THE REHABILITATION JOURNAL
P-ISSN: 2521-344X / E-ISSN: 2521-3458

T. Rehabili. J.
Volume 10, Issue 01
March 2026

RAND PUBLICATIONS
HERF HEALTH EDUCATION RESEARCH FOUNDATION

EDITORIAL TEAM

Research Article

Prevalence of patellofemoral pain syndrome and its effect on lower extremity function in young females

Amina Sarwar[1]*, Samia Naz[2], Alisha[1], Laiba Tariq[1], Zoha Furqan[1], Zahid Mehmood[3]

ABSTRACT

Background**:** Patellofemoral Pain Syndrome (PFPS) causes anterior knee pains in young females, which can be experienced when performing daily activities. The measurement of its prevalence and functional impact provides the assistance in prevention and rehabilitation in its early stages.

Objective**:** To determine the prevalence of PFPS and its effects on lower extremity function in young female adults.

Materials and Methods: The observational cross-sectional study was carried out in the University of Sialkot. The n=357 females between the ages of 20-26 years were recruited through non-probability convenient sampling. The inclusion criteria were females experiencing anterior knee pain during functional activities; recently injured knee, prior knee surgery or systemic joint disease, neurological or instant analgesics/anti-inflammatories. PFPS was evaluated using Clarke test, quadriceps tightness using Ely test, knee symptoms using Kujala Score and lower limb performance using LEFS. The SPSS v27 was used to analyze data.

Results: Clarke's test was positive in 16% of the right knees and 12% of the left knees. Tightness of the quadriceps was observed on 27-33% of the subjects. The participants that were PFPS-positive had significantly lower LEFS scores compared to those participants that were PFPS-negative ($p < 0.001$). The regression analysis showed that both AKPQ and LEFS scores have a significant correlation ($R^2 = 0.311$, $p < 0.001$) meaning that lower extremity functional limitation is predicted by knee-specific symptoms.

Conclusion: PFPS is prevalent among young females and is associated with quadriceps tightness and mild-to-moderate functional limitations.

Keywords: kujala score, lower extremity functional scale, patellofemoral pain syndrome, quadriceps tightness, young females

Designation & Affiliation
[1.] Student, University of Sialkot, Sialkot, Pakistan.
[2.] Internee, Dr. Arifa Polly Clinic, Pakistan
[3.] Assistant Professor, Ibadat International University, Islamabad, Pakistan.

Citation
Sarwar A, Naz S, Alisha, Tariq L, Furqan Z, Mehmood Z. Prevalence of patellofemoral pain Syndrome and its effect on lower Extremity function in young females. T Rehabili. J. 2026:10(01); 03-09 doi: 10.52567/trehabj.v10i01.136.

Article History
Submitted: 10-12-2025
Accepted: 17-01-2026
Published: 19-01-2026

Correspondence*
Amina Sarwar, Student, University of Sialkot, Sialkot, Pakistan.
E-mail: 20105002-027@uskt.edu.pk

INTRODUCTION

Patellofemoral pain syndrome (PFPS) is distinguished by the excessive pain condition in the patellar area, among the most frequent causes of anterior knee pain in teenagers and young adults. The symptoms also comprised of the presence of catching or giving way sensations, short-term stiffness (mostly following sitting) and swelling and crepitus[1]. The symptoms may also prevent sports, working, and physical activities and they may last many year[2]. the prevalence rate of PFPS among adolescents and the general population is 28.9% and 22.7%, respectively[3, 4]. Besides, PFPS is more common in females approximately two times more than it is in males[4, 5].

PFPS etiology is multifactorial, and it includes excessive extensor mechanism use, patella instability, chondral damage, and quadriceps weakness[6]. It is worth mentioning that PFPS could be one of the risk factors in osteoarthritis of the patellofemoral joint, and the instability of the patients[7]. PFPS influences lower extremity functioning, may cause severe pain and progressive functional impairments, and daily tasks such as squatting and climbing stairs will become challenging[8]. Kinematic pattern changes in patients with PFPS have been shown to increase pain and dysfunction during an activity like the stair descent[9]. Further, a variation in lower extremity kinematics and muscle patterns of activity associated with PFPS can result in compensatory movement responses, notably dynamic knee valgus which is one of the biomechanical dysfunctions[10]. The affected balance has also been reported in females with PFPS and both the functional and laboratory dynamic balance tests have significant differences between the affected and the unaffected ones[11]. These functional impairments are able to diminish the participation in physical activities, sports, and work role[12].

The management of the PFPS requires specific care and delayed treatment may lead to develop osteoarthritis, which has a severe effect on their daily lives and the quality of life[13]. Notably, no extensive information is available on the prevalence and functional effect of PFPS in South Asian people and specifically in Pakistan[14]

The patellofemoral pain syndrome has been increasing as a disease among young females, which is mostly linked to sedentary lives, extended sitting and muscle imbalances. Students of the universities are exceptionally susceptible because they lack physical activity and have poor posture when doing their studies too long[3]. Besides, obesity and high body mass index correlates with an increase in musculoskeletal discomposure and functional mobility loss among women[15,16]. The issues can be especially relevant to the South Asian populations with the increasing tendencies of obesity. It is observed that prevalence rates of PFPS are approximately 23% among obese people and prevalence rates of 35% were reported in athletes[5].

Determining the prevalence of PFPS and its functional effects in young female adults in the Pakistani setting are crucial to preventive actions and decrease disability in the long perspective. A better understanding of the epidemiology and functional consequences of PFPS among this population will contribute to the development of evidence-based rehabilitation interventions and efficient healthcare resources distribution. The objective of the study is to identify the prevalence of PFPS and determine its impact on lower extremity functioning among young female adults in Pakistan, and it will fill an important knowledge gap in the South Asian musculoskeletal epidemiology.

METHODOLOGY

Study Design

This observational cross-sectional study was done at the University of Sialkot from November 2024 to April 2025 after ethical approval from research ethical committee of University of Sialkot (Ref: USKT/FAHS/RECLetter-00063) and the informed consent of all the participants participating in the study

Participants

Female participants aged 2026 years who reported experiencing pain in the anterior part of the knee during functional tasks like taking stairs, squatting or sitting were eligible to join the study. Students who had suffered knee injury within a recent period, had knee surgery in the past, suffered systemic joint diseases or neurological disorders were excluded. Also, those that had been taking analgesic or anti-inflammatory drugs regularly in the past month were excluded.

Sample Size

A total sample of n=357 participants was recruited using a non-probability convenience sampling technique. The Raosoft sample size calculator was used in calculating the sample size, with a confidence level of 95%, the margin of error of 5%, and response distribution of 50%. This was the sample size that was deemed to give statistically reliable and valid results.

Variables

Patellofemoral Pain Syndrome (PFPS): Clarke test (patellar grind test) was used in assessing PFPS in order to determine the dysfunction of the

https://doi.org/10.52567/trehabj.v10i01.136

patellofemoral joint. The examiner was pressing the superior border of the patella and the participant had to contract the quadriceps. A positive test result was as a result of the presence of pain or resistance during contraction. Though Clarke test has reported sensitivity of 39% and specificity of 67% and reported inter-rater variability, it was used as a screening test in a multifaceted clinical evaluation[17].

Anterior Knee Pain and Functional Limitation: Functional limitation and severity of pain were determined using the pain scale that included the Kujala Anterior Knee Pain Scale (AKPS). The current self-administered questionnaire is composed of 13 questions on the symptoms and functional activities of the knee, where the overall scores can be as low as zero to as high as one hundred. An increase in scores is a sign of increased knee functioning: 90-100 (excellent), 7089 (good), 5069 (fair), and less than 50 (poor). The sensitivity of the tool has been cited to be 80% and specificity is 90%[18].

Rectus Femoris Tightness: The Ely test was used to determine the tightness of rectus femoris muscle. The test subject was in the prone position with an examiner flexing the knee in a passive manner. Quadriceps tightness present as the existence of pain or tightness on the anterior thigh or knee. Knee flexion <90° was classified as severe tightness, 90-120° as moderate tightness, and >120° as normal flexibility. The test has been proven to have an acceptable intra-rater reliability and construct validity in measuring the rectus femoris flexibility in case of using standardized procedures[19].

Lower Extremity Function: The assessment of lower limb functional status was on the Lower Extremity Functional Scale (LEFS). This questionnaire is a 20-item questionnaire wherein there is a 04 Likert scale which runs on extreme difficulty to no difficulty. A total of 80 is the highest score, and the higher the score, the higher is the level of functioning. Functional categories were categorized as 0-19 (severe limitation), 20-39 (moderate to severe), 40-59 (moderate), 60-79 (mild) and 80 (no limitation). It has shown great reliability (ICC = 0.98) and excellent construct validity to functional limitation in PFPS[20, 21].

Data Collection Procedure

The initial data gathered was demographic information and history of symptoms. All subjects were then subjected to a standardized body examination by a trained physiotherapist. The number of assessments was done during one session of about 20-30 minutes. Data were coded so as to ensure confidentiality and only the research team could access them.

Data Analysis

The SPSS version 27 was used to analyze the data. The characteristics of the participants, their functional scores, and the frequency of patellofemoral pain syndrome (PFPS) prevalence were summarized with the help of descriptive statistics in the form of means, standard deviations, ranges, frequencies, and percentages. PFPS positive and PFPS-negative groups were compared using independent samples t-tests to indicate the difference in Lower Extremity Functional Scale (LEFS) scores between the two groups, as indicated by Clarke test. Linear regression analysis was performed to predict LEFS scores based on Anterior Knee Pain Questionnaire (AKPQ) scores. Statistical significance was set at $p < 0.05$.

RESULTS

The n=357 participant's age ranged from 20 to 26 years (Mean±SD: 21.48±1.31). AKPQ scores ranged from 32 to 100 (86.98±14.16), and LEFS scores ranged from 7 to 80 (64.71±14.30). For the Ely test, right-side knee flexion ROM ranged from 85° to 130° (mean 120.14±8.83), while left-side ROM ranged from 87° to 130° (mean 120.89 8.52).

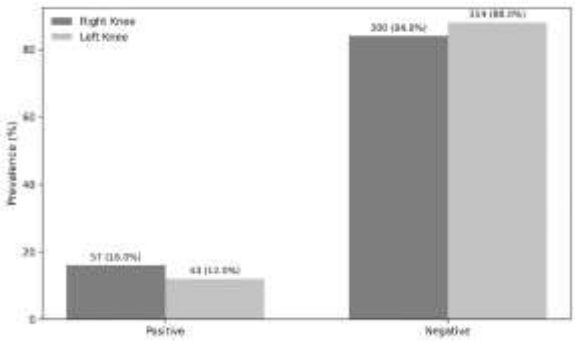

Figure 1: Prevalence of PFPS (Clark's Test)

The positive findings were observed in a minority of participants. Clarke's test was positive in n=57(16.0%) of participants on the right side and n=43(12.0%) on the left side. a total of 100 knees (14.0%) were identified as PFPS negative. Overall, these findings indicate that PFPS affected approximately one in seven knees in the PFPS positive based on Clarke's test, out of 714 assessed knees. The remaining 614 knees (86.0%) were classified study population.

Ely's test showed positive results in n=118(33.1%) on the right and n=97(27.2%) on the left. Among those with positive Ely's test, most had mild limitation in knee flexion, while moderate and severe limitations were uncommon. (table 1)

Participants with a positive Clarke's test demonstrated significantly ($p<0.001$) lower extremity functional scores compared to those with negative test results in right knee (51.66±16.04 vs. 67.00±12.89, MD=-15.34) with a large effect size

https://doi.org/10.52567/trehabj.v10i01.136

(Cohen's d=-1.15). These findings indicate that PFPS is associated with markedly reduced lower extremity function. (figure 2)

Table 1: Ely Test and Functional Scale Classifications

Test / Scale	Right n(%)	Left n(%)	Cut-off / Classification
Ely Test			
Positive	118(33.1)	97(27.2)	-
Negative	239(66.9)	260(72.8)	
Ely Test Scaling			Knee Flexion
None	239(66.9)	260(72.8)	>120°
Mild	89(24.9)	71(19.8)	110-120°
Moderate	28(8.8)	25(7.0)	90-109°
Severe	1(0.3)	1(0.3)	<90°
AKPQ Classification			Score
Poor	9(2.5)	-	0-25
Fair	41(11.5)		26-50
Good	111(31.1)		51-75
Excellent	196(54.9)		76-100
LEFS Classification			Score
Severe	3(0.8)	-	0-19
Moderate-Severe	20(5.6)		20-39
Moderate	80(22.4)		40-59
Mild	254(71.2)		60-79
No Limitation	0(0)		80

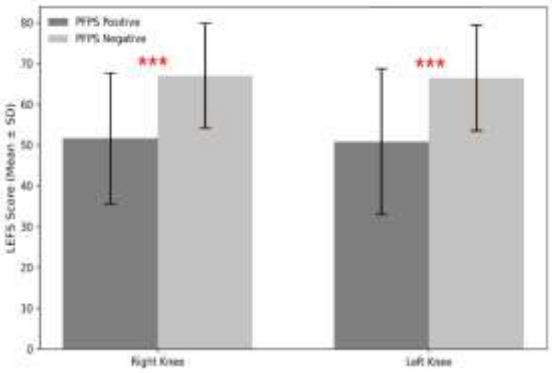

Figure 2: LEFS Scores by PFPS Status (Clarke's Test)

The results of linear regression analysis showed that the Anterior Knee Pain (AKPQ) could predict lower extremity function, as measured by the LEFS. The model was statistically significant ($F=160.40$, $p<0.001$), explaining 31.1% of the variance in LEFS scores ($R^2=0.31$). The regression equation indicated that for every unit increase in AKPQ, LEFS scores increased by 0.563 units ($\beta=0.563$). These findings suggest that higher AKPQ scores are associated with better lower extremity functional outcomes.

DISCUSSION

There were 357 young female university students in this study who showed that a patellofemoral pain syndrome (PFPS) prevalence of 12-16% based on Clarke's test results. These findings lie on the lower part of the population range of PFPS (15-45%) prevalence in the diverse populations[22], with annual prevalence rates of approximately 22.7% in the general population and 28.9% in adolescents[23]. This is lower than the prevalence of 28.8% among Arab medical students where females recorded disproportionately higher incidences[24] and higher than the incidences of 6.14% among Thai athletes[25]. The prevalence in females could be associated with biomechanical peculiarities. The females tend to have high quadriceps activity and less hamstring activity on certain movements thus having a lower hamstring-to- quadriceps [H:Q] ratio than mend[26]. Also, the research shows that dominant limbs in young females have higher knee joint laxity than their non-dominant limbs, and genu recurvatum has been found to be associated with high knee joint laxity[27]. A number of methodological and contextual issues can explain why PFPS had a lower prevalence in this study than the rest of the world[22]. First, most studies on prevalence have used populations that are athletic, military or occupationally active, but the current study used the population that was mostly non-athletic, consisting of university students with moderate activity levels[25]. Second, diagnostic methodology plays a huge role in prevalence estimates; the test by Clarke has high specificity but low sensitivity such that it gives correct estimates of the symptomatic PFPS and might underestimate the subclinical cases[6]. Third, the issue of the symptom manifestation in the university populations is due to the sociocultural and lifestyle variables, including the protracted sitting at the point of studying, in agreement with the prior literature[3].

Although it is at the lower level of the world prevalence distribution, the prevalence of the Clarke test at 12-16% is still clinically significant. Such a result implies that PFPS is prevalent among non-athletic populations, albeit with lesser prevalence than among more physically active ones, whose symptoms are defined by lifestyle requirements and activity habits. This activity-specific manifestation of PFPS in young non-athletic women can be seen in the functional outcome measures used in this paper which shows that PFPS in this population group is functionally expressed as an activity-specific dysfunction and not crippling and global impairment[22].

According to the Ely test, 27-33% of the participants showed tightness of the quadriceps, which was mostly of mild character. The results of this study are consistent with the existing literature that has found muscle tightness as a major risk factor of developing PFPS. Witvrouw et al. established that low quadriceps and gastrocnemius range of motion were significant predictors of the development of anterior knee pains in athletes. Also, it has been found out that the amount of muscle tension was one of the main extrinsic causes of patellofemoral overload during dynamic tasks[28].

https://doi.org/10.52567/trehabj.v10i01.136

It is interesting to note that the prevalence of quadriceps tightness is high among this sedentary group of university students; therefore, it is estimated that sitting and lack of physical activity are factors contributing to adaptive muscle shortening[3]. Resistant to adaptive lengthening, the rectus femoris muscle is a biarticular structure that lies between the hip and knee joints and that is especially vulnerable to the adaptive shortening in those people who retain hip and knee flexion positions during the study sessions[29]. This outcome highlights that muscle flexibility is a preventive intervention that should be addressed in university populations[28, 29].

Quadriceps tightness is a complex relationship with PFPS pathogenesis. Muscle tightness may limit knee flexion range of motion, change patellofemoral joint loading patterns and be a part of compensatory movement strategies which increase patellofemoral joint stress. Also, tightness of quadriceps can lead to a reduction in the capacity to use an eccentric control of muscles during a task, like going down the stairs, which might enhance patellofemoral pain. The reported high prevalence of tightness of the quadriceps in about the third of this group implies that flexibility programs should get priority in PFPS prevention programs[28].

The outcomes of the the Anterior Knee Pain Questionnaire (AKPQ) indicated that half of the sample 54.9% had excellent knee function, and another half 31.1% had good knee function. The average AKPQ score of 86.98±14.16 represents a general good to excellent knee functioning in this group; nevertheless, 13.9% of the respondents reported fair or poor knee functioning (scores <50) which suggests that there is a clinically significant subgroup experiencing significant anterior knee pain and impairments in their functioning [30].

The Lower Extremity Functional Scale (LEFS) indicated that 71.2% of the respondents experienced mild functional limitations (60-79) and 22.4% experienced moderate functional limitations (40-59). The LEFS score means 64.71±14.30 show that the functional limitations are mild in general (no one had the highest score of 80 (no limitation)[21]. The trend also indicates that even those who do not have clinically significant PFPS still have some form of lower extremity functional limitation, which is probably due to the sedentary lifestyle factors[3].

These results prove that the severity of PFPS is connected with the activity and the quality of life. Collins et al. recorded that compared to those without PFPS, patients affected by PFPS scored worse on both condition-specific and generic health status measures, and anterior knee pain causes a very critical negative effect on such measures[31]. The functional limitation in this population is activity specific, which is a characteristic way that PFPS presents in young non-athletic women and the symptoms are seen during activities that are associated with knee flexion loading[22].

The results of the linear regression showed that there is a significant positive correlation between AKPQ and LEFS scores (R^2 = 0.311, $p < 0.001$), where one-point increase in the AKPQ score results in a 0.563-point increase in the LEFS score. This medium effect size shows that knee specific deficits were strong predictors of general lower extremity functional outcomes[32]. The second implication of the R^2 = 0.311 is that the AKPQ scores can explain about 31.1% of the differences in LEFS scores, which means that the antecedent knee pain is an important predictor of lower extremity functioning, but other factors also play a significant role in limiting the functions[32].

The moderate strength of this association represents the multifactorial nature of the lower extremity dysfunction in PFPS[32]. In addition to anterior knee pain, there are other causes of the condition that may result in functional limitations and these include hip muscle weakness, lack of core stability, lower extremity alignment abnormalities, and dynamic knee valgus[32,33,34]. It has been established that PFPS patients experience muscle mechanical imbalances, including quadriceps and gluteus medius muscle atrophy, and loss of strength in the quadriceps that shows a direct relationship with proprioceptive los [33,34].

The high correlation between the AKPQ and LEFS scores is in favour of knee-specific assessment tools as screening tools to identify people at risk of extended lower extremity functional limitations[32]. Nonetheless, the moderate level of R^2 also highlights the importance of thorough evaluation involving several areas of impairment other than anterior knee pain itself[32,33,34].

The results of the current research can be of significant value to the prevention and treatment of patellofemoral pain syndrome (PFPS) among university students. The prevalence of quadriceps tightness (27-33%) as well as the prevalence in the functional limitations suggests the necessity to adopt early and specific preventive measures among young and sedentary students[28]. Sedentary lifestyles, lack of physical exercise and bad posture habits usually present in the academic setting can enhance the stress on the patellofemoral joint and lead to the development of PFPS[3,28]. Movement retraining and gait modification deal with the maladaptive motor patterns and have been reported to be effective in decreasing the pain and enhancing the functionality of people with PFPS[22]. Also, there is research to support combined hip and knee strengthening in comparison to knee exercises alone[14,3].

University-based programs involving ergonomic education, frequent body breaks and multimodal exercise program could be used to mitigate the risk of PFPS and lower extremity functioning among this group.

The research was constrained by the cross-sectional nature which could not lead to a causal relationship of PFPS, tightness of the quadriceps and functional limitations. The sample was selected to comprise young female university students of one institution only, which reduced the possibility of generalization. Also, other important biomechanical variables were not examined in the study, including hip and core muscle strength, dynamic knee valgus, or the morphology of patellafemoral joints.

CONCLUSION

The current research indicated that a significant percentage of the sampled participants showed positive patellofemoral findings on Clarke test, with some of them complaining about fair to poor knee performance on the AKPQ and more than a third experienced tightness of the quadriceps in the Ely test. These results prove that PFPS is widespread in young females and negatively influences the daily mobility and lower extremity performance. The findings support the need to screen and implement preventive measures at an early age to ensure that musculoskeletal health is preserved in both active and inactive groups.

DECLARATIONS & STATEMENTS

Author's Contribution

AA: substantial contributions to the conception and design of the study.
AS, SN, A, LT, ZF, and ZM: acquisition of data for the study.
A, ZF, and ZM: interpretation of data for the study.
A and ZF: analysis of the data for the study.
AS, SN, A, LT, ZF, and ZM: drafted the work.
AS, SN, A, LT, ZF, and ZM: revised it critically for important intellectual content.
AS, SN, A, LT, and ZF: final approval of the version to be published and agreement to be accountable for all aspects.
of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. All authors contributed to the article and approved the submitted version.

Ethical Statement

This cross-sectional study was done at the University of Sialkot from November 2024 to April 2025 after ethical approval from research ethical committee of University of Sialkot (Ref: USKT/FAHS/RECLetter-00063).

AI Use Statement

The authors used Grammarly to improve language clarity during manuscript preparation. Generative AI tools such as ScisSpace and Semantic Scholar were used to assist with literature summarization and refinement of the research rationale. All interpretations, conclusions, and original ideas remain solely those of the authors and approved by the authors.

Consent Statement

Informed consent was obtained from all subjects involved in the study.

Data Availability Statement

The data presented in this study are available on request from the corresponding author.

Acknowledgments

None to declare.

Funding Sources

None to declare.

Conflicts of Interest

None to declare.

REFERENCES

1. Allam NM, Alsirhani H, Alruwaili MB, Dosh DM, Alruwaili HM, Almazyad WH, et. al. Effect of laser acupuncture on pain, range of motion, and function in patellofemoral pain syndrome: a randomised controlled trial. Frontiers in Medicine. 2025 15;12:1613197. [CrossRef]
2. Ayık B, Armağan O, Bakılan F. Comparison of open and closed kinetic chain exercises on vastus medialis and vastus medialis oblique in patellofemoral pain syndrome: A randomized, single-blinded, prospective study. Turk J Phys Med Rehabil. 2025 22;71(2):216-225. [CrossRef] [PubMed]
3. Nilmart P, Yodchaisarn W, Vongsirinavarat M. Patellofemoral pain syndrome in young adult women with low to moderate physical activity levels. Iran. Rehabil. J.2022;20(1):99-108.
4. Aldharman SS, Almuhammadi HH, Madkhali AY, Alnami RA, Alkadi MA, Albalawi DM, et. al. Prevalence of patellofemoral pain and knee pain in the general population of saudi arabia. Cureus. 2022 16;14(10):e30355. [CrossRef] [PubMed]
5. Aboelhassan M, Kattabei O, Khaddah M, Elkady SM. Prevalence and risk factor of patellofemoral pain and knee pain in great cairo obese population. The Egypt. J. Hosp. Med. 2024;94(1):656-62. [CrossRef] [PubMed]
6. Kultur Y, Harbiyeli E, Botanlioglu H, Ozsahin MK, Ozturhalli S, Aydingoz O, Erginer MR. Evaluation of the results of closed kinetic chain exercises applied in the conservative treatment of patellofemoral pain syndrome by means of shear wave elastography: A randomized controlled trial. J Orthop Surg (Hong Kong). 2024; 32(3):10225536241280384. [CrossRef] [PubMed]
7. Coburn SL, Barton CJ, Filbay SR, Hart HF, Rathleff MS, Crossley KM. Quality of life in individuals with patellofemoral pain: A systematic review including meta-analysis. Phys Ther Sport. 2018;33:96-108. [CrossRef] [PubMed]
8. Pereira PM, Baptista JS, Conceição F, Duarte J, Ferraz J, Costa JT. Patellofemoral pain syndrome risk associated with squats: a systematic review. Int J Environ Res Public Health. 2022 28;19(15):9241. [CrossRef] [PubMed]
9. Yoon SW, Son HH. Effects of McConnell and Kinesio taping on kinematic variables during stair descent in patients with patellofemoral pain syndrome. J Back Musculoskelet Rehabil. 2023;36(6):1307-1316. [CrossRef] [PubMed]

https://doi.org/10.52567/trehabj.v10i01.136

10. Sahabuddin FNA, Jamaludin NI, Amir NH, Shaharudin S. The effects of hip- and ankle-focused exercise intervention on dynamic knee valgus: a systematic review. PeerJ. 2021 5;9:e11731. [CrossRef] [PubMed]
11. Nafez S, Ghanavati T, Akbari M, Khalilian-Ekrami N, Salahzadeh Z. Relationship between functional and laboratory balance assessment in females with patellofemoral pain syndrome. Muscles Ligaments Tendons J. 2023;13(03):368.
12. Miao M, Cai H, Zhang L, Cai H. Analysis of lower extremity alignment (LEA) in children with recurrent patellar dislocation by EOS system. Front Pediatr. 2023 25;11:1291739. [CrossRef] [PubMed]
13. Nie Q, Yu Y, Yuan Z, Chen J. Effects of adding neuromuscular electrical stimulation to functional training on muscle recruitment, pain reduction, and knee joint function in patellofemoral pain syndrome patients. Medicine (Baltimore). 2024 19;103(3):e36095. [CrossRef] [PubMed]
14. Jaffri UA, Corbett RO, Jaffri A. Alarmingly low physical activity in pakistani college students compared to american college students. Recreat. Sports J.2023;47(2):98-107. [CrossRef]
15. Menoth Mohan D, Al Anouti F, Kohli N, Khalaf K. Association of obesity with musculoskeletal health and functional mobility in females-a systematic review. Int J Obes (Lond). 2025;49(11):2184-2205.[CrossRef] [PubMed]
16. Sengar M, Gupta A, Kunwar R. Correspondence analysis to demonstrate the relationship between musculoskeletal pain and body mass index. Cureus. 2023 17;15(6):e40570. [CrossRef] [PubMed]
17. Malanga GA, Andrus S, Nadler SF, McLean J. Physical examination of the knee: a review of the original test description and scientific validity of common orthopedic tests. Arch Phys Med Rehabil. 2003;84(4):592-603. [CrossRef] [PubMed]
18. da Silva-Júnior FB, Dibai-Filho AV, Barros DCC, Dos Reis-Júnior JR, Gonçalves MBS, Soares AR, et. al. Anterior Knee Pain Scale (AKPS): structural and criterion validity in Brazilian population with patellofemoral pain. BMC Musculoskelet Disord. 2024 8;25(1):39. [CrossRef] [PubMed]
19. Peeler J, Anderson JE. Reliability of the Ely's test for assessing rectus femoris muscle flexibility and joint range of motion. J Orthop Res. 2008;26(6):793-9. [CrossRef] [PubMed]
20. Fukuda TY, Melo WP, Zaffalon BM, Rossetto FM, Magalhães E, Bryk FF, et. al. Hip posterolateral musculature strengthening in sedentary women with patellofemoral pain syndrome: a randomized controlled clinical trial with 1-year follow-up. J Orthop Sports Phys Ther. 2012;42(10):823-30. [CrossRef] [PubMed]
21. Lützner J, Schubert P, Beyer F, Lützner C. Anterior knee pain is a relevant cause for dissatisfaction after total knee arthroplasty without patellar resurfacing. J Exp Orthop. 2025 5;12(3):e70382. [CrossRef] [PubMed]
22. Hart HF, Patterson BE, Crossley KM, Culvenor AG, Khan MCM, King MG, et. al. May the force be with you: understanding how patellofemoral joint reaction force compares across different activities and physical interventions-a systematic review and meta-analysis. Br J Sports Med. 2022;56(9):521-530. [CrossRef] [PubMed]
23. Mustamsir E, Phatama KY, Pratianto A, Pradana AS, Sukmajaya WP, Pandiangan RAH, et. al. Validity and reliability of the indonesian version of the kujala score for patients with patellofemoral pain syndrome. Orthop J Sports Med. 2020 28;8(5):2325967120922943. [CrossRef] [PubMed]
24. Ateef M. Measurement properties of the knee injury and osteoarthritis outcome score patello-femoral questionnaire in saudi arabians. PeerJ. 2020 31;8:e9323. [CrossRef] [PubMed]
25. Davis IS, Tenforde AS, Neal BS, Roper JL, Willy RW. Gait Retraining as an intervention for patellofemoral pain. Curr Rev Musculoskelet Med. 2020;13(1):103-114. [CrossRef] [PubMed]
26. Jeong J, Choi DH, Shin CS. Core strength training can alter neuromuscular and biomechanical risk factors for anterior cruciate ligament injury. Am J Sports Med. 2021;49(1):183-192. [CrossRef] [PubMed]
27. Chun Y, Bailey JP, Kim J, Lee SC, Lee SY. Sex and limb differences in lower extremity alignment and kinematics during drop vertical jumps. Int J Environ Res Public Health. 2021 3;18(7):3748. [CrossRef] [PubMed]
28. Lee JH, Jang KM, Kim E, Rhim HC, Kim HD. Effects of static and dynamic stretching with strengthening exercises in patients with patellofemoral pain who have inflexible hamstrings: a randomized controlled trial. Sports Health. 2021;13(1):49-56. [CrossRef] [PubMed]
29. Fukuda TY, Rossetto FM, Magalhães E, Bryk FF, Lucareli PR, et. al. Short-term effects of hip abductors and lateral rotators strengthening in females with patellofemoral pain syndrome: a randomized controlled clinical trial. J Orthop Sports Phys Ther. 2010;40(11):736-42. [CrossRef] [PubMed]
30. Halabi MH, Alturkistani BA, Abuhadi RH, Garout AN, Almuqbil FB, Alshehri MS. The efficacy of hip and knee muscles strengthening versus knee muscle strengthening alone in managing patellofemoral pain syndrome: a systematic review and meta-analysis. Musculoskeletal Care. 2025;23(1):e70059. [CrossRef] [PubMed]
31. Santilli G, Martino M, Pacini P, Agostini F, Bernetti A, Giuliani L, et. al. Patellofemoral pain syndrome: focused vibrations plus kinesiotaping with insights into radiological influences-an observational study. J Funct Morphol Kinesiol. 2024 24;10(1):2. [CrossRef] [PubMed]
32. D'Ambrosi R, Meena A, Raj A, Ursino N, Hewett TE. Anterior knee pain: state of the art. Sports Med Open. 2022 30;8(1):98. [CrossRef] [PubMed]
33. Dong C, Li M, Hao K, Zhao C, Piao K, Lin W, et. al. Dose atrophy of vastus medialis obliquus and vastus lateralis exist in patients with patellofemoral pain syndrome. J Orthop Surg Res. 2021 10;16(1):128. [CrossRef] [PubMed]
34. Luo Y, Chen X, Shen X, Chen L, Gong H. Effectiveness of kinesio tape in the treatment of patients with patellofemoral pain syndrome: a systematic review and meta-analysis. Medicine (Baltimore). 2024 7;103(23):e38438. [CrossRef] [PubMed]
35. León-Morillas F, García-Marín M, Corujo-Hernández C, Martín Alemán M, Castellote-Caballero Y, Cahalin LP, et. al. Evaluating the impact of flossing band integration in conventional physiotherapy for patellofemoral pain syndrome. J Clin Med. 2024 17;13(10):2958. [CrossRef] [PubMed]

Research Article

Translation and validation of cognitive failure questionnaire in Urdu among elderly

Aniqa Khalid[1]*, Anam Aftab[2], Suneel Kumar [3], Sara Kafeel[4], Saima Waqar[5], Waqas Ahmed sheikh[6]

ABSTRACT

Background**:** The Cognitive Failure Questionnaire (CFQ) is widely used self-reported instrument for assessing everyday cognitive lapses but no validated Urdu version is available.

Objective**:** to translate, culturally adapt the CFQ into Urdu (CFQ-U), and to evaluate the psychometric properties in the Urdu- speaking elderly population.

Methodology**:** The CFQ was translated and cross culturally modified into Urdu following the Consensus based standards for the selection of health measurement instruments using COSMIN criteria this included forward and backward translation, expert review, content validity assessment (CVI), and pilot testing to ensure semantic, conceptual, and cultural equivalence before finalizing the Urdu version (CFQ-Urdu). Total n=250 community dwelling participants with age ≥60 years completed the questionnaire. Test-retest reliability was assessed in n=70 participants, and they completed questionnaire twice after a week interval. In subsample of n=35 participants, construct validity was assessed. The Urdu CFQ measures subjective cognitive failures in daily life, not objective cognitive impairment. Therefore, in subsample of n=35 participants for construct validity, we used the Urdu versions of Beck Depression Inventory, Beck Anxiety Inventory, and Patient Health Questionnaire-9, as subjective cognitive complaints are theoretically and empirically associated with depression and anxiety. In contrast, Montreal Cognitive Assessment is a performance-based screening tool for objective cognitive impairment, which assesses a different construct than the CFQ. Internal consistency, content validity, construct validity, and exploratory factor analysis were evaluated by using the method of KMO, Barlett's test.

Results**:** The CFQ-U showed good internal consistency (Cronbach's α=0.74) and test-retest reliability (intra-class correlation coefficient=0.996). Three factor structure supported by exploratory factor analysis explained 48.6% of total variance. Non-significant and weak co relation was observed in between CFQ-U scores and anxiety, depression and general health measurement supporting discriminant validity. Small floor effect was identified with no ceiling effect.

Conclusions**:** The CFQ-U is a reliable and psychometrically valid instrument for assessing cognitive failures among elderly Urdu-speaking individuals. It can be useful for research applications and clinical screening in geriatric population.

*Keywords**: cognitive failure, cross cultural adaptation, psychometrics, Urdu.*

Designation & Affiliation

1. Doctor of Physical Therapy, Faculty of Rehabilitation & Allied Health Sciences. Riphah International University. Islamabad Pakistan.
2. Associate Professor, Faculty of Allied Health & Biological Sciences IBADAT International University. Islamabad Pakistan.
3. Lecture, Department of Anthropology and Archaeology, University of Sindh Jamshoro, Pakistan.
4. Assistant Professor, Isra Institute of Rehabilitation Sciences, Islamabad, Pakistan.
5. Clinical Psychologist, National Institute of Rehabilitation Medicine. Islamabad Pakistan.
6. Chief Executive Officer, Tameem international school, Taif, Saudi Arabia.

Citation

Khalid A, Aftab A, Kumar S, Kafeel S, Waqar S, , Sheikh WA. Translation and validation of cognitive failure questionnaire in urdu among elderly. T Rehabili. J. 2026:10(01); 10-20 doi: 10.52567/trehabj.v10i01.143

Article History

Submitted: 14-01-2026
Accepted: 03-03-2026
Published: 06-03-2026

Correspondence*

Aniqa Khalid, Doctor of Physical Therapy, Faculty of Rehabilitation & Allied Health Sciences. Riphah International University. Islamabad Pakistan..
E-mail: aniqakhalid333@gmail.com

INTRODUCTION

Cognitive failures, such as forgetfulness, lapses in attention, and action errors are subjective everyday cognitive lapses that are common among the elderly and may affect daily functioning, safety, and quality of life but they are distinct from MCI and dementia, which involve objective, cognitive decline[1,2]. Identification and assessment of cognitive failures is crucial step to mitigate their consequences and implement timely interventions[3]. It can be caused by several factors, such as age, gender, stress, sleep deprivation and demands of the job[4,5,6,7]. Mild cognitive impairment is a type of cognitive decline that is often linked to aging[8].

Cognitive failures can lead to a range of negative outcomes, including reduced functional ability, increased risk of falls, forgetting to turn off appliances, gait disturbances and decrease in daily activities performance[9]. Cognitive functions can compromise motor planning, balance, and coordination[10]. All this leads to reduced confidence in movement, promoting a sedentary lifestyle[9,10]. It is also associated with heightened emotional distress, including anxiety, frustration, and depression, further exacerbating the risk of social withdrawal and diminished quality of life[11]. They may also contribute to caregiver burden and increased healthcare utilization due to preventable incidents.

The Cognitive Failure Questionnaire (CFQ) is a widely used self-reported tool for assessing the frequency of cognitive failures. It was deemed as a detailed and widely utilized subjective outcome measure in different populations[12]. It is evident that CFQ is a commonly used and recognized metric because it has been translated to different languages, for example, Hebrew[13], German[14], Dutch[15], Italian [16], Brazilian[17], Turkish[18] or Hungarian[19] and it has shown good psychometric properties in all of these languages.

Present study addresses that despite the international utility of CFQ, absence of its Urdu version constraints the accessibility to large group of aging population in Pakistan. Due to language barrier among older adults, use of instrument in non-native language may lead to inaccurate reporting of cognitive function. Increased prevalence of age-related cognitive decline in Pakistan along with limited mental health resources emphasizes the urgent need for validated and accessible tools. Validated Urdu version of CFQ which is culturally adapted is essential for accurate cognitive assessment among Urdu speaking elderly population. By translation and cross-cultural adaptation of CFQ into Urdu, and evaluation of its psychometric properties in representative sample of Urdu speaking elderly population in Pakistan will enable clinicians, researchers and policy makers for cognitive screening with a valid and reliable tool. In geriatric care region critical practical and methodological gap is also filled. The purpose of this study was to translate and culturally adapt the CFQ into Urdu (CFQ-U) using recognized methodologies, as well as to examine the translated version's psychometric properties in Urdu-speaking elderly population.

METHODOLOGY

Study Design

This was a cross-sectional study aimed at the translation and psychometric and validation of Cognitive Failure Questionnaire into Urdu. The process was initiated after receiving consent from the developer of the original CFQ. The study was conducted from March 2023 to January 2024 in accordance with the Consensus-based Standards for the selection of health status Measurement Instruments (COSMIN) criteria[20]. Six steps and Sequential approach in the entire procedure was used for translation process[21]. Ethical approval for this study was obtained from the Research Ethics Committee (REC), Riphah College of Rehabilitation and Allied Health Sciences, Riphah International University, Islamabad under reference number Riphah-RCR&AHS-ISB/REC/MS-PT/01645. All procedures were conducted in accordance with the ethical standards of the institutional research committee and the Declaration of Helsinki. Written informed consent was obtained from all participants prior to their inclusion in the study.

Participants

Total of n=250 community dwelling older adults by nonprobability purposive sampling technique, both male and female patients with age 60 years above fluent in understanding and reading Urdu, mentally alert to give consent and complete forms were recruited from community gathering areas like public parks, mosques, community centres in urban and peri-urban areas of Islamabad and Rawalpindi, Pakistan. Participants not capable to complete the questionnaire without any help or diagnosed with dementia or having any neurological/psychiatric impairment were excluded from the study. To calculate sample size for general psychometric testing and factor analysis, 10:1 subject to item ratio was calculate[25], so (25-items x 10) n=250 participants were recruited for this study which improves generalizability and external validity of findings to broader Urdu- speaking elderly population.

Instruments

Cognitive Failure Questionnaire: The cognitive failure questionnaire (CFQ), a self-report

questionnaire was designed to assess everyday motor lapses, perception, and memory. The 25 items on the CFQ are divided into three categories: distractibility (items 8, 9, 10, 11, 14, 19, 21, and 25), forgetfulness (items 1, 2, 5, 7, 17, 20, 22, and 23), and false triggering (items 2, 3, 5, 6, 12, 18, 23, and 24). The responses from the patients are evaluated using a 5-point Likert scale, where higher scores indicate more cognitive dysfunction[12]. *Beck Depression Inventory:* The BDI has been used to assess the participants' depression symptoms. This scale comprises 21 items ranging from 0 to 3 to assess the cognitive, emotional, and vegetative symptoms of depression. Score ranges from 0 to 63, with higher scores indicating higher levels of depression symptoms and vice versa[22]. *Beck Anxiety Inventory:* This scale uses 21 items ranging from 0 to 3 to assess anxiety symptoms. Scores vary from 0 to 63, higher scores indicating higher levels of anxiety symptoms[23]. *Patient Health Questionnaire:* PHQ-9 assessing the frequency of nine depressed symptoms during the last two weeks, on a 4-point Likert scale, respondents must indicate how frequently each symptom occurs (0 being hardly at all to 3 being almost every day). In addition, if at least one symptom appears, they must also assess the extent to which it interfered with their ability to function at work, take care of their family, or interact with others. Elevated scores signify an increased degree of depression symptoms[24].

Steps

Step 1 - Forward Translation: Two fluent English speakers having Urdu as mother tongue and holds master's degree in Urdu independently translated the CFQ from English into Urdu. *Step 2 - Synthesis I*: The translators and one researcher produced a consensus version by integrating the results of the two translated versions and addressing discrepancies. *Step 3- Blind backward translation:* The agreed-upon Urdu version was translated back into English by a professional translator holding master's degree in English who was blind to the original questionnaire and its concept. *Step 4- Synthesis II:* A multidisciplinary panel of experts including researchers, translators, and a professor of physiotherapy, examined every translation, and after consensus, agreed on idiomatic, semantic, experiential, and conceptual equivalency to obtain a pre-final CFQ. *Step 5- Content validity:* Content validity was assessed by experts on n=20 older adults for relevancy, simplicity, ambiguity and clarity of each item from 0 to 4 content validity index (CVI). *Step 6- Pilot Testing/Cognitive Debriefing:* n=30 subjects evaluated to ensure face validity in Urdu. The expert committee including researchers, translators, and a professor of physiotherapy, assessed all the feedback from this stage of the adaptation process, and consensus was made to develop the final version of CFQ in Urdu (CFQ-Urdu).

Procedure

After informed consent was obtained, structured demographic questionnaire and translated version of CFQ were completed by participants. Using a computerized random number generator, randomly n=70 participants were selected and asked to complete after one-week CFQ-U again to evaluate test-retest reliability. Subset consisting of n=35 participants completed CFQ-U, beck anxiety inventory (BAI), beck depression inventory (BDI) and patient health questionnaire-9 (PHQ-9) for construct validity. All questionnaires were self-administered with research assistant availability to clarify instructions, in a controlled environment. This study was approved by the ethics review committee of Riphah International University, Islamabad. This study adhered to institute research guidelines and declaration of Helsinki.

Bias

To minimize selection bias, uniform inclusion and exclusion criteria were applied consistently to all participants. To address self-report bias, standardized and previously validated instruments were used, and participants completed questionnaires independently in a quiet setting. To reduce recall bias, participants were instructed to respond based on recent everyday cognitive experiences rather than distant memories. Potential cultural interpretation bias was addressed through a structured translation and cross-cultural adaptation process following established guidelines, including expert review and pilot testing. Data collection was administered by trained researchers. Despite these measures, the potential influence of self-report and cultural interpretation of cognitive complaints could not be eliminated and is acknowledged in the Limitations section.

Data Analysis

Data analysis was performed using the Statistical Package and Service Solution (SPSS) version 23 with significance level (α) set at 0.05. Age and questionnaire scores were summarized by means and standard deviations. No categorization was applied for CFQ-U items and taken as ordinal. For exploratory factor analysis items were analysed as continuous. BAI, BDI, and PHQ-9 scores were taken as continuous to develop construct validity. Exploratory model test was used to assess confirmatory factor analysis.

Reliability: Based on expected ICC of 0.81, 95% CI and 80% minimum power, sample size for test re-test n=70 was calculated[26]. Intra class correlation coefficient was used for test- retest reliability. It

was computed by using two- way mixed effects model with absolute agreement. ICC ≥0.80 is considered excellent reliability[27]. Cronbach's alpha was used to evaluate Internal consistency with ≥0.70 is considered acceptable[28].

Content validity: It is the extent to which an instrument's content accurately reflects the construct being assessed[29]. Content validity index was calculated by five clinical experts who rated each item on relevance, simplicity and clarity on 4-point scale, considering ≥0.78 acceptable. Floor and ceiling effects sizes were used to evaluate the content validity. If more than fifteen percent of the respondents obtained the lowest or highest potential total score, floor and ceiling effects are deemed to be present.

Factor analysis: Confirmatory factor analysis was conducted as secondary exploratory procedure to assess factor structure plausibility identified by exploratory analysis not for definitive confirmation of factorial validity. The suitability and importance of the data were assessed using Bartlett's test of sphericity ($p<0.05$) and Kaiser-Meyer-Olkin's measure of sample adequacy (KMO) ≥0.6. The total variance shown in our data was also determined via factor analysis, and since varimax rotation maintains the factors' uncorrelated nature, it was used in addition to the orthogonal rotation approach. Maintaining the eigenvalues >1 was deemed sufficient with item loadings ≥ 0.3[29], the sample size adequacy was n=250.

Construct validity: Two variants of concept validity exist, the degree to which your measures agree with measures of related constructs is known as convergent validity. As opposed to the degree to which your measure is unconnected to or adversely correlated with measures of different constructs is known as discriminant validity[30]. To evaluate construct validity, participants completed four questionnaires: the translated CFQ-U, the BAI, the BDI, and the PHQ-9 in Urdu. For this measure, the Pearson coefficient correlation was computed by comparing the outcomes of the scales that were taken simultaneously. Thus, the values acquired aided in the questionnaire's validation. Excellent correlation values range from 0.81 to 1.0, very good correlation values from 0.61-0.80, good correlation values from 0.41-0.60, acceptable correlation values from 0.21-0.40, and poor correlation values from any value equal to or less than 0.20[31]. The required sample size was n=35 to compute this.

RESULTS

Translation and Cross-Cultural Adaptation

During synthesis II determination, item 16 was modified for semantic clarity while preserving original conceptual meaning. No additional items were modified following pilot testing. All items were comprehendible, and clear in pre-final Urdu version as reported by participants.

Participant Characteristics

The study included n=250 participants. No participant was excluded, and no missing data was reported. The mean age of the participants was 64.3±4.56 years. Of the total sample, n=92(36.8%) was male and n=158(63.2%) were female. The mean score on the Urdu version of the Cognitive Failure Questionnaire (CFQ-U) was 40.4±14.04, suggesting a moderate level of self-reported cognitive failure.

Psychometric Properties

Reliability: The Cronbach alpha (α) of the CFQ-U was 0.74 exceeding the acceptable threshold, indicating the good internal consistency.

Test-retest reliability: The Intraclass Correlation Coefficients (ICC) for individual items range from 0.898 to 0.990, indicating high reliability across all items. A total score ICC was 0.996, reflecting excellent temporal stability Reliability estimates have been reported as unadjusted values as no confounder adjustment was done. (figure 1)

Content validity: it was assessed by experts' ratings for items relevance, clarity and simplicity. After analysis no ceiling effects on the total score of CFQ-U was observed. However, 16% of participants experienced floor effects suggesting very low frequencies of cognitive failure by small proportion of respondents.

Construct validity: The construct validity was assessed for subsample of n=35 participants by examining its Pearson correlations with the Beck Anxiety Inventory (BAI), Beck Depression Inventory (BDI), and Patient Health Questionnaire-9 (PHQ-9). The results showed a non-significant weak negative correlation between CFQ-U and BAI (r=-0.192, p=0.268), between CFQ-U and BDI (r=-0.014, p=0.936), and a very weak positive correlation between CFQ-U and PHQ-9 (r=0.011, p=0.949), supporting the discriminant validity of the CFQ-U by demonstrating that it measures a construct like forgetfulness and attention errors, distinct from anxiety and depression. (figure 2)

Exploratory Factor Analysis

Exploratory factor analysis was conducted on a 25-item questionnaire measuring cognitive lapses in daily activities, using Principal Component Analysis with Varimax rotation. The KMO measure confirmed sampling adequacy (KMO=0.807), and Bartlett's test of sphericity showed significant correlations among variables ($\chi^2(300)=2904.91$, $p<0.001$).

https://doi.org/10.52567/trehabj.v10i01.143

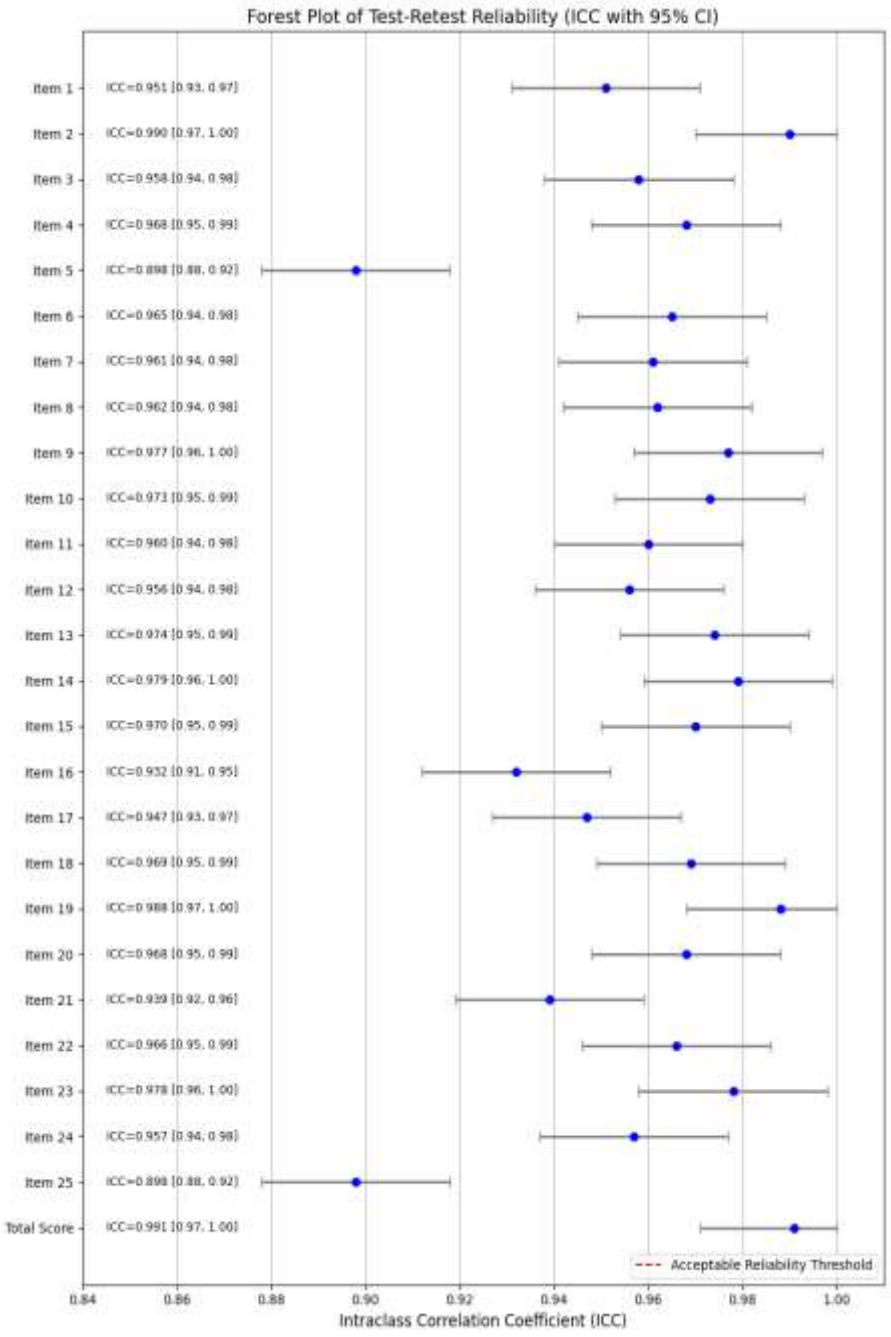

Figure 1: Forest Plot for CFQ-U ICC (95% CI)

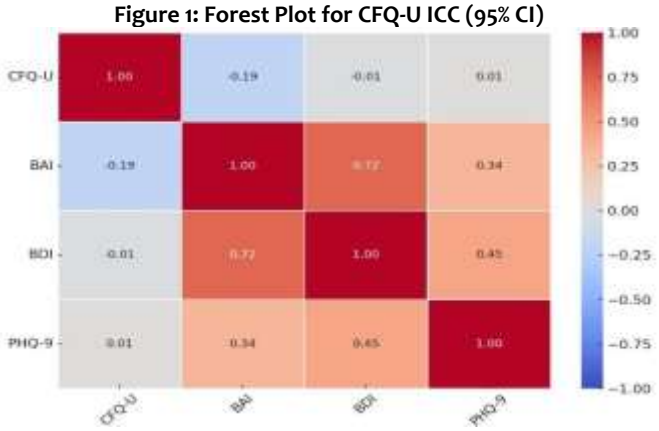

Figure 2: Correlation heatmap (CFQ-U, BAI, BDI and PHQ)

https://doi.org/10.52567/trehabj.v10i01.143

Three factors emerged with eigenvalues >1, explaining 48.6% of the total variance. These factors were identified as (i) Everyday Cognitive Lapses, (ii) Spatial and Environmental Disorientation, and (iii) Communication and Interaction Errors. The model demonstrated simple structure with clear factor loadings, supporting the multidimensional nature of everyday cognitive failures. (table 1)

Table 1: Factor loading and Communality summery

S #	Items	Factor 1	Factor 2	Factor 3	Communality After Extraction
	Item 1	0.739	-	-	0.554
	Item 2	0.713	-	-	0.659
	Item 3	0.703	-	-	0.52
	Item 4	0.653	0.301		0.518
	Item 5	0.62	-	-	0.441
	Item 6	0.59	-	-	0.357
	Item 7	0.572	0.346	-	0.464
	Item 8	0.829	-	-	0.794
	Item 9	0.762	-	-	0.617
	Item 10	0.686	-	-	0.626
	Item 11	0.387	0.686		0.528
	Item 12	0.665	0.421	0.311	0.459
	Item 13	0.643	0.514	-	0.346
	Item 14	0.524	0.514	0.311	0.56
	Item 15	0.446	0.497	-	0.471
	Item 16	0.397	0.38	-	0.294
	Item 17	0.301	-	0.354	0.204
	Item 18	0.756	-	-	0.1
	Item 19	0.74	-	0.354	0.615
	Item 20	0.375	0.65	-	0.625
	Item 21	0.503	0.584	-	0.569
	Item 22	0.481	0.45	-0.532	0.594
	Item 23	0.34	0.468	-	0.717
	Item 24	-0.385	-	-	0.355
	Item 25	0.338	-	-0.493	0.158

The scree plot demonstrated a distinct inflection point after the third component, further supporting a three-factor solution. While most items loaded clearly on one factor, supporting a simple and interpretable structure, several items presented concerns. Specifically, Item 24 (Leave important letters unanswered) exhibited a negative and weak loading (-0.385) and low communality (0.355), suggesting limited contribution to any factor. Similarly, Item 25 (Forget why moved from room to room) demonstrated a cross loading on Factor 3 (-0.493) and the lowest communality (0.158) in the dataset, indicating it may not meaningfully reflect the latent constructs. In addition, items such as Item 17 (Fail to notice signposts) and Item 16 (Lose temper and regret) also showed low communalities (<0.30) and should be interpreted cautiously. (figure 3)

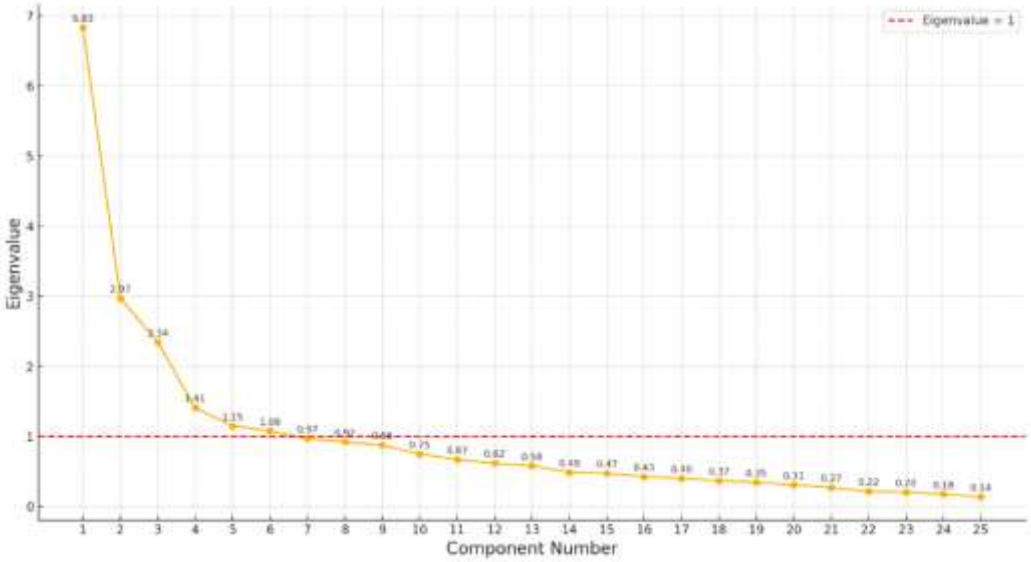

Figure 3: Scree plot

Confirmatory Factor Analysis (CFA)

A Confirmatory Factor Analysis (CFA) was conducted as an exploratory model testing procedure to examine the three-factor structure identified through exploratory factor analysis could be tentatively supported in the present sample. The proposed model comprised of three latent constructs: Cognitive Lapses (measured by Items 15a, 24a, 22a, 19a, 23a, 20a, and 25a), Spatial Disorientation (Items 14a, 13a, 12a, and 11a), and Communication Errors (Items 8a, 6a, 5a, 4a, 2a, and 17a). Covariances among the latent variables were freely estimated.

The CFA results indicated that most of the observed variables loaded significantly onto their intended latent constructs. Standardized factor loadings range from -1.150 to 1.000 for Cognitive Lapses, -0.617 to 1.000 for Spatial Disorientation, and -0.723 to 1.000 for Communication Errors. Some negative loadings were observed, which may reflect reverse-worded items or opposing conceptual relationships within the factors. (table 2)

Table 2: Standardized Factor Loadings for the CFA Model

Factor	Item	Loading
Cognitive Lapses	Item15a	1.000
	Item24a	0.109
	Item22a	-0.054
	Item19a	0.629
	Item23a	0.510
	Item20a	-1.150
	Item25a	-0.468
Spatial Disorientation	Item14a	1.000
	Item13a	0.479
	Item12a	-0.292
	Item11a	-0.617
Communication Errors	Item8a	1.000
	Item6a	0.252
	Item5a	-0.631
	Item4a	0.550
	Item2a	0.973
	Item17a	-0.723

Partial discriminant validity 252 between Cognitive Lapses, Spatial Disorientation, and Communication Errors was suggested by the small and negative covariance between the latent categories. In particular, there was a negative correlation between Cognitive Lapses and Communication Errors (covariance=-0.25) and Spatial Disorientation (covariance=-0.25) and communication error (covariance = 0.23), but Communication Errors and Spatial Disorientation similarly showed a negative covariance (covariance=-255 0.311). With 116 degrees of freedom, the chi-square statistic for model fit was 95.08. The Root Mean Square Error of Approximation (RMSEA) was 0.000, indicating excellent fit. Excellent match was indicated by the Root Mean Square Error of Approximation (RMSEA) of 0.000. However, the Tucker-Lewis Index (TLI=7.85) and Comparative Fit Index (CFI=6.846) were beyond the acceptable range, indicating care when assessing model fit. For future model comparisons, the Akaike Information Criterion (AIC) and Bayesian Information Criterion (BIC) were 72.09 and 168.49, respectively. Future study should modify and re-evaluate the model because the observed CFI and TLI values may have been impacted by sample size constraints or abnormalities in estimate. (table 3)

Table 3: Summary of model fit statistics (Chi-Square, RMSEA, CFI, TLI, AIC, and BIC)

Fit Index	Value
Chi-Square (χ^2)	95.08
Degrees of Freedom (df)	116
Root Mean Square Error of Approximation (RMSEA)	0.00
Comparative Fit Index (CFI)	6.85
Tucker-Lewis Index (TLI)	7.85
Akaike Information Criterion (AIC)	72.10
Bayesian Information Criterion (BIC)	168.49

https://doi.org/10.52567/trehabj.v10i01.143

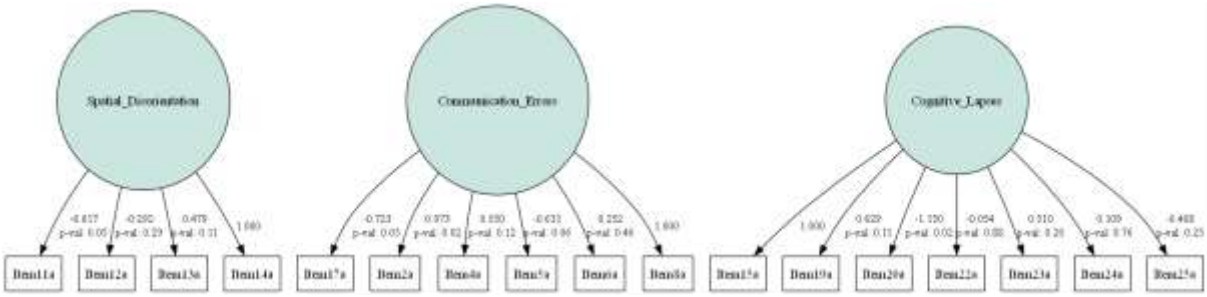

Figure 4: Path diagram illustrating the relationships among the constructs

A path diagram illustrating the relationships among the constructs is presented in Figure 4. The present CFA does not provide definitive evidence for proposed factor structure but offers an initial framework for future model refinement.

DISCUSSION

The goal of current study was to translate, validate, and culturally modify the Cognitive Failures Questionnaire (CFQ) for the older population who speak Urdu. The results show that the Urdu version (CFQ-U) has good psychometric qualities that are quite similar to previous validations in other languages therefore, supporting its applicability in this population.

The CFQ-U displayed excellent test-retest reliability with an Intraclass Correlation Coefficient (ICC) of 0.996. This significantly exceeds reliability values reported in other language adaptations, such as the Hungarian version [19] (ICC=0.900) by Volosin et al. (2023) and the Dutch version[15] (r=0.83) by Merckelbach et al. (1996). Evaluation of temporal stability of CFQ-U scores is confirmed by these findings. The use of a brief, one-week delay between test administrations, which reduces memory deterioration and outside influences on participant responses, may be one explanation for this higher stability[19]. in older populations where, cognitive fluctuation is an issue, the high reliability across questions supports a steady evaluation of cognitive lapses across time.

With a preponderance of female participants, a Cronbach's alpha of 0.74 was acceptable and comparable to earlier validations, the Turkish version (α=0.91)[18], Brazilian Portuguese (α=0.906)[17], and Hungarian (α=0.92)[19]. These consistent results in many cultural contexts support the CFQ's cross-cultural robustness, the instrument's stability across gender distributions, and the goal of evaluating the CFQ-U's internal consistency.

The subjective nature of the CFQ-U questionnaire may be the cause of the floor effect observed in 16% of individuals. This is especially important for older persons, as cognitive declines may be ignored because of diminished metacognitive awareness, denied because of stigma, or normalized with aging[32].

Appropriate discriminant validity was shown by the CFQ-U. The CFQ-U evaluates a different construct from anxiety (BAI: r=-0.192), depression (BDI: r=-0.014), and general health symptoms (PHQ-9: r=0.011), according to weak, non-significant correlations. This contrasts with the original and other translations, where moderate to strong associations with BDI and BAI were found[18] in Turkish version. The lack of association in this study may indicate that older Urdu speakers have a distinct cultural understanding of cognitive lapses as age-appropriate or non-pathological forgetfulness, a theory that merits more investigation.

Three factors Everyday Cognitive Lapses, Spatial and Environmental Disorientation, and Communication and Interaction Errors were found by exploratory factor analysis (EFA) to account for 48.6% of the variance. This outcome is in line with the multifaceted nature of cognitive failures as demonstrated by earlier Turkish literature: five components[18], in English[16]: seven components, in Dutch: nine component[15]. The CFQ-U's content validity is supported by the establishment of three coherent variables that represent contextually relevant categories of cognitive lapses among the elderly. Items 24 (Leave crucial letters unanswered) and 25 (Forget why moved from room to room) showed atypical loadings and low communalities, which raised questions about their construct validity, especially in an older adult group. Instead of identifying fundamental cognitive deficiencies like memory or attention problems, item 24 can identify deficiencies in executive functioning or motivation. Instead of real cognitive impairment, these behaviours in older persons may potentially be a sign of social disengagement, low task engagement, or adaptive prioritizing[33]. Similar to item 25, forgetting one's objective after entering a new area is a relatively common occurrence that increases with age due to natural losses in prospective memory and attention control[34]. However, this behaviour may contribute to the poor discriminative power required for meaningful psychometric differences because it is so prevalent among older people. Previous research has shown

that certain CFQ items perform poorly in elderly people because of decreased variability or cultural/contextual mismatch[35,36,37]. Therefore, these items may not adequately measure meaningful cognitive variability in old age samples and should be reconsidered in future translations of the scale aimed at older adults.

As a secondary, exploratory model testing method, Confirmatory Factor Analysis (CFA) was carried out. Although the RMSEA indicated a decent model fit (0.000), the TLI (7.85) and CFI (6.85) were excessively high and outside of acceptable ranges, which may have been caused by scaling or computational problems rather than model misfit. Furthermore, since comparable anomalies have been addressed in another study, some negative factor loadings (such as -1.150 for Item 20a) imply that some items may need to be reworded or reverse scored in order to fit with latent structures[38]. Confirmatory approaches are recommended by COSMIN for validation research involving larger samples and more advanced models. The results of the current study's CFA should be viewed cautiously and as a hypothesis generator rather than confirmation; yet, the results do not compromise the psychometric integrity of the study; rather, they highlight the difficulty of modelling subjective cognitive impairment in older populations.

With the exception of Item 16, which needed modification because of cultural idiomatic contradiction, translation and cross-cultural adaption were accomplished with little semantic distortion. The items' high level of clarity and relevance was confirmed by participant response, which is consistent with Beaton et al.'s cross-cultural questionnaire adaptation procedure[20].

While the CFQ-U demonstrates strong psychometric performance, some limitations should be acknowledged. The study was conducted in a specific region of Pakistan, which may not represent Urdu speakers from other sociocultural or rural settings. The sample predominantly consisted of females, which limits generalizability to male elderly. Moreover, results of CFA demonstrated instability in model fit indices. Sample size may have been insufficient for complexity of CFA model so findings should be interpreted with caution and should not be considered definitive confirmation for factor validity. Convergent validity with other cognitive screening tools was not considered in the study. These limitations can introduce bias in factor structure interpretation and hence restricts the external validity. Further, Cognitive status was assessed by only clinical judgment rather than any standardized tool (e.g., MMSE or MoCA), which may lead to potential misclassification.

Despite limitations, Urdu version of CFQ demonstrated strong reliability, acceptable factor structure and strong discriminant validity to fulfil the primary objective. CFQ-U can be cautiously applied to Urdu speaking older adults though further studies with diverse regional populations should be conducted for external validity.

CONCLUSION

The CFQ-U is a reliable and valid tool for assessing cognitive failures among elderly Urdu-speaking individuals. It retains the structural and conceptual integrity of the original instrument and demonstrates sound psychometric properties. Future studies should include broader populations based on gender and different region to represent Urdu speakers from other sociocultural or rural settings. The very high ICC should be interpreted cautiously as short retest intervals may affect the ICC .Further, use standardized cognitive screening tools (e.g., MMSE or MoCA), and refine selected items to strengthen factor structure and generalizability.

DECLARATIONS & STATEMENTS

Authors Contribution

AK, AA: substantial contributions to the conception and design of the study.
AK: acquisition of data for the study.
AA, SW, and SKa: interpretation of data for the study.
AK, AA, SW, and SKa: analysis of the data for the study.
AK, AA, SK, and SK: drafted the work.
AK, AA, SKa, SW, WAS, and SKu: revised it critically for important intellectual content.
AK, AA, SKa, SW, WAS, and SKu: final approval of the version to be published and agreement to be accountable for all aspects.
of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. All authors contributed to the article and approved the submitted version.

Ethical Statement

The study was approved by the Research Ethics Committee of Riphah College of Rehabilitation and Allied Health Sciences, Riphah International University, Islamabad (Ref: Riphah-RCR&AHS-ISB/REC/MS-PT/01645).

AI Use Statement

The authors used ChatGPT for language editing and for figure generation used GoogleColab. All content and interpretations were reviewed, verified, and approved by the authors.

Consent Statement

Written informed consent was obtained from all participants prior to data collection and for publication. The authors confirm that all participants voluntarily agreed to participate and that their confidentiality and privacy have been maintained throughout the study.

Data Availability Statement

The data presented in this study are available on

request from the corresponding author.

Acknowledgments

None to declare.

Funding Sources

None to declare.

Conflicts of Interest

None to declare.

REFERENCES

1. Carrigan N, Barkus E. A systematic review of cognitive failures in daily life: Healthy populations. Neurosci Biobehav Rev. 2016;63:29-42. [CrossRef] [PubMed]
2. Tariot PN, Weingartner H. A psychobiologic analysis of cognitive failures. Structure and mechanisms. Arch Gen Psychiatry. 1986;43(12):1183-8. [CrossRef] [PubMed]
3. Simpson SA, Wadsworth EJ, Moss SC, Smith AP. Minor injuries, cognitive failures and accidents at work: incidence and associated features. Occup Med (Lond). 2005;55(2):99-108. [CrossRef] [PubMed]
4. Linden, D. V. D., Keijsers, G. P. J., Eling, P., & Schaijk, R. V. Work stress and attentional difficulties: An initial study on burnout and cognitive failures. Work & Stress, 2005;19(1), 23–36. [CrossRef]
5. Relationship between sociodemographic factors and cognitive failures among employees. Eur. J. Humanit. Soc. Sci. 2023;3(1), 16-22. [CrossRef]
6. Wadsworth EJ, Moss SC, Simpson SA, Smith AP. Psychotropic medication use and accidents, injuries and cognitive failures. Hum Psychopharmacol. 2005;20(6):391-400. [CrossRef] [PubMed]
7. Wanleenuwat P, Iwanowski P, Kozubski W. Alzheimer's dementia: pathogenesis and impact of cardiovascular risk factors on cognitive decline. Postgrad Med. 2019;131(7):415-422. [CrossRef] [PubMed]
8. Ward A, Arrighi HM, Michels S, Cedarbaum JM. Mild cognitive impairment: disparity of incidence and prevalence estimates. Alzheimers Dement. 2012;8(1):14-21. [CrossRef] [PubMed]
9. Zhang T, Yang C, Shu G, Gao C, Ma H, Zou L, Zuo J, Liu S, Yan J, Hu Y. The direct and mediating effects of cognitive impairment on the occurrence of falls: a cohort study based on community-dwelling old adults. Front. Med. 2023 8;10:1190831. [CrossRef] [PubMed]
10. Montero-Odasso M, Speechley M. Falls in cognitively impaired older adults: implications for risk assessment and prevention. J. Am. Geriatr. Soc.2018;66(2):367-75. [CrossRef]
11. Lee JH, Luchetti M, Aschwanden D, Sesker AA, Strickhouser JE, Terracciano A, Sutin AR. Cognitive impairment and the trajectory of loneliness in older adulthood: evidence from the health and retirement study. J Aging Health. 2022;34(1):3-13. [CrossRef] [PubMed]
12. Broadbent DE, Cooper PF, FitzGerald P, Parkes KR. The cognitive failures questionnaire (cfq) and its correlates. Br J Clin Psychol. 1982;21(1):1-16. [CrossRef] [PubMed]
13. Meiran N, Israeli A, Levi H, Grafi R. Individual differences in self reported cognitive failures: The attention hypothesis revisited. Pers Individ Dif. 1994 1;17(6):727-39. [CrossRef]
14. Klumb PL. Cognitive failures and performance differences: validation studies of a German version of the cognitive failures questionnaire. Ergonomics. 1995;38(7):1456-67. [CrossRef] [PubMed]
15. Merckelbach H, Muris P, Nijman H, de Jong PJ. Self-reported cognitive failures and neurotic symptomatology. Pers Individ Dif. 1996 Jun 1;20(6):715-24. [CrossRef]
16. Di Nocera F, Ferlazzo F, D'Olimpio F. Is 'error proneness' specific to errors? Predictive validity of the cognitive failures questionnaire. Int. J. Hum. Factors Ergon. 2014 1;3(2):208-25. [CrossRef]
17. de Paula JJ, Costa DS, Miranda DM, Romano-Silva MA. Brazilian version of the cognitive failures questionnaire (cfq): cross-cultural adaptation and evidence of validity and reliability. Braz J Psychiatry. 2018;40(3):312-315. [CrossRef] [PubMed]
18. Eser HY, Inan MY, Kucuker MU, Kilciksiz CM, Yilmaz S, Dincer N, Kilic O, Ercan AC, Aydemir O. Development, validity and reliability of the 4-point Likert Turkish version of cognitive failures questionnaire.
19. Volosin M, Hallgató E, Csábi E. Validation of the hungarian version of the cognitive failures questionnaire (CFQ). Heliyon. 2023 10;9(1):e12910. [CrossRef] [PubMed]
20. Beaton DE, Bombardier C, Guillemin F, Ferraz MB. Guidelines for the process of cross-cultural adaptation of self-report measures. Spine (Phila Pa 1976). 2000 15;25(24):3186-91. [CrossRef] [PubMed]
21. elamin s. investigating the use of online bilingual resources by translation students: the vertical/sequential model revisited. J. Transl. Lit. Stud. 2023 17; 7(4).
22. Jackson-Koku G. Beck Depression Inventory. Occup Med (Lond). 2016;66(2):174-5 [CrossRef] [PubMed]
23. Oh H, Park K, Yoon S, Kim Y, Lee SH, Choi YY, Choi KH. Clinical Utility of Beck Anxiety Inventory in Clinical and Nonclinical Korean Samples. Front Psychiatry. 2018 4;9:666. [CrossRef] [PubMed]
24. Manea L, Gilbody S, McMillan D. A diagnostic meta-analysis of the Patient Health Questionnaire-9 (PHQ-9) algorithm scoring method as a screen for depression. Gen Hosp Psychiatry. 2015;37(1):67-75. [CrossRef] [PubMed]
25. Anthoine E, Moret L, Regnault A, Sébille V, Hardouin JB. Sample size used to validate a scale: a review of publications on newly-developed patient reported outcomes measures. Health Qual Life Outcomes. 2014 9;12:176. [CrossRef] [PubMed]
26. GUTTMAN L. A basis for analyzing test-retest reliability. Psychometrika. 1945;10:255-82 [CrossRef] [PubMed]
27. Balk EM, Gazula A, Markozannes G, Kimmel HJ, Saldanha IJ, Resnik LJ, Trikalinos TA. lower limb prostheses: measurement instruments, comparison of component effects by subgroups, and long-term outcomes [internet]. rockville (MD): agency for healthcare research and quality (US); 2018. [PubMed]
28. Henson RK. Understanding internal consistency reliability estimates: A conceptual primer on coefficient alpha. Meas. Eval. Couns. Dev.. 2001 1;34(3):177-89. [CrossRef]
29. Swisher LL, Beckstead JW, Bebeau MJ. Factor analysis as a tool for survey analysis using a professional role orientation inventory as an example. Phys Ther. 2004;84(9):784-99. [PubMed]
30. Colliver JA, Conlee MJ, Verhulst SJ. From test validity to construct validity and back? Med Educ. 2012;46(4):366-71. [CrossRef] [PubMed]

31. Schijven M, Jakimowicz J. Construct validity: experts and novices performing on the Xitact LS500 laparoscopy simulator. Surg Endosc. 2003;17(5):803-10. [CrossRef] [PubMed]
32. Tsouvala A, Katsouri IG, Moraitou D, Papantoniou G, Sofologi M, Nikova A, Vlotinou P, Tsiakiri A, Tsolaki M. Metacognitive awareness of older adult drivers with mild cognitive impairment: relationships with demographics, subjective evaluation of cognition, and driving self-efficacy. Behav Sci (Basel). 2024 6;14(6):483. [CrossRef] [PubMed]
33. Knight MJ, Baune BT. Executive function and spatial cognition mediate psychosocial dysfunction in major depressive disorder. Front Psychiatry. 2018 29;9:539 [CrossRef] [PubMed]
34. Craik FIM, Henry JD. Age-related changes in everyday prospective memory. In: Logie R, et al., editors. *Memory in Science for Society: There is nothing as practical as a good theory*. Oxford: Oxford University Press; 2023. [CrossRef]
35. Nielsen TR. Cognitive assessment in culturally, linguistically, and educationally diverse older populations in europe. Am J Alzheimers Dis Other Demen. 2022;37. [CrossRef] [PubMed]
36. Schneider S, Lee PJ, Hernandez R, Junghaenel DU, Stone AA, Meijer E, Jin H, Kapteyn A, Orriens B, Zelinski EM. Cognitive functioning and the quality of survey responses: an individual participant data meta-analysis of 10 epidemiological studies of aging. J Gerontol B Psychol Sci Soc Sci. 2024 1;79(5):gbae030 [CrossRef] [PubMed]
37. Czerwinski-Alley NC, Chithiramohan T, Subramaniam H, Beishon L, Mukaetova-Ladinska EB. The effect of translation and cultural adaptations on diagnostic accuracy and test performance in dementia cognitive screening tools: a systematic review. J Alzheimers Dis Rep. 2024 8;8(1):659-675 [CrossRef] [PubMed]
38. Rast P, Zimprich D, Van Boxtel M, Jolles J. Factor structure and measurement invariance of the cognitive failures questionnaire across the adult life span. Assessment. 2009;16(2):145-58. [CrossRef] [PubMed]

Research Article

Prevalence of carpal tunnel syndrome in female arts and textile students: a cross sectional survey

Rabia Rashid[1]*, Saadia Aziz[1], Hifza Iqbal[2], Zahid Mehmood[3]

ABSTRACT

Background: Carpal tunnel syndrome (CTS) is a common form of entrapment due to compression of median nerve, related to repetitive actions on the wrist. Female students in arts and textiles, particularly are most vulnerable as they are subject to repetitive fine-motor activities and minimal body ability in ergonomics.
Objective: To find the prevalence of Carpal Tunnel Syndrome (CTS) in female arts and textile students

Methods: A descriptive cross-sectional study was conducted using non probability convenience sampling from July 2025 to October 2025 among n=336 female students aged 17-30 years from arts and textile departments in Islamabad and Rawalpindi, engaged in drawing, painting, or sculpting. Data were collected through Durkan test and Boston Carpal Tunnel Questionnaire (BCTQ) which includes the Symptom Severity Scale (SSS) and the Functional Status Scale (FSS).

Results: The mean age of participants was 23.00±2.90 years, with a mean BMI of 22.88±4.79. The CTS prevalence was 53 (15.8 %) on Durkan compression test. The FSS score was 19.32±6.27, indicating predominantly moderate symptom severity and functional limitation. Overall, n=192(57.1%) of participants exhibited moderate symptom severity, and n=224(65.8%) reported moderate functional impairment.

Conclusion: This study found the presence of carpal tunnel syndrome among female arts and textile students alongside moderate CTS symptoms, suggesting early nerve compression due to repetitive hand activities.

Keywords: *arts and textile, boston carpal tunnel questionnaire, carpal tunnel syndrome, ergonomics.*

Designation & Affiliation
1. Consultant Physiotherapist, at Tanveer Hospital Wah Cantt, Pakistan.
2. Physiotherapist, Clinical Internship in Armed Forced Institute of Cardiology (AFI) Nursing Institute for Healthcare Design and (NIHD) Rawalpindi, Pakistan.
3. Assistant Professor, Ibadat International University Islamabad, Pakistan.

Citation
Rashid R, Aziz S, Iqbal H, Mehmood Z. Prevalence of carpal tunnel syndrome in female arts and textile students: a cross sectional survey. T Rehabili. J. 2026:10(01); 21-27 doi: 10.52567/trehabj.v10i01.132

Article History
Submitted: 04-12-2025
Accepted: 17-03-2026
Published: 29-03-2026

Correspondence*
Rabia Rashid, Consultant Physiotherapist, at Tanveer Hospital Wah Cantt, Pakistan.
E-mail: rabiarashid171@gmail.com

INTRODUCTION

Carpal Tunnel Syndrome (CTS) is among the most commonly occurring entrapment neuropathy whose pathophysiology results due to compression of the median nerve in the ossical constraints of the carpal tunnel[1]. The carpal bones make up the dorsal border and the flexor retinaculum makes up the volar bordering, both forming a closed compartment which encloses the nerve and tendons[2,3]. As such, CTS constitutes the most common neuropathic disease in the compression of upper limbs nerves[4,5]. The symptoms of the syndrome are pain and paresthesia, numbness and muscular weakness that affect the territory of the median nerve, often worsening the functioning of hands and general quality of life[6]. Etiology of CTS has multifactorial components of anatomic variance, biomechanical load, systemic disease, and occupational exposure[7]. Sustained repeated wrist movements, maintained grip position and manual dexterity are clinically reported risk factors that increase the intracarpal pressure and subsequently lead to the compression of the nerves[8].

Epidemiological researches always revealed that females are more likely to be affected by CTS compared to males due to their anatomical characteristics like smaller carpal tunnels and variations in hormones which affect the elasticity of connective tissue and their engagement in job that involves repetitive use of the hands[9]. According to population study, it is common that the risk of CTS is two to four times greater in women as compared to male[10]. Recent prevalence data indicate 18.7% in Kuwait female office workers[11], 2.0% in the Japanese general population (OR 7.33 for females)[12], and 21% in a meat-packing cohort with higher incidence in women (18.4 vs 9.7 per 100 person-years; RR 1.9)[13]. Taiwan national data show =0.4% annual incidence, higher in females [14], while European surveys report up to 9% prevalence in women versus 0.6-2% in men[15]. Moreover, women who practices arts, crafts and textile use are especially susceptible because of repetitive hand movements, awkward positions of the wrist as well as poor ergonomic habits[12]. Approximately 30-50% of CTS is due to occupational and activity-related factors, with high body mass index (BMI >25 kg/m²) being linked to two-fold greater risk of developing CTS[16].

The drawing, stitching, embroidery, cutting, and designing through the computer performed by the students of arts and textile require prolonged and repeated movements of the wrists, which puts a significant strain on the flexor tendons and soft tissues around them[17]. These activities can over time result in micro trauma, inflammation, and compression of the median nerve thus posing a risk of CTS in young age[18]. Female students enrolled in arts and textile program are vulnerable targeted population of musculoskeletal research , in contrast to industrial or office workers, is unaware of the ergonomics, early symptoms detection, and preventative measure[1].

Despite substantial literature addressing CTS in industrial and office-based workers, limited evidence exists regarding its burden among student populations, particularly female students engaged in fine motor-intensive academic disciplines. The detailed source of CTS prevalence in the group of individuals will be essential in applying early diagnosis tools, ergonomic training, and avoiding long-term progressive functional loss. It is against this background that the current study aimed at defining the prevalence as well as the severity of CTS symptoms among female students in the arts and textile fields.

METHADOLOGY

Study Design

Cross-sectional survey was conducted among female arts and textile students in Rawalpindi and Islamabad over a four-month period, from July 2025 to October 2025.

Participants

Participants included were female students age 17-30 years enrolled in the arts and textile departments, specifically those studying drawing, painting, and sculpting. Individuals with hand disorders, neurological or psychological conditions, diabetes mellitus, or outside the specified age range were excluded. Data were collected after obtaining informed consent, and after it was received, a demographic information sheet was filled in and then the standardized questionnaire.

Sample Size

A total of n=336 participants were selected through a convenience sampling technique, with the sample size determined using open *Epi Tool* at the 95% confidence interval and 5% margin of error.

Variables

Durkan test was used for the diagnosis of carpal tunnel syndrome and Boston Carpal tunnel Questionnaire (BCTQ) were used to collect data. To diagnose a carpal tunnel syndrome , the median nerve sensitivity in compression test by Durkan is 0.67 (IQR: 0.46-0.82) [19]. The validated instrument, Boston Carpal Tunnel Questionnaire (BCTQ) was used to determine the severity of the symptoms and the functional status of the patients having carpal tunnel syndrome. The BCTQ has two subscales: Symptom Severity Scale (SSS) and the Functional Status Scale (FSS). The symptoms severity scale contains 11 items rated as a five-point

Likert scale, with possible scores, starting with 1 (no symptoms) to the end point of 5 (very severe symptoms). The overall SSS score ranges from 11 to 55 with higher scores depicting severe symptoms. Studies have demonstrated that the SSS has been found to be stable and is useful in assessing the effects of the treatment when it is applied to patients with CTS while checking the severity of the symptoms[20]. The FSS has 8 items that measures functional limitations imposed on the sufferers of CTS and are rated on a scale of 1 (no difficulty) to 5 (very severe difficulty). The FSS has a total score of 8 to 40, as higher the score, the more impaired the daily activities[21].

Statistical Analysis

The analysis was done with SPSS version 27, frequencies and percentages were calculated in the categorical variables and, means with standard deviation in the continuous variables. The chi square test of association was used to find association between categorical variables. This approach guarantees a precise and thorough analysis of the prevalence and the severity of the carpal tunnel syndrome symptoms in female arts and textile students.

Ethical Approval

Ethical approval was obtained from Ethical Research Committee from Sarhad University of Science and Information Technology with Ref. SUIT/REC/2025/024

RESULTS

The mean age of n=336 participants was 23.00±2.90 years, range between 18 to 30 years. In terms of anthropometric measurements the mean Body Mass Index (BMI) of the cohort was 22.88 4.79 which takes the sample to the normative range though there is a significant range of individual variation between underweight and obese groups. The daily activity patterns provided an average of 5.881±0.794 hours work a day.

Table 1: Frequency and percentage distribution of participants by demographic and clinical categories (N=336)

Variable	Category	Frequency (n)	Percentage (%)
Discipline	Textile	173	51.5
	Arts	163	48.5
Working Hours per Day	7 hours	89	26.5
	6 hours	119	35.4
	5 hours	128	38.1
Age Groups (years)	27-30	46	13.7
	22-26	180	53.6
	17-21	110	32.7
BMI Groups	Obesity Class III (≥40)	2	0.6
	Obesity Class II (35-39.9)	8	2.4
	Obesity Class I (30-34.9)	18	5.4
	Overweight (25-29.9)	70	20.8
	Normal (18.5-24.9)	170	50.6
	Underweight (<18.5)	68	20.2

In measuring the symptomatology and functional capability, the average of the Symptom Severity Scale (SSS) was 24.93 at 8.63 which represent the middle level of discomfort in the entire group with a range on the mild side right to the severe side. The outcome of the functional capacity measured using the Functional Status Scale (FSS) offers a mean of 19.32+6.27, which implies a noticeably visible effect on day to day living. By adding these dimensions to the total categorization of Boston Questionnaire, the average score was at 43.82 14.62. Since the maximum score is 77, it had a dichotomy whereby some of the participants were relatively well adjusted, and others faced considerable overall difficulty because of their condition.

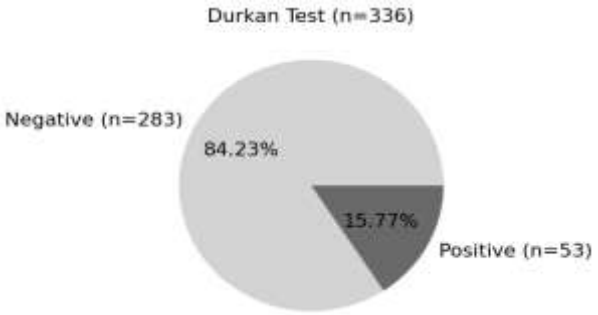

Figure 1: Prevalence of carpal tunnel syndrome

There was a significant association between the Durkan test and Symptom Severity Scale (SSS) (p=0.012). Among participants with moderate symptoms (23-44), 31 (58.5%) tested positive and 113 (39.9%) tested negative. In the mild symptom group (11-22), 22 (41.5%) were positive and 170 (60.1%) were

negative. A significant association was also found between the Durkan test and Functional Status Scale (FSS) (p=0.002). All participants with severe functional limitation (31-40) were Durkan positive 14(26.4%), with no negative cases. In the moderate functional group (16-30), 19(35.4%) were positive and 82(28.9%) were negative. In the mild functional group (8-15), 20(37.7%) were positive and 201 (71.1%) were negative.

Table 2: Association of Durkan Test with Symptom Severity Scale (SSS) and Functional Status Scale (FSS)

Variable	Category	Negative n (%)	Positive n (%)	Total (n)	χ^2	p-value
Symptom Severity Scale (SSS)	Moderate (23-44)	113 (39.9)	31 (58.5)	144	6.29	0.012*
	Mild (11-22)	170 (60.1)	22 (41.5)	192		
Functional Status Scale (FSS)	Severe (31-40)	0(0)	14 (26.4)	14	82.91	0.002**
	Moderate (16-30)	82 (28.9)	19 (35.4)	101		
	Mild (8-15)	201 (71.1)	20 (37.7)	221		

Significance level- p<0.05, p<0.01** & p<0.001***; χ^2- chi-square test; n- frequency; %-percentage*

DISCUSSION

The current study found the prevalence and severity of the carpal tunnel syndrome (CTS) symptoms in the female arts and textile students through use of both objective clinical tests (Durkan test), as well as patient-reported outcome measures, i.e.: the Boston Carpal Tunnel Questionnaire (BCTQ). There were 53 (15.8%) participants were positive on Durkan compression test among 336 participants. The self-reported symptoms and impaired functions were strong with the mean SSS of 24.93±8.63, FSS of 19.32±6.27 and total BCTQ of 43.82±14.62. Although the relative objective positivity rate was rather low, a high percentage of the participants described moderate-to-severe symptom burden and functional limitation. This divergence emphasizes the fact that provocative clinical testing when utilized independently can underestimate the occurrence of early or subclinical CTS therefore providing the need to integrate the use of objective testing with patient-reported outcome measures (PROMs) to create an effective diagnostic paradigm[22,23,24].

The prevalence of carpal tunnel syndrome is dependent on the demographic factors and workplace exposures. Yaseen et al. (2024) recorded a more favourable Durkan positivity result (55.4 %) among pregnant women, thus demonstrating the effect of physiological and temporal determinants. This rate of 15.8 % positivity is relatively smaller, but it supports the opinion that repeated fine-motor activities of arts and textile disciplines contribute to a material increase in the risk of CTS without pregnancy-related factors[25].

Office and industrial populations demonstrate similar patterns. Feng et al., 2021 and Omole et al., 2023 reported high rates of self-reported wrist and hand symptoms among office workers and design students exposed to prolonged computer or drawing tasks[26,27]. Our findings echo these patterns, indicating that repetitive fine-motor tasks in academic settings can produce early CTS signs at a younger age[27].

Meta-analyses show that provocative manoeuvres such as Durkan and Phalen have moderate sensitivity (Durkan =0.67; Phalen =0.57) and variable specificity[22]. Our observation of low Durkan positivity but high PROM-reported symptom burden aligns with this evidence, supporting the notion that provocative tests may miss early or evolving CTS presentations[24].

Modified provocative tests (e.g., Modified Phalen) achieve higher sensitivity but reduced specificity[28]. Reliance solely on Durkan would underestimate CTS burden; incorporation of PROMs such as the BCTQ allows detection of subclinical or functionally meaningful symptoms, guiding early intervention[25,28].

BCTQ is proven measures that describe the severity of the symptoms and the functional limitation of heterogeneous population [23,29]. The SSS and FSS scores of current study are consistent with women in repetitive and hand-intensive work and school studies, thus highlighting that functional diminution can be maintained even in a low provocative test positivity[27,30].

The female sex is considered a known risk factor of CTS, which can be explained by a smaller diameter of the carpal tunnel and hormonal factors [25,26]. The group of females only in this case is a high risk population particularly in manual repetitive tasks. Cumulative loading associated with prolonged fine motor activities (sewing, cross stitching, drawing and digital designing) may trigger the impairment of the early median nerve[26,27,29,31]. BMI also moderates the risk of CTS; half of the respondents had normal BMI with almost 29 percent being overweight or obese, a reflection of the literature showing that high BMI correlates to high intracarpal pressure and CTS vulnerability[26,29].

It is indicated in the evident discrepancy between positive results of the Durkan test and PROM-reported morbidity that a composite assessment model is urgently needed. Diagnostic certainty cannot be obtained by solely using a

single provocative test, an integrated algorithm created to integrate provocative manoeuvres with PROMs, and provided that it is practicable, electrophysiological studies, will provide more better appreciation of the CTS status. Resource-limited academic institutions can consider using PROMs as the primary warning sign of functional impairment, whereas nerve conduction examination is used in the presence of persistent or progressive manifestations. Early identification will allow the timely ergonomic education and specific interventions to prevent the subclinical or moderate CTS development to severe disability[22,24].

It is legitimate to introduce ergonomic training to the arts and textile programs. Workstation optimization, wrist stabilizing exercises, micro-break routines and nerve- gliding routines have all been debated as interventions able to prevent CTS risk and symptomatic progression[27,29,32]. Periodic screening procedures making an interventions of objective monitoring alongside PROMs might recruit at-risk students early enough to enable direct educational interventions and maintenance of integrity.

Longitudinal studies that include nerve conduction studies need to be conducted in the future to clarify the incidence, progression, and exposure-response relationships of CTS in the young and hand-intensive population[5,22,23]. Imaging techniques, such as ultrasound and elastography, could be used in a combination with PROMs and clinical correlates, which will provide anatomical verification of median nerve changes[31,33,34]. Subgroup comparisons between males and females or arts and textile specialists may serve as an informer of tailor-made preventive measures.

CONCLUSION

The study found the existence of carpal tunnel syndrome among female students involved in arts and textiles, most of whom reported moderate symptoms and limitations in functionalities the measurement of which was by the use of BCTQ. To the extent that monotonous hand use that is intrinsic in the academic tasks leads to the early compression of the median nerve in this group of people. A combination of objective clinical testing and patient-reported outcome measures will provide a more detailed assessment of the CTS impact of the academic group. To this end, therefore, timely ergonomic training, frequent screening, and preventive interventions are mandatory to protect the hand functions of the students, reduce the symptoms and academic productivity.

DECLARATIONS & STATEMENTS

Author's Contribution

RR, SA, and ZM: substantial contributions to the conception and design of the study.
RR, HI, and ZM: acquisition of data for the study.
SA, HI and ZM: interpretation of data for the study.
RR and ZM: Analysis of the data for the study.
RR, SA, HI and ZM: drafted the work.
RR, SA, HI and ZM: revised it critically for important intellectual content.
RR, SA, HI and ZM: final approval of the version to be published and agreement to be accountable for all aspects. of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. All authors contributed to the article and approved the submitted version.

Ethical Statement

Cross-sectional survey was conducted among female arts and textile students in Rawalpindi and Islamabad over a four-month period, from July 2025 to October 2025.

AI Use Statement

The authors used Grammarly to improve language clarity during manuscript preparation. All interpretations, conclusions, and original ideas remain solely those of the authors and approved by the authors.

Consent Statement

Informed consent was obtained from all subjects involved in the study.

Data Availability Statement

The data presented in this study are available on request from the corresponding author.

Acknowledgments

None to declare.

Funding Sources

None to declare.

Conflicts of Interest

None to declare.

REFERENCES

1. Hidayati HB, Subadi I, Fidiana F, Puspamaniar VA. Current diagnosis and management of carpal tunnel syndrome: A review. Anaesth. Pain Intensive Care. 2022;26(3):394-404. [CrossRef]
2. Cavalcante JBF, Cembraneli PN, Cavalcante RBF, Junior VFV, Cavalcante JEDS. Post-surgical complications of median nerve release at the wrist level. Pan Afr Med J. 2020;10;36:173. [CrossRef] [PubMed]
3. Hasib SW, Usmani A, Anwar SF, Mumtaz A. The morphology of a smartphonopathic hand - smartphone use and the median nerve cross-sectional area. Pak J Med Sci. 2025;41(1):200-204. [CrossRef] [PubMed]
4. Li S, Kociolek AM, Mariano LA, Loh PY. Grip force modulation on median nerve morphology changes. J Orthop Res. 2025;43(6):1179-1190. [CrossRef] [PubMed]
5. Kanagasabai K. Ultrasound of median nerve in the diagnosis of carpal tunnel syndrome-correlation with electrophysiological studies. Indian J Radiol Imaging. 2022;6;32(1):16-29. [CrossRef] [PubMed]

6. Amin F, Haridy H, Fahmy E, Lasheen Y. A multimodal approach of electrotherapy versus nerve flossing technique in patients with chronic carpal tunnel syndrome: a randomized controlled trial. J. Popul. Ther. Clin. Pharmacol. 2023;30(7):322-34. [CrossRef]
7. Kandemir T, Ercan S, Ataizi ZS. Coexistence of ipsilateral ulnar and median nerve entrapment. Rom Neurosurg. 2022;365-9. [CrossRef] [PubMed]
8. Liao KH, Lin YT, Wu CT, Lin CH, Chen SH, Hsu CC. Preliminary prospective preoperative and postoperative evaluation of median nerve stiffness by using sonoelastography. Ann Plast Surg. 2023;1;91(2):265-269. [CrossRef] [PubMed]
9. Chaudhary SF, Ihtesham A, Amjad S, Ahmad Z. Prevalence of carpal tunnel syndrome among the bds interns of the dental institutes in lahore: a cross-sectional study: prevalence of carpal tunnel syndrome among bds interns. J. Health Rehabil. Res. 2024;4(3):1-5. [CrossRef] [PubMed]
10. Lam KHS, Wu YT, Reeves KD, Galluccio F, Allam AE, Peng PWH. Ultrasound-guided interventions for carpal tunnel syndrome: a systematic review and meta-analyses. Diagnostics (Basel). 2023 16;13(6):1138. [CrossRef] [PubMed]
11. Raman SR, Al-Halabi B, Hamdan E, Landry MD. Prevalence and risk factors associated with self-reported carpal tunnel syndrome (CTS) among office workers in Kuwait. BMC Res Notes. 2012;13;5:289. [CrossRef] [PubMed]
12. Otoshi K, Kikuchi S, Sasaki N, Sekiguchi M, Otani K, Kamitani T, et al. The associated risk factors for entrapment neuropathy in the upper extremity: the locomotive syndrome and health outcome in aizu cohort study (LOHAS). Health. 2018;10:823-37. [CrossRef]
13. Gorsche RG, Wiley JP, Renger RF, Brant RF, Gemer TY, Sasyniuk TM. Prevalence and incidence of carpal tunnel syndrome in a meat packing plant. Occup Environ Med. 1999;56(6):417-22. [CrossRef] [PubMed]
14. Yang C, Chen HH, Lee MC, Kao HK, Lin YT, Chen CT, Chang CJ, Tsai CH. Risk factors of carpal tunnel syndrome in taiwan: a population-based cohort study. Ann Plast Surg. 2022;1;88(1):74-78. [CrossRef] [PubMed]
15. Habib KR. Estimation of carpal tunnel syndrome (CTS) prevalence in adult population in western European countries: a systematic review. Eur J Clin Biomed Sci. 2017;3(1):13-8. [CrossRef]
16. Sridevi ED, Wada ZH, Boroh Z. Pengaruh Nerve Gliding Exercise Terhadap Fungsi Tangan Pada Carpal Tunel Syndrome Karyawan Kantoran. Diagnosa J. Ilmu Kesehat. Keperawatan. 2025;3(3):269-83. [CrossRef]
17. Bicha N, Gashaw M, Chanie ST, Mekie M, Yalew ES. Burden of carpal tunnel syndrome and its associated factors among construction industry workers in Gondar town, Ethiopia. Front Public Health. 2024;12;12:1365124. [CrossRef] [PubMed]
18. Dsouza MR, Bhat AK, Guruprasad Kalthur S, Allwyn Joshua S. Association between carpal tunnel cross-sectional area and carpal tunnel syndrome: a systematic review and meta-analysis. Muscles Ligaments Tendons J.2023;13(4).
19. Kulesza R, Sachsenmeier C, Klein F. Three-headed biceps brachii muscle: a rare site of proximal median nerve entrapment. Cureus. 2024;7;16(6):e61886. [CrossRef] [PubMed]
20. Multanen J, Ylinen J, Karjalainen T, Ikonen J, Häkkinen A, Repo JP. Structural validity of the boston carpal tunnel questionnaire and its short version, the 6-item cts symptoms scale: a rasch analysis one year after surgery. BMC Musculoskelet Disord. 2020;12;21(1):609. [CrossRef] [PubMed]
21. Atthakomol P, Nudchapong J, Sangseekaew K, Manosroi W, Tongprasert S, Wongpakaran T, Wongpakaran N. Field testing and psychometric properties of Thai version of the Boston carpal tunnel questionnaire. Front Neurol. 2023;18;14:1132218. [CrossRef] [PubMed]
22. Ozdag Y, Hu Y, Hayes DS, Manzar S, Akoon A, Klena JC, Grandizio LC. Sensitivity and specificity of examination maneuvers for carpal tunnel syndrome: A Meta-Analysis. Cureus. 2023;24;15(7):e42383. [CrossRef] [PubMed]
23. Naik D, Patel H, Vyas B. From conservative to surgical management in bilateral cts: a case-based approach. ijpra. Int. J. Pharm. Res. Appl. 2025;10(3):1356-62. [CrossRef]
24. Dabbagh A, MacDermid JC, Yong J, Packham TL, Grewal R, Boutsikari EC. Diagnostic test accuracy of provocative maneuvers for the diagnosis of carpal tunnel syndrome: a systematic review and meta-analysis. Phys Ther. 2023;5;103(6):pzad029. [CrossRef] [PubMed]
25. Yaseen F, Mahmood M, Akhtar W, Naseem M, Zafar M, Rizwan M, et al. Prevalence of carpal tunnel syndrome during pregnancy. J. Health Rehabil. Res. 2024;4(1):769-73. [CrossRef]
26. Feng B, Chen K, Zhu X, Ip WY, Andersen LL, Page P, Wang Y. Prevalence and risk factors of self-reported wrist and hand symptoms and clinically confirmed carpal tunnel syndrome among office workers in china: a cross-sectional study. BMC Public Health. 2021;6;21(1):57. [CrossRef] [PubMed]
27. Omole AE, Awosika A, Khan A, Adabanya U, Anand N, Patel T, Edmondson CK, Fakoya AO, Millis RM. An integrated review of carpal tunnel syndrome: new insights to an old problem. Cureus. 2023;8;15(6):e40145. [CrossRef] [PubMed]
28. OMER MUSA AL MIZWRI L. DIAGnostic accuracy of the modified phalen test compared to other clinical maneuvers in carpal tunnel syndrome: a crosssectional study. Duhok Med. J. 2025;19(2).
29. Demissie B, Yenew C, Alemu A, Bantie B, Sume BW, Deml YA, Tegegne E. Carpal tunnel syndrome and its associated factors among computer user bankers in south gondar zone, northwest ethiopia, 2021: a cross sectional study. BMC Musculoskelet Disord. 2023;19;24(1):828. [CrossRef] [PubMed]
30. Teo SJ, Wan Nurul Hana Wan Mohamad S, Subramaniam RN, Hanapi NSM, Yap YHY. The prevalence and associated risk factors of carpal tunnel syndrome among private dentists in klang valley, malaysia: a cross-sectional study. Ann. Dent. Univ. Malaya. 2022;29(-):52-9. [CrossRef] [PubMed]
31. Bulatović D, Nikolić D. Diagnostic modalities and physical therapy in patients with carpal tunnel syndrome. Medicinski Podmladak. 2022;73(3):22-6 [CrossRef]
32. Daliri M, Sahebalam M, Olia NDB, Moradi A. Utility of provocative test positivation time in carpal tunnel syndrome severity assessment. J. Musculoskelet. Res. 2023;27(02). [CrossRef]
33. Wu H, Zhao HJ, Xue WL, Wang YC, Zhang WY, Wang XL. Ultrasound and elastography role in pre- and post-operative evaluation of median neuropathy in patients with carpal tunnel syndrome. Front Neurol. 2022;16;13:1079737. [CrossRef] [PubMed]

34. Haddani H, Sugiharto H, Afriani, Christin T, Legiran L, Ferawaty F. Ultrasound vs nerve conduction studies: a comparative analysis in carpal tunnel syndrome diagnosis. Biosci. Med. J. Biomed. Transl. Res. 2024;8(12):5685-96. [CrossRef]

Review Article

Comparative insights into traditional language therapy and gestalt language processing in autism: a scoping review

Hamamah Ansari[1], Amina Asif Siddiqui[2]*, Tahmeena Tabish[3], Kehkashan Kanwal[3]

ABSTRACT

Background: Language and communication difficulties are common in children with Autism Spectrum Disorder (ASD). Traditionally, behavioral and analytic therapies have been used to address these challenges. Gestalt Language Processing (GLP) proposes that some children with ASD acquire language through memorized multiword units (gestalts) that later develop into meaningful sentences. However, empirical evidence for GLP-based interventions remains limited.

Objective: To identify and compare the existing literature on Gestalt Language Processing and traditional language therapy interventions for supporting language development in children with ASD.

Methods: The study followed a scoping review framework based on PRISMA 2020 guidelines. Two systematic searches were conducted for existing literature. Four databases were searched: PubMed, Scopus, Cochrane Library, and ScienceDirect. The search included English-language studies published between 2020 and 2024. The first search focused on Gestalt Language Processing literature. The second search examined traditional language therapy interventions.

Results: The search yielded 4,074 GLP records and 4,253 on traditional language therapy. No empirical GLP intervention studies were identified; the literature was mainly theoretical. In contrast, eight empirical studies on traditional language therapy reported improvements in expressive and receptive language, lexical development and functional communication following structure interventions such as Applied Behavior Analysis, Discrete Trial Training, and TEACCH-based programs.

Conclusion: Traditional language therapy is supported by empirical evidence demonstrating improvements in language outcomes in children with ASD, whereas GLP remains largely theoretical. Further research is needed to determine the effectiveness of GLP-based interventions

Keyword: autism spectrum disorder, echolalia, gestalt language, natural language acquisition, language intervention, processing, scoping review

Designation & Affiliation

1. MS Scholar, College of Speech Language and Hearing Sciences (CSLHS), Ziauddin University, Karachi, Pakistan.
2. Associate Professor, College of Speech Language and Hearing Sciences (CSLHS), Ziauddin University, Karachi, Pakistan.
3. Assistant Professor, College of Speech Language and Hearing Sciences (CSLHS), Ziauddin University, Karachi, Pakistan.

Citation

Ansari H, Siddiqui AA, Tabish T, Kanwal K. Comparative insights into traditional language therapy and gestalt language processing in autism: a scoping review. T Rehabili. J. 2026:10(01); 28-38 doi: 10.52567/trehabj.v10i01.142

Article History

Submitted: 16-01-2026
Accepted: 17-03-2026
Published: 27-03-2026

Correspondence*

Amina Asif Siddiqui, Associate Professor, College of Speech Language and Hearing Sciences (CSLHS), Ziauddin University, Karachi, Pakistan.
E-mail: amina.siddiqui@zu.edu.pk

https://doi.org/10.52567/trehabj.v10i01.142

INTRODUCTION

Autism Spectrum Disorder (ASD) is a neurodevelopmental condition described as difficulties in social communication, challenges, and behaviours, often accompanied by restricted or repetitive patterns of activity and interests[1]. Repetitive speech, including echolalia, is considered to be a primary feature of Autism, with over 75% of children with ASD exhibiting it[2]. Whilst children with ASD repeat speech more often compared to other children, research on the factors influencing this behavior remains limited, although echolalia is widely considered a prime feature of ASD[3]. Internationally, ASD affects approximately 1 in 100 children, with prevalence rates contrary across regions, ranging from 0.09% to 1.07% in South Asia and up to 2.9% in Gulf countries due to discrepancies in awareness, diagnostic training, and monitoring systems[4].

In Pakistan, autism and developmental disabilities are underreported, where limited studies show a significant rise in rates, such as 2.57 per 1,000 for autism and up to 6.5% for mild intellectual disability. Compared to general Asian trends of rising ASD recognition, Pakistan's lack of large-scale epidemiological data highlights the need for more studies, awareness, and early intervention[5]. However, despite innovations in research, most ASD cases remain idiopathic, underscoring the complex etiology and growing public health impact of the disorder[6].

Earlier to Gestalt Language Processing (GLP) being introduced, gestalts such as repetitive speech, or echolalia were observed as something SLPs needed to correct or eliminate in speech. It was often misinterpreted into meaningless utterances. However, the findings from both previous and recent research[7]. GLP has been proposed as a naturalistic developmental model. Peters was one of the pioneer to describe this process as moving from the whole to the parts, and together with Prizant, helped to established the initial understanding of GLP that informs the line of work today[8]. Before GLP's framework, SLP interventions generally relied on traditional language therapy approaches i.e. clinician-directed methods like discrete trial training, with earlier shifts toward child-led approaches in naturalistic developmental Interventions[9].

The objective of this study is to critically investigate and integrate current studies on Gestalt Language Processing (GLP) in autism, comparing it with traditional language therapy (TLT) approaches. This research is based on the rationale that employing TLT for children with ASD and echolalia may not be the best intervention. Considering TLT as a 'one size fits all' for all children having ASD is not the best methodology. This study aims to explain the usage of GLP, discuss its developmental stages, and evaluate the effectiveness and clinical relevance of ASD intervention therapeutic models. As a result, the study will facilitate clinicians, researchers, and educators with a thorough understanding that advances neurodiversity-affirming, naturalistic language development while considering the intervention methods. The discussion contains existing literature, research gaps, clinical effects, and guidelines for future investigation to improve communication outcomes for children with ASD.

METHODOLOGY

Study Design

This scoping review examines two basically different approaches in therapy for children with ASD, known as GLP-based intervention and traditional language therapy. Due to the significant theoretical and clinical differences between these two approaches, the available literature is diverse in terms of conceptual frameworks, intervention models, outcome measures, and study designs. Therefore, a scoping review framework was selected to systematically map the scope, nature, and descriptions of existing data rather than to evaluate the effectiveness of a single intervention through closely defined outcomes.

Literature Search Strategy

To review the relevant comprehensive literature, two independent systematic searches were conducted for each therapy approach across four databases (PubMed, Scopus, Cochrane, and ScienceDirect), and the search processes were reported separately by following PRISMA 2020 guidelines. Unlike a systematic review, which aims to answer a specific research question through critical appraisal and synthesis of high-quality studies, this scoping review allows for the inclusion of a broad range of study designs without formal quality assessment, enabling identification of key concepts, research trends, and knowledge gaps. All included articles were published in English language between 2020 to 2024.

Search Strategy for Gestalt Language Processing

An intensive systematic search was conducted following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR)[10] criteria to identify relevant literature about Gestalt Language Processing on 20th September 2024, using the following terms *(Children with Autism OR Autism Spectrum Disorder OR ASD) AND (Gestalt Language Processing OR Echolalic Language Development OR Whole Phrase Language Learning OR Scripted*

https://doi.org/10.52567/trehabj.v10i01.142

Language) AND (Language Development OR Communication Skills).

Eligibility criteria for GLP studies

The inclusion criteria were original research studies reported on children diagnosed with ASD who exhibited language development delays or impairments, intervention studies for children with autism or language disorders described as Gestalt Language Processors, their definition and stages of development and using experimental or quasi-experimental designs capable of evaluating intervention effectiveness of GLP, including randomized controlled trials (RCTs), non-randomized controlled trials, single-case experimental designs, and multiple-baseline designs studies reporting language-related outcomes, such as expressive language, receptive language, spontaneous communication, functional language use, or generalization and full-text articles published in English in peer-reviewed journals. The exclusion criteria were studies involving participants without a diagnosis of ASD or without identified communication or language impairments, as well as studies focusing on adolescents or adults with ASD. Studies were also excluded if they did not evaluate traditional or analytic language therapy approaches (e.g., studies focusing solely on behavioural management, sensory integration, visual perception, or other non-language-based interventions) or if they did not report language outcomes, such as receptive or expressive language skills. Additionally, non-empirical studies, conference abstracts, proceedings, editorials, commentaries, protocols, theses, or articles not available in full text and not published in English were also excluded.

Data Extraction for GLP

All records were identified through the described search strategy and imported into an EndNote library (version 20.6). Duplicate records were identified and removed. Subsequently, the titles and abstracts of all retrieved records were screened on basis of the predefined eligibility criteria. The database searches identified a total of 4074 records. After removing duplicate records (n=405) and records with titles or abstracts (n=3669) and excluded (n=3399). Then (n=270) were screened with the abstracts. Most of these records focused on Gestalt psychology, visual processing, or non-language-based constructs, rather than Gestalt Language Processing or language intervention. The remaining (n=06) records were retrieved for full-text review, as eligibility could not be determined from the title and abstract alone. Full-text assessment revealed that all 6 records failed to meet one or more inclusion criteria, most commonly because they did not involve intervention studies or did not evaluate the effectiveness of GLP approaches. In addition to database searching, (n=30) additional records were identified through other sources, including reference list screening and citation tracking, and were assessed according to the same eligibility criteria but after seeking retrieval for (n=30) and assessing (n=8) for eligibility, none met the inclusion criteria. As they were mostly on the literature and theoretical concept of GLP not on the intervention method. In December 2024 [11] published systematic review stating the similar results, searched 18 databases and clinical trial registries for intervention studies on GLP/NLA approaches and found no empirical research evaluating their effectiveness. The study did not fulfill the criteria of inclusion highlights the absence of empirical evidence, reveals critical research gaps, and cautions against premature clinical adoption of untested interventions like GLP/NLA and prompts the call for rigorous trials rather than anecdotal support. (figure 1)

The available studies were categorized by limited sample sizes and significant heterogeneity in participant characteristics, intervention approaches, and language outcomes. This variability limited comparison across studies and indicated gaps in the current evidence base.

Search Strategy for Traditional Language Therapy

The broad search was conducted again on traditional language therapy to review empirical studies on it and for the comparison with GLP. Four databases were searched PubMed, Scopus, Cochrane and Science Direct using the following terms *(Analytic language OR Traditional language therapy OR Discrete trial OR Incidental teaching OR Structured teaching OR Drill-based) AND (Autism OR "autism spectrum") AND (language).*

Eligibility Criteria for Traditional Language Therapy Studies

Inclusion criteria were original empirical research studies involving children diagnosed with ASD and/or developmental language disorder with communication or language impairments, studies evaluating traditional or analytical language therapy (e.g., analytic, developmental, or clinician-directed language intervention, structured teaching or discrete trial training), studies were experimental or quasi-experimental research designs capable of evaluating intervention effectiveness, including randomized controlled trials (RCTs), non-randomized controlled trials, cohort studies, single-case experimental designs, and multiple-baseline designs, studies reporting language-related outcomes, such as expressive language, receptive language, spontaneous communication, functional language use, or generalization and full-text articles published in English in peer-reviewed journals.

https://doi.org/10.52567/trehabj.v10i01.142

Exclusion criteria were the participants without ASD diagnosis, identified communication or language impairments, studies focuses on adolescents and adult autism, studies were excluded if they did not evaluate traditional or analytic language therapy approaches (e.g., studies focusing solely on behavioural management, sensory integration, visual perception, or non-language-based interventions) and not reporting language outcomes, articles were not available as full-text articles (e.g., conference abstracts, editorials, commentaries, protocols, or theses) and articles were not published in English were also excluded.

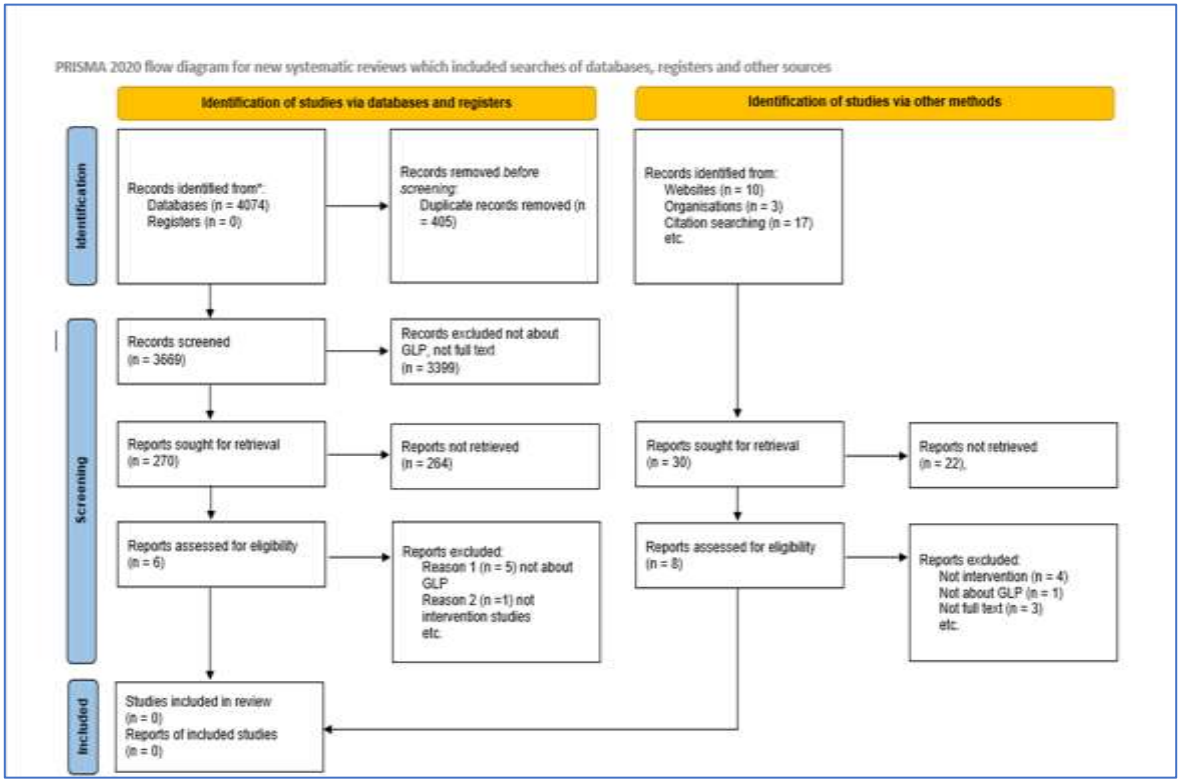

Figure 1: PRISMA 2020 diagram of systematic search and record screening for Gestalt Language Processing [12]

Data Extraction for TLT

The screening process, including the number of records identified, screened, and excluded at each stage of the review, along with the primary reasons for exclusion, is presented in a Figure 2. The database searches identified a total of (n=4253) records. Following the removal of duplicate records (n = 51) and records with titles or abstracts (n= 4202) and excluded (n=4164). Then (n=38) were screened with the abstracts and (n=33) were included for full texts. From which (n=8) were eligible for the designated criteria. Most were the empirical studies and one single case study on the effectiveness of traditional language therapy in developing language skills through structured methods. (Figure 2)

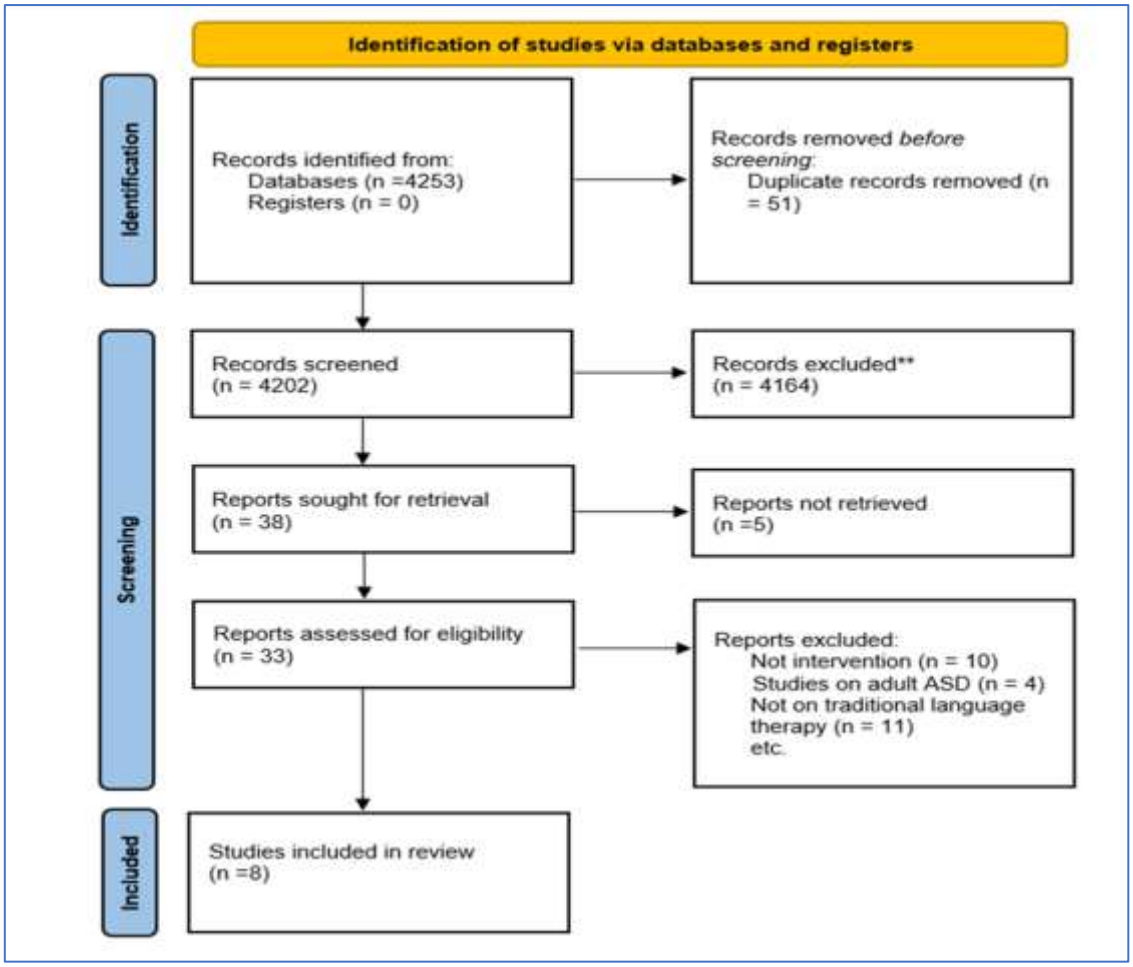

Figure 2: PRISMA 2020 diagram of systematic search and record screening for traditional language therapy [12]

RESULT

The scoping review identified a total of seven records examining Gestalt Language Processing (GLP) and Natural Language Acquisition (NLA) approaches for children with Autism Spectrum Disorder (ASD) [7, 8, 13,14,15,16,17,18].

All included studies were theoretical, literature reviews, editorials, or guidelines for clinical practice, with no empirical intervention studies meeting inclusion criteria. The primary aim of these works was to explain the GLP framework, its relevance to autism, and assistance with clinical practice. For instance, Hans Buffart and Haike Jacob (2021)[13] suggested that language develops from processing to multiword units rather than innate grammar, suggesting that meaningful communication occurs through understanding and altering these whole units. Similarly, Blanc et al. (2023, 2024) [7, 19] described the Natural Language Acquisition protocol, underlining the prospective for functional communication, grammatical pattern, and social communication in children with autism. Comprehensive review of GLP literature highlighted significant limitations. Hutchins et al. (2024)[20] and Beals (2024) [16] reported insufficient empirical support for the progression from memorized phrases to flexible, generative language, cautioning against the premature adoption of GLP in clinical practice. Editorials by Haydock (2024)[17] and Venker & Lorang (2024)[18] emphasized the importance of measuring language outcomes using evidence-based indicators rather than assuming progress within the GLP framework. A dissertation by Urwiler (2025)[8] described theoretical progression from gestalts to self-generated sentences but provided no empirical intervention data. Overall, the GLP literature is largely conceptual, highlighting a significant evidence gap for intervention studies. (table 1)

Table 1: Data extraction table for Gestalt Language Processing

Author and year	Title	Objectives	Intervention methods	Study Design	Participants	Language Outcomes	Type of Record
Hans Buffart and Haike Jacob, 2021 [13]	A Gestalt Theory Approach to Structure in Language	To propose and support a Gestalt-based cognitive model where language structure arises from the perceptual limitations of focus, not from innate grammar or usage alone.	N/A	Theoretical and Analytical Study	N/A	A meaningful communication develops through understanding and reorganizing these whole units, rather than learning isolated words first, progressing to functional, flexible language over time.	Journal Article
Blanc et al, 2023 [19]	Using the Natural Language Acquisition Protocol to Support Gestalt Language Development	Explain gestalt language development, a natural form of language acquisition, and demonstrate how the Natural Language Acquisition (NLA) protocol can be utilized to support children with autism and nonverbal individuals with language development.	N/A	Literature Review	N/A	Improved functional communication, increased grammatical organization, and better ability to express thoughts, emotions, and social communication.	Journal Article
Blanc et al, 2024 [7]	The natural language acquisition guide: Echolalia is all about gestalt language development	To guide clinicians and caregivers in supporting gestalt language processors using the natural language development framework.	N/A	Pamphlet/ Practical guide	N/A	Language becomes grammatically organized, intentional, and meaningful, supporting functional communication, social interaction, and self-expression.	Webpage
Tiffany L Hutchins, Sophie E Knox, E Cheryl Fletcher, 2024 [20]	Natural language acquisition and gestalt language processing: A critical analysis of their application to autism and speech language therapy	To critically review the theory of gestalt language processing, its links to autism, and associated theories (including delayed echolalia, episodic memory, and Blanc's language stages), highlighting definitional, theoretical, and empirical limitations.	N/A	Literature Review	N/A	The authors report that claims of progression to flexible, generative language lack sufficient empirical support, and that current evidence does not reliably demonstrate improved grammatical development or functional language outcomes compared to existing language intervention approaches.	Journal Article
Katharine Beals, 2024 [16]	A Linguist's Take on Blanc's Proposition of Gestalt Language Processing and Natural Language Acquisition: An Implausible Theory at Odds with the Research	This review analyses Blanc's Gestalt Language Processing (GLP) and Natural Language Acquisition (GLP/NLA), and related recommendations for clinical practice.	N/A	Literature Review	N/A	It should be measured by independent, generative grammar and productive sentence formation, which the authors argue is not yet convincingly demonstrated in the existing GLP/NLA literature.	Journal Article
Amanda Haydock, 2024 [30]	Embracing gestalt language development as a fundamental neurodiversity-affirmative practice	To advocate for recognizing gestalt language development as a valid, neurodiversity-affirming language acquisition style in autism and clinical practice.	N/A	Editorial	N/A	It focuses on meaningful communication that promotes self-sufficiency and identity rather than minimizing echolalia. Gestalt language development is acknowledged as a viable route that promotes adaptable, authentic communication.	Journal Article
Courtney E Venker and Emily Lorang, 2024 [18]	Continuing the conversation about echolalia and gestalt language development: A response to Haydock, Harrison, Baldwin, and Leadbitter	To critically respond to Haydock et al. (2024) by clarifying definitions, evaluating theoretical and empirical claims about echolalic speech and gestalt language development, and highlighting the need for stronger evidence to guide clinical practice.	N/A	Editorial	N/A	It highlights that language outcomes should be measured using clear, evidence-based indicators of comprehension and generative language, rather than assumed within the gestalt language processing framework.	Journal Article
Jordynn L. Urwiler, 2025 [8]	Literature Review: Understanding Gestalt Language Processing in Autism Spectrum Disorder	This study provides the clinicians with comprehensive information about gestalt language processing.	N/A	Literature Review	N/A	The children progress from using gestalts, memorized chunks to producing flexible, self-generated sentences with complex grammar. The outcome is functional, meaningful communication that supports social interaction, self-expression in everyday settings.	Dissertations

In contrast, eight empirical studies examining traditional language therapy (TLT) interventions were included[21,22,23,24,25,26,27,28]. These studies utilized a variety of designs, including randomized controlled trials, quasi-experimental studies, clinical trials, longitudinal studies, and single-case designs, with sample sizes ranging from 1 to 194 participants. Therapeutical methods included Applied Behaviour Analysis (ABA), Discrete Trial Training (DTT), TEACCH programs, Early Intensive Behavioural Intervention (EIBI), and adaptive interventions integrating parent training and naturalistic approaches. These studies consistently reported developments in expressive and receptive language, functional communication, lexical and semantic skills, and social interaction. For example, Meçe & Sherifi (2022)[25] and Bekmurat & Autayeva (2025)[28] demonstrated measurable gains in vocabulary, syntactic structure, and contextual language use following ABA-based methods. Frazier et al. (2021)[23] and Hartley et al. (2020)[22] reported that early language processing and comprehension skills predicted effective expressive and receptive outcomes, while Kasaria et al. (2025)[27] highlighted the efficacy of adaptive interventions for minimally verbal school-aged children (table 2).

https://doi.org/10.52567/trehabj.v10i01.142

Table 2: Data extraction table for Traditional Language Therapy

Author and Year	Title	Objectives	Intervention methods	Study Design	Participants	Language Outcomes	Type of Record
Sigmund Eldevik, Hege Aarli, Kristine B. Titlestad, Ellie Kazemi, and Greg Elsky, 2020 [21]	Effects of Functional Discrimination Training on Initial Receptive Language in Individuals with Autism Spectrum Disorder	To examine whether functional discrimination training using functional support improves initial receptive (auditory visual) language skills in individuals with ASD who struggle with traditional teaching methods.	Functional Discrimination Training	Clinical Trial	8	The improvement was observed in receptive language, specifically in the ability to correctly respond to auditory–visual conditional discriminations (AVCDs) by selecting the correct object when given a verbal instruction. This improvement in functional language was associated with the use of functional reinforcement contingencies, where the reinforcement was directly related to the child's response.	Journal Article
Hartley et al, 2020 [22]	Comparing cross-situational word learning, retention, and generalisation in children with autism and typical development	1. Assess cross-situational word learning abilities between children with ASD and typical development children. 2. Examine whether children with ASD can use statistical co-occurrences between words and objects to infer word meanings in ambiguous contexts. 3. Evaluate the correlation between mapping, retention, and generalization in lexical learning as an integrated system.	Cross-situational word learning task	Experimental design	31	The study examined word learning outcomes, including word–referent mapping, retention of newly learned words, and generalisation of words to new category members in children with autism and typical development. These language outcomes were evaluated using the variable of cross-situational word learning with different attentional cues (social vs. non-social) to support word acquisition.	Journal Article
Thomas W. Frazier et al, 2021 [23]	A Longitudinal Study of Language Trajectories and Treatment Outcomes of Early Intensive Behavioral Intervention for Autism	1. To examine language development models and treatment outcomes in children with ASD receiving early intensive behavioral intervention (EIBI) over a period 2. To find indicators of language growth and educational placement.	Early Intensive Behavioral Intervention	Longitudinal Study	131	Its early language processing and comprehension skills are associated with better later expressive and receptive language outcomes.	Journal Article
Hongling Zeng a , Shuo Liu, Run Huang , Yi Zhou, Jun Tang , Jun Xie, Pan Chen, Bing Xiang Yang, 2021 [24]	Effect of the TEACCH program on the rehabilitation of preschool children with autistic spectrum disorder: A randomized controlled trial	To evaluate the efficiency of the TEACCH program (combined with Discrete Trial Teaching) contrast to DTT alone in improving the developmental outcomes of preschool children with ASD in China.	TEACCH and DTT	Randomized controlled trial	60	The study showed that stronger language processing and comprehension abilities are connected to better expressive and receptive language development.	Journal Article
Daniela Meçe, Edo Sherifi, 2022 [25]	Effectiveness of the ABA Method and Individual Education Programs for the Treatment of Autistic Children: A Case Study	The objective of this investigation is to evaluate and to focus on the efficacy of the ABA program in children with autism.	ABA	Single Case Study	1	The study stated significant improvement in language skills, including increased vocal imitation, labelling, sound production, and conversational abilities following ABA intervention.	Journal Article
Freeman et al, 2024 [26]	Effects of script-fading on social initiations during discrete-trial teaching with children with autism	To examine the use of embedding auditory scripts and script-fading procedures within standard Discrete-Trial Teaching (DTT) sessions for children with autism.	Discrete Trial Training	Experimental design	3	The study observed significant increases in socially appropriate language initiations, including requests for materials and instruction.	Journal Article
Kasaria et al, 2025 [27]	Adaptive Intervention for School-Age, Minimally Verbal Children with Autism Spectrum Disorder in the Community: Primary Aim Results	The study objective was to paradigm of 16-week, 2-stages, adaptive intervention containing of DTT (Discrete Trials Training, which is mostly considered usual care for children with autism), JASP-EMT (a blended, naturalistic, developmental Behavioral intervention involving JASPER [Joint Attention, Symbolic Play, Engagement and Regulation] and EMT [Enhanced Milieu Teaching]), and parent training (P) for improving spontaneous communicative utterances in school-aged, minimally verbal autistic children.	DTT, JASP-EMT, JASPER, EMT, Parent training	Randomized clinical Trial	194	The study revealed no significant difference in language outcomes between starting intervention with DTT or JASP-EMT. However, an adaptive intervention (beginning with DTT, adding parent training for early responders, and combining DTT + JASP-EMT for slower responders) produced the outcomes in spontaneous communicative utterances.	Journal Article
Bekmurat & Autayeva, 2025 [28]	The Application of Adapted Applied Behaviour Analysis Therapy for Developing Lexical and Semantic Skills in Preschool Children with Autism Spectrum Disorder	1. The characteristics of lexical and semantic speech in preschool children with autism aged 3 to 6 years. 2. The effectiveness in an adapted ABA therapy program in developing the lexical and semantic phases of speech in these children. 3. To evaluate the implementation of the adapted ABA therapy lead to measurable improvements in the communicative function of speech in preschool children with autism.	ABA	Quasi-experimental	60	The study indicated significant improvements in lexical and semantic language skills in preschool children with ASD who received the adapted ABA intervention, including gains in active and passive vocabulary, word categorization, and contextual language use.	Journal Article

https://doi.org/10.52567/trehabj.v10i01.142

DISCUSSION

This scoping review studied the current literature on Gestalt Language Processing (GLP) and Traditional Language Therapy (TLT) approaches used to facilitate language development in children with Autism Spectrum Disorder (ASD). The findings revealed a significant difference in the nature and strength of evidence supporting these two methods. While traditional language interventions are supported by multiple empirical studies employing experimental and clinical designs, the literature on GLP primarily consists of theoretical papers, reviews, editorials, and conceptual discussions rather than intervention-based empirical research.

Evidence Based for Gestalt Language Processing: The results of the present review indicate that the literature on GLP is largely conceptual and theoretical, with no empirical intervention studies meeting the inclusion criteria. Several publications describe the theoretical basis of GLP and its proposed stages of language development. For example, Buffart and Jacob proposed a Gestalt-based cognitive framework suggesting that language structure emerges from perceptual processing of whole linguistic units rather than isolated words [13]. Similarly, Blanc and colleagues described the Natural Language Acquisition (NLA) protocol, which conceptualizes language development as a progression from memorized language chunks (gestalts) toward flexible and generative language production [7,14].

These publications suggest that children identified as gestalt language processors may initially rely on echolalic or scripted phrases that gradually become reorganized into meaningful and functional language structures. The proposed outcomes of GLP-based approaches include improved functional communication, increased grammatical organization, and enhanced social interaction [7,14]. However, these claims are more theoretical in nature and lack empirical validation[11].

The current critical reviews also highlight the non-existence of empirical evidence for GLP interventions. Hutchins and his team observed that claims of the progression of echolalia speech to generative language are inadequately supported by empirical research[15]. Similarly, Beals observed that the current GLP literature not succeeds to provide clear evidence of improved independent grammatical production and generative language skills [29]. Editorial discussions also emphasize the importance of defining GLP, developing a consensus on outcome measures, and providing empirical evidence of GLP interventions before it can be advised for use[17,18]. These studies indicate that though GLP is gaining more attention in clinical and neurodiversity-related discourse, it is largely theoretical in nature, indicating a research gap for GLP interventions.

Evidence Based for Traditional Language Therapy: The studies on traditional language therapy is supported by wide empirical evidence from randomized controlled trials, clinical trials, longitudinal studies, quasi-experimental designs, and single-case studies. The intervention methods mostly used are Functional Discrimination Training, Discrete Trial Training (DTT), Applied Behaviour Analysis (ABA), TEACCH-based structured teaching, and Early Intensive Behavioural Intervention (EIBI). These methods emphasize systematic teaching, reinforcement, structured practice, and skill generalization.

Clinical studies have demonstrated improvements in various aspects of language development. For instance, Eldevik and colleagues reported that functional discrimination training improved receptive language abilities and communicative responding in individuals with ASD[23]. Similarly, Hartley and colleagues demonstrated that cross-situational word learning tasks support predictive language processing and receptive language development[24]. Longitudinal research has also indicated that early language comprehension and processing skills are associated with improved expressive and receptive language outcomes over time[25]. Structured educational programs such as the TEACCH model combined with Discrete Trial Teaching have shown positive outcomes in randomized controlled trials, with improved language comprehension and expressive language abilities among preschool children with ASD[26].

In addition, interventions based on Applied Behaviour Analysis have been associated with improvements in vocal imitation, labelling, sound production, and conversational abilities following structured therapy programs [27](44). Experimental research has also demonstrated that embedding scripts and implementing script-fading procedures within discrete-trial teaching sessions can significantly increase socially appropriate language initiations[28].

More recent studies have explored adaptive and combined intervention models. Kasari and colleagues evaluated an adaptive intervention combining Discrete Trial Training, naturalistic developmental behavioural interventions, and parent training for minimally verbal children with autism[27]. Although no significant difference was observed between starting interventions with DTT or JASP-EMT, the adaptive intervention approach resulted in improved spontaneous communicative utterances. Similarly, quasi-experimental research

evaluating adapted ABA therapy reported significant improvements in lexical and semantic language skills, including gains in vocabulary, word categorization, and contextual language use among preschool children with ASD[28].

Comparison between GLP and Traditional Language Therapy: A key finding of this review is the contrast between the theoretical nature of GLP literature and the empirical foundation of traditional language therapy research. While a GLP framework focuses on holistic language acquisition through gestalt processing and echolalic language development, many available literatures provide conceptual discussions rather than experimental intervention models. Traditional language therapy, in contrast, has been evaluated through numerous controlled studies that measure language outcomes using structured and evidence-based methods. These studies consistently report progress in language comprehension, expressive vocabulary, social communication, and functional language use among children with ASD[23,24,25,26,27,28].

This difference does not inevitably invalidate the conceptual insights of GLP; however, it highlights the requirement for rigorous empirical evaluation of GLP-based interventions before their effectiveness can be compared directly with traditional therapeutic approaches.

Implications for Clinical Practice: The current evidence suggests that clinicians should use GLP-based interventions with cautious consideration, as the limited empirical support available. Traditional language therapy approaches, including structured teaching methods and behavioural interventions, remain the most evidence-supported strategies for promoting language development in children with ASD[23,24,25,26,27,28].

However, the conceptual insights provided by GLP literature may impact to a broader understanding of language development patterns in autism, specifically for echolalia and scripted speech in early communication[7,14].

Limitations: This scoping review has numerous limitations, including the fact that it is conceivable that relevant studies not indexed in the above databases or in the grey literature may not have been captured. Another limitation is the heterogeneity of the included studies in terms of intervention types, research designs, and population characteristics and outcome measures for comparison with other studies. A major limitation that there were no interventional studies that met the inclusion criteria related to the Gestalt Language Processing (GLP) intervention. As a result, the comparison between GLP and traditional language therapy was mostly based on conceptual literature for GLP and empirical studies for traditional language therapy. This discrepancy highlights the limited availability of experimental evidence evaluating GLP-based interventions.

CONCLUSION

This scoping review studied the current literature comparing Gestalt Language Processing (GLP) and Traditional Language Therapy (TLT) approaches in facilitating language development among children with autism spectrum disorder. The findings indicate prominent contrast in available evidence on both interventions. The literature on GLP is predominantly theoretical, consisting of conceptual discussions, reviews, and editorials that describe the recommended stages of gestalt language development and emphasize the potential role of echolalia in language acquisition. However, no empirical intervention studies evaluating the effectiveness of GLP-based therapy were identified within the inclusion criteria of this review. In compared to traditional language therapy approaches are supported by immense empirical research, including randomized controlled trials, clinical trials, longitudinal studies, and experimental investigations. These studies constantly report improvements in receptive language, expressive language, vocabulary development, and functional communication in children with autism.

Overall, the findings indicate a critical evidence gap in the empirical assessment of the effectiveness of the GLP-based intervention approaches, thus emphasizing the need for thorough research to establish their clinical effectiveness. In the absence of evidence, the traditional language therapy approaches remain the most supported intervention approaches in language development in children with Autism Spectrum Disorder.

DECLARATIONS & STATEMENTS

Author's Contribution

HA, AS, TT and KK: substantial contributions to the conception and design of the study.
HA, AS and KK: acquisition of data for the study.
HA and KK: interpretation of data for the study.
HA and AS, KK: analysis of the data for the study.
HA and AS: drafted the work.
HA, AS, TT and KK: revised it critically for important intellectual content.
HA, AS, TT and KK: final approval of the version to be published and agreement to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. All authors contributed to the article and approved the submitted version.

Ethical Statement

NA

AI Use Statement

The authors used Grammarly to improve language clarity during manuscript preparation. All interpretations, conclusions, and original ideas remain solely those of the authors and approved by the authors.

Consent Statement

Informed consent was obtained from all subjects involved in the study.

Data Availability Statement

The data presented in this study are available on request from the corresponding author.

Acknowledgments

None to declare.

Funding Sources

None to declare.

Conflicts of Interest

None to declare.

REFERENCES

1. Okoye C, Obialo-Ibeawuchi CM, Obajeun OA, Sarwar S, Tawfik C, Waleed MS *et. al.*Early Diagnosis of Autism Spectrum Disorder: A Review and Analysis of the Risks and Benefits. Cureus. 2023;9;15(8):e43226. [CrossRef]
2. Gladfelter A, VanZuiden C. The influence of language context on repetitive speech use in children with autism spectrum disorder. Am J Speech Lang Pathol. 2020;7;29(1):327-334. [CrossRef] [PubMed]
3. Stiegler LN. Examining the echolalia literature: where do speech-language pathologists stand? Am J Speech Lang Pathol. 2015;24(4):750-62. [CrossRef]
4. Rasool A, Rasool SH, Siddique M, Bajwa N, Khan RM, Rasool A, et al. Prevalence of autism spectrum disorders in asian countries. J. Soc. Prev. Advocacy Res. KEMU. 2023;2(3):215-24.
5. Imran N, Azeem MW. Autism spectrum disorders: perspective from Pakistan. Comprehensive Guide to Autism New York: Springer. 2014:2483-96.
6. Baio J, Wiggins L, Christensen DL, Maenner MJ, Daniels J, Warren Z *et. al.* Prevalence of autism spectrum disorder among children aged 8 years - autism and developmental disabilities monitoring network, 11 sites, united states, 2014. MMWR Surveill Summ. 2018 27;67(6):1-23. [CrossRef] [PubMed]
7. Blanc M. The natural language acquisition guide: Echolalia is all about gestalt language development. Madison, WI: Communication Development Center. 2024.
8. Urwiler JL. a literature review: understanding gestalt language processing in autism spectrum disorder. 2025.
9. Leblanc LA, Esch J, Sidener TM, Firth AM. Behavioral language interventions for children with autism: comparing applied verbal behavior and naturalistic teaching approaches. Anal Verbal Behav. 2006;22(1):49-60. [CrossRef] [PubMed]
10. Tricco AC, Lillie E, Zarin W, O'Brien KK, Colquhoun H, Levac D, *et. al.* PRISMA extension for scoping reviews (prisma-scr): checklist and explanation. Ann Intern Med. 2018 2;169(7):467-473. [CrossRef] [PubMed]
11. Bryant L, Bowen C, Grove R, Dixon G, Beals K, Shane H, et al. Systematic review of interventions based on gestalt language processing and natural language acquisition (GLP/NLA): clinical implications of absence of evidence and cautions for clinicians and parents. Curr. Dev. Disord. Rep. 2024;12(1):2.
12. Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD *et. al.*The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. BMJ. 2021;29;372:n71.[CrossRef] [PubMed]
13. Buffart H, Jacobs H. A Gestalt Theory Approach to Structure in Language. Front Psychol. 2021 18;12:649384. [CrossRef] [PubMed]
14. Peters AM. Language learning strategies: Does the whole equal the sum of the parts? Language. 1977:560-73. [CrossRef]
15. Zhu Y, Zhang M, Ma D, Wang P. Efficacy of structured teaching program for rehabilitation of children with autism spectrum disorder: A systematic review and meta-analysis. Pak J Med Sci. 2025;41(9):2658-2666. [CrossRef] [PubMed]
16. Beals K. A linguist's take on blanc's proposition of gestalt language processing and natural language acquisition: an implausible theory at odds with the research. Curr. Dev. Disord.2024;11(4):163-70.
17. Haydock A, Harrison L, Baldwin K, Leadbitter K. Embracing gestalt language development as a fundamental neurodiversity-affirmative practice. Autism. 2024;28(5):1055-1059. [CrossRef] [PubMed]
18. Venker CE, Lorang E. Continuing the conversation about echolalia and gestalt language development: a response to Haydock, Harrison, Baldwin, and Leadbitter. Autism. 2025;29(3):821-824. [CrossRef] [PubMed]
19. Blanc M, Blackwell A, Elias P. Using the Natural Language Acquisition Protocol to Support Gestalt Language Development. Perspect. ASHA Spec. Interest Groups 2023;8(6):1279-86. [CrossRef]
20. Hutchins TL, Knox SE, Fletcher EC. Natural language acquisition and gestalt language processing: a critical analysis of their application to autism and speech language therapy. Autism Dev Lang Impair. 2024 22;9:23969415241249944. [CrossRef] [PubMed]
21. Eldevik S, Aarlie H, Titlestad KB, Kazemi E, Elsky G. Effects of functional discrimination training on initial receptive language in individuals with autism spectrum disorder. Behav Modif. 2020;44(5):670-697. [CrossRef] [PubMed]
22. Hartley C, Bird LA, Monaghan P. Comparing cross-situational word learning, retention, and generalisation in children with autism and typical development. Cognition. 2020;200:104265. [CrossRef] [PubMed]
23. Frazier TW, Klingemier EW, Anderson CJ, Gengoux GW, Youngstrom EA, Hardan AY. A longitudinal study of language trajectories and treatment outcomes of early intensive behavioral intervention for autism. J Autism Dev Disord. 2021;51(12):4534-4550. [CrossRef] [PubMed]
24. Zeng H, Liu S, Huang R, Zhou Y, Tang J, Xie J, Chen P, Yang BX. Effect of the TEACCH program on the rehabilitation of preschool children with autistic spectrum disorder: A randomized controlled trial. J Psychiatr Res. 2021;138:420-427. [CrossRef] [PubMed]
25. Meçe D, Sherifi E. Effectiveness of the ABA method and individual education programs for the treatment of autistic children: a case study. J. Educ. Soc. Res. 2022;12(3):182. [CrossRef]
26. Freeman AS, Reeve SA, MacDuff GS, Reeve KF, DeBar RM. Effects of script-fading on social initiations during

discrete-trial teaching with children with autism. Behav. Interv. 2024;39(4):e2017. [CrossRef]

27. Kasari C, Shire S, Shih W, Kaiser A, Lord C, Levato L, Smith T, Almirall D. Adaptive intervention for school-age, minimally verbal children with autism spectrum disorder in the community: primary aim results. J Am Acad Child Adolesc Psychiatry. 2025;64(6):674-685. [CrossRef] [PubMed]
28. Bekmurat AT, Autayeva AN. The application of adapted applied behavior analysis therapy for developing lexical and semantic skills in preschool children with autism spectrum disorder. Eur. J. Educ. Res. 2025;14(4):1047-62. [CrossRef]
29. Blackburn C, Tueres M, Sandanayake N, Roberts J, Sutherland R. A systematic review of interventions for echolalia in autistic children. Int J Lang Commun Disord. 2023;58(6):1977-1993. [CrossRef] [PubMed]
30. Haydock A, Harrison L, Baldwin K, Leadbitter K. Embracing gestalt language development as a fundamental neurodiversity-affirmative practice. Autism. 2024;28(5):1055-1059. [CrossRef] [PubMed]

https://doi.org/10.52567/trehabj.v10i01.142

Effects of treadmill training on cardiorespiratory endurance and constipation in children with cerebral palsy: a randomized clinical trial

Sulaiman Shah[1]*, Sheeraz Ali[2], RizwanUllah[3], Osama Faisal Mahboob[4]

ABSTRACT

Background: Children with cerebral palsy (CP) commonly experience reduced cardiorespiratory endurance due to limited mobility and sedentary lifestyle. Constipation is also a frequent comorbidity affecting their health and quality of life. Treadmill training has been suggested as an effective intervention to improve physical fitness and functional mobility in children with CP.

Objective: To evaluate the effects of treadmill training on cardiorespiratory endurance and constipation in children with spastic diplegic cerebral palsy.

Methodology: A randomized clinical trial was conducted from January to May 2024 at Rahman Medical Institute and Akbar Kare Institute, Peshawar. Thirty-six children with spastic diplegic CP (aged 4–10 years; GMFCS levels I–II) were randomly assigned to treadmill training plus conventional physical therapy (TT, n=18) or conventional physical therapy alone (CPT, n=18). The intervention lasted 12 weeks with progressive exercise intensity. Cardiorespiratory endurance was assessed using the 6-Minute Walk Test (6MWT), while constipation severity was measured using the Constipation Assessment Scale (CAS). Data were analyzed using MANOVA, independent t-test, and repeated-measures ANOVA ($\alpha \leq 0.05$).

Results: MANOVA showed a significant overall effect of intervention on combined outcomes (Pillai's Trace=0.338, p=0.002). The TT group demonstrated significantly greater improvement in 6MWT distance compared with the CPT group ($p<0.001$). However, no significant between-group differences were observed for CAS scores (p=0.444), although both groups showed within-group improvement over time.

Conclusion: Treadmill training significantly improves cardiorespiratory endurance in children with spastic diplegic cerebral palsy but does not provide additional benefits for constipation compared with conventional therapy alone.

Keywords: cerebral palsy, cardiorespiratory endurance, constipation, 6-minute walk test, physical therapy, treadmill training.

Designation & Affiliation

1. Clinical physiotherapist, Rehman Medical Institute Peshawar, Pakistan.
2. Physical therapist, Yasmin Physical Therapy Center, Turaif Northern Borders, Saudia Arabia.
3. Physical therapist at Helping Hand Rehabilitation Centre Talash Lower Dir KP, Pakistan.
4. Physical Therapist, Yasmin Physical Therapy Center. Hafar Al Batin Eastern Province, Saudia Arabia.

Citation

Shah S, Ali S, Ullah R, Mehboob OF. Effects of treadmill training on cardiorespiratory endurance and constipation in children with cerebral palsy: a randomized clinical trial. T Rehabili. J. 2026:10(01); 28-38 doi: 10.52567/trehabj.v10i01.145

Article History

Submitted: 17-01-2026
Accepted: 19-03-2026
Published: 31-03-2026

Correspondence*

Sulaiman Shah, Clinical physiotherapist, Rehman Medical Institute Peshawar, Pakistan.
E-mail: Sulimanshah000@gmail.com

https://doi.org/10.52567/trehabj.v10i01.145

INTRODUCTION

Cerebral palsy (CP) is a neurodevelopmental disorder that affects motor functions, muscle tone, and posture[1]. It is often associated with various comorbidities, including cardiovascular issues and gastrointestinal problems such as constipation[2]. Physical therapy, particularly treadmill training, has been shown to improve these conditions by enhancing motor skills, cardiovascular fitness, and gastrointestinal function[3]. Purpose of this study is to assess how treadmill training affects children with cerebral palsy's cardiorespiratory endurance and constipation[4,5,6].

Cardiorespiratory endurance is the capacity of the circulatory and respiratory systems to provide working muscles with oxygen and nutrients during an extended duration of physical exercise, because of their restricted movement, stiffness, weak muscles, and sedentary lifestyles children with cerebral palsy (CP) usually have poor cardiorespiratory fitness[4,7]. Decreased cardiorespiratory endurance can worsen overall health, increases the risk of obesity, cardiovascular disease and respiratory dysfunction making it more difficult to perform physical activity[5, 8].

Inpatient Constipation is a common gastrointestinal issue that affects up to 74% of children with cerebral palsy [6,9]. Changes in diet, medication, immobility, and neurological dysfunction are some of the many etiologies of constipation in individuals with cerebral palsy (CP). Constipation has a major impact on the general health, comfort, and quality of life of children with cerebral palsy (CP). If neglected, it may cause pain, discomfort, faecal impaction, faecal incontinence, and urinary system problems[10,11].

Treadmill training has demonstrated potential benefits as a therapeutic intervention for improving motor function, gait, and overall physical fitness. Participants in this intervention can walk on a motorized treadmill under the supervision of certified therapists[12,13]. Furthermore, aerobic exercise through treadmill training has been shown to improve cardiorespiratory endurance by 15% to 40% depending on the intensity and duration of the program[14]. The link between aerobic exercise and cardiovascular health is well-established, but there is limited but emerging evidence suggesting that increased mobility and physical therapy may also improve defecation frequency and constipation severity in children with CP[15].

Despite the known benefits of treadmill training for motor and aerobic outcomes, its potential impact on secondary autonomic functions like gastrointestinal motility remains insufficiently explored. Given that decreased mobility is a primary contributor to constipation in CP, it is hypothesized that the systematic physical activity provided by treadmill training may simultaneously enhance cardiorespiratory fitness and alleviates constipation symptoms. This study aims to evaluate the effects of a treadmill training program on cardiorespiratory endurance and constipation severity in children with cerebral palsy to provide a more holistic approach to their rehabilitation.

METHODOLOGY

Study design and setting

Randomized clinical trial was initiated after getting approval from the Research Ethic Committee (REC) of Riphah International University, Islamabad (Riphah/RCRANS-ISB/REC/MS-PT/01826). The study was conducted at Rahman Medical Institute (RMI)(RMI/30-11-2023) and Akbar Kare Institute (AKI) (AKI-PT/2023-12) Peshawar from Jan 2024 to May 2024. The individuals were told of the study's goal, and participants provided signed informed permission.

Selection criteria

A non-probability convenience sampling technique was employed for data collection. The children diagnosed with spastic diplegic cerebral palsy, aged between 04-10 years, having I or II level of dependency on GMFCS with intact cognitive abilities were included in the study. Moreover, the children with mental retardation, other neurological abnormalities, uncontrolled seizures, prior similar training, multiple contractures, and significant respiratory issues, use of muscle relaxants, and hearing or communication problems were excluded the research.

Randomization and Blinding

Participants who met the eligibility criteria were randomly allocated into treadmill training group (TT) and the conventional physical therapy group (CPT) in a 1:1 ratio. Randomization was performed using a computer-generated random allocation sequence to minimize selection bias. The allocation sequence was prepared prior to participant enrolment, and participants were assigned to groups accordingly. It was not possible to blind the therapists providing the treatment or the participants receiving the intervention. However, to reduce potential assessment bias, the outcome assessor was kept blinded to the group allocation of the participants

https://doi.org/10.52567/trehabj.v10i01.145

during data collection for the 6-Minute Walk Test (6MWT) and Constipation Assessment Scale (CAS). Additionally, the data analysis was conducted without revealing the group identity, ensuring objective statistical evaluation. Therefore, the study followed a single-blinded randomized clinical design, where the outcome assessor and data analyst were blinded, while the therapists and participants were aware of the intervention being delivered.

Sample Size

A total of n=36 was calculated from G power, with an effect size of just 0.2 and an α error margin of 0.05. In order to mitigate the risk of β mistake, a power (1-β) of 0.95% was chosen. Total n=36 children diagnosed with spastic diplegic cerebral palsy were assessed for inclusion, it was found that n=16 people did not meet the selection requirements and were hence not included in the study. A total of n=36 individuals were split into groups A (18) and B (18) at random. A total n=52 participants screened, n=36 were randomized into control (n=18) and experimental (n=18) groups. Sixteen participants were excluded prior to randomization. During follow-up, two participants from the control group were lost, and one participant in the experimental group discontinued the intervention. Finally, n=16 participants in the control group and n=17 in the experimental group were analyzed for cardiorespiratory endurance and constipation outcomes.

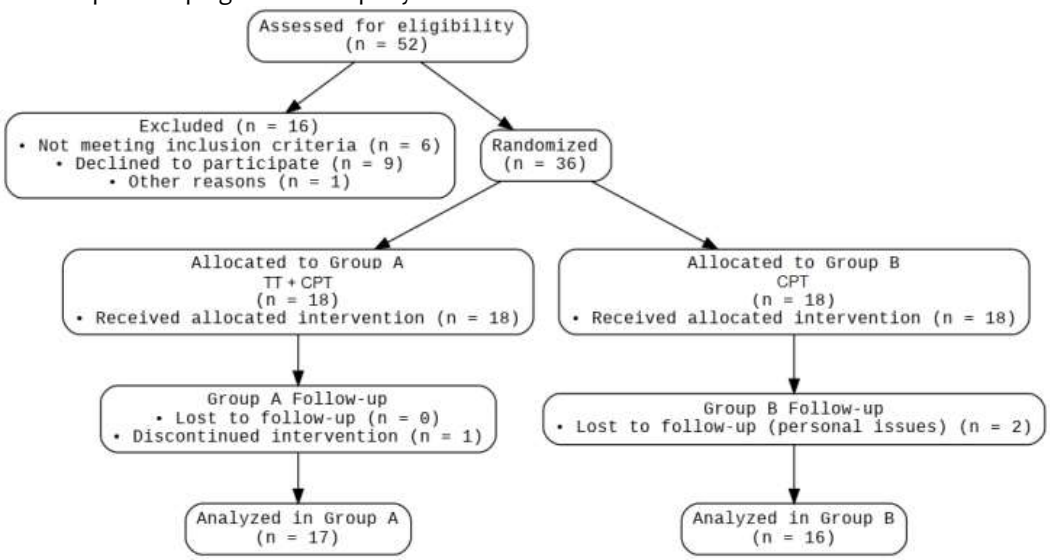

Figure 1: CONSORT Diagram

Intervention Protocol

A 12-week structured intervention program was implemented, with participants assigned to either a treadmill training (TT) plus conventional physical therapy (CPT) group (Group A) or a CPT group (Group B). Both groups followed a progressive, phase-based protocol divided into three 4-week blocks (Weeks 1-4, 5-8, and 9-12), with exercise parameters adjusted at each stage to ensure appropriate progression.

Group A (Treadmill Training): In addition to CPT The treadmill training protocol for Group A progressed in intensity and duration across the three phases. During the initial phase (Weeks 1-4), participants completed three sessions per week, each lasting 10 minutes at an intensity of 50-55% of age-predicted maximum heart rate (MHR) and a speed of 0.3 km/h. In the subsequent phase (Weeks 5-8), session frequency remained at three per week, but duration increased to 20 minutes, intensity was elevated to 55-60% MHR, and speed was increased to 1.0 km/h. During the final phase (Weeks 9-12), training frequency was increased to four sessions per week, with each session lasting 20 minutes at an intensity of 60-65% MHR and a speed of 3.0 km/h. to ensure the safety, support was provided by two trained physical therapists, one therapist stood behind the child and the other at the side, assisting in balance, posture correction during walk on treadmill. Participants were instructed to hold treadmill's parallel bars for added support. A visual feedback was provided by the mirror placed in front of the treadmill to encourage upright posture and correct gait mechanics. Verbal cues were also given throughout the sessions to guide and motivate the children.

Group B (Conventional Physical Therapy): The conventional therapy program for Group B consisted of a structured progression of therapeutic exercises

https://doi.org/10.52567/trehabj.v10i01.145

across the three phases. In Weeks 1-4, participants performed core stability exercises, including supine bridging (10 repetitions, 2 sets), and stretching exercises targeting the hamstrings and calf muscles (10-second hold, 10 repetitions). During Weeks 5-8, the program advanced to weight-bearing exercises such as wall push-ups and standing balance activities (10 repetitions, 3 sets), in addition to balance and coordination training involving cone stepping and single-leg stance with support (10 repetitions, 3 sets). In the final phase (Weeks 9-12), participants engaged in strengthening exercises, including sit-to-stand and resistance band kicking (10 repetitions, 3 sets), gait training involving walking in parallel bars (5 minutes per session), and standing frame activities that required reaching for objects placed on a tray or table to encourage upper limb engagement and trunk control (5 minutes per session).

Outcome Measures

6-Minute Walk Test (6MWT): 6MWT was used to evaluate cardiorespiratory endurance in children with CP. By recording the distance walked in six minutes. The 6MWT showed good levels of validity while using with cerebral palsy children and it has a high degree of test retest reliability (ICC=0.98)[16].

Constipation Assessment Scale (CAS) was used to assess the severity of constipation symptoms in CP children. the Constipation assessment scale showed good level of reliability (ICC=0.95)[17].

Statistical Analysis

SPSS version 28 was used to analyse the data. To determine the effects of interventions on combine dependent variables, MANOVA test was applied on mean change of endurance and constipation severity. As the significant effect observed, so for main effects, between the group differences were measured with independent t-test, and for within group changes EM ANOVA was applied. The level of significance was measured at alpha (α) <0.05. All tests was applied through SPSs ver 26.

RESULTS

There was n=36 participants having age of 7.06±1.55 years, the participants age varies from 4 to 9 years, suggesting a relatively young group with a limited age range scale. Out of the total sample, n=24 (64.9%) participants were male and n=12 (32.4%) participants were female, indicating a higher frequency of males in the study. The multivariate analysis of variance (MANOVA) on mean change, revealed a statistically significant overall effect of group on the combined dependent variables, Pillai's Trace=.338, $F(2, 30)=7.672$, $p=.002$, partial $\eta^2=.338$, indicating a large effect size. This suggests that the type of intervention (CPT+TT vs. CPT) significantly influenced the overall outcome profile. Further univariate analyses showed a significant difference between groups for the Six-Minute Walk Test (Six MWT), $F(1, 31)=15.807$, $p<0.001$, partial $\eta^2=.338$, with the CPT+TT group demonstrating higher mean walking distance ($\bar{x}=86.80$) compared to the CPT group ($\bar{x}= 77.09$). The effect size was large, indicating substantial clinical and statistical importance. In contrast, no significant group difference was observed for the Composite Assessment Scale (CAS), $F(1, 31)=0.601$, $p=.444$, partial $\eta^2=.019$, suggesting a negligible effect. Overall, the findings indicate that the combined CPT+TT intervention significantly improves functional capacity (Six MWT), while it does not produce a meaningful difference in CAS scores compared to CPT alone. (figure 2)

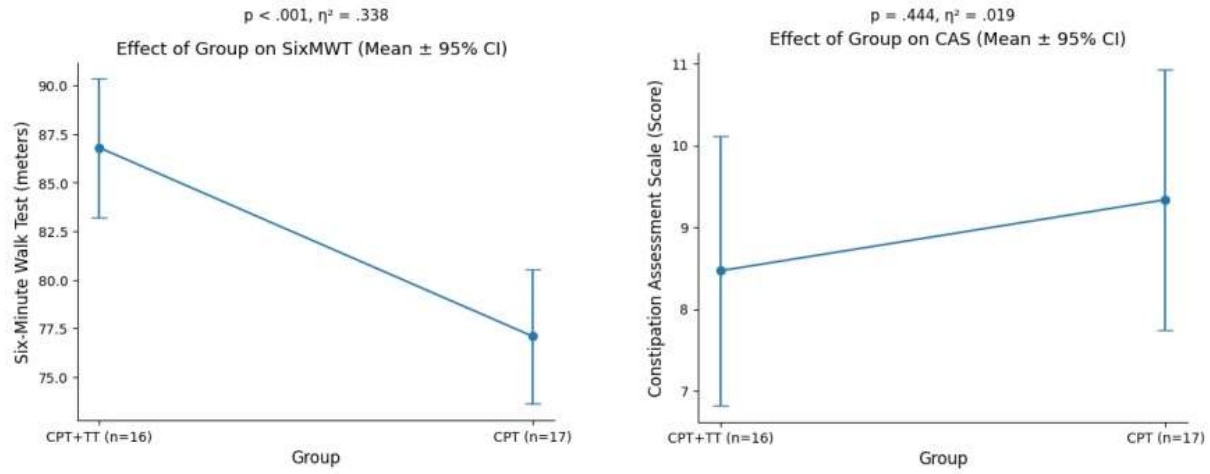

Figure 2: Effect of intervention on combine dependent variable (endurance & constipation)

At baseline, the TT group demonstrated significantly higher scores compared to the CPT group (p=0.027), indicating a statistically significant difference between groups at the start of the study. At the 4th week, the difference was not statistically significant (p=0.083). By the 8th week, the TT group showed marked significant improvement group (p<0.001) compared to the CPT. Similarly, at the 12th week, the TT group continued to improve significantly (p<0.001) than the CPT group. While both interventions reduced the CAS scores over time; however, no statistically significant (p≥0.05) difference between TT and CPT was observed for CAS outcomes. (table 1)

Table 1: Between-group comparison (Independent T-test)

		TT+CPT (n=17)		CPT (n=16)				
		x̄	σ	x̄	σ	MD/F(df)	p-value	Cohen'd
6-MWT	Baseline	81.88	7.59	76.77	5.45	5.11	0.027*	6.61
	4th week	82.00	8.04	77.76	5.34	4.235	0.083	6.78
	8th Week	90.312	11.510	76.23	5.03	14	0.00***	8.78
	12th Week	92.87	12.419	76.23	5.03	6.85(31)	0.00***	9.35
CAS	Baseline	11.18	2.58	11.41	3.021	-0.22	0.821	2.82
	4th week	9.06	3.35	9.29	3.27	-0.23	0.883	3.31
	8th week	7.37	3.36	8.41	3.37	-1.03	0.384	3.36
	12th week	6.25	4.38	8.23	3.54	0862(31)	0.162	3.97

Significance level- p<0.05, p<0.01** & p<0.001****

x̄-Mean; σ- ; MD-Mean difference ; F- F-value; df- Degrees of Freedom; MWT- Minute Walk Test ; CAS- Constipation Assessment Scale

Within group changes with RM ANOVA, the both endurance and constipation were significantly improved from baseline to the twelfth week in the intervention group at each assessment level. While the endurance in the CPT group showed significant improvement (p<0.05) only from baseline to the 4th week, while no significant change from 4th to 8th week (p≥0.05), and from 8th to 12th week. Similarly, Constipation Assessment Scale (CAS) in the control group showed significant improvement only from baseline to the 4th week (p<0.01). (table 2)

Table 2: Within-group analysis (repeated measure ANOVA)

Group		TT+CPT (n=17)				CPT (N=16)			
		x̄	σ	MD/F(df)	p-value	x̄	Σ	MD/F(df)	p-value
6-MWT	Baseline	82.0	8.04	0.00	1[a]	76.41	5.38	-1.353	0.02*
	4th week	82.00	8.04	-8.312	0.001**b	77.76	5.34	1.52	1.0
	8th Week	90.31	11.51	-2.562	0.001**c	76.23	5.03	-1.706	1.0
	12th Week	92.87	12.41	29.4(1.10,16.6)	0.004*d	77.94	4.98	0.58(1.95,31.3)	0.5
CAS	Baseline	11.18	2.58	2.125	0.002**a	11.4	3.02	2.118	0.00***
	4th week	9.06	3.35	1.688	0.002**b	9.2	3.27	882	0.111
	8th week	7.37	3.36	1.125	0.002*c	8.4	3.37	0.176	1.11
	12th week	8.235	4.38	36(1.81,27.1	0.036*d	8.2	3.54	34.1(2, 33.0)	0.00***

Significance level- p<0.05, p<0.01** & p<0.001****

x̄-Mean; σ- ; MD-Mean difference ; F- F-value; df- Degrees of Freedom; MWT- Minute Walk Test ; CAS- Constipation Assessment Scale

DISCUSSION

In this study, treadmill training along with conventional physical therapy significantly the functional endurance with large effect size, as measured by the 6-Minute Walk Test (6MWT). This finding is consistent with study, which shown that structured, progressive exercise protocols (often including treadmill walking) improve walking distance and fitness[18]. Tauro et al. (2024) also reported that a 12-week cardiovascular exercises improved children's 6MWT distance, improved VO_2 max and fatigue scores[19]. The present results also aligned with previous evidence that task-specific, repetitive gait training can substantially boost endurance and walking capacity in ambulatory CP children[20].

Treadmill walking provides a high-repetition, task-specific stimulus that trains both the cardiovascular system and the neuromuscular control of gait. Over 12 weeks, the protocol progressively increased speed and intensity, which would enhance aerobic capacity, stroke volume, and muscular oxygen utilization[19,20]. Repeated practice also likely improved gait efficiency and muscle endurance, allowing children to walk farther before fatiguing. The use of mirrors and verbal cues may have additionally encouraged better posture and effort. In sum, treadmill training appears to recondition the

https://doi.org/10.52567/trehabj.v10i01.145

cardiovascular-pulmonary system and lower-limb musculature, translating into larger 6MWT distances[21].

In contrast treadmill training did not show any additional effect for constipation. Both groups showed significant within-group reductions in Constipation Assessment Scale (CAS) scores over time, but there were no significant between-group differences at any time point (p=0.16). There multiple factor contributing in the constipation among usually related to mobility, muscle tone, diet, etc. and the evidence suggests that targeted interventions are needed. The Awan et al. (2021) reported that a progressive physical therapy exercise program significantly increase defecation frequency and lower CAS scores in spastic CP[15]. Similarly, 6 weeks of daily stretching reduced both spasticity and constipation severity in CP children[21]. In the current study, both groups received stretching, core and gait exercises (Group B) or these plus treadmill (Group A). The lack of difference in improved constipation was likely due to the stretching and weight bearing exercises, which are known to improve abdominal and pelvic mobility[15,21]. Treadmill walking addition, even at moderate intensity may not sufficiently engage core musculature or alter autonomic tone to markedly affect gastrointestinal motility. Thus, the current study suggests that while treadmill training enhances cardiopulmonary fitness, additional or specialized interventions are still needed to address constipation in CP.

The current findings of endurance are similar as previous reports that gait training enhances functional capacity in CP. Although most literature has focused on speed or gait rather than 6MWT distance, but it suggest that repetitive treadmill exercise promotes cardiovascular conditioning and neuromuscular adaptations in CP [19], supporting current finding observation of improved endurance. The current results also suggest that even home-based walking programs improve 6-MWT distance in CP[21]. In short, the evidence consistently indicates that progressive treadmill training is an effective means to increase endurance in ambulatory children with CP.

In contrast, research on relationship between exercise and constipation among CP is limited. Since in current study treadmill group did not show any difference from the CPT in CAS outcomes, it suggests that the moderate intensity aerobic exercises did not add benefit for constipation, consistent with the evidence that aerobic exercise alone has limited direct impact on gut motility in CP. This highlights that stretching exercises and proper positioning reduce tone or abdominal massage directly stimulate the abdomen seem more effective for constipation than generic endurance training[15,21].

The exercise generally can stimulate intestinal motility via increased abdominal pressure and autonomic changes, but this effect may be minimum unless abdominal muscles are strongly engaged. The treadmill protocol focused on gait and kept sessions relatively brief and children held onto support bars, which might limit trunk muscle activation. In contrast, targeted stretching and core exercises more directly mobilize the abdomen and reduce hypertonicity, which can free up the bowel. Indeed, prior work shows a strong correlation between reduced spasticity and improved defecation[21]. Because conventional therapy likely addressed muscle tone and flexibility, both groups showed some improvement in CAS. However, treadmill training itself probably did not provide additional benefits beyond those effects. Therefore, findings suggest that treadmill training's primary physiological impact was on cardiopulmonary function rather than on neural or visceral factors governing bowel function.

These results have practical significance for CP management that progressive treadmill training can meaningfully enhance functional mobility and endurance in spastic diplegic children (GMFCS I-II). Improved walking endurance may translate into greater participation in play, school, and daily activities, and could reduce secondary health risks associated with inactivity[19,20]. On the other hand, because the treadmill did not measurably improve constipation, so a multimodal bowel program should be maintained including stretching, positioning, hydration, diet, perhaps abdominal massage alongside aerobic exercise. In practice, combining treadmill training with the conventional PT used here would produce comprehensive effects like better endurance from the treadmill plus reduced spasticity and improved gut motility from stretches and core exercises.

Limitations: The adherence and effort on the treadmill were monitored but not formally quantified, which could influence outcomes. To determine the combine effect of interventions on both variables, the sample size was limited.

CONCLUSION

The treadmill training is an effective intervention for improving cardiorespiratory endurance in children with cerebral palsy, but it does not appear to independently effective for constipation outcomes. Therefore, a comprehensive rehabilitation approach combining treadmill training with conventional

https://doi.org/10.52567/trehabj.v10i01.145

therapy and targeted bowel management strategies is recommended to optimize both functional mobility and gastrointestinal health in this population.

DECLARATIONS & STATEMENTS

Author's Contribution

SS and RU: conception, design, and manuscript writing.
SS and OFM: supervision and critical revision.
SS: substantial contributions to the conception and design of the study.
SA and OFM: acquisition of data for the study.
SA, RU, OFM: interpretation of data for the study.
SS and SA: analysis of the data for the study.
SS and OFM: drafted the work.
SS, SA, RU, and OFM: revised it critically for important intellectual content.
SS, SA, RU, and OFM: final approval of the version to be published and agreement to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. All authors contributed to the article and approved the submitted version.

Ethical Statement:

The study was conducted at Rahman Medical Institute (RMI)(RMI/30-11-2023) and Akbar Kare Institute (AKI) (AKI-PT/2023-12) Peshawar from Jan 2024 to May 2024.

AI Use Statement

The authors utilized ChatGPT for language editing and employed Python in conjunction with Gemini via Google Colab for figure generation. All content, analyses, and interpretations were thoroughly reviewed, verified, and approved by the authors.

Consent Statement

Written informed consent was obtained from all participants prior to data collection and for publication. The authors confirm that all participants voluntarily agreed to participate and that their confidentiality and privacy have been maintained throughout the study.

Data Availability Statement

The data presented in this study are available on request from the corresponding author.

Acknowledgments

None to declare.

Funding Sources

None to declare.

Conflicts of Interest

None to declare.

REFERENCE

1. Patel DR, Neelakantan M, Pandher K, Merrick J. Cerebral palsy in children: a clinical overview. Transl Pediatr. 2020;9(Suppl 1):S125-s35. [CrossRef] [PubMed]
2. Marpole R, Blackmore AM, Gibson N, Cooper MS, Langdon K, Wilson AC. Evaluation and management of respiratory illness in children with cerebral palsy. Front Pediatr. 2020;8:333. [CrossRef] [PubMed]
3. Ghafoor F, Fatima K, Fawad M, Munawar A, Baig MJ, Ahmad Z. Effectiveness of treadmill training alone versus treadmill training with external clues on improving gait and functional ability in parkinson's patient: improving gait and functional ability in parkinson's patient. Pak. J. Health Sci. 2023;4(10):105-10. [CrossRef]
4. Rajesh S, Kanniappan V, Kanna BS, Veeragoudhaman T. Comparing the effects of virtual reality breathing exercise and incentive spirometry exercise on improving pulmonary function in children with spastic diplegic cerebral palsy. Cureus. 2024;16(4). [CrossRef] [PubMed]
5. Atia 1' DT, Hassan MH. Efficacy Of under water exercise on pulmonary function in cerebralpalsied children. [CrossRef]
6. Santos KP, Silva VMMD, Reis IFD, Aquino MRC, Lana MRV, Teixeira CMMF. Physical conditioning in children and adolescents with cerebral palsy: Systematic review and meta-analysis. J Bodyw Mov Ther. 2023;35:158-163. [CrossRef] [PubMed]
7. Mattern-Baxter K, Looper J, Zhou C, Bjornson K. Low-intensity vs high-intensity home-based treadmill training and walking attainment in young children with spastic diplegic cerebral palsy. Arch Phys Med Rehabil. 2020;101(2):204-212. [CrossRef] [PubMed]
8. Bjornson KF, Moreau N, Bodkin AW. Short-burst interval treadmill training walking capacity and performance in cerebral palsy: a pilot study. Dev Neurorehabil. 2019;22(2):126-133. [CrossRef] [PubMed]
9. Dodd KJ, Foley S. Partial body-weight-supported treadmill training can improve walking in children with cerebral palsy: a clinical controlled trial. Dev Med Child Neurol. 2007;49(2):101-5. [CrossRef] [PubMed]
10. Ochandorena-Acha M, Terradas-Monllor M, Nunes Cabrera TF, Torrabias Rodas M, Grau S. Effectiveness of virtual reality on functional mobility during treadmill training in children with cerebral palsy: a single-blind, two-arm parallel group randomised clinical trial (VirtWalkCP Project). BMJ Open. 2022;3;12(11):e061988. [CrossRef] [PubMed]
11. Doğan H, Mutluay F. Effect of treadmill backward walking training on motor capacity in cerebral palsy: a randomized controlled study. Ann Rehabil Med. 2023;47(2):89-97.[CrossRef] [PubMed]
12. Sinha P, Chaudhary V. Effect of Backward Treadmill Training Versus Conventional Therapies to Improve

Functional Mobility in Children with Spastic Diplegic Cerebral Palsy. Int. J. Converg. Healthc.2024;4(1):11-5.
13. Willoughby KL, Dodd KJ, Shields N, Foley S. Efficacy of partial body weight-supported treadmill training compared with overground walking practice for children with cerebral palsy: a randomized controlled trial. Arch Phys Med Rehabil. 2010;91(3):333-9. [CrossRef] [PubMed]
14. Reuter M, Rosenberger F, Barz A, Venhorst A, Blanz L, Roecker K, Meyer T. Effects on cardiorespiratory fitness of moderate-intensity training vs. energy-matched training with increasing intensity. Front Sports Act Living. 2024;4;5:1298877. [CrossRef] [PubMed]
15. Reuter M, Rosenberger F, Barz A, Venhorst A, Blanz L, Roecker K, Meyer T. Effects on cardiorespiratory fitness of moderate-intensity training vs. energy-matched training with increasing intensity. Front Sports Act Living. 2024;4;5:1298877. [CrossRef] [PubMed]
16. Gacto-Sánchez M, Lozano-Meca JA, Lozano-Guadalajara JV, Montilla-Herrador J. Concurrent validity of the 2-and 6-minute walk test in knee osteoarthritis. Knee. 2023;43:34-41. [CrossRef] [PubMed]
17. Wong WK, Qin J, Bressington D, Yeung WF, Liu N, Ho BYW, Liang S, Li Y. Cross-cultural adaptation and psychometric validation of the constipation assessment scale among chinese adult psychiatric patients. Int J Environ Res Public Health. 2023;2;20(3):2703. [CrossRef] [PubMed]
18. Kim OY, Shin YK, Yoon YK, Ko EJ, Cho SR. The effect of treadmill exercise on gait efficiency during overground walking in adults with cerebral palsy. Ann Rehabil Med. 2015;39(1):25-31.. [CrossRef] [PubMed]
19. Tauro R, Ganesh S, Vincent JG. Effect of cardiovascular endurance training on the exercise capacity and endurance in children with cerebral palsy. Cureus. 2024;3;16(6):e61595. [CrossRef] [PubMed]
20. Alotaibi A, Ibrahim A, Ahmed R, Abualait T. Effectiveness of partial body weight-supported treadmill training on various outcomes in different contexts among children and adolescents with cerebral palsy: a systematic review and meta-analysis. Children (Basel). 2023;20;11(1):9. [CrossRef] [PubMed]
21. Romeo DM, Venezia I, De Biase M, Sini F, Velli C, Mercuri E, Brogna C. The Use of the 6MWT for Rehabilitation in Children with Cerebral Palsy: A Narrative Review. J Pers Med. 2022;23;13(1):28. [CrossRef] [PubMed]