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Preterm and term-equivalent age general movements and one year neurodevelopmental outcomes for infants born before 30 weeks' gestation

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ABBREVIATIONS

AIMS	Alberta Infant Motor Scale
GMA	General movements assessment
LPT	Late preterm
MPT	Moderate preterm
NSMDA	Neurological, Sensory, Motor, Developmental Assessment
TEA	Term-equivalent age
TINE	Touwen Infant Neurological Examination
VPT	Very preterm

AIM To examine the associations between Prechtl's general movements assessment (GMA), conducted from birth to term-equivalent age, and neurodevelopmental outcomes at 12 months corrected age, in very preterm infants.

METHOD One hundred and thirty-seven infants born before 30 weeks' gestation had serial GMA (categorized as 'normal' or 'abnormal') before term and at term-equivalent age. At 12 months corrected age, neurodevelopment was assessed using the Alberta Infant Motor Scale (AIMS), Neurological, Sensory, Motor, Developmental Assessment (NSMDA), and Touwen Infant Neurological Examination (TINE). The relationships between GMA at four time points and 12-month neurodevelopmental assessments were examined using regression models.

RESULTS Abnormal GMA at all time points were associated with worse continuous scores on the AIMS, NSMDA, and TINE ($p<0.05$). Abnormal GMA before term and at term-equivalent age were associated with increased odds of mild–severe dysfunction on the NSMDA (odds ratio [OR] 4.26, 95% confidence interval [CI] 1.55–11.71, $p<0.01$; and OR 4.16, 95% CI 1.55–11.17, $p<0.01$, respectively) and abnormal GMA before term with

increased odds of suboptimal–abnormal motor function on the TINE (OR 2.75, 95% CI 1.10–6.85, *p*=0.03).

INTERPRETATION Abnormal GMA before term and at term-equivalent age were associated with worse neurodevelopment at 12 months corrected age in children born very preterm.

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[Boxed text to appear on page 2]

What this paper adds

- Abnormal general movements before term predict developmental deficits at 1 year in very preterm infants.
- General movements assessment before term identifies at-risk very preterm infants.

[Main text]

Children born very preterm (<32wks' gestation) have higher rates of motor and neurological impairment that persist into adolescence and adulthood, compared with their term-born peers.[1,2] However, not all infants born very preterm will have ongoing developmental issues. Perinatal risk factors such as lower gestational age and birthweight, or abnormal brain neuroimaging, do not entirely explain the heterogeneity of neurodevelopmental outcomes in this population. Hence, clinicians use neonatal neurodevelopmental assessments to provide further individualized information about the integrity of the infant's central nervous system, and potential long-term developmental outcomes,[3] to plan early intervention and target referrals to follow-up services upon discharge from the neonatal nursery.

Prechtl's qualitative general movements assessment (GMA) evaluates specific spontaneous whole-body movements of the infant (termed general movements),[4] and is increasingly used as a tool to identify infants at high-risk for neurodevelopmental impairment. As it is observational, the GMA allows clinicians to assess neurodevelopment before term, unlike other assessments that fragile preterm infants may not tolerate because of handling requirements.[3] Systematic reviews have demonstrated the high predictive validity of the GMA for neurodevelopmental outcome, particularly cerebral palsy (CP), when conducted at 3 months post-term.[5–7] However, less is known about the predictive value of earlier GMA, before term, for neurodevelopmental outcomes in very preterm infants.

Abnormal GMA for infants in the first 10 days after very preterm birth have been associated with abnormal neurological outcome at 24 months corrected age (n=35),[8] and consistently abnormal GMA on serial assessments (before term until 4mo post-term), with increased risk for CP, in more mature preterm infants (<37wks gestational age).[9] However, there is a need for greater understanding of the predictive value of GMA before term, for both motor and neurological outcomes, given the high rates of non-CP motor impairment for very preterm infants.[10] This will help clinicians target early intervention during this period of rapid brain growth and organization, while infants are in the neonatal nursery.

Thus, the aim of this study was to examine the relationships of GMA from birth to term-equivalent age (TEA), with motor and neurological outcome at 12 months corrected age, in infants born before 30 weeks' gestation. We hypothesized that abnormal GMA would be associated with worse motor and neurological outcome at 12 months corrected age on three standardized assessments: the Alberta Infant Motor Scale (AIMS), Neurological, Sensory, Motor, Developmental Assessment (NSMDA), and Touwen Infant Neurological Examination (TINE).

METHOD

Participants

Infants born before 30 weeks' gestation were recruited from the Royal Women's Hospital, Melbourne, Australia, as part of a larger study examining early neurobehavioural development in very preterm infants.[11] Exclusion criteria were infants with congenital conditions known to affect neurodevelopment and infants with non-English-speaking parents, as interpreters were not funded for the study. Research nurses recruited infants up until 2 weeks after birth. The study was approved by the Human Research and Ethics Committees

at the Royal Women's Hospital and the Royal Children's Hospital in Melbourne, Australia, and written parental consent was obtained for all participants.

General movements assessments

After recruitment, serial general movements were recorded weekly up until 32 weeks postmenstrual age, and then fortnightly at 34 and 36 weeks, while infants were inpatients at the Royal Women's Hospital. Infants were recorded by video while in an active behavioural state (according to Prechtl's behavioural states[4]) and three separate general movements sequences were obtained during each recording where possible. At TEA, infants attended the Royal Children's Hospital for a follow-up appointment and general movements were recorded again.

All general movements were scored from the video recordings using Prechtl's method of GMA[4] by assessors with advanced GMA certification. Assessors were blinded to the infants' clinical history and previous assessments. The interrater and intrarater reliabilities for the GMA scoring in this cohort were very good (Cohen's κ 0.75 and 0.94 respectively), as previously reported.[12]

General movements were categorized as normal or abnormal, according to qualitative age-specific features.[4] Normal general movements involve the whole body and are fluent, with variety and complexity in the movement patterns. Abnormal general movements include general movements classified as poor repertoire (monotonous general movements that lack complexity and variety), cramped–synchronized (general movements that are rigid, with synchronized stop/start movements), or chaotic (abrupt, large-amplitude general movements).

Neurodevelopmental assessments at 12 months corrected age

At 12 months corrected age, infants attended a follow-up appointment and neurodevelopment was assessed using the AIMS, NSMDA, and TINE. Three assessments were chosen as they are complementary and assess different aspects of neurodevelopment. The AIMS assesses gross motor development, whereas the NSMDA includes motor, neurological, and sensory items, and the TINE is a comprehensive neurological assessment. Assessors were experienced physiotherapists and occupational therapists unaware of the infant's clinical history and previous GMA findings. Children were not examined specifically for a diagnosis of CP.

AIMS

The AIMS is a norm-referenced assessment of gross motor development with excellent psychometrics, and has been used extensively in studies of very preterm infants with good predictive validity for neurodevelopmental outcome when assessed at 12 months corrected age.[13,14] It comprises 58 items scored by observing an infant's movements across prone, supine, sitting, and standing positional subscales. The subscales are then summed for a total score (range 0–58) and converted to age-based centile ranks. Scores at or below the fifth centile are classified as abnormal.[14]

NSMDA

The NSMDA is a criterion-referenced assessment with high predictive validity for long-term motor outcome in children born preterm and has been used in several studies of very preterm infants.[15] It assesses neurodevelopment across gross motor, fine motor, neurological, postural, and sensory domains, with functional grades for each domain summed for a total functional grade score categorized as normal (score 6–8), minimal deviation (score 9–11), mild deviation (12–13), moderate deviation (14–19), severe (20–25), and profound (>25).

TINE

The TINE is a neurological assessment with good predictive validity for neurological outcome in preterm infants.[16] It has also been used as the neurological outcome measure in previous studies examining the predictive validity of the GMA.[6] It assesses the neurological function of infants at post-term age across five clusters: reaching, gross motor, brainstem, visuomotor, and sensorimotor development. These clusters are then categorized as dysfunctional (yes/no) according to the number of items fulfilling dysfunctional criteria in each cluster. The number of dysfunctional clusters is totalled to determine neurological function classifications: normal, normal sub-optimal, minor neurological dysfunction, or abnormal (score range 0–3, with 0 indicating normal function).

Statistical analysis

Data were analysed using Stata 14.0 (StatCorp, LP, College Station, Texas, USA). General movements were grouped into four time points according to the postmenstrual age at the time of recording: very preterm (VPT: <32wks), moderate preterm (MPT: 32–33+6 weeks), late preterm (LPT: 34–36+6wks), and TEA (38–44wks). For infants who had multiple general movements recorded within a time point, the general movements recorded at the oldest

postmenstrual age were used, given that increased postmenstrual age is associated with improved general movements quality in very preterm infants.[12]

The relationships between GMA at the four time points and outcome scores at 12 months corrected age (total score on the AIMS adjusted for age at assessment, total functional grade score on the NSMDA, and the neurological function classification score on the TINE) were examined using a separate linear regression for each GMA time point and outcome measure. Models were fitted using generalized estimating equations, to account for correlation related to clustering of multiple births (twins/triplets). Logistic regression, also fitted separately for each GMA time point and outcome using generalized estimating equations, was used to examine the associations between abnormal GMA and abnormal development at 12 months, categorized according to cut-off scores defined as AIMS (scores below fifth centile), NSMDA (mild to severe dysfunction on the functional grades), and TINE (suboptimal to abnormal classification). Results are reported as regression coefficients or odds ratios (OR) and their 95% confidence intervals (CI). All the analyses were repeated and adjusted for perinatal variables known to influence the quality of general movements[12] and neurodevelopment, including gestational age, bronchopulmonary dysplasia (defined as oxygen dependence at 36wks postmenstrual age), infection (necrotizing enterocolitis and/or sepsis), and brain injury on cranial ultrasound (grade 3 or 4 intraventricular haemorrhage/cystic periventricular leukomalacia). The following predictive values of abnormal GMA at each time point for abnormal development at 12 months according to the three assessments were calculated: sensitivity, specificity, positive predictive value, negative predictive value, and accuracy.

RESULTS

There were 149 very preterm infants recruited. Of these, 137 infants had at least one GMA and were assessed at 12 months corrected age. Six infants died in the neonatal period, one infant did not have any general movements recorded, and five infants were not assessed at 12 months (two because of geographical distance and three because an appointment with caregivers could not be arranged). Characteristics of the study sample are presented in Table I. There was a high proportion of abnormal GMA at all time points. During the VPT time point 102 out of 120 (85%) general movements were assessed as abnormal, 87 out of 112 (78%) during the MPT period, 68 out of 77 (88%) during the LPT period, and 82 out of 116 (71%) at TEA.

Neurodevelopmental outcomes at 12 months corrected age

The average age at the outcome assessment was 12.8 months corrected age (standard deviation [SD] 0.8; range 11.4–16.9). The mean and SD for total scores on the AIMS and NSMDA functional grades, the median and interquartile range (IQR) for the TINE neurological function classification scores, and the proportions with abnormal scores are presented in Table II. Of note, 53% of participants were categorized as below fifth centile on the AIMS, 76.6% as mild to severe dysfunction on the NSMDA, and 60% as suboptimal to abnormal on the TINE.

Associations between GMA and AIMS at 12 months corrected age

Abnormal GMA at all time points were associated with worse total scores on the AIMS on unadjusted analyses (Table III). After adjusting for gestational age, bronchopulmonary dysplasia, infection, and grade 3/4 intraventricular haemorrhage, the evidence remained for associations between abnormal GMA during the VPT and MPT time points (coefficient −4.27, 95% CI −8.04 to −0.49, p=0.03; and coefficient −5.03, 95% CI −8.31 to −1.75, p=0.003, respectively) and AIMS total scores. There was little evidence of associations between abnormal GMA and the AIMS cut-off scores in the unadjusted (Table III) or adjusted analyses (data not shown).

Associations between GMA and NSMDA at 12 months corrected age

Abnormal GMA at all time points were associated with worse total functional grade scores on the NSMDA (Table III). These associations remained evident in the adjusted analysis for the VPT (coefficient 1.54, 95% CI 0.37–2.72; p=0.01), MPT (coefficient 1.70; 95% CI 0.70–2.71; p=0.001), and TEA (coefficient 1.26, 95% CI 0.35–2.17, p=0.007) time points, but not the LPT time point (coefficient 0.67, 95% CI −0.67 to 2.01, p=0.33). On the NSMDA, abnormal GMA at VPT, MPT, and TEA time points were associated with increased odds of mild to severe dysfunction for the unadjusted analysis (Table III). These associations were still evident in the adjusted analysis for abnormal GMA at the VPT (OR 4.05, 95% CI 1.40–11.76, p=0.01) and TEA (OR 4.19; 95% CI 1.32–13.28, p=0.01) time points.

Associations between GMA and TINE at 12 months corrected age

On the TINE, abnormal GMA at all time points were associated with worse neurological function classification scores on the TINE (Table III). These associations remained evident in the adjusted analysis for the VPT (coefficient 0.27, 95% CI 0.02–0.51, p=0.03) and MPT

time points (coefficient 0.36, 95% CI 0.12–0.59, p=0.003) but not the LPT and TEA time points (coefficient 0.17, 95% CI −0.22 to 0.56, p=0.4; and coefficient 0.19, 95% CI –0.07 to 0.45, p=0.16, respectively). Abnormal GMA during the MPT period were associated with increased odds of suboptimal to abnormal function on the TINE, in both the unadjusted (Table III) and adjusted (OR 3.48, 95% CI 1.27–9.51, p=0.02) analysis.

Predictive values of abnormal GMA for cut-off scores on neurodevelopmental assessments

The predictive validity of the GMA independently at each time point for abnormal cut-off scores on the AIMS, NSMDA, and TINE is summarized in Table IV. The sensitivity of the GMA at all four time points was higher than the specificity for the three outcome assessments. The GMA had higher accuracy for predicting outcome on the NSMDA and TINE than the AIMS, with the GMA at all time points having the highest predictive values for outcome on the NSMDA. The sensitivity of GMA at TEA was slightly lower than the GMA before term, and specificity slightly higher at the TEA time point than GMA before term.

DISCUSSION

This study demonstrated that early GMA (i.e. before term and at TEA) is associated with neurodevelopmental outcome at 12 months corrected age for infants born very preterm. There was a relationship between abnormal GMA at all time points and worse scores on the three outcome assessments at 12 months. At 32 weeks postmenstrual age and earlier, an abnormal GMA was associated with worse motor and neurological scores at 12 months corrected age on the AIMS, NSMDA, and TINE. Of note, abnormal GMA during the VPT period predicted mild to severe dysfunction on the NSMDA with 77% accuracy, and the sensitivity of the GMA was high across all time points for worse neurodevelopmental outcome on all three assessments. Interestingly, the accuracy of the GMA for outcome on the NSMDA was similar at all the time points, in contrast to previous studies that found that predictive value for abnormal outcome increases with higher postmenstrual age at assessment, particularly cramped synchronized general movements close to TEA.[9,17]

Our findings are consistent with previous research[8,18] demonstrating that the GMA can be used in the first few weeks after birth for very preterm infants as a sensitive measure for later neurological outcome. However, similar to other studies, the specificity of the GMA was lower than the sensitivity.[8,19] While GMA at 3 months corrected age has higher

specificity,[20,21] an earlier GMA before hospital discharge may help expedite referrals to follow-up intervention services, rather than delaying access to intervention until GMA post-term. The low specificity does mean, however, that children may be referred to early intervention that might prove to be unnecessary. Therefore, using the GMA in combination with other neurodevelopmental assessments is likely to increase the accuracy for predicting neurodevelopmental outcome, given there is neither 100% sensitivity nor specificity for early GMA.

Importantly, our study demonstrated that early GMA provides information additional to perinatal risk factors, thus potentially helping clinicians to further target intervention and referrals for very preterm infants while in the neonatal nursery. Even after adjusting for perinatal variables known to affect neurodevelopment, there remained evidence of an association between abnormal GMA at several time points and worse continuous scores on all three outcome assessments, with increased odds of mild to severe dysfunction on the NSMDA, and suboptimal to abnormal TINE classification.

The associations between early GMA and 12-month outcome on all three assessments add to the evidence that the GMA provides predictive information about gross motor, fine motor, and neurological outcomes in very preterm infants.[20,21] Previous studies of GMA in the first few weeks after birth,[8,18] and GMA at 36 weeks postmenstrual age,[22] reported dichotomized normal/abnormal outcome according to a neurological assessment, and CP diagnosis. Our study shows that early GMA may also be related to gross and fine motor development, with associations noted between abnormal GMA at preterm and TEA time points and worse motor scores. The current study's findings are similar to previous research showing that GMA at 1 and 3 months corrected age are related to motor outcomes on the AIMS and NSMDA,[20] and has also demonstrated that these associations may be detected even earlier.

There are few studies that have examined the relationships between GMA before term,[23] or at TEA,[24,25] and outcome on standardized motor assessments for very preterm infants. In the current study, there were stronger associations with the NSMDA and TINE than with the AIMS abnormal cut-off scores. There was little evidence of an association between abnormal GMA and abnormal motor function according to the AIMS cut-off, in contrast to previous findings[23] that a single abnormal GMA at 34 weeks postmenstrual age was moderately associated with AIMS scores below fifth centile at 14 months corrected age. Snider et al.[24] reported that a GMA at TEA predicted motor scores on the Peabody

Developmental Motor Scales-2, and the AIMS standing scale, but not on other AIMS scales, at 12 months corrected age.

The current study has several strengths. In particular, it is the first study, to our knowledge, to examine the predictive validity of GMA at different time points from birth to TEA in infants born before 30 weeks' gestation, in a prospective longitudinal study with excellent follow-up rates (93%). Infants were assessed using psychometrically robust standardized assessments, and assessors were blinded to the infant's clinical history for all the GMA and outcome assessments. The current study examined the predictive validity of early GMA with detailed motor and neurological assessments, which is important given the high rates of motor impairment in children born very preterm.[10]

There were some limitations to the current study. Infants who were medically stable were transferred to non-tertiary hospitals, often at 31 to 32 weeks postmenstrual age. These infants may have had fewer medical complications and therefore were more likely to have normal GMA given the influence of perinatal variables on general movements quality.[12] Hence the power to detect an association may have been decreased for GMA during the MPT and LPT time points when these infants were at another hospital (and therefore not assessed). Another limitation was that there was no formal assessment for CP diagnosis at 12 months (although these infants were likely to be identified as neurologically abnormal on the TINE). While the AIMS, NSMDA, and TINE have good predictive validity for long-term developmental outcome in preterm infants,[13,15,16] further follow-up of long-term neurodevelopmental outcome of this cohort is recommended, including CP diagnosis.

CONCLUSION

Abnormal GMA before term and at TEA is associated with worse motor and neurological outcomes at 12 months corrected age in children born very preterm. Early GMA, even before term, may help clinicians identify infants at increased risk for motor and neurological impairment, and facilitate earlier intervention and follow-up referrals for this high-risk population. Given the higher sensitivity for neurodevelopmental outcome compared with lower specificity, using GMA in conjunction with other assessments, along with clinical history, is recommended to increase specificity for predicting neurodevelopmental outcome.

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SUPPLEMENTARY INFORMATION

The following additional materials may be found online:

Appendix SI: Associations between abnormal general movements and neurodevelopmental assessment scores at 12 months corrected age: multivariable regression adjusted for perinatal variables known to affect neurodevelopment.

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Table I: Characteristics of the study sample

Characteristics (*n*=137)	
Mean (SD) gestational age (wks)	27.8 (1.5)
Mean (SD) birthweight (g)	1031 (262)
Mean (SD) birthweight z-score	−0.44 (1.03)
Males, *n* (%)	66 (48)
Multiple births, *n* (%)	62 (45)
Bronchopulmonary dysplasia[a], *n* (%)	41 (30)
Necrotizing enterocolitis, *n* (%)	13 (9)
Sepsis (proven), *n* (%)	19 (14)
Intraventricular haemorrhage grade III/IV, *n* (%)	3 (2)
Surgery before hospital discharge, *n* (%)	7 (5)

[a]Bronchopulmonary dysplasia, oxygen dependence at 36wks postmenstrual age.

Table II: Neurodevelopmental assessment scores at 12mo corrected age

Assessment	*n*	Mean (SD)/*n* (%)	Median (IQR)	Range (minimum–maximum)
AIMS total score	137	45.1 (8.4)	—	10–58
AIMS cut-off (below fifth centile)	137	73 (53%)	—	—
NSMDA functional grade scores	137	10.5 (3.3)	—	6–27
NSMDA cut-off (normal versus mild–severe dysfunction)	137	105 (77%)	—	—
TINE neurological function classification score	135	—	1 (0–1)	0–3
TINE cut-off (normal versus suboptimal–abnormal)	135	81 (60%)	—	—

IQR, interquartile range (25th–75th centile); AIMS, Alberta Infant Motor Scale; NSMDA, Neurological, Sensory, Motor, Developmental Assessment; TINE, Touwen Infant Neurological Examination.

Table III: Associations between abnormal general movements and neurodevelopmental assessment scores at 12mo corrected age

Age at GMA	VPT				MPT				LPT				TEA			
Assessment	*n*	Coeff	95% CI	*p*	*n*	Coeff	95%CI	*p*	*n*	Coeff	95% CI	*p*	*n*	Coeff	95% CI	*p*
AIMS total score	120	-4.99	-7.77, -2.21	**<0.001**	112	-4.73	-7.11, -2.35	**<0.001**	77	-2.96	-5.64, -0.28	**0.03**	116	-3.47	-6.39, -0.55	**0.02**
NSMDA total functional grade score	120	1.96	0.94, 2.98	**<0.01**	112	1.97	0.99, 2.94	**<0.001**	77	1.60	0.24, 2.97	**0.02**	116	1.84	0.86, 2.83	**0.001**
TINE neurological function classification score	119	0.41	0.14, 0.68	**<0.01**	110	0.42	0.17, 0.66	**0.001**	75	0.48	0.09, 0.86	**0.02**	115	0.37	0.10, 0.64	**<0.01**
Cut-off scores	*n*	OR	95% CI	*p*	*n*	OR	95%CI	*p*	*n*	OR	95% CI	*p*	*n*	OR	95% CI	*p*
AIMS (below fifth centile)	120	1.70	0.72, 4.02	0.23	112	1.72	0.75, 3.96	0.20	77	0.49	0.13, 1.89	0.30	116	2.14	0.93, 4.90	0.07
NSMDA (normal versus mild–severe dysfunction)	120	4.26	1.55, 11.71	**<0.01**	112	2.56	1.03, 6.36	**0.04**	77	1.54	0.39, 6.09	0.54	116	4.16	1.55, 11.17	**<0.01**
TINE (normal versus suboptimal–abnormal)	119	2.72	0.99, 7.47	0.05	110	2.75	1.10. 6.85	**0.03**	75	2.87	0.56, 14.77	0.21	115	1.96	0.84, 4.58	0.12

Bold text refers to *p* values <0.05. GMA, general movements assessment; VPT, very preterm; MPT, moderate preterm; LPT, late preterm; TEA, term-equivalent age; Coeff, regression coefficient; AIMS, Alberta Infant Motor Scale; NSMDA, Neurological, Sensory, Motor, Developmental Assessment; TINE, Touwen Infant Neurological Examination.

Table IV: Predictive values of abnormal general movements for abnormal neurodevelopmental assessments at 12mo corrected age

Age at GMA	Outcome	Sensitivity	Specificity	PPV (95% CI)	NPV (95% CI)	Accuracy

		(normal/abnormal cut-off scores)	(95% CI)	(95% CI)			(%)
VPT	AIMS	89 (77–95)	19 (10–31)	53 (43–62)	61 (36–82)	54
	NSMDA	90 (82–95)	32 (17–52)	81 (72–88)	50 (27–73)	77
	TINE	90 (80–95)	23 (13–38)	63 (53–73)	61 (36–82)	63
MPT	AIMS	81 (69–90)	26 (16–41)	55 (44–66)	56 (35–75)	55
	NSMDA	82 (72–89)	36 (19–56)	79 (69–87)	40 (22–61)	71
	TINE	86 (74–93)	32 (20–47)	63 (52–73)	63 (41–80)	63
LPT	AIMS	85 (69–94)	8 (2–23)	50 (38–62)	33 (9–69)	48
	NSMDA	90 (78–96)	16 (4–40)	76 (64–86)	33 (9–69)	71
	TINE	93 (81–98)	17 (7–36)	64 (51–75)	63 (26–90)	64
TEA	AIMS	77 (64–86)	36 (24–50)	57 (46–68)	59 (41–75)	58
	NSMDA	77 (67–85)	52 (32–72)	85 (75–92)	38 (23–56)	72
	TINE	77 (65–85)	38 (24–54)	68 (57–78)	48 (31–66)	63

GMA, general movements assessment; CI, confidence interval; PPV, positive predictive value; NPV, negative predictive value; VPT, very preterm; AIMS, Alberta Infant Motor Scale; NSMDA, Neurological, Sensory, Motor, Developmental Assessment; TINE, Touwen Infant Neurological Examination; MPT, moderate preterm; LPT, late preterm; TEA, term-equivalent age.