

## SHORT REPORT

# Could dehydration in infancy lead to high blood pressure?

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There is considerable evidence that early life exposures influence later blood pressure<sup>1</sup> and the disease end point most strongly associated with blood pressure—haemorrhagic stroke—is also related to indicators of early life adversity.<sup>2</sup> In particular, the number of siblings that a person had was positively associated with haemorrhagic stroke risk.<sup>2</sup> A small case-control study found that an infant or perinatal death in one or more siblings was associated with increased risk of stroke.<sup>3</sup> Both haemorrhagic stroke<sup>4</sup> and blood pressure<sup>5</sup> declined across the 20th century in developed countries, and both show cohort effects, such that each subsequent birth cohort has lower haemorrhagic stroke risk and lower levels of blood pressure than previous birth cohorts.<sup>5</sup> Across countries infant mortality rates 70 years ago correlate strongly with current stroke mortality.<sup>6</sup> One early life factor that would be related to all these indicators of early life exposure is infant diarrhoea. We postulate that severe dehydrating diarrhoea in infancy is associated with higher subsequent blood pressure.

## METHODS AND RESULTS

The Avon longitudinal study of parents and children (ALSPAC) is a population based study investigating the health and development of children (<http://www.alspac.bris.ac.uk>). Women living in three health districts of Bristol, England with expected delivery dates between April 1991 and December 1992 were eligible, 14 541 (85%) enrolled, and there were 14 049 singleton and twin live births. Ethical approval was obtained from the ALSPAC and local research ethics committees. In questionnaires filled out by mothers when the infant was 6 months of age eight cohort members were reported as having been admitted to hospital for dehydration. Of these six attended the 7 year old clinic, where blood pressure was recorded. Comparing these six with the cohort members who attended the clinic and who had not been admitted for dehydration (n = 7834), systolic and diastolic blood pressures were found to be higher (see table 1), although effect estimates were imprecise, were lower for systolic than for diastolic blood pressure, and the confidence intervals for the systolic blood pressure result overlapped the null. This difference was not attenuated by

using multiple regression to adjust for potential confounding factors.

## DISCUSSION

Our results suggest that the very small percentage of children who were dehydrated severely enough in infancy to require hospital admission had, by the age of 7, higher blood pressure than the remainder of the cohort, and this difference was unchanged by adjustment for potential confounding factors. One randomised controlled trial found that sodium restriction during the first six months of life was related to lower blood pressure at age 15.<sup>7</sup> Physiologically, dehydration could be considered the reverse of sodium restriction. There are clear reasons for thinking that salt retention would protect against sudden fluid loss of the kind that may occur during acute infant diarrhoea that may otherwise prove fatal.<sup>8</sup> An evolved adaptive mechanism such that experience of dehydration leads to future salt retention could have important survival advantages. Our data are both intriguing and inconclusive, given the small number of people who experienced dehydration severe enough to require hospital admission. Furthermore, we have no explanation for the apparently greater effect on diastolic blood pressure, than systolic blood pressure, although given the imprecision in our

### What this paper adds

This paper reports the first empirical evidence in support of the hypothesis that dehydration in infancy programmes later life blood pressure.

### Policy implications

If this hypothesis is supported by further data then the implications are that control of infancy diarrhoea and dehydration could reduce the later burden of hypertension and cerebral haemorrhage in populations, in particular for populations in developing countries.

**Table 1** Blood pressure at age 7 according to hospital admissions for dehydration in first six months of life

	Systolic blood pressure mm Hg (mean, 95% CI)	Systolic blood pressure*	Diastolic blood pressure	Diastolic blood pressure*
Dehydration admission	100.4 (93.1, 107.8)	101.4 (94.6, 108.1)	62.4 (57.1, 67.7)	62.7 (57.5, 67.9)
No dehydration admission	98.9 (98.7, 99.1)	98.9 (98.7, 99.1)	56.5 (56.3, 56.6)	56.5 (56.3, 56.6)
Difference	1.5 (−5.8, 8.9)	2.5 (−4.3, 9.3)	5.9 (0.6, 11.3)	6.2 (1.04, 11.4)
p difference	0.7	0.47	0.03	0.02

\*Adjusted for sex, age, height, and BMI at the time of blood pressure measurement, birth weight and gestation, maternal education. The p values are from regression analyses.

effect estimates these could not be clearly distinguished. Repeating this study in places with higher rates of dehydration, or within randomised trials of improved hygiene practices that reduce diarrhoea among infants, combined with animal model experimentation on the influence of severe early life dehydration on later blood pressure, could provide evidence to support our hypothesis. If established, the link between diarrhoea and dehydration in infancy and later blood pressure could explain the secular trends in both blood pressure and haemorrhagic stroke, the ecological associations between past infant mortality and current day stroke, and the association between markers of high diarrhoeal disease risk in infancy (such as number of siblings or the death in infancy of a sibling) and haemorrhagic stroke.

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