Effect of Thermotherapy on Clinical Outcomes among Patients with Osteoarthritis

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Abstract

Background: The most common and crippling type of arthritis is osteoarthritis (OA), which is characterized as a degenerative disorder targeting synovial joints. Patients with osteoarthritis frequently lament a dull aching pain that worsens with movements. When physical agents as heat therapy are used properly, they can combat unpleasant conditions. **Aim:** This study was carried out to determine the effect of thermotherapy on Clinical Outcomes among Patients with Osteoarthritis. Design: A quasi-experimental research design (pre-post study/control) was used to achieve the study's aim. **Setting:** The study was conducted in the orthopedic outpatient department of the shebin EL-Kom Teaching Hospital and Menoufia University Hospital, Menoufia Governorate, Egypt. **Sample:** 80 adults with unilaterally knee osteoarthritis were chosen as a convenient sample. Three different tools were used to collect data. **Tool I:** structured interview questionnaire. **Tool II:** Lysholm Knee Scoring Scale (LKSC). **Tool II1:** The Western Ontario and McMaster Universities Arthritis Index. **Results:** The mean pain and stiffness scores were 13.62±2.10 and 5.40±0.92 respectively among the study group and 13.52±2.01 and 5.50±0.87 respectively among the control group, which were highly significantly decreased among the study group than the control group with P value = <0.001. **Conclusions:** A distinct effect of thermotherapy on knee osteoarthritis was observed in a form of decreasing pain, stiffness, and improving physical functions. **Recommendation:** Superficial heat therapy should be included in managing patients with osteoarthritis to relieve pain, stiffness and improve physical function. Moreover, replication of the study with a larger probability sample must be considered in the development of future research to allow for greater generalization of the results.

Keywords: thermotherapy, clinical outcomes, knee pain, and osteoarthritis.

Introduction

Osteoarthritis (OA) is a major health issue worldwide, characterized as a degenerative joint disease that affects cartilage, bone, and soft tissues of the joint and falls under the category of Rheumatic Diseases **(Monroe et al., 2020a).** The most affected joints are the hips, knees, wrists, feet, and spines. It produces discomfort and instantly inhibits the sufferer's mobility and independence, as well as having psychological consequences **(Nakano et al., 2020)**. Even simple tasks might be difficult for patients with OA due to the limitations imposed by the disease's biology. It is also associated with a variety of co-morbidities such as hypertension and cardiovascular disease **(Monroe et al., 2020 b).**

Among the most prevalent articular illnesses, OA attacks 30% of persons over the age of 65 years old and about 6% of adults over the age of 30. An extremely common affected joint is the knee **(Pandya & Sheth, 2017).** It is the third factor contributing to temporary workplace disabilities and the primary factor causing permanent disabilities **(Leifer et al., 2022).** It affects about 40 million females and males in USA. In 2020, this ratio, currently representing roughly 15% of the general public, increased to 18.2%, affecting 59.4 million Americans. Moreover, it is predicted that 67

million Americans will develop OA by the year 2030 **(Pérez-García et al., 2019).**

It is a chronic condition that restricts movements and causes immobility and excruciating pain. It is characterized by cartilage degradation, bone edge hypertrophy, biochemical alterations in sub-chondral sclerosis, synovial membranes, and joint capsules **(Vitaloni et al., 2020).** The knee joint is the joint that is most susceptible to degenerative alterations. Knee osteoarthritis (OA) may be classified as either primary or secondary. It is considered primary when caused by wear, strain, and progressive breakdown of articular cartilage **(Horta-Baas et al., 2021)**. Whereas secondary osteoarthritis results from either aberrant concentrations of force across the joints, especially post-traumatic reasons, or defective articular cartilage, such as with rheumatoid arthritis, primary osteoarthritis which is articular degradation with no obvious actual reason **(Pontes et al., 2018).**

The precise causes of OA remain unknown. It is claimed that genetic, biomechanical, and mechanical elements are involved **(Jackson et al., 2020).** Obesity, female sex, advanced age, knee joint traumas, employment in jobs requiring excessive mechanical power against knees, including climbing stairs or knees bending, sporting contests that compelled or harm joints, wearing shoes with elevated heels, lack of mobility, and genetic predisposition are all the most significant considerations that may contribute to the development of knees OA **(Oike et al., 2020).**

Each person's clinical signs are likely different in terms of severity. Yet over time, they usually get worse, happen more often, and become more crippled. The rate of advancement is likewise unique **(Kimura et al., 2022).** Knee pain that develops gradually and gets worse with movement is one of the most typical clinical manifestations. It has been characterized as a dull, throbbing discomfort that gradually intensifies and becomes persistent **(Kim, 2023).** Moreover, edema and stiffness are from signs and symptoms that could limit activities and movements, prevent involvement, disrupt sleep, increase fatigue, worsen mood, and ultimately result in loss of independence and lower quality of life **(Monroe et al., 2020 b).** Walking, climbing stairs, and other lower-extremity activities are more affected by knee OA than any other disease. Long-term osteoarthritis results in malfunction, crippling joint pain, and inactivity that weakens the periarticular muscles, and it is expensive to treat with drugs and joint replacement **(JAIN et al., 2021).**

Compared to medical treatment, such as corticosteroid injections, alternative management has been shown to help reduce clinical indicators and improve knee function **(Egwu et al. 2018).** Thermotherapy is one noninvasive treatment that could help reduce the signs and symptoms of knee osteoarthritis. Thermotherapy treats osteoarthritis symptoms by delivering heat or cold to joints using packs, towels, wax, and other methods. Heat may help to improve circulation and relax muscles. It may alleviate pain and stiffness, preserve, or improve mobility, and lower disability and treatment expenses. It could be used alone or in combination with other treatments **(Whittaker et al., 2021).**

Thermotherapy had calming impacts, vasodilation, increased capillary permeability, acceleration of cellular metabolism, and muscular relaxing. All of these effects may relieve pain, and reduce joint stiffness that could improve joint mobility **(Jia et al., 2020).** The effectiveness of thermotherapy for osteoarthritis of the hips and/or knees is not sufficiently proven through studies **(Lee et al., 2021)**. Though, the aim of the current study was to ascertain how thermotherapy affects patients with osteoarthritis' mobility limitations and knee pain.

Operational definition: Clinical Outcomes were impacted by knee pain, stiffness, and movement restriction that was assessed by study tools two and three.

Significance of the study:

OA is the most prevalent joint condition, the common cause of joint replacement, and the leading cause of disability worldwide, costing

an estimated $1 billion annually. It impairs involvement and quality of life by causing pain and limiting exercises, notably walking. The hazard of mortality increases with the severity of OA-related walking impairment **(Schiphof et al., 2018)**

Around 10% of Egyptians suffer from osteoarthritis. The most common kind of arthritis, which causes loss of joint function, is that which is accompanied by agonizing pain **(Basuny et al., 2020).** It has been observed that many patients with knee osteoarthritis who are admitted to the orthopedic outpatient department, physiotherapy, and rehabilitative services departments at Menoufia University Hospital complain of joint pain and knee OA-related movement restrictions, which could make it difficult for them to carry out daily activities. Furthermore, frequent medical visits and hospitalization, as well as greater treatment costs, had a negative impact on the patient's health-related quality of life and could be a risk factor for morbidity and death. Physical limits may cause people to quit engaging in traditional social, communal, and job activities **(Mahmoud et al., 2019).** As a result, this study was conducted in an effort to establish a clear strategy for relieving patients suffering, notably pain and movement limitations, through the use of noninvasive nursing treatment such as thermotherapy.

Research hypotheses:

To achieve the study's goal, we created the following research hypotheses:

1- Thermotherapy for study group I, will lead to reduced knee pain and stiffness compared to the control group II.

2- Thermotherapy will improve joint mobility among study group I compared to control group II.

3- Thermotherapy will significantly increase daily living activity ratings compared to before the intervention.

Methods

Design:

A quasi-experimental research design (pre-post study/control) was used to achieve the study's aim.

Setting:

The current study was conducted at orthopedic outpatient clinics of Menoufia University and teaching hospitals - Egypt.

Sampling:

A random sample of 80 adult patients from both sexes with unilateral knee osteoarthritis were chosen, then assigned randomly and divided into 2 equal groups (study and control),40 patients for each. Study group I was exposed to thermotherapy along with routine hospital care and control group II was exposed to routine hospital care only. They were chosen based on the following criteria**:**

- Free from past knee injuries, such as arthroscopy or serious ligaments or meniscal damage because heat could increase swelling and inflammation and also could interfere with the healing process.
- Did not undergo knee replacement surgery as using heat is not recommended for six weeks or more after surgery.

Sample size calculation: The formula for determining the sample size with a 95% confidence level, 0.5 standard deviation (the expected variance), and a 5% margin of error is as follows.

$$n = \left(\frac{Z\sigma_d}{E}\right)^2$$

- **Z** is the value of the standard normal distribution for the desired confidence level (e.g., Z = 1.96 for 95% confidence)
- **E** is the margin of error
- **σ** is the standard deviation of the outcome of interest.

A 37 patient for each group was estimated but the researchers decided to increase each group to reach 40 patients to compensate for the expected dropout.

Tools of data collection:

Three tools were utilized by the researchers to collect the necessary data. These tools were as follows:

Tool one: **Structured interview questionnaire:** It was developed by the researchers to collect biodemographic data about the subjects of the study. It included the following two parts:

Part 1: Questions about demographic characteristics including age, sex, marital status, education, occupation, residence, and means of transport.

Part 2: Questions about past and present medical history of studied subjects as body mass index, family history of osteoarthritis,duration, and stage of osteoarthritis.

Tool Two: Lysholm Knee Scoring Scale (LKSC): this scale was developed by Tegner & Lysholm, (1985) to give information about how knee pain affects the ability to manage everyday life. It consists of eight parts as follow:

- **Part 1: Limp movement:** It includes 3 questions about the degree of limp movement during the last 4 weeks such as ranging from no or slight limp to sever limp when walkling.

- **Part 2: Using cane or crutches:** It consistes of 3 questions about the support devices that were used during walking in the last 4 weeks such as not using cane or crutches, using a cane or crutches with some weight-bearing.

- **Part 3: Locking sensation in the knee:** it includes 5 questions about the frequency of knee locking sensation during the last 4 weeks.

- **Part 4: Giving way sensation from knee:6** Questions about giving sensation from the knee during athletics or other severe exertion or during daily activities in the last 4 weeks.

- **Part 5: Pain:** It asks about knee pain during the last four weeks, including 6 questions about how often and how much knee pain is felt following vigorous exercise, after walking less or more than one kilometre, and whether the pain is consistent.

- **Part 6: Swelling: it includes 4** questions about occurrence of swelling during the last 4 weeks .

- **Part 7: Climbing Stairs:4** Questions about the ability to climb stairs during the last 4 weeks as slightly impaired or one step at a time.

- **Part 8: Squatting:4** Questions about the ability to perform squatting position during the last 4 weeks.

Scoring system:

Greater scores indicate less complaints and increased rates of functionality on this scale, which is rated on a range from 0 to 100. The lysholm scale currently consists of eight items that measure: limp (5 score), using cane or crutches (5 score), locking (15 score), giving way sensation from knee (25 score), pain (25 score), swelling (10 score), climbing stair (10 score), and squatting position (5 score).

Then all scores are summed to give the indicators as following: -

- Excellent for 95 to 100 degrees which means that there was improvement of knee function and less symptoms.

- Good for 84 to 94 degrees.

- Fair for 65 to 83 degrees.

- Poor for less than 65 degrees which means that there was decrease of knee function and sever symptoms.

Reliability:

Jagiasi et al, (2017) evaluated the scale's validity and dependability. They discovered that this measure had great internal consistency and strong test-retest reliability (Pearson's correlation coefficient = 0.85) (Jagiasi et al., 2017).

Tool three: The Arthritis Index from the Western Ontario and McMaster Universities (WOMAC). It was created by Bellamy etal

(1988) to evaluate individuals with knee and/or hip osteoarthritis (OA) for pain, stiffness, and physical functioning. The WOMAC index has 24 items that are grouped into 3 subscales:

Pain (5 items): It asked about knee pain throughout the previous 48 hours in various positions, such as when climbing and descending stairs.

Stiffness (2 items): It asked about the degree of knees stiffness during the previous 48 hours following initial morning awakening in various positions.

Physical Function (17 items): Items about the level of difficulty encountered when performing daily regular physical activity over the previous 48 hours, such as climbing stairs, how to stand up from a chair, bend over, walk, get in and out of a car, shopping, put on and take off socks, rise from bed, lying in bed, getting in and out of the bath, sitting, using the toilet, and performing heavy or light housework.

Scoring system: The scale is a 5-point Likert scal, with None (zero), Mild (one), moderate (two), sever (three), and extreme (four). With a potential average score of 0-20 for pain, 0-8 for stiffness, and 0-68 for functional ability. A total WOMAC scoring system is often calculated by adding the results for each of the three measures which ranges from zero to 96. The greater values represent worse pain, stiffness, and activity impairment.

Reliability:

Bellamy et al. (1988) used test-retest melted to assess the reliability of the tool giving good reliability values and internal consistency (Cronbach's alpha) of the pain sub - scale as 0.86 and 0.95 for stiffness and functional ability in a research project of the WOMAC's application in a medication study.

Procedure:

- An official written letter was sent from the Dean of Faculty of Nursing to the responsible authorities of Menoufia University hospital and Sebin Elkom Teaching Hospital to get their permission to collect data after explanation of the aim and procedure of the study.

- **Tools development**: the first tool was constructed by the researchers after reviewing the relevant literature **Atta et al., (2022), Ramsey et al., (2020) and Uludag & Kasikci (2019).** The tool was tested for content validity by 5 experts in Nursing and Orthopedic fields. Modifications were done accordingly to ascertain relevance and completeness. While the second tool was developed by Tegner & Lysholm (1985) and the third tool was developed by Bellamy et al (1988)

- The reliability of the interviewing questionnaire was measured using a test- retest method and Pearson correlation coefficient formula to ascertain relevance and consistency of the tool to measure its items. The value was 0.92.

- **Ethical considerations and human rights:** The Faculty of Nursing Menoufia University's ethics and research committee (No. 892) provided formal clearance for data collection. All individuals provided written agreement to participate in the study after being informed of the study's purpose and being guaranteed that all gathered data would be kept secret and used exclusively for the study's purposes. The researchers underlined that participation in the study is completely voluntary, and the individual's privacy was ensured by coding data. Subjects were also advised that refusing to participate in the study would not affect their care.

- Before data collection, pilot research with 8 patients (10% of the sample) tested tools for clarity, objectivity, relevance, practicality, and application. It was also carried out to detect any issues with managing the tools and to estimate the time needed to fill in the study tools for data gathering, after which the necessary changes were implemented. Subjects of the pilot study were excluded from the current study sample.

- **Data collection: -**

  - Data collection lasted 9 months, from September 2020 to May 2021. Patients who

consented to participate and met the inclusion criteria were enrolled in the trial.

- The researcher collected demographic and medical data from both groups through individual interviews using tool one.
- The researcher used tool 2 to measure how knee discomfort impacts individuals' capacity to handle daily activities.
- Participants in both groups were assessed for knee pain, joint stiffness, and total functional impairment using the 24-item WOMAC questionnaire (tool three).
- The researchers scheduled three thermotherapy sessions (two theoretical and one practical) for the entire study group.
- During the first session, the researcher discusses OA (Definition, Causes, clinical manifestations, and management).
- At the beginning of the second session, the researchers reinforced the taught information and explained thermotherapy (Definition, indications and contraindications, importance and its effect on pain, stiffness of knee joint) and at the beginning of the third session the researchers reinforced the acquired knowledge then discussed to them how to apply thermotherapy as the following:
  - Each participant was asked to complete the therapy treatment protocols for one month duration. The applications were applied through a hot water pack over layers of towel around the affected knee within the temperature of water ranging from 37.7 to 40.5 °C. They were told to assess water temperature either by water thermometer or using the inner aspect of the wrist.
  - The first compression was performed on each participant by the researchers then they were trained on how compression should be applied. The treatment therapy was applied for 20 minutes, twice a day (morning and evening) for 15 times in total for 4 weeks and every other day.
- Each session took about 30 – 45 minutes. Lecture, group discussion and demonstration as well as redemonstration were used during all sessions in the waiting area in outpatient clinic.
- Participants of the study group were contacted by phone every other day to remind them to apply hot compression on OA knees.
- Each participant of both groups was assessed by LKSC to assess how knee pain affects the ability to manage everyday life and WOMAC to assess knee pain, joint stiffness, and overall functional disability.
- A comparison was carried out between the results of both groups before and after implementation of the thermotherapy to examine the effect of using the thermotherapy on knee pain, joint stiffness, and overall functional disability levels among patients with osteoarthritis.

Statistical Analysis:

The data collected were tabulated & analyzed by SPSS (statistical package for the social science software) statistical package version 20 on IBM compatible computer **(SPSS, Chicago, IL, USA**).

Two types of statistics were done:

1) **Descriptive statistics:** were expressed as mean and standard deviation (X+SD) for quantitative data or number and percentage (No & %) for qualitative data.

2) **Analytic statistics:**

1- The Pearson Chi-square test ($\chi 2$) and Fisher's exact test are used to analyze the relationship between two qualitative variables.
2- ANOVA (parametric test) is a statistical test used to compare normally distributed quantitative variables across several independent groups.
3- The Kruskal Wallis test (non-parametric test) compares non-normally distributed quantitative data from many independent groups to determine significance.
4- The paired t-test (parametric test) compares two sets of regularly distributed quantitative variables to determine significance.
5- The Wilcoxon test, a non-parametric test, compares two dependent groups of quantitative variables that are not regularly distributed.
6- The student t-test (parametric test) compares two independent sets of normally distributed quantitative variables to determine their significance.

7- The Mann-Whitney test (non-parametric test) compares two independent sets of quantitative variables that are not regularly distributed.
8- Spearman correlation is a test of significance for non-normally distributed quantitative or qualitative data.

A P-value at 0.05 was used to determine the significance regarding:

- P-value > 0.05 to be statistically insignificant.

Results:

Table (1): Revealed that; the mean age for study group was 51.50 ± 7.72 years, while for control group 53.95 ±9.44 years. Female patients in study group were more than half (57.5%) while 52.5% among the control group were male. Most of the study and control groups were married 97.5% and 100% respectively. 45 % and 67% of them respectively had secondary education. 65% of the study group were obese, however 67.5% of the control participants were overweight.

Table (2): Showed that the total mean score of knee pain effect on managing daily life was 20.32±12.73 among study group and as 26.22±18.81 among the control group with significant improvement to 67.87±8.71 among the study group versus 25.75±18.49 among control group post thermotherapy application.

Figure (1): showed that all participants of both group 100% had poor total effect of knee pain on managing daily life with significantly decreased to 20% among the study group versus 100 % among the control group.

Table (3): Reported that there were no statistically significant differences between study and control groups regarding pain, stiffness and difficulty doing physical activity scores pre intervention. While post intervention there were statistically significant improvement of all ties among the study group than control group.

Figure (2): Showed that there were no statistically significant differences between study and control groups regarding total WOMAC score (65.50±10.09 and 65.77±9.18) respectively pre-intervention. While after nursing intervention there were statistically significant improvement among the study group (41.75±10.99) versus 65.70±9.26 the among control group.

Table (4): Illustrated that there was a significant negative correlation between the effect of knee pain on managing daily life and total WOMAC score pre intervention.

Table (5): Illustrated that illiteracy had a significant association with the effect of pain on managing daily life activities pre and post intervention.

Table (1): Distribution of both studied groups regarding bio- demographic characteristics (N= 80).

Bio demographic characteristics	Studied groups				χ^2	P value
	Study Group (n=40)		Control Group (n=40)			
	No.	%	No.	%		
Age (years): Mean±SD Range	51.50 ± 7.72 39.0 – 67.0		53.95 ±9.44 35.0 – 78.0		**t- test =** 1.26	0.20
Sex:						
• Male	17	42.5	21	52.5	0.80	0.37
• Female	23	57.5	19	47.5		
Marital status:						
• Single	1	2.5	0	0.0	1.01	1.0
• Married	39	97.5	40	100.0		
Educational level:						
• Illiterate	6	15.0	3	7.5	5.66	0.12
• Primary	5	12.5	1	2.5		
• Secondary	18	45.0	27	67.5		
• University	11	27.5	9	22.5		
Occupation:						
• Manual	22	55.0	18	45.0	0.80	0.37
• Administrative	18	45.0	22	55.0		
Means of Transport:						
• Public	37	92.5	31	77.5	3.52	0.06
• Private	3	7.2	9	22.5		
BMI:						
• Overweight	14	35.0	27	67.5	8.45	0.004
• Obese	26	65.0	13	32.5		S
Stage of osteoarthritis:						
• Stage 2	12	30.0	16	40.0	0.87	0.34
• Stage 3	28	70.0	24	60.0		
Duration of disease:						
• Less than 1 year	1	2.5	0	0.0	1.62	0.44
• 1-2 year	19	47.5	23	57.5		
• More than 2 years	20	50.0	17	42.5		
Family history:						
• Yes	23	57.5	16	40.0	2.45	0.11
• No	17	42.5	24	60.0		

*Fishers Exact test; S: significant: χ^2: chi square test**; t:** student t test

NB: all subjects of both groups were from urban areas and visited the hospital for follow up

Table (2): Total and subtotal scores effect of knee pain on managing daily life activities among both groups pre and post-intervention (N= 80).

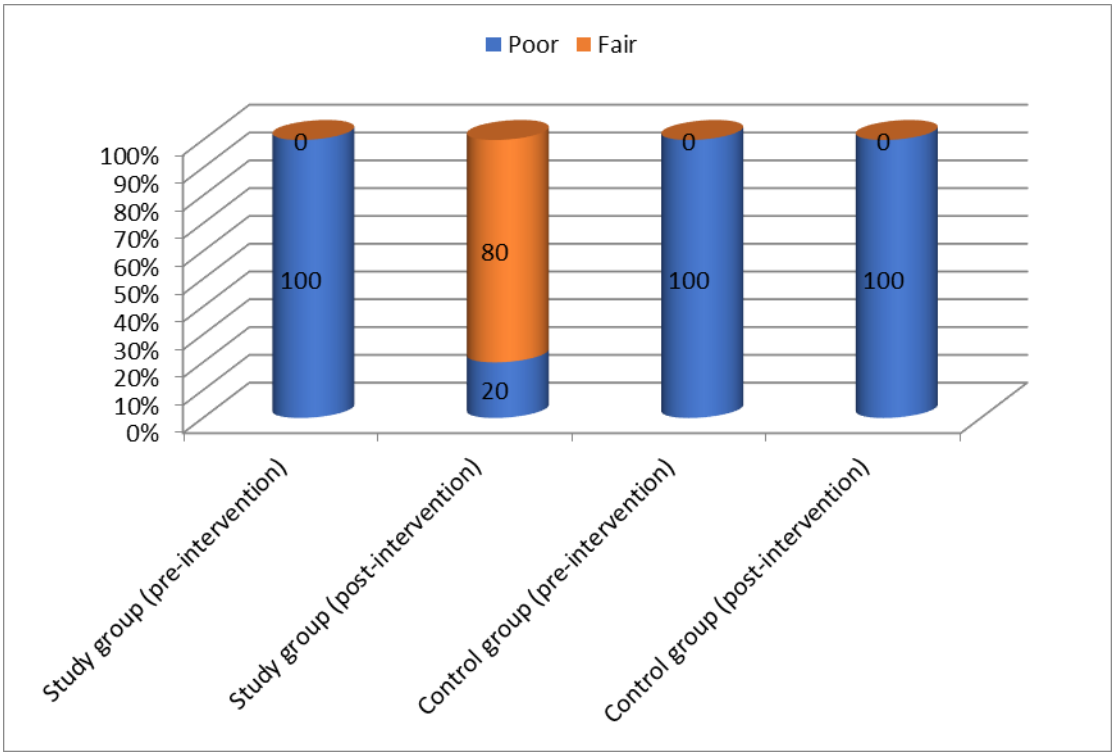
Effect of knee pain on managing daily life	Studied groups Pre-intervention				Studied groups Post-intervention			
	Study Group (n=40)		Control Group (n=40)		Study Group (n=40)		Control Group (n=40)	
	No.	%	No.	%	No.	%	No.	%
Limp pain during movement:								
• No limp movement	0	0.0	0	0.0	3	7.5	0	0.0
• Slight or periodical	8	20.0	12	30.0	37	92.5	11	27.5
• Severe and constant	32	80.0	28	70.0	0	0.0	29	72.5
	χ^2 = 1.06				χ^2 =46.08			
	P value = 0.30				**P value** = <0.001 HS			
Using cane or crutches:								
• Weight-bearing impossible	12	30.0	12	30.0	1	2.5	14	35.0
• Stick or crutch	17	42.5	20	50.0	25	62.5	19	47.5
• No	11	27.5	8	20.0	14	35.0	7	17.5
	χ^2 =0.71				χ^2 =14.41			
	P value=0.69				**P value** = 0.001 HS			
Locking sensation in the knee:								
• Locked joint on examination	8	20.0	11	27.5	0	0.0	11	27.5
• Frequently	25	62.5	13	32.5	1	2.5	14	35.0
• Locking Occasionally	7	17.5	12	30.0	3	7.5	11	27.5
• Catching sensation	0	0.0	4	10.0	33	82.5	4	10.0
• No locking	0	0.0	0	0.0	3	7.5	0	0.0
	χ^2 =9.57				χ^2 =52.56			
	P value = 0.02 S				**P value** = <0.001 HS			
Giving way sensation from knee:								
• Every step	8	20.0	11	27.5	0	0.0	11	27.5
• Often in daily activities	16	40.0	9	22.5	0	0.0	9	22.5
• Occasionally in daily activities	11	27.5	4	10.0	1	2.5	5	12.5
• Frequently in severe exertion	4	10.0	15	37.5	12	30.0	14	35.0
• Rarely in severe exertion	1	2.5	1	2.5	27	67.5	1	2.5
	χ^2 =12.06				χ^2 = 46.96			
	P value = 0.01 S				**P value** = <0.001 HS			
Pain:								
• Constant pain	12	30.0	11	27.5	0	0.0	11	27.5
• Pain after walking <2 km	24	60.0	17	42.5	1	2.5	17	42.5
• Pain after walking >2 km	4	10.0	9	22.5	3	7.5	9	22.5
• Marked during severe exertion.	0	0.0	3	7.5	10	25.0	3	7.5
• Slight pain	0	0.0	0	0.0	26	65.0	0	0.0
	χ2 = 6.16				χ2 = 57.99			
	P value = 0.10				**P value** =<0.001 **HS**			

Continuous table (2): Total and subtotal scores of the effect of knee pain on managing daily life among both groups pre and post-intervention (N= 80).

Effect of knee pain on managing daily life	Studied groups Pre-intervention				Studied groups Post-intervention			
	Study Group (n=40)		Control Group (n=40)		Study Group (n=40)		Control Group (n=40)	
	No.	%	No.	%	No.	%	No.	%
Swelling:								
• Constant	10	25.0	11	27.5	0	0.0	11	27.5
• Swelling after ordinary activity	25	62.5	18	45.0	3	7.5	17	42.5
• On severe exertion	4	10.0	9	22.5	34	85.0	10	25.0
• None	1	2.5	2	5.0	3	7.5	2	5.0
	χ^2 = 3.44				χ^2 =34.09			
	P value = 0.32				**P value** = <0.001 HS			
Climbing stairs:								
• impossible	13	32.5	12	30.0	0	0.0	12	30.0
• one step at a time	25	62.5	17	42.5	1	2.5	18	45.0
• slightly impaired	2	5.0	11	27.5	38	95.0	10	25.0
• no problem	0	0.0	0	0.0	1	2.5	0	0.0
	χ^2 = 7.79				χ^2 = 44.54			
	P value = 0.02 S				**P value** = <0.001 HS			
Squatting:								
• Impossible	8	20.0	11	27.5	0	0.0	11	27.5
• Not beyond 90°	32	80.0	27	67.5	1	2.5	27	67.5
• Slightly impaired	0	0.0	2	5.0	37	92.5	2	5.0
• No problem	0	0.0	0	0.0	2	5.0	0	0.0
	χ^2 =2.89				χ^2 = 68.55			
	P value = 0.23				**P value** = <0.001 HS			
Mean total score:								
• Mean±SD	20.32±12.73		26.22±18.81		67.87±8.71		25.75±18.49	
• Range	0 - 45.0		0 – 54.0		27.0 - 79.0		0 – 54.0	
• Median	21.50		27.0		71.0		27.0	
	U= 1.86				**U**= 7.53			
	P value = 0.06				**P value** = <0.001 HS			

*Fishers Exact test; NA: not applicable; S: significant, HS: highly significant. χ^2: chi square: U: Mann Whitney

Figure (1)



Total score of effect of knee pain on managing daily life among both groups pre and post-intervention (N= 80).

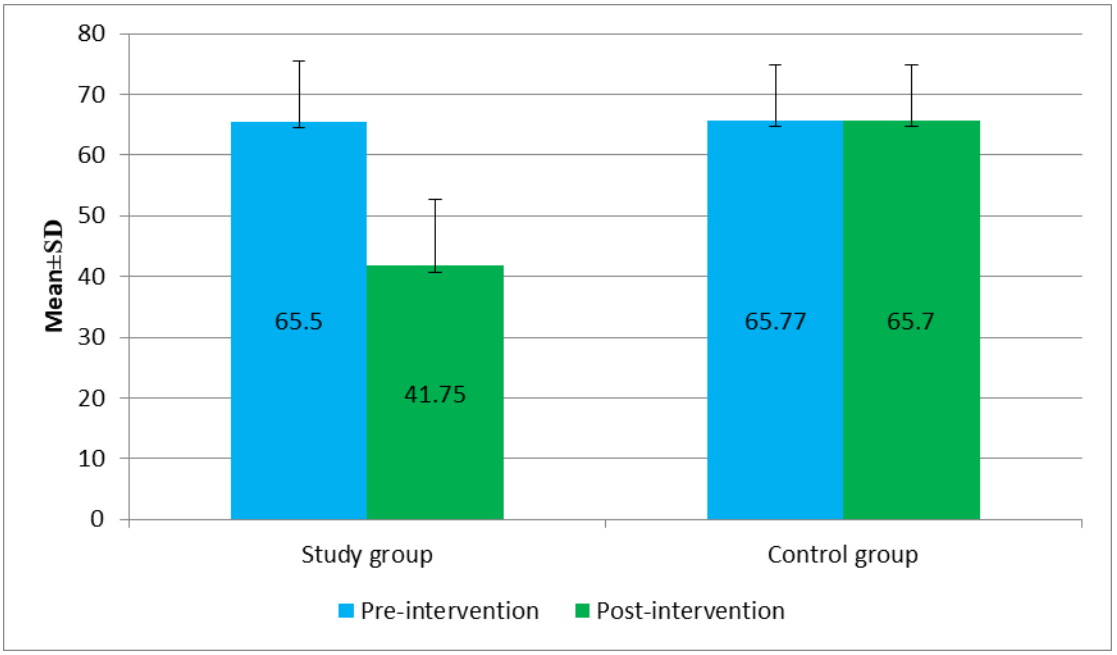
Pre intervention Post intervention

χ^2 = NA χ^2 = 53.33 **P value** = NA **P value** = <0.001 HS

Table (3): Mean scores of pain, stiffness, and physical function among both groups pre and post intervention (N= 80).

Mean score	Studied groups		Student t test	P value
	Study Group (n=40)	Control Group (n=40)		
	Mean±SD Range	Mean±SD Range		
Pain score (pre):	13.62±2.10 10.0 - 15.0	13.52±2.01 10.0 – 15.0	0.21	0.82
Pain score (post):	8.72±2.37 5.0 - 15.0	13.45±2.13 10.0 – 15.0	9.35	<0.001 HS
Stiffness score (pre):	5.40±0.92 4.0 - 6.0	5.50±0.87 4.0 - 6.0	0.49	0.62
Stiffness score (post):	3.55±0.93 2.0 - 6.0	5.52±0.84 4.0 - 6.0	9.91	<0.001 HS
Difficulty doing physical activities score (pre):	46.47±7.32 34.0 - 51.0	46.75±6.56 34.0 - 51.0	0.17	0.86
Difficulty doing physical activities score (post):	29.47±8.18 17.0 - 51.0	46.72±6.55 34.0 - 51.0	10.40	<0.001 HS

Figure (2)



Mean total WOMAC score among study and control groups pre and post-intervention (N= 80).

Paired t-test for study group = 13.07 **Paired t-test for control group** = 0.48
P value study group = <0.001HS **P value control group** = 0.62

Table (4): Correlation between effect of knee pain on managing daily life score and total WOMAC scores among both groups pre and post-intervention (N= 80).

Total WOMAC scores	The effect of knee pain on managing daily life (Pre-intervention)		The effect of knee pain on managing daily life (post-intervention)	
	R (spearman correlation coefficient)	P value	r (spearman correlation coefficient)	P value
Pre-intervention	-0.36	0.02 S		
Post-intervention			0.25	0.10

Table (5): Association between bio-demographic characteristics of the study group and effect of knee pain on managing daily life (Pre- and Post-intervention) (N= 80).

biodemographic characteristic	Study group		Test of sig.	P value
	Pre-intervention (n=40)	Post-intervention (n=40)		
	Mean±SD	Mean±SD		
Age (years):	Spearman rho	Spearman rho	r= - 0.18[a] r= -0.008[b]	0.24[a] 0.96[b]
Sex:				
Male	15.58±10.25	66.0±12.18	U= 1.90[a]	0.06[a]
Female	23.82±13.45	69.26±4.28	t= 1.04[b]	0.30[b]
Education level:				
Illiterate	27.05±9.43	70.50±4.69	K= 9.17[a]	0.02[a]
Primary	12.0±11.57	68.0±4.48	F= 5.12[b]	S
Secondary	12.16±11.51	56.83±16.57		0.005[b] S
University	17.54±14.03	69.54±4.98		
Occupation:				
Work	18.36±11.14	66.86±10.62	U= 1.13[a]	0.25[a]
Not work	22.72±14.41	69.11±5.63	t= 0.80[b]	0.42[b]
Transport:				
Public	20.48±13.23	67.21±8.67	U= 0.69[a]	0.48[a]
Private	18.33±2.30	76.0±4.35	t= 1.72[b]	0.09[b]
BMI:				
Overweight	18.07±15.54	68.85±5.69	U= 0.82[a]	0.40[a]
Obese	21.53±11.09	67.34±10.03	t= 0.51[b]	0.60[b]
Stage of osteoarthritis:				
Stage 2	22.0±12.73	66.83±13.37	U= 0.71[a]	0.47[a]
Stage 3	19.60±12.90	68.32±6.01	t= 0.49[b]	0.62[b]
Duration of disease:				
Less than 1 year	30.0±0.0	73.0±0.0	K= 6.56[a]	0.06[a]
1-2 year	24.57±12.67	70.57±3.93	F= 2.27[b]	S
More than 2 years	15.80±11.67	65.05±11.14		0.11[b]
Family history:				
Yes	22.0±13.25	68.91±6.67	U= 0.63[a]	0.52[a]
No	18.05±12.02	66.47±11.05	t= 0.87[b]	0.38[b]

[a]: Pre-intervention [b]: Post-intervention r: spearman coefficient t: student t test
K: Kruskal wallis F: ANOVA U: mann-whitney S: significant

Discussion

Osteoarthritis (OA) is a chronic degenerative joint disorder that leads to disability and affects more than 500 million populations worldwide. OA was believed to be caused by the wearing and tearing of articular cartilage, but it is now more commonly referred to as a chronic whole-joint disorder that is initiated with biochemical and cellular alterations in the synovial joint tissues, which leads to the histological and structural changes of the joint and ends up with the whole tissue dysfunction (Adhitya et al., 2023).

Thermotherapy is utilized for OA rehabilitation to relieve pain and stiffness while also increasing mobility since it relaxes muscles and increases circulation to the afflicted region. However, there is some risk that this might exacerbate inflammation and edema. Thermotherapy may be conveniently performed by the patient at home (for example, using cold and heat packs), and it could also be integrated with other rehabilitation strategies (Cimin et al., 2021).

The study found that the average age of the study group was 51.50 ± 7.72 years, whereas the control group was 53.95 ± 9.44 years. Jahanjoo et al. (2019) found that balance

training combined with physical therapy was effective in rehabilitating knee osteoarthritis in Iran. The study participants had a mean age of 56.55 ± 0.90 years. Moreover, Agata et al., (2022) conducted a study titled "Impact of chronic pain, stiffness, and difficulties in performing daily activities on the quality of life of older patients with knee osteoarthritis" in Poland and found that the mean age of their study participants was 50 ± 7.44 years for the study group and 60 ± 6.4 years for control group. Also, around half of both groups were female. This could be due to hormonal changes, particularly after menopause, as a result of their age group, which could increase the risk of knee osteoarthritis due to estrogen withdrawal and exacerbate degenerative changes in multiple joints, as well as lower muscle tone and fatter cluster loading on joints, particularly knees.

These results are in the same line with the finding of a study done by Jahanjoo et al. (2019) who reported that the majority of their study was predominantly females. Also, this finding agrees with a study done in Egypt by Shin, (2017), who performed study about "Association between metabolic syndrome, radiographic knee osteoarthritis, and intensity of knee pain " and reported that nearly three quarters of their patients were female. From a researcher's perspective, the higher prevalence of osteoarthritis among females may be attributed to a combination of many factors including hormonal influences, such as estrogen levels during menopause, physiological differences in joint structure and mechanics, and socio-cultural factors related to activity levels and healthcare-seeking.behaviors. However, further study is needed to completely understand the particular processes and combinations of these variables that contribute to the gender gap regarding osteoarthritis prevalence.

The recent study revealed that nearly all individuals in both groups were married. In addition, the majority of individuals in both groups had a secondary education. These findings were consistent with those of Abd El Moniem et al. (2020), who conducted a study in Egypt titled "(Effect of physical exercise and heat application on pain and morning stiffness in osteoarthritis patients)" and discovered that the majority of the studied patients were married, with the high number of them having a moderate education.

Regarding BMI, the results of the present study reported that about two-thirds of the study group were obese, however, more than two-thirds of the control group were overweight. This indicated that there is a strong relation between OA and increasing BMI. These results were consistent with Atta et al. (2022) who carried a study about the "(Effect of nursing care by using Swedish massage, kinesis tape for knee of patients with osteoarthritis on pain, functional status and quality of life) in Egypt and found that more than two-thirds of all studied groups were obese. Moreover, Geyer & Schönfeld (2018) performed a study titled" Novel insights into the pathogenesis of osteoarthritis" in Germany and found that more than half of the studied patients were obese. These findings are in contrast with a study conducted by Felson et al., (2016) who performed a study titled" Weight loss reduces the risk for symptomatic knee osteoarthritis in women " in Suffolk and mentioned that the minority of studied groups who were obese had knee osteoarthritis.

Nearly half of the patients in both groups had a previous family history of osteoarthritis. This result was supported by Abd El Moniem et al. (2020) who concluded that nearly half of the patients had a previous family history of osteoarthritis. These differences may be due to, in the context of Egypt, osteoarthritis could had a hereditary component, with certain gene variants increasing the susceptibility to developing the condition. In families where osteoarthritis is prevalent, there may be a higher likelihood of inheriting these genetic factors, leading to an increased risk of developing osteoarthritis. Lifestyle and dietary habits within families could contribute to a higher prevalence of obesity, further increasing the risk of developing osteoarthritis.

Knee pain is common, and the allied reduction in physical performance is a strong interpreter of future disability. Patients with osteoarthritis had many functional disabilities

with challenges in performing many tasks of daily life which reflects on their independence and productivity. Thus fact explains the result of the current study, when the researchers assessed all participants with lysholm knee scores and reported great difficulties while performing their daily life activities pre-thermotherapy.

In relation to the effect of knee pain on managing daily life activities; the current study results suggested that the study group had significant improvement in their daily life activities after implementation of the thermotherapy compared to the control group. This result is supported by the finding of a study done by Ariana et al., (2021) who carried a study about "(Effect of local heat therapy versus cold rub gel on pain and joint functions in patients with knee osteoarthritis) in Iran and summarized that heat therapy was effective in improving pain and joint function among patients with knee osteoarthritis. Furthermore, Basuny et al. (2020) conducted a study in Iran on the "Responsiveness of pain and associated health issues of patients with knee osteoarthritis to revulsive compresses" and discovered that thermotherapy had a substantial effect on lowering knee pain. According to researchers, heat treatment, such as hot packs or warm water immersion, could assist in improving blood circulation, reduce muscular stiffness, and relieve joint discomfort. Heat therapy could also induce relaxation and increase range of motion in problematic joints, all of which could contribute in improving joint function.

Pre-thermotherapy WOMAC scale data revealed a high score among patients with osteoarthritis, who also had higher levels of pain and joint stiffness, limiting the functioning of the knee joint. While in a study done by Seifeldein et al. (2019) intitule "the correlation between musculoskeletal ultrasound (MSK US) and the Western Ontario and McMaster University (WOMAC) osteoarthritis: index findings in patients with primary knee osteoarthritis in Egypt" and reported that the severity of KOA, based on articular cartilage thickness, which showed a good correlation with the pain and stiffness subclasses of the WOMAC score.

In relation to thermotherapy effects, it was found that thermotherapy reduces the total WOMAC score of knee pain and joint stiffness. Also, it was found that significant differences was existed between the study and control groups regarding pain, joint stiffness, and physical function after the application of thermotherapy. These results were in the same line of the results of Hunter et al., (2018) who studied "the influence of topically applied menthol cooling gel on soft tissue thermodynamics and arterial and cutaneous blood flow at rest" and reported that following local heat therapy application soft tissue thermodynamics improved, pain relief and increased range of knee joint motion that reduces joint stiffens. Also, the current study results agreed with the finding of (Ananias et al., 2017; Bassuny et al., 2020; Ariana et al., 2021), whose results displayed that heat compresses had significant effect in reducing the total mean WOMAC score post-intervention and improved pain and the range of motion exercises (ROM) amng patients with knee OA.

The current research showed that there was a significant negative correlation between the effect of knee pain on managing daily life activities and total WOMAC score pre-intervention. This result is supported by Vitaloni et al., (2019) finding, who carried a study about "Global management of patients with knee osteoarthritis begins with quality-of-life assessment" in Spain, and reported that pain, stiffness, and physical abilities of the patients were significant and negatively correlated with their quality of life, health and also with the physical, psychological and social domains. These correlations are negative, which means that the greater the pain intensity, the lower of managing daily life activities.

Conclusion

Based on the results of the recurrent study, it could be concluded that a distinct effect was observed post use of thermotherapy for knee osteoarthritis because it significantly decreased pain, stiffness, and movement restriction.

Recommendation:

Based on the findings of the current study, the following recommendations could be suggested:

1.Thermotherapy should be included among the early efforts for managing all patients with osteoarthritis.

2.Replication of the study with a larger probability sample should be considered for the development of future research to allow generalization of the results.

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