MS ANNA COOPER (Orcid ID : 0000-0002-5184-5009)
MS MARDEE GREENHAM (Orcid ID : 0000-0003-2466-471X)
DR MARK THOMAS MACKAY (Orcid ID : 0000-0002-3787-1112)
DR ANNE L GORDON (Orcid ID : 0000-0002-6016-5320)

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Motor function and daily living skills 5 years after paediatric arterial ischaemic stroke: a prospective, longitudinal study

ANNA N COOPER[1,2]
VICKI ANDERSON[1,2,3]
MARDEE GREENHAM[1,2]
STEPHEN HEARPS[1,2]
ROD W HUNT[1,2,3]
MARK T MACKAY[1,2,3]
MICHAEL DITCHFIELD[4,5]
LEE COLEMAN[1,3,4]
PAUL MONAGLE[1,2,3]
ANNE L GORDON[6,7]

1 Clinical Sciences, Murdoch Children's Research Institute, Melbourne; **2** University of Melbourne, Melbourne; **3** The Royal Children's Hospital, Melbourne; **4** Monash Medical Centre, Southern Health, Melbourne; **5** Monash University, Melbourne, Australia. **6** Evelina London Children's Hospital, Guy's and St Thomas' NHS Foundation Trust, London; **7** Kings College London, UK.

Correspondence to Anna Cooper, Murdoch Children's Research Institute, Flemington Road, Parkville, Victoria 3052, Australia. E-mail Anna.cooper@mcri.edu.au

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ABBREVIATIONS

AIS	Arterial ischaemic stroke
BOT-2	Bruininks-Oseretsky Test of Motor Proficiency, Second Edition
DASH	Detailed Assessment of Speed of Handwriting
PedsQL	Pediatric Quality of Life Inventory
PEM-CY	Participation and Environment Measure for Children and Youth
PSOM	Pediatric Stroke Outcome Measure
VABS-II	Vineland Adaptive Behavior Scales, Second Edition

AIM To describe 5-year motor and functional outcomes after paediatric arterial ischaemic stroke (AIS) and to explore factors associated with poorer long-term outcome.

METHOD Thirty-three children (21 males, 12 females) with AIS were recruited to a single-site, cross-sectional study, from a previously reported prospective longitudinal stroke outcome study. Children were stratified according to age at diagnosis: neonates (≤30d), preschool (>30d–5y), and school age (≥5y). Motor and functional outcomes were measured at 5 years after stroke. Neurological outcomes were evaluated using the Pediatric Stroke Outcome Measure (PSOM) at 1 month and more than 4 years after stroke.

RESULTS At 5 years after stroke, motor function, quality of life, fatigue, adaptive behaviour, activities of daily living, and handwriting speed were significantly poorer than age expectations. The preschool group had the highest percentage of fine and gross motor impairment. Poorer fine motor skills were associated with subcortical-only lesions and large lesion size. Poorer gross motor outcomes correlated with preschool age, bilateral lesions, and PSOM impairment at 1 month.

INTERPRETATION Children are at elevated risk for motor and functional impairments after AIS, with the preschool age group most vulnerable. Identifying early predictors of poorer outcomes facilitates targeted early intervention and long-term rehabilitation.

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Five-Year Stroke Motor Outcomes *Anna N Cooper et al.*

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What this paper adds

- Following paediatric stroke, children are at elevated risk of motor and functional difficulties.
- Stroke occurring between 30 days and 5 years of age may result in poorer motor and functional outcomes.

[Main text]

Motor impairments after paediatric arterial ischaemic stroke (AIS) are frequently noted at diagnosis, and can persist into adulthood; yet, as current literature is limited, long-term motor outcomes remain poorly understood. The few studies exploring long-term motor outcomes after paediatric AIS have either focused primarily on neonates,[1,2] or have used broad, non-standardized measures in samples where time since stroke onset has varied widely.[3–5] Motor outcome is often described as the presence or absence of a hemiplegia.[4,6,7] There remains limited understanding of the impact of neuromotor impairment on functional daily activities.

Motor skills play a fundamental role in a child's ability to engage and participate in their lives, and motor impairments have broad-reaching implications for daily functioning. The impacts of motor impairments on activity and participation have been described in children with neuromotor impairments,[8–10] demonstrating that even mild motor deficits have the potential to limit a child's ability to engage in social and recreational activities,[11–13] and to learn through social interaction with peers.

Currently, the relationship between early predicting factors and motor outcomes remains unclear. We have previously reported that large lesion size, neurological impairment at 1 month, and school age (≥5y) at diagnosis are associated with poorer motor function at 12 months after diagnosis of AIS.[14] Other studies, primarily in neonates, suggest poorer outcomes for cortical, as opposed to subcortical, infarct location,[15] and for cortical lesions with descending corticospinal tract involvement.[16–18]

This study aimed to measure and describe long-term motor and functional outcomes after AIS and factors associated with long-term outcome. We hypothesized that, at 5 years after stroke, (1) motor function would be poorer than normative expectations; (2) younger age at diagnosis, cortical only strokes, and poorer acute neuromotor impairment scores would be associated with poorer motor outcomes at 5 years; and (3) poorer motor function would be associated with poorer functional outcomes.

METHOD

Participants

This cohort represented a subgroup of children from a larger prospective longitudinal, observational study established in 2007.[14,19] For the original study, 68 children aged between term newborn and 18 years with acute AIS were consecutively recruited from The Royal Children's Hospital, Melbourne, Australia, between December 2007 and November 2013.[19] Children were included if brain magnetic resonance imaging confirmed an acute parenchymal ischaemic infarction in diffusion-weighted imaging that corresponded to one or more arterial territories. Children with previously diagnosed AIS, coexisting diffuse brain injury caused by a traumatic or hypoxic ischaemic event, and infants born preterm (<36wks' gestation) were excluded.

Forty-one children recruited to the original study were 4 to 6 years after stroke between January 2014 and August 2015, and thus eligible to participate (mean time since diagnosis 5y 2mo, range 3y 10mo–5y 10mo), referred to as '5 years' throughout the paper. Three families declined to participate with no reason given and four families were unable to be contacted. One participant was excluded owing to unexplained developmental regression, unrelated to the stroke. Therefore, 33 children were included in this study: 13 neonates (≤30d), 14 preschool age (>30d to <5y), and six school age (≥5y).

Measures

Measures were chosen to capture outcomes across the domains of the International Classification of Functioning, Disability and Health.[20] Measures were chosen for their psychometric properties, on the basis of a previous study of the same cohort to allow comparison over time.[14]

Body Structure and function

Neurological function. The Pediatric Stroke Outcome Measure (PSOM)[8] measures neurological impairments across five domains: right and left sensorimotor, language comprehension, language production, and cognition/behaviour. Where it was not possible to conduct a clinical examination, the Recovery and Recurrence Questionnaire was administered. The Questionnaire is a parent-administered version of the PSOM that correlates strongly with the clinician-administered PSOM.[21] PSOM was completed at the 1-month and 5-year time points with outcomes from the 1-month time point previously reported.[14,19] At the 1-month time point, 22 children were assessed using the PSOM and 11 children were assessed using the Recovery and Recurrence Questionnaire.[21] In presenting the findings, when we reference the PSOM, we are referring to either the PSOM or Recovery and Recurrence Questionnaire. At the 5-year time point all participants were assessed using the PSOM.

Fine motor and gross motor function. The Bruininks-Oseretsky Test of Motor Proficiency, Second Edition (BOT-2)[22] is a comprehensive, age-normed, standardized motor assessment for children aged 4 to 21 years.[22,23] Motor function was assessed across four domains: fine manual control, manual coordination, body coordination, and speed and agility. Standard scores were generated for each subdomain, and an overall motor composite score was derived (mean=50, SD 10). A fine motor score was generated by combining and then averaging scores from the subdomains of fine manual control and manual coordination. Similarly, a gross motor score was calculated by combining and averaging the subdomains of strength and agility and body coordination. Standard scores were converted into z-scores for both fine motor and gross motor functions.

Activity and participation

Activity. The Gross Motor Functional Classification System (GMFCS)[24] classifies gross motor abilities on a scale of I to V, with I representing higher levels of independence. The Manual Ability Classification System[25] measures and classifies use of upper limbs and hands to manipulate objects in daily activities on a scale of 1 to 5, with 1 representing better use of upper limbs.

Participation. The Participation and Environment Measure for Children and Youth (PEM-CY)[26] is a parent-rated measure for children aged 5 to 17 years that measures participation activities in the home, school, and community. It measures how often a child participates, how involved they are, and whether there is anything that the parent would like to change in their participation. The average involvement scores for home (mean=3.9, SD 0.54), school (mean=4.21, SD 0.7), and community (mean=4.2, SD 0.56) were used in analysis, with higher scores representing higher levels of involvement.

Quality of life. The Pediatric Quality of Life Inventory (PedsQL) is a standardized, parent-rated measurement tool for children aged 2 to 18 years that assesses health-related quality of life across four domains of physical functioning, emotional functioning, social functioning, and school functioning. Total scores were used in analyses (mean=87.61, SD 12.33).[27]

Fatigue. The PedsQL Multidimensional Fatigue Scale is an 18-item parent-rated assessment of child fatigue symptoms across three domains (general, sleep/rest, and cognitive). Higher scores indicate fewer fatigue symptoms. Total fatigue scores were used in analyses. Data were compared with published data of healthy children (*n*=259) (mean=88.2, SD 11.1).[28]

Adaptive behaviour. Vineland Adaptive Behavior Scales, Second Edition (VABS-II)[29] is a parent-rated questionnaire which measures a child's activity and participation across four domains: communication, daily living, motor and social skills, as well as total adaptive behaviour (mean=100, SD 15).[29] Total adaptive behaviour and daily living scores were used in this analysis.

Handwriting. The Detailed Assessment of Speed of Handwriting (DASH)[24] is a standardized assessment of a child's speed and legibility of handwriting for children aged 9 years to 16 years 11 months with established validity and reliability. The DASH includes four tasks: copy best, alphabet writing, copy fast and free writing, and an optional task (graphic speed). Raw scores are converted into standard scores in each domain. These scores are combined and averaged to derive a total standard score and centile.

Procedure

Data captured in the first 12 months have been reported previously.[19] Ethics approval for this study was obtained through Human Research Ethics Committee of The Royal Children's Hospital, Melbourne. Families involved in the earlier study were recontacted by telephone and information documents were sent in the mail. Informed, written consent was obtained for participation in the study. Experienced paediatric clinicians (ANC or MG) administered all outcome measures at the 5-year time point, at either the family's home or hospital. Infarct location, lesion laterality, and vascular territory affected were rated by two neuroradiologists (MD, LC) on the basis of visual inspection of images obtained at the time of diagnosis (as described in Gordon et al.).[19] Lesion size was dichotomized into small/medium or large according to degree of vascular territory impacted. Lesion location was categorized as cortical, subcortical, both, or infratentorial. Subcortical classification included grey matter/nuclei, subcortical white matter, or both.

Statistical analysis

There were four children younger than 5 years and one child over 17 years, so the PEM-CY for these children was excluded from analyses. One child had an incomplete data set (PedsQL, the PedsQL Multidimensional Fatigue Scale, VABS-II, and PEM-CY).

Data were entered into SPSS database (version 21; IBM SPSS Statistics, IBM Inc., Armonk, NY, USA) and stratified into three age groups depending on age at stroke onset: neonates (<30d), preschool (30 days to <5y), and school age (≥5y). Descriptive analyses were reported for patient demographic and lesion characteristics between groups. Means and standard deviations were reported for continuous variables and frequencies, and proportions were reported for categorical variables. Total PSOM scores were dichotomized into good (total score ≤0.5) or poor (total score >0.5), consistent with previously published outcome studies.[7,19,30] Children with 'good' PSOM outcomes seemed to have difficulties that were unlikely to interfere with activities of daily living, whereas children with 'poor' PSOM scores were more likely to experience more significant impairments, which were likely to affect their activities of daily living. The sensorimotor subscale was also dichotomized into impaired (score 0.5 or above) or not impaired (score 0) and used to determine the laterality of sensorimotor impairment (unilateral/bilateral).

One-sample *t*-tests were conducted to compare measures of body structure and function (BOT-2), activity and participation (PEM-CY: home, school, and community; DASH: copy best, alphabet writing, copy fast, free writing, and graphic speed), quality of life

(PedsQL, PedsQL Multidimensional Fatigue Scale), and adaptive function (VABS-II: total adaptive behaviour and activities of daily living) with population norms or comparative data. Analyses were performed for the sample as a whole, then again within age groups. Values were adjusted for multiple comparisons by using false discovery rate adjustment. This adjustment was selected as it is less conservative than traditional family-wise error rate controlling methods, not unduly penalizing the smaller sample size and exploration of like outcomes.

Five-year gross motor and fine motor standard scores were dichotomized into 'impaired' (score >1 SD from mean) or 'not impaired' (≤1 SD from mean). Spearman correlations (r) were conducted to explore a relationship between fine motor and gross motor z-scores with adaptive behaviour total scores (VABS-II), activities of daily living subdomain score (VABS-II), quality of life total scores (PedsQL), fatigue total scores (PedsQL Multidimensional Fatigue Scale), and participation at home, school, and in the community (PEM-CY). A strong correlation was indicated by a correlation coefficient above 0.7, moderate in the range 0.5 to 0.7, and a low correlation if less than 0.5.[31]

Finally, multiple regression models with bootstrapped confidence intervals (CI; 1000 replications)[32] explored the prediction of fine motor and gross motor z-scores at 5 years from dichotomized demographic, 1-month PSOM impairment, and lesion characteristics. To explore effect of age at diagnosis across age groups, age dummy variables were generated. Likelihood ratio tests determined model improvement with each predictor. Non-significant improvement resulted in predictor exclusion, and the most parsimonious models were presented. Unstandardized β coefficients and significances were reported, and model assumptions verified.

RESULTS

Sample demographics and lesion characteristics are presented in Table I. Findings are presented for the cohort overall and according to age group at diagnosis. The school-aged group was proportionally smaller than the younger groups (18.2%) and there was a higher percentage of bilateral (71.4) and subcortical-only (66.7) strokes in the preschool age group.

Neurological examination identified four (12%) children with unilateral motor impairments and four (12%) children with bilateral motor impairments. Two children had visual impairments only, and two had auditory impairments only. Standardized motor assessments identified 15% (95% CI 0–35%) of neonates and 29% (95% CI 5–52%) of preschool children had gross motor impairments detected. Fifteen per cent (95% CI 0–35%)

of neonates and 21% (95% CI 0–43%) of preschool children had fine motor impairments detected. No gross motor or fine motor impairments were detected in the school-aged group.

Outcomes compared with normative data: total sample

Mean scores for BOT-2 total scores and fine motor function were significantly poorer than population norms; however, mean gross motor function was within normal range.

VABS-II total adaptive behaviour scores ($p<0.001$), daily living scores ($p<0.001$), PedsQL total ($p=0.001$), PedsQL fatigue ($p<0.001$), DASH 'alphabet writing' ($p=0.043$), and DASH 'copy fast' ($p=0.043$) were significantly lower than age-matched population norms. Participation scores for the PEM-CY fell within the expected range for home ($p=0.79$), school ($p=0.73$), and community ($p=0.86$) domains (Table II).

Outcomes compared with normative data: within age group

The preschool group differed from age norms for BOT-2 total motor ($p=0.048$) and fine motor scores ($p=0.044$), and for the PedsQL total ($p=0.001$), PedsQL fatigue ($p=<0.001$), VABS-II daily living domain ($p=0.001$), and VABS-II total adaptive behaviour ($p=0.001$). The neonatal and school-aged groups fell within age expectations for all outcome measures across all domains (Table III).

Factors associated with 5-year outcomes

Bootstrapped multiple regression models predicted motor function z-scores. The most parsimonious models are presented; likelihood ratio tests with incremental predictor inclusion established model parsimony. Poorer fine motor outcomes were associated with 1-month PSOM impairment only (unstandardized regression coefficient [β]=−1.03, $p=0.001$). Better gross motor outcomes were associated with AIS in the school period ($\beta=1.25$, $p=0.007$), and poorer gross motor outcomes with bilateral lesions ($\beta=-0.85$, $p=0.011$) and PSOM impairment at 1 month ($\beta=-1.41$, $p<0.001$). Lesion size also contributed to the most parsimonious model, but was not statistically significant ($\beta=-0.53$, $p=0.092$).

Relationship between motor outcomes and functional outcomes: total sample

Weak correlations (range: $r=0.37$–0.48) were found for fine motor scores and VABS-II total adaptive behaviour, the daily living domain, and on the PEM-CY, participation at school, as well as for gross motor scores and VABS-II daily living domain, fatigue, and PEM-CY participation in the community. Moderate correlations (range: r=0.52–0.58) were identified between gross motor scores and VABS-II total adaptive behaviour and PedsQL total score.

DISCUSSION

This study describes age-related motor outcomes at 5 years after paediatric stroke and explores the relationship between motor outcomes and functional abilities across different age groups. When exploring outcomes for the overall stroke cohort, fine motor function, adaptive behaviour, daily living skills, and overall quality of life were lower than population norms. Gross motor skills were within age expectations, as was participation in the home, school, and community. Bilateral lesions and PSOM impairment at 1 month were associated with poorer gross motor outcomes. PSOM impairment at 1 month was associated with poorer fine motor outcomes. Children in the school-aged group had better gross motor outcomes. Overall poorer motor abilities were associated with poorer daily living skills, poorer overall adaptive behaviour, reduced quality of life, increased fatigue, and reduced participation.

Examination of outcomes for specific age-at-onset groups demonstrated poorer outcomes for stroke diagnosed in the preschool period. Stroke diagnosis in the preschool period was linked to poorer fine motor abilities, poorer adaptive behaviour, particularly for daily living skills, higher levels of fatigue, and overall lower quality of life. This finding differs from those of our 12-month follow-up where the preschool group had the most favourable motor outcomes.[14] These results are consistent with critical period models, which argue that recovery trajectories are not linear and may vary, depending on the age of the child as well as age at stroke onset. While the presence of higher rates of bilateral (71.4%) and subcortical-only (66.7%) strokes in the preschool group may contribute to poorer results, this is insufficient to explain these differences. These results suggest that 1-month neurological impairment (dichotomized variable), bilateral lesions, and age at stroke onset may be useful characteristics to identify children at higher risk of long-term motor impairments. Understanding early predictors for outcomes enables clinicians to provide children and their families with expectations about likely long-term outcomes, as well as intervention targets to help maximize motor and functional outcomes.

Gross motor impairments were associated with higher levels of fatigue, poorer adaptive behaviour, lower levels of community participation, and lower quality of life. Fine motor impairments were associated with poorer adaptive behaviour and lower levels of school participation. Interestingly, neither gross motor nor fine motor impairments were related to participation at home, suggesting that children may have more physical, environmental, or psychological support in the home environment, which results in fewer barriers to participation. These results highlight the broad-reaching implications of child stroke on daily life, and support the need for thorough, multidisciplinary assessment and treatment that looks beyond physical impairments to capture daily functional abilities.

In this study, we were able to measure motor outcomes across several different age-at-onset stroke groups using the same assessment tools, allowing reliable comparison across age groups. Interestingly, at the 5-year time point, only 12% of children had a unilateral motor impairment, which differs from previous research where estimates of chronic hemiplegia vary from 25% to 56%.[3,33–36] Advances in medical imaging techniques being able to detect more mild strokes may account for this difference. Although gross motor outcomes were not significantly different from age norms, it is possible that the motor assessments available for the stroke population may not be sufficiently sensitive to identify unilateral impairments or more subtle motor impairments such as dystonia and ataxia. The small sample size limited exploration of differences between age groups. In particular, the older age group was proportionally smaller, as these children were more difficult to rerecruit, limiting the breadth of analysis possible.

The study has several limitations. The small number of school-age children assessed limited the more detailed analysis that we could perform and tempered the positive conclusions drawn from this study. The lack of age-matched comparison individuals meant that we relied on normative and published comparison data.

Analysing data at a group level can mask impairments experienced by individual children, so we calculated rates of motor impairment in each age group. There were no gross motor or fine motor impairments identified in the school-aged group. There were, however, two school-aged children who had a unilateral sensorimotor impairment identified by the PSOM. The standardized motor assessments administered in our study may not have been sufficiently sensitive to identify unilateral motor difficulties. When assessing motor function of children after a stroke, a range of assessments may need to be used, specifically targeting the individual’s motor presentation.

This study has important implications for future research. Given the trajectory of recovery is likely to change as social and developmental demands increase, a longer-term observational study is warranted. In addition, a larger sample size would allow greater depth of analysis and might allow identification of more subtle motor and functional changes.

In conclusion, our results suggest that paediatric AIS has a persistent impact on many areas of a child’s life, including motor function, adaptive behaviour, participation, and quality of life. Outcomes may differ depending on the age at diagnosis, with preschool children being more vulnerable to poorer motor outcomes. Long-term clinical surveillance of motor and functional outcomes after paediatric AIS is critical using standardized, functional assessments, to understand the breadth of impact of brain injury and allow targeted early intervention and long-term rehabilitation strategies.

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Table I: Sample demographics and clinical characteristics

	Total	Neonates	Preschool	School age
n (%)	33	13 (39.4)	14 (42.4)	6 (18.2)
Sex (male), *n* (%)	21 (63.6)	11 (84.6)	6 (28.6)	4 (57.1)
Mean age (range) at stroke onset, y:mo	2:9 (0:0–13:8)	0:0 (0:0–0:1)	2:5 (0:2–4:5)	8:6 (5:8–13.8)
Mean age (range) at assessment, y:mo	8:0 (4:0–20:6)	5:1 (4:0–6:6)	7:7 (5:10–9:6)	14:2 (11:5–20:5)
Time (range) since diagnosis, y:mo	5:4 (3:10–6:10)	5:1 (3:10–6:6)	5:2 (4:1–6:10)	5:7 (4:0–6:10)
Lesion characteristics				
Lesion size				
Large (%)	8 (24.2)	4 (50.0)	3 (37.5)	1 (12.5)
Small/medium (%)	25 (76.0)	9 (36.0)	11 (44.0)	5 (20.0)
Vascular territory, *n* (%)				
Middle cerebral artery full	1 (3.0)	1 (100)	0	0
Middle cerebral artery partial	16 (48.5)	7 (43.8)	7 (43.8)	2 (12.5)
Posterior cerebral artery	5 (15.2)	3 (60.0)	0	2 (40.0)
Vertebro-basilar arteries	5 (15.2)	0	3 (60.0)	2 (40.0)
Multiple	6 (18.2)	2 (33.3)	4 (66.7)	0
Laterality				
Left	11 (33.3)	9 (81.8)	2 (18.2)	0
Right	10 (30.3)	3 (30.0)	4 (40.0)	3 (30.0)
Bilateral	7 (21.2)	1 (14.3)	5 (71.4)	1 (14.3)
Infratentorial only	5 (15.2)	0	3 (60.0)	2 (40.0)
Location				
Cortical only	0	0	0	0
Subcortical only	9 (27.3)	1 (11.1)	6 (66.7)	2 (22.2)
Both cortical and subcortical	19 (57.6)	12 (63.2)	5 (26.3)	2 (10.5)
GMFCS levels I and II	31	13	12	6
GMFCS level III[a]	1	0	1	0
MACS levels 1 and 2	29	11	12	6
MACS level 3[a]	3	2	1	0

[a]No child scored in levels IV or V. GMFCS, Gross Motor Function Classification System; MACS, Manual Ability Classification System.

Table II: Motor and functional abilities: comparison with published normative data (whole sample)

	Comparison value		*n*	Mean	SD	*t*	*p*[a]
	Mean	SD					

Motor function							
BOT-2 total score	50	10	33	43.85	11.66	−3.03	**0.013**
BOT-2 fine motor	50	10	33	41.89	10.68	−4.36	**<0.001**
BOT-2 gross motor	50	10	33	47.66	10.81	−1.27	0.289
Fatigue							
PEM-CY home	3.9	0.54	26	3.87	0.59	−0.26	0.851
PEM-CY school	4.21	0.7	26	4.26	0.75	0.35	0.842
PEM-CY community	4.2	0.56	26	4.23	0.77	0.18	0.860
Handwriting							
DASH copy best	10	3	8	7.50	4.27	−1.65	0.213
DASH alphabet writing	10	3	8	6.75	3.06	−3.01	**0.043**
DASH copy fast	10	3	7	5.86	3.63	−3.02	**0.043**
DASH free writing	10	3	5	5.20	3.49	−3.07	0.062
DASH graphic speed	10	3	7	9.14	3.24	−0.70	0.638
Quality of life							
PedsQL total	87.61	12.33	32	73.97	18.04	−4.28	**<0.001**
PedsQL fatigue	88.2	11.1	32	73.83	22.78	−4.99	**<0.001**
Adaptive function							
VABS-II activities of daily living	100	15	32	91.25	9.87	−5.01	**<0.001**
VABS-II total – adaptive behaviour	100	15	32	89.59	11.53	−5.11	**<0.001**

Bold type indicates statistically significant *p* values. [a]False discovery rate adjusted *p* value. BOT-2, Bruininks-Oseretsky Test of Motor Proficiency, Second Edition; PEM-CY, Participation and Environment Measure for Children and Youth; DASH, Detailed Assessment of Speed of Handwriting; PedsQL, Pediatric Quality of Life Inventory; VABS-II, Vineland Adaptive Behavior Scales.

Table III: Motor and functional abilities according to age at stroke onset

	Comparison value		Neonates (birth–30d)					Preschool (30d–5y)					School age (≥5y)				
	Mean	SD	*n*	Mean	SD	*t*	*p*[a]	*n*	Mean	SD	*t*	*p*[a]	*n*	Mean	SD	*t*	*p*[a]
Motor function																	
BOT-2 total score	50	10	13	45.54	11.98	−1.34	0.510	14	41.57	12.81	−2.46	**0.048**	6	45.50	8.60	−1.28	0.433
BOT-2 fine motor	50	10	13	41.88	9.82	−2.98	0.055	14	41.00	12.90	−2.61	**0.044**	6	44.00	7.66	−1.92	0.367
BOT-2 gross motor	50	10	13	50.81	10.68	0.27	0.790	14	43.61	11.17	−2.14	0.074	6	50.00	8.44	0.00	1.000
Fatigue																	
PEM-CY home	3.90	0.54	8	3.71	0.65	−0.81	0.880	13	3.91	0.48	0.57	0.960	5	4.02	0.81	0.33	0.950
PEM-CY school	4.21	0.70	8	4.26	0.50	0.30	0.856	13	4.26	0.94	0.19	0.944	5	4.26	0.66	0.17	0.967
PEM-CY community	4.20	0.56	8	4.33	0.51	0.77	0.671	13	4.30	0.81	0.45	0.825	5	3.86	1.02	−0.74	0.714
Quality of life																	
PedsQL total	87.60	12.33	13	84.04	17.23	−0.75	0.671	13	66.81	13.86	−8.01	**0.001**	6	67.66	19.99	−2.45	0.580
PedsQL fatigue	88.20	11.10	13	90.38	15.34	0.51	0.763	13	60.90	17.72	−5.55	**<0.001**	6	65.97	26.01	−2.09	0.455
Adaptive function																	
VABS-II activities of daily living	100	15	13	93.31	9.86	−2.45	0.100	13	89.31	7.87	−4.90	**0.001**	6	91.00	14.19	−1.55	0.360
VABS-II total, adaptive behaviour	100	15	13	91.23	9.85	−3.21	0.070	13	89.38	7.46	−5.13	**0.001**	6	86.50	20.95	−1.579	0.438

Bold type indicates statistically significant *p* values. [a]Within age-group false discovery rate adjusted *p* value. BOT-2, Bruininks-Oseretsky Test of Motor Proficiency, Second Edition; PEM-CY, Participation and Environment Measure for Children and Youth; PedsQL, Pediatric Quality of Life Inventory; VABS-11, Vineland Adaptive Behavior Scales.