

# Research Paper: Cost-effectiveness of Self-managed Program Versus Usual Physiotherapy Care of Patients With Knee Osteoarthritis in Nigeria



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## ABSTRACT

**Objectives:** This study aims to compare, from a patient's perspective, the cost-effectiveness between a self-managed program and usual physiotherapy care in treating knee osteoarthritis.

**Methods:** The study participants were assigned into two groups: group I received a weekly physiotherapy treatment plus instructions on self-management skills in goal setting, pain management, exercise, healthy eating, and dealing with fatigue (self-managed group); group II had a physiotherapy session three times a week (usual care group). The osteoarthritis cost and consequence and European quality of life-5 dimension (EQ-5D) were used to generate utility scores. The health effects measure of quality-adjusted life year (QALY) was obtained, and an incremental cost-effective ratio was calculated. Cost-effectiveness was determined by plotting a cost-effectiveness plane of incremental cost against QALY obtained.

**Results:** After 8 weeks of intervention, the self-managed group recorded more significant improvements in pain level, function, and health-related quality of life than the usual care group. Clinical consultation costs (Mean±SD NGN [Nigerian naira]=1800±979), physiotherapy treatment costs (Mean±SD NGN=4000±00), and transportation costs (Mean±SD NGN=1,940±1,150) were less for the self-managed group than the usual care group. Imaging (x-ray) and drug costs did not differ significantly between groups. The QALYs gained over the 8-week intervention period was 0.13 for the self-management group compared to 0.11 for the usual care group.

**Discussion:** From the patient's perspective, a self-managed program was cost-effective and cheaper for healthcare resource use. Physiotherapists may adopt the program to reduce out-of-pocket expenses for patients with knee osteoarthritis.

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## Highlights

- The self-managed program compared to usual physiotherapy treatments decreases knee pain significantly and improves functions and health-related quality of life.
- The self-managed program compared to usual physiotherapy treatments is less costly due to fewer consultation visits and treatment sessions.
- Physiotherapists may adopt the program to reduce costs for patients and congestion in the clinics.

## Plain Language Summary

Knee Osteoarthritis (OA) is a chronic, debilitating, and degenerative condition. Knee OA has no known cure. The current treatment guidelines stipulate the empowerment of patients to self-manage the condition to reduce visits to the clinics and save costs associated with care. The self-managed program is cost-effective in settings where treatments are heavily subsidized through the medical insurance scheme; however, it is unknown if the program will be cost-effective in a setting where patients solely pay to access care. The results demonstrate that the self-managed program in this setting is effective and costs less than the usual care and may be adopted by healthcare professionals to reduce costs associated with treatments and transportations.

### 1. Introduction

**K**nee osteoarthritis is the most common form of Osteoarthritis (OA), accounting for more than 80% of all cases of arthritis [1]. Globally, the prevalence rates of symptomatic knee OA are 9.6% for men and 18.0% for women [2]. OA is characterized by pain and reduced function [3].

Exercise and patient education/self-management can lessen pain and enhance function in individuals suffering from chronic knee OA [4]. Aerobic exercise for knee OA has been found to have a moderate effect on pain (0.52, 95% CI: 0.34-0.70) [3]. However, treatment benefits start to wane if patients do not adhere to the therapeutic regimen following discharge [5]. To this end, patient education/self-management on exercise regimens effectively empowers the patients to take control of their health [6]. Self-management, within the context of a chronic disease management program, focuses exclusively on behavioral lifestyle, active coping strategies, and counteracting the negative maladaptive thoughts that exist with chronic pain. It is reported to improve exercise tolerance and reduce depression associated with chronic diseases [7].

The resources to mobilize self-management programs are scarce, though the decision for its widespread implementation is guided not only by its benefits but also by its cost-effectiveness [8]. The concept of cost evaluation

of clinical interventions is based on many perspectives, including patient, health provider, social, and societal perspectives [9]. Studies on self-management programs among patients with chronic knee osteoarthritis [7, 10-12] show that in settings where care costs are heavily subsidized by the government, the outcomes of self-management interventions are diverse. According to Hurley et al. [7], Thomas et al. [11], and Mazzuca et al. [12], self-management programs reduce utilization costs, cost of primary care visits, and intervention costs.

Conversely, in another study [10], a self-management program was observed to reduce intervention and medication costs. Still, the total healthcare costs were not different from those of a group that received usual physiotherapy care. In this respect, in sub-Saharan Africa, interventions for chronic knee osteoarthritis are constrained by out-of-pocket payments made directly by patients to access care in resource-poor settings. This problem is a barrier to access and utilizing healthcare [13, 14]. We should assess the evidence of the cost-effectiveness of self-managed programs on chronic knee osteoarthritis in this setting to encourage physiotherapists to consider the self-management care model and facilitate access to quality care that offers good value for money.

The studies on the cost-effectiveness of self-managed programs in poor-resource settings, including Nigeria, are scarce. It is unknown whether self-management programs are cost-effective from the patient's perspective. Thus, there was a strong reason to examine the

cost-effectiveness of self-managed programs and usual physiotherapy care in individuals with knee OA from a poor-resource setting.

## 2. Materials and Methods

### Study design

This randomized controlled trial is an economic evaluation of the cost of the healthcare resources used during the 8-week intervention period. The study was registered in the Pan African Clinical Trial Registry with the trial number PACTR201804003266300. The participants were recruited consecutively and then randomized into two groups. The randomization was carried out by a physiotherapist who was blinded to all study aspects to prevent selection bias. Fifty-two opaque envelopes, each containing a piece of paper on which group 1 or 2 was written, were prepared. Each time a participant was recruited, the envelopes were reshuffled. Participants who picked out even numbers were allocated to the self-managed group, and those that picked out odd numbers were allocated to the usual physiotherapy group.

### Study participants

Fifty-two participants with knee OA diagnosed by the referring physicians were recruited from the physiotherapy outpatient clinics of two hospitals in Kano State, Nigeria. The patients had to be between 18 and 64 years old and have at least moderate multiple osteophytes and joint space narrowing ( $\leq$  grade III of the Kellgren-Lawrence radiographic classification) [15] to be included in the study. The participants would be excluded if they reported a history of surgical procedure in the lower limbs or had received physiotherapy within the last three months before the study.

### Interventions

The self-management group received the usual outpatient physiotherapy session for 8 weeks plus a followed-up and monitored home-based program. The program included an educational pamphlet with information on self-care and specific-oriented tasks on pain management, exercise, healthy eating, fatigue reduction, and stress management. The physiotherapy only group received usual outpatient physiotherapy sessions 3 times per week for eight weeks.

### Self-managed program

The self-managed program was modeled after the chronic disease self-management program [16] devel-

oped at Stanford University, and aimed at assisting patients to acquire the skills to take care of their condition on their own. The participants were given a weekly performance of specific tasks on the action plan and problem-solving strategies.

The content of the self-managed intervention included discussions on the following topics: self-management principles, goal setting, pain management tools, physical activity and exercise, healthy eating, dealing with emotions, fatigue, and working with healthcare providers. The duration of the program was 30 minutes per week. Participants received phone calls before their appointments and two days after to ensure they performed their exercises and adhered to the instructions given during the discussions. A systematic review of literature for effective delivery of self-management interventions for chronic musculoskeletal pain revealed that interventions more than 8 weeks were no more effective than an 8-week intervention if delivered and monitored by professionals [17].

### Usual physiotherapy

Usual physiotherapy management included cryotherapy (15 min per day), transcutaneous electrical nerve stimulation (Acu-TENS for 40 min), cycling (5 min), and advice. The program was modeled after the fit and strong program [18] and exercise for people with arthritis [19]. The program consisted of muscle stretching, cycling, isometric muscle contractions targeted at reducing the dysfunctional problems associated with knee OA, which are muscle weakness, muscle fatigue, and reduced functional mobility. The physiotherapy sessions took place 3 times a week for 8 weeks. We followed guidelines from a meta-analysis review of randomized controlled trials that stipulated a minimum dose of three times per week of 12 supervised exercise sessions for patients with knee osteoarthritis [20]. Participants in both groups were asked to continue with medications (ibuprofen, diclofenac, Voltaren S.R, Allopurinol, Vit. C, calcium, co-codamol) prescribed by their physicians.

### Clinical outcome measures

Primary outcome measures were pain, range of motion, functional mobility, and health-related quality of life.

### Pain assessment

We assessed pain with the visual analog scale (VAS) 0-10cm: a single dimension horizontal scale from 0 to 10 cm. The participants were asked to rate their pain intensity at that very moment by drawing a vertical line through the

scale, with 0 representing 'no pain' and 10 representing 'worst pain imaginable.' The reading was obtained using a ruler from 0 cm to the point marked by the patient [21].

### Range of movement measurement

The range of motion was measured with a goniometer. To measure knee flexion, the patient lies facing downward with the knee extended and is asked to touch the back of the foot (heel) nearest to the buttocks. The researcher then put the goniometer on the knee's outer part, with the stationary arm in line with the lateral malleolus and the moveable arm in line with the greater trochanter of the femur [22]. The degree obtained gives the range of motion. Clinically, individuals with knee OA have decreased range of knee flexion compared with age-matched 'healthy' people. Limitation of knee movement during flexion is the main cause of disability [22], and this explains the choice of the movement as one of the primary outcomes of effectiveness.

### Functional mobility assessment

Functional mobility was assessed using the "timed up and go test." The assessment was done on a 10-m stretch of the gymnasium floor. The participant was instructed to stand from sitting, walk as fast as possible, turn around at the marked spot and return to the chair and sit down. The time taken to complete the 6-m (from 2 to 8 m) distance is noted using a stopwatch. Participants are allowed to use a cane if they require them. The walk sequence is repeated twice, and the average time is recorded. This method has been shown to demonstrate high test-retest reliability [22].

### Health-related Quality of Life Assessment

The European Quality of Life-5 Dimensions (EQ-5D) is a tool used to assess health-related quality of life and may be used to generate utility scores to assist in health economic evaluation [23]. The EQ-5D consists of two parts. The first part comprises five subscales covering the dimensions of mobility, self-care, usual activities, pain/discomfort, and anxiety/depression, each with three response levels. The second part assesses pain intensity from 0 to 100 mm, with 0 representing 'best imaginable health state' and 100 mm 'worst imaginable health state.' The EQ-5D has demonstrated a sufficient construct validity ( $r=0.43-0.58$ ) in patients with arthritis [23]. This questionnaire was translated to Hausa at the Department of Hausa, Bayero University, Kano, for easy understanding by participants.

### Healthcare resource use and costing assessment

In this study, information on resource use was obtained from patients' files and the use of the osteoarthritis cost and consequence questionnaire [23]. The questionnaire consists of items on work, medications, hospital usage, family health services, community services, services from professions allied to medicine, aids, adaptations to home or lifestyle, and personal, friends or family costs associated with OA. The cost of medications was obtained from the pharmacy departments of the hospitals, while hospital costs were extracted from the patient's case files. The costs of appliances procured (e.g., crutches, bandages, knee braces, etc.) were obtained from patients, and we also contacted the local suppliers for confirmation. Where there was a disagreement in prices, we used the prices obtained from local suppliers at the time when those items were purchased.

### Calculation of the cost of self-management program

First, we calculated the average cost per patient from the cost of self-managed treatment sessions divided by the total number of participants:

$$\text{average cost (per patient)} = \text{cost of all treatment sessions} / \text{total number of participants}$$

Second, we obtained the transportation costs to and from physiotherapy outpatient clinics based on self-reported costs by the patients. Then, we estimated the transportation cost for each participant by multiplying the estimated cost of treatment sessions by the total number of sessions in 8 weeks. All charges were calculated using the Nigeria currency (Naira).

### Health state preferences and benefits calculation

Quality-Adjusted Life Year (QALY) was used to obtain estimates of the cost-effectiveness of the self-management program. The QALY was calculated from utility scores obtained using the EQ-5D index calculator and the value sets for time trade-off (TTO) for Zimbabwe as it was the only African country with the available TTO.

### Data analysis

We analyzed the data using descriptive and inferential statistics. Descriptive statistics of simple frequency, percentage, mean and standard deviation were computed for participant's pain, stiffness, range of motion (ROM), functional status, and health-related quality of life (HRQoL). A histogram with a normality curve (visual inspection of symmetrical shape) was used to test for the

normality of the data. The independent t-test was applied to determine the mean differences at baseline between the self-managed group and the usual physiotherapy group for pain, stiffness, ROM, functional status, and health-related quality of life, while the paired t-test was employed to determine within-group differences in pain, stiffness, ROM, functional status, and health-related quality of life before and after the intervention in both groups. After 8 weeks of intervention, the independent t-test was again applied to determine the mean difference between the two groups.

### Cost-effectiveness analysis

Cost-Effectiveness analyses were conducted from the patient and the healthcare provider's perspectives. Direct healthcare and non-healthcare costs throughout the intervention were summed for each group. Health effects measured were converted to QALY obtained using the EQ-5D calculator and values for time trade-off (TTO) for Zimbabwe, as it was the only available African country. The incremental cost-effectiveness table was constructed by ranking the interventions from the least effective to the most effective and calculating the incremental cost-effectiveness ratio. Cost-effectiveness was determined by plotting a cost-effectiveness plane of incremental cost against QALY gained [24].

The cost effectiveness graph plots the difference in cost on the vertical axis and difference in effect on the horizontal axis [25]. Only 5 of the 52 participants were male. Therefore, to avoid gender bias, only data from the female participants were used in the analysis and presentation of results. All analyses were performed in SPSS v. 22 (Mac, Chicago, IL, USA). A P-value of less than 0.05 was used to indicate statistical significance.

## 3. Results

The flow chart of the enrolment for both groups of participants is illustrated in Figure 1. Fifty-two participants with chronic osteoarthritis of the knee participated in the study. Of these, 47 completed the study; three participants from the self-management group and two from the usual care group withdrew without any reason. The pre-test measures showed no statistically significant differences between self-managed and usual physiotherapy care groups for pain, stiffness, range of motion (ROM), functional status, and health-related quality of life. Within-group differences were observed (as shown in Table 1) in the self-managed group; the results showed statistically significant improvement in pain, functional status, and health-related quality of life ( $P < 0.05$ ) (Table 1). Statisti-

cally significant differences were observed between both treatment groups for pain, stiffness, functional status, and HRQoL, but not for the range of motion (Table 1).

### Direct healthcare and non-healthcare costs and QALY related to the treatment of knee OA for 8 weeks

The participants in the self-management group visited the outpatient physiotherapy clinic once a week (a total of 8 sessions), while participants in the usual care group visited 3 times per week (a total of 24 sessions). This difference resulted in cheaper direct healthcare costs (clinical consultations and physiotherapy management) for the self-management group (Table 2). For non-healthcare costs, the self-management group had lower transportation costs but higher costs for phone calls. The difference was, however, offset by significant savings in other health resources use. Healthcare costs for drugs and imaging were not different between the two groups. The QALY values obtained after 8 weeks of intervention were 0.13 and 0.11 for the self-management group and the usual physiotherapy group, respectively. This score suggests that the maximum probability of cost-effectiveness was 13% for the self-management group and 11% for the usual physiotherapy group.

### Incremental cost-effectiveness

The estimates of incremental cost-effectiveness ratio (ICER) from the patient's perspective, the cost per QALY gained values were N477276 and N325506 for the participants in the self-management group and the usual care group, respectively, indicating the more patient cost savings for the self-management group.

### Cost-effectiveness plane

The cost-effectiveness plane (Figure 2) was used to display the result of the cost-effectiveness analysis showing directly the ICER of the new intervention compared to the old treatment option [26]. The plane consists of four quadrants: The southeast (SE) and northwest (NW) quadrants show negative ICER values, and the northeast (NE) and southwest (SW) quadrants have positive values [26]. If the ICER value falls in the SE quadrant, it indicates that the new intervention is more effective and less costly. If it falls in the NW quadrant, the new intervention is less effective and more expensive. If it falls in the NE quadrant, the new intervention is more effective but more costly. Finally, if it falls in the SW quadrant, then the new intervention is less effective and less expensive [26]. The value for the self-management

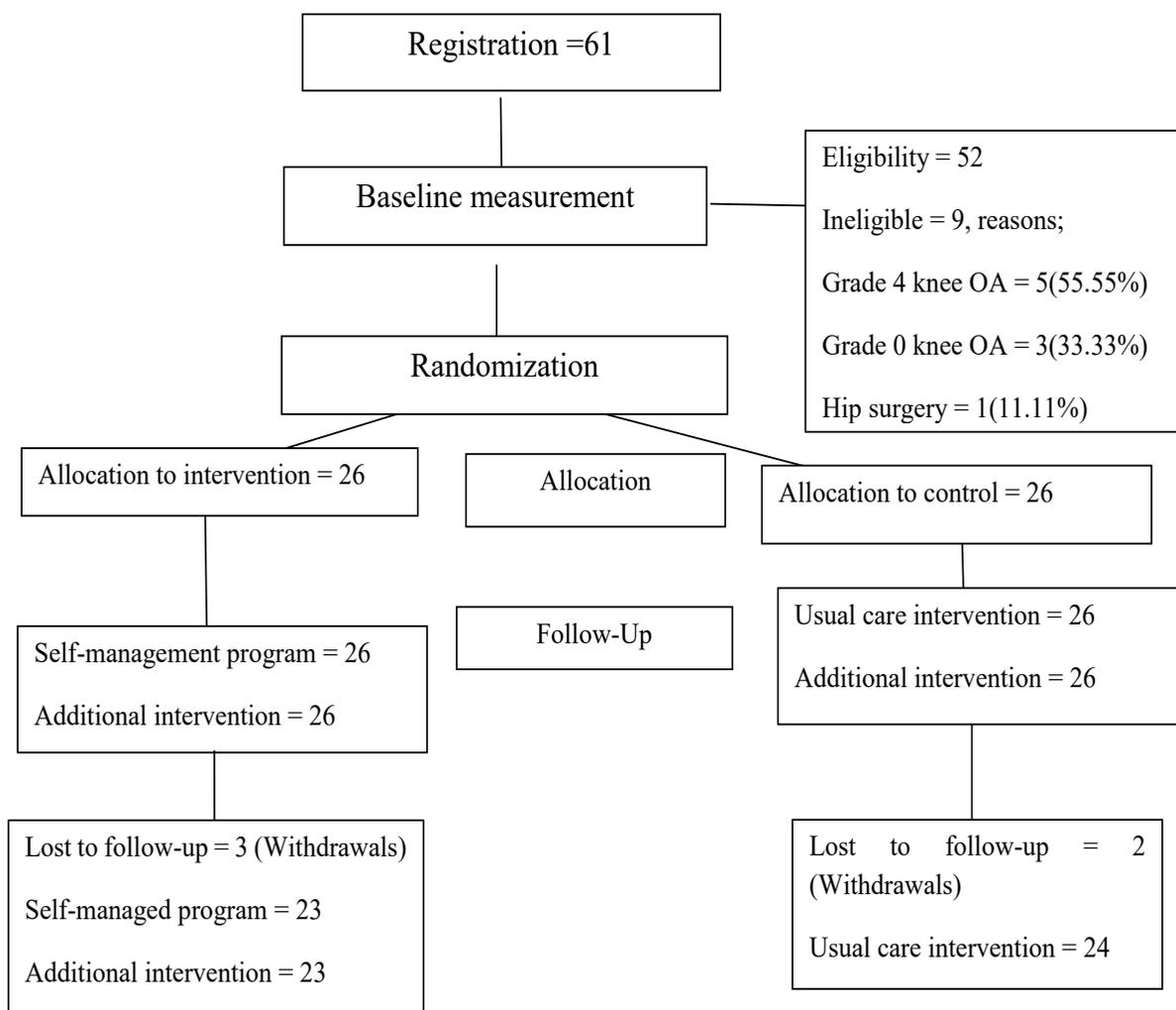


Figure 1. Flow chart showing the process of data collection

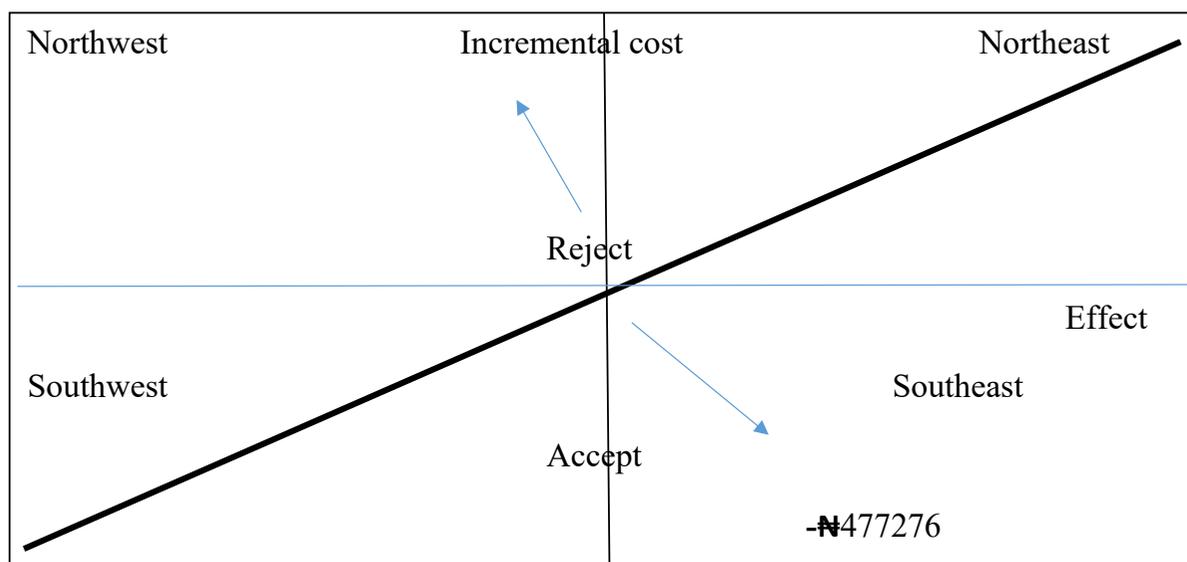


Figure 2. Cost-effectiveness plane

**Table 1.** Mean±SD of pain, Range of Motion (ROM), functional status, and health-related Quality of Life between self-management group and usual care group

Variables	Mean±SD															
	Self-management Group (n=23) Within-Group				Usual Care Group (n=24) Within-Group				Self-management Group (n=23) Between-Group				Usual Care Group (n=24) Between-Group			
	Pre-inter-vention	Post-inter-vention	t	P	Pre-inter-vention	Post-inter-vention	t	P	Pre-inter-vention	Post-inter-vention	t	P				
Pain	5.96±0.91	2.63±0.71	15.560	0.00	6.26±0.92	3.74±1.05	10.770	0.00	2.63±0.71	3.74±1.05	-4.231	0.00				
ROM	96.33±8.61	101.17±8.72	-7.775	0.00	99.48±1.95	100.61±1.80	-6.653	0.00	101.17±8.72	100.61±1.80	0.301	0.77				
Function-al status	39.58±3.76	34.46±2.82	9.165	0.00	39.00±3.90	36.96±4.11	7.365	0.00	34.46±2.83	36.96±4.11	-2.419	0.02				
HRQoL	0.72±0.10	0.869±0.09	-8.923	0.00	0.69±0.12	0.728±0.11	-1.397	0.18	0.869±0.89	0.728±0.11	4.885	0.00				

SD: Standard deviation; ROM: Range of motion; HRQoL: Health-related quality of life.

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group,  $\text{¥}477276$  (\$1308), falls in the SE quadrant; therefore, self-management is more effective and less costly.

#### 4. Discussion

We examined the cost-effectiveness of a self-managed program compared to usual physiotherapy care in adults with knee OA in poor-resource settings. Compared with routine care, the self-managed program demonstrated significant improvements in pain, functional status, and

health-related quality of life. The effectiveness of self-managed programs in improving pain and function has been investigated in several randomized controlled trials. Previous studies on self-management versus usual care interventions in the same population found moderate improvements in pain and function [27, 28].

Self-management is commonly used to deliver exercise therapy and patient education designed to improve the patient's knee pain, functional status, and health-related

**Table 2.** Mean costs per participants in the self-management group and usual care group

Cost Category	Mean±SD	
	Self-management Group (n=23)	Usual Care Group (n=24)
Direct healthcare cost drug	17066±6763	17860±7.267
Imaging (x-ray)	1141±359	1226±486
Uric acid	145±290	186±298
Clinical consultations	1800±979	4034±2765
Physiotherapist	4000±0	8800±0
Direct non-healthcare costs transportation	1940±1150	3603±2668
Manuals	70±0	70±0
Phone calls	96±0	24±0
Total	26260±9543	35805±13487
QALY	0.13±0.00	0.11±0.02
Incremental cost management	-9545.53	35805.70
Effect (QALY)	0.13	0.11
ICER	-477276.50	325506.36

SD: standard deviation; QALY: quality-adjusted life year, ICER: incremental cost-effectiveness ratio.

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quality of life [29]. In the present study, the within-group benefits for ROM provided by both interventions were essential for patients with knee osteoarthritis but were not significantly different between the two groups. This finding is consistent with another study that reported that ROM with physiotherapy might not be restored in the short term [30]. Knowledge of tissue structure and components of stretch are ultimately necessary for tissue elongation [31]. Unfortunately, the data were not available to determine if the education level of patients was sufficient and appropriate for implementing a self-managed program to restore range of motion. In addition, the present study is a short-term 8-week randomized controlled trial. Thus the duration of the study may not be adequate to create significant improvement in the chronic range of motion assessed.

The results of the cost-effectiveness analysis suggest that compared to usual physiotherapy treatments, self-management was associated with significantly lower total healthcare costs, particularly for clinical consultation, physiotherapy management, and transportation. The benefits provided by self-management in overall healthcare cost savings were due to fewer treatment sessions compared to the usual care group. Although there are no specific recommendations for a minimum number of sessions for self-managed programs for adults with knee osteoarthritis, an average of 6 sessions may decrease pain and improve quality of life and function [29]. However, the cost of phone calls is higher for the self-managed group, though the higher cost is offset by significant savings from other health resources use. Even if the cost of phone calls is higher, evidence has shown that follow-up phone calls are essential to improve patients' compliance and adherence to home-based exercise programs [32]. These findings are similar to those from previous studies by Kloek et al. [10] and Thomas et al. [11], which found substantial reductions in intervention costs, medication costs, and cost of primary care visits for self-management interventions.

The QALY calculated from the EQ-5D also demonstrated better health effects but a smaller gain for participants in the self-managed group than the usual care group. The cost-effective probability for the self-managed program is 13%. Therefore, the self-managed intervention should decrease knee pain and improve functional status and health-related quality of life by 13% of QALY gained. The self-managed program was the most cost-effective treatment due to its improvement of QALY relative to usual care, placing the distribution of cost-effectiveness estimate predominantly in the south-east quadrant. The ICER of ₦477276 (\$1308) was as-

sociated with patient cost savings of ₦477276 (\$1308) compared with the usual care. However, this finding is not consistent with a previous study in which QALY from patients' and healthcare providers' perspectives were not significantly different for both arms of interventions [10]. Notably, this study intervention's delivery was based on the web application, and intervention costs were based on self-reported face-to-face physiotherapy sessions; all expenditures were converted to the Euro exchange rate for 2015. These reasons may be responsible for the difference in our study. Overall, our study adds to the existing evidence that self-management is a more cost-effective treatment than usual physiotherapy care in a poor-resource setting where healthcare costs are based on out-of-pocket spending.

The present study has some limitations and should be interpreted with caution. First, the participants were female housewives. Thus we were unable to determine the gender interaction with the intervention, and job productivity-related costs were not included. Second, this study was a short-term cost-effectiveness assessment of the self-management program; further research should determine its long-term effect with large sample size.

## 5. Conclusions

The self-managed program for 8 weeks was more effective and required cheaper healthcare resource use because of its fewer treatment sessions and clinical consultations. From the patient's perspective, the self-managed program is cost-effective, and physiotherapists may adopt the program to reduce treatment costs for patients and congestion in the clinics.

## Ethical Considerations

### Compliance with ethical guidelines

The hospital Research Ethics Committee of the Aminu Kano Teaching Hospital approved the study (No.: AKTH/MAC/SUB/12A/P-3/VI/2371). Also, signed informed consent was sought and obtained from all participants before the study.

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This study was extracted from the MSc. thesis of the first author at the Department of Physiotherapy, Faculty of Allied Health Sciences, Bayero University, Kano, Nigeria.

### Authors' contributions

Both authors equally contributed to preparing this article.

### Conflict of interest

The authors declared no conflict of interest.

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