ESPR YOUNG INVESTIGATOR AWARD

FIRST PRIZE

K. Keunen, Utrecht, The Netherlands

Department of Neonatology, University Medical Center Utrecht, the Netherlands; Brain Center Rudolf Magnus, University Medical Center Utrecht, the Netherlands

PREDICTING SCHOOL-AGE COGNITIVE CAPACITIES FROM THE NEONATAL CONNECTOME IN PRETERM BORN CHILDREN

SECOND PRIZE

C. Ahearne, Wilton, Ireland

Irish Centre for Fetal and Neonatal Translational Research, UCC, Cork, Ireland

BAYLEY SCALES OF INFANT AND TODDLER DEVELOPMENT (EDITION 3) IN A LOW RISK HEALTHY POPULATION

Brain & Development / Structural and Functional Brain Imaging

PREDICTING SCHOOL-AGE COGNITIVE CAPACITIES FROM THE NEONATAL CONNECTOME IN PRETERM BORN CHILDREN

K. Keunen 1,2; M.J.N.L. Benders 1,2,3; A. Leemans 4; I.C. van Haastert 1; P.C. Fieret-Stam 5; L.H. Scholtens 2,6; M.A. Viergever 5; R.S. Kahn 2,6; F. Groenendaal 1,2; L.S. de Vries 1,2; M.P. van den Heuvel 2,6

1. Department of Neonatology, University Medical Center Utrecht, the Netherlands 2. Brain Center Rudolf Magnus, University Medical Center Utrecht, the Netherlands 3. Centre for the Developing Brain, King's College, London, United Kingdom 4. Image Sciences Institute, University Medical Center Utrecht, the Netherlands 5. Department of Medical Psychology, University Medical Center Utrecht, the Netherlands 6. Department of Psychiatry, University Medical Center Utrecht, the Netherlands

Introduction

The organization of human brain wiring is known to be related to intellectual performance, with high performing individuals exhibiting more efficient connectivity patterns. However, when during connectome development the relationship between key features of the human brain network and cognitive functioning are established -and conversely how cognitive deficits are potentially related to early affected early connectome organization-, remains unclear. Here, we examined the putative link between neonatal connectome organization (and disorganization) and cognition until early school age in a cohort of 57 preterm infants (mean gestational age 28.1±1.8 weeks, birth weight 1071±302 grams).

Patients and Methods

For each infant, a connectome map was derived from diffusion weighted imaging data (3T MR, single shot EPI, 32 weighted diffusion scans (b=800 s/mm2) acquired at term equivalent age (TEA). Connectome maps were formed by selecting 56 cortical regions of interest and combining them with deterministic tractography to reconstruct the complete connectivity wiring between these regions. Of each individual connectome, its topological organization was investigated by means of network analysis, with a particular focus on global efficiency (computed as the inverse of the average shortest path length in the network). Next, cognitive outcome scores were obtained in early childhood (at age 2 years) using the BSITD-III) and again at age 5.5 years in now school-going children, using the WPPSI-III NL.

Results

Neonatal network organization was found to be a significant predictor for childhood cognitive capacities. In particular global efficiency (i.e. the inverse of path length) of the neonatal network as a whole –reflecting how well the anatomical infrastructure can support global information integration at TEA- was observed to be significantly related to cognitive composite scores at age two (n=57, r=0.26, p=0.04), performance IQ (PIQ) (n=31, r=0.55, p=0.002), and full-scale IQ (n=31, r=0.47, p=0.01) at age 5.5 years. Clustering coefficient –measuring the level of segregation of the network into clusters specialized for local information processing- was also found to be associated with PIQ (r=0.49, p=0.009). These findings indicate that in particular higher levels of long-range communication capacity of the neonatal network correspond with better cognitive performance later in life.

Conclusions

Our study provides evidence for a sustainable relationship between anatomical organization of the neonatal connectome and long-term cognitive capacities. Conversely, we hypothesize that alterations in neonatal network architecture may comprise a neurobiological substrate for cognitive deficits later in life. The neonatal connectome may thus offer a valuable imaging marker for early identification of infants at risk of these deficits.

Brain & Development / Neurodevelopmental Outcome

BAYLEY SCALES OF INFANT AND TODDLER DEVELOPMENT (EDITION 3) IN A LOW RISK HEALTHY POPULATION

C. Ahearne 1; G. Hannon 1; M. Kiely 1; L. Kenny 1; J. O'B Hourihane 2; D. Murray 1,2

1 Irish Centre for Fetal and Neonatal Translational Research, UCC, Cork, Ireland; 2 Department of Paediatrics and Child Health, Cork University Hospital, Cork, Ireland

Introduction

The Bayley Scales of Infant and Toddler Development (Edition 3) [BSID-III] is a widely used developmental assessment tool for the early detection of disability in high-risk groups. However it was standardised on an American paediatric population, which included 10% from at-risk populations. Recently concerns regarding population differences have been raised (1). In addition the inclusion of high-risk populations may lead to the underestimation of developmental delay. The aim of this study was to determine the performance of a low-risk European population in the BSID-III compared with standardised normative values.

Patients and Methods

A representative sample of children were chosen from within the population based Cork BASELINE birth cohort study and invited to attend for neurodevelopmental assessment using BSID-III at 2 years. Only healthy, low risk singleton infants with no perinatal risk factors were included in analysis. Exclusion criteria were IUGR, prematurity, HIE and congenital anomalies or failure to complete any subtest. Analysis used t-tests to compare mean scores for each scale with standardised norms. Scaled scores were compared to a test value (SD) of 10(3) and composite scores were compared to a test value of 100(15).

Results

240 children were assessed using the BSID-III at a median (min-max) age of 27 months 5 days (24 months 13 days – 32 months 28 days). 198 children had completed all subscales of the BSID-III and 42 assessments were incomplete. Language composite scores (mean ± SD) were significantly higher compared to standardised normative values, 109 ± 13 v. 100 ± 15, $p<0.001$. This was based on raised receptive and expressive language scaled scores, 11.2 ±2 v. 10 ± 3, $p<0.001$ and 11.8 ±3 v. 10 ± 3, $p<0.001$ respectively. Fine motor scaled scores (mean ± SD) also increased significantly, 11.5 ±2 v. 10 ± 3, $p<0.001$ which had an effect on overall motor composite score, 106 ± 11 v. 100 ± 15, $p<0.001$ though gross motor scaled scores did not differentiate significantly, $p=0.151$. Cognitive composite scores also did not show a significant difference from norms, $p=0.214$.

Conclusions

This is the first known data on the performance of a European population of low-risk 2-year olds on the BSID-III. These results further highlight the existence of population variations. These results also suggest that we are at risk of underestimating developmental delay in language and fine motor skills if relying on U.S. standardised scores with whole population norms.

Subtest Score	N	Mean Difference (95% CI)	p-value
Cognitive Scaled Score	234	-0.171 (-0.44, 0.10)	0.214
Receptive Language Scaled Score	214	1.238 (0.95, 1.53)	<0.001
Expressive Language Scaled Score	209	1.766 (1.38, 2.15)	<0.001
Fine Motor Scaled Score	230	1.496 (1.19, 1.8)	<0.001
Gross Motor Scaled Score	216	0.250 (-0.09, 0.59)	0.151
Cognitive Composite Score	234	-0.855 (-2.21, 0.50)	0.214
Language Composite Score	208	9.192 (7.39, 11.00)	<0.001
Motor Composite Score	212	5.807 (4.28, 7.33)	<0.001

Table 1: Comparison of population scores to normative values