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Early motor repertoire and neurodevelopment at 2 years in infants born extremely preterm or extremely-low-birthweight

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ABBREVIATIONS

Bayley-III	Bayley Scales of Infant and Toddler Development, Third Edition
ELBW	Extremely-low-birthweight
GMA	General Movements Assessment
MOS-R	Motor Optimality Score-Revised

AIM To determine the relationship between early motor repertoire and 2-year neurodevelopment in infants born extremely preterm (<28wks' gestation) or extremely-low-birthweight (ELBW) (<1000g).

METHOD This was a geographical prospective cohort of 139 infants born extremely preterm/ELBW (mean gestational age 26.7wks, standard deviation [SD] 2.0, 68/139 [49%] male), with parent-recorded videos suitable for scoring the General Movements Assessment (GMA). Motor repertoire was assessed using the Motor Optimality Score-Revised (MOS-R), with and without the fidgety movement subsection, and the GMA alone at 12 to 13^{+6} weeks corrected age and 14to 15^{+6} weeks corrected age. At 2 years corrected age, impaired development was defined as Bayley Scales of Infant and Toddler Development, Third Edition motor and cognitive development scores 1 standard deviation or less relative to controls born at term; paediatricians diagnosed cerebral palsy (CP).

RESULTS Greater MOS-R scores at 14 to 15^{+6} weeks corrected age were associated with lower odds of CP (odds ratio [OR] per 1-point increase=0.83, 95% confidence interval [CI]=0.71–0.99), and motor (OR=0.93, 95% CI=0.87–0.99), or cognitive impairment

(OR=0.94, 95% CI=0.88–0.99). Absent/abnormal GMA at 14 to 15^{+6} weeks was associated with CP and motor delay. There was little evidence that MOS-R scores at 12 to 13^{+6} weeks were associated with neurodevelopmental outcomes at 2 years.

INTERPRETATION Poorer MOS-R scores and absent/abnormal GMA, scored from parent-recorded videos at 14 to 15^{+6} weeks gestational age, are associated with CP and developmental impairment in 2-year-old infants born extremely preterm/ELBW.

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Early Motor Repertoire and Development *Amanda K L Kwong et al.*

What this paper adds

- The Motor Optimality Score-Revised (MOS-R) is related to neurodevelopment at 2 years.
- A higher MOS-R is associated with less cerebral palsy (CP) at 2 years.
- A higher MOS-R without the fidgety movement subsection is positively related to neurodevelopment at 2 years.
- MOS-R at 14 to 15^{+6} weeks, but not 12 to 13^{+6} weeks, is related to neurodevelopment at 2 years.
- Absent/abnormal General Movements Assessment alone (14–15^{+6} weeks) is related to CP and motor impairment.

[main text]

Children born extremely preterm (<28wks' gestation) or extremely-low-birthweight (ELBW) (<1000g) experience higher rates of developmental delay and cerebral palsy (CP) compared with children born at term.[1] While the rate of CP appears to be declining in children born extremely preterm or ELBW, rates of other motor impairments are increasing and the rates of cognitive impairment and poorer academic achievement at school age are also not improving.[1,2] Neurodevelopmental delay may be attenuated with early intervention in infants born preterm;[3] however, identifying those who are at higher risk of developmental delay early in life is a challenge, particularly when resources for early intervention are limited. Early

detection of CP has gained much attention and infants younger than 6 months corrected age can be classified with an interim 'high-risk of CP' diagnosis. This is determined by a combination of the General Movements Assessment (GMA), neuroimaging, and standardized neurological assessment.[4] While the GMA has high predictive validity for CP,[5–7] there is less evidence for its relationships with non-CP neurodevelopmental outcomes.[6]

While CP affects 6% of surviving infants born extremely preterm, many more (40%) have developmental delay,[8] which also requires early identification and intervention to improve participation in activities of daily living. The Motor Optimality Score, revised in 2019 (MOS-R)[9] from the initial version in the GMA manual,[10] can be scored between 9 and 20 weeks corrected age and may demonstrate a stronger relationship with neurodevelopmental outcomes at 2 years than the GMA alone since it includes a detailed qualitative score of infant postures and movements, along with the GMA. The MOS-R is a continuous score ranging from 5 to 28 and is derived from adding scores for five subsections: (1) fidgety movements (absent general movements=1, abnormal general movements=4, normal general movements=12); (2) observed movement patterns (score 1–4); (3) age-adequate movement repertoire (score 1–4); (4) observed postural patterns (score 1–4); (5) movement character. Higher scores signify better motor performance.[9] A recent study found that the MOS-R without the fidgety movement subsection within a multivariable model with the GMA increased the proportion of variance explained in neurodevelopmental outcomes at 2 years compared with the GMA alone for neurodevelopmental outcomes at 2 years.[11] The relationship between MOS-R subsections 2 to 5 and development are yet to be explored separately. Subsections 2 to 5 focus on motor repertoire separately from fidgety movements (i.e. section 1); there may be benefit in establishing the relationship between the non-fidgety movement motor repertoire and neurodevelopmental outcomes at 2 years since they may provide different information, given that they are looking at different aspects of an infant's early motor repertoire.

Like the GMA, the MOS-R does not require assessor handling and is scored from video-recorded spontaneous movements.[9,10] Therefore, the MOS-R may be beneficial in settings where face-to-face appointments are limited, such as with the current COVID-19 pandemic, and/or where geographical or social isolation prevents families from accessing timely assessments and services. With rapid advances in technology and smartphone ownership, parents are also able to record their infant's movements using dedicated smartphone apps.[12–14] However, the relationships between the GMA and MOS-R scored from parent-obtained infant recordings with later CP or developmental delay have not been determined; they will

be important to establish a shift from clinician-recorded movements to parent-recorded movements.

Furthermore, GMA classifications change over time within the fidgety movement period.[15] Since the MOS-R incorporates the GMA within the fidgety movement subsection, it may be that age at assessment affects the relationship between the MOS-R and neurodevelopmental outcomes at 2 years. This is important given that the MOS-R includes an 'age adequacy score' with age-specific criteria at four time points: 9 to 11; 12 to 13^{+6}; 14 to 15^{+6}; and 16 weeks corrected age and older.

The primary aim of this study was to determine the relationship between the MOS-R scored from parent-recorded videos at 12 to 13^{+6} and 14 to 15^{+6} weeks corrected age with neurodevelopmental outcomes (motor, cognitive, and language) and with CP at 2 years corrected age in children born extremely preterm/ELBW. Given that the GMA classification can change over time, we hypothesized that the MOS-R and GMA at 14 to 15^{+6} weeks corrected age would be more strongly related to neurodevelopmental outcomes at 2 years than the same measures at 12 to 13^{+6} weeks corrected age. Secondary aims were to determine the relationship between the MOS-R without the fidgety movement subsection and GMA alone at 12 to 13^{+6} and 14 to 15^{+6} weeks corrected age and outcomes at 2 years to determine if infant movements, irrespective of fidgety movements, are related to neurodevelopmental outcomes at 2 years. We hypothesized that the higher MOS-R scores at both time points would be associated with better motor, cognitive, and language outcomes, both with and without the fidgety movement subsection, but the GMA at both time points would be strongly associated with motor outcomes only.

METHOD

Participants

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The current study used a subset of infants born extremely preterm/ELBW from the Victorian Infant Collaborative Study 2016/2017 cohort whose parents provided written informed consent and used the Baby Moves smartphone app to record their infant's movements for the GMA.[12] All surviving infants born extremely preterm/ELBW between the 1st April 2016 and 31st March 2017 in the state of Victoria, Australia, were eligible for inclusion. Infants born at term were recruited as controls, used as a reference to define impairment outcomes in the current study, and were matched for expected date of birth, health insurance status as a proxy for sociodemographic status, mother's country of birth (primarily English-speaking or not),

and child's sex. Research nurses collected perinatal data from medical files; data were recorded in a Research Electronic Data Capture database.

Acquisition and scoring of videos and assessment of general movements

At recruitment, participants installed the Baby Moves app on their smartphone. The Baby Moves app notified participants to record up to two videos between 12 to 13^{+6} and 14 to 16^{+6} weeks corrected age (but only videos <16wks were used for the MOS-R analysis given that the age-adequate repertoire is scored differently after 16wks) and had simple instructions on how to record their infant's movements for 3 minutes. Screenshot examples of Baby Moves are available in a previous publication.[12] Once recorded, the Baby Moves app facilitated the transfer of video data to the secure Research Electronic Data Capture database.

An advanced General Movements Trust-certified assessor (AKLK) scored the videos retrospectively; they were blinded to clinical history, according to the updated MOS-R.[9] Three experienced advanced certified assessors (AJS, JEO, ALE) double-scored a random sample of 60 videos (20 videos for each assessor) against the primary scorer (AK) to ensure reliability. The intraclass correlation coefficient between the primary scorer and the other three scorers was 0.93 (95% confidence interval=0.90–0.97), indicating good interrater reliability.

Assessment at 2 years

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At 2 years corrected age, developmental paediatricians, blinded to clinical history, assessed each child neurologically, diagnosed CP on the basis of loss of motor function and abnormal muscle tone or tendon reflexes, and classified CP severity according to the Gross Motor Function Classification System (GMFCS).[16] Blinded assessors also administered the Bayley Scales of Infant and Toddler Development, Third Edition (Bayley-III) and assigned scores for the cognitive, language, and motor domains.[17] Due to known underestimation of Bayley-III scores for developmental delay among children in Australia,[18] we used the mean and standard deviation (SD) of the controls born at term to categorize neurodevelopmental delay. Scores 1SD or less relative to the mean of the scores of infants born at term (controls) were considered impaired and clinically represent the point at which referrals for early intervention would be instigated.

Statistical analysis

Data were analysed using Stata v16 (StataCorp, College Station, TX, USA). The associations between MOS-R scores, both with and without the fidgety movement subsection and the GMA alone with CP, and motor, cognitive, and language impairment were determined using logistic regression. These analyses were performed separately for scores at 12 to 13^{+6} and 14

to 15^{+6} weeks. All models were fitted using generalized estimating equations and exchangeable correlation structures with results reported with robust (sandwich) estimators of variance to account for lack of independence of observations due to multiple births within the same family.[19] Since this was an exploratory study, we focused on the magnitude and direction of differences rather than just the *p*-values when interpreting the results.

Ethical consent

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The Human Research Ethics Committees at the Royal Children's Hospital, Royal Women's Hospital, Mercy Hospital for Women, and Monash Health approved the study.

RESULTS

Over the 12-month period from 1st April 2016, 273 infants born extremely preterm/ELBW survived to 2 years of age, of whom 139 (51%) had both an MOS-R score at either or both 12 to 13^{+6} and 14 to 15^{+6} weeks corrected age and Bayley-III data at 2 years corrected age (Fig. S1, online supporting information). Participant characteristics are summarized in Table 1. The neonatal characteristics of survivors without complete data were like those with at least one MOS-R and at least one Bayley-III domain completed, except for multiple births, which were more common in those without complete data (Table 1). Additionally, those without complete data had poorer performance on the Bayley-III.

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Seven (5%) of the included infants were classified as having CP at 2 years corrected age; the GMFCS classifications were levels I (*n*=3), II (*n*=1), III (*n*=1), IV (*n*=1), and V (*n*=1). The rates of motor, cognitive, and language impairment (measured in relation to the mean scores of the Bayley-III scores of infants born at term [controls]) and mean Bayley-III scores are also detailed in Table 1.

More infants had MOS-R data at 14 to 15^{+6} weeks (*n*=124 with CP data; *n*=122 with Bayley-III data) than at 12 to 13^{+6} weeks (*n*=96). There was little evidence that MOS-R scores at 12 to 13^{+6} weeks corrected age were associated with neurodevelopmental outcomes, including CP. However, there was convincing evidence that higher scores on the MOS-R at 14 to 15^{+6} weeks corrected age were associated with reduced odds of having CP, motor, or cognitive impairment (Table 2). Conclusions were similar when the fidgety movement subsection of the MOS-R was removed (Table 2). There was a similar pattern of results for the GMA: there was little evidence that absent/abnormal general movements at 12 to 13^{+6} weeks were associated with CP or impaired development at 2 years; however, abnormal/absent general movements at 14 to 15^{+6} weeks were strongly associated with increased odds of CP and motor impairment (Table 2).

DISCUSSION

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Higher MOS-R scores at 14 to 15^{+6} weeks corrected age from parent-recorded videos was related to reduced odds of neurodevelopmental impairment at 2 years in children born extremely preterm/ELBW and had strong relationships with more areas of neurodevelopment than the GMA alone. This suggests that the MOS-R at 14 to 15^{+6} weeks scored from parent-recorded videos may have clinical value in identifying infants at risk of motor, cognitive, and/or language developmental impairment. The MOS-R without the fidgety movement subsection was also related to motor and cognitive outcomes in infants born extremely preterm/ELBW. Both the MOS-R with or without the fidgety movement subsection and GMA alone were also strongly related to CP, diagnosed at 2 years corrected age.

The relationship between the MOS-R, assessed using parent-recorded videos in the current study, and later development is consistent with previous studies not using parent-recorded videos. A study in infants born at 31 weeks gestational age or younger or weighing 1500g or less found a stronger association between the Bayley-III and MOS-R without the fidgety movement subsection than with the GMA alone.[11] Although approximately 50% of the infants in that study were born at fewer than 28 weeks or had a birthweight less than 1000g, results were not reported for those subgroups alone, so we cannot directly compare their results with our study. The MOS-R has also shown strong relationships with outcomes at earlier ages, including fine and gross motor function at 1 year of age in infants born weighing less than 1500g, according to the Peabody Developmental Motor Scales, Second Edition.[20] Furthermore, the MOS-R provides a more nuanced measure of early motor repertoire than the GMA, which is more sensitive to non-CP developmental delay. For example, an infant may have normal fidgety movements but a lower MOS-R and may be offered intervention for non-CP neurodevelopmental concerns.

While the predictive ability of the GMA for neurodevelopment is not as established as that for CP, the findings in our study are consistent with those of other studies. A study of children born at fewer than 30 weeks gestational age or with a birthweight less than 1250g found that the absence of fidgety movements was associated with poorer cognitive, language, and motor scores according to the Bayley Scales of Infant Development, Second Edition or Bayley-III at 2 years corrected age and with motor and cognitive performance at 4 years corrected age.[21] Additionally, while the relationship between absent fidgety movements and CP has previously been shown to be strong,[5] false negative classifications existed within our sample: three infants with fidgety movements later had a diagnosis of CP at 2 years corrected

age (classified in GMFCS levels I, II, and III respectively). Future studies of the current cohort are needed to confirm diagnoses of CP, ideally at 5 or more years of age, in accordance with the Australian Cerebral Palsy Register protocols.[22]

While the relationship between the GMA and neurodevelopmental impairment could be weaker when using parent-obtained videos, rather than clinician-recorded videos, our study found that the relationships between the MOS-R and GMA, both assessed via parent-recorded videos, and neurodevelopmental outcomes at 2 years were still present and therefore should not necessitate a shift to clinic-only video recordings. If parent-recorded videos are to be used in future studies and clinically, it is advisable that support and clear instructions are provided to parents to ensure that videos are scorable. The need for additional parent support was particularly evident in a previous study of parents who spoke English as their second language, who received some government income or who had lower maternal education since they were less likely to use the Baby Moves app.[13] Additionally, assessing the MOS-R and GMA on the same videos can streamline the assessment processes and benefit families who are geographically or socially isolated or may be restricted to telehealth visits, for example, due to pandemic-related public health advice. Given the strong relationship between MOS-R, GMA, and neurodevelopmental outcomes at 2 years in the current study, greater accessibility to the GMA and MOS-R via parent-obtained video recordings would seem to outweigh any loss of accuracy of assessment from clinical videos.

Strong relationships were found when infants were assessed at 14 to 15^{+6} weeks corrected age but less so at 12 to 13^{+6} weeks corrected age, which is in accordance with an earlier study that found a later GMA is better at 14 to 16^{+6} than at 12 to 13^{+6} weeks corrected age.[15] Since the MOS-R receives heavy weighting from the GMA numerical score, the findings from the current study also support a later MOS-R assessment at 14 to 15^{+6} weeks corrected age. Further studies that investigate changes in the MOS-R and GMA over the complete fidgety period (between 9wks and 20wks corrected age) are warranted to better understand this phenomenon, which may be driven by innate or population-specific neuronal maturation in young infants.

Strengths of the current study include the prospectively recruited sample of infants born extremely preterm/ELBW; no other studies have recruited infants born so preterm or small at birth. High interrater reliability of the MOS-R was evident in the current study and has also been demonstrated in other studies, with a Cohen's kappa score of 0.91 to 0.98[20,23] based on the original Motor Optimality Score.[10] The MOS-R was also completed with blinding to birth history and outcome. Another strength of this study is that a control group of infants born at

term was used as a reference for the Bayley-III scores to ascertain the level of impairment within the cohort of infants born extremely preterm/ELBW; therefore, the level of impairment was less likely to be underestimated in our sample. A major strength of our study is that we have been able to show evidence of a relationship between the MOS-R scored from parent-recorded videos and later neurodevelopment, opening the possibility for more widespread translation of parent-derived data into clinical practice.

Conversely, several limitations exist. We had a low proportion of parents of recruited infants returning a video for a GMA, as well as lower representation of multiples and participants with poorer neurodevelopmental performance in those who returned scorable videos. There was a lower rate of return for videos at 12 to 13^{+6} weeks corrected age, which may have affected the findings at this age, and selection bias due to the lower representation of families described in this article who did not return a video at all.[13] Furthermore, all domains of the Bayley-III could not be completed for all infants, particularly the language components where English was a participant's second language. Participants not already linked with early intervention and identified as having delays were referred for early intervention support after the Bayley-III assessment at 2 years corrected age.

The MOS-R has the potential to become part of the toolbox of early infant assessment, although future studies could explore prediction of later neurodevelopmental impairments and/or associations in other populations to improve its clinical usefulness. For example, while MOS-R scores less than 25 indicate a 'suboptimal' motor repertoire, prospective studies exploring different cut-off points for predictive validity for neurodevelopmental impairment are warranted within the extremely preterm and/or ELBW populations. Assessment of MOS-R in low-risk infants born at term could also assist in establishing normative scores to measure an infant's performance. Future studies may also explore the relationship between the MOS-R and other variables known to affect long-term outcomes, such as engagement in early intervention, social risk, or perinatal events. Finally, prospective studies in high-risk populations powered to detect a higher rate of CP within a population are warranted to build on the emerging evidence that the MOS-R may differentiate between GMFCS levels,[9,24] and would further increase the ability of clinicians to provide appropriate planning and counselling for families of high-risk infants.

Conclusions

Infants born extremely preterm/ELBW with a higher (better) MOS-R at 14 to 15^{+6} weeks have lower odds of CP and motor or cognitive impairment at 2 years corrected age; the MOS-R without the fidgety movement subsection at 14 to 15^{+6} weeks corrected age is related to

lower odds of motor and cognitive development and CP measured on the Bayley-III. The GMA alone, scored from parent-recorded videos at 14 to 15^{+6} weeks corrected age, is associated with higher odds of CP and motor impairment. Finally, where there is an urgent need for remote assessment, the MOS-R scored from parent-recorded videos can provide a powerful tool to guide clinical decision-making and referral for early intervention.

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Supporting information

The following additional material may be found online:

Figure S1: Participant flow chart

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Table 1: Participant characteristics of infants born extremely preterm/ELBW assessed with at least one MOS-R and one domain of the Bayley-III and participants with no MOS-R or Bayley-III data

	Infants with MOS-R	**Incomplete data,**

	and Bayley-III data, *n*=139	*n*=101
Neonatal characteristics		
Gestational age at birth wks, mean (SD)	26.7 (2.0)	26.6 (1.7)
Birthweight g, mean (SD)	842 (171)	831 (177)
Birthweight z-score, mean (SD)	−0.4 (1.0)	−0.5 (1.1)
Male sex, *n* (%)	68/139 (49)	55/101 (54)
Multiple pregnancy, *n* (%)	34/139 (24)	39/101 (39)
Postnatal corticosteroids, *n* (%)	44/139 (32)	24/101 (24)
Bronchopulmonary dysplasia, *n* (%)	60/122 (49)	36/86 (42)
Neonatal surgery, *n* (%)	34/139 (24)	22/99 (22)
Brain injury (any grade 3–4 IVH or cystic PVL), *n* (%)	9/139 (6)	5/99 (5)
Assessments at 3–4mo		
Absent/abnormal GMA at either assessment, *n* (%)	31/139 (22)	3/17 (18)
Corrected age at 12-wk video (*n*=96), mean (SD)	12.3 (0.4)	13.1 (0.9)
Corrected age at 14-wk video (*n*=122), mean (SD)	14.6 (0.6)	15.9 (1.2)
MOS-R 12–13^{+6} wks (*n*=96), median (IQR)	23 (13–24)	21 (–)[a]
MOS-R 14–15^{+6} wks (*n*=122), median (IQR)	23 (18–24)	23 (21–24.5)
MOS-R without general movement component 12–13^{+6} wks (*n*=96), median (IQR)	11 (10–12)	9 (–)[a]
MOS-R without general movement component 14–15^{+6} wks (*n*=122), median (IQR)	11 (9–12)	11 (11–12.5)
Characteristics at 2y		
Corrected age at Bayley-III assessment, mean (SD)	2.10 (0.14)	2.25 (0.26)
CP, *n* (%)	7/139 (5)	6/76 (8)
Motor sum composite score (*n*=138), mean (SD)	100.6 (16.9)	95.1 (15.0)
Motor impairment,[b] *n* (%)	59/139 (42)	38/71 (54)
Motor impairment (no CP), *n* (%)	52/132 (39)	30/63 (48)
Cognitive composite score (*n*=138), mean (SD)	99.1 (15.9)	94.1 (14.2)
Cognitive impairment,[b] *n* (%)	68/139 (49)	39/72 (54)
Language sum composite score (*n*=116), mean (SD)	96.8 (19.6)	92.6 (16.8)
Language impairment,[b] *n* (%)	51/117 (44)	39/60 (65)

[a]*n*=1, so no IQR. [b]Includes one infant with severe cerebral palsy (CP) who could not be formally assessed with the Bayley Scales of Infant and Toddler Development, Third Edition (Bayley-III) and was allocated a score of ≤4 standard deviations (SD). 'Impairment' indicates Bayley-III scores ≤1SD relative to the mean of infants born at term (controls). Motor impairment is inclusive of CP diagnosis at 2 years corrected age. ELBW, extremely-low-birthweight; MOS-R, Motor Optimality Score-Revised; IVH, intraventricular haemorrhage; PVL, periventricular leukomalacia; GMA, General Movements Assessment; IQR, interquartile range.

Table 2: Associations between MOS-R scores with and without fidgety movement subsection and GMA-only at 12–13^{+6} and 14–15^{+6} weeks and outcomes at 2 years in infants born extremely preterm/ELBW

Outcomes at 2y		Full MOS-R				MOS-R without fidgety movement subsection				GMA			
	n (impaired/not impaired)	Yes mean (SD)	No mean (SD)	OR[a] (95% CI)	*p*	Yes mean (SD)	No mean (SD)	OR[a] (95% CI)	*p*	Absent/abnormal	Normal	OR[a] (95% CI)	*p*
12–13^{+6} wks													
CP	3/93	16.7 (10.1)	19.7 (5.9)	0.93 (0.74–1.16)	0.53	8.3 (4.9)	11.1 (2.0)	0.59 (0.25–1.41)	0.23	1/32 (3)	2/64 (3)	1.00 (0.09–11.68)	1.00
Impaired Bayley-III domain													
Motor	38/58	18.5 (6.8)	20.3 (5.4)	0.95 (0.89–1.02)	0.15	10.7 (2.8)	11.3 (1.7)	0.88 (0.73–1.06)	0.17	15/32 (47)	23/64 (36)	1.59 (0.67–3.76)	0.30
Cognitive	43/53	18.4 (6.8)	20.5 (5.2)	0.99 (0.97–1.01)	0.17	10.8 (2.6)	11.3 (1.7)	0.96 (0.91–1.02)	0.21	18/32 (56)	25/64 (39)	1.50 (0.80–2.82)	0.20
Language	35/48	18.7 (6.6)	20.4 (5.4)	0.97 (0.91–1.03)	0.36	11.0 (2.5)	11.1 (2.0)	0.99 (0.91–1.08)	0.87	14/27 (52)	21/56 (38)	1.40 (0.61–3.24)	0.43
14–15^{+6} wks													
CP	6/118	13.1 (7.6)	20.7 (5.4)	0.83 (0.71–0.99)	0.04	8.7 (3.5)	11.0 (2.1)	0.62 (0.41–0.94)	0.03	4/31 (13)	2/93 (2)	6.74 (1.16–39.24)	0.03
Impaired Bayley-III domain													
Motor	50/72	18.7 (6.0)	21.3 (5.4)	0.93 (0.87–0.99)	0.02	10.4 (2.3)	11.3 (2.2)	0.84 (0.71–0.98)	0.03	17/30 (57)	33/92 (36)	2.24 (1.03–4.86)	0.04
Cognitive	57/65	19.0 (6.0)	21.4 (5.4)	0.94 (0.88–0.99)	0.04	10.3 (2.2)	11.4 (2.2)	0.83 (0.71–0.97)	0.02	18/30 (60)	39/92 (42)	1.75 (0.89–3.42)	0.10
Language	42/62	19.2 (6.1)	21.1 (5.6)	0.95 (0.89–1.01)	0.16	10.5 (2.4)	11.3 (2.1)	0.85 (0.72–1.02)	0.08	13/26 (50)	29/78 (37)	1.58 (0.70–3.54)	0.27

Data are *n* (%) unless otherwise stated. [a]Odds ratio (OR) for the likelihood of the listed 2-year outcomes according to each 1-point increase in Motor Optimality Score-Revised (MOS-R). GMA, General Movements Assessment; ELBW, extremely-low-birthweight; CI, confidence interval; CP, cerebral palsy; Bayley-III, Bayley Scales of Infant and Toddler Development, Third Edition.