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Sources and Correlates of Sodium Consumption in the First 2 Years of Life

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ABSTRACT

Background High sodium intake during infancy and early childhood can change salt preference and blood pressure trajectories across life, representing a modifiable cardiovascular risk factor. Describing young children's sodium intake is important for informing effective targets for sodium reduction.

Objective This study aimed to describe food sources and demographic and behavioral correlates of sodium intake in 295 young Australian children using three unscheduled 24-hour recalls (when children were 9 and then 18 months of age) with mothers participating within an existing randomized controlled trial, the Melbourne Infant Feeding Activity and Nutrition Trial (InFANT) Program.

Methods Differences in individual-level and family-level demographic and behavioral variables were assessed across tertiles of sodium density (mg/1,000 kcal). Descriptive statistics were used to describe food-group contributions to total energy and sodium intakes at both ages.

Results Mean sodium intake was 486 mg (standard deviation=232 mg) at 9 months and had more than doubled to 1,069 mg (standard deviation=331 mg) at 18 months of age. Fifty-four percent of children at 18 months exceeded the Recommended Daily Upper Level for sodium intake, with bread, cheese, breakfast cereal, soup, and mixed dishes all important sources of sodium at both ages. Yeast extracts, processed meats, and bread products became important additional sources at 18 months. A greater proportion of children in the highest sodium-density tertile had ceased breastfeeding and had commenced solids at an earlier age.

Conclusions The key food sources of sodium for children younger than 2 years are those that contribute to the whole population's high salt burden and highlight the essential role governments and food industry must play to reduce salt in commonly consumed foods.
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HYPERTENSION IS CONSIDERED TO BE ONE OF THE most important preventable causes of stroke and cardiovascular disease.[1] After reducing smoking, worldwide reduction in dietary sodium (salt) intake has been proposed to be the most effective strategy to reduce cardiovascular disease.[2,3] The high sodium intake of developed nations is associated with higher levels of blood pressure (BP)[1,4,5] and, importantly, BP has been shown to track across the lifespan.[6-8] Understanding opportunities in early life where this tracking trajectory might be altered will be important for reducing the morbidity and mortality associated with cardiovascular disease.

Evidence suggests that sodium intake predicts BP in older children.[9,10] For example, in a US sample of 6,235 8- to 18-year-olds, each additional 1,000 mg sodium/day was associated with an increased standard deviation (SD) score of 0.097 in systolic BP (95% CI 0.006 to 0.188; approximately 1.0 mm Hg).[10] In addition, a meta-analysis including 10 controlled trials showed a 42% reduction in daily sodium predicted substantial reductions in systolic (−1.17 mm Hg) and diastolic (−1.29 mm Hg) BP in children aged 8 to 16 years.[11]

There is also evidence that exposure to higher sodium intake during infancy increases BP in childhood and adolescence. Hoffman and colleagues,[12] in a randomized controlled trial (n=476) comparing low-sodium with normal-sodium diets from 2 months of age, reported that systolic BP was 2.1 mm Hg (95% CI 0.5 to 3.7) lower in the low-sodium compared with the normal-sodium group at 6 months of age. When followed up at 15 years of age (n=167), the difference between the original low- and normal-sodium diet groups had increased to 3.6 mm Hg (95% CI 0.5 to 6.6).[13] In addition, one longitudinal study reported that sodium intake at 4 months of age (n=533) was positively associated with systolic BP at age 7 years.[14] Relatively little is known about young children's sodium intake, with just five studies worldwide providing high-quality dietary recall data in the last 2 decades.[15-19]

The few existing studies report that most children under 2 years of age are consuming sodium in excess of national recommendations.[15-19] Importantly, however, just two studies report contemporary data,[15,17] with most data now more than a decade old. For example, Australian data were collected in 1998 and 2001, and the latter studies do not

Table 2. Daily dietary intake and demographic characteristics by tertile of sodium density (mg/1,000 kcal) of a cohort of 295 infants enrolled in the Melbourne Infant Feeding Activity and Nutrition Trial Program

Dietary intake and demographics	Tertiles of Sodium Density (mg/1,000 kcal)			Difference between tertiles (*P* value)
	Lowest (1)[a] (n=98)	Middle (2)[b] (n=99)	Highest (3)[c] (n=98)	
	←mean±standard deviation→			
Child daily dietary intake				
Sodium intake at 9 months (T2[d]) (mg)	277±94	454±114	727±192	<0.001[xyz]
Sodium intake at 18 months (T3[e]) (mg)	1,033±356	1,033±292	1,142±334	0.028
Change in sodium intake (mg)[f]	756±357	579±298	415±352	<0.001[xyz]
Sodium density at T3 (mg/1,000 kcal)	991±258	997±230	1,080±260	0.022[x]
Change in sodium density (mg/1,000 kcal)[f]	615±269	441±232	442±302	<0.001[xyz]
Energy (kcal) at 9 months (T2)	729±183	814±181	901±181	<0.001[xyz]
Energy (kcal) at 18 months (T3)	1,035±191	1,040±197	1,059±191	0.663
	←n (%)→			
Child characteristics				
Sex				
Boys	49 (50.0)	53 (53.5)	54 (55.1)	0.764
Girls	49 (50.0)	46 (46.5)	44 (44.9)	
	←mean±standard deviation→			
Age at T2 (mo)	8.9±0.7	9.3±0.7	9.4±0.7	<0.001[xyz]
Age at T3 (mo)	17.4±0.9	17.6±0.8	17.8±0.8	0.003[x]
Weight at T2 (kg)	8.7±1.1	8.9±1.1	9.0±1.2	0.124
Body mass index *z* score at T2	0.07±1.0	0.08±1.0	0.2±0.9	0.617
Weight at T3 (kg)	11.1±1.3	11.3±1.1	11.5±1.3	0.071
Body mass index *z* score at T3	0.8±1.0	0.8±0.9	1.0±1.0	0.111
Cessation of breastfeeding (age in mo)	9.4±4.7	8.2±4.9	7.5±4.7	0.040[x]
Commencement of solids (age in mo)	5.5±0.7	5.3±0.7	5.2±0.7	0.051[x]
Parent characteristics[g]				
Body mass index	24.2±4.8	24.3±5.2	24.6±5.3	0.873
Current employment status	←n (%)→			
Back at work	5 (5.1)	9 (9.1)	4 (4.1)	0.299
Still at home	93 (94.9)	90 (90.9)	94 (95.9)	
Highest level of education				
Trade or high school	32 (32.7)	38 (38.4)	45 (45.9)	0.161
Bachelor degree or higher	66 (67.3)	61 (61.6)	53 (54.1)	
Marital status				
Partner	97 (99.0)	99 (100.0)	95 (96.9)	0.167
Single parent	1 (1.0)	0 (0.0)	3 (3.1)	
Parent country of birth				
Australian	77 (78.6)	77 (77.8)	79 (80.6)	0.881
Other	21 (21.4)	22 (22.2)	19 (19.4)	

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