

Original Article

Exploring the Relationship Between Caregiver Burden, Hand-Eye Coordination and Dexterity Among Informal Caregivers of Individuals with Neurodevelopmental Disorders

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ABSTRACT

Background: Informal caregivers of children with neurodevelopmental disorders often experience sustained physical, emotional, social, and functional demands that may contribute to caregiver burden and affect performance in daily caregiving tasks. While caregiver burden has been widely studied in relation to psychological distress and quality of life, its association with functional motor domains such as manual dexterity and hand-eye coordination remains less explored. **Objective:** To determine the association between caregiver burden, manual dexterity, and hand-eye coordination among informal caregivers of children with neurodevelopmental disorders. **Methods:** A cross-sectional observational study was conducted among 87 informal caregivers under 40 years of age caring for children younger than 18 years with neurodevelopmental disorders. Caregiver burden was assessed using the 12-item Zarit Burden Interview, manual dexterity using the O'Connor Finger Dexterity Test, and hand-eye coordination using the finger-nose test. Data were analyzed using IBM SPSS Statistics version 25. Descriptive statistics were reported as frequencies and percentages, and chi-square tests were used to assess associations, with statistical significance set at $p < 0.05$. **Results:** Most caregivers were female (95.4%), unemployed (78.2%), and mothers of the affected child (80.5%). High caregiver burden was reported by 60 caregivers (69.0%), while poor dexterity was observed in 51 caregivers (58.6%). Normal hand-eye coordination was present in 74 caregivers (85.1%). Caregiver burden was significantly associated with manual dexterity, $\chi^2(6) = 16.454$, $p = 0.012$, whereas caregiver burden was not significantly associated with hand-eye coordination, $\chi^2(4) = 3.544$, $p = 0.471$. Hand-eye coordination was also not significantly associated with manual dexterity, $\chi^2(6) = 2.731$, $p = 0.842$. **Conclusion:** High caregiver burden was common among informal caregivers of children with neurodevelopmental disorders and was significantly associated with poorer manual dexterity, while hand-eye coordination was largely preserved and showed no significant association with burden. These findings suggest that dexterity may be an important functional domain to consider in caregiver health assessment and family-centered rehabilitation. **Keywords:** caregiver burden; dexterity; hand-eye coordination; informal caregivers; neurodevelopmental disorders.

INTRODUCTION

Neurodevelopmental disorders comprise a heterogeneous group of conditions that begin early in life and are characterized by developmental delays or impairments in cognitive, motor, sensory, behavioral, communication, social, academic, or adaptive functioning. These disorders include autism spectrum disorder, attention-deficit/hyperactivity disorder, intellectual disability, cerebral palsy, and

neuromuscular conditions such as Duchenne and Becker muscular dystrophy, all of which may require long-term assistance with daily living, mobility, communication, rehabilitation, health monitoring, and participation in family or community life (1,2). Globally, developmental disabilities affect a substantial number of children, with estimates indicating that millions of children younger than five years live with conditions such as autism, epilepsy, intellectual disability, sensory impairment, cerebral palsy, and other developmental disorders. The global burden of these conditions is clinically important because functional dependency in childhood often extends beyond the affected child and places sustained demands on family members who provide day-to-day care (3-5).

Informal caregivers, most commonly parents or close relatives, provide unpaid and continuous support to children who are unable to independently perform age-appropriate daily activities because of physical, cognitive, behavioral, or developmental limitations. Their responsibilities may include feeding, bathing, dressing, lifting, transferring, positioning, transportation, medication supervision, therapy follow-up, appointment coordination, and prevention of secondary complications. Although informal caregiving is essential to continuity of care and family-centered rehabilitation, caregivers often remain under-recognized within health systems despite carrying responsibilities that may be physically demanding, emotionally stressful, socially restrictive, and financially burdensome (6,7). In children with neurodevelopmental disorders, caregiving needs are frequently prolonged and multidimensional, making caregiver burden a clinically relevant outcome rather than only a family or social concern (2).

Caregiver burden refers to the perceived physical, psychological, emotional, social, and financial strain experienced by individuals who provide care. In families of children with developmental disabilities, caregiver burden has been associated with stress, anxiety, depressive symptoms, reduced quality of life, poor sleep, social isolation, emotional exhaustion, financial pressure, and reduced participation in occupational or social roles (2,8). The intensity of burden may be influenced by the child's level of dependency, behavioral challenges, mobility limitations, severity of disability, availability of social support, caregiver health, coping resources, and family structure. Prior evidence suggests that parents and relatives caring for children with developmental or motor disabilities may experience greater psychological and physical strain than caregivers of typically developing children, particularly when caregiving requires continuous assistance with mobility, personal care, and rehabilitation-related tasks (9,10).

While psychological and social dimensions of caregiver burden have been widely examined, the physical and functional consequences of caregiving remain comparatively less explored. Caregivers of children with neurodevelopmental disorders may repeatedly perform manual and physically demanding tasks, including lifting, supporting posture, assisting transfers, handling adaptive equipment, feeding, dressing, and performing fine care-related activities. These repetitive or sustained tasks may contribute to fatigue, musculoskeletal discomfort, reduced functional efficiency, and possible changes in fine motor performance (8). Manual dexterity is especially relevant in this context because it reflects the ability to perform precise, coordinated finger and hand movements needed for grasping, manipulating, positioning, fastening, feeding, and other caregiving activities. Dexterity depends on complex sensorimotor integration, neuromuscular control, tactile feedback, and motor planning, and even simple hand actions require rapid adjustment of finger posture and grip according to task demands (11).

Hand-eye coordination is another important functional domain because many caregiving activities require visually guided upper-limb movement, spatial accuracy, timing, and controlled reach. Tasks such as feeding, administering medication, dressing a child, supporting movement, and assisting therapeutic exercises may require integration of visual perception with controlled hand movement. However, unlike dexterity, hand-eye coordination may remain preserved in many caregivers unless neurological, visual, cerebellar, or severe fatigue-related factors interfere with motor control. Therefore, evaluating both dexterity and hand-eye coordination may help distinguish whether caregiver burden is more closely related to fine manual performance, broader visuomotor control, or both (12).

Despite growing recognition of caregiver burden among families of children with neurodevelopmental disorders, an important knowledge gap remains. Existing literature has primarily emphasized mental health, quality of life, fatigue, resilience, coping strategies, and social support, whereas limited evidence has investigated whether caregiver burden is associated with objective or clinically observable functional motor outcomes in caregivers. This gap is important because caregiver health directly affects the quality, safety, and sustainability of child care. If greater caregiver burden is associated with poorer dexterity or impaired coordination, then caregiver assessment should extend beyond psychological screening and include functional and ergonomic evaluation. Such evidence could support multidisciplinary interventions focused on caregiver education, physical conditioning, ergonomic training, task modification, rest strategies, and early identification of caregivers at risk of functional decline.

Using a biopsychosocial framework, caregiver burden can be understood as an interaction between physical demands, psychological stress, social support, family responsibilities, and environmental constraints. For informal caregivers of children with neurodevelopmental disorders, the burden of care may not only influence emotional well-being but may also be associated with functional performance required for caregiving tasks. Therefore, this study was designed to examine the association between caregiver burden, hand-eye coordination, and manual dexterity among informal caregivers of children with neurodevelopmental disorders. The study population consisted of informal caregivers under 40 years of age caring for children younger than 18 years; the primary exposure was caregiver burden, and the outcomes were dexterity and hand-eye coordination. The objective was to determine whether higher caregiver burden is associated with poorer dexterity and altered hand-eye coordination among informal caregivers of children with neurodevelopmental disorders.

MATERIALS AND METHODS

This cross-sectional observational study was conducted to determine the association between caregiver burden, manual dexterity, and hand-eye coordination among informal caregivers of children with neurodevelopmental disorders. The study was carried out at the Pakistan Society for the Rehabilitation of the Differently Abled, Lahore, after ethical approval from the School of Health Sciences, University of Management and Technology, Lahore, under approval number RE-039-2025. The target population comprised informal primary caregivers who were directly involved in providing routine care to children diagnosed with neurodevelopmental disorders. A cross-sectional design was selected because the study aimed to assess caregiver burden and motor performance outcomes at a single point in time and to examine whether these variables were statistically associated within the selected caregiver population.

Participants were recruited from caregivers attending or accompanying children receiving services at the study setting. Eligible participants were informal caregivers below 40 years of age who were providing care to children younger than 18 years diagnosed with neurodevelopmental disorders, including cerebral palsy, intellectual disability, autism spectrum disorder, attention-deficit/hyperactivity disorder, Duchenne muscular dystrophy, or related developmental conditions. Informal caregivers included parents or close family members who provided unpaid care and assistance with daily activities, health-related needs, mobility, supervision, or rehabilitation support. Formal caregivers, including trained professional caregivers, paid attendants, institutional staff, and healthcare workers providing care as part of professional duties, were excluded from participation. Written informed consent was obtained from all participants before data collection, and participants were informed about the purpose of the study, voluntary participation, confidentiality of responses, and their right to withdraw without any effect on services received.

The sample size was calculated using the WHO sample size calculator, and a final sample of 87 informal caregivers was included. Data were collected using a structured assessment approach that included demographic information, caregiver-related characteristics, child diagnosis, caregiver burden assessment, manual dexterity testing, and hand-eye coordination assessment. Demographic and

background variables included gender, marital status, employment status, relationship to the child, education level, pre-existing medical conditions, and diagnosis of the child. These variables were recorded to describe the sample and to provide contextual information relevant to caregiver burden and functional performance.

Caregiver burden was assessed using the 12-item Zarit Burden Interview. The Zarit Burden Interview is a caregiver-reported measure used to evaluate perceived burden related to caregiving responsibilities, including emotional strain, role strain, and personal impact of caregiving. The 12-item version provides a brief assessment while retaining clinical usefulness for caregiver burden screening. Each item is scored to generate a total burden score ranging from 0 to 48. Scores from 0 to 10 were categorized as no to mild burden, scores from 11 to 20 as mild to moderate burden, and scores above 20 as high caregiver burden (13,14). Caregiver burden was treated as a categorical exposure variable for the main association analyses.

Manual dexterity was assessed using the O'Connor Finger Dexterity Test, which evaluates the speed and accuracy of fine finger movements while handling small objects. During the test, each participant was instructed to pick up small pins and place them into designated holes as quickly and accurately as possible. The time required to complete the task was recorded using a stopwatch. The time taken to fill the first 50 holes was recorded, followed by the time taken to fill the next 50 holes; the second time value was multiplied by 1.1 to account for fatigue or slowing during task performance. The average of the two recorded time values was used as the final dexterity score. Dexterity performance was categorized as good, average, below average, or poor according to the scoring classification applied during data analysis (15). Manual dexterity was treated as a categorical outcome variable in the association analysis.

Hand-eye coordination was assessed using the finger-nose test, a bedside clinical test of visually guided upper-limb coordination and motor control. Participants were asked to touch their own nose, then reach forward to touch the examiner's finger, return to touch their nose, and then touch their knee. This cycle was repeated five times. Performance was observed for normal coordination, intention tremor, dysmetria, slowed movement, overshooting, undershooting, or jerky movement patterns. Participants were categorized according to observed coordination status as normal coordination, intention tremor, or dysmetria (16). Hand-eye coordination was treated as a categorical outcome variable.

To reduce measurement variability, the same standardized procedures were followed for each participant during administration of the caregiver burden questionnaire and motor performance tests. Instructions were provided in a clear and uniform manner before each test. Testing was performed in a suitable clinical environment to minimize distractions and allow safe completion of upper-limb coordination and dexterity tasks. Data were recorded on structured forms immediately after assessment to reduce entry omissions and transcription errors. Completed forms were reviewed for completeness before data entry, and responses were coded consistently before statistical analysis.

Data were analyzed using IBM SPSS Statistics version 25. Descriptive statistics were calculated for demographic variables, caregiver characteristics, burden level, dexterity level, and hand-eye coordination status. Categorical variables were summarized as frequencies and percentages. The chi-square test was used to assess associations between caregiver burden and manual dexterity, caregiver burden and hand-eye coordination, and hand-eye coordination and manual dexterity. Statistical significance was set at $p < 0.05$. The primary analytical focus was the association between caregiver burden level and dexterity level, while secondary analyses examined caregiver burden in relation to hand-eye coordination and the relationship between dexterity and hand-eye coordination. Ethical principles were maintained throughout the study by obtaining written informed consent, preserving participant confidentiality, using collected data only for research purposes, and ensuring that participation remained voluntary.

RESULTS

A total of 87 informal caregivers of children with neurodevelopmental disorders were included in the analysis. Most participants were female caregivers, accounting for 83 of 87 participants (95.4%), while male caregivers represented 4 participants (4.6%). The majority were married ($n = 78$, 89.7%), followed by single participants ($n = 7$, 8.0%) and divorced participants ($n = 2$, 2.3%). Most caregivers were unemployed ($n = 68$, 78.2%), whereas 19 participants (21.8%) were employed. Regarding relationship to the child, mothers represented the largest caregiver group ($n = 70$, 80.5%), followed by aunts ($n = 10$, 11.5%), sisters ($n = 3$, 3.4%), fathers ($n = 2$, 2.3%), and brothers ($n = 2$, 2.3%). Educational attainment varied across the sample, with secondary education being the most frequent level ($n = 26$, 29.9%), followed by college/university education ($n = 23$, 26.4%), primary education ($n = 17$, 19.5%), no formal education ($n = 13$, 14.9%), and postgraduate education ($n = 8$, 9.2%). Pre-existing medical conditions were reported by 12 caregivers (13.8%), while 75 caregivers (86.2%) reported no pre-existing medical condition. Cerebral palsy was the most common diagnosis among care recipients ($n = 46$, 52.9%), followed by intellectual disability ($n = 21$, 24.1%), Duchenne muscular dystrophy ($n = 10$, 11.5%), autism spectrum disorder ($n = 8$, 9.2%), and attention-deficit/hyperactivity disorder ($n = 2$, 2.3%).

Table 1. Demographic and Caregiving Characteristics of Participants

Variable	Category	Frequency (n)	Percentage (%)
Gender	Male	4	4.6
	Female	83	95.4
Marital status	Single	7	8.0
	Married	78	89.7
	Divorced	2	2.3
Employment status	Employed	19	21.8
	Unemployed	68	78.2
Relationship to child	Mother	70	80.5
	Aunt	10	11.5
	Sister	3	3.4
	Father	2	2.3
	Brother	2	2.3
Education level	No formal education	13	14.9
	Primary	17	19.5
	Secondary	26	29.9
	College/University	23	26.4
	Postgraduate	8	9.2
Pre-existing medical condition	No	75	86.2
	Yes	12	13.8
Diagnosis of child	Cerebral palsy	46	52.9
	Intellectual disability	21	24.1
	Duchenne muscular dystrophy	10	11.5
	Autism spectrum disorder	8	9.2
	Attention-deficit/hyperactivity disorder	2	2.3

Caregiver burden was high in most participants. Of the 87 caregivers, 60 participants (69.0%) had high burden, 21 participants (24.1%) had mild to moderate burden, and only 6 participants (6.9%) had no to mild burden. Manual dexterity performance was also predominantly impaired, with 51 caregivers (58.6%) classified as having poor dexterity. Below-average dexterity was observed in 14 caregivers (16.1%), average dexterity in 15 caregivers (17.2%), and good dexterity in 7 caregivers (8.0%). In contrast, hand-eye coordination was preserved in the majority of participants: 74 caregivers (85.1%) demonstrated normal coordination, while 9 caregivers (10.3%) showed intention tremor and 4 caregivers (4.6%) showed dysmetria.

Table 2. Distribution of Caregiver Burden, Manual Dexterity, and Hand-Eye Coordination

Variable	Category	Frequency (n)	Percentage (%)
Caregiver burden level	No to mild burden	6	6.9
	Mild to moderate burden	21	24.1
	High burden	60	69.0
Manual dexterity level	Good	7	8.0
	Average	15	17.2
	Below average	14	16.1
	Poor	51	58.6

Variable	Category	Frequency (n)	Percentage (%)
Hand-eye coordination	Normal	74	85.1
	Intention tremor	9	10.3
	Dysmetria	4	4.6

The association analysis showed a statistically significant relationship between caregiver burden level and manual dexterity level, $\chi^2(6) = 16.454$, $p = 0.012$. This finding indicates that caregiver burden was significantly associated with dexterity status, with poorer dexterity occurring in relation to higher caregiver burden levels. In contrast, the association between caregiver burden and hand-eye coordination was not statistically significant, $\chi^2(4) = 3.544$, $p = 0.471$. Similarly, hand-eye coordination was not significantly associated with manual dexterity level, $\chi^2(6) = 2.731$, $p = 0.842$. These findings suggest that manual dexterity, rather than hand-eye coordination, showed the clearest statistical association with caregiver burden in this sample.

Table 3. Association Between Caregiver Burden, Manual Dexterity, and Hand-Eye Coordination

Variables Compared	χ^2	df	p-value
Caregiver burden × Manual dexterity	16.454	6	0.012
Caregiver burden × Hand-eye coordination	3.544	4	0.471
Hand-eye coordination × Manual dexterity	2.731	6	0.842

Overall, the results demonstrate that the caregiver sample was predominantly composed of mothers, unemployed participants, and caregivers of children with cerebral palsy. High caregiver burden was present in more than two-thirds of the sample (69.0%), and poor dexterity was observed in more than half of participants (58.6%). Although most caregivers had normal hand-eye coordination (85.1%), dexterity impairment was common and showed a statistically significant association with caregiver burden. The non-significant findings for hand-eye coordination suggest that visually guided coordination was relatively preserved across burden categories, whereas fine manual dexterity appeared to be more closely related to the burden experienced by caregivers.

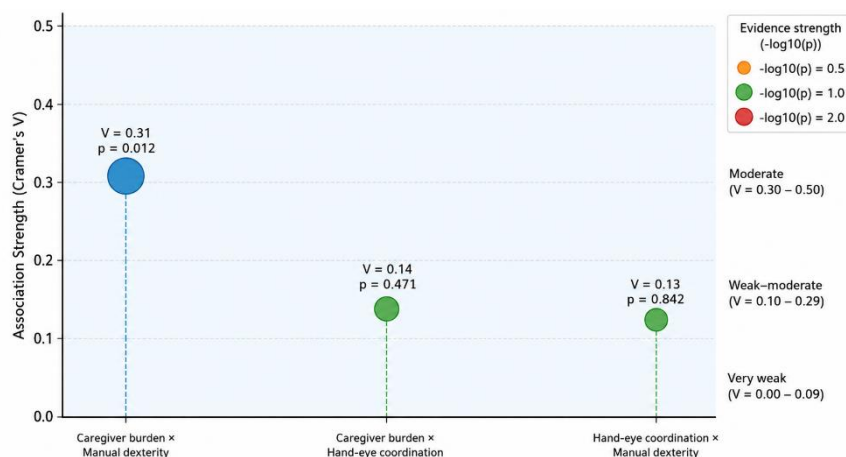


Figure 1. Relative Strength of Associations Among Caregiver Burden, Dexterity, and Hand-Eye Coordination

The association-strength profile showed that the relationship between caregiver burden and manual dexterity had the largest effect magnitude, with $\chi^2 = 16.454$, $df = 6$, $p = 0.012$, and Cramer's $V = 0.31$, indicating a clinically meaningful moderate association. In contrast, caregiver burden showed only a weak association with hand-eye coordination, $\chi^2 = 3.544$, $df = 4$, $p = 0.471$, Cramer's $V = 0.14$, while the association between hand-eye coordination and manual dexterity was similarly weak, $\chi^2 = 2.731$, $df = 6$, $p = 0.842$, Cramer's $V = 0.13$. This pattern indicates that caregiver burden was more strongly linked with fine manual dexterity than with broader visually guided coordination, supporting the interpretation that dexterity may represent a more sensitive functional domain in caregivers experiencing higher burden.

DISCUSSION

This study explored the association between caregiver burden, manual dexterity, and hand-eye coordination among informal caregivers of children with neurodevelopmental disorders. The findings

showed that high caregiver burden was common in this sample, with 60 of 87 caregivers (69.0%) classified as having high burden. Manual dexterity impairment was also frequent, as 51 caregivers (58.6%) demonstrated poor dexterity, while only 7 caregivers (8.0%) had good dexterity. In contrast, hand-eye coordination was largely preserved, with 74 caregivers (85.1%) showing normal coordination. The main statistical finding was a significant association between caregiver burden and manual dexterity, $\chi^2(6) = 16.454$, $p = 0.012$, whereas caregiver burden was not significantly associated with hand-eye coordination, $\chi^2(4) = 3.544$, $p = 0.471$. Similarly, hand-eye coordination was not significantly associated with manual dexterity, $\chi^2(6) = 2.731$, $p = 0.842$. These results suggest that caregiver burden may be more closely related to fine manual performance than to broader visually guided coordination in informal caregivers of children with neurodevelopmental disorders.

The high proportion of caregivers experiencing substantial burden is consistent with the demanding nature of caring for children with neurodevelopmental disorders. In the present sample, most caregivers were female (95.4%), unemployed (78.2%), and mothers of the affected child (80.5%), indicating that caregiving responsibilities were concentrated mainly among women within the family structure. This pattern is clinically relevant because mothers and close female relatives often provide continuous daily care, including feeding, dressing, lifting, positioning, transportation, supervision, and assistance with rehabilitation activities. Such repeated responsibilities may contribute not only to psychological and social strain but also to physical fatigue and reduced functional efficiency. Previous literature has shown that informal caregivers of children with developmental disabilities frequently experience emotional distress, reduced quality of life, social restrictions, financial pressure, and physical strain, particularly when the child has long-term dependency needs (17-19). The predominance of cerebral palsy among care recipients in this study, affecting 46 children (52.9%), may further explain the high caregiver burden because children with cerebral palsy commonly require assistance with mobility, transfers, posture, self-care, and therapy-related activities.

The significant association between caregiver burden and manual dexterity is an important finding because caregiver burden is often studied as a psychological or social construct, while its relationship with functional motor performance is less commonly examined. Manual dexterity reflects the ability to perform precise and coordinated finger movements during tasks that require speed, accuracy, grip adjustment, and object manipulation (20,21). In caregiving contexts, dexterity is relevant to feeding, dressing, fastening clothes, preparing medication, handling assistive devices, supporting therapeutic exercises, and managing child-related daily care tasks. The finding that poor dexterity was common among caregivers and significantly associated with burden supports the possibility that fine motor limitations may increase the perceived difficulty of caregiving tasks, or conversely, that sustained caregiving strain may be linked with reduced manual performance. Because the study design was cross-sectional, the direction of this relationship cannot be established; however, the association highlights manual dexterity as a potentially meaningful functional marker in caregiver health assessment.

The observed relationship between caregiver burden and dexterity can be interpreted within a biopsychosocial framework. Physically demanding caregiving tasks may expose caregivers to repetitive hand use, awkward postures, sustained gripping, lifting, and handling activities, which can contribute to fatigue and discomfort. Psychological stress may also influence physical performance through increased muscle tension, reduced sleep quality, lower recovery, and decreased attention during task execution. Social and environmental factors, including limited support, unemployment, financial constraints, and lack of formal caregiver training, may further intensify the burden experienced by caregivers. Therefore, reduced dexterity among highly burdened caregivers should not be viewed only as a motor issue but as a functional outcome that may reflect the interaction of physical workload, emotional stress, and caregiving context. This interpretation aligns with previous evidence indicating that caregiver burden is influenced by both physical health and psychosocial factors, including social support, coping strategies, and quality of life (22,23).

In contrast to dexterity, hand-eye coordination was not significantly associated with caregiver burden. Most caregivers demonstrated normal coordination, and only a small proportion showed intention tremor or dysmetria. This finding suggests that visually guided upper-limb coordination may remain relatively preserved in informal caregivers, even when perceived burden is high. One possible explanation is that the finger-nose test primarily detects clinically observable coordination abnormalities, such as tremor, dysmetria, and cerebellar-type movement disturbance, rather than subtle fatigue-related or task-specific performance changes. As a result, the test may be less sensitive to the types of functional strain experienced by caregivers during daily activities. Manual dexterity testing, by contrast, involves timed fine motor performance and may better capture subtle reductions in hand function, task speed, and precision. This may explain why caregiver burden was significantly associated with dexterity but not with hand-eye coordination.

The non-significant relationship between hand-eye coordination and manual dexterity also deserves consideration. Although both domains involve upper-limb motor control, they measure different aspects of function. Hand-eye coordination reflects the integration of visual input with reaching accuracy and movement control, whereas manual dexterity depends more heavily on fine finger movement, tactile feedback, grip precision, and speed of object manipulation. The weak association between these variables in the current study, $\chi^2(6) = 2.731$, $p = 0.842$, indicates that preserved coordination does not necessarily imply preserved dexterity. This distinction is important in caregiver assessment because a caregiver may appear neurologically coordinated during bedside testing but may still experience difficulty with fine, repetitive, or speed-dependent caregiving tasks. Therefore, future caregiver evaluations may benefit from including both broad coordination screening and task-specific dexterity measures rather than relying on a single motor assessment.

The findings are also relevant for rehabilitation practice and caregiver support programs. Since caregiver burden was significantly associated with dexterity, clinicians should consider screening highly burdened caregivers for functional hand limitations, fatigue, and musculoskeletal discomfort. Interventions may include caregiver education, ergonomic training, safe handling techniques, task simplification, adaptive equipment, rest scheduling, strengthening exercises, and referral for occupational or physical therapy when needed. Such interventions may help reduce physical strain and improve the sustainability of caregiving. In family-centered rehabilitation, the caregiver's functional capacity is directly linked to the child's continuity of care; therefore, protecting caregiver health should be considered part of comprehensive pediatric neurodevelopmental care.

The study has several limitations that should be considered when interpreting the findings. First, the cross-sectional design prevents conclusions about causality or temporal sequence. It cannot be determined whether high caregiver burden contributed to poorer dexterity, whether poor dexterity increased caregiving difficulty and perceived burden, or whether both were influenced by other factors. Second, the sample was predominantly female, with only 4 male caregivers (4.6%), which limits the generalizability of findings across gender groups. Third, important child-related factors such as severity of disability, gross motor functional level, behavioral severity, dependency level, and duration of caregiving were not included in the analysis. These factors may influence caregiver burden and physical performance. Fourth, the analysis was based on chi-square testing and did not adjust for potential confounders such as caregiver age, education, employment, medical conditions, relationship to the child, or diagnosis of the child. Finally, hand-eye coordination was assessed using a clinical bedside test, which may not detect subtle impairments in visually guided motor performance under real caregiving conditions.

Despite these limitations, the study contributes useful preliminary evidence by highlighting the physical dimension of caregiver burden. The results indicate that high caregiver burden is common among informal caregivers of children with neurodevelopmental disorders and that manual dexterity is significantly associated with burden level. The absence of a significant association with hand-eye

coordination suggests that not all motor domains are equally affected or equally sensitive to caregiving-related strain. These findings support a broader approach to caregiver assessment that includes psychological, social, ergonomic, and functional motor components. Further research using larger and more diverse samples, objective functional measures, and adjusted statistical models is needed to clarify the pathways linking caregiver burden with physical performance and to identify interventions that can preserve caregiver health and caregiving capacity.

CONCLUSION

In conclusion, this cross-sectional study found that high caregiver burden was common among informal caregivers of children with neurodevelopmental disorders, particularly mothers, and that manual dexterity was significantly associated with caregiver burden. Caregivers with higher burden showed poorer dexterity, suggesting that fine motor performance may be an important but under-recognized functional dimension of caregiver health. In contrast, hand-eye coordination was not significantly associated with caregiver burden, and most caregivers demonstrated normal coordination, indicating that broader visually guided coordination may be relatively preserved despite caregiving strain. These findings highlight the need to consider caregiver burden not only as a psychological or social concern but also as a potential contributor to functional difficulty in daily caregiving tasks. Integrating caregiver screening, ergonomic guidance, hand-function assessment, and supportive rehabilitation strategies into family-centered care may help protect caregiver well-being and improve the sustainability of long-term care for children with neurodevelopmental disorders.

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