



# EFFECTIVENESS OF HOT AFFUSION BATH WITH EPSOM SALT IN MANAGING KNEE-RELATED SYMPTOMS AMONG PATIENTS WITH KNEE OSTEOARTHRITIS- QUASI EXPERIMENTAL STUDY

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## ABSTRACT

Osteoarthritis (OA) is a degenerative joint disease characterized by the breakdown of cartilage in joints and the development of abnormal bony growths known as Osteophytes. This chronic condition leads to structural changes and biochemical alterations in the synovial membrane and joint capsule. The World Health Organization (WHO) reports that osteoarthritis affects a significant portion of the elderly population, with 9.6% of men and 18% of women above the age of 60 years affected worldwide. By 2020, it is predicted to become the fourth leading cause of disability.

The primary objective of this study was to evaluate the effectiveness of Hot Affusion Bath with Epsom salt in managing knee-related symptoms among patients diagnosed with knee osteoarthritis. The study employed a quasi-experimental design, and 40 participants aged between 50 and 65 years were included. The subjects underwent a treatment regimen of Hot Affusion Bath with Epsom salt, administered thrice a week alternatively for three weeks. Assessments using the WOMAC index and goniometer were conducted at baseline and after the three-week treatment period.

The results of the study demonstrated a significant reduction in knee-related symptoms, including pain and stiffness, along with an improvement in the range of motion among the participants.

In conclusion, the findings indicate that Hot Affusion Bath with Epsom salt effectively reduces knee-related symptoms, such as pain and stiffness, in patients diagnosed with knee osteoarthritis.

**KEYWORDS:** Hot affusion bath, Epsom salt, knee osteoarthritis, knee-related symptoms, Range of motion, pain.

## I. INTRODUCTION

Pain is defined as an unpleasant sensation occurring in varying degrees of severity as a consequence of injury, disease, or emotional disorder. It is more than unpleasant sensations. It is one of the major component parts of our nervous system. Ultimately it is a perception, and a bodily state. Despite its unpleasantness, pain is a critical component of the body's defense system. It is part of a rapid warning and defense relay instructing the motor neurons of the central nervous system to minimize detected physical harm.

Osteoarthritis (OA) is a wear and tear type arthritis. It has two primary processes; breakdown of cartilage in joints and abnormal bony growth formation called Osteophytes. It is a chronic degenerative disease that leads to structural alteration and biochemical changes of synovial membrane and joint capsule. It is of multi-factorial etiology <sup>[1]</sup>.

The OA which has no cause is called as Primary OA <sup>[3]</sup>. Most people have this type and it is related to aging <sup>[1,2]</sup>. This type of OA can be present as localized, generalized or as erosive OA <sup>[3]</sup>. Secondary OA caused by another disease or condition <sup>[4]</sup>.

Pathological changes in the last stage of osteoarthritis include softening, ulceration and disintegration of the articular cartilage. Inflammation of synovial membrane involved <sup>[2,3]</sup>. Typical Clinical symptoms are pain, sometimes particularly after prolonged activity and weight-bearing; whereas stiffness after inactivity<sup>2</sup>. Degenerative arthritis, usually affects the large weight-bearing joints, such as the hips knees, hands, feet and spine <sup>[1,2]</sup>. OA is the most common cause of disability in older adults<sup>5</sup>. The Global Burden of Disease 2010 states that Musculoskeletal Disorder accounts for 6.8% of DALYs Worldwide <sup>[6]</sup>.

OA is associated both Modifiable and Non modifiable risk factors like obesity, lack of exercise, genetic predisposition, bone density, occupational injury, trauma and gender <sup>[7]</sup>. OA is common more in women than men, but the prevalence increases with age. 45% of Women over the age 65 years have symptoms while 70% women show radiological evidence of those over the age 65 years.

The risk factors which increase OA are age, female gender, increase body weight, occupational knee-bending posture, physical labour, hereditary factors and race, joint trauma, vitamin D deficiency and chondrocalcinosis<sup>8</sup> Lack of exercise, obesity, lifestyle factors like Diabetes, Improper posture, trauma and inflammatory diseases aggravate it. The problem more complicated in Females in the perimenopausal period who gains weight and failure of estrogen and become less ambulant and less active. OA is the second most common rheumatological problem and most common joint disease with prevalence of 22% to 39% in India (Chopra A et al 2001)<sup>9</sup>. Other latest studies in India have reported a prevalence of OA in India is reported to be in the range of 25.2 to 29.1% (Jayaseelan Venkatachalam et al 2018)<sup>10</sup> and 28.7% (Chandra Prakash Pal et al 2016) <sup>[11]</sup>.

Osteoarthritis of the knee is a major cause of mobility impairment, particularly among females. <sup>[2,5]</sup> Before the age of 45, more men have osteoarthritis; after age 45, it is more common in women <sup>[12]</sup>. Average menopausal age in Indian women is 46.3 years as compared to 54 years in western countries <sup>[13, 14]</sup>. This predisposes Indian women to the risk of developing osteoarthritis at earlier age compared to their western counterparts. It could be due to loss of estrogen especially close to menopausal years at this time <sup>[15, 16]</sup> Knee osteoarthritis triggers a vicious cycle. The pain limits mobility of knee joint and exercise, thus increasing body weight, diabetes etc. which in turn worsen the joint. So, multidisciplinary approach needed to treat osteoarthritis knee joint.

Permanent treatment options are away from the financial scope of our ordinary man, who tend to seek relief in NSAIDs (non-steroidal anti-inflammatory drugs) with resultant kidney injury and gastric ulcer disease. Deformities induced by the inflammatory processes make correction impossible when the disease is in the advanced stage. So, the rapid increase in prevalence of OA will lead to a situation wherein the physical disability arising due to the pain and loss of functional capacity reduces quality of life and increases the risk of morbidity associated will pose a major challenge to evolving low resource public health systems like in India and place a major burden on the economy of the country. There was limited evidence regarding depression, occupational and physical activities, and socio- demographic factors such as social class which is of important co-morbidities.

Naturopathy can be defined as a system of man building in harmony with nature cure on constructive principles on physical, mental, moral and spiritual planes of being and consist of non-invasive treatment modalities like diet therapy, fasting therapy, yoga therapy, mud therapy, hydrotherapy, massage, acupuncture, chromo therapy and magneto therapy.<sup>[17]</sup>

One of the naturopathy treatments is Hydrotherapy. The external or internal use of water with various temperatures, pressure, duration, and site and different modes of application in any of its forms (water, ice, steam) for health promotion or treatment of various diseases. It is one of the naturopathic treatment modalities which

was used widely in ancient cultures including India, Egypt, China, etc. Hydrotherapy is one of the most important therapies in naturopathy, which has been used since ancient times. It can be defined as a naturopathic modality that involves the use of water at different temperatures, pressures, states and modes of application for the treatment of various disorders. The physiological effects and therapeutic applications of hydrotherapy are diverse. Water used at various temperatures enhances blood flow, which is thought to help dissipate all chemicals and facilitate muscle relaxation<sup>[18]</sup> In addition, the hydrostatic effect may relieve pain by reducing peripheral oedema and by dampening sympathetic nervous system activity.<sup>[19]</sup> Hipbaths, enema, hot and cold fomentation, hot footbaths, spinal baths, steam baths, immersion baths, application of hot and cold packs as well as advanced modalities like whirlpool baths, sprays and jets are some of the various forms of hydrotherapy.<sup>[20]</sup> The first ultimate treatise on hydrotherapy explaining its techniques and effects was written by John Harvey Kellogg in 1900 entitled Rational Hydrotherapy.<sup>[21]</sup> Affusion according to Webster's revised dictionary "the act of pouring upon or sprinkling with a liquid as water upon a child in baptism". According to Cyclopaedia Affusion in medicine is the act of pouring water on the body as a curative means, as from a vessel. In Hot affusion bath water at 40-50 degree Celsius is poured on the affected part. This bath is useful in providing relief in the pain of muscles and joints.<sup>[3]</sup> Hot affusion bath (HAB) is given in material with facility to pour hot water on the body by a big jug or any nozzle. Epsom salt is so named because it was discovered in EPSOM, England in the late 1600s. Its scientific name is magnesium sulfate and it has soothing benefits. It helps to maintain the proper functioning of muscles and nerves within the body, as well as maintain bone and joint strength. Scientists have learned that the best way to get magnesium into the body is topically through the skin.<sup>[22]</sup> A hot Epsom salt is the old New England home remedy for arthritis pain.

**TABLE 1.1: GRADING OF OSTEOARTHRITIS USING KELLGREN-LAWRENCE RADIOGRAPHIC GRADING**<sup>[59,60]</sup>

Grade	Category	Features
0	None	No visible features of OA
1	Doubtful	Questionable osteophytes or questionable joint space narrowing
2	Minimal	Definite small osteophytes. Minimal / mild joint space narrowing.
3	Moderate	Definite moderate osteophytes. Joint space narrowing if at least 50%.
4	Severe	Severely impaired joint space. Subchondral bone cyst and sclerosis.

## 2.AIMS AND OBJECTIVES:

**2.1 Aim:** To study the effectiveness of hot affusion bath with Epsom salt on pain management in chronic osteoarthritis of knees. It was hypothesized that the Hot Affusion bath with Epsom salt will help to reduce the pain in Osteoarthritis of Knee (OAK).

**2.2 Primary Objective:** To study the effect of hot affusion bath with Epsom salt on relieving pain in osteoarthritis of knee. It was hypothesized that the Hot affusion bath with Epsom salt will help to reduce the pain in Osteoarthritis of Knee (OAK).

**2.3 Secondary Objective:** To study the effect of hot affusion bath with Epsom salt on range of motion in osteoarthritis of knee.

## 3.Review of Literature:

Osteoarthritis is defined as a heterogeneous condition with focal areas of damage to the cartilage surfaces of synovial joints, and is associated with remodeling of the underlying bone, and mild synovitis.<sup>[23]</sup> It is the most common joint disorder.<sup>[24,25]</sup> It is the 6th -leading cause of disability worldwide. It is one of the Major causes of restricted activity.<sup>[26]</sup> It plays the leading cause of disability among the elderly and also predicted to become the 4th leading cause of disability in 2020. One among the various causes for low quality of life.<sup>[26]</sup>

According to Global surveys about 100 million people suffer from Osteoarthritis.<sup>[27]</sup> Osteoarthritis is a slowly progressive degenerative disease which is characterized by gradual loss of articular cartilage.<sup>[44]</sup> In addition to damage to articular cartilage, there is also associated remodeling of subarticular bone, osteophyte formation, ligamentous laxity, weakening of periarticular muscles and in some cases, synovial inflammation. The pathologic features of Osteoarthritis comprise of joint space narrowing and osteophyte formation<sup>[28]</sup>. It is especially due to imbalance in the equilibrium between breakdown and repair of the joints.<sup>[29]</sup>

It can occur in any synovial joints of the body but the most common areas are the hands, knees, hips, and spine. It occurs either involving one joint or multiple joints at a time.<sup>[30]</sup> It affects all the structures of joint in a non-uniform and focal manner.<sup>[31]</sup> The disease not only affect persons, physically but also psychologically and economically.<sup>[32]</sup>

#### 4. RESEARCH METHODOLOGY

##### 4.1 Study Design:

This study employs a quasi-experimental design to assess the effectiveness of hot affusion baths with Epsom salt on knee-related symptoms among patients diagnosed with knee osteoarthritis. A quasi-experimental design is used as it allows for a comparison between pre- and post-treatment measurements without random assignment to treatment groups, given the constraints and practicalities of the study.

##### 4.2 Participants:

Total sample size N = 40 Subjects are recruited from the people of Arignar Anna Hospital of Indian Medicine & Homeopathy, Chennai – 106. Subjects who satisfied the following inclusion & exclusion criteria were recruited for the study. The study includes 40 participants within the age group of 50-65 years, diagnosed with knee osteoarthritis.

##### 4.3 Inclusion Criteria:

- Age: Above 50 years-65 years of age both male and female
- Patients having osteoarthritis of knee for minimum 6 months
- Persons below BMI 35
- Subjects diagnosed with primary osteoarthritis
- Orthopedic doctors diagnosed knee osteoarthritis patients (radiologically confirmed)
- Subjects who were willing to participate
- Informed written consent of the patients.

##### 4.4 Exclusion Criteria:

- Congenital deformities
- Accidental Injury
- Varicose veins
- Chronic kidney failure (CKD)
- Seriously ill patients
- Rheumatoid arthritis
- Reactive arthritis
- Below 50 years and above 65 years of age
- Female who didn't attend menopause
- Old trauma of knee joint
- Subjects who have undergone total knee replacement in both the knees or any other knee surgeries.

##### 4.5 Intervention:

The treatment intervention involves hot affusion baths with Epsom salt. Participants are instructed to undergo hot affusion baths thrice a week, alternately, for three weeks. Hot affusion baths are administered using warm water and Epsom salt, a combination believed to have potential therapeutic benefits in reducing inflammation and providing muscle relaxation. A total of 40 subjects were selected to participate in the study based upon the symptoms experienced. All subjects were subjected to Blood test and other examination to rule out Chronic kidney disease, Varicose vein. The subjects were briefed about the study and informed consent was obtained from them. This study was conducted within the per view of a larger study on the physiological effects of Hot affusion bath, and ethical approval was obtained from institutional ethical committee for the entire study. After getting informed consent from the patient WOMAC Questionnaire is given to the patients to fill according to their symptoms. The temperature will be maintained by adding two mugs of hot water more than 40<sup>o</sup> C and temperature checked with water thermometer.

##### 4.6 Procedure:

- The subject is asked to wear the dress above the knee.
- The subject is asked to sit in a wooden or plastic stool with both legs kept in a tub or bucket
- The cold compress is placed on the head of the subject as a safety measure.

- Then the hot water mixed with Epsom salt is poured on both the knees of the subject for 15 minutes in a circular motion.

#### 4.7 Assessment Tools:

The effectiveness of the intervention is evaluated using two assessment tools: the WOMAC (Western Ontario and McMaster Universities Osteoarthritis Index) and a goniometer. The WOMAC index is a validated questionnaire designed to assess pain, stiffness, and physical function in individuals with osteoarthritis. The goniometer is utilized to measure the range of motion in the affected knee joint.

#### 4.8 Data Collection:

Baseline measurements of knee-related symptoms are taken using the WOMAC index and goniometer before initiating the hot affusion bath treatment. After the three-week treatment period, post-treatment measurements using the same assessment tools are obtained to assess any changes in knee-related symptoms.

#### 4.9 Data Analysis:

Data expressed Mean  $\pm$ SD and Median and IQR. Comparison of Mean in between the group was analyzed by paired t test and Wilcoxon sign Rank Test which is applicable. For Categorical variables Chi-square test is used. SPSS software version 23 was used for the analysis.

Descriptive statistics, such as mean and standard deviation, are used to summarize the participants' characteristics at baseline. Paired t-tests or Wilcoxon signed-rank tests are applied to compare pre- and post-treatment scores of knee-related symptoms obtained from the WOMAC index and goniometer assessments. Statistical significance is set at  $p < 0.05$ .

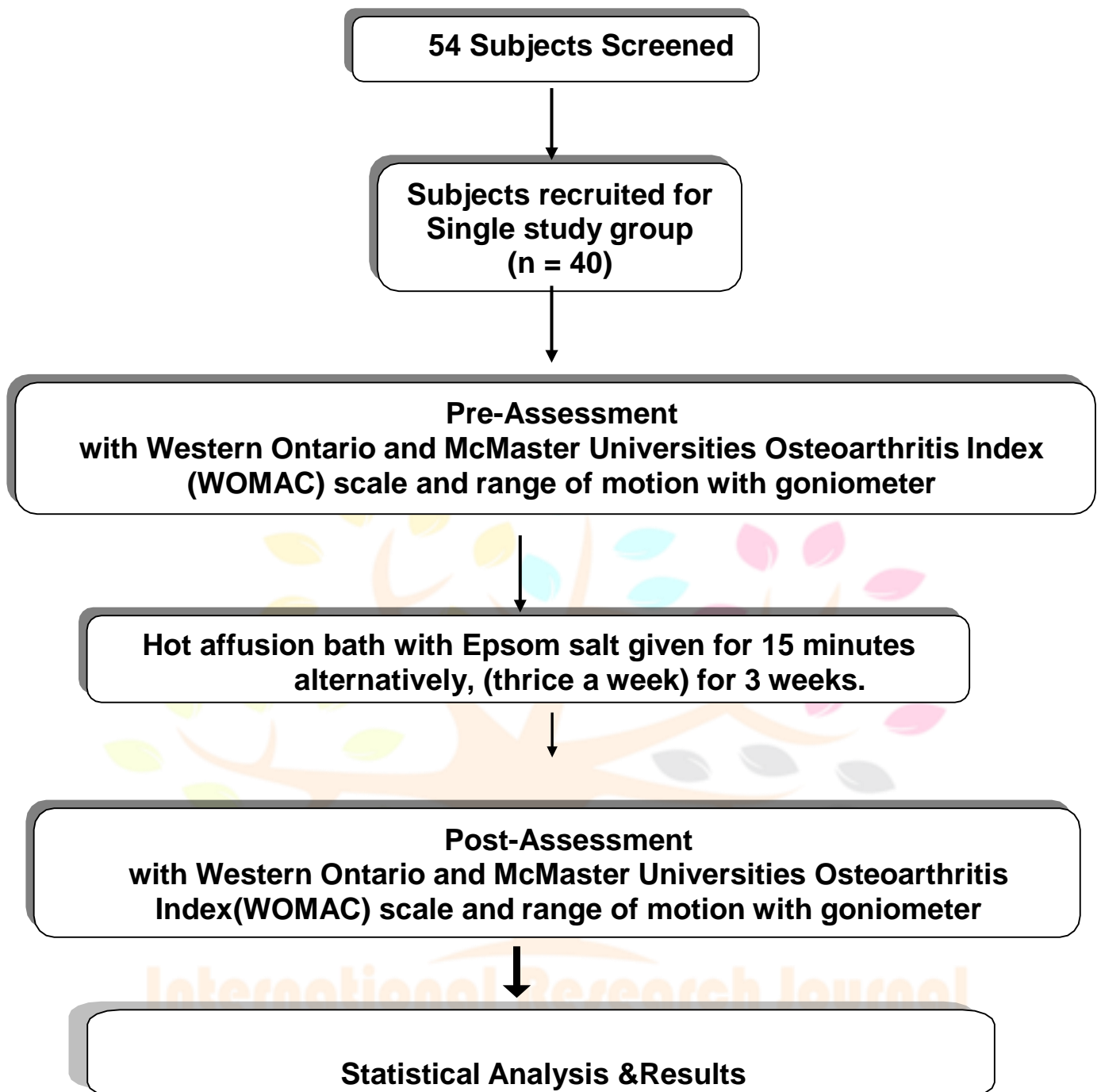
#### 4.10 Ethical Considerations:

Ethical approval is obtained from the relevant institutional review board, ensuring the study adheres to ethical guidelines and safeguards the participants rights and confidentiality. Informed consent is obtained from all participants before their enrolment in the study, and they are informed about the purpose, procedures, and potential risks and benefits of the intervention. Participants are assured of their voluntary participation, and they have the right to withdraw from the study at any point without consequence.

#### 4.11 Withdrawal Criteria:

given to the participants to go through the information sheet and their queries were answered. Their rights to withdraw anytime from the study and the need for willingness to participate voluntarily in the study were explained. All the subjects expressed their willingness to participate in the study by giving a signed informed consent. (A sample information sheet and consent form are enclosed as Annexure-1) Ethical clearance was obtained from the Institutional Ethical Committee prior to the start of the study and the approval for the same was granted.





**ILLUSTRATION OF STUDY PLAN**

#### 4.12 Written Informed Consent:

Subjects who fulfilled the inclusion criteria were appraised about wassought from the Institutional Ethics Committee prior to the start of the study and the approval for the same was granted. The subjects were informed about the project and procedure, duration and effect of the treatment

**4.13 Assessments:** The baseline and post-intervention assessments consisted of:

**1.Womac Questionnaire.**

**2.Range of Motion.**

In both legs, measuring degree of flexion and extension. pain, stiffness and physical function related symptoms were scored, pre and post data collected for assessment.

**Questionnaire:**

A validated semi structured questionnaire. Questionnaire for the present studywas divided into 4 parts namely

- Socio demographic profile of the individuals
- Medical history
- History related to osteoarthritis knee joint
- WOMAC Index (Western Ontario and McMaster Universities Arthritis Index)

The questionnaire for the present study was developed based on WOMAC(the Western Ontario and McMaster Universities osteoarthritis index) it was used for rating of knee osteoarthritis used for accessing osteoarthritis knee joint. The questionnaire was modified according to the local need and validated with the help of expert.

#### 5. Results:

**TABLE:5.1 Primary outcome variable Secondary outcome variables.**

Primary Outcome Variable	Secondary Outcome variable
WOMAC Questionnaire to assess	Range of Motion of Knee joints using Goniometer
Pain	Degree of Flexion
Stiffness	Degree of Extension in both the legs

**TABLE 5.2: MEDIAN FOR PAIN SCORE**

WOMAC pain score	Median (IQR)	P-value
<b>Before</b>	58.8541(56.250-63.541)	.0001*
<b>After</b>	34.375(31.25-39.0625)	

The pain among the study participants measured by WOMAC scale was 58.85 before the hot affusion bath with Epsom salt and reduced to 34.37 after the intervention. This difference was found to be statistically significant. (p=.0001)

TABLE 5.3: MEAN RANGE OF MOTION

Goniometer	Mean $\pm$ SD	Mean Difference	95% Confidence Interval of the difference		P -Value
			Lower	Upper	
Before	80.63 $\pm$ 6.323	23.5 $\pm$ 5.335	25.206	21.794	.0001
After	104.13 $\pm$ 7.586				

The mean range of motion among the study participants measured by goniometer was 80.63 degrees before the hot affusion bath with Epsom salt and increased to 104.13 after the intervention. This difference was found to be statistically significant.  $p=.0001$ )

TABLE: 5.4 ASSOCIATION BETWEEN PAIN REDUCTION AND BASELINE SOCIO DEMOGRAPHIC PARAMETERS:

Socio demographic parameters	No.of. participants(N)	Percentage(%)	X <sup>2</sup>	P- Value
<b>Gender</b>				
Male	27	67.5	8.376	.004*
Female	13	32.5		
<b>Age</b>				
<60	27	67.5	3.723	.054
>60	13	32.5		
<b>Education</b>				
Middle school	37	92.5	.961	.553
Higher secondary	3	7.5		
<b>Type of Toilet</b>				
Indian	10	32.5	2.222	.136
Western	30	67.5		
<b>Occupation</b>				
Employed	36	90	2.963	0.85
Unemployed	4	10		

#### Discussion:

The present study results shows that the Hot affusion bath (HAB) with Epsom salt at a temperature of 104° f for 15 minutes has significant improvement in reduction in knee pain, stiffness and improvement in physical motion and range of motion. The result of the study revealed that HAB with Epsom salt shows significant changes in the post test of primary and secondary outcomes. The trial was expected to produce clinical evidence that Hot affusion bath and Epsom salt is well established for its effect in the pain relief and improve the range of motion. As the incidence is increasing mainly in this trial was conducted. The main focus of this study was to assess the effectiveness of Hot affusion bath with Epsom salt among elderly patients with OA Knee joint pain. The research design adopted was an experimental pre-test and post-test. The population was old age patients in the age group of 50-65 years with knee joint pain. The conceptual framework of this research was based on Modified Imogene



king's Goalattainment theory model. The subjects were assessed patients global assessment (WOMAC - Western Ontario and Mc-Master Universities Secondary Osteoarthritis index) and range of motion(goniometry) these methods have been reported to be most satisfactoryfor assessing severity of pain, patients global assessment and range of motion. In this study HAB with Epsom salt show significantly reduced valuesobtained after 3 weeks of treatment compared to that of the baseline in pain, and significant improvement in range of motion after the 3 weeks of intervention.

A study reported by **Ruby Anitha et al., (2015)** to assess the effectiveness of Epsom salt fomentation on knee joint pain, knee swelling and activities of daily living among elderly. It was one group pre-test post-test experimental design with 30 samples. Results reveals with significant improvement( $p<0.01$ ) in pain, swelling and activities of daily living after 5 days of therapy. **Fioravanti A, Tenti S, Giannitti C, Fortunati NA, Galeazzi M.(2013)** conducted a prospective randomized , single blind controlled trial to evaluate the effectiveness of Epsom salt compress in 60 outpatients with bilateral pain divided in to two groups with experimental group treated with 12 daily generalized thermal baths with magnesium sulfate and normal mineral water for control group for a duration of three months the study results confirmed that Epsom salt bath had a beneficial effect in patients with joint OA .Thus, our study indicates that hot affusion bath with Epsom salt may reduce the body pain, stiffness and improves the range of motion. The study revealedhot affusion bath with Epsom salt reduced the pain score from  $58.854 \pm 34.375$  and increased the range of movement from  $80.63 \pm 6.323$  to  $104.13 \pm 7.586$ . Results reveals with significant improvement ( $p<0.001$ ) in pain, swelling and activities of daily living after three weeks of treatment. The findings of this quasi-experimental study support the effectiveness of hot affusion baths with Epsom salt in managing knee-related symptoms among patients with knee osteoarthritis. The treatment intervention led to a significant reduction in pain and stiffness, which are primary complaints in osteoarthritis patients. The observed improvements in the range of motion indicate that the intervention contributed to enhanced joint mobility, allowing participants to perform daily activities with greater ease. The therapeutic benefits of hot affusion baths with Epsom salt can be attributed to several factors. Epsom salt contains magnesium sulphate, which is known for its anti-inflammatory properties. The warm water in the hot affusion bath helps to relax muscles and soothe joint pain. The combination of these factors may have contributed to the observed reduction in knee-related symptoms. The study's results align with previous anecdotal evidence of the beneficial effects of hot affusion baths on musculoskeletal conditions. The findings support the potential of this non-invasive and cost-effective intervention as an adjunctive treatment for knee osteoarthritis. Incorporating hot affusion baths with Epsom salt into the management of knee osteoarthritis may offer patients a complementary approach to alleviate symptoms and improve their quality of life. Despite the promising results, some limitations should be acknowledged. The quasi-experimental design lacks randomization and control groups, limiting the ability to establish a cause-and-effect relationship between the intervention and the observed outcomes. Additionally, the study's small sample size warrants caution in generalizing the results to a larger population. Future research with randomized controlled trials and larger sample sizes would further validate the efficacy of hot affusion baths with Epsom salt in managing knee osteoarthritis.

#### **In conclusion,**

The present study showed that Hot affusion bath with Epsom salt given thrice a week for period of 3 weeks for patient suffering from OAK shows significant improvement in subjective and objective parameters. In objective parameter WOMAC index and goniometer used, revealed significant reduction in pain and significant improvement in range of movement, in the degree of flexion. Hence, the Hot affusion bath with Epsom salt shows to be effective in patient with Osteoarthritis of knee. The study shows Significance in the physical function and range of motion to extend improves the quality of life in the elderly people of OAK.So, this is a very safe and effective method of treatment as a holistic approach.

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