Effect of Enhanced Exercise Program on Pain and Physical Activity for Patients after Total Knee Arthroplasty

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ABSTRACT

Context: Total knee arthroplasty (TKA) is considered the most effective orthopedic procedure for treating knee osteoarthritis. The need for knee replacement is predicted to increase six-fold between 2005 and 2030 to reflect an increasingly yet functionally demanding population.

Aim: This study aimed to evaluate the effect of an enhanced exercise program on pain and physical activity after total knee arthroplasty.

Methods: Quasi-experimental (pre/posttest) design was utilized in this study .The study was carried out in the orthopedic department, Benha University Hospital, and followed the patients through the orthopedic outpatient clinic from the beginning of May 2020 till the beginning of May 2021. A purposive sample of 64 patients was recruited to achieve the aim of this study. Four tools were used to collect the study data .These are the structured interview questionnaire to assess patients' knowledge regarding total knee arthroplasty, Barthel ADL index scale, Lysholm knee scoring scale, and Numeric Pain Rating Scale to assess the effect of the enhanced exercise program.

Results: Showed that nearly two-thirds of the study sample was ≤60 years old, females, and married. The study also showed a statistically significant difference between pre-and post- enhanced exercise program in terms of total knowledge mean score among the study sample, as well as an increase in the total mean score in Barthel ADL index, decrease Lysholm knee scoring, and pain score after one month and after three months of enhanced program exercise implementation**.**

***Conclusion*:** Implementing an enhanced exercise program for patients with total knee arthroplasty effectively improved knowledge, increased physical activity (Barthel ADL index), decreased Lysholm knee scoring, and pain score. The present study recommended including an enhanced exercise program in the treatment plan for patients with total knee arthroplasty to improve patient's knowledge and practices. Also, repeating the study on a larger probability sample to achieve generalization of the findings**.**

Keywords: Enhanced program exercise, pain, physical activity, total knee arthroplasty

1. Introduction

Total knee arthroplasty (TKA) represents the highest aggregate cost among the rapidly increasing number of orthopedic surgical procedures and poses a large economic burden on health systems around the globe *(Piva et al., 2017).* Total knee arthroplasty (TKA) is an elective surgical procedure considered after failing other conservative management in patients suffering from advanced knee osteoarthritis (KOA). Often, severe KOA is accompanied by constant pain, restricted joint flexibility, quadriceps muscle weakness, and reduced knee functionality in sports and activities of daily living (ADLs) *(Varacallo et al., 2020).* Regardless of the cause of the damage to the joint, the resulting progressively increasing pain and stiffness and decreasing daily function led the patient to consider total knee replacement *(Johns Hopkins Medicine, 2019).*

The prevalence of total knee arthroplasty was 0.83% and 1.52%, respectively. Prevalence was higher among women than men and increased with age, reaching 10.38% for total knee replacement at eighty years. These estimates corresponded to 2.5 million individuals and 4.7 million (3.0 million women and 1.7 million men) with total knee replacement in 2010. Secular trends indicated a substantial rise in prevalence over time and a shift to younger ages *(Maradit Kremers et al., 2015).*

Total knee replacement whereby the diseased knee joint is replaced with artificial material. Metal and plastic parts are used to cap the ends of the bones that form the knee joint, along with the kneecap. The knee is a hinge joint that provides motion when the thigh meets the lower leg. The thighbone (or femur) abuts the large bone of the lower leg (tibia) at the knee joint *(William et al., 2018).* Pain levels and joint flexibility are to be improved after TKA, and 20 to 30% of patients are not satisfied and do not achieve significant symptomatic enhancement, or their impairments in ADLs become even worse, so that these patients need an individualized exercise program *(Canovas & Dagneaux, 2018).*

A total knee replacement is an effective way of improving symptoms of knee arthritis. According to the American Academy of Orthopedic Surgeons (AAOS), over 90 percent of replacement knees are still functioning after 15 years. According to research published in 2019, 82 percent of a trusted source of total knee replacements are still functioning after 25 years. A successful knee replacement typically leads to a higher quality of life, less pain, and better mobility for most people *(Greengard, 2020).*

Several systematic reviews and meta-analyses showed that physiotherapeutic rehabilitation might reduce postoperative limitations in ADLs and improve functional outcomes after TKA. Promising training interventions accompanied by patient education are endurance training to improve overall fitness and proprioceptive neuromuscular facilitation (PNF) techniques to increase joint ROM, improve neuromuscular performance and reduce pain levels. However, the lack of specific information in previously tested rehabilitation protocols concerning exercises, dosage, and intensity makes it difficult to conclude *(Iijima et al., 2019).*

An exercise program is a simple solution capable of alleviating functional limitations, promoting physical activity, and enhancing TKR outcomes. Although programs are beneficial, the effects tend to be small and fade over time. These small and short-lived effects of rehabilitation programs are likely because the exercises have not been sufficiently intensive to reverse long-lasting deficits and have not encouraged lifestyle changes. However, intensive exercise is not tolerated for many patients until at least two to three months post TKR, when they have recovered from the surgical procedure *(Piva et al., 2017).* Regular exercise to restore strength and mobility to the knee and a gradual return to everyday activities are important for full patients' recovery after total knee replacement *(Berkshire, 2020).*

Nursing care planning and goals for patients who underwent total joint arthroplasty include preventing complications, promoting optimal mobility, alleviate pain, and providing information about the diagnosis, prognosis, and treatment needs *(Mattvera, 2019).* After the operation, orthopedic patients face pain and insufficient muscular strength, which affect their ambulatory activities and ability to care for themselves *(Guangjin & Junxin, 2018).* Patients who have had a TKA require education about pain. The education should be done immediately postoperatively and on an ongoing basis during the hospitalization. Educating on topics that include how long to expect pain, the goal of pain management, preventing pain rather than "chasing the pain," treatments to manage pain, how to ring the nurse for analgesia when needed, and the plan for pain management are all critical patients' needs. In addition, lifestyle modifications are considered a core to each patient rehabilitation program *(Auyong et al., 2015).*

2. Significance of the study

Descriptive epidemiology of total joint arthroplasty procedures is limited to annual procedure volumes (incidence). The prevalence of the growing number of individuals living with a total knee replacement is currently unknown *(Mohamed et al., 2017).* The incidence of knee OA had increased with people over the age of 65 reached 60% in the Arabian region and Europe *(Greengard, 2020).* Osteoarthritis (OA) presents in 13% of adults above 16 years old, and the incidence of these doubled in the age of 46-55 and reached 30.8% and 60.6% in the 60-75 years old *(Zaghlol et al., 2020).*

3. Aim of the study

This study aimed to evaluate the effect of enhanced exercise program on pain and physical activity for patients after total knee arthroplasty through:

- Assessing patients ' knowledge regarding the total knee arthroplasty.
- Assessing the level of physical activity and pain after total knee arthroplasty.
- Designing and implementing total knee arthroplasty-related enhanced exercise program.
- Evaluating the effect of enhanced exercise program on patient knowledge, physical activity, and pain.

3.1. Research Hypotheses

H1: The patients' knowledge regarding total knee arthroplasty will be improved after implementing the enhanced exercise program compared to pre-intervention.
H2: The physical activity level will be significantly improved after enhanced exercise program implementation compared to pre-intervention.
H3: The degree of pain and Lysholm knee score among patients will significantly decrease after implementing the enhanced exercise program compared to pre-intervention.
H4: There will be a significant correlation between the knowledge, physical activity, Lysholm knee score, and degree of pain after one month and after three months of enhanced exercise program implementation.

3.2. Operational definition

The enhanced exercise program is defined in this study as an exercise program to increase strength and decrease pain, supported with education for patients after total knee arthroplasty.

4. Subjects & Methods

4.1. Research Design

Quasi-experimental (pre/posttest) design was utilized to conduct the current study. Quasi-experimental research involves manipulating an independent variable without the random assignment of participants to conditions or orders of conditions and can be constructed with single or multiple groups and may involve pretest and posttest or post-test-only measurement *(Mateo & Foreman, 2014).* The quasi-experimental design includes a wide range of nonrandomized or partially randomized pre-post intervention studies *(Handley et al., 2018).*

4.2. Study setting

This study was conducted in the orthopedic department and followed the patients through the orthopedic outpatient clinic at Benha University Hospital. The orthopedic department was composed of five rooms (two rooms for males and two for females). Each room contained five beds. There is also one room for dressing. Benha University hospital is a main central hospital affiliated to Benha University served a wide range of urban and rural communities in Al Qualiobia Governorate North Cairo.

4.3. Subjects

A purposive sample of 64 patients undergoing total knee arthroplasty from the settings mentioned above was recruited. The sample size was calculated based on the previous year's census report of admission in the orthopedic department at Benha University Hospital *(Benha University Admission Office Census, 2019)*, utilizing the following formula *(Yamane, 1967).*

$$n = \frac{N}{1 + N\,(e)2}$$

Where:
n= sample size (64)
N= total population (80)
e= margin error (0.05)
Inclusion criteria

The patients had been selected according to the following criteria: Patients from both genders (males and females), willing to participate in the study, with the first time for total knee arthroplasty, free from severe cognitive, physical, and communication impairment and metabolic syndrome. Besides, they did not receive any exercise program before.

4.4. Tools of data collection

Data was collected through the utilization of the following tools:

4.4.1. Structured Interview Questionnaire

The researchers constructed it after reviewing relevant literature. It was written by the researcher in the simple Arabic language. It is used to assess patients' knowledge regarding total knee arthroplasty and related care. It included three parts:

Part one (pre) is concerned with assessing patients' socio-demographic data such as age, gender, marital status, residence, educational level, occupation, living status, and receiving previous education regarding TKR.

Part two (pre) assessed the past and present medical history. These data were collected on hospital admission. It included the previous hospital admission, previous diagnosis before the operation, smoking history, and previous orthopedic surgeries. Present history included the history of knee pain, type of analgesic medications to manage knee pain, chronic diseases, weight, height, and body mass index.

Part three (pre, after one month, after three months) encompassed the patient's knowledge assessment. It was adapted from *Al-Mohrej (2017); Scott (2014).* It is translated into Arabic and back into English to avoid misunderstanding. It included 31 MCQs about total knee arthroplasty and enhanced program exercise. They are distributed in four sections:

The first section included the knowledge related to total knee arthroplasty. It included 14 questions, the definition of the knee (1 question), function of the natural knee (1 question), definition of knee inflammation (1 question), signs and symptoms (1 question), causes (1 question), knee joint replacement surgery (1 question), reasons for operating (1 question), types of knee replacement surgery (1 question), advantages, and disadvantages (2 questions), laboratory investigation required before operation (2 questions), and complications (2 questions).

The second section included knowledge assessment related to precaution after total knee arthroplasty. It comprised nine questions, including the correct usage of crutches or walker after surgery (1 question), wearing clothes (1 question), the proper timing for sitting, showering, and sleeping (3 questions), activities that cannot do (1 question), food rich in calcium, protein and important vitamins to strengthen bones (3 questions).

The third section incorporated patient information about the medication after a total knee replacement as the most important medicines used when taking pain relievers and medicines used after surgery to avoid clots (3 questions).

The fourth section embraced patient information about the exercise after surgery (5 questions), the type of sport exercises the patient should follow during treatment, important precautions are taken when practicing any physical activity, and resume normal activities without sticks and crutches.

Scoring system

Knowledge obtained from patients was scored and calculated. Each correct question scored one grade and scored zero for an incorrect answer. The total score level for the questionnaire sheet was (1x31=31) 31 grades (equal to 100%).

- The patients' knowledge ≥75% considered satisfactory knowledge.
- The patients' knowledge <75% considered unsatisfactory knowledge.

4.4.2 Barthel ADL Index Scale

It was used three times pre, after one month, and after three months. It was adopted from *Adamson (2019)* and used to measure physical activity and disability. It is used widely to assess behavior relating to ten variables describing activities of daily living for total knee replacement patients as bowels, bladder, grooming, toilet use, feeding, transfers (bed to chair and back), mobility (on surfaces level), dressing, stairs, and bathing on a scale of 0 to 100 (0, very dependent; 100, independent).

Scoring system

Full credits have a score of 100 when the patient did not need minimal help or supervision during the performance and is physically independent, while a score of 91 - 99 is given for minimal dependency, 75 - 90 is given when the patient was mildly disabled. Subsequently, a score of 50-74 is given when the patient is moderately disabled, while a score of 25-49 for severely disabled and a score of 0-24 is given when the patient is very severely disabled and cannot perform activities of daily living.

4.4.3. Lysholm Knee Scoring Scale

It was adapted from *Collins et al. (2011)* and modified by the researcher. This questionnaire is designed to give information about how knee problems have affected managing everyday life. The questionnaire items include eight items that measure: Limb (3 questions), using can or crutches (3 questions), locking sensation in the knee (5 questions), giving way sensation of the knee (6 questions), pain (6 questions), swelling (4 questions), climbing a stair (4 questions), and squatting (4 questions) with a total of (35 questions). It was used three times pre, after one month, and after three months.

Scoring system

Lysholm knee scoring scale is a three-point scale. Each question in this scale ranged from 0-2 grades as the answer scored (0) never, (1) sometimes, (2) always. The total score was 70 scores. They are presented as mean and SD.

4.4.4. Numeric Pain Rating Scale (NPRS)

It was adopted from *Hawker et al. (2011).* It measures the intensity of pain levels for total knee arthroplasty patients. The NPRS is best reflects the intensity of patient pain. It contains seven points. The severity of pain (simple, medium, and severe). The nature of pain (continuous and interrupted). Kind of pain (cannot determine, burring, stabbing, tingling, and pressure). Time of pain is morning, evening, and after any activity). Pain wake from sleep (never, sometimes, and always). How the pain can affect concentration able to concentrate completely, to some extent, and blurred concentration). To relieve pain (by a painkiller, massage, hot compresses, and non. It was used three times pre, after one month, and after three months.

Scoring system

The values on the pain scale correspond to the pain levels as follows: The common format is a horizontal bar or line. It from '0' representing (no pain) to '10 ' representing the other pain extreme (e.g., "pain as bad as the patient can imagine" or "worst pain imaginable"). The values on the pain scale correspond to the pain levels as follows:

- 0 was considered "no pain."
- 1-3 was considered "mild pain."
- 4-6 was considered "moderate pain."
- 7-10 was considered "severe pain."

4.5. Procedures

Permission was granted from the Dean of Faculty of Nursing, Benha University, hospital directors, and head of the orthopedic department at Benha University Hospital. The researcher obtained approval for data collection. The study's objectives and nature were explained, making it possible to conduct it with minimum resistance.

Tools' validity was tested through a jury of five experts from the medical-surgical nursing department, faculty of nursing, Benha University. The modification was made according to the panel's judgment on the clarity of sentences, appropriateness, tool content, and completeness. The enhanced exercise program was validated by the same experts and one professor of orthopedic, one professor of physiotherapy, faculty of medicine, Benha University. The consensus among experts regarding the structured interviewing questionnaire was 95%, and the Lysholm knee scale was 92%. The reliability of the designed tools was tested by Cronbach's alpha test (0.881) for a structured interview questionnaire, (0.713) for the Lysholm knee scale, and (0.887) for the numeric pain rating scale (NPRS).

The pilot study was carried out to ensure the study tools' clarity, applicability, the time needed for each tool to be filled in, and the study process's feasibility. A pilot study was carried out on 10% of the studied subjects (6 patients). They were included in the primary study sample.

During all stages of the study, all ethical issues were taken into consideration. This study's ethical research consideration included the approval of the Ethical Research Committee of Faculty of Nursing, Benha University, before the exercise program for total knee replacement patient's implementation. The objectives and aim of the study were explained to all participants. They were told that they might, at any moment, withdraw from the research. Additionally, verbal consent was taken from the patients who participated in the study. The researcher protected the subjects' privacy and confidentiality.

The preparatory phase included reviewing the available literature and studies related to the research problem and theoretical knowledge using textbooks, evidence-based articles, internet periodicals, and journals.

The researcher designed the enhanced exercise program for total knee replacement patients based on patients' need assessment, literature review, researchers' experience, and experts' opinions. The researchers designed an Arabic instruction booklet with illustrations.

The designed programs were included information about total knee replacement. It is divided into two main parts; the first part included the knowledge related to total knee arthroplasty. The second part included exercises that must be followed during treatment, important precautions are taken when practicing any physical activity, and resume normal activities without sticks and crutches.

Field of work: This study was carried out over 12 months, from the beginning of May 2020 to the end of May 2021. The researchers visited the orthopedic department three days weekly (morning and afternoon) to collect the data using previous tools. The average time took for the questionnaires to be completed was about 15-25 minutes.

Implementation phase: The designed enhanced exercise program of total knee replacement was implemented for patients who underwent a total knee replacement. After admission, it has started in the patient room with an orientation about the total knee replacement. Individualized or small group sessions were made. Each session's duration ranged from 30-45 minutes. The implementation of this enhanced exercise program was conducted in four sessions: The first session (introductory session), orientation and explanation of reasons and importance of educational program which involved the definition, description of the knee joint, the function of the natural knee, inflammation of knee, signs, and symptoms, causes, knee joint replacement surgery, reasons for

operating, types of knee replacement surgery, advantages, disadvantages, laboratory investigation required before operation and complications. This session took about 30 minutes.

The second session involved information about precautions after total knee replacement includes the use of crutches or walkers after surgery, wearing clothes when sitting, showering, activities that cannot do, food rich in calcium, protein, important vitamins, medication after total knee replacement. This session took about 45 minutes. While the third session involved demonstration to the patient regarding knee exercises such as ankle pumps and circuits exercises, thigh press (thigh muscle groups) exercises, heel segments (hip and knee flexion) exercises, leg segments (abduction/adduction) exercises, lying kicks (short arch muscles of the thigh) exercises, straight leg raises exercises, bed movement exercise, push-ups on the chair, knee flexion stretch (bending the knee while sitting) exercises, lengthening straightening the knee (extending the knee while sitting) and knee extension straightening (extension of the knee while sitting) exercises.

The fourth session involved a demonstration of physical activity techniques for everyday life, such as: How to enter and to get out of bed, getting off the chair, slide to its edge, get in and out of the toilet, getting in and out of the bathtub to shower, how to go up and down the stairs, getting in and out of the car. Each exercise was done for one minute, and the patient was asked to repeat it ten times. The researcher demonstrated exercise for patients. Then the patients were instructed to perform the exercise. This session took 60 minutes. The training sessions took place three times a week, taking precautionary measures of infection control for COVID 19 infection.

The content of the program was similar for all patients except for its simplicity. The booklet was handed to the studied patients at the end of the sessions. The teaching methods included lectures and group discussions, individual teaching, demonstration, and re-demonstration. Visual aids included a colored printed booklet (handout), Microsoft PowerPoint presentation, illustrated pictures, and videos.

Evaluation phase: The researcher evaluates the effect of the enhanced exercise program on patient knowledge; Barthel index scale, Lysholm knee score, and the pain were used by the researcher using the same study tools (pretest format). These tools were also used for effect evaluation after one month and three months of designed enhanced exercise program implementation.

4.6. Limitation of the study

The small sample size was a restriction. It hinders the generalizability of the results.

4.7. Data analysis

The collected data were organized, coded, computerized, tabulated, and analyzed using the statistical package for social science (SPSS) version (20). Data analysis was accomplished using the number, percentage distribution, chi-square test, mean, standard deviation, and correlation coefficient; a Paired t-test was used to test the significance of some variables. Statistical significance was considered as follows:

- P-value >0.05 Not significant
- P-value ≤0. 05 Significant
- P-value ≤0.001 Highly significant

5. Results

Table 1 shows the socio-demographic characteristics of patients with TKA. It was observed that the study sample age ≤ 60 years old (65.6%) with a mean (37.6±11.4), more than half (64.1%) were females as well as 67. 2% were married, 59.4% live in an urban area with family 78.1%, 37.5% had a university education, 51.6% were employees, and 94.7 % do not receive any information about TKR.

Table 2 demonstrates the patients' past and present medical history; more than half of the study sample (65.6 %) had the previous hospitalization, the majority of them (71.9%) were diagnosed with osteoarthritis before surgery. Also, 79.7% were non-smokers, 46.87% had the previous hip joint replacement. 75% of patients had a history of knee pain over six years. Their mean weight was 70.69±9.60. More than one-third of patients were overweight (37.5%), nearly two-fifths were obese (18.8%), and around a tenth was morbidly obese (9.4%). The mean height was 168.64±6.22, and the body mass index's mean was 25.58±2.86.

Table 3 reveals an increase in the mean score of total knowledge with statistical significance difference after one month and three months of enhanced exercise program implementation.

Figure 1 illustrates a comparison of total patients' knowledge pre, after one month, and after three months of enhanced exercise program implementation. The table shows that 100 % of patients had an unsatisfactory level of knowledge at pre-enhanced exercise program. However, 95.3% of patients had a satisfactory level of knowledge after one month of enhanced exercise program implementation. 82.8% had a satisfactory level of knowledge after three months of implementing the enhanced exercise program.

Table 4 clarifies the increase in the total mean score of ADL (Barthel index) mean score with statistical significance difference after one month and after three months of enhanced exercise program implementation.

Figure 2 elucidates that in pre-enhanced exercise program implementation, 50% of patients have a severe disability, but after one month, 31.3% only have severe disability and decreased to 7.8% after three months of enhanced exercise program implementation.

Table 5 clarifies the decrease in the total mean score of Lysholm knee score with a statistically significant difference after one month and after three months of enhanced exercise program implementation compared to their pre-intervention level.

Table 6 clarifies a decrease in total mean pain score with a statistically significant difference after one month

and after three months of enhanced exercise program implementation compared to their pre-intervention level.

Figure 3 elucidates that pre-enhanced exercise program implementation 62.5% of patients have severe pain, but after one month, 9.5% only have severe pain and decreased to 0% after three months of enhanced exercise program implementation.

Table 7 shows a high statistically significant positive correlation between total knowledge and activity of living score. Also, there were negative correlations between total Lysholm Knee score, total pain score, and total knowledge after one month and after three months of enhanced exercise program implementation.

Table (1): Frequency and percentage distribution of socio-demographic characteristics of the studied patients (n=64).

Socio-demographic characteristics	No.	%
Age (Year)		
40- 50	3	4.7
51- 60	42	65.6
61-65	19	29.7
Mean±SD	37.6±11.4	
Gender		
Male	23	35.9
Female	41	64.1
Marital status		
Single	12	18.8
Married	43	67.2
Divorced	6	9.4
Widower	3	4.7
Residence		
Rural	26	40.6
Urban	38	59.4
Level of Education		
Illiterate	9	14.1
Read & write	13	20.3
Secondary education	18	18.1
University education	24	37.5
Occupation		
Worker (manual)	27	42.1
Employee	33	51.6
Not working	4	6.3
Living Status:		
Lives alone	14	21.9
With family	50	78.1
Receiving previous information about TKR		
Yes	60	94.7
No	4	6.3

Table (2): Frequency and percentage distribution of medical history among the studied patients (n=64).

Medical history	No.	%
Past history		
Previous hospital admission		
Yes	42	**65.6**
No	22	34.3
Previous diagnosis before the operation		
Osteoporosis	5	7.8
Rheumatoid	13	20.3
Osteoarthritis	46	**71.9**
Smoking history		
Yes	13	20.3
No	51	**79.7**
Previous orthopedic surgeries		
Hip joint replacement	30	46.87
Slides and screws	16	25
Fixations	18	28.25
Present history		
History of knee pain		
From 1-3 years	7	10.9
4-6 years old	9	14.1
Over six years old	48	**75**
Type of analgesic medications to avoid knee pain		
Panadol	5	7.8
Diclofenac	35	**54.7**
Cortisol	24	37.5
Chronic diseases		
Non	44	**68.8**
Heart disease	6	9.4
Kidney disease	6	9.4
Liver disease	1	1.6
Diabetes	7	10.9
Weight		
Mean±SD	70.69±9.60	
Height		
Mean±SD	168.64±6.22	
Body Mass Index classification		
Underweight,	5	7.8
Average	17	26.6
Overweight	24	**37.5**
Obese	12	18.8
Morbid obese	6	9.4
Mean±SD	25.58±2.86	

Table (3): Comparison of patients' knowledge throughout the enhanced exercise program phases.

Knowledge items	Pre-program Mean±SD	After 1 month Mean±SD	After 3 months Mean±SD	T-test (1)*	P-value (1)	T-test (2)	P-value (2)
Total knee arthroplasty	9.92±2.68	11.86±2.44	10.60±4.11	23.15	<0.001	29.61	<0.001
Precautions after total knee arthroplasty	0.98±1.29	7.45±1.46	7.73±1.39	21.13	<0.001	24.26	<0.001
Medication after total knee arthroplasty	0.23±0.49	2.42±0.66	2.45±0.83	22.03	<0.001	17.22	<0.001
Exercises after total knee arthroplasty	0.98±0.72	4.71±0.45	4.42±0.81	18.52	<0.001	24.92	<0.001
Total	3.42±2.46	23.109±7.05	23.78±4.07	26.81	<0.001	18.07	<0.001

**(1) Difference between the level of knowledge pre & after one month of enhanced exercise program implementation, (2) Difference between the level of knowledge pre-of enhanced exercise program implementation & after three months of implementing the enhanced exercise program*

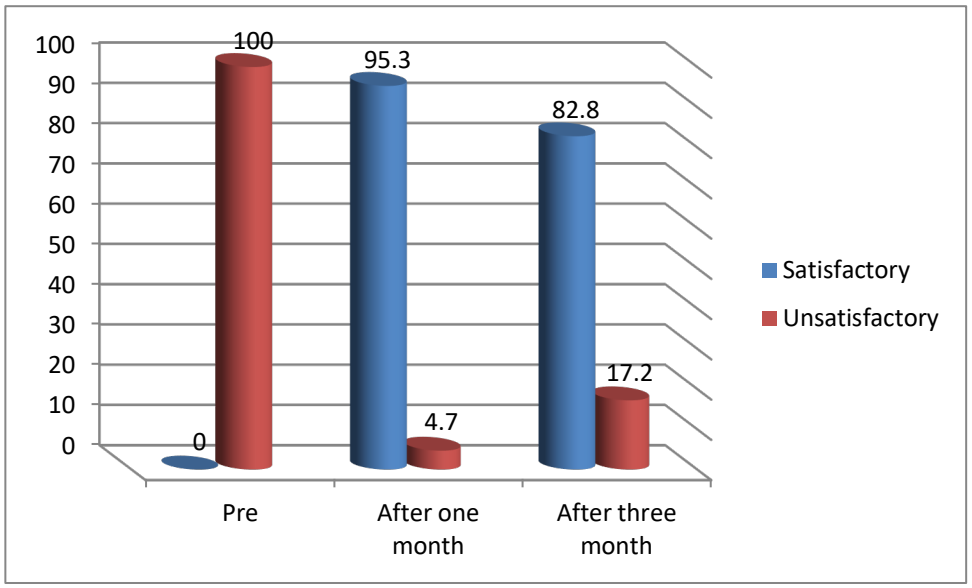

Figure (1): Comparison of total patients' knowledge pre, after one month, and after three months of enhanced exercise program implementation.

Table (4): Comparison of activities of daily living of studied patients throughout the program phases.

Activities of daily living	Pre-program Mean±SD	After 1 month Mean±SD	After 3 months Mean±SD	T-test (1)*	P-value (1)	T-test (2)	P-value (2)
Bowels	3.75±2.67	8.28±2.39	9.60±1.35	10.98	<0.001	17.90	<0.001
Bladder	3.28±3.35	8.43±2.33	9. 29± 3.35	9.45	<0.001	13.033	<0.001
Grooming	3.43±3.06	9.14±1.90	9.53±1.46	10.71	<0.001	13.48	<0.001
Toilet use	2.18±3.31	7.03±2.74	9.60±1.35	11.24	<0.001	17.81	<0.001
Feeding	2.73±3.32	9.29±1.75	9.75±1.57	13.93	<0.001	15.46	<0.001
Transfer	1.76±2.41	8.43±2.33	1.80±0.95	17.15	<0.001	4.95	<0.001
Mobility	1.64±2.36	11.015±2.02	14.53±1.46	27.31	<0.001	41.43	<0.001
Dressing	1.32±2.22	12.05±2.85	13.98±3.03	27.82	<0.001	32.85	<0.001
Straits	2.42±2. 51	6.25±2.18	9.60±1.35	8.6 6	<0.001	20.53	<0.001
Bathing	1.71±2.39	6.40±2.26	9.14±1.90	11.73	<0.001	16.17	<0.001
Total	22.10±9.71	86.34±8.90	102.87±8.06	35.94	<0.001	46.642	<0.001

**(1) Difference between the level of activities of daily living pre & after one month of enhanced exercise program implementation, (2) Difference between the level of activities of daily living pre & after three months of implementing an enhanced exercise program.*

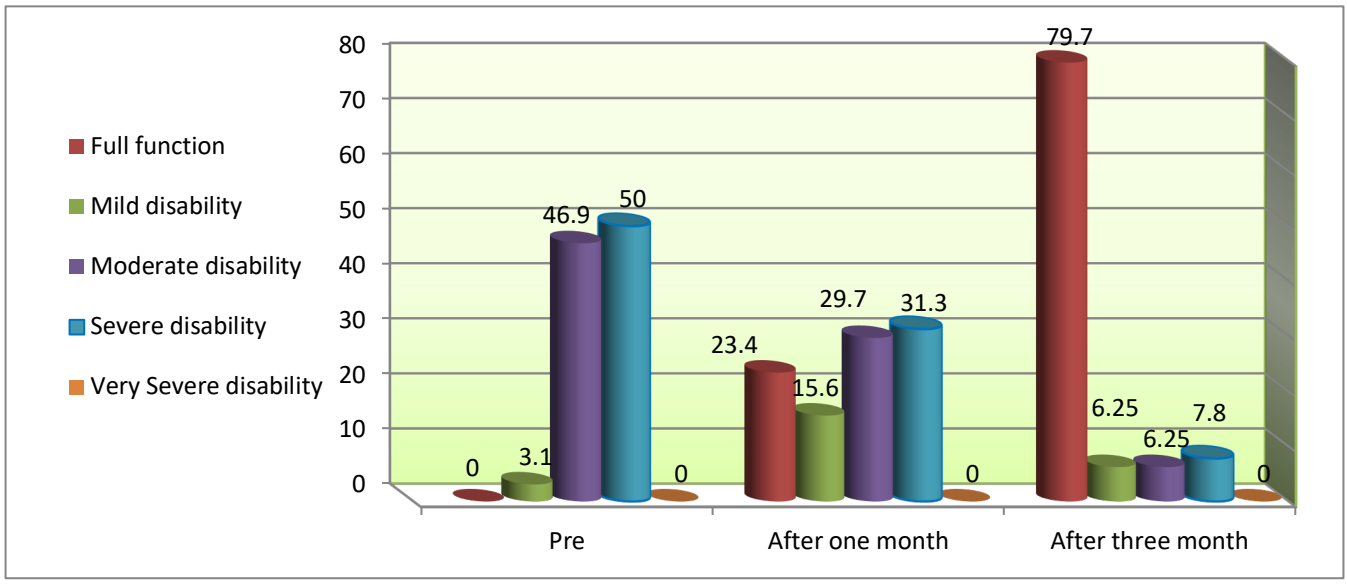

Figure (2): Total percentage score of independence in activities of daily living at pre, after one month, and after three months of enhanced exercise program implementation.

Table (5): Comparison of patients' Lysholm Knee score at pre, after one month, and after three months of enhanced exercise program implementation (n = 64).

Items	Pre-program Mean±SD	After 1 month Mean±SD	After 3 months Mean±SD	T-test (1)*	P-value (1)	T-test (2)	P-value (2)
Limp	5.59±0.55	2.25±1.03	0.34±0 .56	23.67	<0.001	49.63	<0.001
Using cane or crutches	5.45±0 .75	2.46±0 .77	0. 406±0 .49	27.076	<0.001	41.079	<0.001
Locking sensation in the knee	9.00±1.038	4.50±0.75	0.64±0.80	33.21	<0.001	41.35	<0.001
Giving way sensation from the knee	11.23±0.75	4.71±1.63	0.79±0.71	26.59	<0.001	78.24	<0.001
Pain	11.31± 0.73	4.85±0.90	0.75±0.73	53.87	<0.001	88.25	<0.001
Swelling	7.75±0.88	3.40±0.93	0.56±0.70	42.32	<0.001	52.20	<0.001
Climbing stairs	7.84±0.59	3.59±0.77	0.40±0.63	19.39	<0.001	56. 83	<0.001
Squatting	7.42±0.86	3.03±0.77	0.15±0.40	33.03	<0.001	58.36	<0.001

**(1) Difference between Lysholm knee score pre & after one month of enhanced exercise program e implementation, (2) Difference between Lysholm knee score pre & after three months of implementing an enhanced exercise program.*

Table (6): Comparison of pain characteristics at pre, after one month, and after three months of enhanced exercise program implementation.

Pain characteristics	Pre-program N	%	After 1 month N	%	After 3 months N	%	X^2 (1)*	P-value (1)	X^2 (2)	P-value (2)
Severity of pain										
Simple	0	0	24	37.5	64	100	4.98	0.04	7.42	0.07
Medium	9	14	40	62.5	0	0				
Severe	55	85.9	0	00	0	0				
Nature of pain										
Continuous	40	62.5	6	9.4	4	93.8	3.97	<0.046	11.034	0.008
Interrupted	24	37.5	58	90.6	60	6.3				
Kind of pain										
Cannot determine	8	21.5	6	9.4	10	15.6	84.37	<0.001	69.61	<0.001
Burning sensation	23	35.9	27	42.1	23	35.9				
Stabbing	5	7.8	9	14	6	9.4				
Tingling	21	32.8	9	14	21	32.8				
Pressure	7	10.9	13	20.3	4	6.3				
Time of pain										
At the morning	27	42.2	25	29.1	34	53.1	10.71	<0.001	15.26	<0.001
At the evening	19	29.7	15	23.4	30	46.9				
After performing any activity	24	37.5	18	28.1	0	0				
Pain awake from sleep										
Always	57	89	21	32.81	2	3.3	4.78	0.029	6.67	0.059
Sometimes	7	10.9	20	31.25	18	28.1				
Never	0	0	23	35.93	44	68.8				
Pain affect concentration										
Able to concentrate completely	0	0	19	29.68	52	81.3	6.29	0.031	26.29	<0.001
To some extent	14	21	40	62.5	12	18.8				
Blurred concentration	50	78	5	7.81	0	0				
Relieve the pain										
Take the painkiller and try to move the painful part	20	31.3	18	28.1	5	7.8	14.72	0.005	31.61	<0.001
Massage and pressure on the site of pain	14	21.9	30	46.9	16	25				
Making hot compresses	30	46.9	16	25	12	18.8				
None	0	0	0	0	31	48.4				
Mean total	10.09±2.09		8.23±1.59		4.92±2.07		t= 17.85	<0.001	t= 11.99	<0.001

**(1) Difference between the level of pain pre & after one month of enhanced exercise program implementation, (2) Difference between the level of pain pre & after three months of implementing an enhanced exercise program.*

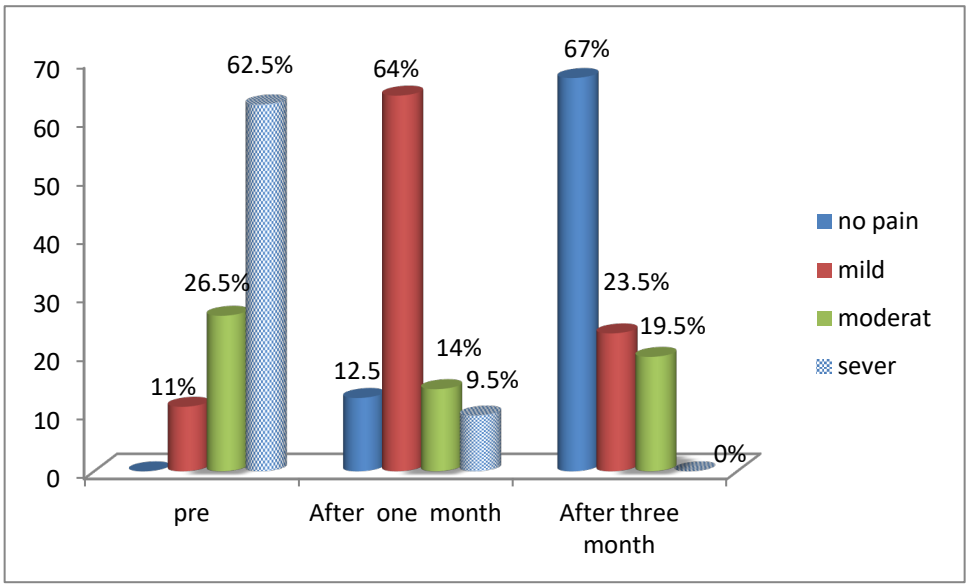

Figure (3): Percentage distribution of pain levels at pre, after one month, and after three months of enhanced exercise program implementation.

Table (7): Correlation between knowledge, activities of daily living, and Lysholm score after one and three months of enhanced exercise program implementation.

Variables	Total knowledge			
	After one month		After three months	
	R	p	r	P
Total Barthel index scale	0.928	0.011	0.707	0.048
Total Lysholm Knee scale	-0.689	0.000	-0.240	0.065
Total pain score	-0.571	0.072	-0.246	0.050

6. Discussion

Patients who undergo a TKA are generally adults who experience considerable functional limitations, muscle weakness, and poor balance and tend to be overweight and physically inactive *(Piva et al., 2017)*. The need for knee replacement is predicted to increase six-fold between 2005 and 2030 to reflect an increasingly yet functionally demanding population *(Khired 2018)*. So, the study aimed to evaluate the effect of enhanced exercise program on pain and physical activity for total knee arthroplasty.

The socio-demographic characteristics of patients with TKA reveal that more than half of the study sample was ≤60 years old with a mean of 37.6± 11.4, more than half were females, married, residing in an urban area with more than three quarters are living with their families as well as more than one third had a university education, and more than half of were employed. The increasing age in the study sample is related to the cumulative exposure to various risk factors and biological changes that occur with aging, such as thinning of the cartilage, decreased muscle strength, and oxidative stress. This study shows that women preferably developed osteoarthritis. This fact is probably related to menopause, which interferes with female hormone levels.

These results agreed with *Khired (2018)*, who conducted a study about "The influence of improvement in pain and function after total knee replacement in patients' satisfaction." They reported that most of the sample were females, and the patients' age range was between 55-70 years. On the same line, *Billona et al. (2017)* studied "The prospective assessment of patients' knowledge and informational needs and surgeon-to-patient information transfer before and after knee arthroplasty." This study reported that 67% of TKR patients were aged 41–83 years, 59% were females, and 56% lives with a partner.

Also, following the study of *Francisco da Silva Souza et al. (2016)* about "Clinical, demographic characteristics of total knee arthroplasty in a university hospital," and reported a total of 81 patients were included patients were older (mean age 64 years), women (79%). On the other side, this finding disagreed with *Chen's (2014)* study about "The effect of educational intervention on the pain and rehabilitation performance of patients who undergo a total knee replacement" and reported that 92% of participants were unemployed.

Regarding diagnosis, the majority of them are diagnosed with osteoarthritis. This finding agreed with *Khired (2018)* that 98.8% of patients had primary osteoarthritis. The study conducted by *Francisco da Silva Souza et al. (2016)* showed that osteoarthritis affected 87.65% of patients.

Regarding present history, most patients had a history of knee pain over six years, and a mean weight of 70.69±9.60, more than one-third of them were overweight, near two-fifths were obese, and around tenth is morbidly obese. The current study also shows a mean height of 168.64±6.22 and a mean body mass index of 25.58±2.86.

This result indicates that overweight and morbidly obese people are more likely to develop osteoarthritis and need total knee arthroplasty. The current study results agree with *Piva et al. (2017)* studied "The effect of comprehensive behavioral and exercise intervention on physical function and activity participation after total knee replacement: A pilot randomized study." This study reported that mean height was 163 ± 8.2 cm, mean weight was 82.9±11.9 kg, and mean body mass index was 29.3±4.1 kg/m.

Regarding the knowledge about total knee replacement, the present study points out to increase in the mean score of total knowledge between pre, after one month, and after three months of an enhanced exercise program with a statistically significant difference between the three study phases. Moreover, most patients had a satisfactory level of knowledge after one month and three months of enhanced exercise program implementation. This result asserts the assumption that meeting the informational needs of the patients who go to TKR would help fulfill the daily activity, decrease the level of pain, decrease the incidence of complications of the TKR and educate the patient on how to deal with it if it occurs. Hypothesis one was achieved through this finding.

This result agrees with *Shemesh et al. (2016),* who declared in their study about respondents who had undergone TKA or knew someone who had the surgery scored significantly higher than their counterparts did. This finding highlights the importance of educating the patients because it could disseminate knowledge to the patient community. This result agrees with *Greene et al.'s (2014)* study about "Education attainment is associated with patient-reported outcomes: Findings from the Swedish hip arthroplasty register." The study concluded that we should support patients with low and medium education to a greater extent, identifying patients who will benefit most from total hip arthroplasty and educating those at risk for poorer outcomes, like patients with low and medium education, may ultimately improve patient satisfaction.

In the same line, *Billona et al. (2017)* showed that assessing changes in patient knowledge during the management process for hip or knee arthroplasty revealed that patient knowledge was fairly low and varied considerably across individuals and time points in the management process. These data highlight the importance of providing patients with information throughout their management and particularly at discharge when the desire for information seems greatest.

The results of the current study agree with *Chyang et al. (2013)* in their study of "Patient perception and knowledge on total joint replacement surgery." The proportion of patients who wanted written information was higher. Most patients sought information before the outpatient visit. At each management process step, the patients wanted information on the surgical procedure, the rehabilitation program, and the prosthesis**.**

Regarding physical activity of patients with TKA, the current study reveals an increase in the total mean score of activities of daily living with statistical significance difference after one month and after three months of enhanced exercise program implementation. This result evidenced the positive effect of enhanced exercise program on improving patient physical activity. Hypothesis two was achieved through this finding.

The current study results agree with *Oktas & Vergili's (2018)* study about "The effect of intensive exercise program following total knee arthroplasty on functional recovery of patients." They reported that the program, which was initiated in the early postoperative period following TKA, improved the functional recovery of patients positively by the end of the first postoperative month. On the same line, *Piva et al. (2017)* demonstrated that more intensive exercise combined with physical activity promotion and health education delivered at least three months after TKR was safe and well-tolerated by subjects, supported by low attrition, high exercise adherence, and no adverse events.

These results agree with *Francisco da Silva Souza et al. (2016),* who showed that the health-educational intervention partially enhanced patients' self-care skills, thereby contributing to the recovery of their physical functions after surgery. These findings are consistent with the results reported by *Yeh et al. (2005)* study about "Effects of multimedia with the printed nursing guide in education on self-efficacy and functional activity and hospitalization in patients with knee arthroplasty" and stated that the use of multimedia-based health education leads to enhancement of patients' functional activities after total knee arthroplasty.

However, inconsistencies exist between the current study findings and those of other studies on health education before TKA surgery. *Mcdonald et al. (2004)* studied "Pre-operative education for hip or knee replacement" and showed that pre-operative health education did not affect patient mobility. However, such inconsistencies may also be attributable to the guidance we provided to patients after surgery.

Regarding Lysholm knee score and pain characteristics, there was a decrease in the total mean score of the Lysholm knee scale and a decrease in the total mean score of pain with statistical significance difference after one month and after three months of enhanced exercise program implementation. It indicates that when the Lysholm knee scale decrease, the level of pain also decreases, signifying that the enhanced exercise program has positively affected the TKR patients' outcomes. This finding is supporting the third research hypothesis.

These results agree with *Chang-Gong (2014),* who conducted a study about "Korean medical rehabilitation for total knee replacement" and found that the pain and functional ability were improved. Lysholm's knee score and the physical function of the knee joint were also improved. On the same line*, Chyang et al. (2013)* reported that because the pre-operative health education provided information regarding postoperative pain management, patients developed accurate pain control concepts, having an appropriate understanding of patient-controlled analgesia that enabled patients to manage pain effectively.

This result is consistent with the findings of other studies *Johansson et al. (2005); Carr (2007); Wong et al. (2010); Papanastassious et al. (2011);* who examined the effects of pain-related health education for patients who had undergone spinal surgeries and found that the education effectively alleviated patients' postoperative pain. *Papanastassious et al. (2011)* also confirmed that participants who attended patient education classes were more satisfied with the efficacy of pain management.

However, other studies proposed that health education did not affect postoperative pain control for joint-replacement patients *(Mcdonald et al., 2004; Kearney et al., 2011).* In their review of five independent studies, *Mcdonald et al. (2004)* found no significant differences between the levels of postoperative pain experienced by patients who received pre-operative education and those who did not. Furthermore*, Kearney et al. (2011)* found that pre-operative education had no significant effect on patients' pain levels following joint-replacement surgery. These findings may be attributed to the additional guidance provided after surgery and the educational intervention before surgery.

The correlation between total knowledge, total activities of daily living (Barthel index score), Lysholm knee score, and total pain score among patients reveals that a highly statistically significant positive correlation between total knowledge and ADLs (Barthel), total pain score, and total knowledge after one month and after three months of enhanced exercise program implementation. These results indicate that as the patient's level of knowledge and activities of daily living is improved, the Lysholm scale and pain score decreased. It is supporting the fourth research hypothesis.

This result matched a study conducted by *Francisco da Silva Souza et al. (2016)*, who mentioned a significant inverse correlation between mobility and pain relief. Overall, negative correlations could be found between patients' physical activity with total knee arthroplasty and Lysholm knee score, showing that a better-enhanced exercise program leads to lower morbidity.

Also, in *Khired (2018),* there is a positive correlation between improvement in pain and functional activity after TKR. Also, *Oktas and Vergili (2018)* concluded that the correlation between patient education, pain, and physical activity was significant in their study. They also found that the extent of influence of patient education is great. This finding reflects an improvement in the patients' knowledge levels that leads to an improvement in daily living activity and decrease of knee pain, and this was the primary goal of this research, and it has been proven.

7. Conclusion

Based on the current study's findings, it can be concluded that implementing an enhanced exercise program for patients with total knee arthroplasty effectively improved knowledge, improved daily living activities (Barthel ADL index), and decreased Lysholm knee scoring and pain score.

8. Recommendations

- Implement the enhanced exercise program as part of routine care service for patients with a total knee replacement.
- Further research should be conducted to determine the most effective method of incorporating an enhanced exercise program into routine care service provided for total knee replacement.
- Repeating the study on a larger probability sample to achieve generalization of the findings.

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