Public Health Nutrition: 15(6), 1039–1046 doi:10.1017/S1368980011002497

Food sources and correlates of sodium and potassium intakes in Flemish pre-school children

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Submitted 4 December 2010: Accepted 8 September 2011: First published online 6 October 2011

Abstract

Objective: The aim of the present study was to investigate dietary sources of Na and K intakes among Flemish pre-school children using multiple linear regression analyses.
Design: Three-day estimated diet records were used to assess dietary intakes. The contribution to Na and K intakes of fifty-seven food groups was computed by summing the amount provided by the food group for all individuals divided by the total intake for all individuals.
Setting: A random cluster sampling design at the level of schools, stratified by province and age, was used.
Subjects: A representative sample of 696 Flemish pre-school children aged 2·5–6·5 years was recruited.
Results: Mean Na intake was above and mean K intake was largely below the recommendation for children. Bread (22 %) and soup (13 %) were main contributors to Na intake followed by cold meat cuts and other meat products (12 % and 11 %, respectively). Sugared milk drinks, fried potatoes, milk and fruit juices were the main K sources (13 %, 12 %, 11 % and 11 %, respectively). Although Na and K intakes were positively correlated, several food categories showed Na:K intake ratio well above one (water, cheeses, soup, butter/margarine, fast foods and light beverages) whereas others presented a ratio well below one (oil & fat, fruits & juices, potatoes, vegetables and hot beverages).
Conclusions: Flemish pre-school children had too high Na and too low K intakes. The finding that main dietary sources of Na and K are clearly different indicates the feasibility of simultaneously decreasing Na and increasing K intake among children.

Keywords
Dietary sources
Sodium
Potassium
Child

A large number of studies indicate that elevated blood pressure, which may lead to stroke, CHD and kidney disease, is associated with increased Na and inadequate K intakes(1–3). In addition, some research has reported increased risks for gastric cancer with higher salt intake(4). Although most studies have focused on health effects in adults, more recently it was shown that a modest salt reduction in children also causes an immediate fall in blood pressure and, if continued, may lessen the subsequent rise in blood pressure with age(5–7). As demonstrated by Wang and colleagues, children are likely to maintain their dietary intake patterns from childhood into adolescence (the 'tracking' phenomenon)(8). Therefore, children with high salt intakes are likely to consume high amounts of salt in adulthood, which increases their risks for hypertension and CVD in adulthood.

Epidemiological studies also suggest that higher levels of K intake from foods are associated with decreased bone loss(9). Furthermore, evidence shows the important role of K intake in regulating blood pressure and other beneficial effects of K which may be independent of and additional to its effect on blood pressure(1,3,10–12). It is important to note that the beneficial effects of K in these studies appear to be mainly from the forms of K that are associated with bicarbonate precursors, the forms found naturally in foods such as fruits and vegetables(1).

Previous results on intakes of Na and K among Flemish pre-school children revealed that more than three-quarters

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of the children younger than 4 years old and more than 40 % of the children at least 4 years old exceeded the Upper Level (UL) for Na recommended by the Institute of Medicine (IOM)[13]. Furthermore, more than three-quarters of the children did not reach the IOM's recommended Adequate Intake (AI) for K[13].

Consequently, these increased Na and inadequate K intakes, in comparison with the IOM recommendations, are cause for concern for the health of Belgian pre-school children. Therefore, it is important to investigate what food sources are contributing most to the daily total Na and K intakes among Flemish pre-school children.

The present study analyses a dietary survey that was performed among Flemish pre-school children, and aims to identify their main food sources of Na and K intakes. The ratio of Na to K in the pre-school children's dietary intakes was also investigated since the dietary Na:K intake ratio is related to the rise in blood pressure in childhood and may be important in the early pathogenesis of primary hypertension[11].

Methods

Survey population

The present study used data from the Flanders pre-school dietary survey (data collected from October 2002 until February 2003), in which usual dietary intake was estimated from 3 d estimated dietary records (3d EDR) and an FFQ with forty-seven food items, completed by a proxy (the parents or a caregiver). The Flanders pre-school dietary survey is the only large-scale dietary survey conducted in Flanders that included all the different Flemish provinces and in which the number of children participating in the survey was proportional to the total number of children living in each province. A multistage stratified random cluster design was used, with schools as primary sampling units and classes as secondary sampling units (stratified per province). In total, sixty-five nursery schools had to be selected (randomly per province) from lists made available by the Flemish Ministry of Education and Training, in order to achieve our study aim of fifty nursery schools spread all over Flanders. Although willingness to participate in a survey leads to some selection bias, the data obtained in this survey represent a more general population of pre-school children in Flanders compared with other food consumption surveys in the past which were restricted to local areas. The sampling design, methods, representativeness and response rate (50 % response rate and 49 % after data cleaning) have been described in detail previously[14].

The percentage of under-reporters was calculated using the individual Goldberg cut-offs[15] (adapted for children) and has been described in depth in a previous paper where the under-reporting was shown to be low (<2 % of the children)[13]. Under-reporters have not been excluded from the study sample that was used for the analyses reported in the present paper.

The Ethical Committee of the Ghent University Hospital (Belgium) granted ethical approval for the study. Informed written consent was obtained from all parents.

Assessment of dietary Na and K intakes

For the current analyses, only food diaries including three completed record days were included. After exclusion of diaries that included only one or two complete record days, a final sample of 696 (66 % of collected) diaries was left for the statistical analyses. A record day was considered complete if at least two meals were recorded. Two dietitians, with long-standing experience in nutritional epidemiological fieldwork, performed the EDR exclusion procedure.

The food composition data for calculating nutrients were based on the following tables: the Belgian food composition table NUBEL[16], the Dutch food composition database NEVO[17], the food composition table of the Belgian Institute Paul Lambin[18] and McCance and Widdowson's UK food composition table[19]. Loss of vitamins and minerals during preparations were taken into account as all relevant foods were coded 'as eaten' and not 'as raw'.

In total 936 foods and composite dishes were encoded in the original database. All recipes that were described in depth as ingredients in the diaries were encoded as ingredients in the original database. After the disaggregating procedures, food items and ingredients were divided into fifty-seven food groups of similar nutrient content based on the classification of the Flemish food-based dietary guidelines and the expert opinion of the investigators (see food groups listed in Table 3).

As mentioned before, discretionary salt has not been included in the current analyses since use of salt was seldom reported and/or quantified in the diaries.

Statistical analyses

The SPSS for Windows statistical software package version 14 (SPSS Inc., Chicago, IL, USA) was used to perform statistical analyses.

Mean and median 'usual' intakes of the population, and the proportion below or above defined cut-offs, were calculated using statistical modelling (using the Software for Intake Distribution Estimation, C-SIDE; Iowa State University, Ames, IA, USA[20]) in order to correct for day-to-day variability in the 3d EDR. Since the recommendations of the IOM try to consider health benefits of increased K levels higher than the minimal needs for losses and growth as well, these Dietary Reference Intakes (DRI) from the IOM were used to compare with the total Na and K intakes[1,21].

Dietary sources of Na and K were evaluated through the fifty-seven food and beverage categories that were constituted by grouping items with similar characteristics. The population proportion formula was used to determine the percentage contribution of each of the fifty-seven

Table 1 Distributions of sodium and potassium intakes and of their ratio among Flemish pre-school children (*n* 696) aged 2·5–6·5 years, Flanders pre-school dietary survey, 2002–2003

	Dietary recommendations						Percentile					
Nutrient intake*	Belgian SHC (AR)	IOM (AI)	IOM (UL)	Mean	95 % CI	Min	10th	25th	50th	75th	90th	Max
Total population (*n* 696)												
Na (mg/d)				1872	1833, 1911	623	1280	1498	1822	2174	2560	5591
K (mg/d)				2381	2337, 2425	910	1672	1979	2327	2717	3148	5499
Na:K ratio				0·81	0·80, 0·83	0·27	0·54	0·64	0·78	0·93	1·14	2·65
Children 2–3 years (*n* 197)†												
Na (mg/d)	225–500	1000	1500	1758	1689, 1828	623	1225	1387	1710	2035	2498	3400
K (mg/d)	800–1000	3000	NA	2322	2235, 2409	933	1625	1900	2263	2659	3058	5499
Na:K ratio				0·78	0·75, 0·82	0·27	0·53	0·63	0·76	0·89	1·11	1·60
Children 4–6 years (*n* 465)†												
Na (mg/d)	300–700	1200	1900	1919	1870, 1967	650	1322	1536	1851	2211	2615	5591
K (mg/d)	1100–1400	3800	NA	2405	2351, 2458	910	1695	2004	2358	2745	3184	4581
Na:K ratio				0·83	0·80, 0·85	0·33	0·55	0·64	0·79	0·96	1·19	2·65

SHC, Superior Health Council; AR, Acceptable Range; IOM, Institute of Medicine; AI, Adequate Intake; UL, Upper Level; NA, not applicable.
*Distribution was corrected for within-person variability and for day of the week using C-SIDE[20].
†Because the birth date and age were missing for thirty-four children, the sum of the children included in the two age groups is only 662 instead of 696.

food groups to the intake of Na and K. This was done by summing the amount of the component provided by the food for all individuals divided by the total intake of that component from all foods for the entire study population[22].

Pearson's correlation coefficients and partial correlation coefficients adjusted for age were computed to test the associations between Na and K intakes and total energy intake. Linear regression analyses (univariate) were used to investigate the associations of Na and K intakes with the behavioural and sociodemographic variables available in the survey: total energy intake, sex, age, perceived family income as sufficient to provide a healthy diet (yes, perceived as sufficient; most of the time perceived as sufficient; most of the time perceived as insufficient; no, perceived as insufficient), household size (≤2 or >2 children), occupational status (employed or unemployed), educational level (lower secondary, secondary or higher education) and smoking (currently smoking: yes/no) of the parents, and relevant interactions. In a second step, the significant variables (according to the univariate analysis) were combined in the final model using multiple linear regression analyses. All statistical analyses were tested with a significance level set at $P<0·05$.

Results

Overall distributions of Na and K intakes and their ratio

The minimum and maximum values and percentiles of Na and K intakes and of their ratio are reported in Table 1. Mean Na intake was 1872 (95 % CI 1833, 1911) mg/d, mean K intake was 2381 (95 % CI 2337, 2425) mg/d and the mean Na:K intake ratio was 0·81 (95 % CI 0·80, 0·83).

In total, 57 % of the children exceeded the IOM's UL for Na intake of 1500 mg and 1900 mg for children younger than 4 years old and children at least 4 years old, respectively. Ninety-four per cent of the children had a K intake lower than the IOM's AI value (3000 mg and 3800 mg for children younger than 4 years old and children at least 4 years old, respectively)[1].

Table 2 Correlations between sodium and potassium intakes and total energy intake among Flemish pre-school children (*n* 696) aged 2·5–6·5 years, Flanders pre-school dietary survey, 2002–2003

Pearson correlation	*r*	*P*	*r**	*P**
Na (mg) × K (mg) intake	0·406	<0·0001	0·401	<0·0001
Energy × Na (mg) intake	0·575	<0·0001	0·566	<0·0001
Energy × K (mg) intake	0·695	<0·0001	0·711	<0·0001
Na (mg/4184 kJ (1000 kcal)) × K (mg/4184 kJ (1000 kcal))	0·038	0·332	0·041	0·287

*Adjusted for age, using partial correlations.

Correlations between Na and K intakes and total energy intake

As shown in Table 2, Na and K intakes were positively correlated with each other and with total energy intake. These correlations were also observed after adjustment for age.

Dietary sources of Na and K

Table 3 lists food and beverage groups with their relative contributions to daily Na and K intakes in pre-school children. Bread (22 %) and soups (13 %) were the main contributors to Na intake followed by cold cuts (from meat products) and other meat and meat products (12 % and 11 %, respectively). Sugared milk drinks, fried potatoes, milk and fruit juices were the main sources of K intake (13 %, 12 %, 11 %, and 11 %, respectively).

Although Na and K intakes were positively correlated to each other and to total energy intake (Table 2), several food categories showed an Na:K intake ratio well above one (olives, water, cheeses, soups, butter/margarine,

Table 3 Dietary sources of sodium and potassium among Flemish pre-school children (*n* 696) aged 2·5–6·5 years, Flanders pre-school dietary survey, 2002–2003

	Food intake (g/d)		Na		K	
Food group	Mean	SD	%	Order	%	Order
Beverages (incl. juices but no drinks from Restgroup)	486·2		13·8		13·3	
Water	224·2	226·4	0·3		0	
Light beverages	23·1	90·1	0·1		0	
Tea and coffee without sugar	8·2	43·5	0		0·1	
Fruit juice	172·8	209·3	0·3		11·3	4
Vegetable juice	0·2	6·0	0		0	
Soup/bouillon	57·7	101·7	13·1	2	1·8	
Bread and cereals	86·7		26·6		6·5	
Bread/rolls/crackers/rice cakes	70·3	46·8	22·0	1	5·2	8
Sugared bread	7·5	22·5	2·0		0·5	
Breakfast cereals (ready-to-eat/hot)	8·9	20·0	2·6	10	0·8	
Potatoes and grains	87·2		0·4		11·7	
Pasta/noodles	15·4	41·0	0		0·1	
Rice	6·3	25·5	0		0·1	
Potatoes	65·0	69·3	0·4		11·5	2
Vegetables (excluding soup)	66·5		1·7		7·1	
Cooked vegetables	53·7	60·1	1·6		5·8	6
Raw vegetables	12·8	38·3	0·1		1·3	
Fruit (sweetened/unsweetened)	109·8		0·2		8·3	
Fresh fruit	94·0	102·7	0·1		7·5	5
Canned fruit	15·4	45·4	0·1		0·6	
Dried fruit	0·4	3·7	0		0·1	
Milk, milk products and Ca-enriched soya milk	439·9		11·5		28·1	
Milk*	179·0	218·5	4·7	7	11·3	3
Sugared milk drinks (e.g. Fristi, chocolate milk)	188·3	226·8	4·4	8	12·6	1
Yoghurt	4·5	25·3	0·2		0·4	
Sugared or aromatized yoghurt	14·2	46·9	0·4		1·0	
Soya drinks	15·7	82·5	0·5		0·6	
Milk desserts	19·9	56·2	0·7		1·1	
Milk desserts based on soya	2·3	19·1	0·1		0·1	
Probiotics (e.g. Actimel, Yakult)	0·7	7·4	0		0	
White (fresh) cheese	15·3	43·3	0·4		1·0	
Cheese	14·5		6·5		0·6	
Hard cheese†	11·8	22·6	5·1	5	0·4	
Cheese spread	2·7	8·8	1·4		0·2	
Fat and oil‡	8·6		0·9		0·1	
Butter/margarine	8·3	9·5	0·9		0·1	
Oil	0·3	1·4	0		0	
Frying oil	0·0	0·6	0		0	
Meat/poultry/fish/egg/meat substitutes	90·3		26·1		11·6	
Meat, game and meat products	37·2	46·1	11·2	4	5·3	7
Chicken/turkey	15·9	34·7	0·8		2·2	
Fish/shellfish	8·5	28·7	1·3		1·0	
Cold cuts (from meat products)	20·7	30·2	11·7	3	2·4	
Cold cuts (from fish products)	0·9	6·8	0·3		0·1	
Eggs§	5·1	18·2	0·4		0·3	
Meat substitutes (e.g. tofu, tempe)	1·7	11·6	0·3		0·3	
Nuts and seeds	0·3	3·4	0		0·1	
Restgroup (snacks and desserts)	201·8		11·1		12·2	
Brioches	3·5	17·0	0·9		0·2	
Sweet snacks	43·6	43·5	5	6	2·7	10
Savoury snacks	2·1	9·8	0·6		0·8	
Tea and coffee with sugar	3·2	26·6	0		0	
Soft drinks	97·7	169·4	0·2		0·2	
Savoury sauces	12·5	24·9	2·6	9	1·0	
Cream	0·3	2·6	0		0	
Sweet sauces	0·1	2·5	0		0	
Chocolate	3·1	9·5	0·2		0·5	
Chocolate spread	9·4	13·9	0·3		1·7	
Other sweet spread (e.g. jam, honey)	5·3	11·6	0·1		0·2	
Sugar	0·1	0·9	0		0	
Fried snacks	0·1	2·6	0		0	
French fries/croquettes	14·6	37·7	0·9		4·3	9
Sweet desserts (e.g. ice cream, tiramisu)	6·2	23·2	0·3		0·4	
Miscellaneous	4·3		1·2		0·3	
Olives	0·1	1·5	0·1		0	
Pizza and quiches	2·2	17·8	0·7		0·2	
Other miscellaneous‖	2·0	21·3	0·5		0·2	

The contributions of each food group are expressed in percentage of daily Na and K intakes. The Na:K intake ratio is the ratio between the daily amounts of Na and K provided by each food category.
*Includes cow's milk and goat's milk.
†Excludes cream cheese.
‡Includes lard/animal fats and regular/low-fat/fat-free versions of cream cheese/sour cream/half-and-half.
§Includes only eggs reported separately and eggs included in disaggregated food mixtures.
‖Includes foods or components with negligible contributions to total nutrient intake that could not be categorized in the above food groups (e.g. herbs and spices (including mixtures that include salt)/monosodium glutamate/starch/plain gelatine/artificial sweeteners/pectin/cocoa powder/etc.).

fast foods and light beverages), whereas others presented a ratio well below one (oil & fat, fruits & juices, potatoes, vegetables and hot beverages; Table 3).

Associations of Na and K intakes with other covariates

No associations were found between Na and K intakes and socio-economic status (SES) and lifestyle factors when using the univariate regression analysis. However, a positive association was found between energy intake and both Na and K intakes ($\beta = 1\cdot004$, $P < 0\cdot001$; $\beta = 1\cdot402$, $P < 0\cdot001$, respectively). With an increase in energy intake of 4·184 kJ (1 kcal), Na and K intakes increased by 1·004 and 1·402 mg, respectively.

Discussion

Main results

The dietary survey performed in 2002 and 2003 among Flemish pre-school children provided us with information on Na and K intakes among the children and about the main food sources contributing to these daily intakes. Mean Na intake was well above, whereas mean K intake was largely below, the current DRI recommendations in children. The mean Na:K intake ratio for the total population was below one. Na and K intakes were both positively associated with energy intake, while most of the other participant characteristics such as parental occupational status and educational level, perceived family income and size were not associated with Na and K intakes. This finding suggests that food habits are relatively uniform across the social categories with respect to Na or K intake.

Differences could be found between foods included in the same food group, suggesting that recommendations to lower Na intake should be rather on a more detailed food item level than on a large food group level.

Comparison with the literature

Although our results correspond well with other studies investigating Na and K intakes and their most important food sources among children[23–27], some interesting differences were also found. An important finding was the fact that our Na:K intake ratio is less than half that found in French children[26]. This lower ratio is mainly explained by lower Na intake in our Flemish pre-school children. In both surveys, table salt was not included in the analysis. Although differences in food grouping made it difficult to compare our food contributions to Na and K intakes with the results derived from French children[26], some interesting differences in food contributors could be found when aggregating some of the food groups. The main differences were found for dairy and meat products, for which the contributions to Na intake were respectively 12 % and 26 % in Flemish pre-school children and 7 % and 19 % among French children. It is also worth mentioning that the age range of the children in the French study (2–14 years old) was much larger than in our study (2·5–6·5 years old). When comparing the ranking of food groups in the contribution to Na and K intakes with other studies, we observed very similar results. Bread, soup and meat products were the major sources of Na, whereas vegetables (when including potatoes), dairy products and fruit (juices) were the major providers of K, similarly to what has been described in other industrialized populations[23–27]. Although the contribution from water to total Na intake was not analysed in the previous surveys mentioned, it should be noted that also water can contribute to total Na intake. While most of the Na contents of the different water types consumed in Belgium were below 20 mg/l, for some water types the Na level was higher than 20 mg/l (e.g. Gerolsteiner and Tönissteiner; data not shown).

Similar to the findings of Meneton and colleagues, several food categories showed an Na:K intake ratio well above one (cheeses, bread, breakfast cereals and soups) whereas others presented a ratio well below one (fruits (excluding olives), vegetables, dairy products and hot beverages)[26]. Thus, despite the strong positive correlation between Na and K intakes at the population level, the main dietary sources of Na and K were, for the most part, not the same. This emphasizes the feasibility of increasing the consumption of K-rich foods while reducing that of Na-rich foods at the individual level.

Our finding that some participant characteristics such as perceived family income and size were not associated with Na and K intakes and their ratio compared well with the results derived from French children[26] and suggests that food habits are relatively uniform across the social categories with respect to Na or K intake. However, this finding is in contrast to what has been described in other countries[28–31]. It is noteworthy that the lack of information on discretionary salt could bias this conclusion as there might be differences in the use of discretionary salt between different socio-economic classes.

The strong positive correlation between Na and K intakes can be explained by the ubiquitous nature of K that is naturally present in most foods and by the widespread use of Na in processed foods[32]. Thus the main determinant of Na and K intakes appeared to be the total amount of food ingested, which is strongly correlated with both Na and K intakes. The latter correlation has been described in our study as well as in other populations with energy intake as a surrogate measure of food intake[33,34].

Strengths and limitations

Although willingness to participate leads to some selection bias, the current data represent a more general population of pre-school children in Flanders compared with other food consumption surveys which have mostly been restricted to local areas. Nevertheless, as shown

previously in our design paper[14], the study sample was subject to some selection bias, with lower socio-economic classes being under-represented.

As mentioned before, only 66 % of the collected diaries included three completed record days and could therefore be used for statistical analyses. Many factors typical among pre-school children (e.g. illiteracy and short memory) make assessing diet intake in this young population very difficult. The most important barriers for measuring dietary intake in pre-school children are the fact that they are not able to complete diaries on their own and that they have a limited cognitive ability to recall, estimate and otherwise cooperate; and they often spend time under the care of several individuals[35,36]. Therefore it is always a challenge to assess dietary intakes in children of pre-school age and an important loss/lack of information is common in many surveys which often leads to the exclusion of extra participants[37].

It is also noteworthy that like any dietary assessment methodology, diet records are prone to a degree of misreporting and this may have influenced our classification of compliance and non-compliance with DRI. The percentage of under-reporters in the final sample for analysis was low (<2 %). In addition, a 3 d diet record does not necessarily reflect an individual's usual intake. However, a statistical modelling method (the Nusser method) that accounts for within-individual variability was used in order to calculate usual Na and K intakes. Since all days of the week were included in the study, it was possible to adjust our data to remove the effect of the day of the week. Unfortunately, it was impossible to correct for seasonal variations, because the fieldwork was conducted only during autumn and winter. No data were found about potential seasonal influences on nutrient intake in this population group in Belgium. However, from our national food consumption survey in 2004 it could be concluded that seasonal variations were only small for nutrient intakes[38]. These low seasonal variations could be due to the widespread availability of most foods all year round.

The underestimation of Na intake due to the non-assessment of discretionary salt use and the potential bias of dietary records for evaluating the actual intake were less critical for the present analysis whose main objective was to assess the dietary sources and correlates, rather than the absolute intake values of Na and K. Despite these limitations, the reported contributions of Na and K intakes in Flemish pre-school children are very similar to the values described in other industrialized populations[6,26,39–41]. Nevertheless it should be noted that the under-representation of low-SES families could have biased our results and might be hiding a possible relationship between SES and Na intake. In addition, the difference in Na intake between low- and high-SES groups might be due to differences in table salt which was not included in our analyses[42].

Another potential problem encountered was that the Estimated Average Requirement (EAR) values for pre-school children are still lacking for the nutrients under study, which made it difficult to establish inadequacy. However, when comparing K intakes obtained from our pre-school population with the AI values for K intake, it is still possible to say that the intakes of our pre-school children are adequate when the intake is above the AI (<15 % of our Flemish pre-school children had an intake above the IOM's AI of 3000 mg/d)[43].

Finally, it should be noted that the food composition data used for calculating nutrient intakes might also introduce some bias in dietary surveys reporting such data. Therefore, the authors would like to emphasize the growing requirement for good food composition data. In addition, it remains important to consider other dietary intake recommendations as well when developing guidelines to reduce the Na:K intake ratio among children.

Recommendations

From the results derived in the present study, the comparison with the literature and the knowledge that the reported Na intakes are an underestimation of the true intakes as discretionary salt was not included in the analyses, it is clear that unfavourably high Na intakes remain prevalent even among childhood populations. In addition it seems that K intakes, which presumably could compensate for the harmful effects of high Na intakes, are too low in childhood populations. Although higher K intakes could be obtained via dietary guidelines stimulating the consumption of fruit and vegetables and low-fat milk among children, a recent review from Brown and colleagues demonstrates the obstacles in reducing salt intake in different populations[44]. An important barrier is the high Na content of manufactured/industrial food products and food catering[44]. Even some types of water can have high Na contents (higher than 20 mg/l, with a maximum of 119 mg/l for Gerolsteiner). Therefore, public health initiatives, in tandem with efforts by the food industry, are urgently needed to lower salt consumption and consequently lower CVD burden and increase life expectancy[44].

In Finland for instance, a comprehensive public health campaign in collaboration with the food industry to reduce CVD resulted in remarkable reductions in salt intake over a 20-year period, which coincided with a decrease of 60 % in both CHD and stroke mortality[45].

Conclusions

In summary, in Flemish pre-school children surveyed in 2002 and 2003, mean Na intake largely exceeded, whereas mean K intake was well below, that recommended. This situation could be improved by promoting the consumption of food categories with a low Na:K ratio such as fruits, vegetables and dairy products. Although some food groups that importantly contribute to pre-school children's daily Na intakes (e.g. cheeses, meat products and

savoury snacks) could be discouraged, it is important to consider other nutrient requirements as well (e.g. contribution to water and vegetable intakes of soup and to fibre intake of bread). It is noteworthy that a decrease in the consumption of cheese should be compensated by an increase of alternative Ca sources that contribute less to the total Na intake (e.g. milk) in order to guarantee sufficient Ca intakes.

Acknowledgements

The Flanders pre-school dietary survey was funded by the Belgian Nutrition Information Center (NICE). C.V. is postdoctoral researcher funded by the FWO-Flanders. The authors declare no conflict of interest. I.H. performed and interpreted statistical analyses and drafted the article. M.B. and M.D.M., the dietitians of the team, were responsible for the data input and contributed to the conceptualization of the FFQ. All other authors helped in the evaluation of the results and the writing of the manuscript. Moreover, I.H. and S.D.H. were responsible for the study protocol and the fieldwork. All authors have read and have approved the manuscript as submitted. We thank all the parents and teachers who participated in this project and generously volunteered their time and knowledge.

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