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A COMPARATIVE ANALYSIS OF THE THERAPEUTIC EFFICACY OF INFRARED RADIATION (IRR) AND SHORTWAVE DIATHERMY (SWD) ON CHRONIC NECK PAIN AMONG OFFICE WORKERS IN GUJARAT

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ABSTRACT

Background: Chronic neck pain (CNP) is a common musculoskeletal problem among office workers due to prolonged sitting, poor posture, and computer use. These factors contribute to muscle imbalance, pain, and restricted mobility. Physiotherapeutic heat modalities like Infrared Radiation (IRR) and Shortwave Diathermy (SWD) are widely used for pain relief, but their comparative efficacy remains unclear.

Objective: To compare the therapeutic efficacy of Infrared Radiation (IRR) and Shortwave Diathermy (SWD) in reducing pain and disability among office workers with chronic neck pain in Gujarat.

Methods: A randomized controlled trial was conducted among 60 office workers (aged 25–60 years) with chronic neck pain lasting over three months. Participants were randomly divided into two groups: Group A received IRR therapy and Group B received SWD therapy. Both groups underwent standard physiotherapy protocols. Pain and disability were assessed using the Numeric Pain Rating Scale (NPRS) and Neck Disability Index (NDI). Data were analyzed using paired and unpaired t-tests, with significance set at $p < 0.05$.

Results: Both groups showed significant post-intervention improvements. Group A (IRR) showed reductions in NPRS (6.3→2.8, p=0.01) and NDI (34.13→18.3, p=0.02). Group B (SWD) demonstrated greater reductions in NPRS (6.2→2.5, p=0.01) and NDI (33.23→16.2, p=0.02). Between-group analysis revealed statistically significant differences favoring SWD (p=0.012 for NPRS; p=0.001 for NDI).

Conclusion: Both IRR and SWD effectively reduced pain and disability in office workers with chronic neck pain, with SWD showing slightly superior outcomes due to deeper tissue heating. Incorporating these modalities into rehabilitation can enhance pain management and functional recovery in sedentary populations.

Keywords: Chronic neck pain, Infrared radiation, Shortwave diathermy, Office workers, Physiotherapy, Thermal therapy

INTRODUCTION

The cervical spine, comprising seven vertebrae (C1–C7), is one of the most mobile and functionally significant regions of the vertebral column. It supports the head, facilitates multidirectional movement, and protects vital neurovascular structures such as the spinal cord, carotid arteries, and cervical nerves.[1] The upper cervical vertebrae, atlas (C1) and axis (C2), are primarily responsible for nodding and rotational movements, whereas the lower segments (C3–C7) contribute to flexion, extension, and lateral bending.[2] Due to its high mobility and load-bearing role, the cervical spine is vulnerable to mechanical strain, poor posture, and repetitive microtrauma that often lead to musculoskeletal pain and dysfunction.[3]

Neck pain is one of the most prevalent musculoskeletal disorders globally, ranked fourth among causes of years lived with disability.[4] It can be classified as acute or chronic depending on symptom duration and is often multifactorial linked to muscular imbalance, joint restriction, or neural irritation.[5] Chronic neck pain (CNP) is particularly concerning in occupational populations where prolonged static postures and repetitive movements are common.

In India, studies have reported that nearly 45% of office workers experience neck pain at some point in their careers, with higher rates observed among females and older adults.[6] A regional study from Gujarat also indicated that sedentary employees in IT and administrative sectors have a high incidence of work-related neck disorders due to long working hours and inadequate ergonomic setups.[7] The typical office environment involves sustained forward-head posture, repetitive computer use, and reduced physical activity—all of which contribute to increased mechanical load on the cervical extensors and postural muscles. Prolonged flexion and poor ergonomics shift the head's centre of gravity anteriorly, increasing strain on the posterior cervical muscles, ligaments, and intervertebral discs.[8] Over time, these biomechanical stresses can lead to adaptive shortening of anterior muscles, weakness of deep neck flexors, and joint dysfunction, culminating in chronic pain and disability.[9]

Physiotherapy plays a vital role in both prevention and management of neck pain by addressing the underlying mechanical, muscular, and postural components. Therapeutic exercise, ergonomic education, and manual therapy are the mainstays of conservative treatment.[10] Among adjunct modalities, electrotherapy has been extensively used to relieve pain, improve circulation, and facilitate tissue healing.[11] Heat-based electrotherapeutic modalities help increase tissue extensibility, reduce muscle spasm, and promote relaxation thereby preparing the patient for active exercise and manual interventions.[12]

Infrared Radiation (IRR) and Shortwave Diathermy (SWD) are two commonly used electrotherapeutic heating modalities in physiotherapy practice. Infrared radiation therapy uses electromagnetic waves with wavelengths between 780 nm and 1 mm to deliver superficial heat up to 2–3 cm below the skin surface. The resulting vasodilation enhances oxygenation, decreases muscle spasm, and promotes pain relief through improved local metabolism and waste clearance. It is particularly beneficial in

reducing stiffness and discomfort in superficial muscle tissues. [13]

In contrast, Shortwave Diathermy (SWD) utilizes high-frequency electromagnetic energy (commonly 27.12 MHz) to generate deep tissue heating. SWD acts on muscles, tendons, and joints located deeper beneath the skin, promoting vasodilation, increased metabolic rate, and enhanced connective tissue extensibility. Clinical studies have shown that SWD can effectively reduce chronic pain and stiffness by improving deep tissue circulation and reducing inflammatory mediators. However, its application requires careful dosage and technique to avoid thermal discomfort or burns.[14,15]

While both IRR and SWD are established modalities for musculoskeletal pain management, there is limited comparative evidence on their relative effectiveness for chronic neck pain, particularly in sedentary occupational populations. In the context of Gujarat's growing office-based workforce, identifying an optimal treatment approach is essential for reducing work-related disability and improving quality of life.

Therefore, the present study aims to compare the therapeutic efficacy of Infrared Radiation (IRR) and Shortwave Diathermy (SWD) on pain intensity and functional disability among office workers with chronic neck pain in Gujarat. This research seeks to determine which modality provides superior outcomes in reducing pain and improving function, thereby contributing to evidence-based physiotherapy practice for occupational neck disorders.

OBJECTIVES OF THE STUDY:

- To evaluate the effectiveness of infrared radiation (IR) therapy in reducing pain intensity and disability associated with chronic neck pain among office workers in Gujarat.
- To evaluate the effectiveness of shortwave diathermy (SWD) in alleviating pain and improving neck function in the same population.
- To compare the outcomes of IR and SWD therapies in terms of pain reduction, functional improvement, and disability reduction, as measured by the Numeric Pain Rating Scale (NPRS) and the Neck Disability Index (NDI).
- To identify which modality, IR or SWD, provides more significant and lasting therapeutic benefits for managing chronic neck pain among office workers.

METHODOLOGY

Study Design: This study was designed as a Randomized Controlled Trial (RCT) to evaluate the therapeutic efficacy of Infrared Radiation (IRR) and Shortwave Diathermy (SWD) on chronic neck pain among office workers in Gujarat.

Population: The study targeted office workers in Gujarat with chronic neck pain (lasting >3 months) due to prolonged computer use, poor ergonomics, and sedentary work habits.

Participants: A total of 60 office workers aged 25–60 years with chronic neck pain lasting more than

three months were recruited using simple random sampling. Eligible participants were required to spend at least four hours per day using a computer and provide written informed consent. Participants were randomly assigned into two groups, with 30 receiving Infrared Radiation (IRR) therapy (Group A) and 30 receiving Shortwave Diathermy (SWD) therapy (Group B). Individuals were excluded if they had acute neck pain, pain due to trauma, a history of cervical spine surgery, significant neurological deficits, systemic conditions such as rheumatoid arthritis, ankylosing spondylitis, or fibromyalgia, were pregnant or lactating, or were currently receiving any other treatment for neck pain.

Materials Required: Assessment forms and scales, consent forms, pen, pencil, paper, mat or plinth, table, Infrared Radiation (IRR) equipment, Shortwave Diathermy (SWD) unit, and towels or cushions.

Intervention:

- IRR Group (Group A): Participants received infrared radiation therapy applied to the affected cervical region. Treatment sessions were conducted according to a standardized protocol, with frequency and duration guided by established clinical guidelines and prior research, ensuring consistent delivery across all participants.
- SWD Group (Group B): Participants underwent shortwave diathermy therapy targeting the cervical area. Treatment parameters, including intensity, duration, and application technique, were standardized in accordance with recognized protocols for shortwave diathermy.

Procedure: Participants were recruited through advertisements in office settings across urban and suburban areas of Gujarat. Individuals meeting the inclusion criteria underwent eligibility screening, and those eligible were provided with detailed information about the study objectives, procedures, and potential risks and benefits, after which written informed consent was obtained. Participants were then randomly assigned to either the IRR group or the SWD group using computer-generated randomization, with allocation concealment maintained to minimize bias. The IRR group received infrared radiation therapy to the affected neck region, while the SWD group underwent shortwave diathermy, both delivered according to standardized protocols over a predetermined number of sessions scheduled at regular intervals. Baseline assessments of neck pain severity, functional ability, and disability were conducted prior to the intervention, with outcomes reassessed during and after the treatment period. Participants were followed up at predetermined intervals to evaluate long-term effects and monitor for adverse events

Outcome measures: The primary outcome measures for this study were the Numeric Pain Rating Scale (NPRS) and the Neck Disability Index (NDI). The NPRS is a validated self-reported tool used to assess pain intensity on a scale of 0 to 10, with 0 indicating no pain and 10 representing the worst pain imaginable. The NDI is a widely used questionnaire that evaluates functional disability related to neck pain across daily activities, providing

a comprehensive measure of neck-related impairment.

Statistical Analysis: Data were analyzed using SPSS software. Descriptive statistics, including mean and standard deviation, were calculated for all outcome measures. Within-group comparisons of NPRS and NDI scores were performed using paired t-tests, while between-group comparisons were conducted using independent t-tests. The level of statistical significance was set at $p < 0.05$.

RESULTS

Table 1: Distribution of Participants Based on Gender

Gender	Number of Participants	Percentage (%)
Males	34	56.67
Females	26	43.33
Total	60	100

Table 1 shows that the study included 60 participants, with a higher proportion of males (56.67%) compared to females (43.33%), indicating a slightly male-dominant sample population.

Chart 1: Gender Distribution

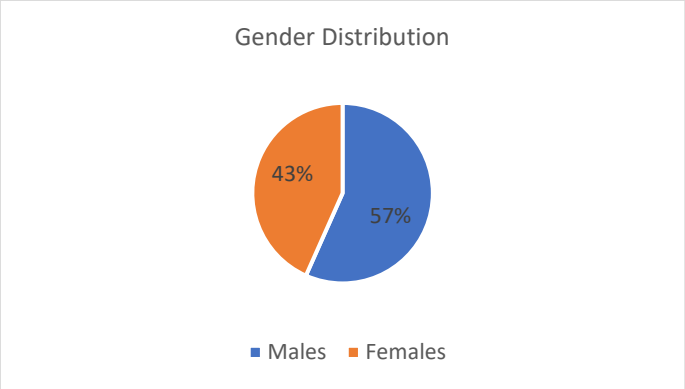


Table 2: Pre- and Post-Intervention Effects on Pain and Disability in Group A

OUTCOME MEASURE		MEAN	SD	T value	P value
NPRS	PRE	6.3	1.2	5.23	0.01
	POST	2.8	0.9		
NDI	PRE	34.13	5.4	4.89	0.02
	POST	18.3	4.8		

Group A showed a significant reduction in pain (NPRS: 6.3 → 2.8, $p = 0.01$) and disability (NDI: 34.13 → 18.3, $p = 0.02$) after the intervention, indicating improved pain relief and functional outcomes.

Chart 2: Pain & Disability Pre/Post - Group A

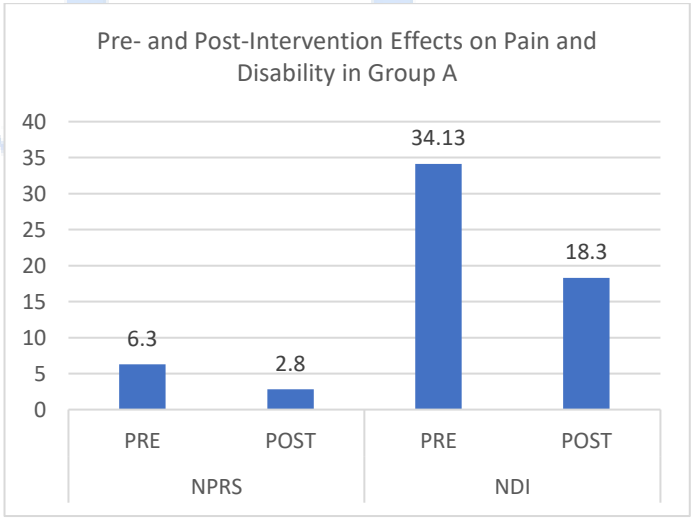


Table 3: Pre- and Post-Intervention Effects on Pain and Disability in Group B

OUTCOME MEASURE		MEAN	SD	T value	P value

NPRS	PRE	6.2	1.1	5.47	0.01
	POST	2.5	0.8		
NDI	PRE	33.23	5.6	5.01	0.02
	POST	16.2	4.5		

Group B demonstrated a significant reduction in pain (NPRS: 6.2 → 2.5, p = 0.01) and disability (NDI: 33.23 → 16.2, p = 0.02) post-intervention, indicating marked improvement in both pain relief and functional ability.

Chart 3: Pain & Disability Pre/Post - Group B

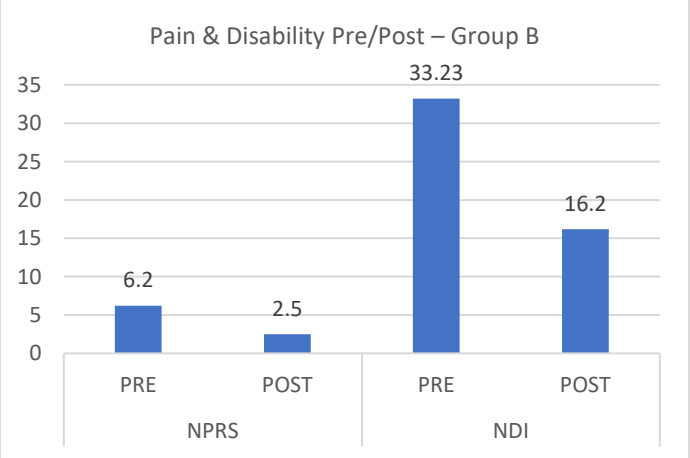
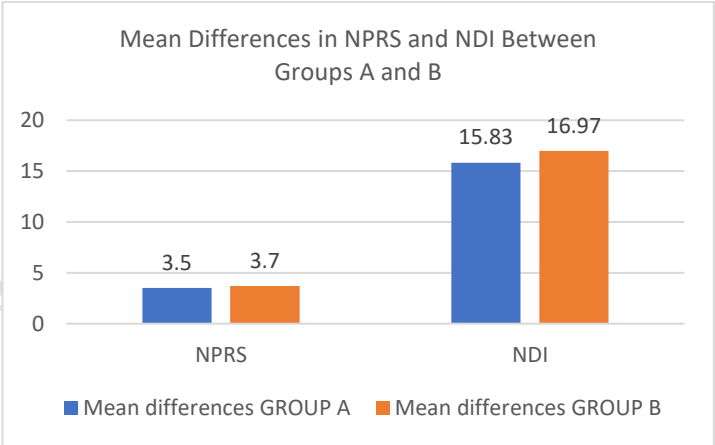


Table 4: Comparison of Mean Differences in NPRS and NDI Scores Between Group A and Group B

From Mean differences	GROUP A		GROUP B		t value	p value
	Mean	SD	Mean	SD		
NPRS	3.5	0.3	3.7	0.3	2.58	0.012
NDI	15.83	0.6	16.97	1.1	4.54	0.001

Comparison between Group A and Group B shows that Group B had slightly greater improvements in pain (NPRS: 3.7 vs. 3.5, p = 0.012) and disability (NDI: 16.97 vs. 15.83, p = 0.001), indicating a statistically significant difference in favor of Group B.

Chart 4: Mean Differences in NPRS and NDI Between Groups A and B



DISCUSSION

The present study included 60 participants, with a slightly higher proportion of males (56.67%) compared to females (43.33%), reflecting a mildly male-dominant sample population. This gender distribution is consistent with previous studies on musculoskeletal pain, which often report a higher prevalence of symptoms or treatment-seeking behaviour among males in occupational or physically demanding settings. The balanced representation of both genders in this study ensures that the results are applicable across sexes while still highlighting subtle gender-related trends that may influence outcomes.

Analysis of pre- and post-intervention data revealed significant improvements in both pain and disability scores within each group. Group A demonstrated a reduction in NPRS from 6.3 to 2.8 (p = 0.01) and

NDI from 34.13 to 18.3 (p = 0.02), indicating substantial improvement in pain relief and functional ability following the intervention. Similarly, Group B showed reductions in NPRS from 6.2 to 2.5 (p = 0.01) and NDI from 33.23 to 16.2 (p = 0.02), suggesting that both interventions were effective. However, when comparing the mean differences between groups, Group B exhibited slightly greater improvements in pain (3.7 vs. 3.5, p = 0.012) and disability (16.97 vs. 15.83, p = 0.001), indicating a statistically significant advantage in favour of Group B. These findings suggest that the intervention applied in Group B may provide superior clinical benefits in reducing pain intensity and improving functional outcomes.

Several studies have investigated the efficacy of IRR in treating chronic neck pain. Odagiri et al. (2022)[16] conducted a feasibility study on a LED light irradiation device, reporting improvements in subjective symptoms of chronic neck with shoulder muscle pain/stiffness following IRR therapy. They attributed these improvements to mechanisms such as anti-inflammatory effects, reduction of oxidative stress, and alleviation of muscle fatigue. Additionally, a pilot study by Lin et al. (2015)[17] assessed the effects of a far-infrared-emitting collar on neck disorders, finding beneficial effects in pain reduction and improved neck function. In contrast, a study by Ortega et al. (2014)[18] on microwave diathermy for treating nonspecific chronic neck pain reported no significant impact compared to a sham treatment, suggesting that not all forms of infrared therapy yield positive outcomes

SWD has been widely studied for its therapeutic effects on musculoskeletal pain. Masiero et al. (2019)[19] reviewed the clinical management of musculoskeletal pain using SWD, concluding that it is effective in reducing pain in the short term and improving the quality of life. Moreover, Pollet et al. (2023)[20] reviewed various electromagnetic diathermy therapies, including SWD, and found them to be effective in reducing pain and improving function in patients with musculoskeletal disorders. However, a study by Sutariya et al. (2023)[21] compared SWD with interferential therapy for mechanical neck pain and found that interferential therapy was more effective in improving pain and function, suggesting that SWD may not always be the superior modality.

When comparing the efficacy of IRR and SWD, our study found that both modalities led to significant improvements in pain and disability scores. However, Group B (SWD) exhibited slightly greater improvements in both NPRS and NDI scores compared to Group A (IRR), with statistically significant differences. This aligns with findings from Pollet et al. (2023)[22], who reported that electromagnetic diathermy therapies, including SWD, are effective in reducing pain and improving function. The slight superiority of SWD in our study may be attributed to its deeper tissue penetration and higher thermal effects, which could lead to more pronounced therapeutic outcomes.

IRR, particularly in the form of near-infrared radiation, penetrates the skin and underlying tissues, promoting vasodilation and increasing local blood circulation. This enhanced circulation facilitates the delivery of oxygen and nutrients to the affected tissues while aiding in the removal of metabolic waste products, thereby reducing pain and

inflammation. [17,18] SWD, on the other hand, utilizes high-frequency electromagnetic waves to generate deep heat within tissues. This deep heating effect increases tissue extensibility, reduces muscle spasm, and enhances the elasticity of collagen fibers, leading to improved range of motion and decreased pain perception. [21,22]

The findings of this study have significant clinical implications for the management of chronic neck pain among office workers. Both IRR and SWD therapies can be effectively integrated into rehabilitation programs to alleviate pain and improve functional outcomes. The choice between IRR and SWD may depend on factors such as availability of equipment, patient preference, and specific clinical indications. Given the slight superiority of SWD observed in this study, clinicians may consider prioritizing SWD for patients requiring deeper tissue penetration and more substantial thermal effects. However, IRR remains a viable option, particularly for patients who may benefit from its non-invasive nature and ease of application.

Despite the promising results, several limitations in which, The sample size of 60 participants may not be sufficient to generalize the findings to the broader population of office workers with chronic neck pain. Additionally, the study's duration was limited to the intervention period, and long-term effects of IRR and SWD therapies remain unknown. Furthermore, the study did not account for potential confounding factors such as ergonomic practices, psychological stress, and individual pain thresholds, which could influence the outcomes. Future studies should aim to include larger, more diverse populations and incorporate long-term follow-up assessments to ascertain the enduring effects of these therapies.

Both IRR and SWD effectively reduced pain and disability in office workers with chronic neck pain, with SWD showing slightly greater improvements. These findings support their use in rehabilitation, highlighting the importance of choosing the modality based on patient needs, tissue depth, and treatment goals.

CONCLUSION

The present study demonstrates that both Infrared Radiation (IRR) and Shortwave Diathermy (SWD) are effective in reducing pain intensity and functional disability in office workers with chronic neck pain. SWD showed slightly superior improvements compared to IRR, likely due to its deeper tissue penetration and enhanced thermal effects. Clinically, both modalities can be integrated into rehabilitation programs to improve pain management and functional outcomes, with modality selection tailored to patient needs and treatment goals. Future research should focus on long-term efficacy, optimal treatment dosages, and combined therapy approaches to further enhance management strategies for occupational neck disorders.

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