The Influence of Pregnancy Duration on Cerebellar Volume in Healthy 9-year-old Children

Inge L.C. van Soelen [1,2], Rachel M. Brouwer [2], Jiska S. Peper [3], Toos C.E.M. van Beijsterveldt [1], Marieke van Leeuwen [1], Linda S. de Vries [4], René S. Kahn [2], Hilleke E. Hulshoff Pol [2], Dorret I. Boomsma [1]

[1] Department of Biological Psychology, VU University Amsterdam, Amsterdam, the Netherlands. [2] Rudolf Magnus Institute of Neuroscience, Department of Psychiatry, University Medical Center Utrecht, Utrecht, the Netherlands. [3] Department of Experimental Psychology, Utrecht University, Utrecht, the Netherlands. [4] Department of Neonatology, University Medical Center Utrecht, the Netherlands.

Background and Aim

The association between cerebral abnormalities and very preterm birth (VPT; < 32 weeks) or very low birth weight (VLBW; < 1500 g) has been well established[1]. More specifically, several studies have illustrated a possible relationship with prematurity and disturbed cerebellar development at birth and later in life[2,3]. The majority of these studies concerns children born VPT and with VLBW. Recently, the importance to examine the long-term effects on infants born between 32 to 37 weeks (also referred to as late-preterm) has been acknowledged[4].

We explored the effects of gestational age and birth weight on brain volumes in a population-based sample of normal developing 9-year-old children that were born between 32 and 40 weeks of gestation, with birth weight above 1500 g and without major medical complications.

Methods

Children were recruited from the Netherlands Twin Register (NTR). In total 195 children (96 male) underwent an MRI scan operating at 1.5 T. Data on gestational age and birth weight was reported by parents shortly after birth (Table 1). Intracranial (IC), total brain, cerebellum (Figure 1), cerebrum and gray and white matter volumes were assessed. To correct for familial dependency, structural equation modelling was used to estimate the regression effects of gestational age and birth weight on brain volumes, with IC volume, age at scan, and sex as covariates.

Tabel 1. Mean (SD) and range of gestational age (weeks), birth weight (gram), age at moment of scan (years), cerebrum and cerebellar volume (ml).

	Mean *(SD)*	Range
Gestational age *(weeks)*	36.8 *(1.6)*	32.5 – 40.0
Birth weight *(grams)*	2616.5 *(438.8)*	1525 – 3820
Age at time of scan *(years)*	9.2 *(0.1)*	9.0 – 9.7
Cerebrum *(ml)*	1192.4 *(105.9)*	966.3 – 1458.3
Cerebellum *(ml)*	153.2 *(13.8)*	126.3 – 192.0

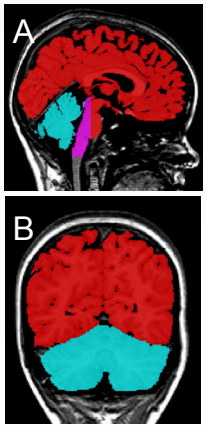

Figure 1. Example of a cereballar volume segmentation in sagital (A) and in coronal view (B).

Results

Age at moment of scanning was not correlated to gestational age. Increase in gestational age was associated with relative larger cerebellar volume at 9 years of age (β = 1.77 ml / week; p < 0.01; Figure 2). Increased birth weight was associated with relative larger cerebrum volume at age 9 (β = .8 ml / 100 gram; p < 0.05). No other brain volumes were influenced by birth weight or gestational age differences.

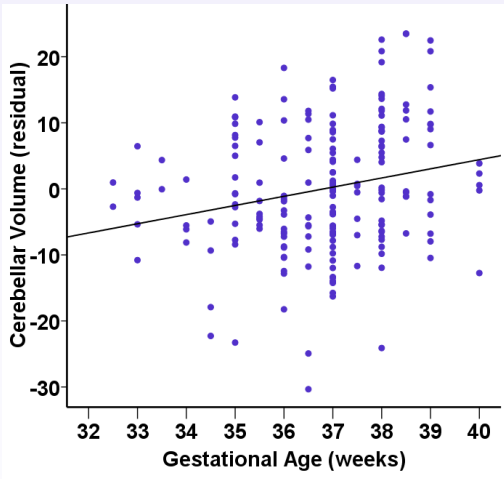

Figure 2. Relative cerebellar volume increase (corrected for IC, sex, age at scan, and birth weight) plotted against the increase in gestational age.

Conclusions

Shorter gestational age was associated with a relatively smaller cerebellar volume, and lower birth weight was associated with a relatively smaller cerebrum volume at age 9 (i.e. influences on relative brain volumes, after differences due to head size were excluded).

Our findings on the effect of gestational age on cerebellar volume are consistent with other studies on VPT infants with VLBW vs. controls. One important difference is that the present study is a population based sample, born between 32 and 40 weeks of gestation and with birth weight > 1500 g. This study emphasis the importance not to ignore this low risk group (born after >32 weeks) and future research should focus on their long term developmental trajectories.

Contact Information:
ilc.van.soelen@psy.vu.nl

Rudolf Magnus Institute of Neuroscience

vrije Universiteit amsterdam

University Medical Center Utrecht

[1]Hart, et al., *Dev.Med.Child Neurol.*, 2008; [2] Limperopoulos, et al., *Pediatrics,* 2005; [3] Allin, et al.,*Brain,* 2001; [4] Morse, et al. *Pediatrics*, 2009