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Parent-Reported Fine Motor Function Limitations in Children with Cerebral Palsy at Saidu Group of Teaching Hospital, Swat: A Cross-Sectional Study

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Abstract

Background: Cerebral palsy (CP) is a significant childhood disability and it is mostly linked with life-long challenges of fine motor skills, self-care skills, and functional independence. These problems may be compounded by insufficient access to rehabilitation services and assistive devices in low-resource settings like Swat, Pakistan. There is need of study because limited local evidence on parent-reported functional performance is present in children with CP.

Methods: The analytical cross-sectional study was a quantitative study carried out in Saidu Group of Teaching Hospital, Swat. The convenience sampling was used to recruit a total of 249 children with clinically diagnosed cerebral palsy and their primary caregivers. The demographic and clinical information form and modified parent-reports Pediatric Evaluation of Disability Inventory that evaluates self-care, mobility, and social function were used to collect data. The SPSS version 27 was used to analyze the data. The Chi-square test and descriptive statistics were used to summarize the results and establish a correlation.

Results: The mean age of children with CP was 4.20 + 2.26 years and the mean score for the PEDI was 49.65 + 21.52. In functional domains, it was found that almost one-third of children were independent, one-third needed help, and one-third were not able to perform daily tasks. The most dependent ones were fine motor and self-care tasks. It was also revealed that there were no statistically significant relationships between functional performance and CP subtype, distribution, age at diagnosis, comorbidities, treatment status, and assistive device use.

Conclusion: Children with cerebral palsy in Swat exhibit considerable functional limitations, particularly in fine motor and self-care activities, underscoring the need for accessible, targeted rehabilitation services.

Keywords: Cerebral palsy; Fine motor function; Functional independence; Parent-reported outcomes; Rehabilitation; Pakistan

Introduction

Overview

Cerebral palsy (CP) refers to a collection of permanent and non-progressive disorders of movement and posture that result as a consequence of damage to the developing fetus or infant brain. CP centrals limitation in activities and movements, which are accompanied by problems with sensation, thinking, communicating, and acting, and secondary musculoskeletal troubles and epilepsy are common(1, 2). Fine motor skills which include the ability to handle small objects, feeding, writing, and dressing are some of the essential aspects of the child independence and involvement at home and school. CP is distinguished by fine motor deficits as a result of a complex of spasticity, the absence of selective motor control, dystonia, sensory dysfunction and associated neurocognitive impairment (3, 4). Coordinated movements of hands and fingers are important in independence of children, thus referred to as fine motor skills. These skills are required in tasks like manipulation of utensils, dressing, writing, handling classroom materials, among others (5). A combination of spasticity, loss of selective motor control, dystonia, sensory dysfunction, and related cognitive deficit is the prevalent cause of fine motor impairment in children with CP. The impairment of fine motor skills thus leads to lack of self-care independence, and limits educational activities and makes people dependent on others(2). In routine clinical practice and research, functional assessment can be performed by clinicians (direct assessment) or by caregivers (parent-reported measures). Parent-reported instruments are valuable because they capture the child's performance in the home and community, the settings where most daily activities occur, and they are often more feasible in low-resource contexts where time, equipment, and trained assessors are limited. The Pediatric Evaluation of Disability Inventory (PEDI) and its adaptive versions (PEDI-CAT) are caregiver-report instruments designed to evaluate self-care, mobility and social function. They have been widely used internationally to profile functional performance in children with CP and other developmental disabilities and have demonstrated good reliability and construct validity in CP populations(6).

Global estimates suggest that CP remains a common cause of childhood disability, with prevalence and severity varying between regions according to perinatal care quality and socioeconomic factors. While high-income countries have seen improvements in prevalence and outcomes due to advances in neonatal care and early intervention, many low- and middle-income countries (LMICs) continue to experience higher rates of preventable causes (perinatal asphyxia, neonatal infection) and constrained access to rehabilitation services(7, 8). Consequently, children with CP in LMICs frequently have more severe impairments and delayed access to therapy, conditions that exacerbate fine motor deficits and caregiver demands. The combination of higher incidence of preventable perinatal insults and limited rehabilitation infrastructure in LMICs argues for context-sensitive functional assessment approaches that consider the home environment, caregiver capacity, and service availability. Parent-reported measures are therefore widely recommended in such contexts for rapid, ecologically valid documentation of functional needs(2, 9).

CP in Pakistan: Regional Evidences

Pakistan lacks a nationwide CP registry, so much of the evidence about prevalence, risk factors and functional outcomes comes from hospital or district-based studies. Published studies in Pakistan have repeatedly found perinatal asphyxia, preterm births, neonatal infections and inadequate antenatal and perinatal care as the leading risk factors of CP (9). The most frequently reported subtype is spastic presentations and a significant percentage of children have severe motor involvement. These results are evidence of endemic lapses in perinatal care and inadequate early rehabilitation supports in most regions of the nation (7). Simultaneously, studies in the nation have started to focus more on caregiver outcomes, demonstrating that family members especially mothers tend to suffer a lot of psychological disturbances associated with the degree of disability and the severity of care that the children need. The functional and social implications of CP in Pakistan are hence based on the caregiver perspective (10).

The province of Khyber Pakhtunkhwa (KP) has also provided a number of regional studies of CP though there is little evidence at the level of the district. A community-based prevalence investigation of the District Swabi, KP found a CP prevalence of 1.22 per 1,000 live births in 4-10 years old and reported the high prevalence of extreme motor involvement (high proportion with spastic quadriplegia). This research shows that CP is a quantifiable health issue in some of the KP and offers an opportunity to experience major functional deficits in impacted children(10). The prevalence data of Swabi are helpful but fail to reveal fine motor functional status and caregiver views. No published studies have examined caregiver-reported fine motor outcomes in Swat district. This is regardless of the fact that in remote or semi-urban environments, caregivers frequently are the main providers of day-to-day care and therapy; their ideas of what children can do through fine motor tasks are very informative in setting realistic therapy outcomes, implementing assistive technology and resource allocation. The lack of functional information generated locally and reported by caregivers leaves clinicians and planners in Swat with little evidence by which to base specific occupational therapy, assistive devices provision or caregiver training interventions.

Fine Motor Function: Implications for the Child and Family

Caregiver-reported measures are functional performance in real-life, and they are feasible in case direct testing or regular clinic visits are not possible under the circumstances. The parents of children with cerebral palsy (CP) especially mothers may experience a lot of psychological and physical stress because the child has long term functional impairments through his inability to perform certain tasks like fine motor and self-care tasks which require constant support. According to international studying, it is confirmed that more significant motor impairment in CP is closely connected to higher caregiver burden, stress, and lower quality of life because parents have to spend more time to feed, clothe, and involve their children in everyday activities (11, 12). Similar results have been observed in Pakistan: a study conducted in Peshawar revealed that over half of mothers of children with CP were suffering moderate-to-severe depression, and increased levels of the condition were related to children being unable to perform activities of daily living, including fine motor skills (5). Fine motor deficits affect more than just tasks that involve using the hands alone. They impact feeding self-sufficiency, personal care, dressing, school-related (writing, drawing) and social engagement. Low academic performance and low self-esteem are linked to the poor fine motor skills. To families, such deficits are translated to more family time spent on activities related to care giving, greater stress on caregivers and low household productivity(12). Both international and Pakistani empirical studies have indicated that the more severe the motor impairment of the child, the greater the burden on the caregiver, the depressive and poorer the quality of life. In Pakistan, research has indicated high rates of maternal depression in parents whose children had CP with higher rates of depressive symptoms being associated with an increased functional dependency of the child. The importance of this problem and its applicability to service planning is supported by a national tertiary hospital study and a recently conducted multi-center study of caregiver burden(13).

There are several tools on how to assess fine motor skills and functional performance among children with CP. Direct evaluation instruments like the Peabody Developmental Motor Scales, Assisting Hand Assessment, and standardized clinical examinations are very detailed in motor profiling, and might be time-consuming and demand trained evaluators and apparatus. In comparison, caregiver-reported measures allow them to do a useful evaluation in larger sample sizes and they are also able to test the performance of the child in natural settings. The Pediatric Evaluation of Disability Inventory (PEDI) is a caregiver-report measure, a standardized caregiver-report scale that assesses functional performance in three domains self-care, mobility and social function. PEDI (and the PEDI-CAT adaptive version) is strongly psychometrically supported in CP populations; reliability and construct validity research indicates PEDI scores

are meaningfully related to clinical measures and provide a reliable source of information of day-to-day functioning. PEDI being the caregiver-report in format and rated as reliable is a suitable measure of fine motor performance in Swat as long as proper translation and cultural adaption measures are implemented(14).

Problem Statement

Although CP is recognized as a major childhood disability in Pakistan, little district-level evidence exists about fine motor function explaining the performance of children with CP on fine motor tasks in their daily settings. Swat district, having limited rehabilitation resources and relying on family caregivers has no published, caregiver-reported evidence regarding self-care and hand function in children. This lack means that clinicians cannot give priority to the targets of therapy that meets the needs of the family, and restricts the policymakers in the planning of their services like occupational therapy units, provision of assistive devices, or caregiver training programs.

Research Gap

In Pakistan, research on cerebral palsy has largely focused on prevalence, causes, and gross motor function, with little attention to fine motor abilities. This gap is critical because fine motor difficulties in tasks such as feeding, dressing, and writing directly increase caregiver burden, especially in Swat where parents provide most daily care due to limited rehabilitation services. At the policy level, the absence of fine motor outcome data prevents planners from allocating resources for occupational therapy, assistive devices, and caregiver support. No published study from Swat has yet assessed fine motor function in children with CP using standardized parent-reported tools like the PEDI, leaving a significant evidence gap for both families and policymakers.

Rationale & Significance

Cerebral palsy continues to be one of the leading causes of long-term disability among children, but local information regarding the functional limitations of affected children in Pakistan, especially in rural and semi-urban areas like Swat, is limited. Although various studies have investigated the overall occurrence and categories of cerebral palsy, there is a lack of research focusing on fine motor skills and self-care capabilities from the viewpoint of parents in this area. Grasping these limitations is essential as they directly influence a child's autonomy, involvement, and the burden on caregivers. The Pediatric Evaluation of Disability Inventory (PEDI) offers a systematic, parent-reported evaluation of a child's everyday functional abilities, emphasizing self-care, mobility, and social interaction. Utilizing this tool within the Swat context will produce quantitative data regarding the level of fine motor difficulties encountered by children with cerebral palsy, mirroring the actual challenges faced by families in household and community environments. For healthcare professionals in Swat, the PEDI outcomes are anticipated to emphasize the most impacted self-care and fine motor areas, assisting physiotherapists and occupational therapists in prioritizing therapy objectives, creating family-focused interventions, and distributing rehabilitation resources more efficiently. This information can likewise guide local policy, rehabilitation program development, and community awareness regarding early intervention and supportive techniques.

Literature Review

Search Strategy

PubMed, Google Scholar, Mendeley Database, Systematic Reviews and cross-sectional studies of Biomed central and PubMed Central (PMC) were accessed for searching articles related to our research topic.Various combination of keywords was used for our search. Keywords used during our study were 'Prevalence', 'Cross-sectional study', 'Systemic reviews', 'Meta analysis', 'PEDI', 'Cerebral Palsy, 'Parent-reported outcome, 'fine motor skills, 'Pakistan'. Operators such as 'OR' and 'AND' were used for various combinations of the keywords. The results were then filtered with articles which were published within

the last 15 years andorganized further by the best match with the topic. Then, articles were carefully studied and referenced as below in this literature review.

Studies Reviewed

In 2023, Liu et al. carried out a **systematic review and meta-analysis** based on correlates of caregiver burden. Liu et al. combined observational studies and discovered that there was a consistent moderate relationship between child functional dependency (self-care limitations) and burden/depressive symptoms of caregivers. The meta-analysis data supports the probable association between the caregiver outcomes in Pakistan and parent-reported fine motor limitations (PEDI results), which gives policy and clinical relevance to the proposed Swat study. This study supports the use and reliability of PEDI in caregiver reported measurements(15).

Ahmad et. al. in **2017** conducted a study Entitled "**Prevalence of Cerebral Palsy in Children of District Swabi, Khyber Pakhtunkhwa, Pakistan**". They Found 278 Children with CP (Mean Age of Approximately 7.6 years), which translated into a prevalence of 1.22/1,000 live births; the study indicated that approximately 39.2 per cent of those children were really severely involved in their motor situation and spastic quadriplegia was prevalent. Even though the analysis involved prevalence and topography and not item-level fine motor performance, it shows that a significant local burden of severe CP exists in KPK, which supports the requirement of neighboring district (Swat) data on functional (fine motor) limitations(10).

M. Mughal et. al., 2023 (Review of CP research in Pakistan; gaps & trends). Mughal highlights in his reviews of Pakistani CP literature that most studies primarily focus on etiology and gross motor classification. He notes that there are few studies capturing parent-reported daily functioning and fine motor skills restrictions in the documents at the district level. He explicitly recommends conducting district level parent-reported functional assessments in order to direct local rehabilitation. This directly supports the current study being undertaken in Swat(9).

Brandão et al., 2014 conducted a Cross-sectional descriptive study on Functional priorities reported by parents in Brazil, including 100+ caregivers). Parents of children with CP reported that more importance was given to self-care activities along with hand use activities and tasks regardless of severity. The study justified the need to measure Swat parent-reported fine motor/self-care limitations. This is because parent priorities significantly influence therapy goal setting and resource allocation for children. Similar patterns may emerge among caregivers in Swat, highlighting the importance of assessing fine motor self-care tasks in the local context (Swat)(16).

Arnould et al., conducted a **cross-sectional study** in **2014** to study **hand-functioning** a sample size of 136 children with CP**.** Arnould et. al. used objective hand-skill assessments (grip strength, stereognosis, Box & Block, Purdue Pegboard) in 136 children with CP (different subtypes), in which they found variability of impairment based on topography and side (dominant vs non-dominant). Their findings emphasized that fine motor impairments are prevalent and differ among CP subtypes, suggesting that item-level caregiver assessments (like PEDI self-care items) need to reflect a range of task limitations when applied in a local sample. Use of PEDI for measurement supports our methodology and its reliability(17).

Eliasson et al., 2006 (MACS development and validation; scale construction and validation sample). They created the Manual Ability Classification System (MACS), showing its reliability and construct validity for categorizing how children with CP utilize their hands in daily activities. MACS is easy to implement and offers valuable context for understanding PEDI self-care/fine motor results reported by caregivers(18).

Sultana S. et al., 2024 (Tertiary hospital case series, Pakistan; functional profiles and service gaps). This report from the regional tertiary hospital highlighted the functional difficulties faced by children with CP seeking rehabilitation, indicating common restrictions in feeding, dressing, and classroom activities (fine motor-related) along with a shortage of

occupational therapy services. This evidence regarding service levels demonstrates the necessity for local, parent-reported functional information to validate the enhancement of occupational therapy resources in areas like Swat(19).

Khan et al., 2022 (multi-center Pakistani clinical study; cross-sectional). Khan et. al. examined children with CP across various centers in Pakistan to outline risk factors, types of CP, and neuroimaging results; they discovered a significant occurrence of perinatal injuries (e.g., birth asphyxia) and prematurity as clear causes and recorded a range of motor severity. The data at the sample level highlight why numerous Pakistani children exhibit bilateral and severe issues, which would likely entail significant fine motor deficits necessitating functional assessment at the district level(2).

Saeed et al., 2024 (mixed-methods tertiary hospital study on caregiver burden; quantitative sample and qualitative interviews). They examined caregivers of children facing chronic pediatric conditions (including CP) and found that a significant number encountered moderate-to-severe burden, with qualitative themes emphasizing financial stress, time demands, and emotional distress. The research emphasizes that recording child functional dependency (including fine motor skills) is crucial for comprehending and meeting caregiver requirements in Pakistan(7).

Elvrum et al. (BFMF development/validation), 2016 (classification study; scale development & validation). They created and analyzed the Bimanual Fine Motor Function (BFMF) classification as an additional assessment to MACS, showing that BFMF provides insights into real bimanual fine motor abilities. The BFMF outlines five levels of fine motor abilities and has proven effective in characterizing hand function across populations, serving as a valuable clinical benchmark for PEDI-related caregiver assessments that emphasize daily self-care activities(20).

Yousaf & Razaq, 2020 (cross-sectional study in Lahore; n = 100 caregivers of children with CP). This cross-sectional study from Pakistan examined caregiver burden and its related factors; the authors found statistically significant links ($p < 0.05$) between increased caregiving burden and elevated child dependency alongside diminished socioeconomic status. The study's results indicate that assessments of daily functional impairments (such as fine motor activities) are essential for measuring caregiving requirements in Pakistani contexts(21).

Shore et al., 2019 (psychometric reliability study; PEDI-CAT in CP; test–retest ICCs reported). In subsequent psychometric studies, the same team reported strong test–retest reliability for PEDI-CAT domains in children with CP (the original paper indicated excellent ICCs), and notable convergent validity with external clinical measures (for instance, correlations with personal care and mobility assessments). These robust reliability metrics endorse the use of PEDI-type caregiver reports in cross-sectional surveys and establish methodological precedent for the current PEDI administration in Swat(6).

Myrhaug et al., 2014 (Systematic review; parent-reported outcomes in motor training for preschoolers). This review discovered that benefits reported by parents are frequently noted in motor-training research and advocated for including parental viewpoints in assessing motor interventions. The results indicate that parent reports are attuned to functional improvements and can consistently inform practice, emphasizing the importance of a parent-reported baseline of fine motor challenges to direct local interventions(22).

Arner et al., 2008 (large clinical report on hand function; n = 367 children). Arner et. al. presented findings from 367 children with CP, detailing hand function patterns among subtypes and the frequency of particular task difficulties. The extensive sample offers a strong depiction of the variability in hand dysfunction and reaffirms the necessity for item-specific caregiver assessments (PEDI) to determine which self-care activities are the most challenging in a specific community(23).

Kwon et al., 2013 (cross-sectional study on relationship between gross motor function and daily function). They explored the relationships between GMFCS levels and daily functional abilities (WeeFIM/PEDI items), finding substantial correlations ($p < 0.01$) that suggest gross motor impairment impacts daily self-care, while also indicating that manual/fine motor restrictions contribute additional explanatory strength to daily function. This methodological connection aids in assessing fine motor skills specifically instead of deducing fine motor ability solely from gross motor condition(24).

Cabral et al., 2023 (study on fine motor skills and cognition using Bayley-III; sample and statistical associations). The authors examined the association between fine motor skills and cognitive tasks in Bayley-III data, revealing that reliance on fine motor abilities can impact cognitive test outcomes. Their findings emphasize the wider developmental consequences of fine motor deficits and support the need to prioritize fine motor evaluations (e.g., using PEDI self-care items) in pediatric CP assessments(25).

Baker et al., 2022 (Cochrane review on early motor interventions; methods & conclusions). The Cochrane review summarized randomized trials of early motor interventions for infants and toddlers with CP, finding that task-specific and family-centered strategies can enhance motor outcomes, although the quality of the evidence varied. The assessment highlights that initial documentation of functional impairments (such as fine motor restrictions) is essential for planning and assessing interventions, justifying the need for a PEDI-based cross-sectional survey(26).

Barnett et al., 2016 (population study on motor competence correlates; educational and participation implications). Barnett et. al. utilized extensive population data to demonstrate that fine motor skills are linked to school preparedness and academic results. Translating these discoveries to CP, fine motor constraints from PEDI will likely correlate with diminished educational involvement in Swat, further emphasizing the study's implications for service planning(27).

Varni et al., 2008 (Cross-sectional study – Health related quality of life in children with CP; n = 200+). The study examined HR-QoL and discovered significant links between the level of impairment and decreased quality of life in various domains; restrictions in daily activities (many depending on fine motor skills) were linked to worse parent-reported QoL. This research connects functional limitations, such as dependency on fine motor skills, to significant family outcomes and emphasizes the importance of recording parent-reported fine motor challenges in Swat for public health(28).

Barney et al., 2013 (Cross-sectional; parent-reported musculoskeletal/pain outcomes related to motor function; n reported). Their results showed that levels of motor impairment forecasted parent-reported musculoskeletal issues and pain in children with CP, and they identified connections between increased functional limitations and more significant parent-reported difficulties. These results emphasize that parent observations identify clinically significant outcomes related to motor restrictions and indicate that parent-reported fine motor challenges will similarly indicate subsequent issues requiring local focus(29)

Methodology

Objective

Primary Objective:

To assess the level of parent-reported functional limitations in fine motor functioning of children aged 2–12 years with cerebral palsy (CP) attending Saidu Group of Teaching Hospital, Swat, using the Pediatric Evaluation of Disability Inventory (PEDI).

Secondary Objective:

To examine the relationship between functional limitations in fine motor skills and caregiver burden in children with CP in Swat.

Operational Definitions

Cerebral Palsy (CP):
Cerebral palsy is a group of permanent but non-progressive disorders of movement and posture caused by disturbances in the developing fetal or infant brain, leading to limitations in activity and participation. For this study, CP will include children clinically diagnosed with spastic, dyskinetic, or mixed forms of CP aged between 2–12 years who are receiving care at Saidu Group of Teaching Hospital, Swat.

Fine Motor Function:
Fine motor function refers to the coordinated movement of small muscles, particularly of the hands and fingers, that enable precision tasks such as grasping, manipulating objects, dressing, feeding, or writing. In this study, fine motor function will be assessed through parent-reported data using the Pediatric Evaluation of Disability Inventory (PEDI) self-care domain, which measures daily fine motor activities and self-care tasks.

HYPOTHESIS

Not applicable.

Study Design:
This was a quantitative, analytical, cross-sectional study.

Study Setting:
The study was conducted at Saidu Group of Teaching Hospital (SGTH), Saidu Sharif, Swat, Khyber Pakhtunkhwa, Pakistan, a major tertiary care and referral center for pediatric and rehabilitation services in the Malakand division. SGTH was chosen for its accessibility to the local CP population and its multidisciplinary rehabilitation setup, making it feasible for participant recruitment within the proposed timeframe.

Study Duration:
The study was conducted over a period of six months, including ethical approval, data collection, and analysis phases.

Sample Size:
The sample size was calculated using the Raosoft Sample Size Calculator. Based on hospital records, approximately 116 CP patients attend SGTH monthly, averaging 700 patients over six months. With a 95% confidence interval, 5% margin of error, and estimated population size of 700, the required sample size is 249 participants.

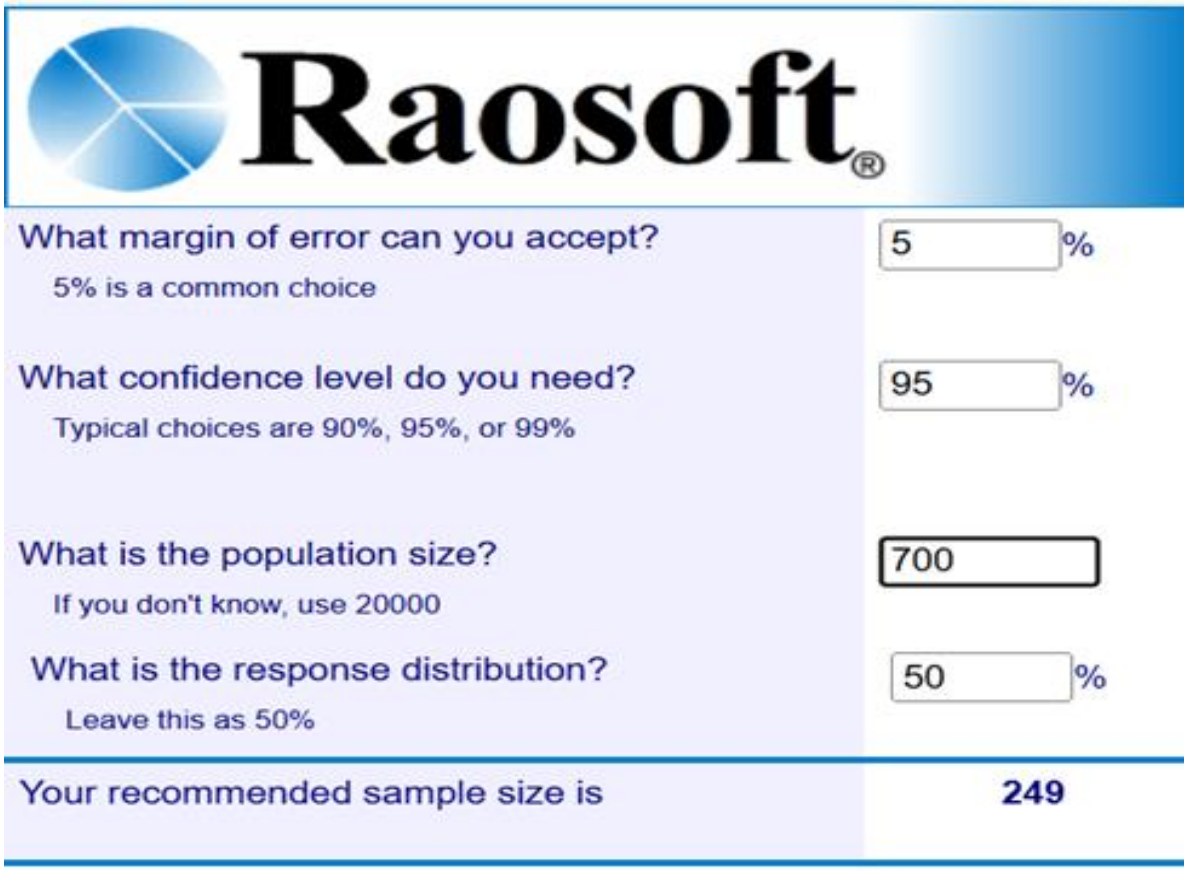

Figure 1 Sample Size

Sampling Technique:

Non-probability convenience sampling was chosen to select the population considering the area and region, where patients are inaccessible with limited resources.

Data Collection Tools

Primary Tool: Pediatric Evaluation of Disability Inventory (PEDI)

The PEDI is a standardized parent-report questionnaire that evaluates functional abilities and performance in children aged 6 months to 7.5 years but it has now been widely used for older children (aged more than 8 years) with developmental delays, such as cerebral palsy. It assesses three major functional domains:

1. **Self-care** - including feeding, grooming, dressing, and toileting.
2. **Mobility** - including transfers, walking, and stair climbing.
3. **Social Function -** including communication, play, and problem-solving.

Scoring:

Each item is rated on a 3-point ordinal scale:

- **0** = unable to perform the task
- **1** = performs the task with difficulty or requires assistance/adaptation
- **2** = performs the task independently and easily

Raw domain scores are converted to scaled scores (0–100) representing the percentage of functional skills achieved. Higher scores indicate greater independence and better fine motor function; lower scores reflect greater dependency and limitations.

Validity and Reliability:

PEDI has demonstrated excellent psychometric properties in children with cerebral palsy, with test–retest reliability (ICC > 0.95) and internal consistency (Cronbach's $\alpha > 0.90$) across domains. It has been validated in multiple populations, including those with physical disabilities(30, 31).

Language Adaptation and Administration:
The questionnaire was administered through structured interviews conducted by trained physiotherapy students fluent in Urdu and Pashto. The PEDI questionnaire was translated to Urdu using Google Translator, which was originally in English.

Data Collection Procedure
After obtaining approval from the Swat Institute of Research and Medical Sciences (SIRMS) Institutional Review Board (IRB) and permission from the Medical Superintendent (MS) of SGTH, eligible participants will be identified from the hospital's pediatric and rehabilitation departments.

1. The purpose and procedure of the study will be explained to caregivers in their preferred language (Urdu or Pashto).
2. Written informed consent will be obtained before data collection.
3. Each caregiver will complete the PEDI questionnaire and demographic form under supervision of trained researchers to ensure accuracy and comprehension.
4. Average interview time per participant is expected to be 20–25 minutes.

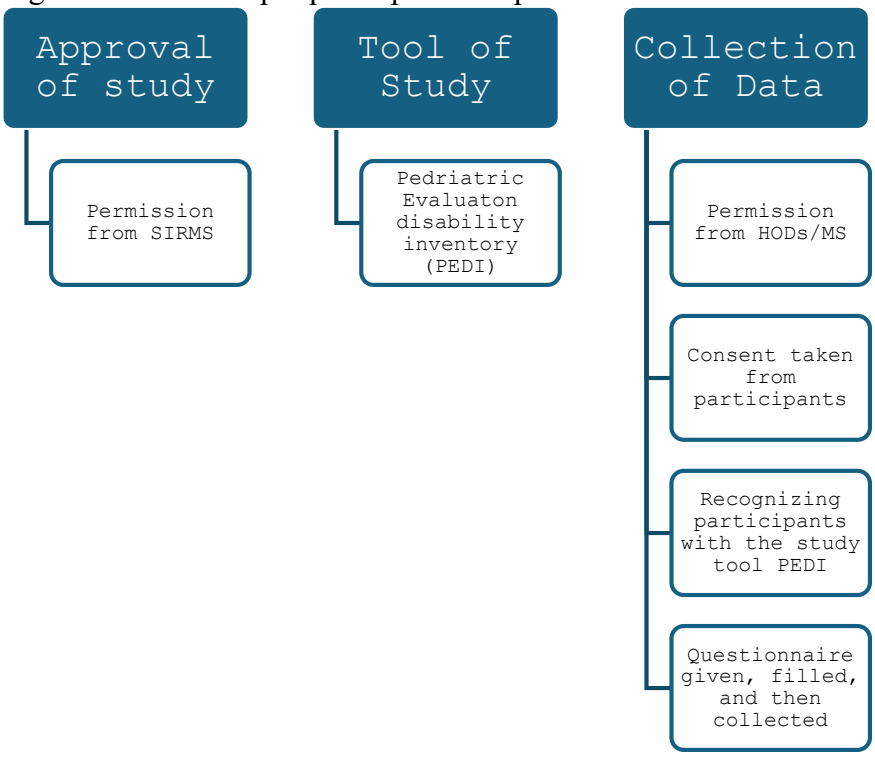

Figure 2 Data Collection Procedure Char

Data Storage and Confidentiality
All data will be treated with strict confidentiality:

- Each participant will be assigned a unique study ID; no names or contact details will be recorded on data forms.
- Completed paper questionnaires will be stored in locked cabinets accessible only to the principal investigator.
- Data will be digitized and stored as encrypted files on a password-protected laptop and backed up in encrypted cloud storage.
- After study completion, all identifiable data will be destroyed; only de-identified datasets will be retained for analysis and publication.

Data Analysis Procedure
Data will be analyzed using SPSS version 27.

- Descriptive statistics (mean, standard deviation, frequencies, percentages) was used to summarize demographic variables and PEDI scores.
- Fine motor function levels were categorized as independent, partially dependent, or dependent based on scaled scores.
- Data was presented using tables, bar charts, and pie charts to illustrate functional limitations across age, gender, and CP type.
- For correlation or comparison analyses (e.g., between fine motor limitation and caregiver characteristics), chi-square test was applied.
- Value <0.05 was considered statistically significant.

Ethical Considerations

- Ethical approval was obtained from the SIRMS Institutional Review Board (IRB) before initiating the study.
- Written informed consent was obtained from caregivers after a detailed explanation of study objectives, procedures, potential benefits, and rights to withdraw at any time without affecting the child's care.
- Participant privacy was respected throughout data handling and reporting. The study involves minimal risk and was adhere to the principles of the Declaration of Helsinki (2013).

Results

A total of 249 caregivers of children with cerebral palsy (CP) at Saidu Group of Teaching Hospital, Swat have been discovered. The results are divided into demographic characteristics, clinical profile, caregiver profile (all participants), parent-reported functional performance (PEDI), and associations between functional performer ship with selected variables.

Demographic Characteristics of Children and Caregivers

Age of Children and Caregivers

Table 1 presents the age distribution of the participants who were investigated. Children aged 1 to 12 years had the mean age 4.20 ± 2.26 years. The median age at diagnosis was 2.97 ± 1.74 years, and diagnoses were made between the ages of 1 and 7. Younger adult caregivers participated in the study, as did older adult care homes, with an average caregiver age of 41.39 ± 13.06 years, ranging from 20 to 64 years old. the mean PEDI score on a scale (0–100) was 49.65 ± 21.52, suggesting that the children had moderate functional limitations.

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
Patient age	249	1	12	4.20	2.258
Age at Diagnosis	249	1	7	2.97	1.742
Caregiver Age	249	20	64	41.39	13.058
PEDI Total Score	249	0	100	49.65	21.516
Valid N (listwise)	249				

Table 1 Descriptive Statistics

Gender Distribution

As per Table 2, out of 249 children, the majority were female, with 65.1% (n=164) being female, and 34.1% (n=85) and. It is suggested by this that roughly 66% of the participants were females.

Gender

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Male	85	34.1	34.1	34.1
	Female	164	65.9	65.9	100.0
	Total	249	100.0	100.0	

Table 2 Gender Distribution of the participants

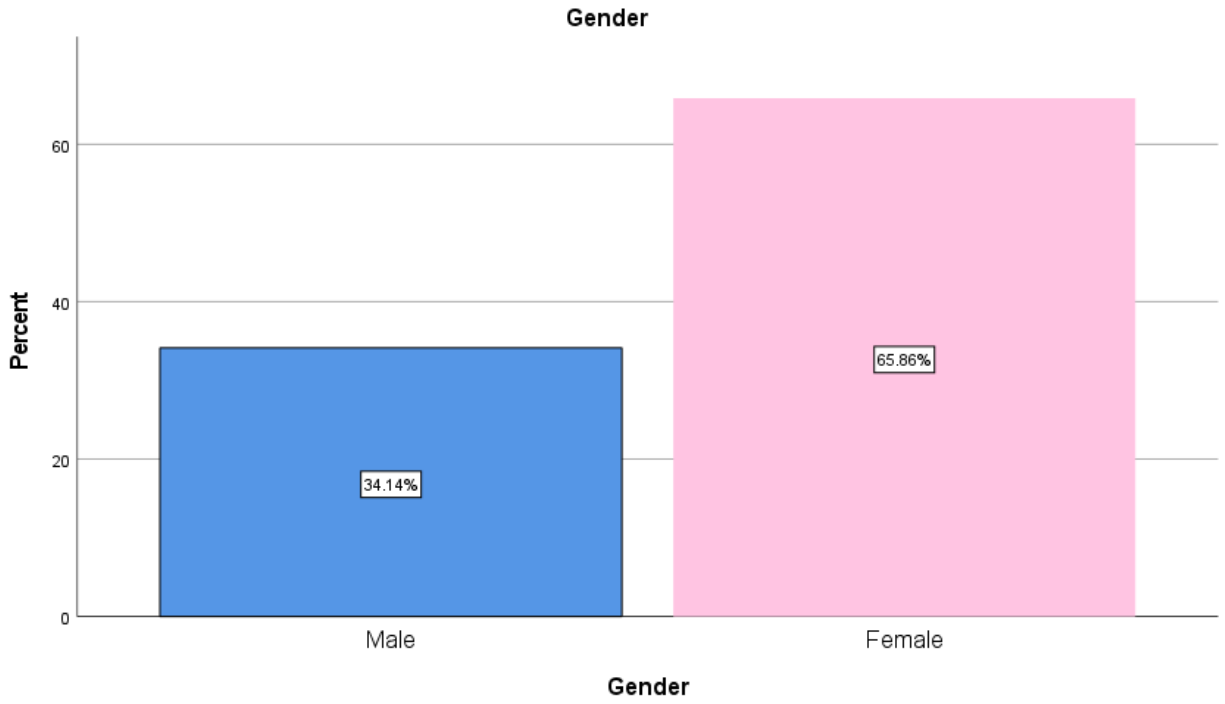

Figure 3 Gender Distribution of the participants

School Attendance

School attendance status is shown in Table 4.5. At the time of the study, only 69 children (27.7%) were attending school. One-third of the 180 children (72.3%) were not attending school, highlighting a significant educational access gap among those with CP.

School Attendees

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	69	27.7	27.7	27.7
	No	180	72.3	72.3	100.0
	Total	249	100.0	100.0	

Table 3 School Attendees

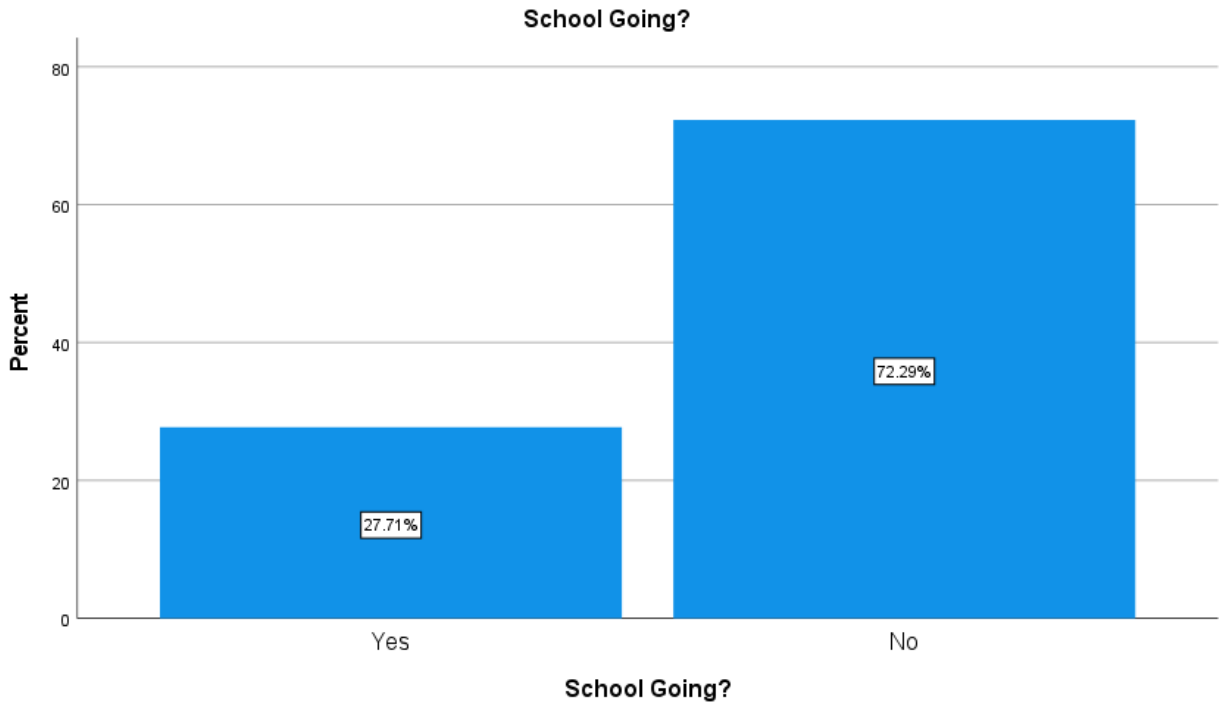

Figure 4 School Attendees

Clinical Profile of Children with Cerebral Palsy

Distribution of Cerebral Palsy

CP's topography can be determined by reading Table 4. Diplegia was the most frequently diagnosed type in 110 children (44.2%). After quadriplegia, 79 (31.7%) of them were affected, while 120 (120) suffered from hemiplegia and 120 (12%) from triplegic. A significant proportion of cases involving bilateral involvement, such as diplegia and quadriplegia combined, were present.

CP Distribution

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Hemiplegic	30	12.0	12.0	12.0
	Diplegic	110	44.2	44.2	56.2
	Triplegic	30	12.0	12.0	68.3
	Quadriplegic	79	31.7	31.7	100.0
	Total	249	100.0	100.0	

Table 4 Distribution of Cerebral Palsy

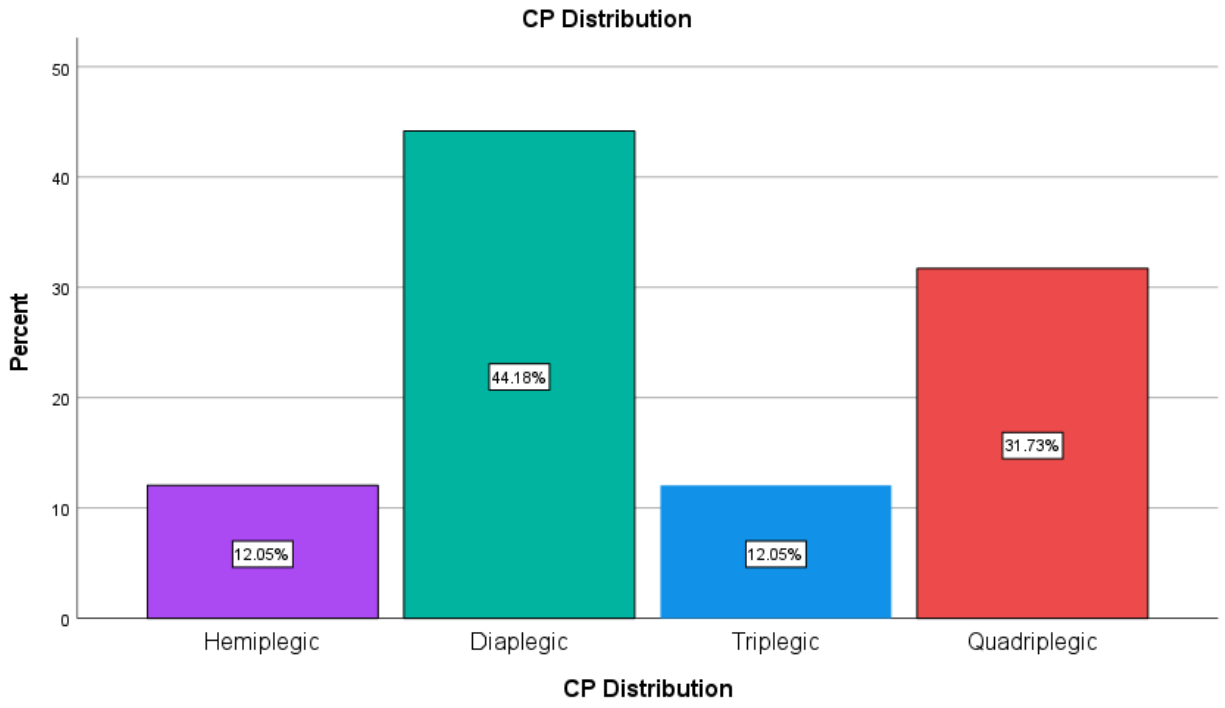

Figure 5 School Attendees

Age at Diagnosis

The age at diagnosis is categorized according to the table 5, Most children were diagnosed from age 1 (24.9 %) and up to 21.4 % at age 4 (11.7 per 100). The diagnosis rate was only in the range of 5-7 years.

Age at Diagnosis

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	62	24.9	24.9	24.9
	2	57	22.9	22.9	47.8
	3	37	14.9	14.9	62.7
	4	54	21.7	21.7	84.3
	5	11	4.4	4.4	88.8
	6	14	5.6	5.6	94.4
	7	14	5.6	5.6	100.0
	Total	249	100.0	100.0	

Table 5 Age at Diagnosis

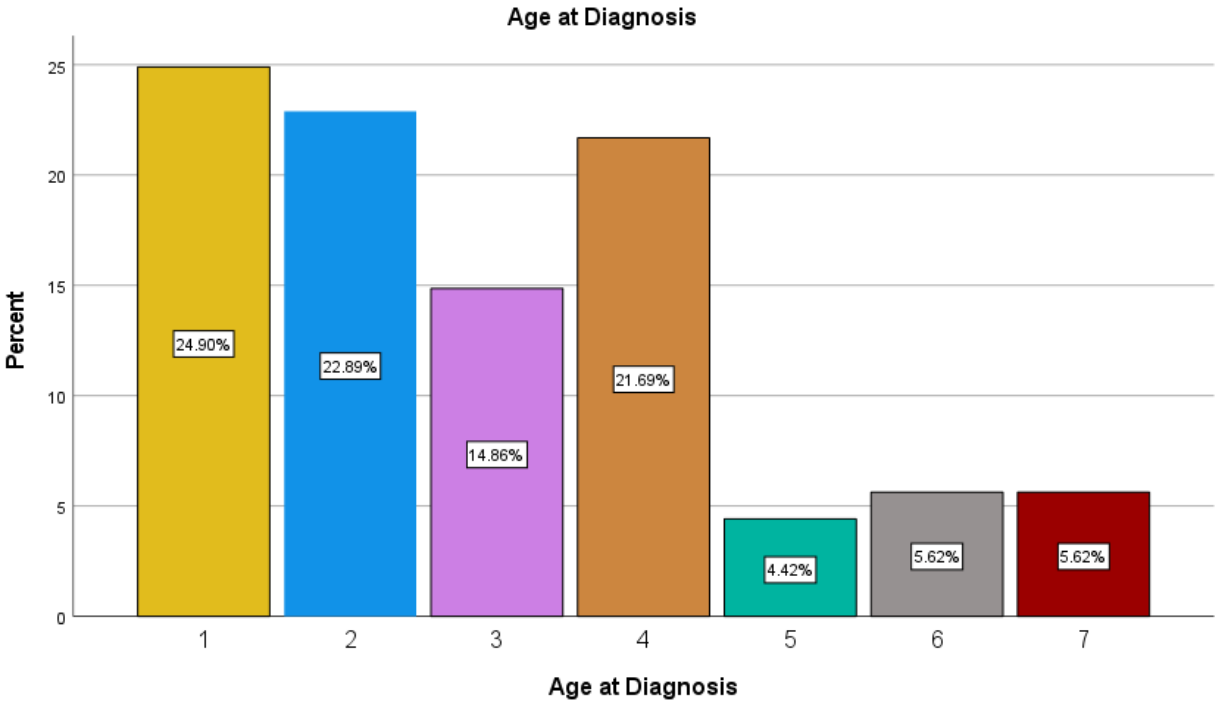

Figure 6 Age at Diagnosis

Comorbidities

Table 6 summarizes the causes of comorbidity. 71.1% of 177 children had some form of intellectual impairment, the most common comorbidity. Other disorders included hearing loss (12.9%), visual impairment (11.2%), and epilepsy (4.8%).

Comorbidities

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Epilepsy	12	4.8	4.8	4.8
	Visual Impairment	28	11.2	11.2	16.1
	Hearing Impairment	32	12.9	12.9	28.9
	Intellectual Impairment	177	71.1	71.1	100.0
	Total	249	100.0	100.0	

Table 6 Other Associated Comorbidities of the Patients

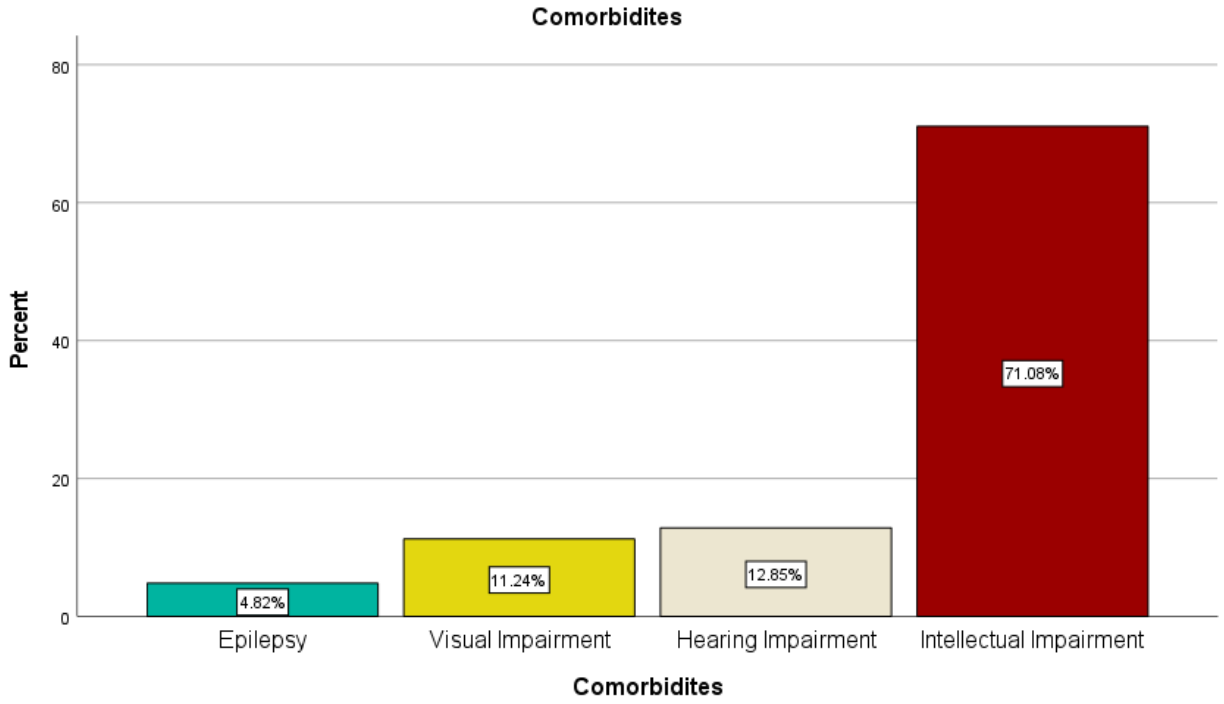

Figure 7 Other Associated Comorbidities of the Patients

Current Treatment Status

The majority of treatment (41.8%) was through physiotherapy, as shown in Table 4.9. In proportions that were smaller, occupational therapy (6.4%) was followed by speech therapy (6.4%), and medical treatment (4.8%).

Current ongoing treatment

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Physiotherapy	104	41.8	41.8	41.8
	Occupational Therapy	16	6.4	6.4	48.2
	Medical Treatment	12	4.8	4.8	53.0
	Speech Therapy	16	6.4	6.4	59.4
	None	101	40.6	40.6	100.0
	Total	249	100.0	100.0	

Table 7 Current on-going treatment of the cerebral palsy patient

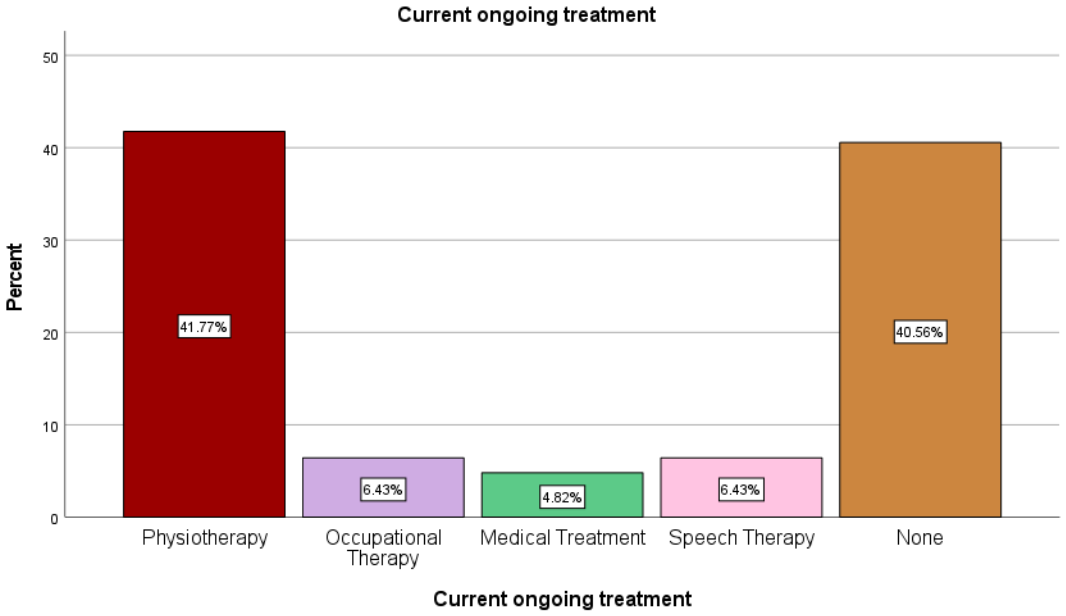

Figure 8 Current on-going treatment of the cerebral palsy patient

Use of Assistive Devices for Hand Function

The use of assist devices is documented in Table 8. Hand-function assistive devices were not used by 88.0% of the children, while only 30% (120) did.

Assistive devices used for hand function

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	30	12.0	12.0	12.0
	No	219	88.0	88.0	100.0
	Total	249	100.0	100.0	

Table 8 Assistive Devices used for Hand Functioning

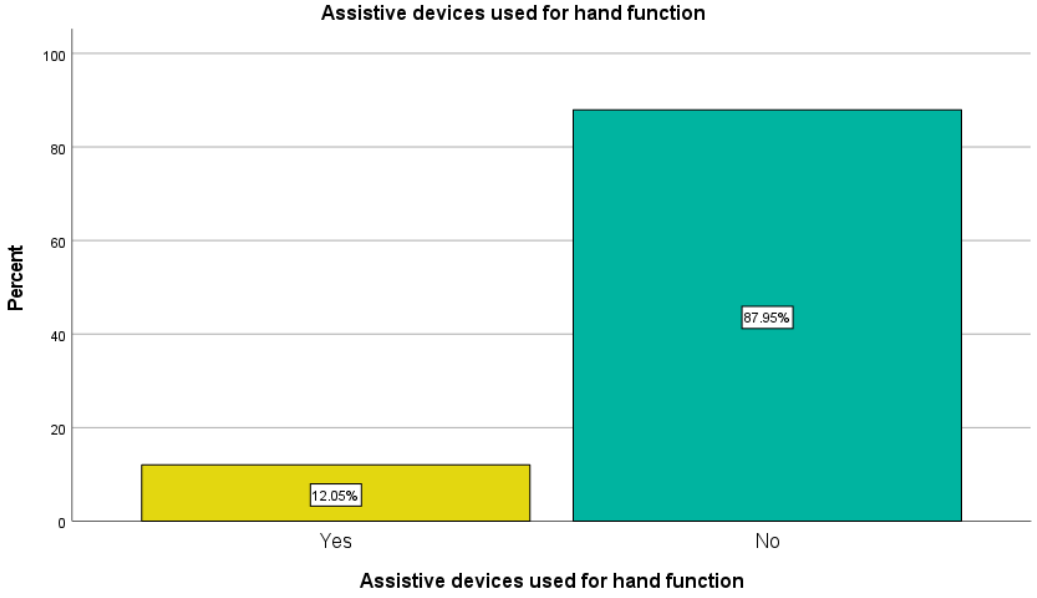

Figure 9 Assistive Devices used for Hand Functioning

Type of Cerebral Palsy

CP types are distributed as shown in Table 9. The top four types of CP in our population were mixed type cp (32.9%), ataxic (26.9%), flaccid (21.7%) and spastic (18.5%).

CP Type

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Spastic	46	18.5	18.5	18.5
	Flaccid	54	21.7	21.7	40.2
	Ataxic	67	26.9	26.9	67.1
	Mixed	82	32.9	32.9	100.0
	Total	249	100.0	100.0	

Table 9 Type of cerebral palsy of the patient

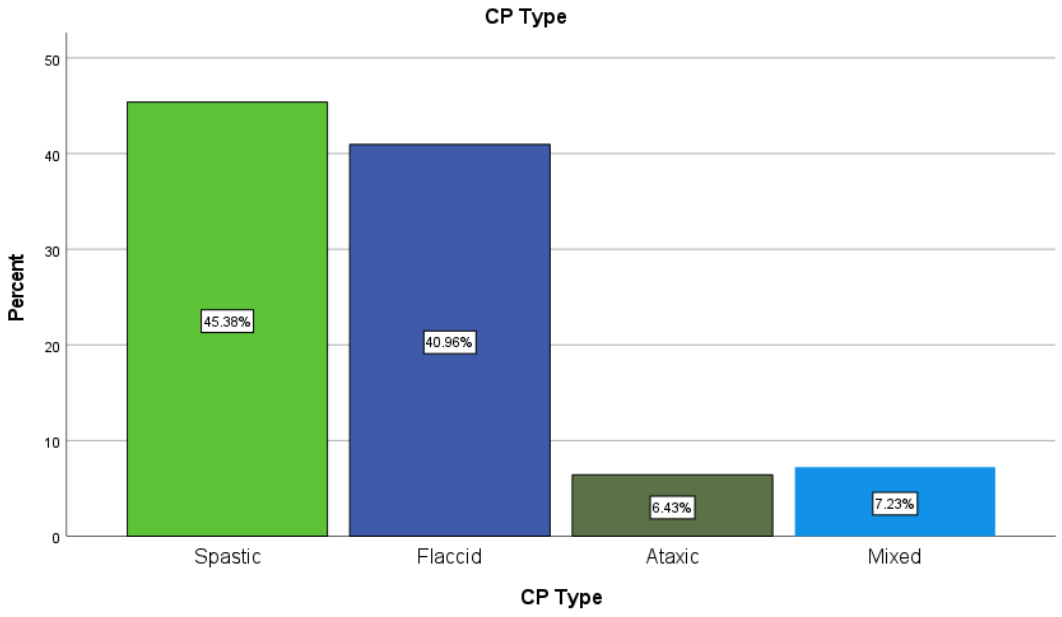

Figure 10 Type of cerebral palsy of the patient

Caregiver Characteristics

Relationship to the Child

In Table 10, the relationship between primary caregiver and child is outlined. Mothers were responsible for 37.3% of cases, while siblings (26.9%), grandparents (13.3%), and fathers (8.0%) accounted for the remaining percentage or roles. Other relatives accounted for 14.5%. The results show that extended families tend to share caregiving responsibilities.

Primary Caregiver Relationship

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Father	20	8.0	8.0	8.0
	Mother	93	37.3	37.3	45.4
	Grandparents	33	13.3	13.3	58.6
	Siblings	67	26.9	26.9	85.5
	Other	36	14.5	14.5	100.0
	Total	249	100.0	100.0	

Table 10 Primary Caregiver Relationship to the patient

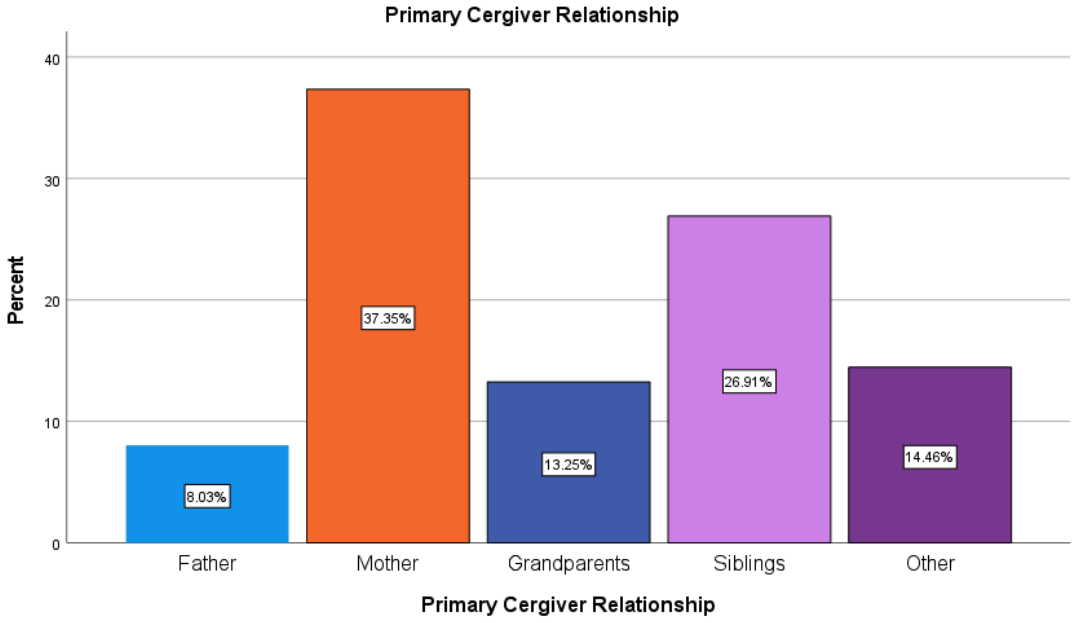

Figure 11 Primary Caregiver Relationship to the patient

Caregiver Age Distribution

The frequency of caregiver age in Table 4.13 is presented. The range of the population falls between 20 and 64 years, matching the average age as previously mentioned, which is 41 years.

Caregiver Age

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	20	6	2.4	2.4	2.4
	21	5	2.0	2.0	4.4
	22	3	1.2	1.2	5.6
	23	9	3.6	3.6	9.2
	24	4	1.6	1.6	10.8
	25	5	2.0	2.0	12.9
	26	7	2.8	2.8	15.7
	27	9	3.6	3.6	19.3
	28	7	2.8	2.8	22.1
	29	7	2.8	2.8	24.9
	30	7	2.8	2.8	27.7
	31	3	1.2	1.2	28.9
	32	8	3.2	3.2	32.1
	33	4	1.6	1.6	33.7
	34	8	3.2	3.2	36.9
	35	5	2.0	2.0	39.0
	36	2	.8	.8	39.8
	37	5	2.0	2.0	41.8
	38	8	3.2	3.2	45.0
	39	1	.4	.4	45.4
	40	9	3.6	3.6	49.0
	41	5	2.0	2.0	51.0
	42	3	1.2	1.2	52.2

	43	5	2.0	2.0	54.2
	44	9	3.6	3.6	57.8
	45	10	4.0	4.0	61.8
	46	3	1.2	1.2	63.1
	47	5	2.0	2.0	65.1
	48	4	1.6	1.6	66.7
	49	3	1.2	1.2	67.9
	50	4	1.6	1.6	69.5
	51	4	1.6	1.6	71.1
	52	7	2.8	2.8	73.9
	53	6	2.4	2.4	76.3
	54	6	2.4	2.4	78.7
	55	8	3.2	3.2	81.9
	56	4	1.6	1.6	83.5
	57	5	2.0	2.0	85.5
	58	5	2.0	2.0	87.6
	59	2	.8	.8	88.4
	60	6	2.4	2.4	90.8
	61	8	3.2	3.2	94.0
	62	4	1.6	1.6	95.6
	63	6	2.4	2.4	98.0
	64	5	2.0	2.0	100.0
	Total	249	100.0	100.0	

Table 11 Age of the caregiver

Caregiver Occupation

Figure 12 displays the breakdown of occupational categories. Housewives made up the majority of 65.9%. The remaining professions were laborers (11.6%), business workers (8.4%), health workers (5.6%), farmers (4.8%), and teachers (3.6%).

Caregiver Occupation

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Business	21	8.4	8.4	8.4
	Farmer	12	4.8	4.8	13.3
	Health worker	14	5.6	5.6	18.9
	Housewife	164	65.9	65.9	84.7
	Laborer	29	11.6	11.6	96.4
	Teacher	9	3.6	3.6	100.0
	Total	249	100.0	100.0	

Table 12 Occupation of the caregiver

Parent-Reported Functional Performance (PEDI Items) Result

Feeding Performance

In Table 13, it was found that 85 out of 354.1 children were unable to feed on their own, while 38.2% needed help and 27.7% required assistance alone. Thus, feeding tasks were restricted in more than 70%.

Feeding

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Unable to perform	85	34.1	34.1	34.1
	Perform with difficulty or assistance	95	38.2	38.2	72.3
	Performs Independently	69	27.7	27.7	100.0
	Total	249	100.0	100.0	

Table 13 Feeding performance of the patient

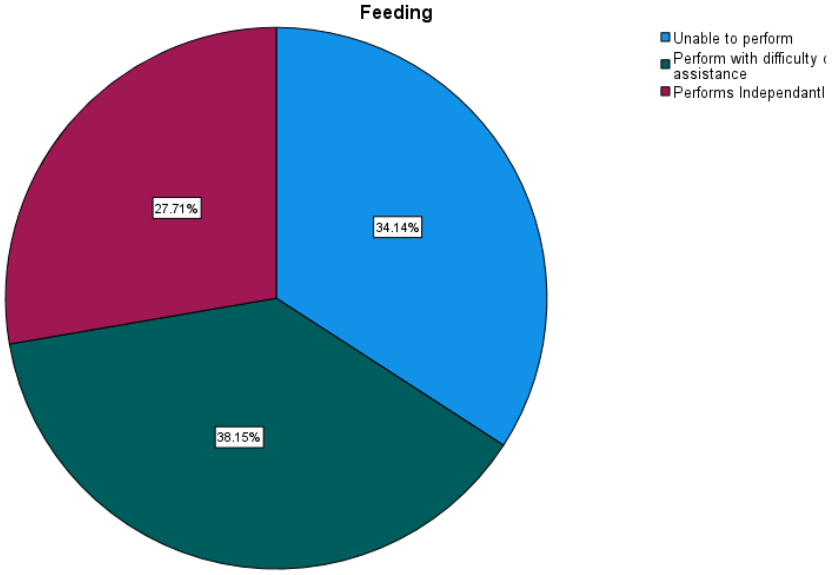

Figure 12 Age of the caregiver

Dressing Performance

According to Table 14, 74 individuals (29.7%) were not capable of dressing themselves, 80 (32.1%) needed help, and 95 (38.2%) had no one to depend on for clothing.

Dressing

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Unable to perform	74	29.7	29.7	29.7
	Perform with difficulty or assistance	80	32.1	32.1	61.8
	Performs Independently	95	38.2	38.2	100.0
	Total	249	100.0	100.0	

Table 14 Dressing performance of the patient

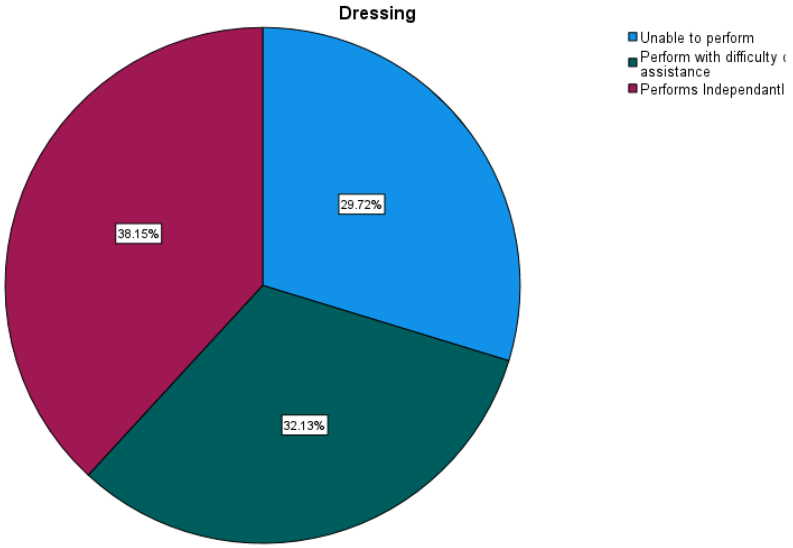

Figure 13 Dressing performance of the patient

Grooming Performance

As per Table 15, 99 children (39.8%) were not able to perform grooming tasks, while 28.5 percent needed help and 31.7% were self-sufficient. The self-care component of grooming was the most incompetent.

Grooming

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Unable to perform	99	39.8	39.8	39.8
	Perform with difficulty or assistance	71	28.5	28.5	68.3
	Performs Independently	79	31.7	31.7	100.0
	Total	249	100.0	100.0	

Table 15 Grooming performance of the patient

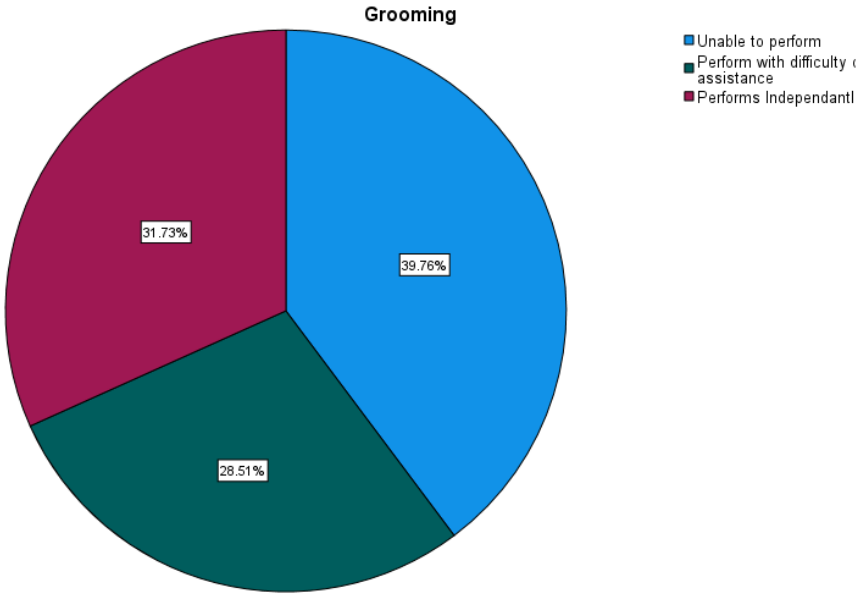

Figure 14 Grooming performance of the patient

Toileting Performance

As per Table 16, 33.3% of the children could not use their bathroom on their own; 30.1% needed help, and 91.5% were self-sufficient while 33.3% required assistance.

Toileting

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Unable to perform	83	33.3	33.3	33.3
	Perform with difficulty or assistance	75	30.1	30.1	63.5
	Performs Independently	91	36.5	36.5	100.0
	Total	249	100.0	100.0	

Table 16 Toileting performance of the patient

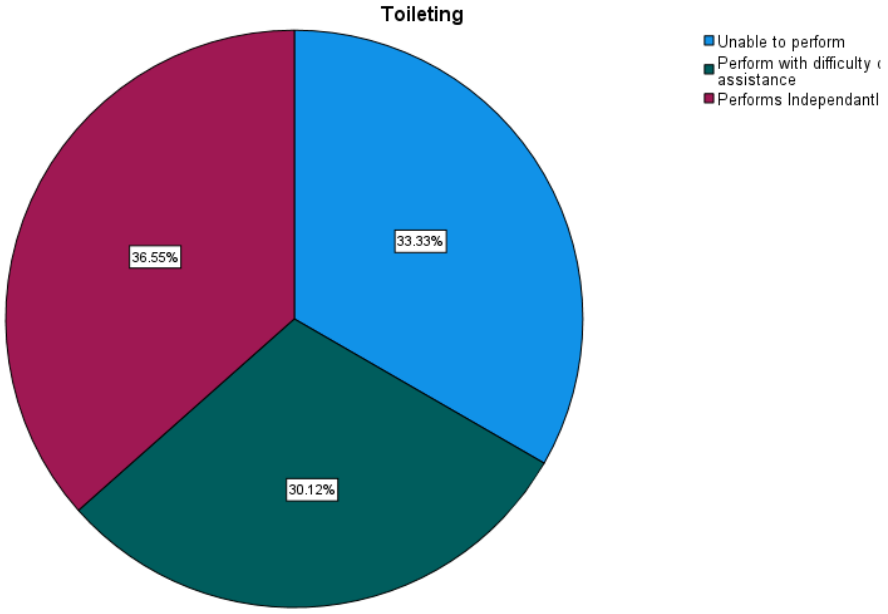

Figure 15 Toileting performance of the patient

Mobility Performance

All the children performance was assessed in four areas: crawling, walking, climbing, and transfers. The results reflect a reasonably even distribution across the three categories, indicating a fair amount of gross motor skill difference.

Crawling, in particular, had the highest rates of inactivity, with 37.8% of the children being completely unable to crawl, and 31.3% crawling only with assistance or very limited. Likely, around 30.9% of the sample managed to crawl independently (Table 17).

Crawling

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Unable to perform	94	37.8	37.8	37.8
	Perform with difficulty or assistance	78	31.3	31.3	69.1
	Performs Independently	77	30.9	30.9	100.0
	Total	249	100.0	100.0	

Table 17 Crawling performance of the patient

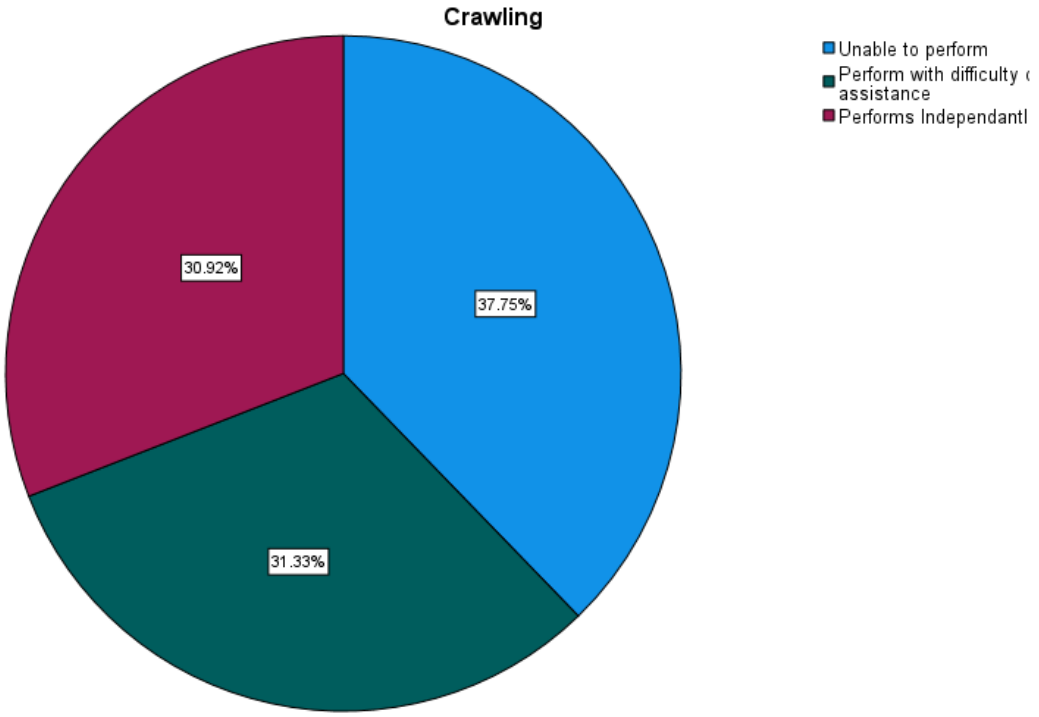

Figure 16 Crawling performance of the patient

With respect to walking, a similar pattern was seen whereby 34.1% of the children could not walk, 32.9% needed assistance or had difficulty with walking, and the same 32.9% were able to walk independently.

Walking

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Unable to perform	85	34.1	34.1	34.1
	Perform with difficulty or assistance	82	32.9	32.9	67.1
	Performs Independently	82	32.9	32.9	100.0
	Total	249	100.0	100.0	

Table 18 Walking performance of the patient

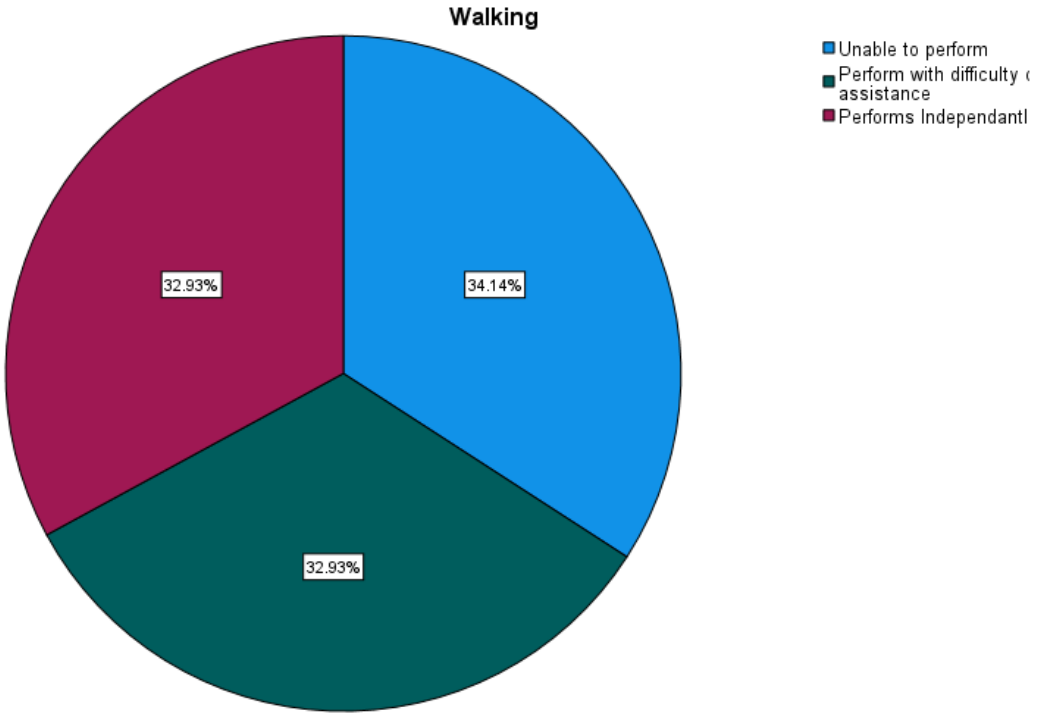

Figure 17 Walking performance of the patient

The general pattern was the same in performance of climbing activities, like stairs or higher surfaces. Over a third (35.3%) was unable to climb at all and 30.9% needed support. Only 33.7 %were able to climb on their own.

Climbing

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Unable to perform	88	35.3	35.3	35.3
	Perform with difficulty or assistance	77	30.9	30.9	66.3
	Performs Independently	84	33.7	33.7	100.0
	Total	249	100.0	100.0	

Table 19 Climbing performance of the patient

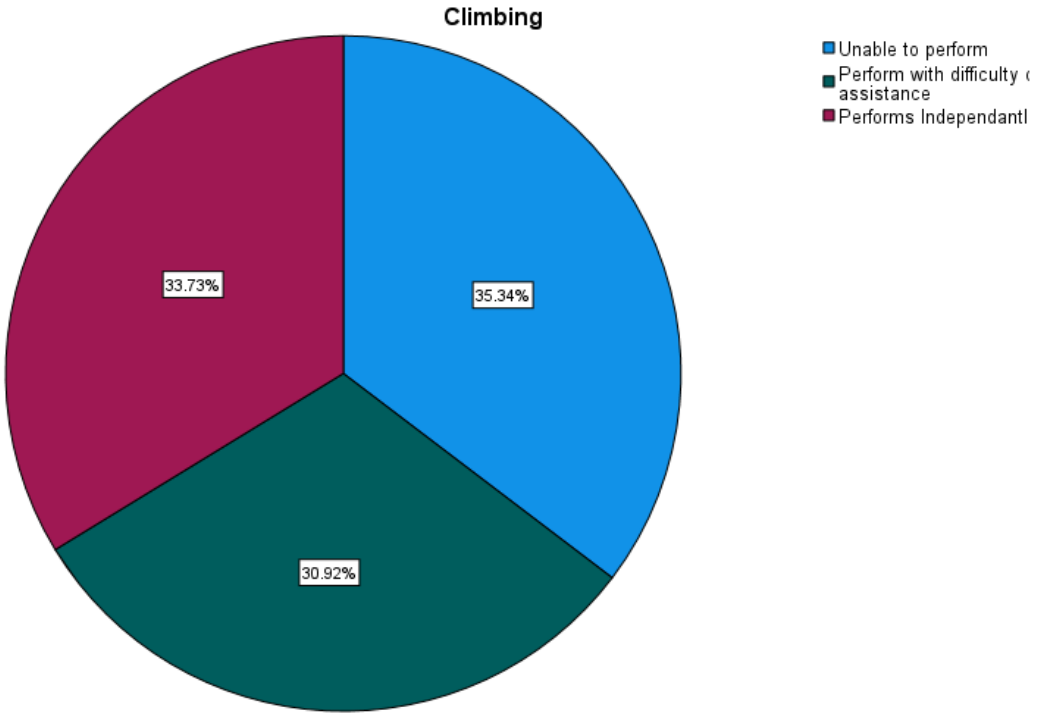

Figure 18 Climbing performance of the patient

Transfer activities, such as movement between position or surface, also had almost the same proportions in categories: 35.3% could not, 32.5% had to be assisted, and 32.1% did the transfers independently.

Transfers

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Unable to perform	88	35.3	35.3	35.3
	Perform with difficulty or assistance	81	32.5	32.5	67.9
	Performs Independently	80	32.1	32.1	100.0
	Total	249	100.0	100.0	

Table 20 Transfer performance of the patient

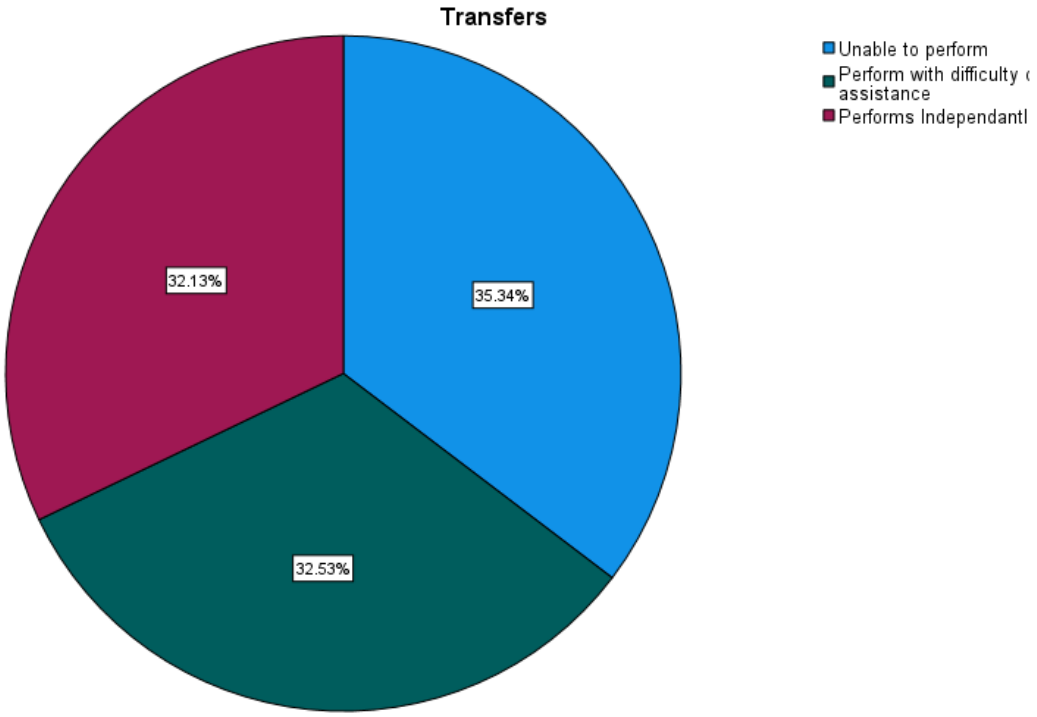

Figure 19 Transfer performance of the patient

Social Function

The same trend of variability was observed in social functional performance, which was composed of communication, play, problem solving, and social interaction. The findings in all the four domains indicate that children in the sample had a wide variety on social and adaptive functioning, with almost equal numbers of children fitting every of the three functional categories.

The children in communication were almost equally divided with 33.3% having no ability to communicate, 34.1% having difficulty or need of assistance, and 32.5% having ability to communicate on their own.

Communication

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Unable to perform	83	33.3	33.3	33.3
	Perform with difficulty or assistance	85	34.1	34.1	67.5
	Performs Independently	81	32.5	32.5	100.0
	Total	249	100.0	100.0	

Table 21 Communication performance of the patient

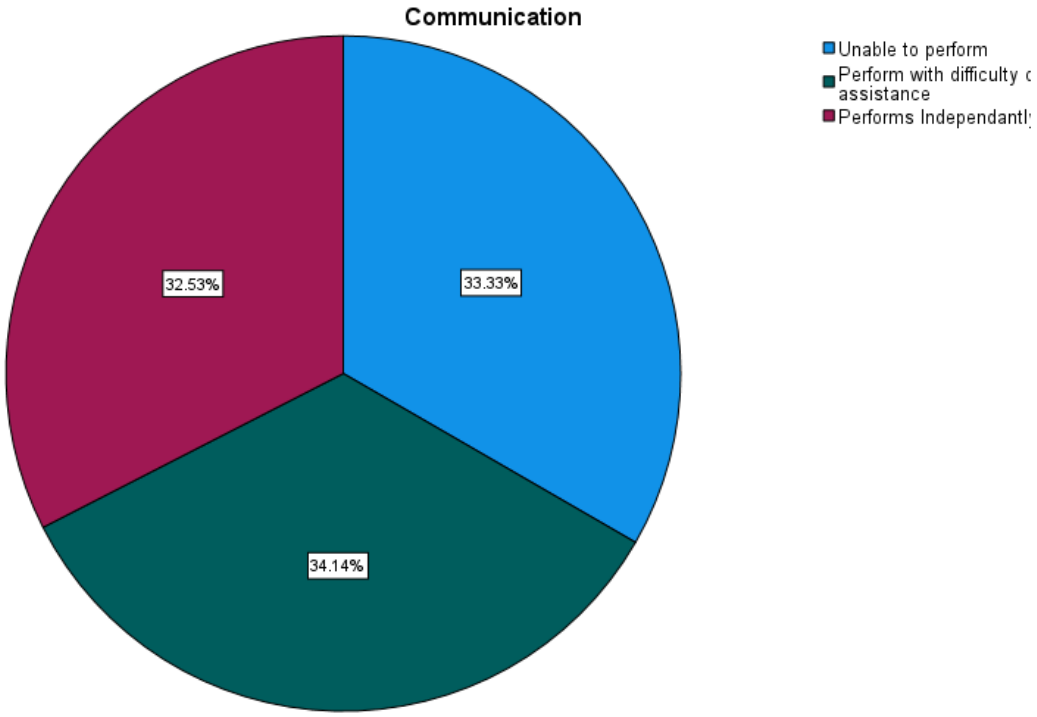

Figure 20 Communication performance of the patient

The trend was similar in the activities practiced during play, with 27.7 not being able to have any play, 34.1 needed assistance, and 38.2 could play without any assistance.

Play

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Unable to perform	69	27.7	27.7	27.7
	Perform with difficulty or assistance	85	34.1	34.1	61.8
	Performs Independently	95	38.2	38.2	100.0
	Total	249	100.0	100.0	

Table 22 Playing performance of the patient

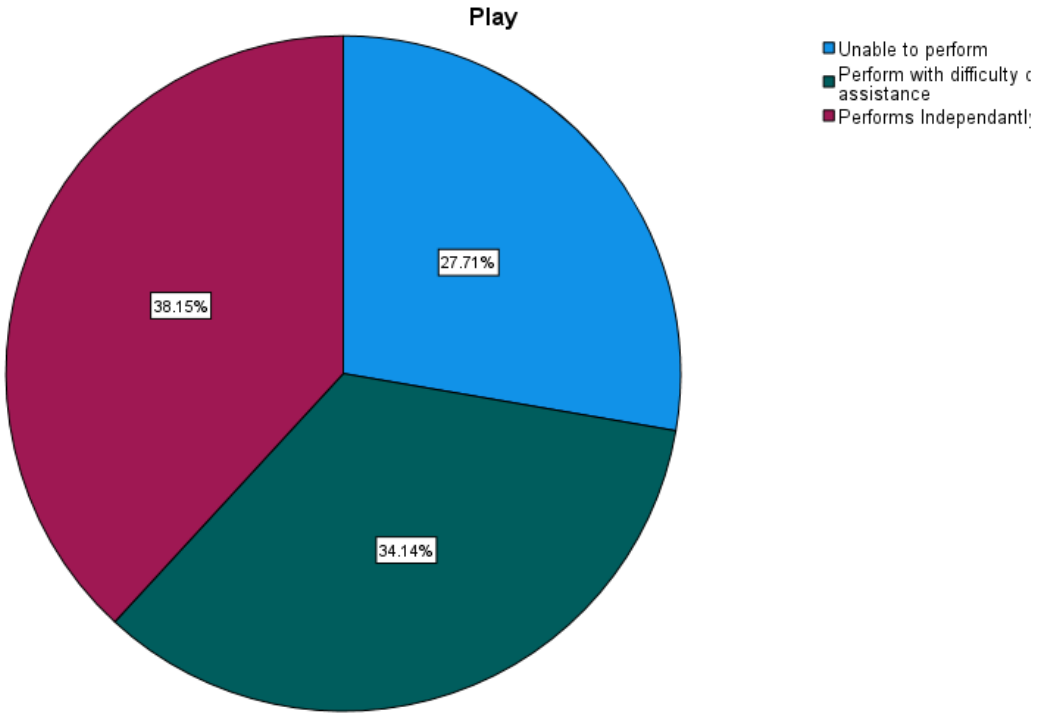

Figure 21 Playing performance of the patient

In the case of problem-solving activity, 34.9% failed to carry out problem-solving activity, 30.5% needed to be helped and 34.5% could solve simple problems on their own.

Problem Solving

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Unable to perform	87	34.9	34.9	34.9
	Perform with difficulty or assistance	76	30.5	30.5	65.5
	Performs Independently	86	34.5	34.5	100.0
	Total	249	100.0	100.0	

Table 23 Performance in Problem Solving of the patient

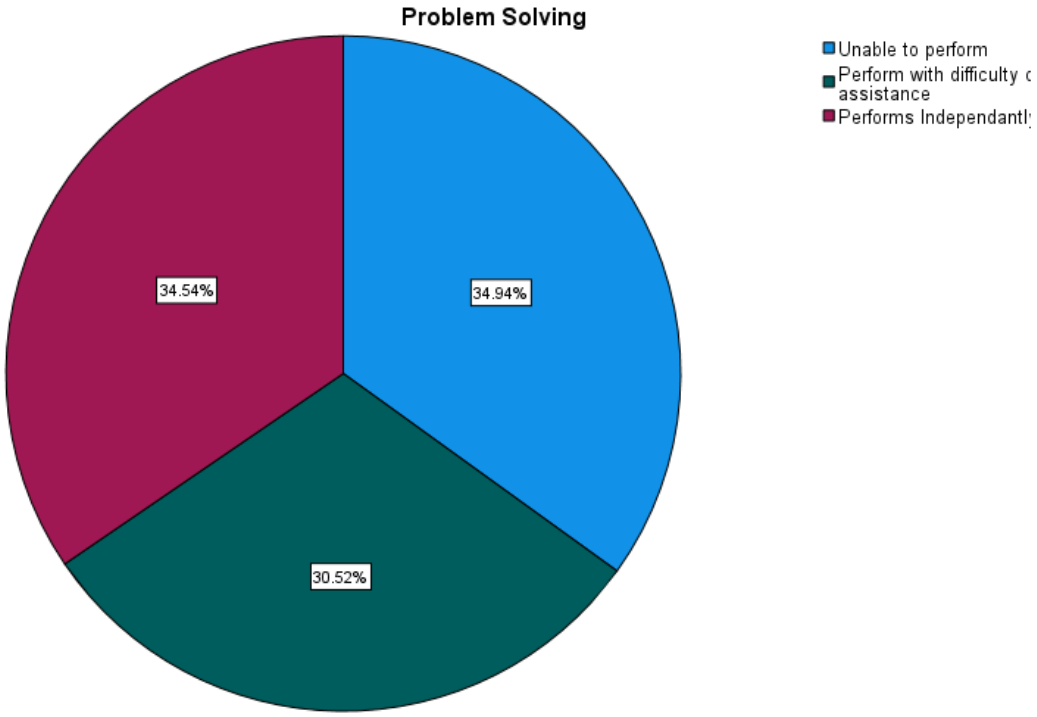

Figure 22 Performance in Problem Solving of the patient

Similarly, social interaction skills demonstrated an almost perfect balance, with 32.9% incapable, 33.3% requiring support, and 33.7% autonomous.

Social Interaction

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Unable to perform	82	32.9	32.9	32.9
	Perform with difficulty or assistance	83	33.3	33.3	66.3
	Performs Independently	84	33.7	33.7	100.0
	Total	249	100.0	100.0	

Table 24 Social Interaction performance of the patient

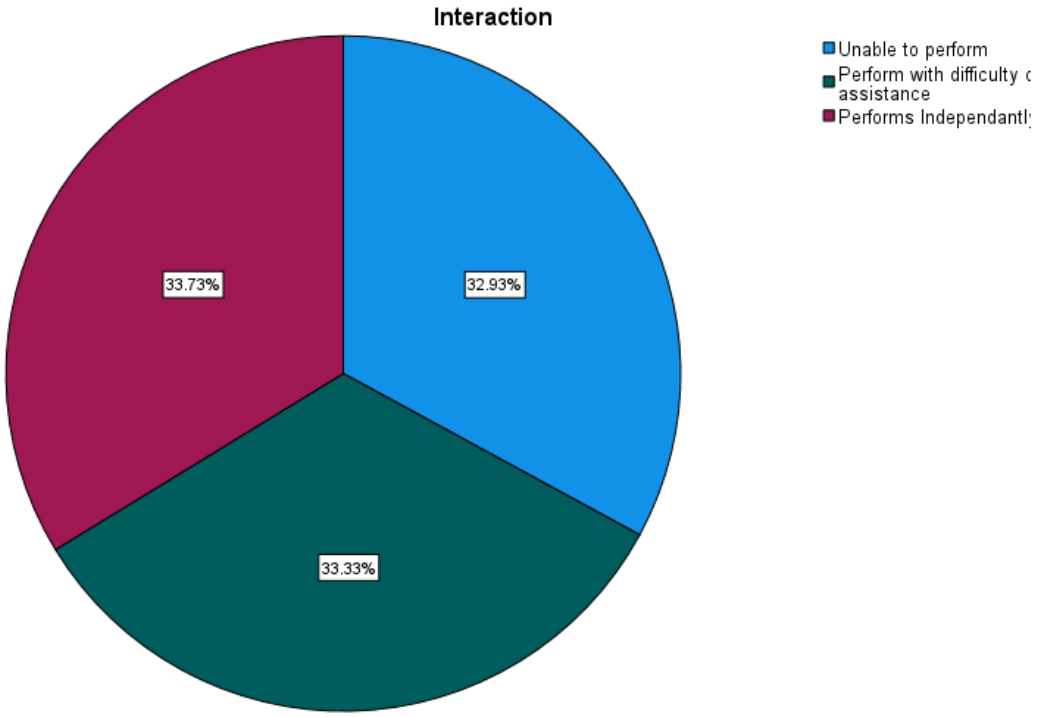

Figure 23 Social Interaction performance of the patient

Chi-Square Associations Between PEDI Functional Levels and Clinical Variables

Association of functionality with CP Type

The association between the specific type of cerebral palsy and overall functional performance on the PEDI was valuated using a chi-square test. The results showed not a statistically significant connection between CP type and functional level, χ^2 (24) = 12.111, p = 0.97. This implies that, within this sample, children's functional skills did not rely on whether or not their CP was spastic, ataxic, flaccid, or mixed.

Crosstab

Count

		CP Type Spastic	Flaccid	Ataxic	Mixed	Total
PEDI Total Score	0	2	1	0	1	4
	13	8	5	2	1	16
	25	10	11	7	2	30
	38	16	13	10	8	47
	50	27	12	9	11	59
	63	15	15	8	7	45
	75	11	8	4	6	29
	88	6	3	3	3	15
	100	2	1	1	0	4
Total		97	69	44	39	249

Table 25 Association of functionality with CP Type

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	12.111[a]	24	.979
Likelihood Ratio	13.986	24	.947
Linear-by-Linear Association	.591	1	.442

N of Valid Cases	249			

a. 16 cells (44.4%) have expected count less than 5. The minimum expected count is .63.

Table 26 Chi-square association of functionality with CP Type

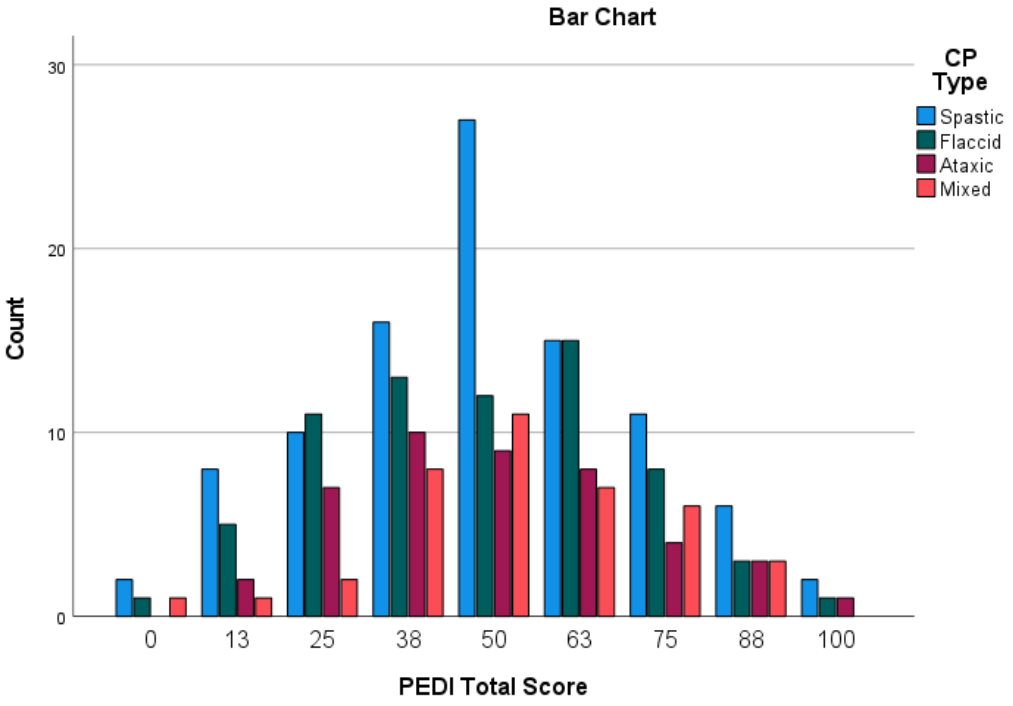

Figure 24 Association of functionality with CP Type

Association of functionality with CP Distribution

Similarly, there was no significant relationship between CP distribution (hemiplegia, diplegia, triplegia, or quadriplegia) and PEDI functional scores. The chi-square test yielded χ^2 (24) = 24.161, p = 0.452, indicating that the pattern of limb involvement did not substantially affect functional independence.

Crosstab

Count

		CP Distribution				
		Hemiplegic	Diplegic	Triplegic	Quadriplegic	Total
PEDI Total Score	0	0	4	0	0	4
	13	3	8	1	4	16
	25	5	16	3	6	30
	38	5	24	7	11	47
	50	4	24	6	25	59
	63	6	14	9	16	45
	75	4	10	3	12	29
	88	3	8	1	3	15
	100	0	2	0	2	4
Total		30	110	30	79	249

Table 27 Association of functionality with CP Distribution

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	24.161[a]	24	.452
Likelihood Ratio	26.598	24	.324
Linear-by-Linear Association	3.239	1	.072
N of Valid Cases	249		

a. 17 cells (47.2%) have expected count less than 5. The minimum expected count is .48.

Table 28 Chi-Square association of functionality with CP Distribution

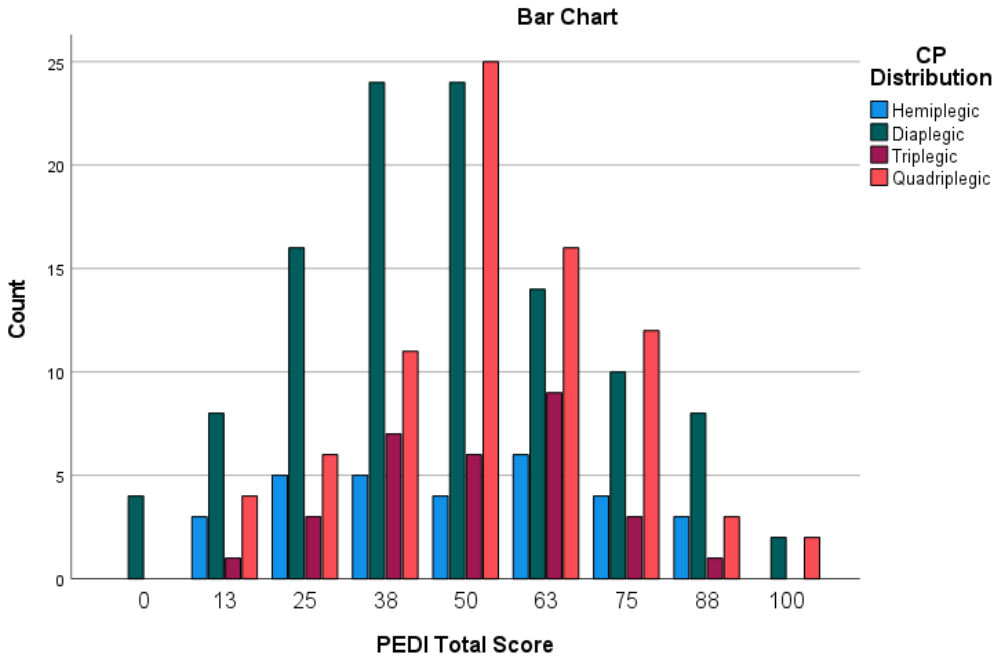

Figure 25 Association of functionality with CP Distribution

2.1.1. Association of functionality with Age at Diagnosis

When functional ratings were compared to age at diagnosis, there was no significant correlation (χ^2 (48) = 50.976, p = 0.357). This implies that children diagnosed sooner did not always have higher or poorer functional abilities than those diagnosed later.

Crosstab

Count

		Age at Diagnosis							
		1	2	3	4	5	6	7	Total
PEDI Score Total	0	2	0	1	1	0	0	0	4
	13	2	7	3	4	0	0	0	16
	25	6	7	3	5	4	1	4	30
	38	13	10	4	12	3	2	3	47
	50	12	12	11	17	3	3	1	59
	63	9	10	9	9	1	4	3	45
	75	11	9	2	3	0	3	1	29
	88	7	2	3	2	0	0	1	15

100	0	0	1	1	0	1	1	4
Total	62	57	37	54	11	14	14	249

Table 29 Association of functionality with Age at Diagnosis

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	50.976[a]	48	.357
Likelihood Ratio	54.347	48	.246
Linear-by-Linear Association	.090	1	.764
N of Valid Cases	249		

a. 45 cells (71.4%) have expected count less than 5. The minimum expected count is .18.

Table 30 Chi-square association of functionality with Age at Diagnosis

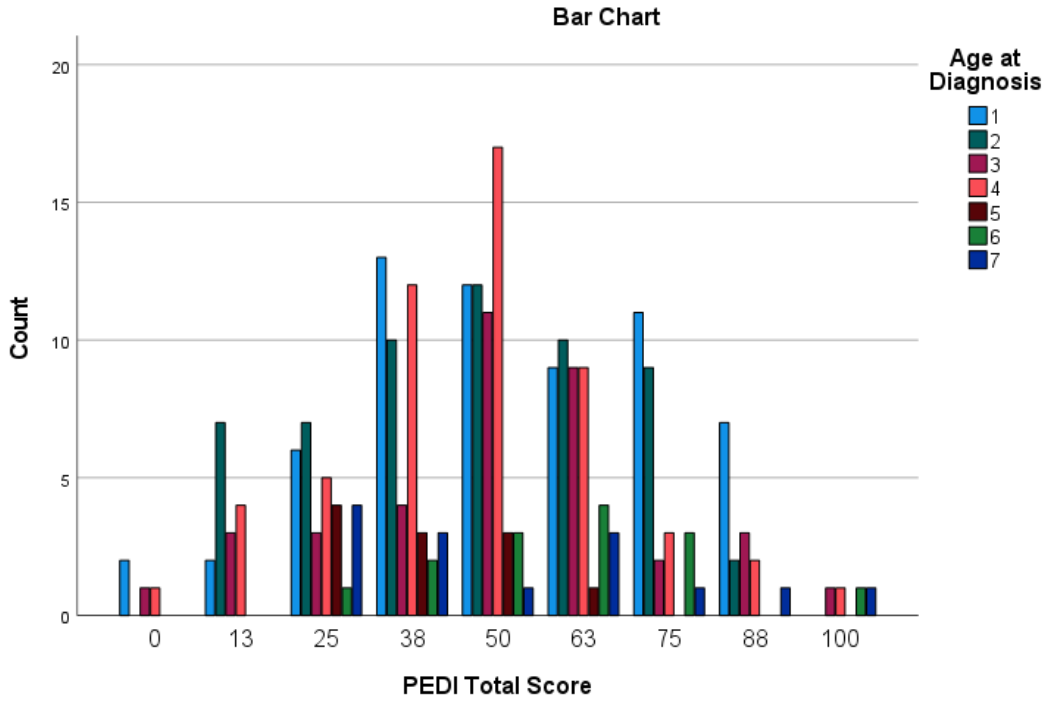

Figure 26 Association of functionality with Age at Diagnosis

2.1.2. Association of functionality with associated comorbidities

The study of comorbidities revealed no statistically significant connection with PEDI total scores (χ^2 (24) = 27.424, p = 0.285).

Crosstab

Count

		Comorbidities				
		Epilepsy	Visual Impairment	Hearing Impairment	Intellectual Impairment	Total
PEDI Total Score	0	0	0	0	4	4
	13	0	2	0	14	16
	25	1	1	3	25	30
	38	1	5	6	35	47
	50	5	5	7	42	59

	63	3	7	5	30	45
	75	0	4	7	18	29
	88	2	2	3	8	15
	100	0	2	1	1	4
Total		12	28	32	177	249

Table 31 Association of functionality with associated comorbidities

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	27.424[a]	24	.285
Likelihood Ratio	29.828	24	.191
Linear-by-Linear Association	9.580	1	.002
N of Valid Cases	249		

a. 23 cells (63.9%) have expected count less than 5. The minimum expected count is .19.

Table 32 Chi-square association of functionality with associated comorbidities

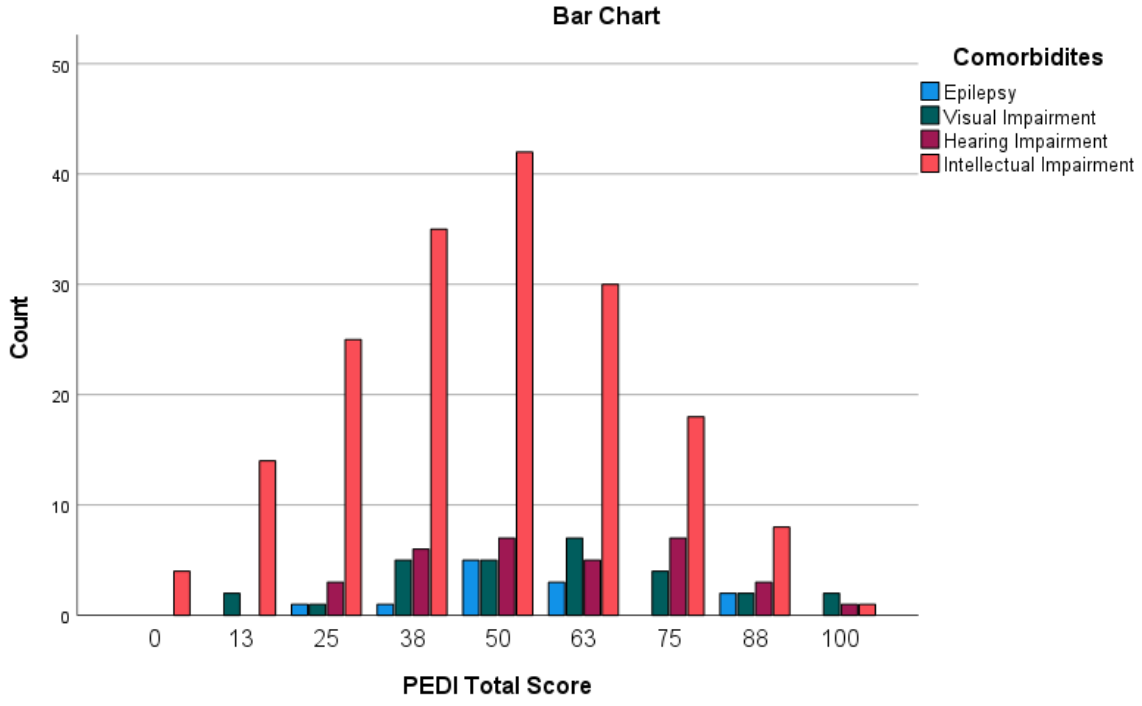

Figure 27 Association of functionality with associated comorbidities

2.1.3. Association of functionality current treatment status

The study found no significant correlation between the present treatment (including physiotherapy, occupational therapy, speech therapy, medical treatment, or none) and functional performance (χ^2 (32) = 23.797, p = 0.852). This implies that getting a specific therapy at the time of evaluation did not substantially affect total functional independence in this cross-sectional picture.

Crosstab

Count

		Current ongoing treatment					
		Physiotherapy	Occupational Therapy	Medical Treatment	Speech Therapy	None	Total
PEDI Score Total	0	3	0	0	0	1	4
	13	6	1	2	0	7	16
	25	10	3	1	1	15	30
	38	20	1	1	4	21	47
	50	28	5	1	3	22	59
	63	22	3	3	4	13	45
	75	10	2	2	2	13	29
	88	4	1	1	1	8	15
	100	1	0	1	1	1	4
Total		104	16	12	16	101	249

Table 33 Association of functionality current treatment status

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	23.797[a]	32	.852
Likelihood Ratio	23.603	32	.858
Linear-by-Linear Association	.087	1	.768
N of Valid Cases	249		

a. 31 cells (68.9%) have expected count less than 5. The minimum expected count is .19.

Table 34 Chi-square association of functionality current treatment status

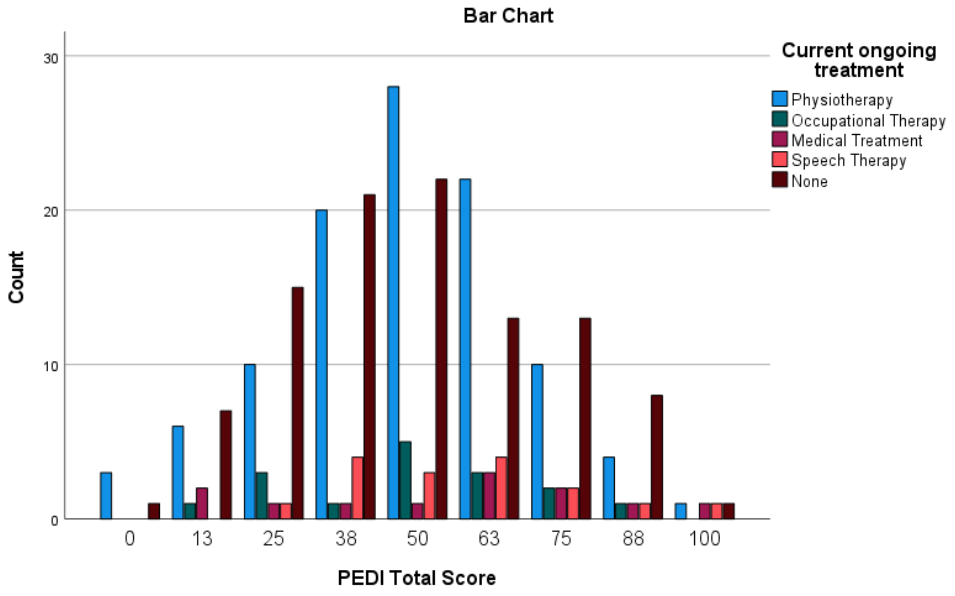

Figure 28 Association of functionality current treatment status

2.1.4. Association of functionality with the use of assistive devices for hand functioning

The usage of assistive devices for hand function did not substantially correlate with PEDI functional levels (χ^2 (8) = 7.792, p = 0.454). Thus, there was no significant difference in functional independence between children who utilized assistive devices and those who did not.

Crosstab

Count

		Assistive devices used for hand function		
		Yes	No	Total
PEDI Total Score	0	0	4	4
	13	1	15	16
	25	3	27	30
	38	7	40	47
	50	7	52	59
	63	6	39	45
	75	2	27	29
	88	2	13	15
	100	2	2	4
Total		30	219	249

Table 35 Association of functionality with the use of assistive devices for hand functioning

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	7.792[a]	8	.454
Likelihood Ratio	6.460	8	.596
Linear-by-Linear Association	1.000	1	.317
N of Valid Cases	249		

a. 8 cells (44.4%) have expected count less than 5. The minimum expected count is .48.

Table 36 Chi-square association of functionality with the use of assistive devices for hand functioning

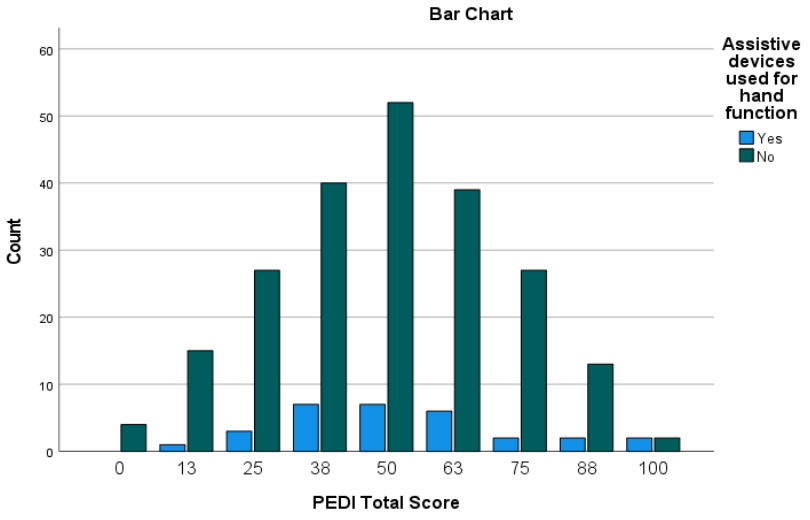

Figure 29 Association of functionality with the use of assistive devices for hand functioning

Discussion

Parent-reported variables through a Pediatric Evaluation of Disability Inventory (PEDI) of 249 children with cerebral palsy (CP) in Swat revealed significant functional impairments in self-care, mobility, and social aspects in this cross-sectional research study. The mean PEDI score was approximately 50/100 that reflected moderate general disability. Approximately one-third of children in all tasks (feeding, dressing, grooming, toileting, mobility, social functioning) became independent; the rest were either dependent or needed help.

This part interprets these findings through the existing literature, discusses similarities and differences, finds out the reasons (possibly), elaborates the implications and recommends directions in the future.

Fine Motor and Self-Care Limitations

It is documented that upper-limb and fine motor problems in CP are very prevalent. In a classic study of hand functioning in children with CP, close to 50% showed considerable arm-hand dysfunction with most being incapable of utilizing the paretic hand spontaneously in their daily routines(17). Similarly, a recent survey reported a wide heterogeneity in motor skill development in CP individuals: some improve to significant degree, whereas others still experience difficulties at adolescence and adulthood(32). Similar to previous research, a significant number of children demonstrated dependence or need for fine motor and self-care tasks such as feeding, dressing themselves, grooming, and toileting. Fine motor dysfunction is not a minor impairment that goes away quickly in CP; it is the main obstacle to independence and daily life. Furthermore, the reported lack of access to assistive devices among our sample is in line with international reports on inadequate accessibility of adaptive equipment in low- and middle-income communities(33). An amalgamation of functional limitations and a lack of assistive care maintain impairment and reliance.

The broad diversity in mobility and gross motor function shown in our study, ranging from non-ambulatory to independently walking children, mirrors the recognized variety of CP. The Annals of Rehabilitation Medicine study on Korean children (n = 112) indicated that gross motor function explained significant variance in daily functional skills: 49.7% for self-care, 67.4% for mobility, and 26.1% for social functioning(24). However, even in that cohort, not all children with strong gross motor capacity exhibited proportionate independence, indicating influencing variables beyond gross motor ability. Although many children with cerebral palsy preserved some mobility (walking, transfers, and climbing), a significant minority remained reliant or required help, even in actions that were technically within their gross motor skill range. This shows that mobility alone may not provide functional independence, maybe owing to poor fine motor control, balance/postural control, or cognitive/behavioral constraints. Indeed, investigations on postural control in CP children demonstrate considerable abnormalities in static and dynamic balance, which affects stability during functional activities(34). Thus, mobility restrictions may originate from deficiencies in coordination, balance, and upper-limb control, as well as gross motor dysfunction.

The study's findings indicate that there is no statistically significant connection between functional performance levels and traditional clinical variables, such as CP type, distribution, age at diagnosis, comorbidities, therapy status, and assistive device use. This is consistent with statements in the literature that clinical categorization (type of CP, limb distribution) poorly predicts real-world activity and engagement(24). For example, in unilateral (hemiplegic) CP, a recent scoping study found that although hand deficits are widespread, there is significant diversity in functional hand usage, and evaluations frequently depend on clinical scales rather than performance-based measures(35). Furthermore, even in children with equal gross motor function levels, manual ability (fine motor, hand function) emerges as a major predictor of self-care and daily living performance(36). 2023 research of spastic diplegic CP children found a substantial connection ($r = 0.752$, $p < 0.001$) between gross motor categorization (GMFCS) and

manual ability (MACS), but also noted that manual ability is a unique concept determining daily function(37). Therefore, our findings corroborate the premise that assessment of functional independence must incorporate performance-based measures, particularly fine motor and self-care assessments.

Other regional studies confirm the low proportion of continuous therapy (about 59% of children not getting therapy) and limited utilization of hand-function assistive devices (12%). 2022 Pakistani research revealed a significant prevalence of difficulty in activities of daily life among children with CP, particularly those with severe forms, and criticized limited rehabilitation coverage(38). Further, evidence from around the world demonstrates that children with CP greatly benefit from intensive, task-oriented strategies such as upper-limb training, constraint-induced movement therapy (CIMT), and task-specific strengthening that lead to better hand functioning and improvements in activities of daily living and bimanual performance(17). The absence of such initiatives within our context may significantly add to enduring functional disabilities. Several contextual and clinical factors may explain the observed patterns of functional performance and the absence of strong relationships between clinical classification and PEDI scores in this study: Children in regions like Swat encounter numerous socio-economic and environmental challenges such as the absence of physiotherapy, occupational therapy, specialized rehabilitation facilities, and the absence of rehabilitation assistive technology. These challenges limit the opportunity for regular and structured practice of functional skills, even if the child has the physical potential to gain improvement. Research shows that in CP, the collaborative performance of the environment impacts the functional performance of the child and that children in low-resourced environment suffer greater deficits in daily living performance than children in high-resourced environment(39, 40). This gap is well-documented and is known as the gap between capacity (what the child is able to do in optimal situation) and performance (what the child is able to do in daily living situation). The low proportion of children in ongoing therapy (40.6%) and low assistive technology use (12%) in our sample likely explains sufficiently the functional deficits observed(41).

Clinical practice in many LMIC contexts tends to focus predominantly on gross motor function (e.g. sitting, standing, walking) because these impairments are more visible. There is also a tendency, though, to under-assess fine motor impairments which, nonetheless, greatly impact one's independence with regards to feeding, dressing, grooming, self-care and related activities. It has been shown that self-care and functional independence in CP is most profoundly impacted by upper limb deficits(17). Without standardized assessments that focus on fine motor ability (for example, the Manual Ability Classification System (MACS) and other assessments that measure grip/dexterity), hand function problems may go undetected, and, as a result, untaught. This could explain the findings of our study whereby, children with the same gross motor classification levels, grossly differed in their self-care, as measured by the PEDI, and fine motor skills. Cerebral palsy is a heterogeneous condition affecting multiple domains and systems of the body other than the motor. Among the coexisting symptoms are cognitive impairment, sensory deficits, visual/ocular motor dysfunction, behavioral and epileptic conditions, each of which may adversely affect one's functional performance on their own. It has also been shown that the cognitive and perceptual deficits within this population greatly limit their daily activities and social participation(42). While noting that our analysis of comorbidities showed no statistically significant associations by category for PEDI scores, the presence of comorbidities having at least some level of association with the loss of function has been documented and corresponds to other international evidence(41-44). Such evidence has found that the presence of cognitive and sensory comorbidities, and even the subtype of motor function impairment, can further complicate the daily functioning of an individual. There is evidence that the earlier the intervention, the more the motor learning, especially fine motor control, hand function, and self-care independence improves for children with CP(45). There is

ample evidence supporting the effectiveness of certain therapies, including constraint-induced movement therapy (CIMT), and bimanual and repetitive, goal-directed activity training. The low access to therapy in our cohort suggests that many children neglected these early evidence-based interventions. Such findings, to some degree, suggest that even children with some therapy potential may have ended up with the more chronic outcomes of no therapy(46, 47).

Postural instability is a key impairment in CP, affecting upper-limb coordination, self-care stability, transfer safety, and mobility. Studies have demonstrated that children with cerebral palsy have considerable deficits in both static and dynamic balance, which closely correspond with limits in fine motor activities and ADLs. This could explain why children with normal walking ability in our sample had severe limits in activities requiring upper-limb accuracy and trunk stability, such as grooming, dressing, and feeding.

Implications of the Findings

The results of this study draw valuable patterns that go beyond the outcomes of this study. Though not statistically significant, the distribution or subtype of cerebral palsy was not found to be associated with overall PEDI functional scores, however, further analysis of the domain-level performance indicates that functional limitations appear differently across domains regardless of CP classification. There were no significant differences in the performance of the children with unilateral and bilateral involvement in self-care and fine motor activities, which suggests that performance of the upper limbs and daily functioning cannot be reliably predicted only after using the CP subtype. This confirms accruing evidence that the outcome of activity and participation is determined by a combination of motor control and postural stability, cognitive ability and environmental support but not motor type isolated.

In the CP subtypes, self-care and fine motor domains available were always found to be a more limited area in contrast to certain mobility tasks. Dependence in feeding, grooming, and dressing was prevalent even in those children that had shown partial or independent walking. This observation leads one to believe that there is a dis-relationship between gross motor capacity and fine motor performance, which supports the necessity to evaluate and intervene in hand functioning and self-care skills as independent though equally important elements of rehabilitation. It also describes the reasons why the functional outcomes as assessed by PEDI were not significantly different among the types of CP or distributions-because the determinants of daily performance are not limited to conventional motor classifications. These results are further put in perspective by caregiver traits. Most of the caregivers were adults aged between 30 and 64 years mainly mothers and the female members of the family, which is typical of caregiving systems in this area. Though the age of caregivers was not statistically directly related to the PEDI scores, the burden associated with caregiving probably interacts with functional status of children in complex ways. Physical and emotional demands on caregivers are bound to increase with the high degree of dependence of children in self-care activities especially those that require constant care such as feeding, toileting and grooming. This can also reduce possibilities of regular home-based therapy or skill practice in families in which caregivers are older or have multiple responsibilities, thus continuing to limit functional limitations.

The absence of correlation between the present treatment status and the functional performance is also to be interpreted together. The percentage of children not being treated, or having minimal intervention, was high despite subtype and severity of CP. This implies that access to rehabilitation services and not clinical need per se, is a significant determinant of functional outcomes. The children of all forms of CP can still exhibit the same degree of functional dependence without early, intensive, and focused interventions - especially interventions to work on fine motor skills and self-care. This is also the reason that CP classification failed to distinguish functional outcomes in this group. Collectively, these results highlight the need to change clinical and policy priorities that focus on models of diagnosis to performance-based

and family-based care. The systematic application of functional assessment tools (like the PEDI and MACS) would enable the clinician to detect domain level deficits that would otherwise be missed, particularly in children whose gross motor skills seem to have remained relatively intact. It is also through such assessments that a better foundation of goal setting, counselling of the caregiver and tracking of the progress with time is achieved.

From a service delivery perspective, the analysis of results synthesis reveals a range of priorities. The rehabilitation programs need to be more focused on the upper limb function, fineness, and autonomy in self-care instead of being focused mainly on ambulation. Enhancing the accessibility to assistive technology, in-home care-based intervention, and training of caregivers may serve to close or reduce the discrepancy between the ability of a child and their actual performance. Moreover, based on the low attendance in schools, implementation of rehabilitation measures in learning and community environments can be very important in enhancing their participation and long-term results.

In general, the combined explanation of functional, clinical, and caregiver-related results indicates that the concept of functional independence in children with cerebral palsy is determined by a complex of motor, cognitive, environmental, and caregiving variables. The solution to these aspects in isolation is not likely to bring any significant improvement. Rather, an interdisciplinary, holistic, and situational strategy is needed to improve the day-to-day functioning, decrease the burden on caregivers, and encourage the children with CP to participate in Swat and other low-resource environments.

Conclusion

This study looked at how well children with cerebral palsy (CP) can do everyday tasks and their fine motor skills, based on what parents reported using PEDI Scale. In total, 249 children and their caregivers, the results showed that most of the children had moderate to serious disability with everyday activities in areas like taking care of themselves, moving around, and interacting with others. While some children could do certain tasks independently, about two-thirds needed help or couldn't do important daily activities such as eating, washing up, using the toilet, crawling, climbing, and communicating clearly. A major finding was that there's a big gap in access to rehabilitation services. This means that just knowing a child's medical details alone isn't enough to predict how well they can do things. As a whole, this study gives important information about the daily challenges faced by children with CP in Swat. It also shows the need for better rehabilitation programs, training for caregivers, and support for inclusive education.

Recommendations

Several recommendations for clinical practice, policy creation, and future study are made in light of the results and limitations.

Recommendations for Policy Reforms

1. More rehabilitation services like physiotherapy, occupational therapy, and early intervention should be available in district hospitals to help fill the gap in therapy services.
2. Special training programs should be created for improving hand movement, grip strength, finger dexterity, and self-care skills, as these areas need the most help.
3. Children with cerebral palsy should be checked for the right assistive devices like special grips, modified utensils, or splints. Setting up affordable programs for these tools may be necessary.
4. Caregivers should be taught how to help children with fine motor activities, daily routines, safe handling, and how to do therapy at home.
5. Community sensitization can help to minimize stigma and increase the engagement of children with CP in regular activities.

6. Structured referral mechanisms should be implemented to guarantee early diagnosis, prompt therapy, and coordinated multidisciplinary care.
7. Given Swat's hilly geography and travel problems, home-based or community-level CBR initiatives might lessen obstacles to care.
8. Local health authorities could engage with NGOs or prosthetics and orthotics units to promote the availability of low-cost devices.

Recommendations for Future Research

1. **Longitudinal studies Future:** Future Research should look at how fine motor skills and functional abilities change over time and how they respond to certain treatments.
2. **Use objective fine motor tests:** Tests like the Box-and-Block Test, Nine-Hole Peg Test, or grip strength measurements should be included to better understand hand abilities.
3. **Look into caregiver burden, stress, and quality of life:** Checking how caregivers feel and how stressed they are can give more information about the needs of families.
4. **Study the impact of socioeconomic and environmental factors:** Research should explore how things like family income, a mother's education, the home environment, and support from society influence a child's ability to function independently.
5. **Include a wider range of areas within Khyber Pakhtunkhwa**: Future studies that involve multiple centers in Khyber Pakhtunkhwa can help make findings more useful and support the development of local guidelines.

Limitations

This research gives some useful information, but there are some important things to note:

1. The study only looked at one point in time, so it can't show if things get better or worse over time, or if one thing causes another.
2. We used a version of the PEDI that was adapted for this study. For geographical relevance, it was translated to Urdu language by Google translator, and mostly interpreted in Local Pashto language verbally to the illiterate caregivers of the patients. Some of the words used might be different, which could make it harder to compare with other studies around the world.
3. The information about how well the child can do things came from the parents or caregivers. This means there could be bias, because they might not remember things exactly right, or they might see the child's abilities differently than others would.
4. We only included people who came to a single big hospital. This means the results might not apply to all children with CP in Swat, especially those who don't go to the hospital.
5. We didn't use any tests to measure things like how strong a child's grip is, how well they can move their fingers, or how well they can do small tasks with their hands. This makes it harder to understand how much they can do versus how well they actually perform.
6. Some groups of health problems that children might have were not common enough to help us find clear connections between them and other factors.

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