RESEARCH ARTICLE

EFFECTIVENESS OF LEMON PEEL EXTRACT ON KNEE PAIN AMONG PATIENTS WITH RHEUMATOID ARTHRITIS

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ARTICLE INFO

ABSTRACT

A true experimental study to evaluate the effectiveness of lemon peel extract on knee pain among patients with Rheumatoid Arthritis in a village at Kanyakumari district. **Aim:** The aim of the study was to evaluate the effectiveness of lemon peel extract on knee pain among patients with Rheumatoid Arthritis. **Materials and Methods:** A true experimental pre-test post-test control group design was adopted for the study. Sample size was 60, calculated using Slovin's formula and with the help of simple random sampling method 30 participants were allotted in study group and 30 participants in control group. Pre- intervention and post-intervention knee pain was assessed using Western Ontario And McMaster University Osteoarthritis Index (WOMAC) Scale. Lemon peel extract was applied for 20 minutes once a day for 15 days for the study group and control group had not received any intervention. Mean, standard deviation and paired and unpaired 't' test was used to evaluate the effectiveness of lemon peel extract on knee pain. The comparison of post- intervention knee pain score between study group and control group was analysed by unpaired 't' test. The comparison of pre-intervention and post-intervention pain score within the group was analysed using paired 't' test. Chi-square test was used to find out the association between demographic variables and clinical variables of the participants with their pre-intervention knee pain score. **Results:** The study results showed that, in study group, the mean post-intervention score on knee pain (29.63) was lower than the mean pre-intervention score on knee pain (79.5), which showed that, there was a significant difference between the mean pre-intervention and post-intervention score on knee pain, in study group, whereas the mean post- intervention score on knee pain in study group (29.63) with the standard deviation of (9.73)was lower than the mean post- intervention score on knee pain in control group (75.9) with the standard deviation of (10.998). Unpaired 't' test value for knee pain was 18.259 which was significant at $p \leq 0.05$ and was highly significant at $p \leq 0.01$, $p \leq 0.001$. In study group the paired 't' test value for knee pain was 11.411 which was significant at $p \leq 0.05$ and was highly significant at $p \leq 0.01$, $p \leq 0.001$, and in control group the paired 't' test value for knee pain was 3.636 which was significant at $p \leq 0.05$ and was highly significant at $p \leq 0.01$, $p \leq 0.001$. This represents the effectiveness of lemon peel extract on knee pain. **Conclusion:** According to the results, application of lemon peel extract had considerably reduced the knee pain, which revealed that the lemon peel extract was one of the most important and effective intervention in reducing knee pain.

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INTRODUCTION

Rheumatoid Arthritis is an autoimmune and inflammatory disease, the immune system attacking the healthy cells in the body causing inflammation over the affected parts of the body. It mainly attacks the joints, usually many joints at once. It commonly affects the joints in the hands, wrists and knees. In a joint with Rheumatoid Arthritis, the lining of the joint become antioxid, causing damage to the joint tissue. This tissue damage can cause long-lasting chronic pain, unsteadiness and deformity.

Citrus fruits – like oranges, grapefruits and limes are rich in vitamin C. The study conducted by Dorothy J Pattison. (2021) on getting the right amount of vitamin aids in preventing inflammatory arthritis and maintaining healthy joints with osteoarthritis and Rheumatoid Arthritis. Lemon water may helpinreducing some symptoms of arthritis when consumed alongside the normal routine medication by promoting collagen synthesis tendon repair. The citrus fruits are the good sources of inflammation, and fighting antioxidants, beneficial for those with Rheumatoid Arthritis.

Need for the study: Effective treatments of Rheumatoid arthritis are available, from 2021, the treatments for Rheumatoid arthritis aregetting better than ever. There are phenomenal therapies for Rheumatoid arthritis and most patients may have a completely normal life. A study conducted by Guang Shi *et al.*, (2023) showed that up to 1% of the global population are affected byRheumatoid arthritis. A news report (2021) shows that, 1.3 crore people in India suffer from Rheumatoid arthritis, Arthritis, Gout and other joint problems due to inflammation of joints. Vitamin C can reduce the level of inflammation in the body, so applying lemon peel extract on joints can relieve the symptoms of arthritis and similar conditions that cause joint pain and stiffness.

A study conducted by Vineet Babu *et al.*, (2021) to evaluate the effectiveness of Hesperidin-rich ethanol extract from waste peels of lemon and citrus limetta mitigates on rheumatoid arthritis and related complications.120 participants were selected for the study. The aim of this study is to explore the possible pharmacological effects of fruit waste that may have a key role in converting the fruit waste into pharmaceutical agents.The extract was applied to the participants in the joints for 2 weeks. After two weeks the data was collected from the participants. The results shows that the post-intervention mean score was 8.37 and the standard deviation is 5.74 which was significant at $p<0.05$. The findings of this study suggests the suitability of citrus limetta and lemon peel extract have the effective reduction in the symptoms of Rheumatoid Arthritis and related complications.

Rheumatoid Arthritis (RA) is a chronic disease that causes inflammation around the body and commonly presents with pain in the joints. Untreated, Rheumatoid Arthritis can cause severe damage to the joints and the surrounding tissues. It can lead to heart, lungs and nervous problems.Common symptoms include chronic pain, stiffness, tenderness, warmth and swelling over the joints. Rheumatoid Arthritis can make it hard to move and perform daily activities.The causes of Rheumatoid Arthritis are unknown. Risk factors include smoking, obesity and exposure to air pollution. Women and older people have a higher risk of developing Rheumatoid Arthritis.If diagnosed timely, symptoms and disease progression shall be controlled with pharmacological treatment, and optimal functioning can be maintained through rehabilitation (including the use of assistive products). In cases with severe joint damage, surgical procedures, including joint replacement may help to restore movement or manage pain, and maintain physical function. During the community visit, the investigator identified that most of the people suffered with knee pain due to Rheumatoid Arthritis, disrupting their normal daily activities and it was also noted that the people restrain themselves from going to work. Hence the researcher developed an interest to evaluate the effectiveness of lemon peel extract on knee pain among patients with Rheumatoid Arthritis.

Objectives

- To assess and compare the pre-intervention and post-intervention score on knee pain among patients with Rheumatoid Arthritis in study group and control group.
- To evaluate the effectiveness of lemon peel extract on knee pain among patients with Rheumatoid Arthritis in study group and control group.

- To find out the association betweenselected demographic and clinical variables among patients withRheumatoid Arthritis with their score in study group and control group.

Hypotheses

H_1 **:** There is a significant difference between pre-intervention and post-intervention score on knee pain among patients with Rheumatoid Arthritis in study group and control group.

H_2 **:** There is a significant difference between post-intervention score on knee pain among patients with Rheumatoid Arthritis between study group and control group.

METHODOLOGY

Research approach – A quantitative research approach was utilized.

Research design – The research design used in this study was true experimental pre-test post-test control group design.

Independent variable – In this study, lemon peel extract was the independent variable.

Dependent variable– In this study, knee pain was the dependent variable.

Research setting –The setting of this study was a rural village,Saral, Kanyakumari district.

Sample – The sample consists of patient aged between 35-75 years who have been diagnosed asRheumatoid Arthritis.

Sample size – The sample size was 60 (30 for study group and 30 for control group)which was calculated using Slovin's formula.

Sampling technique – A simple random sampling technique (Lottery method) was used to select the patients diagnosed asRheumatoid Arthritis in study group and control group.

Tool – The tool was divided into 3 sections:

Section A Part I – The demographic variables were age, gender, education, occupation, marital status, dietary pattern.

Part II – The clinical variables were duration of illness, Body Mass Index, history of medical illness, history of previous hospitalization.

Section B –Western Ontario And McMaster University Osteoarthritis Index (WOMAC) Scalewas used for data collection. The knee pain was rated as3 components – Mild pain (0-34%), Moderate pain (35-67%), Severe pain (68-100%).

Content validity and reliability – The content was validated by five experts including one orthopedist, one Naturopathy specialist and three Nursing personnels from the Medical Surgical Nursing Department. The experts were requested to give their opinion about the content and the appropriateness of the tool. The WOMAC scale consists of 24 items measuring 3 subscales such as Physical function (17 items), Pain (5items),

and Stiffness (2 items). The reliability of the scale was checked by test retest method. The value of the reliability was r = 0.8 expressing the perfect correlation. It shows that (WOMAC) scale was reliable for this study.

Ethical consideration – The proposed study was conducted after the approval of the Institutional Ethics Committee ofSt.Xavier's Catholic College Of Nursing, Chunkankadai. Informed written consent was obtained from each participant before starting the data collection. Assurance was given to the study participants regarding confidentiality of data.

Data collection process: After establishing rapport with the participants, the pre-intervention assessment was done to those who fulfilled the criteria of sample selectionusing Western Ontario And McMaster University Osteoarthritis Index (WOMAC) Scale. The tool consists of sectionApart I demographic variables, part II clinical variables and section B Western Ontario And McMaster University Osteoarthritis Index (WOMAC) Scale.

The investigator explained the importance of lemon peel extract and demonstrated to the participants in study group. All the participants in study group were verbally encouraged and motivated toapply lemon peel extract application for 20 minutes over the affected area by themselves once a day for 15 days and control group was not given any intervention.After 15 days of applying lemon peel extractby the study group, post-intervention score on knee pain was assessed for both study and control group usingWestern Ontario And McMaster University Osteoarthritis Index (WOMAC) Scale.

RESULTS AND DISCUSSION

Findings were analysed and discussed based on the objectives of the study.

Demographic Variables: According to age in study group, 17 (56.67%) belonged to age group of 56-65 years and in control group, 12 (40%) belonged to the age group of 46-55 years. Regarding gender in study group, 19 (63.33%) were female population and in control group, 17 (56.67%) were female population. According to the educational status in study group, 21 (70%) had undergone school education and in control group, 20 (66.67%) had undergone school education. Regarding the occupational status in the study group, 16 (53.33%) were moderate workers and in control group, 17 (56.67%) were sedentary workers. Assessing the marital status in study group, 29 (96.67%) were married and in control group, 22 (73.33%) were married. According to dietary pattern in study group, 19 (63.33%) were non-vegetarians and in control group, 14 (46.67%) were non-vegetarian.

Clinical variables: Analyzing the duration of illness in study group, 12 (40%) were diagnosed as Rheumatoid Arthritis for 1-2 years. In control group, 11 (36.67%) had Rheumatoid Arthritis for 1-2 years. Regarding Body Mass Index (BMI) in study group, 15 (50%) had maintained a healthy weight. In control group, 11 (36.67%) had healthy weight. According to the history of medical illness in study group, 28 (93.33%) had no history of medical illness. In control group, 22 (73.33%) had no history of medical illness. Regarding history of previous hospitalization for Rheumatoid Arthritis in study group, 29 (96.67%) had nothospitalized and in control group

22 (73.33%) had no previous history of hospitalization for Rheumatoid Arthritis.

The first objective was to assess and compare the pre-intervention and post-intervention score on knee pain among patients with Rheumatoid Arthritis in study group and control group.

Fig No.1: In pre-intervention among study group and control group there was no one,affected with mild knee pain and 9 (30%) participants from study group and 11 (36.67%) from control group had moderate knee pain and 21 (70%) participants from study group and 19 (63.33%) participants from control group had severe knee pain. In post-intervention among study group 22 (73.33%) participants, none from control group had mild knee pain and 8 (26.67%) participants from study group and 8 (26.67%) from control group had moderate knee pain and no one from study group and 22 (73.33%) participants from control group had severe knee pain.

The first objective was supported by a study conducted by Guo Sheng Zou *et al*., (2020) An experimental study to evaluate the effectiveness of lemon peel extract ameliorates Rheumatoid Arthritis by reducing xanthine oxidase and inflammatory cytokine levels. 120 participants were selected for the study. The lemon peel extract was administered to the participants orally for five consecutive weeks, and antioxidant and inflammatory markers were investigated.

The results showed that the post-intervention mean score was 9.46 and the standard deviation was 4.66 which was significant at $p < 0.05$.Bringing all these data together, it was suggested thatthe lemon peel extract reduced the inflammatory effects of Rheumatoid Arthritis by reducing inflammatory cytokines and xanthine oxidase levels.

Table 1. Comparison of mean, standard deviation and paired 't' test value of pre-intervention and post-intervention score on knee pain among patients with Rheumatoid Arthritis in study group and control group

N= 60

Variables	Group	Intervention	Mean	Standard Deviation	Paired 't' Test
Pain Perception	Study Group (n=30)	Pre-intervention	79.5	16.74	11.411***
		Post-intervention	29.63	9.73	
	Control Group (n=30)	Pre-intervention	74.37	11.26	3.636***
		Post-intervention	75.9	10.998	

Significant at* $p \leq 0.05$, **$p \leq 0.01$, ***$p \leq 0.001$.

Table 1. shows the comparison of the mean, standard deviation and paired 't' test score on pre-intervention and post-intervention knee pain among patients with Rheumatoid Arthritis in study group and control group. The mean score on kneepain among patients with Rheumatoid Arthritis in study group was, 79.5 in pre-intervention and 29.63 in post-intervention. The paired 't' test value for the knee pain was 11.411*** which was significant at $p \leq 0.05$ and was highly significant at $p \leq 0.01$, $p \leq 0.001$.The findings showed that the lemon peel extract was effective in reducing knee pain among patients with Rheumatoid Arthritis. In control group, the mean score on knee pain among patients with Rheumatoid Arthritis was 74.37 in pre-intervention and 75.9 in post-intervention.

The estimated paired 't' test value for knee pain among patients with Rheumatoid Arthritis was 3.636*** which was significant at $p \leq 0.05$ and was highly significant at $p \leq 0.01$, $p \leq 0.001$. It showed that there was a reduction in knee pain. By comparing both values, lemon peel extract was effective in reducing knee pain among patients with Rheumatoid Arthritis. Hence, the research hypothesis H_1 was accepted.
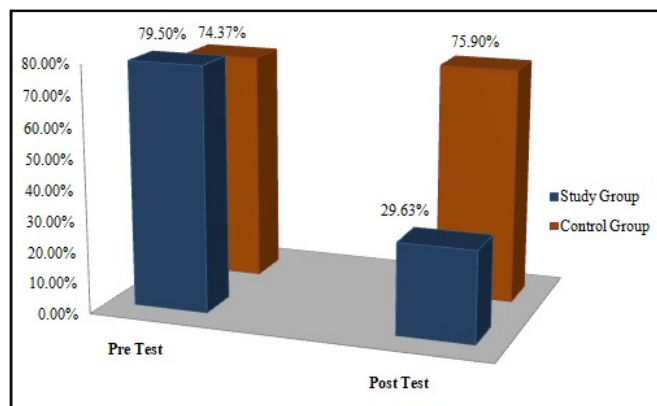
N=60

Fig No 2. Frequency and percentage distribution of pre-intervention and post-intervention score on knee pain in study group and control group

Fig No. 2. shows that in study group, the mean score on kneepain among patients with Rheumatoid Arthritis in study group was 79.5 in pre-intervention and 29.63 in post-intervention. In control group the mean score on knee pain among patients with Rheumatoid Arthritis was 74.37 in pre-intervention and 75.9 in post-intervention.

The second objective was to evaluate the effectiveness of lemon peel extract on knee pain among patients with Rheumatoid Arthritis in study group

Table 2. Comparison of mean, standard deviation and unpaired 't' test on post test score on knee pain among patients with Rheumatoid Arthritis in study group and control group.

N=60

Variables	Group	Mean	Standard Deviation	Unpaired 't' test
Knee Pain	Study Group (n=30)	29.63	9.73	18.259***
	Control Group (n=30)	75.9	10.998	

Significantat *$p \leq 0.05$, **$p \leq 0.01$, ***$p \leq 0.001$.

Table 2 represents the comparison of mean, standard deviation and unpaired 't' test score on knee pain among patients with Rheumatoid Arthritis. In study group, the post-intervention mean score was 29.63 with the standard deviation 9.73. In control group, the post-intervention mean score was 75.9 with the standard deviation 10.998. The estimated unpaired 't' test value was 18.259***, significant at $p \leq 0.05$ and highly significant at $p \leq 0.01$, $p \leq 0.001$. Hence, lemon peel extract was more effective in knee pain among patients with Rheumatoid Arthritis. Hence research hypothesis H_2 was accepted. The second objective was supported by the study conducted by Moumita *et al.*, (2020) on the effectiveness of lemon peel extract application on joint pain among elderly. The data was collected using structured questionnaire and WOMAC index with the help of numeric rating scale for both study group and control group. In the post-intervention, the comparison of

experimental group mean score was 22.833 with standard deviation of 17.67. In control group post-intervention mean score was 44.100 with the standard deviation of 17.67. The calculated 't' test value 5.052 was found to be statistically significant at $p \leq 0.01$. This study conclude that the lemon peel extract was more effective on reduction of knee pain.

The third objective was to findout he association between the selected demographic and clinical variables on knee pain among patients with Rheumatoid Arthritis in study group and control group.

In study group, the calculated value of the demographic variables such as age ($\chi^2 = 7.079$) was greater than the table value which indicates that there was a significant association at $p \leq 0.05$ and was highly significant at $p \leq 0.01$ with their pre-intervention score on knee pain among patients with Rheumatoid Arthritis. The calculated value of the demographic variables such as gender ($\chi^2 = 0.884$), education ($\chi^2 = 2.966$), occupation ($\chi^2 = 0.794$), dietary pattern ($\chi^2 = 1.325$), marital status ($\chi^2 = 0.84$) were lesser than the table value which indicated that there was no significant association at $p \leq 0.05$, $p \leq 0.01$, $p \leq 0.001$ with their pre-intervention score on knee pain among patients with Rheumatoid Arthritis.

In control group, the calculated value of demographic variables such as age ($\chi^2 = 7.079$), gender ($\chi^2 = 0.884$), education ($\chi^2 = 2.966$), occupation ($\chi^2 = 0.794$), dietary pattern ($\chi^2 = 0.84$) and marital status ($\chi^2 = 1.325$) were lesser than the table value which indicated that there was no significant association at $p \leq 0.05$, $p \leq 0.01$, $p \leq 0.001$ with their pre-intervention score on knee pain among patients with Rheumatoid Arthritis.

In study group, the calculated value of the clinical variables such as duration of illness ($\chi^2 = 1.706$), body mass index ($\chi^2 = 1.428$), history of medical illness ($\chi^2 = 0.408$), history of previous hospitalization for Arthritis ($\chi^2 = 2.413$) were lesser than the table value which indicated that there was no significant association at $p \leq 0.05$, $p \leq 0.01$, $p \leq 0.001$ with their pre-intervention score on knee pain among patients with Rheumatoid Arthritis. In control group, the calculated value of demographic variables such as duration of illness ($\chi^2 = 5.632$), body mass index ($\chi^2 = 1.387$), history of medical illness ($\chi^2 = 3.142$), history of previous hospitalization for Arthritis ($\chi^2 = 3.142$) were lesser than the table value which indicated that there was no significant association at $p \leq 0.05$, $p \leq 0.01$, $p \leq 0.001$ with their pre-intervention score on knee pain among patients with Rheumatoid Arthritis.

Implications

- Nurses shall develop their knowledge regarding the benefits of lemon peel extract application on knee pain among patients with Rheumatoid Arthritis.
- Nurses shall develop skills in implementing the lemon peel extract application.
- Nurses shall create awareness on benefits of lemon peel extract application, promote and encourage practicing lemon peel extract application on knee pain among patients with Rheumatoid Arthritis.
- Nurses working in hospitals and community areas shall implement lemon peel extract application on knee pain among patients with Rheumatoid Arthritis.

RECOMMENDATION

- The similar study shall be done with larger samples in different settings to strengthen the findings.
- An analogous study shall be conducted to assess the effectiveness of lemon peel extract in combination with other complimentary therapies.

CONCLUSION

The aim of the study was to evaluate the effectiveness of lemon peel extract on knee pain among patients with Rheumatoid Arthritis. The statistical evidence proved that the lemon peel extract was very effective in reducing knee pain among patients with Rheumatoid Arthritis. Hence the study concluded that, the lemon peel extract shall be applied in the hospital and community settings to reduce the knee pain among patients with Rheumatoid Arthritis.

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