



# The relation between gestational age, attainment of motor milestones and volumetric brain measures in healthy 9-year old twins.

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## Abstract

Delayed attainment of motor milestones has been suggested to act as a predictor for psychiatric illnesses at a later age <sup>a</sup>. Furthermore, earlier motor development was associated with increased gray and white matter density in healthy adults <sup>b</sup>. Therefore, we explored the association between the attainment of motor milestones and volumetric brain measures at 9-years of age in healthy children and the influence of gestational age (GA) on these measures.

## Methods

A total of 112 twin pairs were recruited from the Netherlands Twin Register (NTR, VU Amsterdam) at the age of 9 years for an ongoing study, including structural MRI (209 individuals completed the scan protocol). Total brain, cerebellum, cerebrum and gray (GM) and white matter (WM) volumes were assessed. The attainment of motor milestones (months) was reported at age 2 by the parents. See Table 1 for descriptives.

**Table 1.** Average birth weight (gr), Gestational age (weeks) reported after birth and average attainment of the motor milestones (months) reported by the parents at age 2.

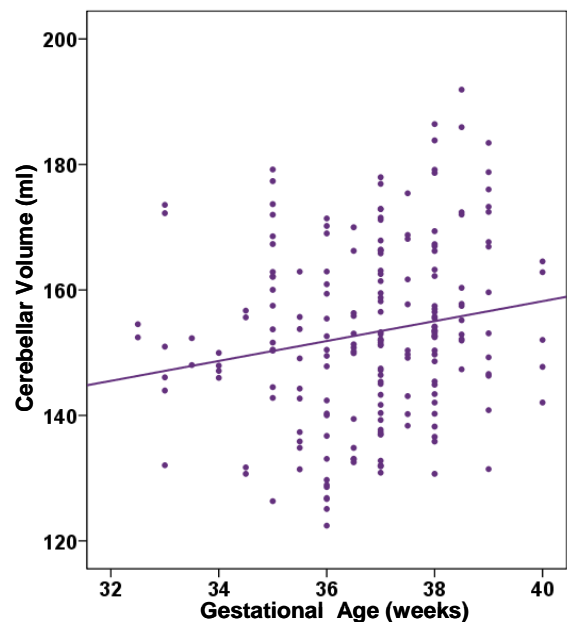
	Mean (SD)	N	
Gestational age (weeks)	36.9 (0.1)	109	(twin pairs)
Birth weight (gr)	2672 (32)	214	(individuals)
Turn from back to belly (months)	6.6 (0.1)	189	
Sitting without support	9.1 (0.1)	186	
Hands and knees crawling	10.5 (0.2)	187	
Standing without support	12.8 (0.2)	184	
Walking without support	15.5 (0.1)	190	

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## Results

GA was correlated with Turning ( $r = -.17, p = .018$ ), Standing ( $r = -.23, p = .002$ ), and Walking ( $r = -.18, p = .014$ ). Only cerebellum volume was correlated with GA, see Figure 1 ( $r = .19, p = .008$ , corrected for sex).



**Figure 1.** The correlation between GA and cerebellum volume at age 9.

GA had an effect on motor milestones, therefore twins were ordered as "first" or "second" to achieve a specific milestone compared to their own co-twin. Using paired T-tests, differences in brain measures were tested for significance within twin pairs. Because sex has an effect on brain volumes, only same-sex twin pairs were included in this analysis. GM volume was significantly larger for twins that started walking earlier compared to their own co-twin ( $N = 45$  twin pairs,  $p = 0.033$ ).

## Conclusions

- Shorter GA was related to;
- Later attainment of turning, standing, and walking.
  - Smaller cerebellar volume at 9 years old.

Twins that were earlier with walking compared to their own co-twin, had larger GM volume.



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<sup>a</sup> Jones, et al., 1994, Lancet; <sup>b</sup> Ridler, et al., 2006, PNAS