Kashf Journal of Multidisciplinary Research
Vol:03 - Issue03 (2026)
P-ISSN: 3007-1992 E-ISSN: 3007-200X
https://kjmr.com.pk

PREVALENCE & ASSOCIATION OF COGNITIVE DYSFUNCTION WITH CERVICAL DYSTONIA: A CROSS-SECTIONAL STUDY

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Article Info

doi.org/10.71146/kjmr854

Abstract

Background: *Cervical dystonia (CD) is a chronic neurological movement disorder characterized by involuntary contractions of the neck muscles, resulting in abnormal head postures and movements. While motor manifestations are well recognized, non-motor symptoms (particularly cognitive dysfunction) remain underexplored. Cognitive impairment may substantially affect daily functioning, social interaction, and overall quality of life in individuals with CD, highlighting the need for comprehensive evaluation.*

Objective: *The objective of this study is to determine the prevalence and association of cognitive dysfunction in people with cervical dystonia.*

Methodology: *A cross-sectional study was conducted among 73 patients diagnosed with cervical dystonia in Karachi, Pakistan. Cognitive function was assessed using the Mini-Mental State Examination (MMSE), and motor symptom severity was evaluated using the Toronto Western Spasmodic Torticollis Rating Scale (TWSTRS). Descriptive statistics were calculated, and inferential analysis using the Pearson chi-square test was performed to assess associations between cognitive impairment and disease severity, age, and gender. A p-value < 0.05 was considered statistically significant.*

Result: *A total of 73 participants (36 males and 37 females) were included, with the majority aged 18–29 years (42.5%). Based on TWSTRS, moderate cervical dystonia was most prevalent (63.0%), followed by severe (23.3%) and mild (13.7%). MMSE results showed mild cognitive impairment in 38.4% of participants, severe impairment in 31.5%, and no impairment in 30.1%. Statistical analysis demonstrated a significant association between cognitive function and dystonia severity ($\chi^2 = 63.216$, $p < 0.001$) as well as age ($p = 0.023$), whereas no significant associations were observed with gender ($p = 0.704$)*

Conclusion: *Cognitive impairment is highly prevalent among patients with cervical dystonia and is significantly associated with both age and disease severity. These findings underscore the importance of incorporating cognitive assessment into routine clinical evaluation and adopting a multidisciplinary approach that addresses both motor and non-motor manifestations of cervical dystonia.*

Keywords: *Cervical Dystonia Primary, Cognitive Dysfunction, Torticollis, Basal Ganglia.*

INTRODUCTION

Cervical dystonia (CD), a neurological movement disorder, is characterized by involuntary, sustained neck muscle contractions that result in abnormal head postures [1]. It specifically refers to a hyperkinetic movement disorder in which dystonia is the primary clinical feature [2]. Abnormal movements remain the defining characteristic of the condition [3]. Cervical dystonia, frequently referred to as spasmodic torticollis, is the most common form of focal dystonia observed in adults [4]. Previous prevalence estimates may have been underestimated due to underreporting or misidentification of cases [5]. With a prevalence of 4.98 per 100,000 individuals, cervical dystonia (CD) is now recognized as relatively common in the general population [6]. Cervical dystonia (CD), once primarily recognized as a disorder of the basal ganglia (BG), is now understood to arise from a complex neural network involving multiple brain regions, including the cerebral cortex (motor and sensory areas), brainstem, cerebellum, and basal ganglia [2]. The pathophysiological characteristics of CD include metabolic abnormalities, dysregulation of neural signaling, and genetic alterations [7]. Clinically, many individuals experience diffuse, sharp, or shooting radiating pain, occasionally accompanied by burning and pulling sensations [8]. Additionally, symptoms such as imbalance, discomfort, abnormal posture, and abnormal gait are frequently observed in patients with CD [9]. In addition to motor manifestations, non-motor symptoms such as depression, anxiety, cognitive impairment (CI), and sleep disturbances significantly impact the quality of life in patients with cervical dystonia (CD) [10]. Cognitive dysfunction is characterized by a significant decline in cognitive capacities across multiple domains, including executive function, attention, verbal memory, motor initiation, and visuospatial processing. These deficits reflect disturbances in the brain's ability to coordinate and integrate cognitive processes [10] efficiently. Botulinum toxin (BoNT) has been established as a first-line treatment for cervical dystonia (CD) [11]. Additionally, certain surgical interventions, particularly ramisectomy, have proven effective in alleviating CD symptoms when performed by qualified surgeons [12]. Physiotherapy is considered an effective adjunctive treatment for reducing pain, improving function, and enhancing quality of life in individuals with cervical dystonia (CD) [13]. A variety of physical therapy interventions are employed in the management of CD, including stretching, aquatic relaxation therapy, home exercise programs, active and passive neck mobilizations, taping, biofeedback, and exercise therapy targeting posture, coordination, proprioception, strengthening of underactive muscles, motor learning, relaxation, and sensorimotor exercises with feedback. Additionally, transcutaneous electrical nerve stimulation (TENS) is commonly used in treatment [14]. Moreover, numerous randomized controlled trials (RCTs) suggest that physical therapy interventions are likely to improve both the severity of CD and patients' overall quality of life [15]. Oral medication is frequently prescribed to address mood-related symptoms and psychological issues in individuals with dystonia. Additionally, activities such as juggling or playing musical instruments promote both physical and mental coordination, thereby improving cognitive function [16]. Therefore, this study aims to advance the early identification of both cognitive and physical symptoms in individuals with cervical dystonia (CD), enabling more timely and precise clinical interventions.

METHODOLOGY:

This analytical cross-sectional study was conducted at multiple tertiary care hospitals in Karachi, Pakistan, including LNH, AKU, Saifee Hospital, Jinnah Hospital, Indus Hospital, PNS Shifa, Sindh Government Hospital, Abbasi Shaheed Hospital, Usman Memorial Hospital, and Memon Hospital. Data were collected from both inpatient and outpatient departments from patients diagnosed with cervical dystonia (CD). The study adhered to STROBE guidelines [17] and was conducted over six months using a non-probability purposive sampling technique. Participants aged 18–65 years with focal cervical dystonia and a willingness to provide informed consent were included [6]. Exclusion criteria were prior

botulinum toxin injections or medications such as benzhexol or clonazepam, recent surgery, severe cognitive or psychiatric disorders, other neurological conditions, severe comorbidities, or pregnancy/breastfeeding [6]. The minimum sample size was calculated as 73 participants using Open Epi software with a 5% margin of error and 95% confidence interval [6]. Cognitive function was assessed using the Mini-Mental State Examination (MMSE) [18], and cervical dystonia severity was measured using the Toronto Western Spasmodic Torticollis Rating Scale (TWSTRS) [19]. Cervical tilt and rotation were objectively measured with a goniometer. Data collection involved structured interviews conducted by physiotherapists to ensure consistency and accuracy. The MMSE and TWSTRS provided standardized measures of cognitive dysfunction and motor symptom severity, respectively, with established reliability and validity [18, 19]. Data were analyzed using SPSS. Descriptive statistics summarized demographics, MMSE, and TWSTRS scores. The Pearson chi-square test examined associations between CD severity and cognitive impairment, with $p < 0.05$ considered significant. Written informed consent was secured from all participants [20]. Participant confidentiality and the right to withdraw were strictly maintained throughout the study.

RESULT: A total of 73 participants were included in the study. Among them, 36 (49.3%) were male, and 37 (50.7%) were female, indicating an almost equal representation of both genders in the study sample. There were no missing values; therefore, the valid percentages corresponded directly to the calculated percentages. **(Figure 1)**

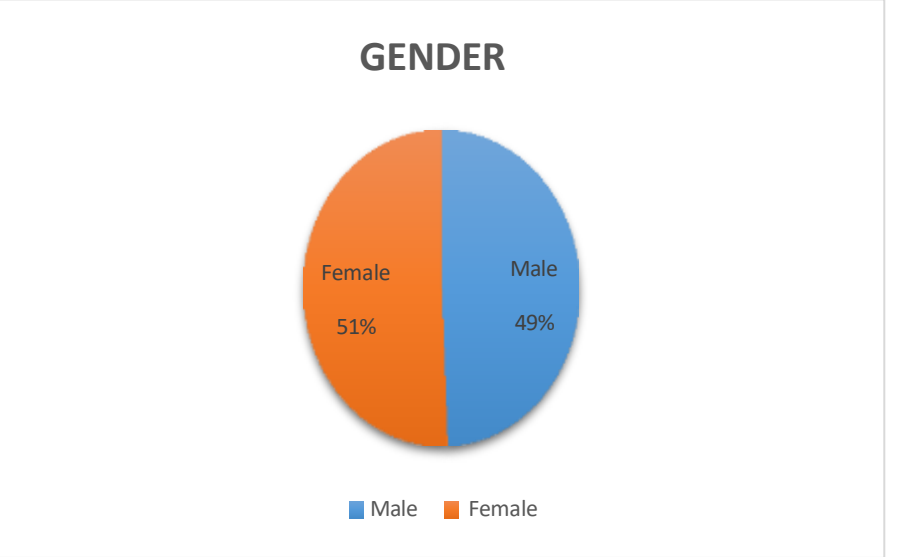

Figure 1: Gender Distribution of Study Participants (n = 73)

Regarding age distribution, the majority of participants belonged to the 18–29 years age group (31 participants; 42.5%). This was followed by the 42–53 years age group comprising 18 participants (24.7%) and the 30–41 years age group with 16 participants (21.9%). The smallest proportion of participants was observed in the 54–65 years age group, accounting for 8 participants (11.0%). Overall, the sample predominantly consisted of younger adults **(Figure 2)**

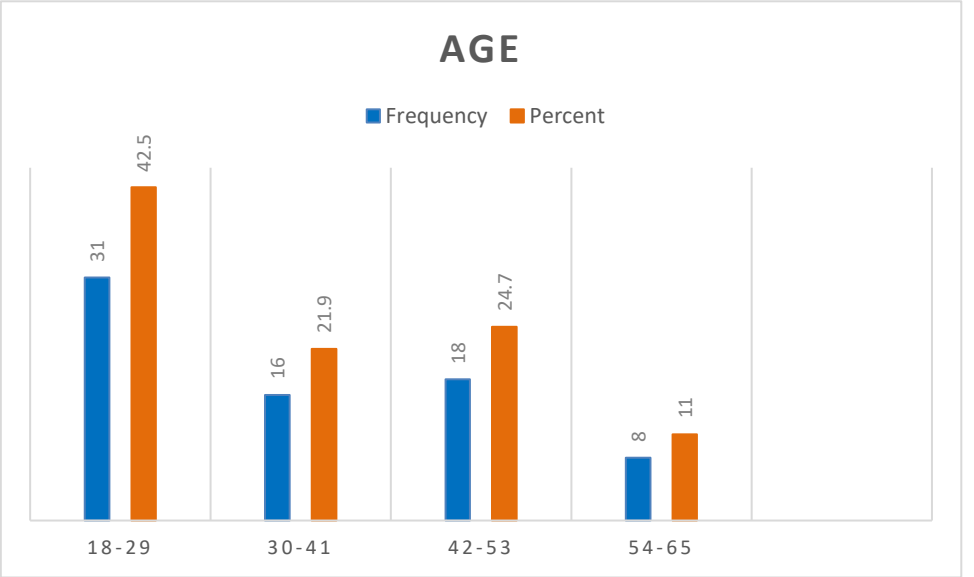

Figure 2: Age Distribution of Study Participants (n = 73)

Toronto Western Spasmodic Torticollis Rating Scale:
Cervical dystonia severity was assessed using the Toronto Western Spasmodic Torticollis Rating Scale (TWSTRS). The majority of participants exhibited moderate dystonia, comprising 46 individuals (63.0%). Severe dystonia was observed in 17 participants (23.3%), while a smaller proportion demonstrated mild dystonia, accounting for 10 participants (13.7%). These findings indicate that most participants in the study experienced moderate disease severity **(Table 1).**

Table 1: Severity of Cervical Dystonia According to the Toronto Western Spasmodic Torticollis Rating Scale

	Frequency	*Percent*
Mild Dystonia	**10**	**13.7**
Moderate Dystonia	**46**	**63.0**
Severe Dystonia	**17**	**23.3**
Total	**73**	**100.0**

:

Mini-Mental State Examination (MMSE):
Cognitive function was evaluated using the Mini-Mental State Examination (MMSE). Among the 73 participants, 22 (30.1%) demonstrated no cognitive impairment. Mild cognitive impairment was observed in 28 participants (38.4%), representing the largest subgroup. Severe cognitive impairment was identified in 23 participants (31.5%). Overall, a considerable proportion of participants exhibited some degree of cognitive impairment **(Table 2).**

Table 2: Distribution of Cognitive Function According to the Mini-Mental State Examination (MMSE)

	Frequency	*Percent*
No Cognitive Impairment	**22**	**30.1**
Mild Cognitive Impairment	**28**	**38.4**
Severe Cognitive Impairment	**23**	**31.5**
Total	**73**	**100.0**

Table 3 presents the association between cognitive function, assessed using the Mini-Mental State Examination (MMSE), and selected clinical and demographic variables. A statistically significant association was observed between MMSE scores and cervical dystonia severity measured by the Toronto Western Spasmodic Torticollis Rating Scale (TWSTRS) (χ^2 = 63.216, df = 4, $p < 0.001$).
No statistically significant association was found between gender and MMSE scores ($p = 0.704$). However, a significant association was observed between age group and cervical dystonia severity ($\chi^2 = 14.699$, df = 6, $p = 0.023$).

Table 3: Association Between Cognitive Function and Clinical and Demographic Variables

Association Tested	*Chi-Square Value(X^2)*	*df*	*p-Value*
Mini-Mental State Examination × Toronto Western Spasmodic Torticollis Rating Scale	**63.216[a]**	**4**	**<0.001**
Gender × Mini-Mental State Examination	**0.702[a]**	**2**	**0.704**
Age × Cervical Dystonia	**14.699[a]**	**6**	**0.023**

DISCUSSION:

In this cross-sectional study, we found a high prevalence of cognitive dysfunction (69.9%) among patients with cervical dystonia (CD), with mild and severe impairment observed in 38.4% and 31.5% of participants, respectively. These findings support growing evidence that cognitive dysfunction is a significant non-motor manifestation in CD and not merely a secondary consequence of motor disability. A recent systematic review by Xia et al. reported that individuals with CD often exhibit cognitive difficulties across domains, including processing speed, verbal and visual memory, executive function, and social cognition. However, the extent of impairment may vary depending on study design, patient characteristics, and the cognitive assessment methods used. [21]. This underscores that cognitive impairment can be a prevalent and clinically relevant feature of CD, supporting the findings reported in the present study.

We also found that cognitive dysfunction was significantly associated with dystonia severity ($p < 0.001$), indicating that individuals with more severe motor symptoms are more likely to exhibit cognitive deficits. This finding is consistent with the study by Terranova S et al., which used comprehensive neuropsychological assessments and reported impairments in

specific cognitive domains, including verbal fluency and delayed verbal recall, in patients with cervical dystonia. These deficits may reflect the involvement of broader cerebellar and cortical networks beyond the traditional motor circuits. [22]. While some earlier studies by Bastos MS et al. did not detect global cognitive differences using broad screening tools like the MMSE, domain-specific assessments often reveal subtle deficits in visual attention, planning, and executive function [23]. Such variability highlights the importance of using sensitive tools and multidimensional batteries to capture the cognitive profile in CD.

Our study also identified age as a significant factor associated with cognitive impairment ($p = 0.023$), suggesting that advancing age may exacerbate cognitive decline in CD. Age-related neurodegenerative processes combined with the chronic burden of movement disorder symptoms may contribute to this relationship. In contrast, gender was not significantly associated with cognitive dysfunction ($p = 0.704$), indicating that cognitive impairment occurs similarly in male and female patients, a finding consistent with other dystonia cohorts that did not find consistent gender effects on cognitive performance [23].

The predominance of moderate and severe dystonia in our sample may contribute to the high cognitive impairment rates observed, reinforcing the need for routine cognitive screening in clinical practice. Overall, our results emphasize that cognitive dysfunction is a clinically relevant nonmotor feature of cervical dystonia, significantly associated with disease severity, and should be considered in comprehensive care planning to optimize functional outcomes and quality of life.

Strengths of Study:

This study utilized standardized and validated tools, including the MMSE and TWSTRS, ensuring reliable assessment of both cognitive and motor aspects of cervical dystonia. Data collection from multiple tertiary care hospitals in Karachi enhanced sample diversity and local generalizability. Additionally, the integration of motor and non-motor evaluations provided a comprehensive

understanding of disease impact. Ethical approval and informed consent procedures further ensured the study's integrity and participant safety.

Limitations of Study:

The cross-sectional design restricts the ability to establish causal relationships between cervical dystonia and cognitive dysfunction. At the same time, the relatively small sample size and recruitment from a limited number of settings may limit the generalizability of the results. Moreover**,** potential confounding factors such as education level, depression, anxiety, medication use, and disease duration were not analyzed in detail and may have influenced the observed associations.

Recommendations

Routine cognitive screening should be incorporated into the clinical evaluation of patients with cervical dystonia to enable early identification of cognitive deficits. Additionally, future studies should employ larger, multicenter samples to improve external validity and generalizability of findings. The use of a comprehensive neuropsychological tool is also recommended to assess specific cognitive domains that may not be detected through general screening tools. Furthermore, longitudinal research designs are needed to evaluate the progression of cognitive dysfunction over time. Rehabilitation programs should adopt a multidisciplinary approach that integrates both cognitive and motor management strategies to improve overall patient outcomes.

CONCLUSION:

This study concludes that cognitive dysfunction is highly prevalent among patients with cervical dystonia, affecting nearly two-thirds of the study population. Cognitive impairment was found to be significantly associated with the severity of cervical dystonia and age, while gender showed no significant relationship. These findings reinforce the concept that cervical dystonia is a multidimensional disorder with important non-motor manifestations. Early identification and management of cognitive dysfunction may contribute to improved

functional outcomes and quality of life in individuals with cervical dystonia.

Acknowledgements
None

Informed Consent
Written informed consent was obtained from all participants before their inclusion in the study.

Conflict of Interest
No conflict of interest.

Funding Statement
This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

Ethical Approval
The study was approved by an independent Institutional Ethical Review Board (IERB) at the Foundation of Indus University under Protocol Number**:** IERB–01/U/AHS-DPT/25-26/017.

AUTHOR CONTRIBUTION:

Author	Contribution
Aliza Qureshi	**Substantial Contribution to study design, analysis, and acquisition of data.** **Manuscript Writing.** **Has Given Final Approval of the version to be published.**
Khadija Usman	**Substantial Contribution to study design, acquisition, and interpretation of data.** **Critical Review and Manuscript Writing.** **Has Given Final Approval of the version to be published**
Okasha Anjum	**Substantial Contribution to acquisition and interpretation of data.** **Has Given Final Approval of the version to be published.**

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