



**International Journal of Biology, Pharmacy
and Allied Sciences (IJBPAS)**
'A Bridge Between Laboratory and Reader'

www.ijbpas.com

**EFFECT OF HYDROTHERAPY VERSUS CONVENTIONAL PHYSIOTHERAPY
ON PAIN AND GRIP STRENGTH IN CORPORATE EMPLOYEES WITH CARPAL
TUNNEL SYNDROME: A COMPARATIVE INTERVENTIONAL STUDY**

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Received 14th Dec. 2025; Revised 19th Jan. 2026; Accepted 2nd May 2026; Available online 1st Oct. 2026

<https://doi.org/10.31032/IJBPAS/2026/15.10.10512>

ABSTRACT

Background: Carpal Tunnel Syndrome (CTS) is a common entrapment neuropathy among corporate employees engaged in repetitive computer-based activities. It results in pain, sensory disturbances, reduced grip strength, and functional limitations that affect work performance. Conservative physiotherapy is the first-line treatment for mild to moderate CTS; however, evidence comparing hydrotherapy with conventional physiotherapy remains limited.

Objective: To compare the effectiveness of hydrotherapy and conventional physiotherapy on pain reduction and grip strength improvement in corporate employees with mild to moderate Carpal Tunnel Syndrome.

Methods: A comparative interventional study was conducted on 40 corporate employees clinically diagnosed with mild to moderate CTS. Participants were allocated into two groups: Group A (n=20) received hydrotherapy and Group B (n=20) received conventional land-based physiotherapy. Both groups underwent supervised treatment three times per week for eight weeks. Pain intensity was assessed using the Visual Analogue Scale (VAS) and grip strength was measured using a hand-held dynamometer before and after the intervention. Within-group comparisons were analyzed using the Wilcoxon signed-rank test, and between-group differences were analysed using the Mann-Whitney U test, with significance set at $p < 0.05$.

Results: Both groups demonstrated statistically significant improvements in pain and grip strength ($p < 0.001$). The hydrotherapy group showed significantly greater pain reduction ($p = 0.018$) and grip strength improvement ($p = 0.024$) compared to the conventional physiotherapy group.

Conclusion: Both hydrotherapy and conventional physiotherapy were effective in reducing pain and improving grip strength in individuals with Carpal Tunnel Syndrome. However, hydrotherapy demonstrated significantly superior outcomes, suggesting that aquatic-based interventions may offer additional therapeutic benefits for corporate employees with CTS.

Keywords: Carpal Tunnel Syndrome, Hydrotherapy, Conventional Physiotherapy, Grip Strength, Corporate Employees

INTRODUCTION

Carpal Tunnel Syndrome (CTS) is the most common peripheral entrapment neuropathy, caused by compression of the median nerve within the carpal tunnel at the wrist. It is characterized by pain, numbness, tingling sensations, reduced grip strength, and functional impairment of the hand, which negatively affects activities of daily living and occupational performance. CTS is increasingly prevalent among corporate employees due to prolonged computer usage, repetitive wrist and hand movements, sustained static postures, and poor ergonomic practices in the workplace [1, 2]. The rapid growth of computer-based occupations has contributed significantly to work-related musculoskeletal disorders, with CTS representing a major occupational health issue. Repetitive keyboard and mouse use elevate intercarpal pressure, resulting in mechanical stress, impaired nerve conduction, and ischemic changes of the median nerve [3]. If not managed appropriately, CTS may progress from mild

sensory symptoms to motor deficits, muscle weakness, and permanent functional limitations [4].

Conservative management is widely recommended as the first-line treatment for individuals with mild to moderate CTS. Physiotherapy interventions such as wrist splinting, nerve mobilization techniques, strengthening exercises, electrotherapy modalities, and ergonomic modifications have demonstrated effectiveness in reducing pain and improving hand function [5, 6]. Hydrotherapy, also referred to as aquatic therapy, is an alternative rehabilitation approach that utilizes the therapeutic properties of water, including buoyancy, hydrostatic pressure, viscosity, and thermal effects. Warm water immersion facilitates muscle relaxation, enhances blood circulation, reduces pain perception, and allows exercises to be performed with reduced mechanical stress [7, 8].

Therefore, the present study aims to compare the effectiveness of hydrotherapy

and conventional physiotherapy on pain reduction and grip strength improvement in corporate employees with mild to moderate Carpal Tunnel Syndrome.

Aim of the Study To compare the effectiveness of Hydrotherapy versus Conventional physiotherapy on pain reduction and improvement of grip strength in corporate employees with mild to moderate carpal tunnel syndrome.

Objectives of the Study

1. To assess the level of pain in corporate employees with mild to moderate Carpal Tunnel Syndrome before and after hydrotherapy intervention.
2. To assess the level of pain in corporate employees with mild to moderate Carpal Tunnel Syndrome before and after conventional physiotherapy intervention.
3. To evaluate grip strength in corporate employees with mild to moderate Carpal Tunnel Syndrome before and after hydrotherapy intervention.
4. To evaluate grip strength in corporate employees with mild to moderate Carpal Tunnel Syndrome before and after conventional physiotherapy intervention.
5. To compare the effectiveness of hydrotherapy and conventional physiotherapy on pain reduction in

corporate employees with mild to moderate Carpal Tunnel Syndrome.

6. To compare the effectiveness of hydrotherapy and conventional physiotherapy on improvement of grip strength in corporate employees with mild to moderate Carpal Tunnel Syndrome.

METHODOLOGY

Study Design

This study was designed as a comparative interventional study to evaluate the effectiveness of hydrotherapy versus conventional physiotherapy on pain reduction and grip strength improvement in individuals with carpal tunnel syndrome.

Study Setting and Duration

The study was conducted in a physiotherapy clinical setting over a duration of eight weeks.

Sample Size

A total of 40 participants clinically diagnosed with mild to moderate carpal tunnel syndrome were recruited and allocated into two equal groups (n = 20 each).

- Group A: Hydrotherapy
- Group B: Conventional Physiotherapy

Sampling Technique

Participants were selected using convenience sampling and allocated into two groups using simple allocation methods.

Inclusion Criteria

- Age between 20–60 years
- Both male and female participants
- Clinically diagnosed (Tinnels sign) mild to moderate carpal tunnel syndrome
- Corporate/office employees involved in repetitive computer-based work
- Symptom duration of at least 3 months
- Willingness to participate and provision of written informed consent

Exclusion Criteria

- Severe CTS requiring surgical intervention
- History of wrist or hand fracture or surgery
- Presence of inflammatory arthritis or other neurological disorders
- Pregnancy
- Skin infections, open wounds, or contraindications to hydrotherapy

Intervention

Group A: Hydrotherapy

Participants in Group A received supervised hydrotherapy sessions three times per week for eight weeks. Each session lasted 30–40 minutes and included active wrist and finger movements, grip-strengthening exercises, and functional hand activities performed against water resistance. Water temperature was maintained between 32–34°C. Exercise intensity was progressively increased based on participant tolerance to promote pain-free movement and improvement in grip strength [7].

Group B: Conventional Physiotherapy

Participants in Group B received conventional land-based physiotherapy three times per week for eight weeks. The intervention included wrist splinting, tendon and nerve gliding exercises, stretching of wrist flexors and extensors, strengthening exercises, electrotherapy modality (TENS), and ergonomic advice [14, 15].

Outcome Measures

Pain Intensity:

Pain was assessed using the Visual Analogue Scale (VAS), ranging from 0 (no pain) to 10 (worst imaginable pain) [16].

Hand-Held Dynamometer

Grip strength was measured using a hand-held dynamometer (Jamar dynamometer) in kilograms. Measurements were taken with the participant seated, shoulder adducted, elbow flexed at 90°, forearm in neutral position, and wrist in slight extension, following standardized testing protocol. Three trials were recorded, and the average value was used for analysis [17].

Ethical Approval and Informed Consent

The study protocol was conducted in accordance with the ethical standards of human research and the Declaration of Helsinki. As this was a student-based interventional study involving non-invasive, routine physiotherapy procedures with minimal risk, institutional ethical clearance was waived. Written informed consent was

obtained from all participants prior to enrolment. Confidentiality and anonymity of participant data were strictly maintained throughout the study.

Data Collection Procedure

Baseline measurements of pain and grip strength were recorded prior to the intervention. Post-intervention measurements were recorded after completion of the eight-week intervention period under identical conditions.

Statistical Analysis

- Within-group comparisons were performed using the Wilcoxon signed-rank test.
- Between-group comparisons were analyzed using the Mann–Whitney U test.
- A confidence level of 95% was maintained.
- A p-value less than 0.05 was considered statistically significant.
- Statistical analysis was performed using SPSS software.

RESULTS

A total of 40 participants who were clinically diagnosed with mild to moderate

Carpal Tunnel Syndrome successfully completed the eight-week intervention protocol. The participants were equally divided into two groups, with 20 participants in each group. Group A received Hydrotherapy intervention, while Group B received Conventional Physiotherapy intervention. The mean age of the participants was 35.8 ± 6.4 years, indicating that the study population consisted predominantly of middle-aged adults.

Pain Intensity (VAS Scores)

Pain intensity was assessed using the Visual Analogue Scale (VAS) before and after the eight-week intervention. Both groups demonstrated statistically significant within-group reduction in pain following intervention ($p < 0.001$) (**Figure 1**).

Group A (Hydrotherapy) showed a greater reduction in VAS scores compared to Group B (Conventional Physiotherapy). Between-group comparison using the Mann–Whitney U test revealed a statistically significant difference favouring the hydrotherapy group ($p = 0.018$).

Table 1: Pre- and Post-Intervention VAS Scores

Group	VAS Pre (Mean $\pm$ SD)	VAS Post (Mean $\pm$ SD)
Group A (Hydrotherapy)	6.8 ± 0.9	3.1 ± 0.8
Group B (Conventional)	6.9 ± 1.0	4.2 ± 0.9

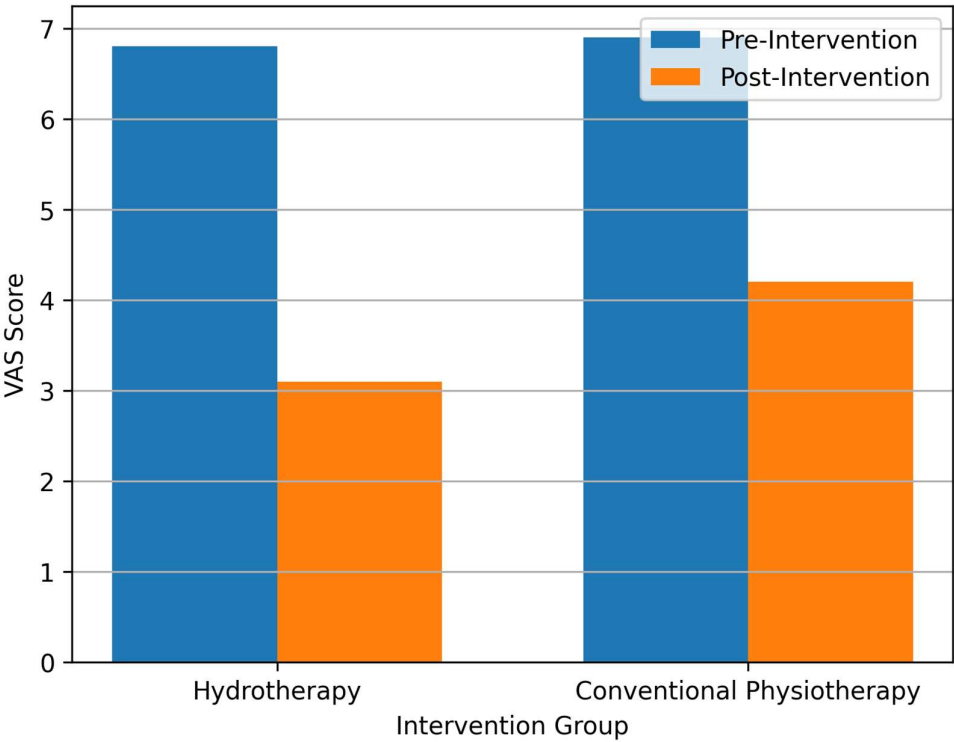


Figure 1: Comparison of Pre and Post Intervention VAS Scores graph

Grip strength was measured using a hand-held dynamometer before and after the intervention. Both groups showed statistically significant within-group improvement in grip strength following treatment ($p < 0.001$) (Figure 2).

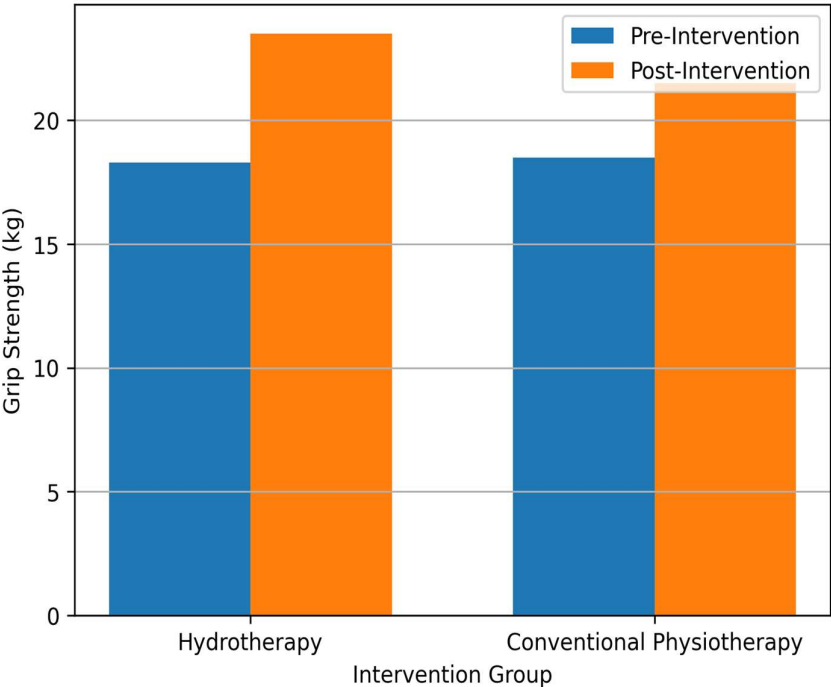


Figure 2: Pre- and Post-Intervention Grip Strength

Group A (Hydrotherapy) demonstrated greater improvement in grip strength compared to Group B (Conventional Physiotherapy). Between-group analysis

using the Mann–Whitney U test showed a statistically significant difference favoring the hydrotherapy group ($p = 0.024$).

Table 2: Pre- and Post-Intervention Grip Strength

Group	Grip Strength Pre (Mean $\pm$ SD)	Grip Strength Post (Mean $\pm$ SD)
Group A (Hydrotherapy)	18.3 $\pm$ 3.4	23.5 $\pm$ 3.6
Group B (conventional)	18.5 $\pm$ 3.2	21.5 $\pm$ 3.4

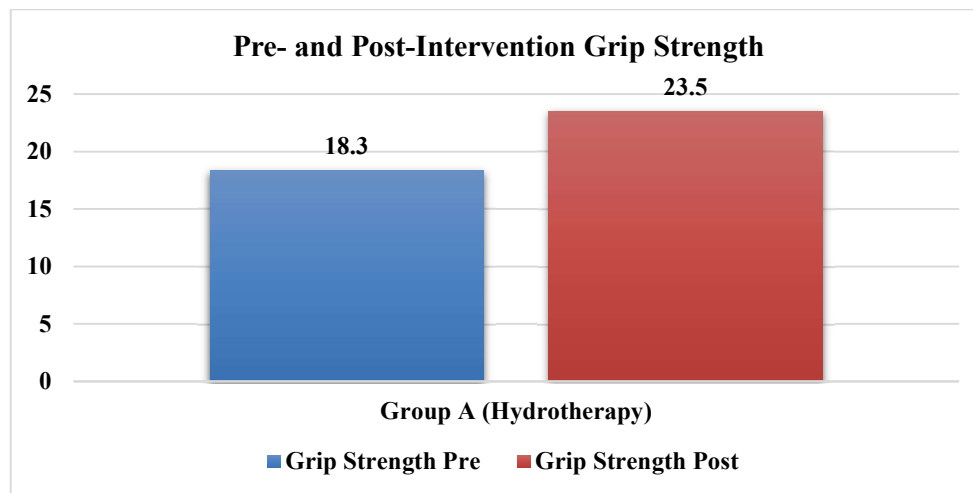


Figure 3: Shows mean value of Pre- and Post Grip Strength of two groups

Table 3: Mean Difference Between Groups

Outcome Measure	Group A (Hydrotherapy) Mean Change	Group B (Conventional Physiotherapy) Mean Change	Between-Group Mean Difference	p-value
Pain (VAS)	-3.7	-2.7	-1.0	0.018*
Grip Strength (kg)	+5.2	+3.0	+2.2	0.024*

Between-group comparison (Mann–Whitney U test): Grip Strength $p = 0.024$ (Statistically significant)

DISCUSSION

The present study aimed to compare the effectiveness of hydrotherapy and conventional physiotherapy on pain reduction and improvement in grip strength among corporate employees with mild to moderate Carpal Tunnel Syndrome (CTS). The findings of the present study demonstrated that both hydrotherapy and conventional physiotherapy were effective

in significantly reducing pain and improving grip strength following the intervention period. These results are consistent with previous studies that have reported the effectiveness of conservative physiotherapy interventions in reducing symptoms and improving hand function in individuals with CTS. Conservative management, including therapeutic exercises and physical agents, has been shown to improve nerve mobility,

reduce inflammation, and enhance functional outcomes in CTS patients [19, 20].

However, when comparing the two intervention groups, hydrotherapy demonstrated superior outcomes compared to conventional physiotherapy. The hydrotherapy group showed a greater reduction in pain and a greater improvement in grip strength than the conventional physiotherapy group. These findings are supported by previous research indicating that aquatic therapy provides additional therapeutic benefits due to the unique physical properties of water [7, 12].

The therapeutic effects of hydrotherapy can be explained by the properties of buoyancy, hydrostatic pressure, viscosity, and thermal effects of water. Buoyancy reduces the effective body weight and decreases mechanical stress on joints and surrounding soft tissues, allowing patients to perform movements with less pain and discomfort [7]. Hydrostatic pressure improves venous return, reduces edema, and enhances circulation, which contributes to pain reduction and tissue healing [12]. Furthermore, warm water immersion promotes muscle relaxation, reduces muscle spasm, and improves tissue extensibility, thereby facilitating better functional performance [21]. The resistive properties of water also provide multidirectional

resistance, which enhances muscle activation, strength, and proprioceptive feedback, leading to greater improvements in grip strength [7, 21].

Previous studies have also reported that hydrotherapy improves muscular strength, reduces pain, and enhances functional ability in patients with musculoskeletal and neurological conditions [12, 22]. The sensory stimulation provided by water immersion may also improve neuromuscular control and functional performance. Therefore, the superior outcomes observed in the hydrotherapy group in the present study may be attributed to the combined mechanical, thermal, and physiological effects of aquatic therapy.

Thus, the findings of the present study suggest that while both hydrotherapy and conventional physiotherapy are effective in the conservative management of CTS, hydrotherapy may provide additional benefits in reducing pain and improving grip strength. These results support the inclusion of hydrotherapy as an effective treatment modality in the rehabilitation of individuals with Carpal Tunnel Syndrome

Limitations

1. Sample Size and Sampling Technique: The study included only 40 participants recruited through convenience sampling, which may limit generalization to larger corporate populations.

2. Short-Term Intervention: The study evaluated outcomes over an eight-week period; long-term effects of hydrotherapy and conventional physiotherapy remain unknown.

3. Lack of Blinding: Participants and therapists were not blinded to the intervention, which may have introduced performance or expectation bias.

4. Limited Outcome Measures: Only pain (VAS) and grip strength were assessed. Functional outcomes such as hand dexterity, quality of life, or work performance were not evaluated.

5. Single-Center Study: Conducted at a single physiotherapy clinical setting, limiting the external validity of the findings across different workplaces or populations.

Clinical Implications

Hydrotherapy may be incorporated as an effective conservative treatment option for corporate employees with mild to moderate Carpal Tunnel Syndrome, particularly for individuals experiencing pain during land-based exercises.

CONCLUSION

Both hydrotherapy and conventional physiotherapy were effective in reducing pain and improving grip strength in corporate employees with mild to moderate Carpal Tunnel Syndrome. However, hydrotherapy demonstrated superior outcomes, providing greater pain relief and

higher improvement in grip strength compared to conventional land-based physiotherapy. The therapeutic properties of water, including buoyancy, hydrostatic pressure, and resistance, likely contributed to enhanced muscle activation and pain-free exercise performance. These findings suggest that hydrotherapy can be considered an effective and potentially superior conservative intervention for CTS management, particularly in corporate populations engaged in repetitive computer-based work. Future studies with larger sample sizes, longer follow-up periods, and additional functional outcome measures are recommended to further validate and generalize these results.

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