▪ *Basic Research*

Effect of Reflexology Foot Massage on Pain intensity and Physical Functional Abilities Among Patients with Knee Osteoarthritis

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Abstract

Introduction: Knee Osteoarthritis is the eighth leading cause of disability and a degenerative disease that deteriorates over time. It is the chief contributor to impaired mobility and occurrence of chronic pain. Hence, early diagnosis and treatment remains the key in the management of Osteoarthritis. Non-pharmacological methods such as reflexology have been used to alleviate symptoms and to improve patients' functional ability. **Aim:** Evaluate the effectiveness of Reflexology Foot Massage on pain intensity and physical functional abilities among patients with Knee Osteoarthritis. **Research hypothesis:** Patients with knee osteoarthritis, who receive Reflexology Foot Massage experience less pain intensity, improvement in health status and physical functional abilities than those who do not receive such intervention. **Methods:** A quasi experimental research design was utilized to conduct this study on 60 patients with Knee Osteoarthritis at the Rheumatology and Rehabilitation clinic of El-Hadra Orthopedic and Traumatology University Hospital, Alexandria. **Tools:** Three tools were used in this study for data collection. Tool I: Patient's Socio-demographic and Clinical Data Structured Interview Schedule, Tool II: Western Ontario and MCMaster Osteoarthritis Index (WOMAC) questionnaire structured interview schedule, and Tool III: Range of Motion Exercise of the knee joint assessment. **Results:** Patients' pain intensity, knee joint stiffness, and function abilities were improved significantly in the study group immediately after second, third and fourth foot reflexology sessions, moreover, the mean difference for knee R.O.M between the patients in the study group including, knee flexion and extension were improved significantly immediately after second, third and fourth foot reflexology sessions than those in the control group. **Conclusion:** The therapeutic effects of Reflexology massage sessions on the study group were much better than that of control group in relation to decrease patients' pain intensity, improvement in their health status and physical functional abilities. **Recommendations:** Illustrated self-administered Reflexology massage intervention booklets distributed to patients with knee osteoarthritis, could be of help, and development and implementation of Reflexology training program for nurses, health care personnel and caregivers should be applied.
Key words: Reflexology Foot Massage, Pain intensity, Physical Functions Abilities , Knee Osteoarthritis.

1. Introduction

Knee Osteoarthritis (KOA) is the eighth leading cause of disability and a degenerative disease that deteriorates over time. It is the foremost contributor to impaired mobility and occurrence of chronic pain **(Mehta, 2021)**. In further, patients with KOA at a greater risk for mortality than overall population. For that, this disease has become not only a huge health care challenge, but also a growing socioeconomic concern **((Soysal et at.,2016, Nelson,2018,).**

Knee Osteoarthritis is characterized by the advanced destruction of the cartilage that outlines the knee joints, the subchondral bone surfaces, synovium, ligament and certain muscles. While KOA is related to ageing, it is also linked with a range of both modifiable as well as non-modifiable risk factors, comprising: obesity, gender, lack of exercise, genetic factors, bone density, and trauma. KOA can be defined on the basis of radiography or clinical presentation, with radiographies KOA being the benchmark **(Lespasio et al., 2017)**. Radiological KOA denotes the morphological changes within knee apparent on X-rays, and divided into three grades: mild, moderate and severe. Whereas, Clinically the most obvious symptoms of KOA include; pain, stiffness, crepitus, instability, muscle weakness and decrease range of motion **(Nilsson et al.,2018 & Elsiwy et al.,2019)**.

Pain is frequently identified as the most distressing symptom of KOA, unpleasantly influencing the quality of life of people; physically, mentally, socially, and spiritually, and impacts patients' ability to live independently. The majority of people with KOA have some degree of activity limitations, some, cannot perform the instrumental activities of daily living, and the other of the total affected population reporting the need of personal care **(Heiden et al., 2009 & Fernandes et al., 2013).**

As there are no treatment options for KOA, treatment presently focus on alleviate the symptoms, enhance functional status, improve patients' quality of life and impede disease progression **(Gay et al., 2019).** The major clinical guidelines for disease management should involve a combination of non-pharmacologic and pharmacologic therapies (**Kolasinski** et al.,2020). Non-pharmacologic modalities for KOA generally divided into educational, and physical approaches. Educational approaches are based on lifestyle pattern changes including; diet, exercise, and joint protection techniques by using different walking aids (**Cutolo** et al.,**2015**). Physical exercises include aerobic activity, muscle strengthening and range-of-motion exercises. Physiotherapy strategies such as Electrotherapy, thermal modalities and manual therapy are also recommended according to each patient condition **(Kaya et al.,2018, Allen et al.,2019)**.

The American College of Rheumatology and European League pointed that pharmacologic modalities are recommended for the early management of patients with osteoarthritis which include; oral and topical non-steroidal anti-inflammatory drugs, and intra-articular corticosteroid injections, and other nutritional complements (**Chen et al;2021, Lundgren et al;2018**). surgery is the final options that is reserved for patients with

unremitting pain and loss of function impairing their quality of life, and which are not responded satisfactory to conservative treatments **(Katz et al.,2010)**.

The disappointment with medical treatment, invasive procedures and the need of using daily analgesics, in addition the harmful effects of drugs, all of these keep the patients to ask about different line of management. Non-pharmacological methods such as reflexology, massage, hydrotherapy, therapeutic touch, acupuncture, music therapy have been used to alleviate symptoms and to improve patients' functional ability (**Cramp,   2019**). Between different forms of complementary therapies, reflexology management which is a low-cost therapy that can be applied simply, needs little information, and has no side effects. It is a type of therapy that is depend on the stimulation of the nerves and circulatory system of the body in which all the reflexology points, equivalent to different parts of the human body, are considered **(Embong et al;2015).**

There are some theories on the mechanism of action of reflexology. Conferring to the hemodynamic theory, reflexology stimulation increases blood flow to the associated organ or body part. On the other hand, the nerve impulse theory claims that reflexology stimulation boosts nervous connection to the conforming body parts. Regarding to the energy theory; organs and body parts are connected through electromagnetic fields and that these pathways are blocked in states of disease. Finally, lactic acid theory pointed that lactic acid accumulates on the soles of the feet in the form of crystals which promotes free circulation, so reduces regular flow **(Koraş &Karabulut, 2019).** Foot reflexology has a comforting and relaxing effect, reduces tension and stress associated with physical diseases. This, in turn, influences the responses from the autonomic system, and affects hormonal balance and the immune system. From a psychological standpoint, reflexology is a form of showing concern and care for patients **(Li & Murphy,2018, Rateau, 2019).**

Foot reflexology has constantly been a part of the nursing care, and a way to reinforce the nurse-patient interrelationship **(Airosa et al., 2016).** Today nursing care focusing on holistic patient' care and it is thought that complementary therapies are also a part of holistic nursing care **(Kwai, 2015).** So every nurse who assume integrated approach in patient care, should develop nursing applications depending on evidence by references for Complementary and Alternative medicine (CAM), to have knowledge about its effects, hazards and capability to direct every patient to its uses properly and safely **(Lindquist, et al., 2018).**

However, there are insufficient number of evidence-based studies that expound the effects of foot reflexology on improving physical complains of KOA. Therefore, this study was conducted to evaluate the effectiveness of reflexology foot massage on pain intensity and physical functional abilities among patients with Knee Osteoarthritis.

2. **Significance of the Study**:

   The use of Reflexology foot massage may help in reducing pain intensity and improving physical functional abilities among patients with Knee Osteoarthritis.

3. **Aim of the Study:** This study aimed to evaluate the effectiveness of Reflexology foot massage on pain intensity and physical functional abilities among patients with Knee Osteoarthritis.

4. **Research hypothesis:** Is patients with knee osteoarthritis, who receive Reflexology foot massage experience less pain, improvement in health status and physical functional abilities than those who do not receive such intervention.

5. **Subjects and Methods:**

5.1. **Research Design:** A quasi experimental research design was used to conduct this study.

5.2. **Settings**:The present study was conducted at the Rheumatology and Rehabilitation clinic of El-Hadra Orthopedic and Traumatology University Hospital, Alexandria.

5.3. **Subjects**:

 - A convenience sample of 60 knee osteoarthritis patients, in the above mentioned settings were recruited in the study. They were randomly assigned into two equal study and control groups (25patients each). *Control group (G1);* received hospital conventional physical therapy treatment only, while *study group(G2)*received hospital conventional physical therapy treatment in addition to reflexology intervention.

 - The **Epi- info-7 program** was used to estimate the minimum sample size using the following parameters, population size 300, prevalence rate of 50%, confidence coefficient 95%, and acceptable error of 10%. The minimum sample size required is 60 patients.

- **Inclusion criteria:** Adult patients aged from21-60 years, confirmed diagnosis of knee OA-according to the American College of Rheumatology (ACR) criteria. In this criteria the presence of knee pain along with at least three of the following six items can classify the knee OA in the patients; 1) Age > 50 years old, 2) Morning stiffness < 30 minutes, 3) Crepitus on knee motion, 4) Bony tenderness, 5) Bony enlargement, 6) No palpable warmth, had been diagnosed with osteoarthritis in mild and moderate stage not in the acute stage (exacerbation stage), and not received reflexology therapy at pervious time.

   - **Exclusion criteria:** Patient had secondary KOA, post-traumatic KOA, knee surgery, any concurrent systemic inflammatory diseases, patient with skeletal deformities (Congenital abnormalities in feet), patients with injury including; (lesions, fracture, sprain, open wounds, foot ulcer and or burn of the lower extremities), thrombosis, hemorrhage, epilepsy, irregular heartbeat,

hypotension and varicose vein, and patient who complicates with osteoarthritis.

5.4. Tools:

Three tools were used in this study for data collection.

5.4.1. Tool I: Patient's Socio-demographic and Clinical Data Structured Interview Schedule:

This tool was developed by the researcher after reviewing the related literature **(Abd Elhameed, et al;2018, Mahmoud et al;2019,)**

It was composed of two parts:

Part I: Patient's Socio-demographic data such as age, sex, residence area, marital status, level of education and occupation,

Part II: Patient's history and clinical characteristics such as medical history, duration of disease, Anthropometric Measurements as; weight, height, and body mass index.

5.4.2. Tool II: Western Ontario and MCMaster Osteoarthritis Index (WOMAC) questionnaire structured interview schedule:

- This tool was developed by **((Guermazi et al;2004, Gandek, 2015)** to assess the effectiveness of reflexology on the experience of pain intensity level, functional disability and stiffness before and after treatment protocol.
- Western Ontario and McMaster University Osteoarthritis (WOMAC) Index is a self-report items with 5-point Likert.
- It includes 24 self-report questions. *The first ;* five questions were used to assess the patients feeling and their experience of pain (walking, climbing stairs, sleeping at night, resting, and standing) , *the second*; two questions were used to assess stiffness,(Morning &Evening) and *the last seventeen questions* were used to assess functional limitation as; (descending& ascending stairs, rising from sitting, standing, bending to floor, taking off socks, Lying in bed, getting in/out of bath, etc).
- The Likert type scale for each item is scored from 0 to 4. Patients were asked to rate the activities in each category according to the following scale of difficulty: "0" for none, "1" for mild, "2" for moderate, "3" for severe, and "4" for extreme.
- The total score for each subscale is the sum of scores for each response to each item, and can be calculated manually or using a computer. The range for possible subscale scores in the Likert format were: Pain (5 items each scored 0–4), Stiffness (2 items, each scored 0–8), and Physical function (17 items, 0–68). Higher scores indicate worse pain, stiffness, or physical function. The maximum score obtained by the subjects would be 96.

- Based on the WOMAC score obtained, patients were categorized as low disabilities (score ≤ 32), moderate disabilities (score 32–64) and high disabilities (score ≥64). Internal consistency (Cronbach's alpha) and test-retest reliability (Kendall's tau c statistic) were moderate-to-excellent for pain (0.86 and 0.68, respectively), stiffness (0.90 and 0.48), and physical function (0.95 and 0.68). Construct validity was high for the domains of pain, stiffness and physical function.

5.4.3. Tool III: Range of Motion Exercise of the knee joint assessment.

- This tool was developed by the researcher using the goniometer based on literature review **(Norkin &White, 2016)** to measure the flexibility of the knee joint in performing the range of motion (R.O.M) of the affected knee as flexion and extension. Normal R.O.M at the knee was considered to be 0 degrees of extension (completely straight knee joint) to 135 degrees of flexion (fully bent knee joint). Data obtained was compared with normal values. The goniometer has been demonstrated to possess good to excellent reliability (> .088) and good concurrent validity.

- **Foot reflexology program** was developed by researchers after review of related literatures **(Kielar, et al;2017, Pasyar, et al;2018, Abdelaziz, et al;2019, Kiani, et al;2020).** A special training in the field of Reflexology was obtained by the study investigator at the Faculty of Physical Education, Alexandria University from (31-10-2019 to 3-11-2019).

5.5. Method:

- Written approval from Ethical Committee of Faculty of Nursing, Alexandria University was obtained.
- An official letter was submitted from the Faculty of Nursing, Alexandria University to the directors and head of the departments of the selected hospital settings in order to obtain their approval for conducting the study after explaining the aim of the study.
- Three tools were used by researchers to collect necessary data:

- Tools validity: Tool I, III were developed by the researcher and translated into Arabic language, and tool II was adapted. Tools were tested to assure the content validity, completeness and clarity of its items by five experts in the field of Medical -Surgical Nursing, Faculty of Nursing - Alexandria University and orthopedic specialist. Comments and suggestions of the jury were considered and necessary modifications, correction and clarification of the items were done accordingly.
- Reliability to the tools was tested by using the Cronbach's Alpha Statistical Test. Tool I &II were proved to be internally reliable, with a Cronbach's Alpha Test of 0.90/ and 0.88 respectively that indicated high reliability of the tools.

- A pilot study was initially carried out prior to the actual data collection phase on six patients to check clarity, feasibility and applicability of the tools and determine obstacles that may be encountered during period of data collection, accordingly, needed modifications were done. Pilot study subjects were excluded from the study.
- Data were collected over a period of 9 months, starting from the beginning of September 2020 to the
End of May 2021.

- Patients meeting the inclusion criteria were selected using convenience sampling technique and divided into two equal groups (control group and study group). (25patients each) as following.
  - Group one (control group): received hospital conventional physical therapy treatment only as; (stretching, strengthening exercises, ultrasound and warm pack around the knee).
  - Group two (study group): received hospital conventional physical therapy treatment; in addition to foot reflexology program.
  - Data were collected by the researcher initially from the control group followed by the study group to prevent any influence on the knowledge and practices of patients in the control group.

- **The study was carried out through the following four phases:**

  Assessment phase:
  - An initial assessment was carried out individually for every patient in both the control and study groups after careful listening and documenting history taking using tool I, II, and III, to collect baseline data, calculate body mass index, measuring patients 'pain intensity level, knee functional disability and joint stiffness, and measuring the flexibility of the knee joint in performing the range of motion (R.O.M).
  - The assessment session took approximately from 30-60 minutes on individual basis.
  - The patients in the study group were informed to attend regularly three times per week for four weeks, then assessment was carried out after reflexology session. The control group was receiving routine hospital care only and assessment was carried out after routine session.
  - Subsequent assessment was carried out after 4 weeks thereafter, in order to evaluate patient's progress for the both control and study groups.

  Planning phase:

- Control & study patients were notified individually regarding steps of implementation phase.
- An Arabic handout booklet with colored pictures which was developed by the researchers based on review of the recent related literature was given to every patient in the study group to provide clear information about reflexology technique, points, and its benefits.

Implementation phase (Reflexology sessions for the study group):

- Explaining the purpose and effects of foot reflexology and its importance.
- A comfortable, private environment conducive to deep relaxation was maintained prior to and throughout Reflexology sessions.
- Patients were advised to wear comfortable clothes since tight collars, belts, or shoes can obstruct circulation, and to wash feet with soap and warm water and dry it if needed.
- Deep breathing exercises were taught immediately before the session to release any pain or tension from the Reflexology points and encourages healing energy to flow through the whole body.
- Investigator's hands were kept warm, and nails short to prevent any patient's discomfort.
- The patient was kept in the lying position and covered with a blanket with raising the head of the bed from "30 to 45" degrees to promote relaxation, and to facilitate the reflexology procedure with the patients' legs uncrossed, extended, so he/she can feel the flow of energy.
- Firstly, the foot was relaxed by applying primarily effleurage, shaking rotation, and stretching methods before starting and after the reflexology sessions, this help to increase circulation, provide relaxation to the feet and make reflexology work easier, because a relaxed person is more receptive to technique application.
- Secondly, massaging was conducted on the outer edge of the foot (corresponding to knee region) followed by applying pressure to knee zone reflex area with the side of thumb or other fingers and turning it clockwise continuously without losing contact with the skin. Intensity of the pressure could be low at the beginning and increased as the treatment progresses. Knee zone was on the lateral aspect of the foot in a triangle like area (between the base of the fifth metatarsal and calcaneus). This was the same zone on both feet for the knee.

- Reflexology sessions were carried out three days weekly (Saturday, Monday, and Wednesday) for four weeks consecutively; duration of each session for every patient was about 30-45 minutes.

Evaluation phase:

- Every patient in the *control group* was re-evaluated 4 times (one/week) for one month, following hospital conventional physical therapy treatment only. While re-evaluation for *study group* was done 4 times (one/week) for one month, following foot reflexology program using tool II, III.
- Comparisons between the findings of both groups were carried out using appropriate statistical analysis in order to determine the effect of reflexology massage sessions on pain intensity, and physical functional abilities among patients with Knee Osteoarthritis.

5.6. Ethical consideration:

- A written informed consent from patients to participate in the study was obtained before data collection and after explanation of the aim of the study.

- Privacy of the study participants was asserted.

- Confidentiality of the collected data was assured.

- Participants' voluntary participation and their right to withdraw from the study at any time were emphasized.

5.7. Statistical Analysis:

- Data were fed to the computer and analyzed using IBM SPSS software package version 23.0. Qualitative data were described using number and percent. Quantitative data were described using minimum and maximum, mean and standard deviation.
- Comparison between the control and study groups regarding categorical variables was tested using Chi-square test. When more than 20% of the cells have expected count less than 5, correction for chi-square was conducted using Fisher's Exact test or Monte Carlo correction.
- Correlation between two normally distributed quantitative variables using Pearson coefficient. Reliability statistics was assessed using Cronbach's Alpha test. For normally distributed quantitative variables, comparison between the control and study groups was analyzed using Student t-test. Significance of the obtained results was judged at the 5% level. Body mass index (BMI, ratio of height and weight, expressed as body weight in kg/ height in cm^2)

6. Results:

Table (1): Frequency distribution of the control and study groups according to their Socio demographic characteristics (n= 60).

Socio demographic characteristics		G1 Control Group (n =30)		G2 Study Group (n =30)		Test of sig. (P-value)
		No=30	%	No=30	%	
Age	20 - <30	0	0.0%	2	6.7%	χ2=4.171 P= 0.24
	30 - <40	3	10.0%	4	13.3%	
	40 - <50	9	30.0%	4	13.3%	
	50-< 60	18	60.0%	20	66.7%	
Sex	Male	6	20.0%	4	13.3%	χ2=0.480 P= 0.49
	Female	24	80.0%	26	86.7%	
Marital status	Single	2	6.7%	4	13.3%	χ2=1.618 P= 0.66
	Married	18	60.0%	16	53.3%	
	Divorced	5	16.7%	3	10.0%	
	Widow	5	16.7%	7	23.3%	
Education	Illiterate	14	46.7%	13	43.3%	χ2=1.323 P= 0.72
	Primary+ preparatory	8	26.7%	6	20.0%	
	Secondary	5	16.7%	5	16.7%	
	High education	3	10.0%	6	20.0%	
Residence	Urban	18	60.0%	17	56.7%	χ2=0.069 P= 0.79
	Rural	12	40.0%	13	43.3%	
Occupation	Housewife	16	53.3%	17	56.7%	χ2=1.848 P= 0.40
	Employee	4	13.3%	7	23.3%	
	Manual	10	33.3%	6	20.0%	
Income	Insufficient	21	70.0%	20	66.7%	χ2=0.077 P= 0.78
	Sufficient	9	30.0%	10	33.3%	

χ2: Calculated value for Chi square test
P: P value for comparing between the studied groups
*: Statistically significant at p ≤ 0.05

Table (1), shows frequency distribution of the control and study group according to their socio-demographic characteristics, more than half of the patients in both control and study group (60% and 66%) respectively were between 50 to 60 years old. Female were more prevalent (80%, 86.7%) consecutively in both groups. More than one third of the studied patients in the control and study group (60% and 53.3%) respectively were married. Illiteracy was prevailing among more than one third of patients in the control and study groups (46.7% and 43.3%) correspondally. Additionally, (53.3 and56.7%) respectively of the patients in both groups were housewives and manual workers, and (60 and56.7%) sequentially of them were from urban areas, and more than half of them (70% and 66.7%)

separately did not have enough monthly income. No significant differences in socio-demographic characteristics between the two groups was found.

Table (2): Frequency distribution of the control and study groups according to their clinical data (n=60).

Clinical data		G1 Control Group (n =30)		G2 Study Group (n =30)		Test of sig. (P-value)
		No=30	%	No=30	%	
Family history of illness	yes	19	63.3%	17	56.7%	χ2=0.278 P= 0.60
	No	11	36.7%	13	43.3%	
Duration illness	1-5years	21	70.0%	19	63.3%	χ2=5.767 P= 0.12
	5-10 years	3	10.0%	9	30.0%	
	10-15 years	4	13.3%	2	6.7%	
	15-20 years	2	6.7%	0	0.0%	
Stages of illness	Stage1	1	3.3%	3	10.0%	χ2=1.904 P= 0.59
	Stage2	14	46.7%	10	33.3%	
	Stage3	13	43.3%	14	46.7%	
	Stage4	2	6.7%	3	10.0%	
Total body mass index	Normal	4	13.3%	2	6.7%	χ2=1.126 P= 0.57
	Overweight	9	30.0%	12	40.0%	
	Obese	17	56.7%	16	53.3%	

χ2: Calculated value for Chi square test
P: P value for comparing between the studied groups
*: Statistically significant at p ≤ 0.05

Table (2): Shows frequency distribution of the control and study groups according to patient's clinical data, this table showed that more than half (63.3% and 56.7%) respectively of studied sample have previous family history for osteoarthritis, three quarters (70% and 63.3 %) serially of them their disease duration was less than five years ago, while two fifth (46.7%) were suffered from stage two &three of osteoarthritis, and more than half of them (56.7%, 53.3%) consecutively were obese among control and study groups with no statistical significance differences.

Table (3): Comparison between mean and standard deviation of WOMAC subscale subdomain among control and study groups before and after each foot reflexology massage sessions throughout four weeks (n= 60).

WOMAC subscale Subdomain/ Sessions	G1 Control Group (n =30)	G2 Study Group (n =30)	P		
	Mean ±SD	Mean ±SD	M/D	t	sig
First session Pain subscale	12.70±2.17	12.00±1.31	0.70	1.51	0.14
Stiffness subscale	5.40±1.07	5.10±0.88	0.30	1.18	0.24
Function subscale	43.53±3.01	42.57±3.35	0.97	1.18	0.24
Total WOMAC subscale	61.63±4.31	59.67±3.91	1.97	1.85	0.07
Second session Pain subscale	12.27±1.55	8.90±1.79	3.37	7.79	**0.00***
Stiffness subscale	4.67±0.96	3.60±1.13	1.07	3.94	**0.00***
Function subscale	42.90±3.22	38.57±4.26	4.33	4.45	**0.00***
Total WOMAC subscale	59.83±3.38	51.07±4.61	8.77	8.40	**0.00***
Third session Pain subscale	11.43±1.72	6.67±1.95	4.77	10.04	**0.00***
Stiffness subscale	4.30±1.02	3.23±0.97	1.07	4.14	**0.00***
Function subscale	41.77±3.39	32.43±4.61	9.33	8.94	**0.00***
Total WOMAC subscale	57.50±4.01	42.33±5.27	15.17	12.54	**0.00***
Fourth session Pain subscale	10.40±1.48	4.00±1.23	6.40	18.23	**0.00***
Stiffness subscale	4.20±0.92	2.97±1.00	1.23	4.96	**0.00***
Function subscale	39.93±4.01	24.67±3.93	15.26	14.89	**0.00***
Total WOMAC subscale	54.53±4.18	31.63±4.12	22.90	21.35	**0.00***

*: Statistically significant at P ≤ 0.05   M/D: mean difference

Table (3); illustrates comparison between mean and standard deviation of subdomain of WOMAC subscale among control and study groups before and after each foot reflexology massage sessions throughout four weeks. This table conveyed that, patients in the study group had lower mean scores than those of control group after each foot reflexology massage session. In addition, statistically significance differences between the study and control group after second, third and fourth foot reflexology massage weeks in pain intensity, stiffness, physical function and total WOMAC subscale were observed, where P value < 0.00. Moreover, the total mean scores of disabilities were (31.63±4.12) in the study group, then decreased significantly after application of reflexology program compared with the control group to be (54.53±4.18) which indicated significant difference between the two groups after application of intervention p value = <0.001.

Table (4): Comparison between Mean difference of WOMAC subscale subdomain among control and study groups before and after each foot reflexology massage sessions throughout four weeks (n= 60).

Knowledge (I)Factor 1/ Sessions	Factor (1J)/ (Sessions)		G1 Control Group (n =30)				G2 Study Group (n =30)			
			MD (IJ)	Sig	F/ P	Effect size of Reflexology	MD (IJ)	Sig	F/ p	Effect size of Reflexology
Pain subscale	1	2	0.43	0.31	12.68 p= **0.00****	30%	3.10	0.00**	134.15 p= **0.00****	82%
		3	1.26	0.00**			5.33	0.00**		
		4	2.30	0.00**			8.0	0.00**		
	2	3	0.83	0.08			2.23	0.00**		
		4	1.86	0.00**			4.90	0.00**		
	3	4	1.03	0.00**			2.66	0.00*		
Stiffness subscale	1	2	0.73	0.00**	21.08 p= **0.00****	42%	1.50	0.00**	43.82 p= **0.00****	60%
		3	1.10	0.00**			1.86	0.00**		
		4	1.20	0.00**			2.13	0.00**		
	2	3	0.36	0.03*			0.36	0.01**		
		4	0.46	0.00**			0.63	0.01*		
	3	4	0.10	0.50			0.27	0.10		
Function subscale	1	2	0.63	0.02**	19.61 p= **0.00****	40%	4.00	0.00**	606.387 p= **0.00****	95%
		3	1.76	0.00**			10.13	0.00**		
		4	3.60	0.00**			17.90	0.00**		
	2	3	1.13	0.00**			6.13	0.00**		
		4	2.96	0.00**			13.90	0.00**		
	3	4	1.83	0.01*			7.76	0.00**		
Total WOMAC subscale	1	2	1.80	0.00*	42.75 p= **0.00****	60%	8.60	0.00**	736.38 p= **0.00****	96%
		3	4.13	0.00*			17.33	0.00**		
		4	7.10	0.00*			28.03	0.00**		
	2	3	2.33	0.00*			8.73	0.00**		
		4	5.30	0.00*			19.43	0.00**		
	3	4	2.96	0.00*			10.70	0.00**		

P: P-value for Repeated measure ANOVA test for comparing between before intervention and each other period for every items in each group.

*: Statistically significant at P ≤ 0.05   M/D: Mean Difference (Ij) between each other session for every items in every group.

(1): First session   (2): Second session   (3): Third session

(4): Fourth session

F value = variance of the group means

Table (4): Illustrates comparison between Mean difference of WOMAC subscale subdomain of among the control and study groups before and after each foot reflexology massage sessions throughout four weeks. The mean difference for each domain of WOMAC subscale, including pain subscale, stiffness subscale and function subscale were improved significantly in the study group immediately after second, third and fourth foot reflexology sessions with the effect size of the intervention 93%. Moreover, the scores for total and all domain of WOMAC subscale of the control group

were somewhat increased immediately after hospital conventional physical therapy treatment, but the improvement was significantly differences between the two groups in post intervention in all items (P< 0.00).

Table (5): Comparison between the control and study groups according to knee joint range of motion before and after each foot reflexology massage sessions throughout four weeks (n=60).

Knee ROM/ Sessions	G1 Control Group (n =30)	G2 Study Group (n =30)	P		
	Mean ±SD	Mean ±SD	M/D	t	sig
First session Knee flexion	107.17±5.58	108.30±6.28	1.13	0.74	0.46
Knee extension	3.27±0.91	3.30±0.95	0.03	0.14	0.89
Second session Knee flexion	107.77±5.31	111.47±5.97	3.70	2.54	**0.01***
Knee extension	3.03±0.96	2.70±0.75	0.33	1.49	0.14
Third session Knee flexion	109.70±5.58	115.40±5.43	5.70	4.01	**0.00****
Knee extension	2.93±0.83	1.70±0.99	1.23	5.24	**0.00****
Fourth session Knee flexion	111.23±5.34	118.33±5.81	7.10	4.93	**0.00****
Knee extension	2.67±0.76	0.77±0.77	1.90	9.61	**0.00****

*: Statistically significant at P ≤ 0.05   M/D : mean difference

Table (5): Illustrates the comparison between the control and study groups according to knee joint range of motion before and after each foot reflexology massage sessions throughout four weeks. It was observed that the total mean score of knee range of motion increased significantly from the first assessment to second, third and fourth weeks of foot reflexology intervention between two groups. Significant improvement in knee flexion and extension was observed noticeably in the study group as compared to the control group after second, third, and fourth sessions, where p value = (<0.01,0.00) consecutively.

Table (6): Comparison between Mean difference of knee range of motion among control and study group before and after each foot reflexology massage sessions throughout four weeks (n=60).

Knowledge (I)Factor 1/ Sessions	Factor (J) 1/ Sessions		G1 Control Group (n =30)				G2 Study Group (n =30)			
			MD (IJ)	Sig	F/ p	Effect size of Reflexology	MD(IJ)	Sig	F/ p	Effect size of Reflexology
Knee Flexion	1	2	0.60	0.36	14.74 p= 0.00**	34%	3.16	0.00**	48.74 p= 0.00**	63%
		3	2.53	0.00**			7.10	0.00**		
		4	4.06	0.00**			10.03	0.00**		
	2	3	1.93	0.00**			3.93	0.00**		
		4	3.46	0.00**			6.86	0.00**		
	3	4	1.53	0.00**			2.93	0.00**		
Knee extension	1	2	0.23	0.01*	13.22 p= 0.00**	31%	0.60	0.00**	136.02 p= 0.00**	82%
		3	0.33	0.00**			1.60	0.00**		
		4	0.60	0.00**			2.53	0.00**		
	2	3	0.10	0.08			1.00	0.00**		
		4	0.36	0.00**			1.93	0.00**		
	3	4	0.26	0.02**			0.93	0.00**		

P: P-value for Repeated measure ANOVA test for comparing between before intervention and each other period for every items in each group.
*: Statistically significant at P ≤ 0.05   M/D: Mean Difference (I-j) between each other period for every items in each group.
 (1): First session   (2): Second session   (3): Third session
 (4): Fourth session   F value: variance of the group means

Table (6); shows comparison between mean difference of knee range of motion among the control and study groups before and after each foot Reflexology massage sessions throughout four weeks. The mean difference for knee ROM including knee flexion and knee extension were improved significantly in the study group immediately after second, third and fourth foot Reflexology sessions with the effect size of the intervention was 82% as compared to the patients in the control group and the improvement was significantly differences between the two groups in post intervention knee R.O.M, where P< 0.00.
Discussion

Osteoarthritis (OA), a major health problem, is the most common chronic degenerative joint disorder, affecting synovial joints which mainly cause degeneration of hyaline cartilage. It is characterized by increasing joint pain, stiffness, and limitations in ROM of joints (**Fitzgerald et al; 2015**). Foot reflexology applied to the patients with knee osteoarthritis has a positive effect on reducing their foot pain and improving their QOL as a complementary and alternative therapy, furthermore, foot reflexology is an effective, easy to apply, economical, does not require any special instrument and potentially risk free intervention. (**El Hoty, Ali, & Elmoghazy, 2020**).

Concerning sociodemographic data: Aging is a significant factor influencing the course of knee osteoarthritis; the present study demonstrated that about two thirds of the sample were among the age group of (50 < 60 years). This finding was consistent with (**Zelman ;2020**) who reported that people over age 50 and 60 have osteoarthritis due to joint injury or repetitive joint stress from overuse. Additionally, (**Cleveland Clinic, 2021**) who stated that the majority of older adults, ages 55 years and older, have evidence of osteoarthritis on X-ray.

Regarding sex, the finding of this study showed that the majority of the studied patients were females. This result was congruent with (**Goolspy,2018**). Who reported that, among people with osteoarthritis, there are twice as many women as men, especially for those with arthritis in the knees and hands. Symptoms typically begin to appear in women in their 40's and 50's, and the disparity becomes even greater after age 55, after women enter menopause. Furthermore, this result was in the same line with (**Cleveland Clinic,2021**) who explained that post-menopausal women have decreased estrogen which is protective of bone health specifically reducing oxidative stress to the cartilage.

As for **the marital status,** it is clear that around two thirds of the studied patients were married. This could be related to the fact that knee osteoarthritis is more common among married females due to specific physical conditions in women as; physical changes due to monthly menstruation, pregnancy, labor and delivery children as well as home responsibilities that could be attributed to such disorders. This finding was supported by (**Hussain et al; 2018**) who stated that reproductive and hormonal factors were associated with risk of knee OA.

The main findings of the current study revealed that, the majority of the studied patients were illiterate, housewife, came from urban residence and had insufficient monthly income. These findings were supported by (**Lee et al; 2021**) who studied effects of education, income, and occupation on prevalence and symptoms of knee osteoarthritis and concluded that lower education, lower income level, and non-managerial or no job were associated with higher prevalence of knee OA and knee symptoms.

As regards **family history**, the findings of the present study revealed that the majority of the studied patients were had positive family history of knee osteoarthritis. This finding was congruent with (**Yucesoy et al; 2015**) who emphasized on the influence of genetic variability in the pathogenesis of OA. In the same line with (**Warner & Valdes ,2016**) who found that the Genes are the strongest risk factor for OA. In relation to **clinical data** of the studied patients, the results revealed that, the majority of patients diagnosed as knee osteoarthritis from one to five year and around half of them had third stage of disease. Similar findings were reported by (**Abdelaziz et al; 2019 & Abd Elstaar et al; 2015**) who illustrated that fifty participants diagnosed as grade II or III of knee OA.

In relation to **body mass index**, the present study showed that more than half of patients were obese, in the same line, (**Vaz, 2020 & Zheng, Chen,2015**) illustrated in their study that obesity was a major risk factor of knee osteoarthritis. In relation to comparison between mean and standard deviation of subdomain of WOMAC subscale among the studied patients before and after foot reflexology massage sessions, the present study illustrated that all WOMAC subscale were highly statistically significance differences between the study and control groups after second, third and fourth foot reflexology massage sessions in pain intensity, stiffness, physical function and total WOMAC subscale.

These findings were congruent with the result of (**Babadi, et al, 2016**)**,** who studied the effect of reflexology on pain perception aspects in nurses with chronic low back pain and found that there was a significant difference in the total score of perceptual aspects of pain between the two groups, compared to the score before the intervention. Similarly, (**Nisha ,2014**) concluded that there was a significant difference on the level of pain among patients with osteoarthritis who received foot reflexology. Thus, an application of foot reflexology was effective to control the level of pain among osteoarthritis patients.

Regarding Mean difference of subdomain of WOMAC subscale among the control and study groups, the present study results revealed that the mean difference for each domain of WOMAC subscale, including pain , stiffness and function subscale were improved significantly in the study group immediately after second, third and fourth foot reflexology sessions with an increase in the effect size of the intervention. This result was in the same line with (**El-Fadl ,2021**)**,** who revealed in their study entitled "Effects of Reflexology on Post-Operative Pain Severity after Laparoscopic Appendectomy for Patients at Surgical Units" that, there was high statistically significant difference between study and control groups post intervention in relation to the pain severity.

Also, this result was in agreement with (**Rejeh et al., (2020**)**,** who reported in their study entitled "The Effect of Hand Reflexology Massage on Pain and Fatigue in Patients after Coronary Angiography: A Randomized Controlled Clinical Trial" that, statistically significant difference was observed in pain and fatigue scores between both groups after the

intervention. The intervention had medium to large effects on patients' pain and fatigue levels. In this regard, (**Kielar et al; 2017**) found that, reflexology is an effective analgesic method, as a notable reduction in pain severity was observed. Reflexology increases the activity of patients and reduces the intake of pain medications.

The current study has been developed to help patients in the study group to improve their physical functional abilities, which is evident by the current findings. The applied foot reflexology sessions significantly increase and improve the knee range of motions of study group patients, as the total mean score of knee range of motion increased significantly from the first assessment to second, third and fourth sessions of foot reflexology intervention. This comes in line with the results of (**Abdelaziz et al; 2019**) who found that the reflexology sessions were effective in increasing R.O.M of knee flexion and extension. Similar findings were reported by (**Kazemi, Ghasemi, & Moradi, 2015**), who studied the effect of combination of physiotherapeutic and reflexology treatments over 24 senile patients with knee osteoarthritis, and found that reflexology is more effective in improving pain, functional disability, and knee ROM than physiotherapeutic treatments alone.

Furthermore, the mean difference for knee ROM in the present study including, knee flexion and extension were improved significantly in the study group immediately after second, third and fourth foot reflexology sessions with an increase in the effect size of the intervention This could be related to the fact that, the reflexology technique helped to transfer the oxygen-laden blood in larger quantities and faster into the muscles, which led to a marked improvement in muscular strength and range of motion of knee joints. In this context, (**Rasheed & Hussein ,2021**) explained and interpreted that, the technique of reflexology worked to reduce the degree of pain suffered affected joints, which helped to revitalize the area of injury, and then activate the blood circulation in the place of injury, which leads to similar healing led to an improvement in muscle work and reduced the feeling of pain during movement performance, and this gave an indication of recovery.

Finally, the obtained results have put in evidence that reflexology foot massage has a positive effect in decreasing patients' pain intensity with knee osteoarthritis, as well as improvement in their health status and physical functional abilities.

7. Conclusion

Based on the findings of the present study, it can be concluded that, the therapeutic effects of reflexology massage sessions on the study group were much better than that of control group in relation to decreasing patients' pain intensity, improvement in their health status and physical functional abilities.

8. Recommendations

Based upon the findings of the study, the following recommendations should be considered:

- Illustrated self-administered Reflexology massage intervention booklets distributed to patients with knee osteoarthritis, could be of help.
- Development and implementation of reflexology training program for nurses, health care personnel and caregivers should be considered.

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الملخص العربى

تأثير تدليك القدم الانعكاسي على شدة الألم والقدرات الوظيفية البدنية لدى مرضى التهاب مفصل الركبة

المقدمة: التهاب مفصل الركبة هو السبب الثامن الرئيسي للإعاقة وهو عبارة عن مرض تأكل بالمفصل الذي يتدهور مع مرور الوقت. إنه المسؤول الرئيسي في صعوبة الحركة وحدوث آلام مزمنة. وبالتالي، لا يزال التشخيص والعلاج المبكر هو المفتاح في علاج التهاب المفاصل.

الهدف من الدراسة: تقييم تأثير تدليك القدم الانعكاسي على شدة الألم والقدرات الوظيفية البدنية لدى المرضى الذين يعانون من التهاب بمفصل الركبة.

افتراضات البحث: المرضى الذين يعانون من التهاب مفصل الركبة، والذين يتلقون تدليك القدم الانعكاسي يشعرون بالالم اقل شدة وعندهم تحسن في الحالة الصحية والقدرات الوظيفية البدنية من أولئك الذين لا يتلقون مثل هذا التدخل.

منهجية البحث : تم استخدام تصميم بحثي تجريبي لاجراء هذه الدراسة على 60 مريضا يعانون من التهاب بمفصل الركبة في عيادة الروماتيزم وإعادة التأهيل بمستشفى الحضرة الجامعى بالإسكندرية..
أدوات البحث: تم استخدام ثلاث أدوات في هذه الدراسة لجمع البيانات.
الأداة الاولى : استمارة المقابلة الشخصية الخاصة بالبيانات الاجتماعية والديموغرافية والاكلينيكية للمريض.
الاداة الثانية : مؤشر أونتاريو ويسترن أونتاريو (.WOMMcMaster)
الاداة الثالثة: تقييم مدى حركة مفصل الركبة.

النتائج: لقد اسفرت نتائج البحث عن الاتى: تحسن بشدة فى آلام مفصل الركبة ، صلابة مفصل الركبة، والقدرات الوظيفية بشكل كبير في مجموعة الدراسة مباشرة بعد تطبيق جلسات التدليك المنعكس للقدمين الثانية والثالثة والرابعة، وعلاوة على ذلك، فإن الفرق المتوسط لمدى حركة مفصل الركبة بين المرضى في مجموعة الدراسة بما في ذلك حركتى فرد وثنى الركبة تم التحسن به بشكل كبير فورا بعد تطبيق جلسات التدليك المنعكس للقدمين الثانية والثالثة والرابعة عن تلك الموجودة في المجموعة الضابطة.

الخلاصة: كانت الآثار العلاجية لجلسات التدليك المنعكس للقدمين في مجموعة الدراسة أفضل بكثير من المجموعة الضابطة فيما يتعلق بانخفاض شدة آلام المرضى، وتحسن الحالة الصحية والقدرات الوظيفية البدنية.

التوصيات: يجب توفير وتوزيع كتيبات توضيحية لكيفية تطبيق التدليك المنعكس للقدمين على المرضى الذين يعانون من التهاب مفصل الركبة، وايضا تنفيذ برنامج تدريبى للممرضات, وموظفي و مقدمى الرعاية الصحية.