

Responsiveness of Pain and Associated Health Issues of Patients with Knee Osteoarthritis to the Revulsive Compresses

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Abstract:

Background: Osteoarthritis disease (OA) is a major public health problem globally, affecting the cartilage of joint and contributing to reduced function that affects the quality of life. Knee Osteoarthritis disease (KOA) is considered the most frequent reason for knee pain in both adult and elder people. Although pain is the main and most common disabling symptom for KOA patients; however, knee stiffness, oedema, disfigurement, and decreased functional ability such as walking, are widespread associated health issues of those patients. Since there is no cure for OA, the aim of therapy is generally to reduce pain, manage symptoms, improve joint function, and minimize disability. Revulsive compresses are a hydrotherapy procedure commonly used to eliminate or reduce pain and related KOA effects. **Study aim:** evaluate the responsiveness of pain and associated health issues of patients with knee osteoarthritis to the revulsive compresses. **Study Design:** a quasi-experimental design. **Setting:** Orthopedic and Rheumatology Outpatient clinics at Zagazig University Hospitals, Egypt. **Subject:** a purposive sample included 60 adult patients with knee osteoarthritis. **Tools:** A structured interview questionnaire; 0-10 Numeric pain rating scale; and Knee Injury and Osteoarthritis Outcome Score were used to collect data. **Results:** there was a statistically significant reducing and improving the pain intensity level and knee OA associated health issues as pain; other symptoms; difficulty in performing activities of daily living functions, activities of sports and recreational functions and quality of life-related to the knee after applying of revulsive compresses compared to before applying it. **Conclusions:** the pain and associated health issues of patients with knee osteoarthritis have positive responsiveness to Revulsive compresses, this leads us to conclude that the Revulsive compresses are effective in reducing and improving both pain and associated health issues of those patients. **Recommendations:** The early strategies for managing patients with knee osteoarthritis should include revulsive compresses to reduce pain and improve the associated health issues for those patients.

Keywords: Knee osteoarthritis, Pain, Associated health issues, Revulsive compresses.

Introduction:

Musculoskeletal diseases are major public health problems; in most countries, they cause more functional disabilities in the adult and geriatric population than any other category of

disorders (Picavet & Hazes, 2003). Osteoarthritis (OA) is considered the most common musculoskeletal disease all over the world (Panahi et al., 2016), it is a painful and disabling inflammatory

disease of the joints; it is caused by multiple factors as joint injury or overuse, obesity, and heredity and dramatically increases in prevalence with age (Johnson & Hunter, 2014). OA often occurs in weight-bearing joints (Wagner & Luna, 2018), and the knee is considered the most commonly affected joint by OA, followed by the hip and the hand joints (Turkiewicz et al., 2015).

Knee osteoarthritis (KOA) is a common degenerative disease that causes the bones and cartilage to break down in a joint. Such changes take place over time and cause pain, discomfort, swelling, rigidity, and weakness in the knee joints, which eventually contribute to disability (Centers for Disease Control and Prevention, 2018). It generally affects the elderly and the middle-aged, contributing to walking difficulty and a decrease in quality of life (Wang et al., 2017). The severity of its clinical symptoms can differ from one person to another. Over time, however, they usually become more serious, more frequent, and more disabling (Springer, 2019; Elsiwy et al., 2019 & Lundgren-Nilsson, 2018).

The most significant symptom of osteoarthritis is pain and previous findings have shown that patients with OA experience different pain levels (Panah et al., 2016). The pain has several negative forms that affect the quality of life of individuals with knee osteoarthritis. Although underestimated very often, it induces irritability, insomnia, depression, and other physical and psychological changes. As a result, a disease aggravates a decrease in the degree of physical activity and a loss of physical function (Farr et al., 2008). Also, KOA patients report joint rigidity or stiffness in the morning when they wake up for a certain period and after immobilization. Knee stiffness often doesn't take longer than thirty minutes but

results in diminished physical activity (Karadakovan & Arslan, 2009).

Since OA is not cured, its care typically focuses on preserving the patient's functional ability by managing pain, other symptoms, and improving joint movement and function; treatment involves both pharmacological and non-pharmacological modalities (Hafez et al., 2014). Although the role of pharmacological management is well recognized in reducing swelling and pain, also the costs of treatment and the prolonged-term side effects of medication should not be underestimated (Salmon et al., 2018).

Nowadays, the propensity to use non-pharmacological and complementary treatments to treat disease symptoms is growing (Shafii et al., 2018). Furthermore, conservative nonpharmacological management is considering the primary option for patients with OA (Hochberg, 2012). The nonpharmacological treatment strategy of KOA involves using revulsive compresses (alternate hot and cold compresses) as a safe and low-cost option that can be used on its own or in conjunction with other knee Osteoarthritis therapies (Oosterveld & Rasker, 1994). Revulsive compresses have been used as a nonpharmacological method for long-term pain reduction, stiffness, and inflammation among patients with Osteoarthritis (Ashford & Williard, 2014, Patel et al., 2012).

Revulsive compress is an application of very hot (36-40° C) and very cold compresses (12-18° C) in alternation (one following the other), which improve blood circulation, ease inflammation, reduce edema, and strengthen the connective tissue (Prashanth Shetty, Selva Kumar

& Sujatha Dinesh, 2018). It is one of naturopathic treatment modality used widely in ancient cultures as India, Egypt, and China; it is considered a treatment of choice in the management of KOA in naturopathy (Mooventhan & Nivethitha, 2014).

Applying a revulsive compress will cause a circulatory reaction (alternate vasoconstriction and vasodilatation) with no thermal reaction within a short time after the heat is removed. The circulatory reaction is much more lasting following cold application; due to this alternate vasoconstriction and vasodilatation, the smooth muscles of blood vessels (endothelium) and vascular permeability by that it will induce tissue oncotic pressure (colloid osmotic pressure) to pull water into the circulation to reduce edema, inflammation, which helps prevent more damage, also provide analgesia and a better range of motion which help in preventing further damage, will provide analgesic effect and improved range of motion (John Hall, 2010, Cochrane, 2004, Taunton et al., 2001, Kellog, 1902).

The revulsive compress is much easier, more practical and more effective to apply to the limbs, also it should be a standard part of rehabilitation for many musculoskeletal disorders (Paul Ingraham & Vancouver Canada, 2009). The use of revulsive compresses for KOA patients can help to alleviate pain, stiffness, swelling, and also it detoxifies the applied part by removing the metabolic waste, inflammatory products, and other toxins (Kambach, 2015). Hence the present study was aimed to evaluate the responsiveness of pain and other associated health issues of knee osteoarthritis patients to the revulsive compresses.

Significance of the study:

Osteoarthritis is the utmost common arthritic conditions in adults worldwide and is the main reason of musculoskeletal system pain and disability (Bennell et al., 2018); it affects two hundred forty million people worldwide, about ten percent of males and eighteen percent of females, (Nelson, 2018). OA is Egypt's most prevalent disease that affects 5,596,869 of the total population (National Institute of arthritis, 2016). Knee osteoarthritis is the most frequently diagnosed type of arthritis and will continue to increase its prevalence as life expectancy and obesity rise (Magnusson et al., 2019 & Li et al., 2019). The high prevalence of OA has underlined the significance of initial prevention. The main preventative methods of OA include both pharmacological and nonpharmacological (Ratzlaff & Liang, 2010). The nonpharmacological methods, which can be applied for the treatment of KOA, include physical therapy, exercise, weight loss, acupuncture, and hot and cold applications (Kirazh, 2011).

Revulsive compresses are effective, low-cost, time-saving, 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). Besides alleviating pain, the application of revulsive compresses on knee OA can help to relieve stiffness and swelling (Kambach, 2015). The application of revulsive compresses may improve the pain and associated health issues of patients with knee osteoarthritis. Therefore the present study was conducted to provide evidence for this.

Aim of the study:

The current study aimed to evaluate the responsiveness of pain and associated health issues of patients with knee osteoarthritis to the revulsive compresses.

Research hypotheses:

To achieve the study's aim the following research hypotheses were formulated:

1.H1: Revulsive compresses application will be improving or reducing the pain intensity of patients with knee osteoarthritis.

2.H2: Revulsive compresses application will be improving or reducing the other associated health issues of patients with knee osteoarthritis.

Subjects and methods:**Research design:**

A quasi-experimental design was used to achieve the study's aim.

Setting:

The study was performed at orthopedic and rheumatology outpatient clinics of Zagazig University Hospitals.

Subjects:

A purposive sample consisted of 60 adult patients with knee osteoarthritis. They were selected according to the following inclusion criteria:

- Male and female adult patients.
- Capable of communicating and willing to take part in the study.

- No history of Revulsive compresses for any purpose.

- Have a good sensation to heat or cold in the knee area and free from wounds.

- Have no history of knee local injection of corticosteroids over the past 6 months.

- No previous history of knee arthroplasty or any other orthopedic surgery.

Tools of data collection:

To achieve the study's aim, three tools were used to collect the pre- and post-intervention data. These tools are included:

Tool I: A Structured interview questionnaire:

It was designed by the researchers after reviewing related pertinent literature to assess the Patients' sociodemographic, medical history, anthropometric studies, and patients' pain characteristics. It had the following 3 sections in it:

- **Part 1: Socio-demographic characteristics:** This part incorporated information on the age, sex, social state, educational level, occupation, residence, and income of patients.

- **Part 2: Health history information:** This part integrated six questions about the presence of other systemic diseases; complaints that keep patient seek medical assistance; affected knee; duration of disease; family health history regarding knee OA; in addition to the calculation of body mass index (BMI) by assessing body height (cm) and weight (kg.) to indicate the degree of obesity by

using the following equations according to Guidelines for Taiwan, (2011):

▪ **BMI = (weight in kilograms) / (height in meter)²**: It was broken down 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).

- **Part 3: Pain assessment questionnaire**: This part was concerned with assessing the characteristics of patients' pain and stiffness; it included seven MCQ questions about quality or type of pain, frequency of pain, the time of pain occurrence, the effect of pain on sleep quality, patients' self-control trial to pain, time of knee stiffness and its frequency.

Tool II: Numeric pain rating scale (0-10):

This tool was adopted from **McCaffery & Beebe, (1993)** to evaluate the intensity of pain before and after the application of revulsive compresses for patients with KOA. The scale consists of a 10 cm line that was enumerated from 0 to 10 (zero mean no pain and 10 mean worst pain). The patient selects their pain intensity. It is classified as follow: 0 indicates "no pain", 1 – 3 indicates mild pain (little interfering with activities of daily living), 4 – 6 indicates moderate pain (interfering significantly with activities of daily living), and 7 – 10 indicates severe pain (disabling, unable to perform activities of daily living)

Tool III: Knee Injury and Osteoarthritis Outcome Score (KOOS):

This tool was adopted from **Roos & Lohmander (2003)** to assess and measure knee associated health issues or problems for patients with KOA as knee

pain associated with specific activities, other disease-specific symptoms (other related symptoms), difficulty in performing activities of daily living functions (ADL), difficulty in performing activities of sports and recreational functions (Sport / Rec), and quality of life-related to the knee (QOL). The English version used and researchers modified the scoring system. It comprised 42 questions in five subscales as the following:

1- Concerned with pain: This subscale is used to assess pain experienced by patients during performing specific activities, it included nine questions about feeling of knee pain throughout the past week such as frequency and degree of knee pain during twisting, straightening, bending the knee, walking on a flat surface, going up and fall stairs, and feeling of pain at night while in bed, sitting or lying, and standing upright.

2- Concerned with other disease-specific symptoms: This subscale included seven questions about other experienced symptoms by patients throughout the past week, such as knee stiffness after first waking up in the morning, knee stiffness after sitting, lying or resting later in the day, knee swelling, feeling grinding, clicking or any other kind of noise when the knee moves, ability to fully straight and bend the knee.

3- Concerned with activities of daily living (ADL): This subscale included seventeen questions related to the degree of experienced difficulties of patients in performing daily living activities throughout the last week when they tried descending and ascending stairs, rising from sitting, standing, bending to pick up an object from the floor, walking on a flat surface, getting in and out of the car, going shopping,

putting on and off socks, lying in and raising from the bed, getting in and out of bath and toilet and having light and heavy domestic duties.

4- Concerned with sport and recreation function: This subscale included five questions related to the degree of experienced difficulties of patients in performing sports and recreation activities throughout last week when they tried squatting, running, jumping, twisting, and kneeling with their injured knee.

5- Concerned with the knee-related quality of life: This subscale included four questions about patients' awareness to knee problems, such as whether the lifestyle is changed to avoid potentially harmful activities, the amount of knee movement difficulty over the past week and the troubles associated with lack of confidence in the knee.

Scoring system: a five Likert boxes were given to the standardized answer options and each question had a score from 0 to 4 in which 0 reflects no problems, while 4 reflects extreme problems. Each of the five scores was calculated as the sum of the included items. The total score that less than 56 represents no knee symptoms and 56 to 99 indicates mild symptoms, while 100 to 143 score indicates moderate symptoms, but 144-186 indicates extreme knee symptoms.

Method:

Administrative design:

After clarifying the purpose of the study, formal assent was taken from the directors and the responsible authorities of the study setting to perform this study.

Ethical considerations:

The research ethical considerations in the present study included the following: approval of research was obtained before the implementation of the program, the purpose of the present study was clarified to the participants and oral informed consent was obtained from them, the study participants were made aware that they are free to refuse to participate or withdraw from the study at any time and the researchers have told the study participants that all their data would be confidential and will only be used for research purposes.

Developing the tools of study:

Based on the review of pertinent literature, tools were designed and developed.

Tools validity and reliability:

- The researchers designed the first tool after reviewing the related literature and 5 experts of nursing and rheumatology field checked it for content validity, then modifications were done accordingly to ascertain relevance and completeness. The reliability of the tool I was tested using a test-retest method and a Pearson correlation coefficient formula was used, it was 8.79.

- The second and third tool was adopted from McCaffery & Beebe, (1993) and Roos & Lohmander (2003).

Pilot study:

A pilot study was performed on 10% (6 patients) of the participant patients after the final tools were created to test the consistency and applicability of the tools and subsequently the necessary modifications were made. The data

obtained from the pilot study had been omitted from the present study.

4. Collection of data:

The data was gathered over 7 months, beginning from January 2019 to July 2019. It was executed in three stages:

A. Preparatory stage (Assessment stage):

- The researchers interviewing with each patient with knee osteoarthritis in the orthopedic and rheumatology outpatient clinics of Zagazig University Hospitals, the researchers have introduced themselves and expound the study's purpose to patients who fulfilled the inclusion criteria, the researchers have told the study participants that all their data would be secret and will only be used for research's purposes, and then oral informed consent was obtained from each one.

- Then researchers initiated data collection by assessing sociodemographic, medical history, and pain characteristics through interviewing each participant individually using **Tool I (part I, II, III)**.

- Each participant was assessed for pain intensity level using a standardized 0-10 numeric pain rating scale (**Tool II**).

- The knee associated health issues or problems of each participant were assessed using Knee Injury and Osteoarthritis Outcome Score (KOOS) (**Tool III**).

B. Implementation stage (intervention stage):

- Once the assessment phase was completed, patients were interviewed by the researchers in orthopedic outpatients' clinics and explained all items of application, and before application of

revulsive compresses the patients were assured through their doctors that revulsive compresses could be used as a hydrotherapeutic modality and nonpharmacological therapy.

- The Revulsive Compresses have been applied through a hot and cold water bottle bag covered with a thin cotton cloth or towel and applied around the affected Knees. 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; then under the researchers' observation the patients re-demonstrated the procedure to ensure that they apply the revulsive compresses by the correct way and after confirmed from that, each participant 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 telephone number to follow up with them for 15 days.

- The patients were handed the educational booklet, with explanations from the researchers regarding its contents and benefits. The educational booklet was included a detailed description of the knee osteoarthritis disease, its management, nonpharmacological management of it, revulsive compresses, and knee exercises illustrated with pictures.

C. Evaluation stage (post-intervention stage):

- The efficacy of the application of Revulsive compresses to the symptoms of patients with knee osteoarthritis was assessed after 15 days of application in outpatient clinics. This efficacy was based on the finding of differences or no

between pre-intervention stage (baseline evaluation) and post-intervention stage ascertaining changes of pain intensity and knee associated health issues or problems scores as pain, other symptoms, degree of experienced difficulty in daily living activities, sport and recreation activities, and quality of life-related to the knee by using (Tool II & Tool III).

Statistical analysis of the data:

The collected data were coded, computed, and statistically analyzed using SPSS (the Statistical Package for the Social Sciences; SPSS Inc., Chicago,

Illinois, USA), version 20. Qualitative variables were shown as frequencies and percentages. Quantitative continuous variables were shown as mean \pm SD; the difference and relation of qualitative variables were represented by the Chi-square test (χ^2). Differences between quantitative independent variables were represented by paired t-test and qualitative by Mac Nammar. The difference was deemed to be significant when P-value below or equal to 0.05 and highly significant when P-value below or equal to 0.001.

Reresults:

Table 1: Socio-demographic characteristics of studied patients (n= 60):

Socio demographic characteristics	No.	%
Age:		
▪ 20-30 years	15	25.0
▪ > 30 years	45	75.0
Mean \pm SD:	45.46 \pm 7.43	
Sex:		
▪ Male	9	15.0
▪ Female	51	85.0
Social State:		
▪ Married	57	95.0
▪ unmarried	3	5.0
Residential area:		
▪ Rural area	41	68.3
▪ Urban area	19	31.7
Education Level:		
▪ Illiterate	28	46.7
▪ Read & write	18	30.0
▪ Intermediate qualification	12	20.0
▪ High qualification	2	3.3
Occupation:		
▪ Manual works	9	15.0
▪ Administrative works	10	16.7
▪ Housewife Not working	41	68.3
Live:		
▪ Alone	4	6.7
▪ With family	56	93.3
Income:		
▪ Enough	3	5.0
▪ Not enough	57	95.0

Table 1 shows that three quarters (75.0 %) of participant patients were > 30 years old with mean \pm SD 45.46 \pm 7.43 years, the most (85.0%) of them were females, the majority (95%) of them were married, two-third (68.3%) of them lives in rural areas, the highest percentage (46.7%) of the patients were illiterate, while only 3.3% of them had high education. Moreover, two-third (68.3%) of the subjects were housewives or not working, the majority of them (93.3% and 95.0 % respectively) were lives with their families and hadn't enough income.

Table 2: Health history information of studied patients (n= 60):

Medical history information	No.	%
Systemic diseases:		
▪ No diseases	25	41.7
▪ Hypertension	27	45.0
▪ Diabetes Mellitus	5	8.3
▪ Renal diseases	3	5.0
Complaints that keep patient seek medical assistance:	30	50.0
▪ Knee pain	10	16.7
▪ Knee swelling	17	28.3
▪ Pain and movement restriction	3	5.0
▪ All of the above		
Affected knee:		
▪ One knee	31	51.7
▪ Bilateral knees	29	48.3
Disease's duration:		
▪ Less than 5 years	44	73.3
▪ From 5 to 10 years	13	21.7
▪ More than 10 years	3	5.0
Family history regarding knee osteoarthritis:		
▪ Yes	43	71.7
▪ No	17	28.3
Body Mass Index (BMI):		
▪ Normal weight	10	16.7
▪ Overweight	20	33.3
▪ Obese	30	50.0
BMI: Mean \pm SD		33.35\pm4.79

Table 2 illustrates that more than half (58.3%) of participant patients had systemic diseases while more than two fifths (41.7%) of them hadn't. It was identified that half (50.0%) of the participant patients were seeking medical assistance because of knee pain, while 28.3% of them due to both knee pain and movement restriction and the ratio of the patients whose one knee was affected by OA was 51.7%.

Concerning the duration of disease and family history for osteoarthritis, it was seen that more than two-thirds (73.3% and 71.7%) of the patients suffered from knee OA for < 5 years and had a previous family history for osteoarthritis respectively. Also, half of the studied patients (50.0%) were obese, while only 16.7 % of them were of normal weight and the BMI mean was 33.35 \pm 4.79.

Table 3: Pain characteristics assessment of studied patients (n= 60):

Pain characteristics assessment	No.	%
Quality or type of Pain:		
▪ Burning	16	26.7
▪ Tingling	15	25.0
▪ Sharp	26	43.3
▪ Dull	3	5.0
Frequency of pain:		
▪ Continues	35	58.3
▪ Intermittent	25	41.7
The time of pain occurrence (<u>overlapped</u>):		
▪ In the morning	39	65.0
▪ At night	19	31.7
▪ After performing daily activities	28	46.7
▪ During, after stairs climbing and descending	36	60.0
Effect of pain on sleep quality:		
▪ Never affect	2	3.3
▪ Some time affect	13	21.7
▪ Always affect	45	75.0
Patients self-control trials to pain:		
▪ Take analgesic	51	85.0
▪ Make knee massage	4	6.7
▪ Apply knee compresses	0	0.0
▪ Nothing	5	8.3
Time of knee stiffness:		
▪ Yes	58	96.7
▪ No	2	3.3
Frequency of Stiffness:		
▪ Every day	28	46.7
▪ Sometimes	18	30.0
▪ Intermittent	12	20.0

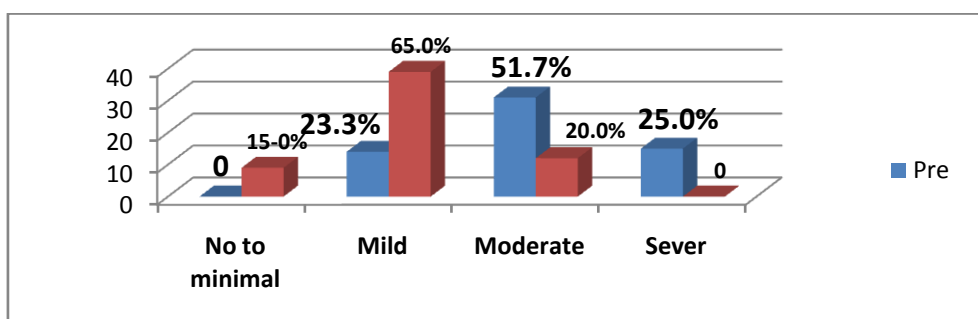
Table 3 demonstrates that more than two fifths (43.3%) of patients had a sharp pain and more than half (58.3%) of them had continuous pain. On the other hand, there is overlapping regarding the time of pain occurrence among studied patients as (65.0%, 60.0%, 46.7%, and 31.7% respectively) of them reported that pain occurred in the morning, during, after stairs climbing and descending, after performing daily activities and at night. Moreover, three quarters (75.0%) of studied patients their sleep affected by pain and most of them (85.0%) controlled their pain by taking analgesics as self-control trials, while nothing of them apply knee compresses. As for knee stiffness, the majority (96.7%) of the studied patients had stiffness and 46.7% of them experienced stiffness every day.

Table 4: Pain intensity level among studied patients before and after the intervention (n= 60):

Numerical pain rating scale (NRS)	Before Intervention		After Intervention		X ²	P-value	
	No.	%	No.	%			
No to minimal pain:	0	0.0	9	15.0	42.7	0.00**	
Mild pain:	14	23.3	39	65.0			
Moderate pain:	31	51.7	12	20.0			
Sever pain:	15	25.0	0	0.0			
Percentage of change: Mean ± SD	33.89±11.8						

(*) Statistically significant differences at $p \leq 0.05$

Table 4 and figure 1 demonstrates that there was a statistically significant reduction with improvement in the pain intensity level after the intervention of revulsive compresses and there was a highly statistically significant difference in pain intensity level after intervention as compared to before intervention (P-value < 0.01) with mean of the percentage of change 33.89±11.8. This finding pointed out that those revulsive compresses had a significant effect in reducing pain intensity.

**Fig. 1: The difference in the pain intensity level of studied patients before and after the intervention (n= 60).****Table 5: KOOS Score among studied patients before and after the intervention (n= 60):**

Knee Injury and Osteoarthritis Outcome Score (KOOS)	Before Intervention	After Intervention	Paired T-test	P-value
	Mean ± SD	Mean ± SD		
KOOS - Pain:	24.76±2.58	16.53±1.85	20.071	0.00**
KOOS - Other Symptoms:	17.56±2.54	11.35±1.88	15.197	0.00**
KOOS - ADL Function:	46.46±4.97	32.23±6.2	13.852	0.00**
KOOS - Sport Recreation Function:	14.58±1.39	10.3±2.29	12.359	0.00**
KOOS - Quality of Life:	9.61±1.61	7.8±1.08	7.225	0.00**
Total KOOS Score:	113.0±8.75	78.21±9.97	20.297	0.00**

(*) Statistically significant differences at $p \leq 0.05$

- low KOOS' score means mild knee symptom

Table 5 demonstrates that there was a statistically significant reducing with improving in total KOOS score and KOOS' five patient-relevant dimensions, which referred to knee associated health issues as pain; other related symptoms; difficulty in performing activities of daily living functions, the difficulty of performing activities of sports and recreational functions and quality of life-related to the knee after the intervention of revulsive compresses. In addition to a highly statistically significant difference in KOOS scores after intervention as compared to before intervention (P-value < 0.01). This finding pointed out that the revulsive compresses had a significant effect on the improvement of health issues associated with osteoarthritis in the knee.

Table 6: Impacted change in KOOS score before and after intervention among studied patients (n= 60):

Impacted change on KOOS score	Before Intervention		After Intervention		Mac Nammar	P value
	No.	%	No.	%		
Total pain:						
▪ Impacted	53	88.3	12	20.0	81.6	0.00**
▪ Not Impacted	7	11.7	48	80.0		
Total symptom:						
▪ Impacted	34	56.7	6	10.0	34.63	0.0**
▪ Not Impacted	26	43.3	54	90.0		
Total ADL function:						
▪ Impacted	55	91.7	18	30.0	58.36	0.00**
▪ Not Impacted	5	8.3	42	70.0		
Total Sport and Recreation function:						
▪ Impacted	55	91.7	50	83.3	1.9	0.16
▪ Not Impacted	5	8.3	10	16.7		
Total Knee - related quality of Life:						
▪ Impacted	27	45.0	11	18.3	18.95	0.00*
▪ Not Impacted	33	55.0	49	91.7		
Total KOOS:						
▪ Impacted	58	96.7	14	23.3	67.22	0.00**
▪ Not Impacted	2	3.3	46	76.7		

(*) Statistically significant improving at $p \leq 0.05$ except in sport

Table 6 shows that the majority (96.7%) of the studied patients was impacted with total KOOS dimensions (KOA associated health issues) before the intervention, and only 23.3% of them were impacted with it after the intervention, while more than three quarter (76.7%) of studied patients not impacted with KOOS dimensions after the intervention. Also, there was a statistically significant improvement and a difference in the rate of impacted change of all KOOS dimensions after intervention except sport and recreation function that had impacted change but not reach statistical significance ($p > 0.05$).

Table 7: Relation between the percentage of change in pain intensity level and demographic characteristics of studied patients (n= 60):

Demographic characteristics	Percentage of change in pain Intensity level				t/X ²	P-value
	Inadequate		Adequate			
	No.	%	No.	%		
Age:						
Mean ± SD						
		47.26±8.2		41.57±2.5	-2.930	0.005*
Sex:						
▪ Male	0	0.0	9	100.0	4.9	0.027*
▪ Female	19	37.3	32	62.7		
Marital Status:						
▪ Married	16	28.1	41	71.9	6.81	0.009*
▪ Unmarried	3	100.0	0	0.0		
Residential area:						
▪ Rural area	15	36.6	26	63.4	1.44	0.22
▪ Urban area	4	21.1	15	78.9		
Education Level:						
▪ Illiterate	8	28.6	20	71.4	3.04	0.38
▪ Read & write	5	27.8	13	72.2		
▪ Intermediate	6	50.0	6	50.0		
▪ High education	0	0.0	2	100.0		
Occupation:						
▪ Manual works	0	0.0	9	100.0	5.2	0.074
▪ Administrative	3	30.0	7	70.0		
▪ Housewife	16	39.0	25	61.0		
BMI:						
Mean ± SD		33.38±3.64		34.26±5.02	-1.232	0.110
Co-morbidity:						
▪ No diseases	10	40.0	15	60.0	3.17	0.36
▪ Hypertension	8	29.6	19	70.4		
▪ Diabetes	0	0.0	5	100.0		
▪ Renal diseases	1	33.3	2	66.7		
Family history of Osteoarthritis:						
▪ Yes	18	41.9	25	58.1	7.28	0.007*
▪ No	1	5.9	16	94.1		

(*) Statistically significant at $p \leq 0.05$

Table 7 illustrates the relationship between the percentage of change in pain intensity level and studied patients' demographic characteristics. The results revealed that adequate statistically significant change of pain intensity level was associated with lower age, male gender, married, and negative family history of studied patients (P -value ≤ 0.05).

Table 8: Relation between the percentage of change in KOOS score and demographic characteristics of studied patients (n= 60):

Demographic characteristics	Percentage of change in KOOS score				t/X2	P-value
	Inadequate		Adequate			
	No.	%	No.	%		
Age:						
Mean ± SD		45.5±7.4		45.43±7.5	0.03	0.97
Sex:						
▪ Male	5	55.6	4	44.4	0.33	0.56
▪ Female	23	45.1	28	54.9		
Marital Status:						
▪ Married	28	49.1	29	50.9	2.76	0.096
▪ Unmarried	0	0.0	3	100.0		
Residential area:						
▪ Rural area	14	34.1	27	65.9	8.15	0.004*
▪ Urban area	14	73.7	5	26.3		
Education Level:						
▪ Illiterate	8	28.6	20	71.4	10.25	0.017*
▪ Read & write	12	66.7	6	33.3		
▪ Intermediate	8	66.7	4	33.3		
▪ High qualification	0	0.0	2	100.0		
Occupation:						
▪ Manual works	2	22.2	7	77.8	6.75	0.034*
▪ Administrative	8	80.0	2	20.0		
▪ Housewife	18	43.9	23	56.1		
BMI:						
Mean ± SD		35.21±3.87		31.71±4.98	2.95	0.004*
Co-morbidity:						
▪ No diseases	9	36.0	16	64.0	10.66	0.014*
▪ Hypertension	16	59.3	11	40.7		
▪ Diabetes	0	0.0	5	100.0		
▪ Renal diseases	3	100.0	0	0.0		
Family history of osteoarthritis:						
▪ Yes	24	55.8	19	44.2	5.1	0.024*
▪ No	4	23.5	13	76.5		

(*) Statistically significant at $p \leq 0.05$

Table 8 demonstrates the relation between the percentage of change in KOOS score and studied patients' demographic characteristics. The findings revealed that adequate statistically significant change of KOOS score was associated with lower BMI, rural, illiterate and high educated, manual works, diabetic, and negative family history of studied subjects (P -value ≤ 0.05).

Discussion:

Knee osteoarthritis is a widespread, progressive condition known

as joint degenerative disease, usually induced by wear, tear, and progressive

articular cartilage loss (Springer, 2019 & Elsiwy et al., 2019). Osteoarthritis is the most frequently identified issue among older people (Abd Allah, 2017). Its prevalence increases with age, and more often influences women than men, it is strongly associated with aging and heavy physical occupational activity; many risk factors such as trauma, overuse, and genetic disorders also lead to the occurrence of the disease. With disease progression, patients' complaints of pain, physical limitations, and functionality restriction increase, leading to an important decrease in their quality of life (Chandra Prakash Pal et al., 2016 & Kawano MM, 2015). Such issues must be solved using up-to-date treatment strategies and practices of care (Atalay-Gümüş, Alkan & Aytakin, 2013).

For the treatment of symptoms of knee osteoarthritis, various types of, or a combination of, surgical, pharmacological and nonpharmacological therapies are used (Shafii et al., 2018). Conventional medications of KOA such as opioids, nonsteroidal anti-inflammatory drugs are involving on potentially lethal side effects (Zhang, Kerrin & Zikri 2018), also there are risks associated with knee surgery, that are not associated with some nonpharmacological therapies (Zhang et al., 2007). Numerous nonpharmacological methods such as educating patients, joint protection, weight loss, exercise performing, and revulsive compresses (alternating heat and cold application), can be applied for the treatment of KOA (Jordan et al., 2003).

Revulsive compresses are a nonpharmacologic method, the principal objective is to the dominance of the symptoms of the disease; it is involving of A single extended hot application, accompanied by a very brief application of cold in a treatment session, provides

another choice for treating several different musculoskeletal circumstances, including knee OA (Lindquist, Snyder, & Tracy, 2014, SooHoo, 2006). In several treatment guides for osteoarthritis, it is recommended as uncomplicated and reliable methods to eliminate pain (Kirazli, 2011).

The Revulsive compresses are a common hydrotherapy treatment, in which the hot application expands blood vessels, filling them with blood and causes relaxation in the subcutaneous and intramuscular tissues while the cold application constricts the blood vessels, forcing the blood to move on to other parts of the body. Hot and cold water can be applied to any part of the body that is inflamed, congested, or injured (Chinju Sara Mathew et al., 2016). Therefore, the current study aimed to evaluate the responsiveness of pain and associated health issues of patients with knee osteoarthritis to the revulsive compresses.

A discussion of the results will cover five main areas in the following sequence: First, the demographic characteristics of studied patients; Second, the health history of studied patients; Third, the pain characteristics assessment of studied patients; Fourth, the difference in pain intensity level before and after application of revulsive compresses; Fifth, the difference in KOOS Score among studied patients before and after application of revulsive Compresses. Sixth, the relationship between pain intensity change percentage, KOOS score, and demographic characteristics of studied patients.

Firstly, discussion of findings relating to demographic characteristics of patients:

Regarding Sociodemographic of studied patients, the current study found

that three-quarters of them were over thirty years of age and the mean age of them was 45.46 ± 7.43 years, this findings agreement with **Mohamed (2019)**, who mentioned that the majority of patients in the groups studied were between 45 and 55 years old. Moreover, **Murphy et al., (2018)** indicated that more than half of the population older than 65 years old has been diagnosed with osteoarthritis, and **Saffari et al., (2018)** added that the prevalence of osteoarthritis will increase incredibly in the near future due to the aging of the population.

This research also coincides with **Zhang et al., (2018) & Salehi-Abari (2016)**, who found that the majority of patients were over fourteen years of age. Moreover, **Patel & Mackworth-Young (2012)** demonstrated that 50 percent of patients with osteoarthritis were in the 48-57 age groups. Also, this result supported by **Tsauo, Cheng & Yang (2008); Sarzi-Puttini et al., (2005)**, who showed that the incidence of osteoarthritis increased with age and that prevalence increased extraordinarily after 50 years in women and 55 years in men. The findings of this study were also consistent with **Cunha-Miranda et al., (2015); Henrotin et al., (2010)**, who declare that osteoarthritis is one of the most prevalent types of arthritis after age 80.

It was shown that the age ranges were close to ours in the other studies performed with OA patients. This may be due to the fact that, along with the rise in age, the related risk factor of obesity is increasingly rising due to progressive sedentary behavior, improvements in lifestyle habits, dietary routine, and working conditions in the adult population.

Regarding gender, the current results showed that the most of studied patients were females. This finding agrees

with a study in Egypt of **Abd Elstaar et al., (2016)** evaluated the quality of life of 116 patients admitted to the outpatient clinic with primary knee osteoarthritis of rheumatology and orthopedics in Menoufia University Hospital, recorded that 74.1 percent of these patients were female and 25.9% were male. Even these results are in the same line with **Katz (2015); Shehata & Fareed (2013)**, who found that three-fourths of their studied sample was women.

Also, **Shin (2014); Lewis et al., (2010); Sarzi-Puttini (2005)** reported that osteoarthritis of the knee is common in women than men. This can be due to hormonal changes, especially after menopause and osteoporosis, which can increase the risk of knee osteoarthritis due to estrogen withdrawal, which 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.

The current research showed that the majority of studied patients were married regarding marital status. This result correlates with **Ulusoy & Yildirim (2008)**, who found that majority of the studied patients were married. Also, the current study agreement with **Atamaz et al., (2006)**, who found that more than half of the studied sample was married; Similarly, in the study of **Groessl et al., (2003)** done with elderly OA patients, it was identified that most of the patients were married too. It is distinctive that the majority of patients in the current study were married to find people who can assist them in the application of revulsive compresses to dealing with symptoms of the disease and help them to meet their daily needs.

Regarding knee osteoarthritis patients' residence, the current findings

showed that two-thirds of studied patients live in rural areas. This finding agrees with a systematic review and meta-analysis report conducted by **Usenbo et al., (2015)** mentioned that the highest prevalence for knee osteoarthritis in rural South Africa. Moreover, the current study consistent with **Jorgensen et al., (2011)**, who found that living in a rural setting was related to OA. Furthermore, **Fransen et al. (2011)** documented that rural patients exhibited about twice of the symptomatic knee osteoarthritis prevalence relative to their urban counterparts.

The current result consistent with the study of **Haq & Davatchi, (2011)** also examined the prevalence of KOA and pain, gender ratio, urban/rural disparities and other risk factors in oriented community- program for control of rheumatic disorder publications, and noted that the prevalence of OA in rural societies was higher after adjustment for age and gender. This may be due to those participants who live in rural areas may engage in harder labor e.g., agriculture, which may increase disease risk.

When analyzing the distribution of patients in the current study about the educational level, it was found that the highest number of patients were illiterate. This finding is in the same line with **Abd Elfatah, Weheida & Mekkawy (2019)**, who illustrated that above half of the studied patients were illiterate, and agreement with the **Uludağ & Kaşıkçı (2019)** study which found that 41 percent of patients not literate. Furthermore, current results are in the same line with **Alkan et al., (2014) & Jhun et al., (2013)**, who mentioned that on the other side higher education patients had better functional ability compared to patients educated in primary school.

Also, these findings agree with the study of **Patel & Mackworth-Young (2012)**, who was found that more than third of patients were uneducated and the research of **Soeroso et al., (2005)** which reported a lower risk of developing knee OA for those with a high education status; this can be attributed to the fact that people with high educational level care for themselves and their wellbeing more than those with low educational level, and low education can contribute to poor awareness of disease and management steps.

Concerning occupation, it was seen that two-third of the subjects were housewives or not working. This agrees with **Uludağ & Kaşıkçı (2019)**, who noticed that most KOA patients didn't work anywhere and in the same line with **Shehata & Fareed (2013)**, who found that about two-thirds of the sample were housewives. Moreover, this finding is an agreement with the study of **Mousa (2012)** examined "Effect of self- care practice on the lifestyle of elderly people with osteoarthritis knee" in Mansoura University and revealed that more than two-thirds were housewives from both classes. This might be related to housewives performing daily home activities which cause stress on joints act as a factor to develop knee osteoarthritis.

Moreover, **Soeroso et al., (2005)** found almost all the women patients examined were housewives and never worked at all, and **Ulusoy & Yıldırım (2008)** reported that the majority of patients also reported being housewives and not working. We assume that being female, low educational level and advanced age may have led to the non-work of patients. Furthermore, **Lievens et al., (2003)** reported that every work requires repetitive activities, and overloading of joints and associated

muscles raises the risk of osteoarthritis in the knees.

Regarding living with family, the findings of this study clarified that the majority of studied patients were lives with their families. This finding is congruent with the study of **Elsayed (2016)** examined "Health-related quality of life for patients with knee osteoarthritis" in Ain Shams University, and revealed that who found that the majority of the study subjects were living with their families. Similarly, **Taha & Ali (2011)** added that more than half of the studied patients were living with their families. This might be due to the strong family bonding between the members of families in Egyptian society.

Concerning the income of patients, the current study findings illustrated that majority of patients had insufficient income. This finding is in agreement with **Yuan Liu (2016)**, who found that insufficient income and long term walking increase the prevalence of knee OA. This may be because the low-income population is typically engaged in hard physical labor, which raises the pressure on the knee joints, thereby exacerbating any cartilage damage.

Second, discussion over findings related to patients' health history:

Regarding Body Mass Index (BMI), the current result illustrated that half of the studied patients were obese, and 33.3% of them were of overweight, which agreed with the study of **Abd Elfatah, Weheida, & Mekkawy (2019)** illustrated that more than half of study subjects were obese patients, also it is in the same line with **Uludağ & Kaşıkçı (2019)**, who was seen that 50.8% of the patients were obese, and 39.3% of them were of overweight. Furthermore, the results of the agreement with **Abd**

Elstaar (2016) that report that fatness, female gender, and advanced age have been significantly associated with increased knee OA risk. This may be due to increased strain on the articular cartilage, which speeds up degeneration. However, several studies have shown that obesity is also positively linked to OA prevalence in non-bearing joints like the hand (**Koonce&Bravman 2016**).

Furthermore, the current result is consistent with the study of **Ramadan et al., (2016)** evaluated the impact of physical exercise on the activities of daily living in women with early OA, recruited from the El-Demerdash University Hospital outpatient clinic, confirmed that more than half of the patients surveyed were obese. Also **Chu et al., (2018)**; **Urban & Little (2018)** mentioned that the primary risk factor for knee OA pain is obesity. Furthermore, **Liu (2016)** stated that there was a significant increase in knee osteoarthritis prevalence rate among the population with high BMI. It can be attributed to the increased mechanical loading of the knee and hip from obesity and overweight, which can result in damage to the cartilage of weight-bearing joints.

While analyzing the variable whether or not patients had systemic disease, it was found that more than half of participant patients had systemic disease, and more than two-fifths did not. This finding is consistent with the research conducted with OA patients by **Uludağ & Kaşıkçı (2019)** that about two-thirds of knee OA patients had another disease apart from osteoarthritis. **Singh et al., (2002)** also reported that patients with OA are more likely to have diabetes mellitus (11% vs. 6%), high blood pressure (40% vs. 25%), renal impairment conditions (37% vs. 27%), and high total cholesterol level

(32% vs. 24%) compared to the non-affected population.

Another research performed with OA patients by **Atamaz et al., (2006)** found that 46.1 percent of patients had gastrointestinal diseases, 41.1 percent had high blood pressure, 36.9 percent had diabetes and 34.8 percent had anemia. The mechanism may include ischemia below the cartilage of patients with knee OA due to hypertension; this form of ischemia may inhibit articular cartilage metabolism and bone remodeling.

Concerning symptoms that hold patients seek medical assistance, it has been shown that half of the participant patients were admitted to the hospital due to knee pain problems. In the **Uludağ & Kaşıkçı (2019)** study with OA patients, more than two-thirds of patients reported complaining of knee joint pain. In the research on elderly OA patients by **Jakobsson & Hallberg (2002)**, it was also found that most of these patients encountered various levels of pain from mild to severe pain. **Cerit's analysis, (2003)** also found that most OA patients suffered from knee pain.

When examining the knee distribution affected by osteoarthritis, it was found that OA affected only one knee of more than half of the patients. These findings agreement with **Uludağ & Kaşıkçı (2019)**, who reported that only one leg of the two-third of the patients was affected by OA. However, the current study disagreement with the report of **Ulusoy & Yıldırım (2008)** that found the percentage of patients whose knees were affected by OA was 73.9 percent.

Regarding the length of the illness or disease's duration, it was found that for more than 5 years more than two-thirds of

the patients examined suffered from knee OA. This agreement with **Uludağ & Kaşıkçı (2019)**, who estimated that for one to four years, 52.5 percent of patients suffered from knee pain and restriction of movement. Additionally, **Acıkgöz et al., (2017)** found that the mean period of disease-related symptoms of knee-OA patients was 5.01 ± 2.86 .

Concerning the family history of osteoarthritis, the present research found that over two-thirds of the patients had a previous family history of osteoarthritis. The finding is the agreement with **Silverwood et al., (2015)**, who stated that environmental factors, genetic factors, and their interactions are associated with OA susceptibility. Also, **Valdes & Spector (2011)** added that in addition to age, excessive BMI, joint surgery, and trauma, also genetic factors contribute to the development of OA.

Furthermore, **Ulusoy & Yıldırım (2008)** revealed that there were a higher number of patients whose family members had knee OA disease. But this finding contrasts with the **Uludağ & Kaşıkçı (2019)**, who reported that more than half of KOA patients had no family members with OA, whereas 47.5% of patients had family members with OA. Also this finding inconsistent with **Shehata & Fareed (2013)** who found that the majority of OA studied patients had no familial predisposition for osteoarthritis.

Third, discussion over findings related to patients' pain characteristics assessment:

Concerning the quality or type of pain among patients studied, the present study discovered that more than two-fifths of participant patients had a sharp pain, and more than one-quarter had a

burning sensation of pain. This result consistent with **Abd Elfatah, Weheida & Mekkawy (2019)**, who indicated that more than one-quarter of knee osteoarthritis patients was suffering from the worst pain. Moreover this finding in the same line with **Nakasato & Yung (2011)**, who found more than half of patients with OA were suffering from burning pain. **Panah et al., (2016)** added that pain is the most significant symptom of osteoarthritis (OA) and confirmed that OA patients experience various rates of pain. Also, **Dogan et al., (2016)** recorded that 78.5 percent of patients with osteoarthritis had pain.

Regarding the frequency of pain and the effect of pain on sleep quality among patients studied, this study discovered that over half of patients had continuous pain, and three-quarters of them always their sleep affected by pain. These findings consistent with **Esmat & Hussein (2012)**, who found that two-thirds of OA patients were suffered from continuous pain; **Lin, Davey & Cochran (2009)** also reported that most of the studied patients had knee joint movement limitation and sleep disturbance. This may be linked to pain, which is the most prominent symptom in OA patients that are always interrupting their sleep.

Relation to the time of pain occurrence, the results of the current study revealed that there is overlapping regarding the time of pain occurrence among studied patients, but about two-thirds of them reported that pain occurred in the morning. This result is consistent with **Mohamed (2008)** at Ain Shams University, who stated that OA patients reported that their feeling of pain interfered with their work performance. This may be related to increased stiffness following long periods of inactivity.

Regarding the patients' self-control trials to pain, the results of the present study revealed that most of the studied patients controlled their pain by taking analgesics as self-control trials, while nothing of them apply compresses on the knee. The present study agreement with **Ghaleb (1998)** revealed that pain management methods carried out by a minority of the sample, but this finding is inconsistent with **Davis & Atwood (2000)**, who found that three-quarters of patients used to heat and cold application for temporary pain relief. Moreover, the current study disagreement with the study of **Boutaugh (2003)** found that about two-thirds of patients used pain management techniques.

As regard knee joint stiffness, these study findings showed that the majority of patients studied were knee-stiff in the morning. This result is in the same line with the result made by **Hafez et al., (2014)** that life quality of knee OA patients influenced by knee stiffness, pain, significantly reduced physical function, sleep disturbances, depression, and anxiety of those patients. Also consistent with **Ibrahim (2013)**, who found that all the studied subjects had pain and morning stiffness. This could be attributed to the connective tissues or cartilage degenerates caused the bones to rub painfully against each other, and this process results in stiffness and chronic pain after a period of inactivity.

Fourth, discussion over findings related to the difference in pain intensity level before and after application of Revulsive Compresses:

Regarding pain intensity level of the studied patients before and after applying the revulsive compresses, this study verified that pain intensity level was significantly reduced after the intervention and there was a highly

statistically significant difference in pain intensity scores after the intervention of revulsive compresses as compared to before intervention (P -value < 0.01). This result consistent with **Abd Elfatah, Weheida & Mekkawy (2019)**, who reported that there was a decreased mean of pain among the contrast hydrotherapy group than the cold group with highly statistically significant differences.

Also, this study results along the same lines as a recent study by **Archanah (2018)** in India investigated the effect of alternate hydrotherapy-based compresses on knee joint osteoarthritis, presented that pain intensity was significantly reduced after alternative hot and cold compresses were administered. Furthermore, these findings are consistent with **Jain Raj & Shiny Mol (2017)**, who reported statistically significant differences between total score of the numerical pain scale, edema scale and movement range

Fifth, discussion over findings related to the difference in KOOS Score among studied patients before and after application of Revulsive Compresses:

In respect to the effect of revulsive compresses on knee osteoarthritis outcome score (KOOS) among the patients studied, this study displayed that the effect of revulsive compresses was significant in reducing the mean of total KOOS and KOOS subscales or dimensions score (knee associated health issues) after intervention as compared to before the intervention.

These findings agreement with **Archanah et al., (2018)**, who reported that alternate hot and cold compress (revulsive compress) had a significant decrease in pain intensity, symptoms and function daily living, quality of life difficulty but no significant changes were seen in sports and

in knee osteoarthritis patients pre and post-application of revulsive compress, which indicates that revulsive compress may have a potential role in treating knee osteoarthritis associated problems.

Also the present study in the same line with the study of **Shehata & Fareed (2013)** that conducted in Egypt and compared the cold, warm and contrast therapy effectiveness on the management of related problems for knee osteoarthritis in outpatient orthopedic clinics at Menoufia University hospitals, which concluded that all three therapy methods (cold, warm and contrast therapy) resulted in improving the pain but the most effective medical procedure for managing pain is a contrast therapy. Also, **Denegar et al., (2010)** confirmed that the highest improvement in total pain scores was provided by contrast water therapy.

recreational activities. **Jain Raj & Shiny Mol (2017)** also concluded that the revulsive compresses are the appropriate safe treatment protocol to relieve symptoms and knee osteoarthritis-related pain

Also, the present study agreement with **Shehata & Fareed (2013)**, who revealed that using contrast water therapy (revulsive compresses) was decreased the total KOOS scores to a mild degree. On the other hand, **Denegar et al., (2010)** confirmed that the highest improvement in total KOOS scores was provided by contrast therapy (revulsive compresses) compared to cold or warm therapy. **Bonhaman et al., (2005)** also indicated that contrast therapy has a significant impact on knee osteoarthritis symptoms such as pain, stiffness, edema, and inflammation reduction. Furthermore, **Abd Elfatah, Weheida & Mekkawy (2019)** recorded an improvement in mean scores in the

contrast hydrotherapy group as compared to the cold group one month after intervention in all areas of quality of life with statistical differences in the physical, psychological, social and total quality of life.

Sixth, discussion over findings related to the relationship between the percentage of change in pain intensity, KOOS score, and demographic characteristics of studied patients:

The current study revealed that adequate statistically significant change of pain intensity level was associated with lower age, male gender, married, and negative family history of studied patients (P -value ≤ 0.05). These findings agree with **Mohamed (2019)**, who mentioned that there were positive statistically significant correlations between VAS of pain and age post-4th-week heat application. **Alrushud et al., (2017) & Leung et al., (2014)** further revealed that factors like advanced age, sex, body mass index, and repeated joint activity contribute to OA growth.

The current study also reported that adequate statistically significant change in the KOOS score was associated with lower BMI, rural, illiterate, and high educated, manual works, diabetic and negative family history of studied patients. This result is consistent with **Mohamed (2019)**, who revealed that a statistically significant correlation existed between the overall WOMAC scores (scale-like KOOS score used to evaluate associated health issues of osteoarthritis) and the level of subject education.

Also, **Nur Aimi et al., (2019)** noted that OA patients with disease knowledge seemed to cope better and had less pain, as well as those, had changed their lifestyles such as weight

loss and increased physical activity have shown to improve health-related quality of life, and according to the Framingham Heart Report, women who lost five kilograms were 50 percent less likely to develop symptomatic knee OA. **Claudia Lckingerm et al., (2010)** also reported that loss of weight improves the pain and joints function of knee OA patients.

Conclusion:

Based on the findings of this study it can be concluded that the pain and associated health issues of patients with knee osteoarthritis have positive responsiveness to Revulsive compresses, this leads us to conclude that the Revulsive compresses are effective in reducing and improving both pain and associated health issues of those patients. Furthermore, the application of revulsive compresses at the workplace is very easy and is economical.

Recommendation:

Based on the results of this study, the following recommendations can be proposed :

1.The early strategies for managing patients with knee osteoarthritis should include the revulsive compresses to reduce pain and improve the associated health issues for those patients.

2.Continuation of prospective studies to evaluate the impact of long-term application of the revulsive compresses

3.Consideration must be given to replicating the study with a large sample size to allow for a wider generalization of the findings.

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