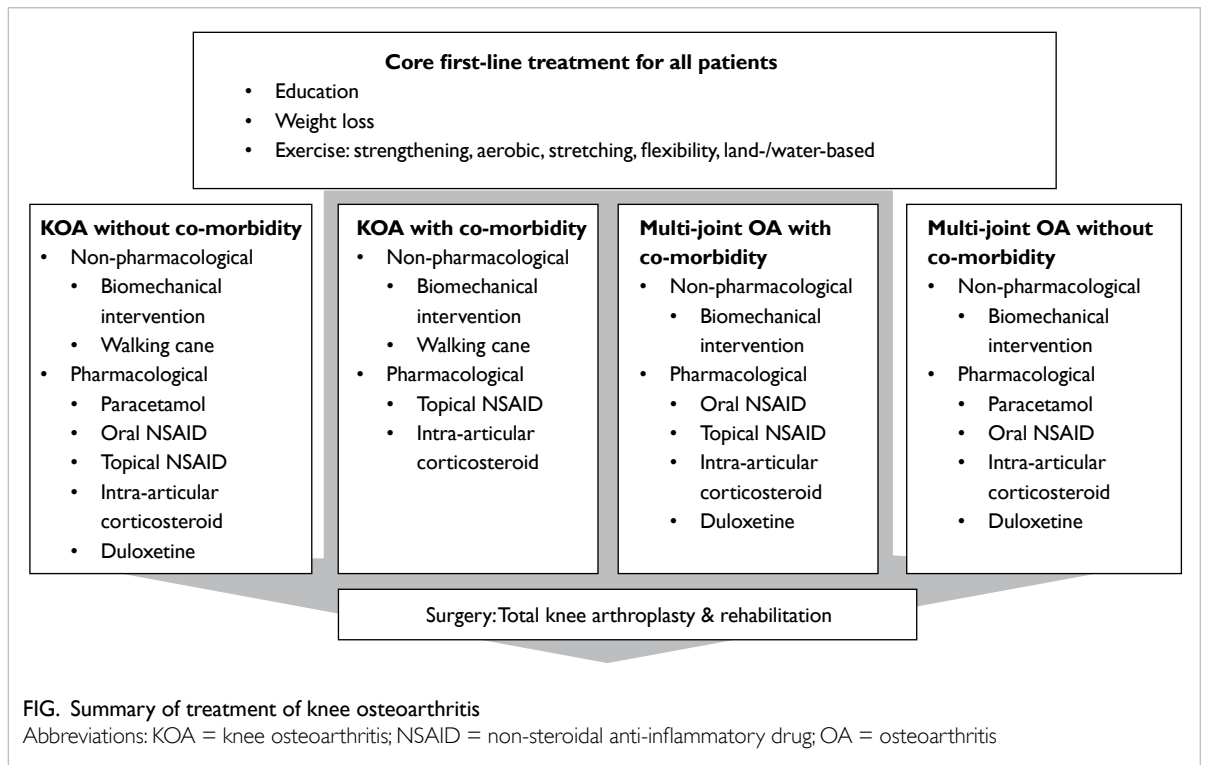
Abbreviations: AAOS = American Academy of Orthopedic Surgeons; ACR = American College of Rheumatology; BMI = body mass index; KOA = knee osteoarthritis; LLOA = lower limb osteoarthritis; NSAID = non-steroidal anti-inflammatory drug; OA = osteoarthritis; OARSI = Osteoarthritis Research Society International

positive impact on decreasing pain and stiffness and improving physical function. However, conclusions about their effectiveness have yet to be made because of the lack of clinical trials and the heterogeneity of interventions among the studies reviewed.<sup>17</sup> Both the OARSI and ACR guidelines suggest that walking canes are appropriate for KOA but not appropriate for multi-joint OA because they may increase weight loading on other affected joints.<sup>18</sup> In contrast, the AAOS guidelines are inconclusive about this topic.

## Pharmacological treatment of knee osteoarthritis

### Paracetamol

The Hong Kong LLOA guidelines stipulate that paracetamol is a key medication for knee OA. It is regarded as the first-line treatment for mild to moderate OA pain because of its efficacy, safety, and cost, and it is also the preferred essential component of long-term pain control. However,



it is no longer the first-line treatment suggested by OARSI, as a meta-analysis showed that paracetamol has low efficacy for pain management.<sup>19</sup> The OARSI guidelines recommend that paracetamol be given in conservative doses and durations, as there is concern regarding an increasing risk of gastrointestinal disturbance and multi-organ failure.<sup>20</sup>

### Non-steroidal anti-inflammatory drugs

The Hong Kong LLOA and ACR guidelines suggest NSAIDs as an alternative to paracetamol, whereas the OARSI guidelines suggest NSAIDs as the preferred first-line pharmacological treatment, because systematic reviews have found that NSAIDs are superior to paracetamol for resting and overall pain.<sup>21</sup> Although NSAIDs are recommended in patients without risk, OARSI is reserved in its recommendation for NSAID use in patients with a high risk of co-morbidities. Non-selective NSAIDs have greater associated upper gastrointestinal risks, whereas selective NSAIDs have more cardiovascular side-effects like myocardial infarction; in addition, both selective and non-selective NSAIDs cause side-effects like hypertension, congestive heart failure, and renal toxicity. The AAOS recommendations about NSAIDs are inconclusive for symptomatic KOA. The Hong Kong LLOA guidelines and all international guidelines strongly suggest that topical NSAIDs (eg, topical diclofenac) be considered as an option for knee-only OA, but their applicability for multiple

joint OA is still uncertain. Both topical and oral NSAIDs have similar efficacy and significant benefits over placebo. Topical ones have less gastrointestinal risk but a higher risk of dermatological side-effects.<sup>22</sup>

### Intra-articular steroids

The Hong Kong LLOA, ACR, and OARSI guidelines recommend that steroids only be used in acute exacerbations of joint inflammation, as frequent use can result in cartilage or joint damage and increase infection risk. The AAOS recommendation on this topic is inconclusive.

### Intra-articular hyaluronic acid

The Hong Kong LLOA guidelines recommend hyaluronic acid for management of KOA for both pain reduction and functional improvement, as it is considered to have effects comparable to those of oral NSAIDs or steroid injections. However, the AAOS and ACR guidelines do not recommend the use of hyaluronic acid because of the lack of data from randomised controlled trials on either its benefits or safety. The OARSI recommendation is also uncertain because of the inconclusive results of recent meta-analyses. A meta-analysis with blinded trials found only small benefits for pain.<sup>23</sup>

### Glucosamine

The Hong Kong LLOA guidelines consider glucosamine to have moderate to large effects on



pain and disability in LLOA compared with placebo, and it is associated with few side-effects. It is used commonly as an alternative treatment, especially for mild to moderate KOA. However, all the international guidelines strongly recommend against the use of glucosamine because recent randomised controlled trials showed similar effects to placebo, with independent trials showing smaller effects than commercially funded ones.<sup>24</sup>

### Opioids

In Hong Kong, opioid analgesics are considered if paracetamol is inadequate and NSAIDs are contraindicated, ineffective, or poorly tolerated. The ACR also suggested that opioids may be an alternative in failed initial therapy. However, with reference to international guidelines for OA management, we should consider the long-term overall usefulness of opioids. Although they have benefits for pain and physical function, compared with those who

are not, patients taking opioids have a chance of adverse withdrawal effects that is 4 times higher, and a risk of developing serious side events, including fractures and cardiovascular events, that is 3 times higher.<sup>25</sup> International guidelines provide a similar recommendation, AAOS makes an inconclusive recommendation, and OARSI is uncertain about opioid use because of the increased risk of side-effects.

### Duloxetine

The use of duloxetine is not suggested by the Hong Kong LLOA guidelines or AAOS. However, OARSI and AAOS suggest that co-existing depression and neuropathic pain contribute to the overall pain syndrome, as the pain experienced in OA is multifactorial. A study showed that duloxetine has pain reduction benefits over placebo.<sup>26</sup> Therefore, it is recommended as a potential adjunct to conventional OA treatment for pain reduction.<sup>27</sup>

TABLE 2. Comparison between Hong Kong (COME<sup>31</sup>) and international exercise programmes (OACCP,<sup>28</sup> BOA,<sup>29</sup> GLA:D<sup>30</sup>)

Programme	Target OA	Targeted intervention	Duration	Outcome	No. of patients enrolled
COME (Hong Kong)	Knee OA	3-Hour nurse-led education session, 12 sessions of physiotherapist-supervised exercises; and 5-8 sessions of occupational therapist-led management programme with emphasis on disease coping strategies and fatigue management	6 Weeks; follow-up at 6 weeks, 3 months, and 1 year	Improved pain, physical function, physical activity, and quality of life at both short- and long-term compared with baseline	50 since 2016
OACCP (Australia)	Hip, knee OA	Coordinated multidisciplinary management including exercise, diet, psychological support, occupational therapy, orthotics, and medical management	Up to 12 months	Significantly improves clinical outcomes (ie, functionality, mobility, and pain) in knee OA but modest benefits for hip OA. Hospital running OACCP has less length of stay for knee and hip replacement separations than other hospitals have. 11% of Knee and 4% of hip OA participants who had been waiting for joint replacement surgery agreed that they no longer need surgery. Correlated with a slight reduction in the likelihood of a patient being diagnosed with obesity or hypertension.	~10 000 since 2012
BOA (Sweden)	Hip, knee, hand OA	Physical therapist, occupational therapist, and OA communicator (ie, "expert patient") delivered education, supported self-management, physical activity recommendations, optional individualised exercise programmes, and optional supervised exercise group sessions (using individual programmes)	3 Months, follow-up at 12 months	94% Rated the programme as good/very good, whereas 62% reported daily use of what they learnt during the course, and 91% reported weekly use after 3 months; compliance was 37% and 72%, respectively after 12 months	~60 000 since 2010
GLA:D (Denmark)	Hip, knee OA	Physical therapists trained according to clinical guidelines, patient education includes 2 sessions of physical therapist-delivered information, supported self-management, physical activity recommendations, and 12 supervised neuromuscular exercise sessions; immediate follow-up and additional online follow-up at 12 months for data collection and evaluation of results	3 Months, follow-up online at 12 months	Data collected from 9825 participants and results showed improvement in pain intensity, quality of life, physical function, and activity at 3 months of participation; fewer participants were on painkillers and sick leave by 12 months	~15 000 since February 2013

Abbreviations: BOA = Better management of patient with OsteoArthritis; COME = Comprehensive Osteoarthritis ManagEment; GLA:D = Good Life with Arthritis in Denmark; OA = osteoarthritis; OACCP = Osteoarthritis Chronic Care Program

## Models of knee osteoarthritis management and comparison

As mentioned above, an increasing number of studies has proven the effectiveness of exercise and physiotherapy on OA management; with the increasing ageing of the population, it would be ideal for Hong Kong to develop a well-established exercise programme for patients with OA as both a non-surgical treatment and follow-up. There have already been different well-established exercise programmes for non-surgical OA management throughout the world, and they have achieved great outcomes. Successful examples include the Osteoarthritis Chronic Care Program in Australia (OACCP),<sup>28</sup> Better management of patients with OsteoArthritis in Sweden,<sup>29</sup> and Good Life with osteoArthritis in Denmark (Table 2).<sup>30</sup> All of these programmes have been proven to improve patients' pain, mobility, physical function, and quality of life. The OACCP has also proven that an exercise programme helps to decrease the demand for arthroplasty; 11% of knee and 4% of hip OA participants who had been waiting for arthroplasty agreed they no longer needed surgery. Different programmes may have minor arrangements targeting their patients, but their content and training duration are generally similar; these programmes consist of education delivered by

physiotherapists and sharing from “expert” patients, supported self-management, and supervised neuromuscular exercise sessions of progressive intensity. These programmes usually last at least 3 months with follow-up for 12 months.

Comprehensive Osteoarthritis ManagEment (COME) initiated in 2016 is a pioneering programme for Hong Kong.<sup>31</sup> The COME programme is a multidisciplinary exercise programme for non-surgical KOA that consists of a 6-week intensive training programme: the components include a 3-hour nurse-led education session, 12 sessions of physiotherapist-supervised exercises; and five to eight sessions of an occupational therapist-led management programme with emphasis on disease coping strategies and fatigue management. After 1 year, patients enrolled in the COME programme reported short-term improvement in Pain Self-Efficacy Questionnaire, Functional Assessment of Chronic Illness Therapy–Fatigue Scale, physical capacity assessed by quadriceps strength, and physical function assessed by one-minute chair test. One-year improvement showed in Patient-Specific Functional Scale, Chinese version of Self-Efficacy of Exercise, and weekly time spent for exercise (Table 3).

## Conclusion

In ageing populations, the prevalence of KOA is expected to increase; thus, there is a need for consensus on non-surgical OA management, so as to improve outcomes for patients with OA and to decrease the burden of arthroplasty. Various exercise programmes for non-surgical OA management have been shown to be effective for improvement of pain, physical function, mobility, and quality of life, and these programmes have even decreased the need and waiting times for arthroplasty. Long-term follow-up of such exercise programmes should be considered to further assess their outcomes.

## Author contributions

All authors had full access to the data, contributed to the study, approved the final version for publication, and take responsibility for its accuracy and integrity.

Concept or design: RHS Kan, PK Chan, KY Chiu, CH Yan.  
 Acquisition of data: T Ho.  
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 Drafting of the manuscript: RHS Kan.  
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TABLE 3. Patients receiving Comprehensive Osteoarthritis ManagEment (COME) showed consecutive significant improvements over each assessment time point (n=55)\*<sup>31</sup>

	Data			
	Baseline	6 Weeks	3 Months	12 Months
Age (years)	63.3 ± 7.4			
Gender				
Male	13			
Female	42			
PSEQ score	42 ± 11.2	46.7 ± 10†		
FACIT score	34.4 ± 8.5	38.4 ± 7.1‡		
One-minute chair test repetitions	26.8 ± 11.3	35.5 ± 12.2‡	38.1 ± 11.1‡	
Right quadriceps strength (kg)	25.6 ± 8.9	29.9 ± 9.9‡	31.1 ± 11.0‡	
Left quadriceps strength (kg)	24.8 ± 9.2	28.0 ± 9.2‡	30.5 ± 10.4‡	
PSFS score	3.5 ± 2.3	6.7 ± 1.8‡	6.8 ± 1.8‡	6.7 ± 1.9‡
SEE-C score	47.3 ± 14.0	64.9 ± 11.1‡	65.2 ± 12.4‡	62.0 ± 17.6‡
Weekly time spent for exercise (mins)	58.4 ± 44.9	81.8 ± 50.5‡	88.4 ± 33.8‡	107.5 ± 26.3‡

Abbreviations: ACIT = Functional Assessment of Chronic Illness Therapy; PSEQ = Pain Self-Efficacy Questionnaire; PSFS = Patient-Specific Functional Scale; SEE-C = Chinese version of Self-Efficacy of Exercise

\* Data are shown as mean ± standard deviation, unless otherwise specified

† P<0.005

‡ P<0.001

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