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Effect of Revulsive Compresses on Knee Associated Symptoms and Pain Severity among Patients with Knee osteoarthritis

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ABSTRACT

Osteoarthritis (OA) is a progressive disease of the joints. Knee osteoarthritis (KOA) is the most common form of osteoarthritis and a leading cause of pain and impaired function. Revulsive compresses are techniques used to reduce pain and related KOA effects**. Aim:** Evaluate the effect of revulsive compresses on knee associated symptoms and pain severity among patients with knee osteoarthritis. **Design:** A quasi-experimental design was utilized. **Setting:** The study was conducted at the Orthopedic and Rheumatology Outpatient Clinics of El Nasr Insurance Hospital in Helwan. **Sample:** A purposive sample of 60 adult patients with knee osteoarthritis. **Tools:** Four tools were used including; A Structured Interviewing Questionnaire, Knee injury and Osteoarthritis Outcome Score (KOOS), Pain Disability Index (PDI) & Numeric Pain Rating Scale. **Results:** Mean age of studied patients were 47.4 ± 10.04, 70% complained of pain, swelling and movement restriction. There was a highly statistically significant difference in total KOOS scores post intervention as compared to pre intervention. There was a highly statistically significant difference among studied patients pre and post intervention total pain disability index (p-value = 0.00). There was a statistically significant reduction with improvement in the total mean score of pain severity level post intervention of revulsive compresses . **Conclusion:** Revulsive compresses had a positive and significant effect in reducing the knee osteoarthritis symptoms and pain level of patients. **Recommendations:** Revulsive compresses should be recommended as a nursing intervention protocol during the care of patients with knee osteoarthritis.

Keywords*:* Knee osteoarthritis, Pain Severity, Revulsive Compresses.

Introduction

The most prevalent health hazard in the world's population is chronic diseases of musculoskeletal system. Osteoarthritis **(**OA) is the most common and frequently disabling of the joint disorders. The functional impact of OA on quality of life, for patients is often ignored. OA has been classified as primary (idiopathic), with no prior event or disease related to the OA, and secondary, resulting from previous joint injury or inflammatory disease **(Paul & Williams, 2016).**

Knee osteoarthritis (KOA) is the most common form of osteoarthritis and a widely prevalent joint disease over the world. In the USA, OA affects nearly 40 million women and men which almost makes up 15% of the general population, and will rise to 18.2% by 2020. It is estimated that by 2030 there will be 67 million people diagnosed with OA in the United States **(Uludağ & Kaşikçi, 2019).**

The prominent symptoms of KOA are swelling, joint pain and stiffness which are most commonly experienced in the morning or after awakening, usually

lasts less than 30 minutes and decreases with movement. Also, restrictions in movement including walking, stair climbing and bending. The symptoms worsen over time and elderly patients are affected more frequently than patients in other age groups. The presence of OA in the knee reduces activity of daily life and eventually leads to disability, which can sustain high costs related to loss in productivity **(Alghadir et al., 2019).** The severity of clinical symptoms could be differ from one person to another, over time, they usually become more serious, frequent and more disabling **(Elsiwy et al., 2019)**.

The treatment goal of KOA is to alleviate the signs and symptoms of the disease and if possible to show its progression, because it is not a curable disease, as the mechanism by which it arises and progress remains unclear. Multiple treatment options are available for patients with KOA including the use of superficial heat or cold, obesity management, exercises, oral pharmacological therapy, injection of corticosteroid or ultimately knee joint replacement surgery **(Hsu & Ryan, 2021)**.

Revulsive compresses are simple technique in which application of very hot (36-40° C) and very cold compresses (12-18° C) in alternation (one following the other), which improve blood circulation, decrease inflammation, reduce edema and strengthen the connective tissue**.** It is one of naturopathic treatment modality used widely in ancient cultures as India, Egypt and China; it considered a treatment of choice in the management of KOA in naturopathy **(Shetty, Kumar & Dinesh, 2018).**

Nurses could help patients to decrease symptoms by implementing non-pharmacological methods and ensuring that patients learn the procedures they can use by themselves, as well the nurse should evaluate the effect of these methods to provide the desired results **(Fernandes et al., 2013)**. Local hot and cold applications are used to decrease the symptoms in knee osteoarthritis, it is reported that hot applications could be implemented for decreasing the pain level and providing flexibility, while cold applications used to decrease edema **(Shin, 2014).**

Significance of the study

Knees are the most commonly affected joints by primary OA and it was reported that radiographic progression has been detected even with early (KOA) involvement in Egyptian patients carrying a substantial and increasing public health burden. Knee osteoarthritis (KOA) is the most prevalent arthropathies affecting up to 251 million people worldwide. In Egypt, a recent epidemiologic studies reported that KOA prevalence was 29.2 per 1000 (**Weheida, Abdel-Naby & Abd alwahab, 2019).** Knee osteoarthritis (KOA) is one of the leading causes of global disability that could limit the ability to perform daily activities and to achieve in work (**Mahmoud et al., 2019**).

It is widely accepted that no methods could prevent the disease completely, therefore; patients should protect themselves from side effects of the treatments. In many cases, pharmacological and non-pharmacological methods could be employed together as these are the best for pain control (**Saccomano, 2018)**. Local hot and cold compression, which is a non-pharmacological method, has been used for a long time in order to reduce pain, stiffness and swelling among OA patients (**Ashford & Williard , 2014)**. Revulsive compresses are time-saving, effective, low-cost and easy-to-use alternate hot and cold compresses that have an immediate impact on pain relief as seen in most clinical situations **(Shehata & Fareed, 2013).**So**,** the researchers conducted this study to evaluate effect of revulsive compresses on the pain severity and

associated health symptoms of patients with knee osteoarthritis.

Aim of the study

This study aimed to evaluate the effect of revulsive compresses on knee associated symptoms and pain severity among patients with knee osteoarthritis.

Research hypotheses:

The following research hypotheses were formulated to achieve the aim of this study:

H1: Application of revulsive compresses will improve the associated symptoms of patients with knee osteoarthritis.

H2: Application of revulsive compresses will reduce the pain severity of patients with knee osteoarthritis.

Subjects and methods:

Research design

A quasi-experimental design was utilized to achieve the aim of the study.

Setting

The study was conducted at the Orthopedic and Rheumatology Outpatient Clinics of El Nasr Insurance Hospital in Helwan. Orthopedic and Rheumatology Outpatient clinics consisted of two rooms in the first floor of the hospital, each room contained one bed, table and chairs.

Subjects

A purposive sample consisted of 60 adult patients with knee osteoarthritis. The sample size calculation done according to this formula **(Steven &Thompson, 2012)**.

$$n = \frac{N\,P\,(1-P)}{(N-1)\left(\frac{d}{Z_{1-\alpha/2}}\right)^2 + P(1-P)}$$

N= population size z = confidence level at 95 % (1.96) d=error proportion (0.05)

p= probability (50%)=0.50

Inclusion criteria

The patients were selected according to the following criteria:

- Both sexes
- Free from diminished sensation to heat or cold in knee area.
- No history of previous knee arthroplasty or any other orthopaedic surgical procedure.
- Have no history of receiving corticosteroid injection.

Tools of data collection

Data for this study were collected using the following tools:

Tool I: A Structured Interviewing Questionnaire

It was designed by the researchers in simple Arabic language after reviewing the related recent literature (**Ronald, Celeste & Joyce, 2018)** and consisted of two parts:

Part 1: Demographic Characteristics: This part included information about the age, sex, level of education, marital status, occupation, family income according to patients' opinion and place of residence.

Part (2): Patients' Medical History: This part consisted of six questions including co-morbidity, complaints that keep patient seek medical assistance, affected knee, duration of disease, family history regarding knee osteoarthritis and the calculation of body mass index (BMI) to indicate the degree of obesity by using the following equations according to guidelines from **(Connor & Arif, 2021).**

BMI = (weight in kilograms) / (height in meter)^2 : It was divided into four levels: underweight (BMI < 18.5), normal BMI (≥ 18.5- 24.0), overweight (25.0 - 29.0) and obese (BMI ≥ 30 - 40) Morbid obese (> 40).

Tool II: Knee injury and Osteoarthritis Outcome Score (KOOS)

This tool was adopted from **Roos & Lohmander (2003)** to assess and measure knee associated health problems for patients with KOA. The KOOS's five patient-relevant dimensions were contained 42 questions in five subscales as following:

Pain: It included nine questions about sensation of knee pain during the last week such as frequency and amount of experiencing knee pain during twisting, straightening, bending knee, walking on flat surface, going up and down stairs, being in bed at night, sitting or lying and standing upright.

Symptoms: It consisted of seven questions about the experienced other symptoms during the last week such as swelling of knee, hearing noise on moving knee, hanging up knee on moving and the ability to fully straight and bend knee. Also there were questions about amount and severity of experienced knee joint stiffness during the last week after awaking in the morning, after sitting, lying or rest later in the day.

Daily Activities function: It consisted of **(17)** questions about degree of experienced difficulty in function of daily living in the last week during descending and ascending stairs, rising from sitting, standing, bending to pick up an object from the floor, walking on flat surface, getting in and out of car, going shopping, putting on and off socks, lying in and raising from bed, getting in and out of bath and toilet as well, having light and heavy domestic duties.

Sport and Recreation Function: It consisted of five questions about degree of experienced difficulty in sports and recreational activities during the last week in squatting, running, jumping, twisting, and kneeling the injured knee.

Quality of Life: It consisted of four questions about frequency of awareness of knee problem, whether life style are modified to avoid potentially damaging activities, the amount of having difficulty with the knee during the last week.

Scoring system

A five Likert scale was used and all items have five possible answer options scored from 0 to 4 in which (0) reflected no problems, while 4 reflected extreme problems. Each of the five scores was calculated as the sum of the included items. The total score that less than 56 represented no knee symptoms and 56 to 99 indicated mild symptoms, while 100 to 143 score indicated moderate symptoms, but 144-186 indicated extreme knee symptoms.

Tool III: Pain Disability Index (PDI)

It was adopted from **Chibnall & Tait (1994)** ; it is a simple and short self-report instrument for measuring the degree of interference of pain on the ability of a patient to participate in essential life activities. It consisted of **(7)** categories of life activity including family/home responsibilities, recreation, social activity, occupation, sexual behavior, self-care and life-support activities.

Scoring system

This scale described the level of disability that patient typically experience ranged from 0 to 10. A score of 0 means no disability at all and a score of 10 signified that all of the activities in which patient would normally be involved have been totally disrupted or prevented by pain. Total pain disability index included SUM (points for all 7 categories), in which (0) minimal index and (70) maximal index. The higher the index, the greater the patient's disability due to pain.

Tool IV: The Numeric Pain Rating Scale

This tool was adopted from **Mc Caffery & Beebe (1993)** to assess the pain severity pre and post application of revulsive compresses for patients with KOA. The scale consisted of a 10 cm line that was enumerated from 0 to 10 (zero mean no pain and 10

mean worst pain). The patient selected the number from (0-10) that best reflected their pain severity, it is classified as follow: (0) indicates no pain, (1 - 3) indicated mild pain, (4 - 6) indicated moderate pain and (7 - 10) indicated severe pain.

Operational Design

Preparatory Phase:

It included reviewing current and past available literature and theoretical knowledge of various aspects of the study using the booklet, articles, internet, periodicals and magazines to develop the tools for data collection.

Content validity:

Content validity was conducted to test the tool for appropriateness, relevance, and clearance through a jury of five experts, from the medical-surgical nursing staff at the faculty of nursing, Helwan University. Juries were from different academic categories (professors and assistant professors). Their opinions were elicited regarding the tools format layout, consistency, and scoring system.

Testing reliability:

The Cronbach's alpha model which is a model of internal consistency was used in the analysis. Tools showed good internal consistency and good reliability. It was tool II (8.79), tool III, (0.780) and tool VI (0.793).

Ethical Considerations

An informed consent was taken from patients who agreed to participate in the research process. The agreement for participation of the patients was taken after the aim of the study had been simply explained to them before data collection. They were assured that anonymity and confidentiality would be guaranteed and the right to withdraw from the study at any time without giving any reason. Values, culture, and beliefs would be respected.

Pilot Study:

A pilot study was applied on a group of 6 patients (10% of the sample) to test the applicability of the study and applicability of the designed tools, as well as to estimate the time needed to answer the tools. Patients included in the pilot study were included in the main study patients as there were no modifications required in the tools.

Field Work (Procedure)

- Data collection was started and completed within 6 months in the period from beginning of January 2021 until the end of June 2021.
- The researchers were available at the outpatients' clinics at El Nasr Insurance Hospital 2 days/week (Saturday & Wednesday) in the morning to collect data from the studied patients. Filling in the tools was done according to the patients` understanding and health condition.
- The researchers have introduced themselves and explained the study's purpose to patients who fulfilled the inclusion criteria.
- **The collection of data was done through three phases:**

Assessment phase

The researchers interviewing each patient with knee osteoarthritis and collected data using the pre discussed tools. It took about (20-30) minutes for each patient to fulfill. Data that was obtained during this phase was considered the basis for the revulsive compresses (pre-test).

Implementation phase

The revulsive compresses have been applied through a hot and cold water bottle covered with a thin cotton cloth or towel and applied around the affected Knee. The intervention consisted of 4 minutes of hot compresses followed by 1 minute of cold compresses;

this process has been repeated three times in a total session of 15 minutes.

The researchers have demonstrated the procedures in front of patients after divided them into subgroups (10 groups); then under the researchers' observation the patients re-demonstrated the procedure to ensure that they apply the revulsive compresses correctly, then each patient asked to complete the course of the revulsive compresses for 15 days (15 minutes application twice a day, morning and evening). Otherwise, the researchers asked the patients his/her telephone number to follow up with them for 15 days.

The researchers distributed educational booklet in the Arabic language to the patients, with explanations from the researchers regarding its contents and benefits. The educational booklet was involved a comprehensive description of the knee osteoarthritis disease, its management including pharmacological and non-pharmacological management, revulsive compresses including its benefits and application as well knee exercises illustrated by pictures.

Evaluation phase

The effectiveness of the revulsive compresses application on the symptoms of patients with knee osteoarthritis and pain severity level was evaluated after 15 days of application. The researchers interviewing patients at the outpatients' clinics of El Nasr Insurance Hospital in Helwan using the same pretest tools.

Administrative Design

To carry out the study, the necessary approvals were obtained from the hospital and nursing director of El Nasr Insurance Hospital. Official letters were issued to them from the Faculty of Nursing, Helwan University explaining the aim of the study to obtain permission for data collection.

Statistical Design

Collected data was organized, categorized, tabulated, and analyzed. Data were presented in tables, and figures using the Statistical Package for Social Science (SPSS), version 20. Statistical significant associations were assessed using percentage (%), mean, standard deviation, chi-square, paired t-test and p-value. The p-value is the probability that an observed difference is due to chance and not a true difference. A significant level value was considered when the p-value < 0.05 and a highly significant level value was considered when p-value< 0.001, while p-value > 0.05 indicates non-significant results.

Results

Table (1): Shows that 70% of studied patients were ranged from 40 to less than 60 years old with the mean age were 47.4 ± 10.04 years old. Regarding sex, 80 % were females. Additionally 55 % were married; as well 38.٤% were middle educated, while 13.3 % were illiterate. 50% of the studied patients were house wife, while 5% were non workers. Concerning family income, 61.7 % had an insufficient income according to their opinion. Additionally regarding place of residence 80% of the studied patients were from urban areas.

Table (2) shows that, 53.3% of studied patients had comorbidity moreover 50% of them were hypertensive and 25% were diabetic.70% of studied patients complains of pain, swelling and movement restriction. Furthermore 81.7 % of the studied patient had bilateral knee arthritis, while 18.3 had only one knee affected. Regarding disease duration, 51.٦% suffered from knee OA for less than 5 years, 55% of studied patients had family history. As well 50% were obese and the mean and standard deviation values of BMI were 32.1±8.57.

Table (3): Clarifies that, there was a statistically significant reducing with improving in total KOOS

mean score and KOOS' five patient-relevant dimensions, which referred to knee associated health symptoms as pain, other related symptoms, difficulty in performing activities of daily living, the difficulty of performing sports and recreational activities and quality of life-related to the knee post the intervention of revulsive compresses. In addition to a highly statistically significant difference in total KOOS scores post intervention as compared to pre intervention (P-value < 0.05).

Table (4): Illustrates that, the total mean score of pain disability index was 36.86±5.84 pre intervention which was decreased to 17.33±7.82 post intervention with a highly statistically significant difference among the studied patients pre and post intervention regarding total pain disability index and its categories with (p-value = 0.00).

Figure (1): Illustrates that 83.7% of studied patients had severe pain pre intervention which was dropped to 13.3% post intervention. Additionally 80% of studied patients had mild pain post intervention of revulsive compresses. This finding pointed out that revulsive compresses had a significant effect in reducing pain severity.

Table (5): Demonstrates that there was a statistically significant reduction with improvement in the total mean score of pain severity level post intervention of revulsive compresses and there was a highly statistically significant difference in pain severity level post intervention as compared to pre intervention with (p-value = 0.000).

Table (6): Reveals that there were detected statistically significant strong direct relation among the studied patients between pain and demographic characteristics as regard age , gender, Level of education and place of residence with (p-value = 0.000, 0.01, 0.000 & 0.01 respectively). While there was no statistically significant difference among the studied patients regarding pain and marital status, occupation and income with (p-value = 0.167, 0.350 & 0.08 respectively).

Table (7): Shows that, there was a highly statistically significant relation among the studied patients between KOOS and demographic characteristics as regard gender, marital status, occupation, income and place of residence with (p-value = 0.00, 0.01, 0.000, 0.000 & 0.05 respectively).

Table (8): Reflects that, there was a highly statistically significant direct correlation among the studied patients between KOOS and pain disability index with (p-value = 0.000).

Table (1): Frequency and Percentage Distribution of Demographic Characteristics of the Studied Patients (n=60)

Items	The studied Patients (n=60)	
	No	%
Age group		
20 to less than 40	14	23.3
40 to less than 60	42	70
More than 60	4	6.7
Mean ± SD	47.4±10.04	
Gender		
Male	12	20
Female	48	80
Level of Education		
Illiterate	8	13.3
Read/ write	11	18.3
Middle school	23	٤38.
Higher education	18	30
Marital Status		
Single	11	18.3
Married	33	55
Widowed	16	26.7
Occupation		
Manual work	16	26.7
Administrative work	11	18.3
Housewife	30	50
Not working	3	5
Income according to patients' opinion		
Sufficient	23	38.3
Insufficient	37	61.7
Place of Residence		
Urban	48	80
Rural	12	20

Table (2): Frequency and Percentage Distribution of Studied Patients' Medical History (n=60)

Items	The studied Patients (n=60)	
	No	%
Comorbidity		
No	28	46.7
Yes	32	53.3
HTN	16	50
DM	8	25
Both	8	25
Complaint		
Knee pain	18	30
Knee swelling	4	6.7
Pain and movement restriction	14	23.3
All of the above	42	70
Affected Knee		
One knee	11	18.3
Bilateral knees	49	81.7
Duration of disease	31	٦51.
5 years<	19	31.7
5-10 years	10	16.7
10 years>		
Family history regarding knee osteoarthritis		
Yes	33	55
No	27	45
Body Mass Index (BMI)		
Normal weight	22	36.7
Overweight	8	13.3
Obese	30	50
(BMI) Mean ± SD	32.1±8.57	

Table (3): Comparison between Knee injury and Osteoarthritis Outcome Score (KOOS) Pre and Post Intervention (n=60)

KOOS Related Dimensions	Pre Intervention Mean ± SD	Post Intervention Mean ± SD	T-test	*P*-value
KOOS- Pain	32.96±4.37	15.53±7.43	15.65	0.02*
KOOS -Symptoms	24.96±4.42	11.46±6.04	13.96	3*٠0.
KOOS -Daily Activities	62.46±7.4	29.91±14	15.91	0.05**
KOOS -Sports& recreational Activities	19.61±1.18	10.1±4.11	17.20	0.00**
KOOS -QOL	14.6±1.99	6.71±3.95	13.78	0.00**
Total –KOOS	154.62±16.52	73.73±16.52	23.87	0.02*

*** Significant at P ≤ 0.05**

Table (4): Comparison of Pain disability index mean scores Pre and Post Intervention (n=60)

Pain disability index Categories	Pre Mean ± SD	Post Mean ± SD	T-test	P-value
Family/Home Responsibilities	5.483±1.32	2.95±1.52	32.15	0.000*
Recreation	5.33±1.16	2.67±1.13	35.63	0.000*
Social Activity	5.68±1.14	2.85±1.27	38.54	0.000*
Occupation:	5.50±0.96	2.55±1.36	44.13	0.000*
Sexual Behavior:	3.70±2.16	1.62±1.40	13.24	0.000*
Self-Care	5.77±0.56	2.42±1.20	79.27	0.000*
Life-Support Activities	5.40±0.79	2.28±1.24	53.25	0.000*
Total	36.86±5.84	17.33±7.82	48.84	0.00**

*** Significant at P ≤ 0.05**

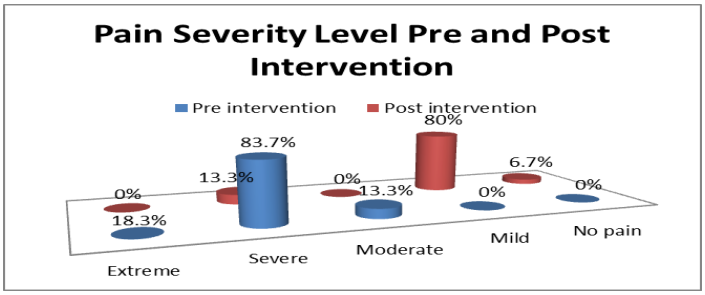

Fig. 1: Pain Severity Level of Studied Patients Pre and Post Intervention (n= 60)

Table (5): Frequency and Percentage Distribution of Studied Patients' Pain Severity Level Pre and Post Intervention (n=60)

Numerical pain rating scale (NRS)	Pre		Post		X2	*P*-value
	N	%	N	%		
No	0	0	4	6.7		
Mild	0	0	48	80		
Moderate	8	13.3	0	0		
Severe	41	83.7	8	13.3	93.22	0.000*
Extreme	11	18.3	0	0		
Total (Mean± SD)	8.25±1.22		2.56±2.28		52.48	0.000*

*** Significant at P ≤ 0.05**

Table (6): Relation between Pain Severity Level and Demographic Characteristics of Studied Patients (n= 60)

Items	Pain severity						X2	*P*-value
	Moderate		Severe		Extreme			
	N	%	N	%	N	%		
Age group								
20 to less than 40	4	6.7	10	16.7	0	0		
40 to less than 60	4	6.7	31	51.7	7	11.7	23.55	0.000*
More than 60	0	0	0	0	4	6.7		
Gender								
Male	4	6.7	4	6.7	4	6.7	9.03	0.01*
Female	4	6.7	37	61.7	7	11.7		
Level of Education								
Illiterate	4	6.7	4	6.7	0	0		
Read/ write	0	0	7	11.7	4	6.7	24.72	0.000*
Middle school	4	6.7	12	20	7	11.7		
Higher education	0	0	18	30	0	0		
Marital Status								
Single	2	3.4	7	11.7	2	3.4	3.58	0.167
Married	6	10	22	36.7	5	8.3		
Widowed	0	0	12	20	4	6.7		
Occupation								
Manual work	4	6.7	8	13.3	4	6.7		
Administrative work	0	0	8	13.3	3	5	6.70	0.350
Housewife	0	0	3	5	0	0		
Not working	4	6.7	22	36.7	4	6.7		
Income								
Sufficient	4	6.7	29	48.3	4	6.7	4.87	0.08
Insufficient	4	67	12	20	7	11.7		
Place of residence								
Urban	4	6.7	37	61.7	7	6.7	9.03	0.01*
Rural	4	6.7	4	6.7	4	11.7		

***: Significant at P ≤ 0.05**

Table (7): Relation between KOOS and Demographic Characteristic of Studied Patients (n=60)

Items	KOOS				X2	P-value
	Good		Poor			
	N	%	N	%		
Age group						
20 to less than 40	3	5	11	18.3		
40 to less than 60	11	18.3	31	51.7	1.44	0.49
More than 60	0	0	4	6.7		
Gender						
Male	8	13.3	4	6.7	15.75	0.00*
Female	6	10	42	70		
Level of Education						
Illiterate	0	0	8	13.3		
Read/ write	3	5	8	13.3	4.67	0.198
Middle school	8	13.3	15	32.6		
Higher education	3	5	15	32.6		
Marital Status						
Single	4	6.7	7	13.3	6.64	0.01*
Married	10	16.7	23	38.3		
Widowed	0	0	16	26.7		
Occupation						
Manual work	8	13.3	8	13.3		
Administrative work	0	0	11	18.3	22.55	0.000*
Housewife	3	5	0	0		
Not working	3	5	27	45		
Income						
Sufficient	14	23.3	23	38.3	11.35	0.000*
Insufficient	0	0	23	38.3		
Place of residence						
Urban	14	23.3	34	56.7	4.57	0.05*
Rural	0	0	12	20		

*** Significant at P ≤ 0.05**

Table (8) Correlation between Patients' Total KOOS and Pain Disability Index

Items	Patients' KOOS	
	Correlation Coefficient (r)	P-value
Pain Disability Index	0.791	0.000*

*** Significant at P ≤ 0.05**

Discussion

Knee osteoarthritis (OA) is a common progressive multifactorial joint disease and is characterized by chronic pain and functional disability. Knee OA accounts for almost four fifths of the burden of OA worldwide and increases with obesity and age (**Cui et al., 2020)**.The present study evaluated the effect of revulsive compresses on associated symptoms and pain severity level for patients with knees osteoarthritis following 15 days of regular application of revulsive compresses (alternate hot and cold compresses).

Part I: Demographic Characteristics & Medical History of studied patients

Concerning the age of studied patients, the study results indicated that more than two-thirds of the studied patients were from 40 to less than 60 years and the mean age of them was 47.4 ± 10.04. This could be due to the truth that, there is an exponential increase in age, the related risk factor of obesity is rising due to progressive sedentary behavior, dietary routine, improvements in lifestyle habits and working environments in the adult population. This finding was in agreement with **Zhang et al., (2018),** in a study entitled "Evaluation of the effect of Aromatherapy in Management of Knee Osteoarthritis Patients" who found that, the majority of the cases age were more than 40 years old. As well , the previous results were in accordance with **Mohamed & Abdel Fattah (2019),** who evaluated "the Effect of local Heat Application on Complaints of Patients with Moderate Knee Osteoarthritis" and mentioned that the majority of patients in the groups studied were between 45 and 55 years old. While this results in disagreement with **AlKuwaity et al., (2018),** in a study about "Prevalence and Determinant Factors of Osteoarthritis of the Knee Joint among Elderly in Arar" who reported that the mean age (± SD) was 70.4 (±9.3) years.

Regarding gender, the result of the present study revealed that the majority of the studied patients were females. This finding was consistent with **Basuny, Zatton &Abo- Hashem (2020),** in their paper titled "Responsiveness of pain and associated health issues of patients with knee osteoarthritis to the revulsive compresses" who showed that most of studied patients were females. Likewise, **Kozora et al., (2015),** in their study titled " Major life stress, coping styles, and social support concerning psychological distress in patients with Osteoarthritis" indicated that the majority of the sample were females whereas only a few were males. While this result in disagreement with **Mukharrib et al., (2018),** in a study entitled "Knowledge of knee osteoarthritis among general population in Aseer region" who reported that more than two thirds were male. According to researchers' point of view, this could be due to hormonal changes especially after menopause which can increase the risk of knee

osteoarthritis due to estrogen withdrawal that can exacerbate degenerative changes in multiple joints muscle strength changes as well as, less muscle and more fat cluster loading on joints, pelvic structures and knees.

As regards educational level the present study finding indicated that about two fifth of the studied patients were middle educated. This result was in the same line with **Mohsen et al., (2021),** in a study entitled "The Effect of Nursing Intervention on Knowledge and Practice among Elderly with Knee Osteoarthritis" who stated that two fifth of their cases were technical diploma. While this result was incongruent with **Uludağ & Kaşikçi (2019),** in a study titled "The Effect of Local Cold Compression upon Pain and Movement Restriction among Patients with Knee Osteoarthritis" who mentioned that two fifth of the studied patients were illiterate. Also, **Al-Khlaifat et al.,(2020),** in a study entitled "Knowledge of Knee Osteoarthritis and Its Impact on Health in the Middle East: Are They Different to Countries in the Developed World A Qualitative Study" as they stated that more than two fifth of study were high school and only one fifth were Diploma graduate. As well **AlKuwaity et al., (2018),** found that near than half of their studied patients were illiterate.

As regards to marital status the present study results indicated that more than half of the patients were married. The study results were supported by **Bennell, Hunter & Hinman (2018),** in a study titled "Management of osteoarthritis of the knee" who showed that more than half of the sample was married. Similarly, the previous results agreed with the study conducted by **El-Adham, Abdelhady & Osman (2019),** in a study titled "Effect of Nursing Education program on Knowledge, Uncertainty, Mastery, Pain, and Quality of Life for Knee Osteoarthritis Patients "and confirmed that more than half of the sample were married. From the researchers' points of view this could be related to Egyptian culture that at the age of 40 the majority of people especially females were married.

Regarding patients' occupation, the current study finding indicated that half of the patients were housewives .This finding came in the same line with **Basuny et al., (2020),** who showed that two-third of the subjects were housewives. In the same context **Imam et al., (2020),** in a study titled "Heel pain in female patients with early knee osteoarthritis" revealed that more than half of the sample were housewives. This could be due to the majority of the studied patients were females, as well this might be related to housewives performing daily home activities which cause stress on joints and act as a factor to develop knee osteoarthritis.

Concerning family income, the present study result indicated that about two-thirds of the patients had insufficient income according to their opinion. This finding was in the same line with **Laires et al., (2018),** in a study entitled "The impact of osteoarthritis on early exit from work: results from a population-based study" who reported that half of the study subjects had insufficient income. Likewise, this finding was in agreement with **Yuan (2016)**, who found that insufficient income is considered risk factor which increase the prevalence of knee OA. From the researchers' point of view could be due to that low-income population is typically engaged in hard physical labor which raises the pressure on the knee joints, thereby exacerbating any cartilage damage.

Concerning place of residence the current study result showed that the majority of the patients from urban . This result was consistent with **Hong, Noh & Kim (2020)**, in a study entitled "The prevalence of and demographic factors associated with radiographic knee

osteoarthritis in Korean adults" who reported that three quarter of study sample were from urban areas. On the other hand this result was inconsistent with **Usenbo et al., (2015),** who mentioned that highest prevalence of knee osteoarthritis lived in rural South Africa. It is possible that participants who live in rural areas may engage in harder labor e.g., agriculture, which may increase disease risk. This variation of results between studies is probably due to differences in the study design, setting and techniques used for conducting the study.

Continuing talking about medical characteristics, regarding comorbidities the study results showed that more than half of the studied patients had comorbid disease and half of them were hypertensive and one fourth were diabetic. This results were in agreement with **Laires et al., (2018),** who stated that the participants with OA had more comorbidities in particular cardiovascular diabetes. The previous results also were in accordance with **Al-Khlaifat et al., (2020),**who mentioned that half of study sample had hypertension and one fifth had diabetes.

In relation to patients' complaint it is noticed that about three quarter of studied patients complained of pain, swelling and movement restriction. This finding was supported by **Al-Khlaifat et al., (2020),** who clarified that majority of participants in their study experienced symptoms including pain, stiffness, fatigue, swelling, muscle weakness, crepitus.

As regard affected knee, the majority of studied patients had bilateral knee osteoarthritis. This result goes in the same line with **Wang et al., (2018),** who studied "Effects of exercise therapy for knee osteoarthritis" and reported that more than half of sample had both knees OA. On the other hand this result was incongruent with **Uludağ & Kaşikçi (2019),** who reported that more than two thirds had one knee affected with OA.

Concerning disease duration, the present study result revealed that more than half of studied patients suffered from knee OA for less than five years. This result agreed with **Uludağ & Kaşikçi (2019),** who clarified that slightly more than half of studied patients suffered from knee OA for one to four years. In the same line **Mohamed & Abdel Fattah (2019),** reported that near than two fifth of studied patient had OA from three to less than five years. Likewise **Acıkgöz, Akyuz, & Tunay (2017),** found that the mean period of disease-related symptoms of knee-OA patients was 5.01 ± 2.86. As well, the previous result on the same line **Hatef et al., (2019),** who carried out a study of "Effect of Self-Management Program on Pain and Disability Index in Elderly Men with Osteoarthritis" and concluded that mean duration of illness was 4.43 ± 1.00.

Regarding family history of knee Osteoarthritis, more than half of studied patients had positive family history. This result was congruent with **Mohamed & Abdel Fattah (2019),** who mentioned that half of studied subjects had family history regarding knee OA. Nevertheless, **Uludağ & Kaşikçi (2019),** stated that more than two thirds of the patients reported no history of damage or injury to knee joint. the previous finding also was incongruent with **Shehata & Fareed (2013)** who compared the effect of cold, warm and contrast therapy on controlling knee osteoarthritis associated problems and revealed that the majority of their studied patients had no familial predisposition for OA.

Regarding Body Mass Index (BMI) the current study result indicated that half of patients were obese with mean ± SD 32.1±8.57. This result was consistent with **Abd El Fatah, Weheida & Mekkawy (2019),**

who examined "the Effect of Cold application Versus Contrast Hydrotherapy on Patients Knee Osteoarthritis Outcomes" and indicated that more than half of patients were obese. Furthermore, **AlKuwaity et al., (2018),** reported that more than two fifth of patients were obese with mean ± SD 30.0±10.2. According to researchers point of view, the effect of obesity on OA has been mediated through the increased mechanical loading of the knee and hip which would lead in cartilage damage in weight bearing joints as well, obesity is considered a critical risk factor for knee OA. Additionally **Abdelaleem & Rizk (2018),** who studied "Health-related quality of life in Egyptian patients with knee osteoarthritis" and reported that BMIs ranged from 25.97 to 49.12% with a mean of 36.83±5.37%.

Part II: Effect of revulsive compresses on KOOS Score among studied patients' pre and post intervention

Regarding the total Knee injury and Osteoarthritis Outcome Score Pre and Post Intervention the present study results clarified that there was a statistically significant reduction with improving in total KOOS mean score and KOOS' five patient-relevant dimensions post the intervention of revulsive compresses. These results verified the research hypothesis **(H1)** which stated that application of revulsive compresses will improve the associated symptoms of patients with knee osteoarthritis. The study results agreed with **Basuny et al.,(2020),** whose study results displayed that revulsive compresses had significant effect in reducing the total mean KOOS and KOOS dimensions score post intervention as compared to pre intervention. Similarly a recent study conducted by **Ariana et al., (2021),** who evaluated "The Effect of Local Heat Therapy versus Cold Rub Gel on Pain and Joint Functions in Patients with Knee Osteoarthritis" and showed that local heat therapy and cold rub gel had improved pain and joint symptoms in patients with knee OA.

The previous results in the same line **Jain & Shiny (2017),** who carried out a study titled "Effect of revulsive compress on knee associated symptoms among knee joint osteoarthritis patients" and revealed that the revulsive compresses were the appropriate safe treatment protocol to relieve symptoms and knee osteoarthritis-related pain. Additionally**, Archanah et al., (2018),** in their study titled "Effect of a hydrotherapy based alternate compress on osteoarthritis of the knee joint: a randomized controlled trial" concluded that an alternate hot and cold compress was effective in the management of pain for patients with knee OA.

Moreover, **Shehata & Fareed (2013),** reported that all of the three methods (cold, warm and contrast therapy) resulted in improving pain but the most appropriate protocol of treatment to relive pain was contrast therapy.

Part III: Effect of revulsive compresses on pain disability index mean scores and pain severity level among studied patients pre and post intervention

As regard comparison of pain disability index mean scores pre and post intervention**,** the present study results indicated that, there was a highly statistically significant difference among the studied patients pre and post intervention regarding total pain disability index and its categories. These results were congruent with **Thenmozhi et al., (2019),** who concluded that contrast hydrotherapy is significantly effective in reducing the knee pain without side effects among patients with osteoarthritis, thereby improve the functional ability, health status and quality of life. Similarly, **Hatef et al., (2019)** indicated that there was

a statistically significant reduction of mean score of the disability of patients with knee OA.

Continuing talking about pain, as relating to pain severity level of the studied patients pre and post revulsive compresses intervention, the present study findings revealed that the majority of studied patients had severe pain pre intervention which was dropped to less than one fifth post intervention with a significantly reduction and there was a highly statistically significant difference in pain severity scores post intervention as compared to pre intervention. These results were in agreement with **Mohamed & Abdel Fattah (2019),** who showed that majority of subjects had severe knee pain pretreatment and a statistically significant difference was found after application of revulsive compresses in relation to their pain intensity. In addition, the previous results were in accordance with **Jain & Shiny (2017),** who showed that there was statistically significant difference between total score of the numerical pain scale, post implementation of revulsive compress . From the researchers' field experience these results could ensure that as heat and cold applications is preferred by patients because it is considered a simple and reliable non pharmacological method for the relief of pain as well no side effects on patients health.

As well, the previous findings were congruent with **Abd El fatah et al., (2019)**, who stated that there was a decreased of mean pain score among the contrast hydrotherapy group than the cold group with highly statistically significant differences. In the same line **Basuny et al., (2020),** verified that there was a highly statistically significant difference in pain intensity scores after the intervention of revulsive compresses as compared to before intervention.

In the same context **Archanah et al. (2018),** concluded that an alternate hot and cold compress was effective in the management of pain and improves the Range of motion (ROM) in case of knee OA. So the study findings confirmed the the research hypothesis **(H2)** which stated that application of revulsive compresses will reduce the pain severity of patients with knee osteoarthritis.

Part IV: Relation between demographic characteristics and pain severity level and KOOS of studied patients.

On the light of the present study finding, results revealed that there were detected statistically significant strong direct relation among the studied patients between pain, and demographic characteristics as age, gender, Level of education, and place of residence. This results were in accordance with **Mohamed (2019),** who mentioned that there were positive statistically significant relations between pain and age in the study subjects.

Finally, the present study results indicated that there was a highly statistically significant relation among the studied patients between KOOS and gender, marital status, occupation, income and place of residence. This results were in agreement with **Basuny et al., (2020),** who reported that there was statistically significant relation between the KOOS and place of residence, level of education and occupation of studied patients.

Conclusion:

Based on results of the present study, it could be concluded that revulsive compresses had a positive and significant effect in reducing the knee osteoarthritis symptoms and pain severity of patients. Additionally, a positive relation between Knee injury and Osteoarthritis Outcome Score (KOOS), pain severity level and demographic characteristics as age, gender, level of education, occupation and place of residence.

Recommendations:

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

- Revulsive compresses should be recommended as a nursing intervention protocol during the care of patients with knee osteoarthritis.
- Replicating the study with a large sample size to allow for a wider generalization of the findings.
- Further researches to evaluate long term effect of revulsive compresses application.

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