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Association of stress signals with developmental outcome at 10 months in premature infants

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BACKGROUND
The aim of this study was to investigate if uncoordinated sucking, swallowing, and respiration (SSR) during the preterm period, which results in stress signals during bottle-feeding, is indicative of developmental outcomes when evaluated at 10 months of corrected age.

Methods
We retrospectively reviewed the medical records of premature infants born between January 2014 and December 2016 at * National University Hospital (*NUH). At least two minutes of video-recording was conducted for all referred infants, which was then reviewed for assessment using the Neonatal Oral-Motor Assessment Scale (NOMAS). A total of 71 premature infants were assigned a NOMAS score at the preterm period and a Bayley score at 10 months of corrected age (CA). Of these, 70 premature infants exhibited a disorganized sucking pattern according to the NOMAS. The disorganized sucking pattern was divided into two groups according to incoordination findings (Table 1). The incoordination-positive group included cases exhibiting stress signals (i.e., head bobbing, extraneous movements of the body or limbs during sucking, choking, gagging, coughing, yelping, and grunting) and defined as cluster 4. The incoordination-negative group included clusters 2 and 3 and included cases exhibiting no stress signals.

Results
Of the premature infants belonging to the incoordination-positive group (cluster 4, n=22), 4 (18.18%) had a Bayley-III cognitive composite score of less than 85 at 10 months of CA. The Bayley-III cognitive composite score was significantly lower (p=0.004 by Mann-Whitney U test) in the incoordination-positive group (cluster 4) than in the incoordination-negative group (cluster 2, 3). In univariate analysis, moderate-to severe bronchopulmonary dysplasia (BPD), presence of stress signals (incoordination positive group= cluster 4), Grades 3 or 4 germinal matrix hemorrhage-intraventricular hemorrhage (GMH-IVH), total parenteral nutrition duration, and birth weight were considered predictive of cognitive development at 10 months. Meanwhile, a multple linear regression analysis indicated that the presence of stress signals, Grades 3 or 4 GMH-IVH, and moderate-to-severe BPD were predictive of cognitive development at 10 months.

Conclusions

There is a need for periodic follow-up and early intervention for developmental delay when incoordination that results in stress signals in NOMAS is observed before 40 weeks post-menstrual age.

TABLE 1 | Scoring instructions and interpretation for each Neonatal Oral-Motor Assessment Scale cluster.

Cluster	Interpretation	Scoring instruction
1	Normal sucking pattern	
2	Disorganized sucking pattern	Only an arrhythmical sucking pattern, without the observation of "unable to sustain" or "incoordination of suck/swallow and respiration" sucking patterns
3	Disorganized sucking pattern	An arrhythmical and "unable to sustain" suckle pattern The "unable to sustain" suckle pattern includes the following: 1. The infant ceases sucking completely during the first 2 min of nutritive sucking, or 2. The pauses are longer than the burst, or 3. The bursts are shorter than three sucking phases
4	Disorganized sucking pattern	An arrhythmical and "incoordination of suck/swallow and respiration" sucking patterns that cause stress signals; the "unable to sustain" suckle pattern may or may not be present "Incoordination of suck/swallow and respiration" includes all the following stress signals: nasal flaring, head turning, head bobbing, extraneous movements of the body or limbs, gagging, choking, coughing, yelping, and grunting
5	Dysfunctional sucking pattern	The interruption of sucking activity owing to abnormal movements of the tongue and jaw which includes the following: 1. Excessively wide excursions of the jaw or 2. Minimal excursions: clenching or 3. Flaccid tongue with absent tongue groove or 4. Retracted tongue with posterior humping

Table 2. Multiple regression analysis for Bayley-III cognitive composite score at 10 months of corrected age

Variable	B	95% CI for B	Beta	t	P value
Presence of stress signals (Incoordination-positive vs. negative group on NOMAS)	-8.926	-15.118 to -2.734	-0.306	-2.880	0.005
Grades 3 or 4 GMH-IVH	-21.714	-33.525 to -9.902	-0.373	-3.670	0.001
Moderate-to-severe BPD	-6.213	-12.355 to -0.072	-0.216	-2.020	0.048

NOMAS, Neonatal Oral-Motor Assessment Scale; TPN, total parenteral nutrition; BPD, bronchopulmonary dysplasia

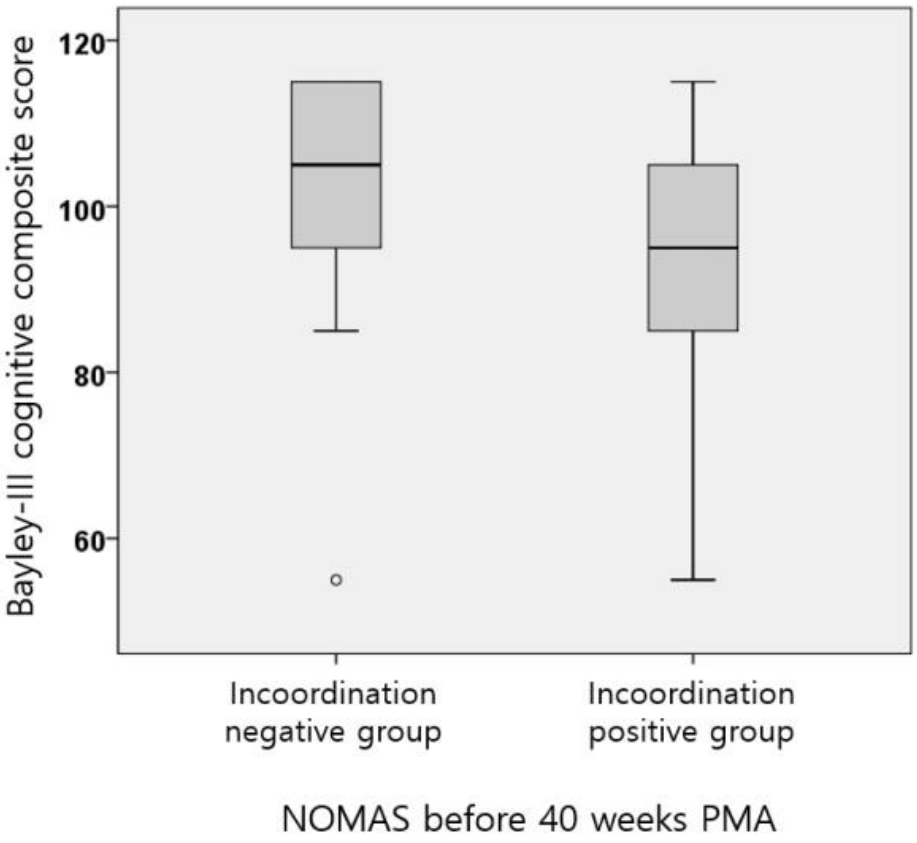

Figure 1. Bayley-III cognitive composite score at corrected age 10 months based on incoordination findings in Neonatal Oral-Motor Assessment Scale