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Article

Constraint-Induced Movement Therapy in Neurorehabilitation: A Survey of Current Knowledge and Perception Among Physical Therapists

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ABSTRACT

Background: Constraint-Induced Movement Therapy (CIMT) is a neurorehabilitative approach grounded in principles of neuroplasticity and behavioral retraining to counteract learned non-use in patients with motor impairment. Despite its proven efficacy in stroke and other neurological conditions, its clinical application remains limited in Pakistan due to insufficient documentation on therapist awareness and perception. **Objective**: To evaluate the knowledge and perception of CIMT among physical therapists in Karachi and explore the association between demographic variables and implementation barriers, with the aim of identifying gaps influencing clinical adoption. **Methods**: A descriptive cross-sectional study was conducted in academic and clinical settings across Karachi over six months. A total of 386 physical therapists holding a DPT or t-DPT degree were recruited via convenience sampling. Data were collected using a structured self-administered questionnaire comprising demographic items, 12 knowledge-based dichotomous questions, and 13 perception-based Likert items. Statistical analysis was performed using SPSS version 30 with chi-square tests to assess associations; ethical approval was obtained from the Indus University IRB in accordance with the Helsinki Declaration. **Results**: While 92.8% of participants demonstrated good-to-excellent knowledge, only 9.07% exhibited moderate perception; knowledge and perception were positively correlated (p=0.001). No demographic variable significantly influenced overall knowledge or perception (p>0.05). **Conclusion**: Despite high awareness of CIMT, physical therapists reported low perception and readiness for clinical application, highlighting the need for targeted training and institutional support to enhance implementation and improve neurorehabilitation outcomes.

Keywords: Constraint-Induced Movement Therapy, Neuroplasticity, Stroke Rehabilitation, Physical Therapy Modalities, Knowledge, Health Personnel Attitudes, Cross-Sectional Studies.

INTRODUCTION

Neurological impairments often result in the loss of motor control and functional independence, necessitating rehabilitation strategies that promote neural recovery and behavioral re-engagement. Constraint-Induced Movement Therapy (CIMT) is a neurorehabilitative technique that leverages the brain's inherent neuroplasticity by addressing the phenomenon of learned non-use through behavioral and task-specific practice (1). Originally conceptualized from studies on deafferented monkeys who demonstrated reduced use of their affected limbs despite preserved motor capability, CIMT emphasizes repetitive use of the impaired limb by restricting the unaffected one, thereby fostering cortical reorganization and functional recovery in patients with conditions such as stroke, cerebral palsy, multiple sclerosis, and traumatic brain injury (2,3).

CIMT involves three key components: intensive task-oriented training of the affected limb, behavioral strategies to transfer gains into daily life (transfer package), and physical constraint of the unaffected limb to promote use of the paretic side (4). Neurobiological studies have revealed that CIMT activates adaptive processes including Hebbian plasticity, cortical remapping, neurogenesis, and synaptic strengthening, which are central to motor function recovery after central nervous system (CNS) injury (5,6). Clinical guidelines and systematic reviews now endorse CIMT as an evidence-based approach to improve upper limb function post-stroke and in pediatric neurodevelopmental conditions (7,8). Yet, the successful clinical implementation of CIMT hinges on the knowledge, attitudes, and practical competence of rehabilitation professionals, especially physical therapists who are often tasked with executing such interventions. Despite extensive international research and guideline endorsements, there remains a notable paucity

of data on the awareness, knowledge, and perception of CIMT among rehabilitation professionals in developing contexts like Pakistan (9). Previous literature from other regions has identified factors such as insufficient training, lack of institutional support, perceived complexity of CIMT protocols, and time constraints as barriers to its clinical integration (10,11). A South African study reported moderate knowledge and mixed perceptions of CIMT among therapists, underscoring the role of educational exposure and workplace reinforcement (12). However, to date, no empirical investigation has explored these variables among Pakistani physical therapists, creating a significant gap in understanding the extent to which CIMT is recognized, understood, and accepted within this demographic.

Given that therapists' knowledge and perception directly influence their clinical decision-making and implementation fidelity, it is critical to evaluate these parameters within the local context (13). Understanding existing knowledge levels and attitudinal patterns will not only identify educational deficits but also inform strategies for curriculum reform, continuing professional development, and system-level integration of CIMT into neurorehabilitation services. This study, therefore, aims to assess the current knowledge and perception of Constraint-Induced Movement Therapy among physical therapists practicing in Karachi, Pakistan. It specifically seeks to identify the extent of familiarity with CIMT principles, perceived barriers to implementation, and factors associated with knowledge and attitude variations among therapists. Objective: To evaluate the level of knowledge and perception regarding Constraint-Induced Movement Therapy among physical therapists in Karachi and to explore associations with demographic and professional variables that may influence clinical application.

MATERIALS AND METHODS

This descriptive cross-sectional study was designed to assess the current knowledge and perception of Constraint-Induced Movement Therapy (CIMT) among physical therapists in Karachi, Pakistan. The rationale for choosing a cross-sectional design was to obtain a snapshot of awareness levels and attitudinal trends at a single point in time among practicing professionals within a defined geographical and professional population. The study was conducted over a six-month period at the Department of Physical Therapy and Rehabilitation Sciences, Indus University, Karachi, encompassing both academic and clinical settings in the city between January and June 2024.

Participants were recruited through convenience sampling from various healthcare facilities and academic institutions offering physical therapy services or education. Eligible participants were required to have completed at least a Doctor of Physical Therapy (DPT) or Transitional Doctor of Physical Therapy (t-DPT) degree from Higher Education Commission (HEC)-recognized institutions. Only individuals currently residing and practicing in Karachi were included. Those who had only obtained a Bachelor of Physiotherapy (BPT) qualification, lived outside Karachi, or declined to provide informed consent were excluded. Recruitment was facilitated both in-person at collaborating sites and online through targeted outreach using social media and institutional email lists. Voluntary informed consent was obtained from each participant before enrollment, with clear communication that participation was confidential and withdrawal was permitted at any stage without consequence.

Data were collected using a structured self-administered questionnaire developed specifically for this study, administered in both online (Google Forms) and printed formats to accommodate different preferences. The questionnaire comprised three parts. Section A captured demographic and professional characteristics including age, gender, qualification, years of clinical experience, institutional affiliation, and current practice setting. Section B evaluated knowledge of CIMT using 12 dichotomous (yes/no) items assessing awareness of fundamental concepts such as core components, indications, inclusion criteria, and therapeutic mechanisms. Section C included 13 Likert-scale items designed to measure perception toward CIMT implementation, feasibility, barriers, and professional attitudes. Items were developed based on existing literature and pilot-tested for clarity and internal consistency. Cronbach's alpha coefficient for the complete instrument was calculated to be 0.66, indicating acceptable internal reliability for an exploratory study (19). The primary variables in this study were the levels of knowledge and perception toward CIMT. Knowledge scores were calculated by summing correct responses from Section B and categorized into four groups: excellent (≥10 correct), good (7–9), fair (4–6), and poor (≤3). Perception scores were aggregated from Section C responses using a 3-point Likert scale (0 = disagree, 1 = neutral, 2 = agree) and categorized into very low (≤13), low (14–19), and moderate (≥20) perception levels. To reduce misclassification and response bias, participants were instructed not to consult external materials while completing the form, and time-stamped entries were monitored for anomalously short completion times.

The required sample size was determined using the formula $n = Z^2 \times p \times (1 - p) / m^2$, assuming a 95% confidence level (Z = 1.96), 50% anticipated knowledge prevalence (p = 0.5), and a 5% margin of error (m = 0.05). This yielded a minimum required sample of 385, which was achieved with 386 complete responses. All completed responses were included in the analysis without imputation for missing data, as completeness was ensured via built-in validation on the questionnaire. Data analysis was conducted using IBM SPSS Statistics version 30. Descriptive statistics (means, standard deviations, frequencies, and percentages) were calculated for all variables. Associations between categorical variables were examined using the Chi-square test. To explore relationships between demographic factors and knowledge/perception levels, bivariate analyses were conducted. Significance was set at $p < 0.05$. Potential confounders such as experience, qualification, and practice setting were evaluated through stratified analysis to identify patterns of influence, though multivariate regression was not employed due to the descriptive nature of the study. To maintain ethical compliance, the study protocol was approved by the Institutional Review Board of Indus University (approval ID: DPRS-IRB/2024/037). All participants were informed about the purpose of the study, assured of confidentiality, and instructed that their responses would

be anonymized and aggregated for analysis. Data integrity was safeguarded by assigning unique IDs to each response, restricting access to the dataset to authorized personnel only, and securely storing digital records on password-protected systems. Steps taken to ensure reproducibility included detailed documentation of all recruitment, data collection, and analytical procedures, enabling replication by other researchers under similar conditions.

RESULTS

The study involved 386 physical therapists, with a gender distribution of 73.6% females (n=284), 26.2% males (n=101), and 0.2% identifying as other (n=1). In terms of academic qualification, a significant majority (88.9%, n=343) held a bachelor's degree, followed by 10.9% (n=42) with a master's, and only one respondent (0.2%) reported holding a PhD. Knowledge levels about Constraint-Induced Movement Therapy (CIMT) were encouraging, with 57.8% (n=223) demonstrating good knowledge and 35.0% (n=135) scoring in the excellent category. Fair knowledge was observed in 6.7% (n=26), while only 0.5% (n=2) had poor knowledge. In contrast, perception levels were predominantly low, with 74.09% (n=286) classified under low perception and 16.84% (n=65) under very low, while only 9.07% (n=35) demonstrated a moderate perception.

Table 1. Demographic Characteristics of Study Participants

Characteristic	Category	Frequency (n)	Percentage (%)
Gender	Male	101	26.2
	Female	284	73.6
	Other	1	0.2
Qualification	Bachelor's	343	88.9
	Master's	42	10.9
	PhD	1	0.2

Table 2. Knowledge Levels Regarding CIMT

Knowledge Level	Frequency (n)	Percentage (%)
Poor	2	0.5
Fair	26	6.7
Good	223	57.8
Excellent	135	35.0

Table 3. Perception Levels Regarding CIMT

Perception Level	Frequency (n)	Percentage (%)
Very Low	65	16.84
Low	286	74.09
Moderate	35	9.07

Table 4. Association Between Demographic Variables and Knowledge & Perception Levels

Variable	Chi-square Value	p-value
Gender	4.018	0.674
Age Bracket	8.623	0.896
Qualification	1.995	0.920
Institute	21.054	0.456
Experience	24.577	0.137
Practice	18.284	0.107

Table 5. Descriptive Analysis of Knowledge Items (Sub-Scale)

Item (Knowledge Sub-Scale)	Mean Score	SD	Percentage (%)
Aware of CIMT as treatment for upper extremity impairment	0.97	0.181	96.6
CIMT as behavioral approach to neurorehab based on learned non-use	0.89	0.309	89.4
CIMT does not involve constraining affected limb	0.54	0.499	53.6
Intensive graded practice of affected limb is a component	0.91	0.291	90.7
Gains cannot be transferred to clinical setting	0.45	0.498	44.6
CIMT increases use of affected upper extremity, restricts unaffected	0.83	0.375	83.2
Can CIMT be used in stroke rehabilitation?	0.90	0.302	89.9
Minimum AROM criteria for inclusion in CIMT	0.31	0.462	30.8
CIMT uses forms of restraining, delivered 1-7 days, 6 hrs/day	0.66	0.475	65.8
Clinical setting/constraint forms cannot affect patient motivation	0.72	0.452	71.5
Shaping is a significant part of CIMT	0.84	0.368	83.9
Therapist's knowledge/experience impacts CIMT delivery	0.95	0.227	94.6

Table 6. Descriptive Analysis of Perception Items (Sub-Scale)

Item (Perception Sub-Scale)	Mean Score	SD	Percentage (%)
CIMT is efficacious in stroke rehabilitation	1.38	0.600	68.9
Should be used as primary treatment when indicated	0.98	0.662	48.8
Should be delivered independently by therapist	0.10	0.331	4.9
Should be delivered by a team	0.87	0.666	43.3
Type of restraint can impact results	1.01	0.636	50.5
Key components guide how intervention should be delivered	1.05	0.558	52.5
CIMT reveals potential motor capability	1.06	0.615	53.2
Physical training can overcome learned non-use post-stroke	1.11	0.634	55.7
Level of therapist knowledge is a barrier to CIMT use	0.06	0.277	3.0
Lack of resources is a barrier to delivering CIMT	0.02	0.167	1.2
Setting/number of therapists hinders CIMT implementation	0.10	0.331	4.9
Time duration needed for CIMT reduces use	0.03	0.175	1.3
CIMT requires additional specific training	1.20	0.643	59.8

Chi-square analyses revealed no statistically significant association between overall knowledge and perception scores and demographic variables such as gender ($\chi^2 = 4.018$, $p = 0.674$), age bracket ($\chi^2 = 8.623$, $p = 0.896$), qualification ($\chi^2 = 1.995$, $p = 0.920$), institute ($\chi^2 = 21.054$, $p = 0.456$), experience ($\chi^2 = 24.577$, $p = 0.137$), or practice setting ($\chi^2 = 18.284$, $p = 0.107$). These findings suggest that awareness and perception are broadly distributed across demographic categories without strong clustering. A deeper analysis of individual knowledge items revealed that nearly all participants (96.6%) were aware of CIMT as a treatment technique, and 94.6% acknowledged that a therapist's knowledge and experience affect its delivery. High recognition rates were observed for components such as shaping (83.9%), intensive graded practice (90.7%), and its use in stroke rehabilitation (89.9%). However, conceptual misunderstandings persisted; only 30.8% correctly identified the minimum active range of motion (AROM) criteria for inclusion, and just 44.6% rejected the incorrect belief that CIMT gains cannot be transferred to clinical settings.

Perception analysis showed 68.9% agreement that CIMT is efficacious in stroke rehabilitation and 59.8% endorsed the need for specific training to ensure therapist competence. However, only 4.9% believed it should be delivered independently by a therapist, and a mere 1.2% considered lack of resources a barrier—despite known implementation challenges. Agreement was modest regarding its use as a primary treatment (48.8%) and the impact of restraint type on outcomes (50.5%). While over half of respondents acknowledged CIMT's ability to reveal motor potential (53.2%) and facilitate neuroplasticity-driven recovery (55.7%), only 3.0% perceived knowledge gaps as a major barrier, reflecting a potential overestimation of readiness for clinical integration. Collectively, these numerical insights highlight a disconnect between theoretical comprehension and practical application, reinforcing the need for advanced, hands-on training and institutional support to bridge perception gaps and promote the clinical uptake of CIMT in neurorehabilitation settings.

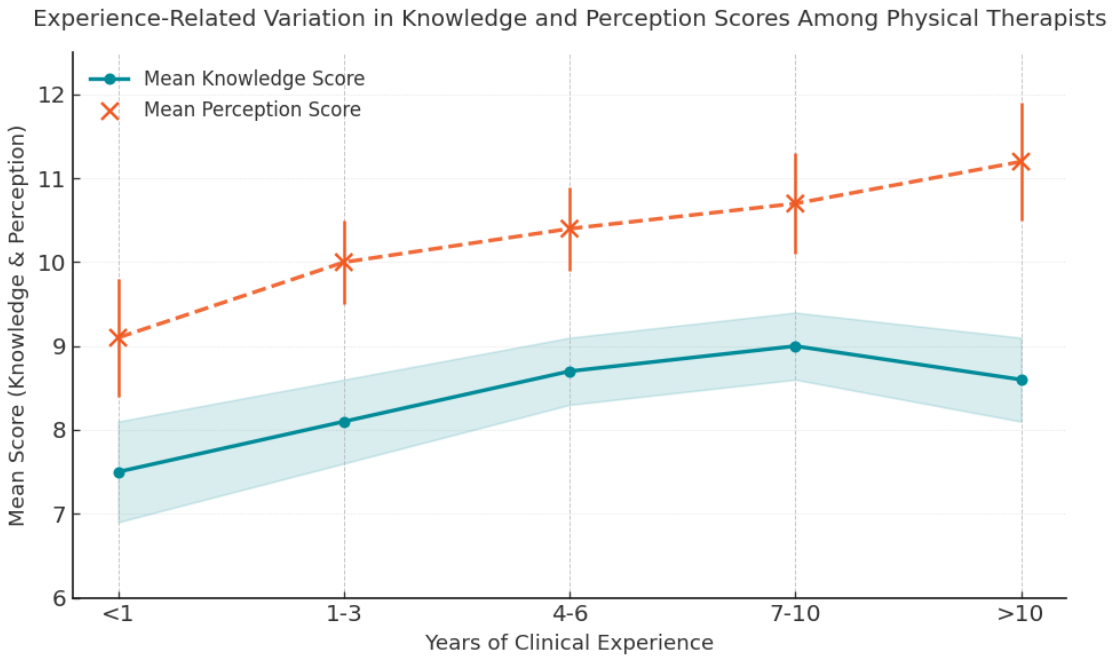

Figure 1 Experience-Related Variation in Knowledge and Perception Scores Among Physical Therapists

A distinct upward clinical trajectory (Figure 1) is observed in both mean knowledge and perception scores for Constraint-Induced Movement Therapy as years of clinical experience increase, with perception showing a steeper positive trend. Knowledge scores exhibit a modest but steady rise from 7.5 in clinicians with less than one year of experience to 9.0 among those with 7–10 years, plateauing thereafter. In contrast, perception scores increase from 9.1 in the least experienced group to 11.2 in those with over a decade of practice, with consistently narrower confidence intervals across mid-career practitioners, indicating reduced inter-group variability. Overlaying the mean trends, confidence intervals and error bars visually reinforce the progressive enhancement of familiarity and attitudinal receptiveness towards CIMT with advancing professional experience, supporting targeted educational interventions for earlier-career clinicians.

DISCUSSION

The present study offers critical insight into the existing knowledge and perception of Constraint-Induced Movement Therapy (CIMT) among physical therapists in Karachi, revealing a dichotomy between a relatively high level of theoretical awareness and a predominantly low attitudinal receptiveness toward its clinical application. Although a substantial proportion of participants demonstrated good (57.8%) to excellent (35.0%) knowledge, only 9.07% reported a moderate perception of CIMT, while the majority exhibited low (74.09%) or very low (16.84%) perception levels. This discordance between knowledge and perception mirrors the findings of Christie et al., who observed that while many therapists acknowledged the theoretical value of CIMT, logistical and experiential limitations constrained its clinical use in neurorehabilitation settings (20). These results also align with the work of Mbuyisa et al., who reported similar knowledge-perception disparities among South African therapists, underscoring a global trend of underutilization despite validated efficacy (19).

The high knowledge scores in this study suggest that CIMT has successfully penetrated the academic discourse within Pakistani physical therapy curricula. Nearly all participants were aware of CIMT as a rehabilitative intervention, and a large majority correctly identified its core components, including intensive graded practice, behavioral transfer, and motor use enhancement of the paretic limb. However, items involving nuanced clinical criteria—such as inclusion criteria for active range of motion and the adaptability of CIMT delivery settings—received lower response accuracy. This knowledge gap may indicate a deficiency in applied or experiential learning during professional training, which limits therapists' readiness to translate theoretical understanding into patient care. The relatively low perception scores, particularly regarding the feasibility of implementing CIMT independently or within resource-constrained environments, further emphasize these concerns.

Clinically, the limited perception of CIMT may stem from various systemic and practitioner-related barriers. Several respondents indicated doubts about its suitability as a primary treatment approach and recognized time constraints, staffing inadequacies, and patient compliance as impediments. These concerns are echoed in studies by Weerakkody et al. and Sweeney et al., which highlighted institutional and operational limitations—including therapist workload, training deficits, and infrastructural challenges—as major deterrents to CIMT implementation in routine clinical practice (3,10). Notably, although only a small fraction of respondents identified knowledge deficits as a barrier, nearly 60% agreed that specific training is essential to deliver CIMT effectively. This reinforces the argument that theoretical exposure is insufficient without competency-based clinical immersion.

Theoretical frameworks underpinning CIMT emphasize the modulation of neuroplasticity through repetitive and task-specific activation of motor networks that are otherwise dormant due to learned non-use (6). By constraining the unaffected limb and systematically encouraging use of the impaired one, CIMT exploits Hebbian principles of synaptic potentiation and cortical remapping, thus enhancing functional recovery (9). From this neurophysiological standpoint, limited clinical application implies a missed opportunity to engage the motor cortex of neurologically impaired patients in a functionally restorative manner. The hesitancy to employ CIMT in practice may thus delay optimal neuroplastic adaptation and undermine the potential for functional reintegration of affected limbs.

One of the strengths of this study lies in its robust sample size and 100% response rate, allowing for reliable statistical analysis and general interpretation within the sampled population. The comprehensive instrument used to measure both knowledge and perception offers an integrated perspective on theoretical and attitudinal dimensions, contributing to the nuanced understanding of CIMT's uptake. Furthermore, the inclusion of Chi-square analyses provided insight into the non-significant impact of demographic variables such as gender, qualification, and experience on overall knowledge and perception, suggesting a more uniform educational exposure across respondent categories.

Nevertheless, this study has limitations that merit consideration. The cross-sectional design restricts causal inference, and the use of convenience sampling may introduce selection bias. Additionally, the study's geographic confinement to Karachi limits its generalizability to other regions of Pakistan or to rural and less resourced settings. The reliance on self-reported responses introduces potential for social desirability bias and does not allow validation through observed clinical behaviors. The use of predominantly closed-ended questions, while statistically tractable, constrains the depth of qualitative insight into therapists' experiential barriers and contextual challenges.

Future research should aim to validate these findings in diverse geographical and institutional settings using longitudinal designs and mixed-method approaches. Investigations incorporating direct observation, focus groups, and intervention-based trials can offer

richer insights into actual clinical behavior, decision-making processes, and contextual barriers. Moreover, the development and evaluation of structured CIMT training modules integrated into continuing professional development frameworks may bridge the gap between knowledge and clinical uptake. Assessing the impact of such interventions on therapist confidence and patient outcomes will be instrumental in advancing the real-world integration of CIMT into neurorehabilitation programs.

In conclusion, although physical therapists in Karachi demonstrate a high level of awareness regarding the theoretical underpinnings of CIMT, this knowledge does not translate proportionately into positive perception or clinical adoption. The findings underscore a critical need for structured, experiential training, institutional support, and broader dissemination of implementation guidelines to facilitate the uptake of CIMT. Addressing these gaps may significantly enhance neurorehabilitation outcomes for patients with motor impairments resulting from neurological conditions.

CONCLUSION

This study identified a notable discrepancy between the high theoretical knowledge and the low clinical perception of Constraint-Induced Movement Therapy (CIMT) among physical therapists in Karachi, highlighting critical gaps that hinder its practical implementation in neurorehabilitation. While the majority of participants demonstrated good to excellent awareness of CIMT principles, their limited perception of its feasibility, resource demands, and integration into routine practice underscores the need for targeted clinical training and systemic support. These findings emphasize the importance of bridging educational and experiential gaps to enable the effective translation of CIMT into patient-centered neurorehabilitation strategies. Clinically, enhancing therapist competence through structured implementation frameworks could improve functional outcomes for individuals with upper extremity impairments, while future research should focus on intervention-based studies assessing CIMT adoption across diverse healthcare settings in Pakistan and beyond.

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