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# Assessment of Knowledge and Clinical Competency in Vestibular Rehabilitation Among Physical Therapists in Karachi: A Cross-Sectional Study

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## ABSTRACT

***Background:*** *Vestibular disorders disrupt the inner-ear balance system and manifest as vertigo, dizziness, and imbalance, impairing daily function and increasing fall risk. Their annual global incidence is approximately 7.4%, rising to over 30% in adults older than 65 years, while in Pakistan vestibular complaints account for an estimated 3-24.7% of neurological presentations, with a disproportionate burden reported in Karachi. Vestibular rehabilitation (VR), originating from the Cawthorne-Cooksey exercise program and later refined by Herdman, employs habituation, adaptation, and substitution strategies-including gaze-stabilization exercises and canalith repositioning maneuvers such as the Epley maneuver-to achieve symptom resolution in 70-80% of patients within 4-6 weeks.*

***Objective:*** *To evaluate the level of knowledge and clinical competency in vestibular rehabilitation among physical therapists practicing in Karachi.*

***Methods:*** *An observational cross-sectional study was conducted among physical therapists practicing in Karachi (Liaquat National Hospital, Ziauddin Hospital, and Saifee Hospital), recruited through non-probability convenience sampling. A minimum sample of 250 was targeted (WHO OpenEpi, 5% margin of error, 95% CI; minimum required n = 149). Physical therapists with prior specialist certification in vestibular rehabilitation or those not currently managing dizzy patients were excluded. Data were collected using a 22-item, Delphi-developed questionnaire spanning awareness, assessment-test knowledge, rehabilitation-maneuver knowledge, clinical competency, and training/practice exposure, validated by three vestibular rehabilitation specialists (Cronbach's alpha = 0.77 in the study sample). Data were analyzed in IBM SPSS (v29.0) following STROBE reporting guidelines, using descriptive statistics, Pearson correlation, chi-square tests of association, and diagnostic checks (multicollinearity, normality, homogeneity of variance).*

***Results:*** *Of 265 questionnaires distributed, 249 were included in the final analysis (94.0% valid response). Respondents were predominantly young and early-career (89.6% aged 25-28 years; 35.7% with under one year of clinical practice). Overall knowledge and competency was poor in 171 respondents (68.7%), moderate in 56 (22.5%), and good in only 22 (8.8%). By domain, knowledge of assessment tests was poor in 70.3% and knowledge of rehabilitation maneuvers was poor in 78.7% (the weakest domain overall), whereas general awareness of vestibular rehabilitation was good in 94.4% and reported training/practice*

*exposure was good in 85.5%. Clinical-competency scores were more evenly distributed (30.1% good, 30.5% moderate, 39.4% poor). Competency improved with increasing age and years of clinical experience, and respondents who learned through workshops or self-study showed slightly higher rates of good knowledge than those relying on formal curricula alone. The questionnaire demonstrated satisfactory internal consistency (Cronbach's alpha = 0.77) and no problematic multicollinearity among predictors (all VIF < 2). Chi-square analysis showed significant associations between knowledge level and age (p = 0.01) and between knowledge level and years of clinical practice (p = 0.02), whereas the source through which vestibular rehabilitation was learned was not significantly associated with knowledge (p = 0.12).*

***Conclusion:*** *Physical therapists in Karachi report high awareness of vestibular rehabilitation but demonstrate a substantial deficit in the practical knowledge and clinical skills required to assess and treat vestibular disorders, particularly in diagnostic testing and repositioning maneuvers. This awareness-competency gap indicates an urgent need for structured, hands-on, competency-based training-including supervised clinical practice and standardized skills assessment-integrated into physiotherapy curricula and continuing professional development, with support from academic institutions and professional bodies to standardize training and embed vestibular rehabilitation competencies into licensing and re-certification requirements.*

***Keywords:*** *Vestibular rehabilitation; Benign Paroxysmal Positional Vertigo (BPPV); Dix-Hallpike test; canalith repositioning maneuver; vestibulo-ocular reflex; physical therapists; clinical competency*

## INTRODUCTION

Vestibular rehabilitation (VR) is a specialized, exercise-based intervention for the physical and psychological impairments arising from vestibular disease or dysfunction [1]. Vestibular disorders-encompassing vertigo, dizziness, imbalance, and nystagmus-represent a substantial global health burden, contributing to significant morbidity, reduced quality of life, and rising healthcare costs [2]. These disorders originate from dysfunction of the vestibular system, the inner-ear sensory apparatus that detects head motion and, through integration with visual and proprioceptive input, maintains spatial orientation and balance. Common causes include benign paroxysmal positional vertigo (BPPV), which accounts for 20-30% of cases through displacement of otoconia within the semicircular canals; vestibular neuritis, typically of viral origin; Meniere's disease, characterized by endolymphatic hydrops; and central pathologies such as vestibular migraine or cerebrovascular events [3].

Globally, dizziness has a lifetime prevalence of approximately 35%, an annual incidence of 7.4%, and a prevalence exceeding 30% in adults over 65, contributing to 5-10% of emergency department visits [2]. In Pakistan, and particularly in Karachi-a metropolis of over 16 million residents-vestibular complaints comprise an estimated 3-24.7% of neurological evaluations and 3.11% of emergency neurology presentations, a burden compounded by urban traffic accidents, pollution-related exacerbations, and limited access to specialized vestibular diagnostics.

The vestibular system relies on the semicircular canals for angular acceleration, the utricle and saccule for linear acceleration and gravity detection, and neural projections to the vestibular nuclei, cerebellum, and extraocular muscles via the vestibulo-ocular reflex (VOR) and vestibulospinal tract [4]. Peripheral hypofunction or central lesions that disrupt this integration produce acute vertigo, oscillopsia, and postural instability; without intervention, central compensation is achieved in only about half of cases, and unresolved symptoms are associated with recurrent falls (a 2-3-fold increase in risk), anxiety, avoidance behavior, and reduced functional independence [5].

Physical therapists are positioned as the principal providers of VR, an evidence-based intervention first described by Cawthorne and Cooksey in the 1940s and subsequently developed by Herdman around three mechanisms: habituation (desensitization to provocative stimuli), adaptation (recalibration of VOR gain through gaze-stabilization exercises), and substitution (enhanced reliance on visual and proprioceptive input) [6]. Randomized controlled trials consistently demonstrate that structured VR produces 70-80% symptom resolution within 4-6 weeks and clinically meaningful reductions in Dizziness Handicap Inventory scores, with lower recurrence than symptomatic pharmacotherapy such as vestibular suppressants, which mask rather than resolve the underlying dysfunction [7].

Despite this evidence base, VR remains underutilized, particularly in resource-constrained settings. Regional studies report marked knowledge and competency gaps among healthcare professionals: physical therapy interns in Saudi Arabia averaged only 28% on standardized VR knowledge assessments, with most learning occurring through informal workshops rather than formal curricula; comparable patterns of beginner-level proficiency have been reported in South Korea and Ghana despite routine exposure to balance-disordered patients [8]. In Pakistan, vertigo management continues to be dominated by pharmacotherapy, reflecting both physician misconceptions about VR and limited therapist confidence, with correspondingly low adoption of standardized assessment maneuvers such as the Dix-Hallpike test and canalith repositioning procedures such as the Epley maneuver [9]. In Karachi specifically, an estimated 2,000-3,000 licensed physical therapists serve a growing caseload of geriatric and trauma-related vestibular presentations, yet local physiotherapy training programs allocate minimal dedicated instruction in vestibular assessment and treatment, favoring musculoskeletal and cardiopulmonary rehabilitation content and leaving graduates with theoretical familiarity but limited practical competence-for example, difficulty differentiating peripheral from central vertigo or performing canalith repositioning independently [10].

This disparity between the demonstrated efficacy of VR and the realities of clinical practice in Karachi underscores the significance of the present study. No prior Karachi-specific data quantify physical therapists' knowledge of, or competency in, vestibular rehabilitation, despite global benchmarks-such as the American Physical Therapy Association's Clinical Practice Guidelines-mandating entry-level competencies including oculomotor screening and gait analysis [1,13]. Quantifying these gaps can inform curriculum reform, targeted continuing-education workshops, and policy engagement with the Pakistan Physical Therapy Association, with the broader aim of reducing unnecessary emergency neuroimaging, lowering fall-related morbidity, and improving access to evidence-based, first-line rehabilitative care for vestibular disorders in Pakistan's largest city [11,12].

### *Objective and Hypothesis*

The primary objective of this study was to evaluate the level of knowledge and clinical competency in vestibular rehabilitation among physical therapists practicing in Karachi. The null hypothesis (H0) stated that there is no significant difference in knowledge and clinical-competency levels in vestibular rehabilitation among physical therapists in Karachi; the alternative hypothesis (Ha) stated that a significant difference exists.

## METHODS

### *Study Design and Setting*

This was an observational, cross-sectional study conducted over a six-month period following synopsis approval, at three tertiary-care teaching hospitals in Karachi, Pakistan: Liaquat National Hospital, Ziauddin Hospital, and Saifee Hospital. Ethical approval and institutional permission for data collection were obtained from the Department of Allied Health Sciences, Indus University, Karachi.

### *Population and Sampling*

The target population comprised licensed physical therapists actively practicing in hospitals, rehabilitation centers, and private clinics across Karachi, with heterogeneous levels of professional experience, qualification, and exposure to vestibular rehabilitation. Participants were recruited using non-probability convenience sampling. Inclusion criteria comprised physical therapists aged 20-35 years of either gender with clinical exposure to vestibular disorders. Physiotherapy students and therapists not directly involved in clinical practice were excluded, as were therapists holding prior specialist certification in vestibular rehabilitation or those not currently managing dizzy patients.

### *Sample Size*

The minimum required sample size was calculated using OpenEpi (version 3.01) with a 5% margin of error and 95% confidence interval, yielding a minimum of n = 149. A target of 250 was set to improve precision. A total of 265 questionnaires were collected; 16 were excluded for incomplete data, leaving 249 valid responses for analysis (94.0% valid response rate).

### *Instrument and Data Collection*

Data were collected using a structured, 22-item questionnaire developed through the Delphi method and validated by three vestibular rehabilitation specialists. The instrument comprised a demographic section (age, gender, duration of clinical practice, and source of vestibular rehabilitation training) and four assessment domains: (i) awareness of the physical therapist's role in vestibular disorders; (ii) training and clinical-practice exposure; (iii) knowledge of assessment tests and rehabilitation maneuvers learned during academic training; and (iv) two applied clinical vignettes assessing differentiation of peripheral versus central vertigo and canal-specific localization. Items were scored dichotomously (yes/no) or by maneuver/test recognition and aggregated into good, moderate, and poor categories for each domain. The instrument demonstrated satisfactory internal consistency (Cronbach's alpha = 0.77). Data were collected using both physical questionnaire copies and an online Google Forms survey, administered after participants provided informed consent.

### *Variables*

Dependent variables were knowledge of, and clinical competency in, vestibular rehabilitation. Independent variables comprised age, duration of clinical practice, and source of vestibular rehabilitation training (formal university curriculum, workshops, self-learning, or media).

### *Statistical Analysis*

Data were analyzed using IBM SPSS Statistics (version 29.0) in accordance with STROBE reporting guidelines for observational studies. Descriptive statistics (frequencies, percentages, means, standard deviations) characterized the sample and each knowledge domain. Pearson's correlation coefficient assessed inter-item relationships within the knowledge and awareness scale. Pearson chi-square tests evaluated associations between knowledge level and age, clinical practice duration, and training source, with the null hypothesis rejected at $p < 0.05$. Diagnostic analyses included Cronbach's alpha for internal-consistency reliability, variance inflation factor (VIF) for multicollinearity among independent variables, the Shapiro-Wilk test for normality, and Levene's test for homogeneity of variance.

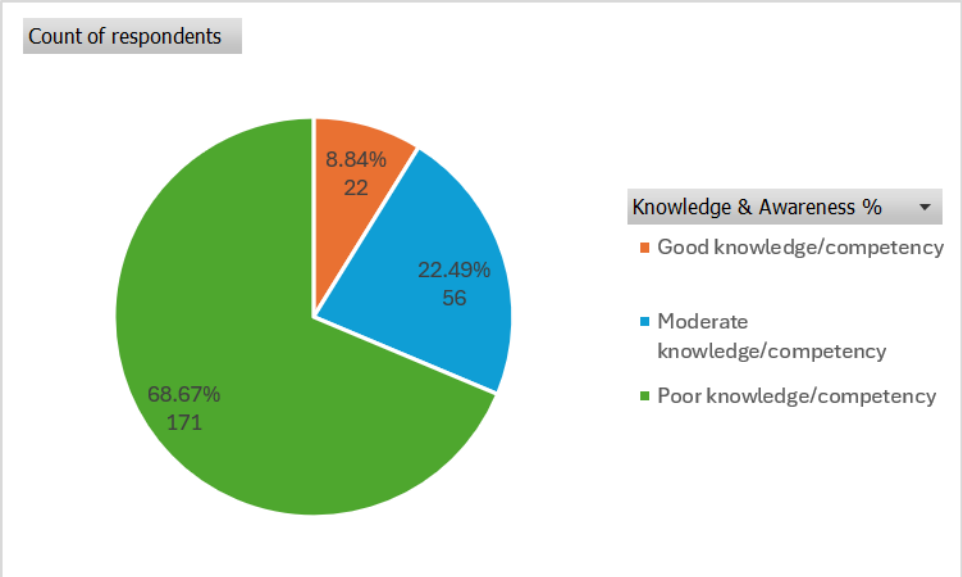
## RESULTS

### *Sample Characteristics*

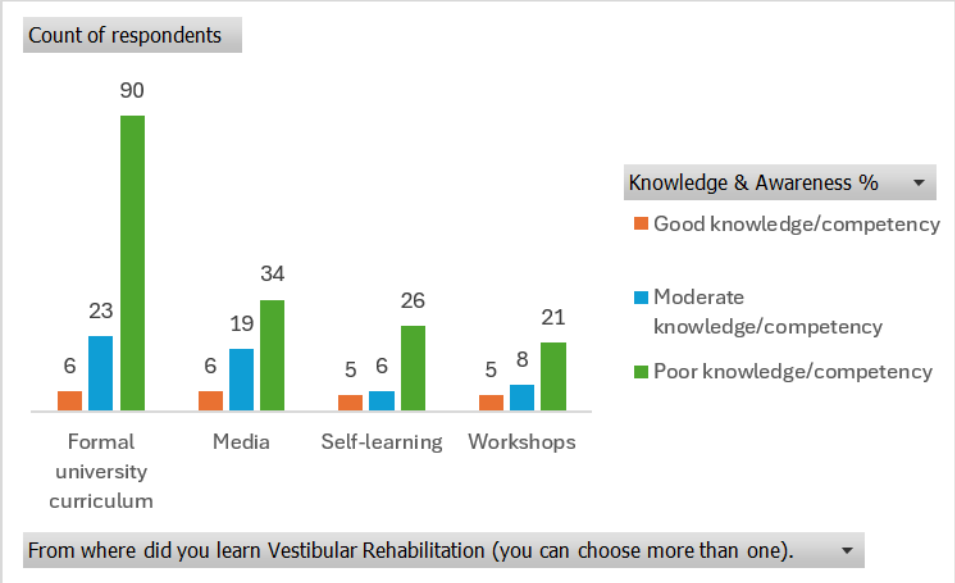
Of the 249 respondents, the large majority (223, 89.6%) were aged 25-28 years, 22 (8.8%) were aged 29-35 years, and 4 (1.6%) were aged 36-40 years, reflecting a predominantly young, early-career sample. Regarding clinical experience, 89 respondents (35.7%) had less than one year of practice, 81 (32.5%) had more than one year, 40 (16.1%) more than two years, 15 (6.0%) more than three years, 10 (4.0%) more than four years, and 14 (5.6%) more than five years. Vestibular rehabilitation knowledge was most commonly acquired through formal university curricula (119, 47.8%), followed by media (59, 23.7%), self-learning (37, 14.9%), and workshops (34, 13.7%).

**Table 1. Descriptive statistics of demographic and training variables (N = 249)**

| Variable | N | Min | Max | Mean | SD |
|---|---|---|---|---|---|
| Age category | 249 | 1 | 3 | 1.12 | 0.37 |
| Duration of clinical practice | 249 | 1 | 6 | 2.27 | 1.40 |
| Source of VR training | 249 | 1 | 4 | 2.14 | 1.25 |




Among the 249 respondents, only 22 participants (8.84%) demonstrated good knowledge/competency, while 56 (22.49%) exhibited moderate knowledge/competency. The majority, 171 respondents (68.67%), fell within the poor knowledge/competency category. These findings indicate a substantial knowledge gap regarding vestibular rehabilitation among participants. The predominance of poor competency suggests that most respondents may lack adequate theoretical understanding or clinical confidence in this area. The relatively small proportion of highly competent individuals highlights the need for enhanced educational and professional training initiatives.




Among respondents who learned through a formal university curriculum, 6 (5.0%) had good knowledge, 23 (19.3%) moderate knowledge, and 90 (75.6%) poor knowledge. Media learners demonstrated 10.2% good and 57.6% poor knowledge, while self-learners showed 13.5% good and 70.3% poor knowledge. Workshop participants exhibited 14.7% good knowledge and 61.8% poor knowledge. Analytically, workshops and self-learning produced relatively higher proportions of good competency than formal curricula alone, suggesting that supplementary educational approaches may enhance vestibular rehabilitation knowledge more effectively than traditional academic exposure.

***Overall Knowledge and Clinical Competency***

Overall knowledge and clinical competency in vestibular rehabilitation was poor in 171 respondents (68.7%), moderate in 56 (22.5%), and good in only 22 (8.8%), indicating a substantial knowledge-practice gap across the sample.

***Domain-Specific Performance***

Performance varied markedly across the five assessed domains. Knowledge of vestibular assessment tests (e.g., Dix-Hallpike, roll test) was poor in 175 respondents (70.3%), moderate in 51 (20.5%), and good in 23 (9.2%). Knowledge of rehabilitation maneuvers (e.g., Epley, canalith repositioning) was the weakest-performing domain, poor in 196 respondents (78.7%), moderate in 38 (15.3%), and good in only 15 (6.0%). By contrast, general awareness of the physical therapist's role in vestibular disorders was very high, with 235 respondents (94.4%) rated good, 13 (5.2%) moderate, and only 1 (0.4%) poor. Reported training/practice exposure was also comparatively strong, rated good in 213 respondents (85.5%), moderate in 23 (9.2%), and poor in 13 (5.2%). Clinical-competency scores, reflecting applied clinical reasoning, were more evenly distributed: 75 respondents (30.1%) good, 76 (30.5%) moderate, and 98 (39.4%) poor. Collectively, these findings show that high awareness of vestibular rehabilitation did not translate into corresponding technical knowledge or applied clinical skill.

### *Correlation Analysis*

Pearson correlation among the twelve knowledge and awareness items showed generally weak-to-moderate positive relationships, indicating that individual items captured distinct facets of vestibular rehabilitation knowledge while contributing to a common underlying construct. The strongest inter-item correlation was between items 9 and 10 (r = 0.70), and both items correlated strongly with the overall knowledge and awareness score (r = 0.80 each), identifying them as key contributors to the composite measure. Negative correlations were minimal and weak, indicating limited contradictory response patterns and supporting acceptable internal coherence of the instrument.

### *Associations with Demographic and Training Variables*

Chi-square analysis identified statistically significant associations between age and knowledge/awareness level (chi-square = 12.64, p = 0.01) and between duration of clinical practice and knowledge/awareness level (chi-square = 21.49, p = 0.02), indicating that both increasing age and accumulated clinical experience were associated with higher knowledge. In contrast, the source through which participants learned vestibular rehabilitation was not significantly associated with knowledge level (chi-square = 10.11, p = 0.12), suggesting that ongoing clinical exposure contributed more to knowledge acquisition than the initial educational pathway. Consistent with this pattern, subgroup analysis showed that the proportion of respondents with good knowledge rose from 9.0% among those with under one year of experience to 35.7% among those with more than five years of experience. By training source, workshop-based (14.7% good) and self-directed learners (13.5% good) showed slightly higher rates of good knowledge than those trained solely through formal university curricula (5.0% good) or media (10.2% good), although poor knowledge remained the predominant category across all training pathways.

**Table 2. Chi-square analysis of associations between knowledge/awareness and demographic variables**

| Association | Pearson chi-square | p-value | Interpretation |
|---|---|---|---|
| Age * Knowledge & Awareness | 12.64 | 0.01 | Significant association |
| Clinical practice * Knowledge & Awareness | 21.49 | 0.02 | Significant association |
| Training source * Knowledge & Awareness | 10.11 | 0.12 | Not significant |

### *Reliability and Diagnostic Checks*

The twelve-item knowledge and awareness scale demonstrated good internal consistency (Cronbach's alpha = 0.77), exceeding the conventional 0.70 threshold. Variance inflation factors for the independent variables were all well below the conservative threshold of 5 (age, VIF = 1.51; clinical practice, VIF = 1.55; training source, VIF = 1.04), indicating no problematic multicollinearity among predictors. Shapiro-Wilk and Levene's tests were conducted to assess distributional assumptions across demographic subgroups; results supported adequate distributional stability and homogeneity of variance for the comparative analyses performed.

## DISCUSSION

This cross-sectional study is, to our knowledge, among the first to quantify knowledge and clinical competency in vestibular rehabilitation among physical therapists specifically within Karachi, Pakistan. Among 249 respondents, the majority-predominantly young, early-career clinicians-demonstrated poor overall competency (68.7%), despite near-universal awareness of the relevance of vestibular rehabilitation to physical therapy practice (94.4% good awareness). This awareness-competency disconnect was most pronounced in the technical domains of assessment-test knowledge (70.3% poor) and rehabilitation-maneuver knowledge (78.7% poor), the two domains most directly tied to hands-on patient management.

These findings are consistent with regional literature documenting a persistent gap between theoretical familiarity and applied clinical skill in vestibular rehabilitation. Comparable knowledge deficits have been reported among physical therapy interns in Saudi Arabia, where most respondents relied on informal workshops rather than structured curricula to acquire vestibular rehabilitation skills [8], and among physiotherapists more broadly, where specialized training-rather than awareness alone-has been repeatedly identified as the strongest predictor of competency [22-25]. The present findings extend this pattern to the Pakistani context, where vertigo management in clinical practice continues to be dominated by pharmacotherapy rather than physical-therapist-led rehabilitation [9].

The significant associations between knowledge level and both age ($p = 0.01$) and years of clinical practice ($p = 0.02$) suggest that competency accrues gradually through cumulative clinical exposure. This is consistent with prior evidence that therapists with more than five years of experience demonstrate superior assessment accuracy and treatment application compared with less-experienced peers [15]. Notably, however, the source of initial training was not significantly associated with knowledge ($p = 0.12$), and workshop-based and self-directed learners in this sample showed marginally higher rates of good knowledge than those trained solely through formal university curricula. This pattern implies that current entry-level physiotherapy education in Karachi may not adequately equip graduates with practical vestibular rehabilitation skills, and that supplementary, hands-on educational formats may be comparatively more effective at building applied competency than didactic instruction alone-consistent with prior calls to integrate structured vestibular rehabilitation modules and hands-on workshops into physiotherapy curricula [23,28].

Clinically, the near-universal awareness of vestibular rehabilitation observed here is an encouraging foundation, but it does not, by itself, ensure competent patient care. Given that VR-particularly canalith repositioning maneuvers such as the Epley maneuver-achieves 70-80% symptom resolution within 4-6 weeks when correctly applied [7], the low rates of maneuver knowledge documented in this study represent a missed opportunity for a low-cost, first-line, non-pharmacological intervention in a healthcare system where emergency neuroimaging for dizziness is frequently overutilized. Strengthening physical therapists' technical competency in vestibular assessment and treatment could plausibly reduce unnecessary investigations, fall-related morbidity, and reliance on symptomatic pharmacotherapy, in line with WHO Rehabilitation 2030 priorities for non-communicable disease management [16].

### *Limitations*

This study has several methodological limitations. The cross-sectional observational design precludes causal inference regarding the relationships among age, clinical experience, and vestibular rehabilitation knowledge. Non-probability convenience sampling increases the risk of selection bias and limits generalizability to all physical therapists in Karachi or elsewhere in Pakistan. Reliance on a self-reported questionnaire may introduce social desirability and recall bias, potentially over- or under-estimating actual clinical competency, as no objective, observed skills assessment (e.g., an Observed Structured Clinical

Examination) was performed. Data collection was restricted to three tertiary-care teaching hospitals, which may not represent therapists working in private clinics or rural facilities, and the sample skewed heavily toward early-career practitioners, limiting insight into the competency of more experienced clinicians. The mixed online and paper-based data collection modes may also have introduced minor response inconsistencies, and the absence of longitudinal follow-up precludes assessment of how competency changes with training interventions over time.

***Recommendations***

Future research should employ longitudinal or cohort designs, probability-based sampling (e.g., stratified or cluster sampling), and objective competency measures-such as Observed Structured Clinical Examinations or supervisor-rated skills assessments-alongside self-report questionnaires. Expanding data collection to private clinics, rural healthcare centers, and community rehabilitation services, and including both physiotherapy students and senior clinicians, would improve representativeness and enable comparison across the full range of clinical experience. Intervention-based studies evaluating the impact of structured training programs on knowledge and clinical-skill acquisition over time are also warranted. Clinically, the present findings support integrating competency-based vestibular rehabilitation modules-incorporating simulation, supervised clinical rotations, and standardized maneuver training-into undergraduate physiotherapy curricula, alongside continuing-education opportunities such as short courses, mentorship programs, and formal competency certification. Collaboration among policymakers, academic institutions, and professional bodies such as the Pakistan Physical Therapy Association is recommended to standardize vestibular rehabilitation training and, where feasible, incorporate related competencies into licensing and re-certification requirements.

## CONCLUSION

This study reveals a clear disconnect between high awareness and low practical competency in vestibular rehabilitation among physical therapists in Karachi, with the largest deficits in assessment-test knowledge and rehabilitation-maneuver knowledge. Although awareness levels were exceptionally high, this did not translate into corresponding hands-on skill, and overall clinical competency was poor in more than two-thirds of respondents. Knowledge improved with age and years of clinical experience but was not significantly associated with the initial source of training, suggesting that current educational pathways-including formal university curricula-may be insufficient on their own to build applied competency. Addressing this gap through structured, competency-based training, supervised clinical practice, and standardized skills assessment is essential to strengthen first-line, evidence-based vestibular rehabilitation services, reduce fall-related morbidity and unnecessary healthcare utilization, and align physical therapy practice in Pakistan with international evidence-based standards.

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## Conflicts of Interest

The authors declare no conflicts of interest.

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