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## Correlation between Frequency of Therapy Sessions and Quality of Life Index to Knee OA Grade Severity using TENS and USD

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**Abstract:** Osteoarthritis (OA) is the most common musculoskeletal disorder affecting a large population of all genders, races, and countries. Hence, this study aimed to determine the correlation between frequency of therapy sessions and quality of life using Western Ontario and McMaster Universities (WOMAC) index to grade the severity of knee OA using Transcutaneous Electrical Nerve Stimulation (TENS) and Ultrasound Diathermy (USD). This is a cross sectional study. Total 33 patients from purposive sampling with both unilateral and bilateral knee OA were recruited into this study. Patients were assigned into three groups based on Kellgren-Lawrence Radiological Staging System. All patients received 5 minutes of 3 MHz, 0.5 - 1.0 watt continuous USD, and 15 minutes of 80-100 Hz, 30-50 mAmp TENS for twice sessions a week or 8 times sessions a month. Patients were asked to answer each question of WOMAC index. Number of therapy sessions according to the patient's medical records. There was correlation between frequency of therapy sessions and WOMAC index to knee OA grade severity ( $p < 0.05$ ). The greater severity of knee OA, the more therapy session of combination USD and TENS is needed. The higher WOMAC index, the lower quality of life of knee OA patients.

**Keywords:** Knee OA, frequency of therapy sessions, quality of life, severity, WOMAC index, USD, TENS.

## **Introduction**

Osteoarthritis (OA) represents the most prevalent musculoskeletal disorder, impacting a significant demographic across all genders, ethnicities, and nations. (1) Epidemiological studies indicate a higher incidence of this condition in females compared to males. (2) Furthermore, women experience a greater degree of impact and distress associated with osteoarthritis of the knee than their male counterparts. (3)

The knee joint, being the largest synovial joint in the human body, comprises osseous structures including the distal femur, proximal tibia, and patella, along with cartilage consisting of the meniscus and hyaline cartilage, ligaments, and a synovial membrane. The synovial membrane is responsible for synthesizing synovial fluid, which serves to lubricate and provide essential nutrients to the avascular cartilage. Regrettably, the frequent utilization and mechanical stress imposed on this joint often culminate in painful conditions, notably knee OA. (4)

The severity of knee OA can be systematically categorized based on radiographic evaluations utilizing the Kellgren–Lawrence (KL) grading system, which was delineated in 1957. (4) The KL classification was initially conceptualized through the use of anteroposterior knee radiographs, assigning a grade ranging from 0 to 4, with Grade 0 indicating an absence of OA and Grade 4 denoting advanced OA. (5)

With the increasing prevalence of knee OA, there is a corresponding rise in the incidence of knee arthroplasty procedures. (2) The American College of Rheumatology and the Osteoarthritis Research Society International provide guidelines for nonsurgical interventions for knee OA, which encompass exercise regimens, weight management, biomechanical strategies, administration of

acetaminophen, and the use of oral or topical nonsteroidal anti-inflammatory drugs (NSAIDs), as well as intra-articular corticosteroid injections. (6)

Transcutaneous electrical nerve stimulation (TENS) is a therapeutic modality widely implemented to alleviate pain in individuals afflicted with knee OA. (7) Despite the availability of various forms of electrical stimulation, conventional TENS remains the most prevalently utilized method. (8) Additionally, therapeutic ultrasound diathermy (USD) is frequently employed as a treatment modality for pain associated with knee OA. (9) The efficacy of TENS and therapeutic ultrasound diathermy (USD) in managing knee OA has been extensively researched, with reports suggesting the benefits of integrating multiple physical modalities, such as TENS and USD. Consequently, the primary objective of physical therapy management is to mitigate pain, enhance functional activities, and reduce disability, thereby improving the overall quality of life. According to regulations set forth by National Health Insurance, patients are eligible for physical therapy sessions twice weekly or a total of eight sessions per month. (2)

In order to assess the quality of life of patients diagnosed with knee osteoarthritis, various patient-reported subjective instruments have been developed in recent decades. The self-administered Western Ontario and McMaster Universities (WOMAC) index is recognized as the most frequently utilized clinical tool for appraising individuals with knee OA, comprising five inquiries concerning pain, two regarding stiffness, and seventeen pertaining to the extent of disability in daily living activities. (10) Thus, this study aims to elucidate the correlation between the frequency of therapeutic sessions and the quality of life as measured by the WOMAC index, in relation to the grading of knee OA severity through the application of TENS and USD.

## **Methods**

This research constitutes a cross-sectional investigation involving a cohort of 46 patients diagnosed with knee osteoarthritis (OA) who were referred to the Physical Medicine and Rehabilitation outpatient clinic at 'Aisyiyah Hospital, Bojonegoro, East Java, Indonesia during the period of June to July 2024. The study incorporated a sample size of 33 participants (11 individuals per group) derived from purposive sampling methodology, employing a 10% margin of error as delineated by Slovin's formula. The purposive sampling technique was implemented to identify subjects most likely to provide pertinent and valuable data, serving as a strategic approach for the selective identification of cases that can optimize the utilization of limited research resources effectively.

The criteria for inclusion encompassed 1) both unilateral and bilateral knee OA, 2) individuals of all ages, and 3) individuals of all genders. Patients were excluded from the study if they presented with any of the following conditions: 1) sensory deficits, 2) recent surgical interventions involving the knee joint, 3) traumatic injuries surrounding the knee joint, 4) the presence of an open wound in the knee joint, 5) any implants located in or around the knee joint, 6) dermatological conditions affecting the knee, and 7) either mechanical or non-mechanical low back pain. The patients were categorized into three distinct groups. Group 1 consisted of individuals with stage I knee OA, Group 2 comprised those with stage II knee OA, and Group 3 included patients with stage III knee OA, as classified according to the Kellgren-Lawrence Radiological Staging System for osteoarthritis. All participants received ultrasound diathermy (USD) and transcutaneous electrical nerve stimulation (TENS) treatments administered twice weekly, amounting to eight sessions per month. The physical therapy regimen entailed 5 minutes of continuous USD at a frequency of 3 MHz and an intensity of 0.5-1.0 watts for deep tissue heating, alongside 15 minutes of

TENS at a frequency of 80-100 Hz and an intensity of 30-50 mAmp for analgesic purposes.

Participants were requested to complete each item of the Western Ontario and McMaster Universities (WOMAC) index. The WOMAC instrument encompasses 24 distinct items: 5 pertaining to pain, 2 related to stiffness, and 17 concerning physical function. The index generates three subscale scores (pain, stiffness, and physical function) along with a cumulative total score. The number of therapy sessions administered was recorded in accordance with the patients' medical documentation.

Statistical analysis was conducted utilizing the SPSS software, version 26. Descriptive statistical methods were employed to analyze demographic data. Numerical data were expressed as mean  $\pm$  standard deviation.

## **Results**

A total of thirty-three participants were enrolled in this investigation in accordance with the established inclusion and exclusion criteria. As depicted in Table 1, the cohort comprised 29 female patients (87.9%). The Body Mass Index (BMI) classifications indicated that 14 patients (42.4%) were categorized as overweight.

The participants were classified into three distinct groups based on the Kellgren-Lawrence Radiological Staging System. No statistically significant differences were observed regarding age and BMI among the groups. A noteworthy escalation in the frequency of therapeutic sessions was noted from group 1 to group 2; however, no significant difference was identified between group 2 and group 3. Additionally, measures of pain, stiffness, functional

limitations, and the WOMAC Index exhibited an increasing trend from Group 1 to Group 3.

There was a statistically significant relationship between the frequency of therapy sessions and the severity of osteoarthritis (OA) grades ( $p = 0.024$ ), accompanied by a weak correlation coefficient ( $r = 0.393$ ). Furthermore, the interpretation of the WOMAC index in relation to OA grade severity also yielded significant results ( $p = 0.002$ ) with a moderate correlation coefficient ( $r = 0.462$ ).

Table 1. Demographic characteristic

No		Frequency (n= 33)	%
1	Gender		
	Man	4	12.1
	Woman	29	87.9
2	BMI Categories		
	Underweight	0	0

	Normal	12	36.4
	Overweight	14	42.4
	Obesity	7	21.2

Table 2. Demographic characteristic and clinical parameters

No		Total	Group 1 (Knee OA Grade I)	Group 2 (Knee OA Grade II)	Group 3 (Knee OA Grade III)
1	Age (years old)	60.3 ± 9.8	58.1 ± 10.9	61.7 ± 8.3	61.2 ± 10.5
2	BMI	27.1 ± 3.9	27.5 ± 5.1	26.5 ± 3.1	27.3 ± 3.5
3	Frequency of Therapy Sessions	15.3 ± 16.1	6.0 ± 4.8	19.0 ± 18.5	20.9 ± 18.1
4	Pain	7.7 ± 3.7	6.0 ± 3.4	8.4 ± 4.2	8.7 ± 3.2
5	Stiffness	3.1 ± 2.1	2.1 ± 2.2	3.0 ± 1.7	4.3 ± 2.0
6	Functional Limitation	27.3 ± 11.8	21.6 ± 9.9	25.5 ± 9.5	34.9 ± 12.5
7	WOMAC Index	38.3 ± 15.7	29.9 ± 12.8	37.0 ± 13.8	48.0 ± 16.0

Table 3. Correlation between Frequency of Therapy Sessions and WOMAC Index to OA Grade Severity (spearman)

	Knee OA Grade Severity
Frequency of Therapy Sessions	p= 0.024 r= 0.393
WOMAC Index	p= 0.007 r= 0.462

significant  $p < 0.05$

correlation coefficient  $r = 0.01-0.20$  very weak,  $0.21-0.40$  weak,  $0.41-0.60$  moderate,  $0.61-0.80$  strong,  $0.81-0.99$  very strong

## **Discussion**

In this investigation, the average age of participants was recorded between 51 and 70 years. This observation aligns with the heightened incidence of knee osteoarthritis (OA) among the elderly population. The age-adjusted prevalence of radiographic knee OA among individuals aged over 45 years was documented at 19.2% in the Framingham Study and 27.8% in the Johnston County Osteoarthritis Project (12). According to findings from the third National Health and Nutrition Examination Survey (NHANES III), nearly 37% of individuals aged 60 years and older exhibited radiographic knee OA (6) (12).

In the results of our study, a predominant proportion of patients (87.9%) were identified as female. The Hame study indicated that women experience a greater prevalence and burden of knee osteoarthritis compared to their male counterparts (3). The notable increase in OA prevalence among women, particularly around the menopausal transition, has prompted researchers to hypothesize that hormonal influences may contribute to the pathogenesis of OA. Nonetheless, findings regarding the impact of estrogen, whether endogenous or exogenous, on OA derived from observational studies have yielded inconsistent results (13).

In this research, the Body Mass Index (BMI) across all groups exhibited a similar average of approximately 27.1, categorizing them as overweight. The association of obesity and overweight with increased risk factors for OA, particularly knee OA, has been well-documented (13). In a cohort study encompassing 1,420 participants, Felson reported that individuals classified as obese possess a 1.5 to 2-fold increased risk of developing knee OA in comparison



to their leaner peers (14). Within a comprehensive meta-analysis examining risk factors for the onset of knee OA, obesity was found to be significantly associated with knee OA (OR=2.63, 95% CI 2.28 to 3.05) (15).

This case study elucidated that an increase in the severity of knee osteoarthritis (OA) necessitates a higher number of therapeutic sessions. The average frequency of therapy sessions from first to second degree knee OA exhibited a notable increase. This phenomenon may be attributed to the fact that the patients were attending the outpatient clinic for the initial time. Furthermore, they were still categorized within the earlier stages of knee OA and were reaping the therapeutic benefits. Exercise regimens should be customized to align with each patient's individual requirements, tolerances, and preferences; high-impact activities should be eschewed, and efforts should be made to enhance long-term adherence in order to optimize therapeutic success. In advanced stages of knee OA, there exists an augmented risk of exacerbation of severity, thereby necessitating an increased frequency of therapeutic interventions. Combination therapy synergistically delivers the therapeutic effects of Transcutaneous Electrical Nerve Stimulation (TENS) and Ultrasound (USD) concurrently. When a peripheral nerve is subjected to USD, its resting membrane potential is diminished due to an increase in the permeability of the nerve membrane to various ions, including sodium and calcium. This alteration results in a lowered threshold for neuronal stimulation, thereby allowing for depolarization of the nerve with the application of a lesser current. Nonetheless, the precise mechanism underlying the analgesic effect remains inadequately elucidated. The overarching objective of knee OA treatment is to mitigate pain and joint eburnation, preserve and enhance joint mobility, reduce physical limitations, augment quality of life, prevent further joint degradation, and educate patients regarding prognosis and disease outcomes.

In this investigation, the average pain sub-scale score was 7.7 (out of 20), the average stiffness sub-scale score was 3.1 (out of 8), the average functional limitation sub-scale score was 27.1 (out of 68), and the average Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) score was 38.3 (out of 68). These results collectively indicate that patients generally experienced moderate levels of knee OA severity, pain intensity, joint stiffness, and limitations in physical function. However, in the Bashekah study, these scores were found to be lower than those reported in our findings. Overall, the mean values for each sub-scale and the WOMAC index exhibit an upward trajectory from knee OA grade I to grade III. Knee pain associated with OA may correlate with heightened pressure sensitivity, and exercise interventions hold the potential to alleviate this sensitivity. Additionally, various factors are linked to pain severity in individuals with knee OA, including elevated serum interleukin-6 levels associated with pain severity in both early and advanced stages of knee OA. Stiffness of the knee joint and increased muscular co-contraction have been noted in individuals with medial knee OA, potentially jeopardizing the overall health of the joint. However, multiple factors contribute to compromised physical functioning in knee OA, encompassing the intensity of knee pain, body mass index (BMI), and age.

A significant correlation was identified between the frequency of therapeutic sessions and the WOMAC index in relation to the severity of knee OA grades. The greater the severity of knee OA, the more therapeutic sessions combining TENS and USD are required. Furthermore, a higher WOMAC index corresponds to a diminished quality of life among patients afflicted by knee OA.

## **Conclusion**

There was correlation between frequency of therapy sessions and WOMAC index to knee OA grade severity. The greater severity of knee OA, the more therapy session of combination TENS and USD is needed. The higher WOMAC index, the lower quality of life of knee OA patients.

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