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Neuropredictors of oromotor feeding impairment in 12 month-old children

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ABSTRACT

Background: Feeding impairment is prevalent in children with neurodevelopmental issues. Neuroimaging and neurobehavioural outcomes at term are predictive of later neuromotor impairment, but it is unknown whether they predict feeding impairment.

Aims: To determine whether neurobehavior and brain magnetic resonance imaging (MRI) at term predict oromotor feeding at 12 months in preterm and term-born children.

Study design.

Prospective cohort study.

Subjects

248 infants (97 born < 30 weeks and 151 born at term) recruited at birth.

Outcome measures.

Neurobehavioral assessments (General Movements (GMA), Hammersmith Neonatal Neurological Examination (HNNE), Neonatal Intensive Care Unit Network Neurobehavioral Scale (NNNS)); and brain MRI were administered at term-equivalent age. Oromotor feeding was assessed at 12 months corrected age using the Schedule for Oral Motor Assessment.

Results

49/227 children had oromotor feeding impairment. Neurobehavior associated with later feeding impairment was: suboptimal NNNS stress (odds ratio [OR] 2.68; 95% confidence interval [CI] 1.20–6.01), non-optimal reflexes (OR 3.33; 95% CI 1.37–8.11) and arousal scales (OR 2.54; 95% CI 1.03–6.27); suboptimal HNNE total (OR 4.69; 95% CI 2.20–10.00), reflexes (OR 2.62; 95% CI 1.06–6.49), and tone scores (OR 3.87; 95% CI 1.45–10.35); and abnormal GMA (OR 2.60; 95% CI 1.21–5.57). Smaller biparietal diameter also predicted feeding impairment (OR 0.88; 95% CI 0.79–0.97). There was little evidence that relationships differed between birth groups.

Conclusions

Neurobehavior and biparietal diameter at term are associated with oromotor feeding at 12 months. These results may identify children at greatest risk of oromotor feeding impairment.

1. Introduction

Oromotor feeding skills — coordinated movements of the orofacial musculature for eating and drinking — are crucial for maintaining nutrition, and thus affect growth, health and neurodevelopment [1]. Early identification of infants at greatest risk of oromotor feeding impairment can facilitate early intervention [1]. Yet key risk factors for

Abbreviations: GMA, general movement assessment; HNNE, Hammersmith Neonatal Neurological Examination; MRI, magnetic resonance imaging; NNNS, Neonatal Intensive Care Unit Network Neurobehavioral Scale; SOMA, schedule for oromotor assessment

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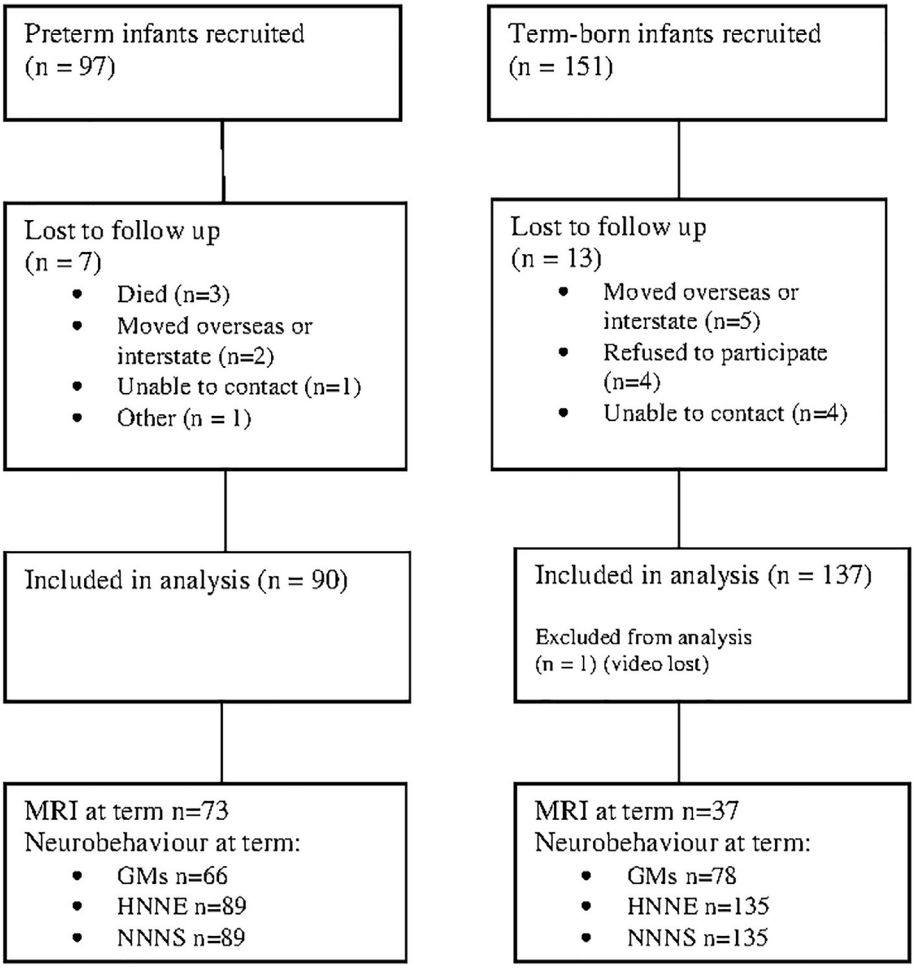

Fig. 1. Participation flowchart.

oromotor feeding impairment are largely unknown. Importantly, clinical factors associated with feeding skills more broadly (such as gavage feeding duration and birth weight) are not consistently shown to be predictive of oromotor feeding impairment [2]. Thus clinicians are unable to reliably predict which infants will have lasting oromotor feeding difficulties, and would therefore benefit from surveillance.

There may be an association between neurobehavioral assessment outcomes measured from birth to four months of age, and feeding skills from the neonatal period up to age two years [3–5]. Specific neurobehavioral features correlated with neonatal feeding include orientation, state regulation (maintaining and transitioning between levels of arousal) and range (demonstrating a range of levels of arousal), and spontaneous movement repertoire [4,5]. While less is known about neonatal neurobehavior and later feeding outcomes, neonatal hypotonia has been associated with feeding outcomes at two years, despite little evidence of an association between cerebral structure alterations and feeding outcomes in the same study [3].

The neuroanatomical correlates of feeding or swallowing disorder (dysphagia) have been investigated in adults post-stroke, with various areas of the cerebral cortices, cerebellum and brainstem all contributing to swallowing function [6]. Oromotor skills in adolescents born preterm have also been associated with central nervous system abnormalities, particularly damage to the corticospinal and corticobulbar tracts [7]. However, there is less understanding of the neural correlates of pediatric feeding impairment, with a small number of studies reporting associations (predictive and concurrent) between pediatric feeding impairment and injury to the basal ganglia and brainstem [8,9], and general measures of brain injury or abnormality [10,11]. Whilst brain size and injury at term equivalent age have been shown to be predictive of neuromotor outcomes, oromotor feeding outcomes have not been specifically studied [12,13].

Many infants who spend time in neonatal intensive care units, particularly those born preterm, may undergo neurobehavioral assessment and neuroimaging as part of clinical care; [14,15] and several studies have demonstrated that brain size [13,16], brain abnormality scores [12,16,17], and neurobehavioral assessments [13,18] are associated with neuromotor outcomes. Preterm children are at increased risk of poor oromotor feeding outcomes [2], yet no study has examined the value of these assessments in predicting oromotor feeding outcomes, or in exploring the neuromechanisms of oromotor feeding ability.

Here we aimed to determine whether, in our cohort of term and preterm children, (1) neonatal neurobehavioral assessments administered at term-equivalent age predict oromotor feeding impairment at 12 months; and (2) brain abnormality on magnetic resonance imaging (MRI) at term-equivalent age predicts oromotor feeding impairment at 12 months. We hypothesized that poorer neurobehavior, greater global brain abnormality, and reduced brain size would predict oromotor feeding impairment. A secondary aim was to determine whether these relationships differed between infants born preterm or at term.

2. Methods

2.1. Participants

Infants in this study were recruited from the Royal Women's Hospital and Frances Perry House in Melbourne, Australia, between 2011 and 2013, as part of a longitudinal cohort study of neurobehavior