Analysis of Salt Content in Meals in Kindergarten Facilities in Novi Sad

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SUMMARY

Introduction Investigations have brought evidence that salt intake is positively related to systolic blood pressure and that children with higher blood pressure are more susceptible to hypertension in adulthood. In developed countries the main source of salt is processed food.

Objective The aim of this paper was to determine total sodium chloride (NaCl) in average daily meal (breakfast, snack and dinner) and in each of three meals children receive in kindergarten.

Methods From kindergarten, in the meal time, 88 samples of daily meals (breakfast, snacks and dinner) offered to children aged 4-6 years were taken. Standardized laboratory methods were applied to determine proteins, fats, ash and water in order to calculate energy value of meal. The titrimetric method with $AgNO_3$, and K_2CrO_4 as indicator, was applied in order to determine chloride ion. Content of NaCl was calculated as %NaCl = ml$AgNO_3 \times 0.05844 \times 5 \times 100$/g tested portion. NaCl content in total daily meal and each meal and in 100 kcal of each meal was calculated using descriptive statistical method. Student's t-test was applied to determine statistical differences of NaCl amount among meals.

Results NaCl content in average daily meal was 5.2±1.7 g (CV 31.7%), in breakfast 1.5±0.6 g (CV 37.5%), in dinner 3.5±1.6 g (CV 46.1%) and in snack 0.3±0.4 g (CV 163.3%). NaCl content per 100 kcal of breakfast was 0.4±0.1 g (CV 29.5%), dinner 0.7±0.2 g (CV 27.8%) and snack 0.13±0.19 g (CV 145.8%). The difference of NaCl content among meals was statistically significant ($p<0.01$).

Conclusion Children in kindergarten, through three meals, received NaCl in a quantity that exceeded internationally established population nutrient goal for daily salt intake. The main source of NaCl was dinner, a meal that is cooked at place.

Keywords: salt; meals; children; kindergarten

INTRODUCTION

Epidemiological investigations have brought overwhelming evidence that dietary salt intake within population is in a positive correlation with average blood pressure and prevalence of hypertension, incidence of acute coronary events and with cardiovascular and all causes of death [1-4]. High salt intake has been recognized as a risk factor for end stage of renal failure [5, 6]. It is also in a positive association with stomach cancer and osteoporosis in adults [7, 8].

Population-based intervention studies showed that reduction of salt intake was followed with systolic and diastolic blood presure depletion [9, 10, 11], stroke and chronic heart disease mortality rate reduction and with increased life expectancy within controlled population [11]. Non-personal health interventions of salt reduction were recognized as cost-effective methods for reduction of health care costs of chronic cardiovascular diseases [12, 13, 14]. Investigation on the global level indicated that governmental actions in stimulating non-personal health interventions in salt content of processed foods were cost-effective ways to reduce chronic cardiovascular diseases burden measured as disability adjusted life years (DALYs) [15].

Although high blood pressure is not common in children, it was demonstrated that salt intake of children was positively related to systolic and pulse blood pressure [16, 17] and that children with higher blood pressure were more susceptible to hypertension in adulthood [18]. Data from investigations in developed countries indicated that the main source of salt for the general population [19, 20, 21] and children [22, 23] was processed food. For further concerns are data demonstrating a positive relationship between salt intake and soft drink consumption in children and adolescents and its potential link to obesity within these population groups [24].

In the Republic of Serbia, cardiovascular diseases are a leading cause of death. They participate with 55.2% in the total death cases. Ischaemic heart diseases are responsible for 150,889 DALYs. Cerebral and other vascular diseases are responsible for further 136,090 DALYs of the population [25]. The latest national health survey indicated that a prevalence of hypertension (systolic blood pressure ≥140 mm Hg and diastolic blood pressure ≥90 mm Hg) in the Republic of Serbia was 46.5% among adults aged 18 years and more [26]. In the Province of Vojvodina, prevalence of hypertension (applied criteria for measured blood pressure were the same as in Serbia) among adults aged 45 years and more, was 48.7% and in the city of Novi Sad it was 69.8% [27]. Population-based investiga-

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tions on salt intake, concerning adults, or children and adolescents have not been performed.

In the city of Novi Sad, there is one large public kindergarten that takes care of approximately 12,000 preschool children aged 1-6 years. Children usually spend 5-8 hours per day in the kindergarten and there they have a daily meal: breakfast, snack and dinner. Other meal(s) children receive at home. Breakfast is usually made from processed food items and dinner is cooked at place using raw food items, except for bread. Snacks, usually, are fruit, or juice, or yogurt, with, or without, biscuit (sweet or salty). Data on our recently performed control of salt content in the processed food retailed in Novi Sad indicated that majority of tested food items should be marketed as food with a high salt content, if the standards of the Food Standards Agency of the Great Britain were applied [28]. Average sodium chloride (NaCl) amounted from 1.3 g/100 g in canned vegetable to 2.1 g/100 g in sausages and related meat products [29, 30]. No published data were available on population salt intake. We were interested to determine salt content in food that children received in the kindergarten and to determine the main source of salt in their daily meal.

OBJECTIVE

The purpose of this paper was to determine total NaCl in daily meals and in each of three meals (breakfast, snack and dinner) and its contribution to the NaCl content in average daily meal that children aged 4-6 years had in kindergarten.

METHODS

Trained samplerers, during the year 2008, took 88 daily meals. They visited kindergatens at meal time and took 88 samples of breakfast, 88 samples of snacks and 88 samples of dinner prepared for children aged 4-6 years from the kindergarten. Samplerers' visits were not announced.

Each single sample (breakfast, snack, dinner) was transferred into the container of high-speed blender and mixed thoroughly. Test sample was stirred immediately before removing test portion for analysis. Determination: 10.0 g of prepared test sample was weighted into 100 ml volumetric flack and diluted to volume with distilled H_2O. After mixing and filtering, 20 ml aliquot was transferred to 250 ml erlenmayer and 0.5 ml of chromate indicator (cold saturated K_2CrO_4 solution) was added. Solution was titrated with standardized $AgNO_3$ solution until turned permanent brownred. Calculation: % NaCl = ml AgNO3 × 0.05844 × 5 × 100/g tested portion. Standardized methods were applied in order to determine quantity of proteins, fats, ash and water. The obtained results were applied to calculate energy value of each and daily meal.

NaCl content was presented by using descriptive statistical method including average ± standard deviation (SD) and coefficient of variation (CV) of NaCl per daily meal and per each meal. Contribution of each meal in daily meal NaCl content was expressed as percentage. NaCl density was calculated as NaCl (g) per 100 kcal of each meal, as well. The Student's t-test was applied to find out whether there were statistically significant differences of NaCl content, expressed in absolute number and as g/100 kcal ratio of each meal: breakfast/snack, breakfast/dinner and snack/dinner.

RESULTS

Obtained results showed that NaCl content in average daily meal that children received in kindergarten was 5.2±1.7 g and CV 31.7%. Average NaCl content in breakfast was 1.5±0.6 g (37.5%), in dinner 3.5±1.6 g (CV 46.1%) and in snack 0.3±0.4 g (CV 163.3%). NaCl content varied very much in controlled meals (CV was 37.5% for breakfast and 163.3% for snack). Dinner participated with 66.3% and breakfast with 28.7% in daily meal NaCl content. Snack contributed with 4.9% to the total NaCl content in average daily meal that children had in kindergarten. These data indicated that dinner was the main source of total NaCl in daily meal. The reason could be that the dinner was the largest meal with the greatest energy contribution in daily meal. It participated with 47.1%, compared with breakfast and snack which participated with 37.5% and 15.4% in total energy value of the daily meal, respectively (Table 1).

Table 1. Energy values and average salt content in controlled meals in kindergartens in Novi Sad

Meal	Number of meals	Energy values (kcal)	CV of energy values	% of energy of controlled meals in a daily energy intake	Average salt content in controlled meals (g)	CV of average salt content in controlled meals	% of average salt content in controlled meals
Breakfast	88	363.63±81.59	22.44%	37.51%	1.50 ± 0.56	37.53%	28.74%
Dinner	88	456.07±133.39	29.25%	47.05%	3.46 ± 1.59	46.09%	66.28%
Snack	88	149.66±75.86	50.69%	15.44%	0.26 ± 0.42	163.32%	4.98%
Total	264	969.36±162.86	16.81%	100.00%	5.22 ± 1.66	31.74%	100.00%

Table 2. Average salt content in 100 kcal of controlled meals in kindergartens in Novi Sad

Meal	Number of meals	Average salt content in 100 kcal of controlled meals (g)	CV of average salt content in 100 kcal of controlled meals	% of average salt content in 100 kcal of controlled meals in a whole daily energy/salt intake
Breakfast	88	0.41±0.12	29.51%	35.34%
Dinner	88	0.75±0.21	27.83%	64.65%
Snack	88	0.13±0.19	145.81%	11.21%
Total	264	0.54±0.31	57.49%	100.00%

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Table 3. Computation of average salt content in controlled meals (g/meal) and average salt content in 100 kcal of controlled meals (g/100 kcal of meal)

Meal	Average salt content (g/meal)	Average salt content in 100 kcal of controlled meals (g/100 kcal of meal)
Breakfast / Dinner	t=10.84*	t=13.11*
Breakfast / Snack	t=16.52*	t=11.62*
Dinner / Snack	t=18.15*	t=18.44*

* p<0.01

When NaCl density was computed, it appeared that the highest NaCl density was also recorded in dinner followed by breakfast and snack. NaCl density, expressed as g per 100 kcal, was 0.7±0.2 (CV 27.8%), 0.4±0.1 (CV 29.5%) and 0.1±0.2 (CV 145.8%) in dinner, breakfast and snack respectively. NaCl density in average daily meal was 0.5±0.3 (CV 57.5%). NaCl density of the dinner participated with 64.6%, NaCl density of the breakfast with 35.3% and NaCl density of the snack with 11.2% in the total sodium density of the daily meal (Table 2).

The differences of NaCl content, expressed as grams per meal, and NaCl density expressed as grams per 100 kcal of the meal, between meals were statistically significant (Table 3).

DISCUSSION

High blood pressure has been indicated as a major risk factor for stroke, ischaemic heart disease, hypertensive disease and other cardiovascular diseases worldwide [31, 32]. More than 80% of the attributable burden of diseases was recorded in low-income and middle-income countries in the Eastern Europe and Central Asia with a greater proportion of the burden in young age groups [3]. From the public health point of view, it is important to elucidate modifiable risk factors within population and to implement intervention programmes [32, 33]. Lowering salt intake in high blood pressure reduction, stroke and cardiovascular diseases mortality was recognized as a cost-effective method [12-15]. National programmes, conducted with participation of food industry followed by educational programmes for population, have been successfully carried out in several countries for a relatively long period of time. The obtained results confirmed beneficial outcomes in reducing cardiovascular and stroke mortality rate up to 80% [4, 10, 11]. Meta-analyses indicated that sodium intake was in positive relationship with blood pressure of children and adolescents [17]. Modest reduction in salt intake was followed with blood pressure reduction. Reduction in systolic and diastolic blood pressure for 1/1 mm Hg had beneficial health implications in terms of preventing cardiovascular diseases in their future life [34]. Kindergartens are places where non-personal, cost-utility, life style interventions can be widely applied [35, 36].

Data provided by our investigation showed that average daily meal which included three meals (breakfast, snack and dinner), offered to children aged 4-6 years, contained 5.2±1.7 g (CV 31.7%) of NaCl. The detected amount of sodium in NaCl was not the whole one because the laboratory method which we applied in our investigation was not able to identify all sodium presented in tested food samples. It detected only sodium that was bound to chlorine. The average amount of NaCl detected in controlled daily meals in this kindergarten was higher compared with the amount that children had for the whole day in affluent societies [18, 21, 29]. The detected NaCl content in the controlled samples of the daily meal exceeds about 73% daily recommendations of the Scientific Advisory Committee on Nutrition of the Great Britain [28]. It also exceeds the population salt nutrient goal of the World Health Organization [37]. The main source of NaCl was dinner, the main meal and the meal that was prepared at place, except for bread. The amount of NaCl in the average dinner-meal participated with 66.3% in the total NaCl content of the whole daily meal. At the same time, salt density of this meal was the highest compared to the salt density of the breakfast and the snack. NaCl content in dinner-meal participated with 64.6% in 100 kcal of the average daily meal. The NaCl in the breakfast participated with 35.3% and NaCl in the snack participated with 11.2% in 100 kcal of the average daily meal. Salt content in the whole dinner-meal and salt content per 100 kcal of dinner-meal were significantly higher compared to breakfast and snack (p<0.01). It appeared that processed food retailed in Novi Sad, used for meal preparation in the kindergarten, was not the dominant source of salt. The main source of salt was food cooked at place. These data suggest that international recommendation for salt intake reduction [36-39] were not considered when children nutrition was planned.

CONCLUSION

The obtained results indicated that, throughout three meals children had in kindergarten, they received salt in a quantity that exceeded the internationally established population goal for average daily intake and recommendations for salt intake of children aged 4-6 years recommended by the Scientific Advisory Committee on Nutrition of the Great Britain. This amount also exceeds daily salt intake of children in developed countries. Having in mind that children take some extra salt at home, it is reasonable to presume that they consume salt in a quantity that could be of great importance for later high blood pressure development. Further, more specific, investigations are needed in order to provide data relevant to highlight a magnitude of risk factors within children and adolescent population that could be responsible for high blood pressure and related chronic diseases in adulthood in our community. Beneficial effects of that kind of investigations and implemented programmes have been already extensively evaluated in several affluent societies.

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Анализа садржаја соли у оброцима за децу у новосадским вртићима

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КРАТАК САДРЖАЈ

Увод Унос соли је у позитивној корелацији с висином систолног крвног притиска код деце. Деца са већим вредностима крвног притиска чешће имају хипертензију у одраслом добу. Главни извор соли у развијеним земљама је индустријски произведена храна.

Циљ рада Циљ рада је био да се утврде садржај натријум-хлорида (*NaCl*) у целодневном оброку који деца добијају у новосадским вртићима и врста оброка која је главни извор соли.

Методе рада У време поделе оброка обављено је узорковање 88 целодневних оброка (доручака, ужина и ручкова) намењених деци узраста од четири године до шест година. Коришћена је титриметријска метода са $AgNO_3$ и K_2CrO_4 као индикатором за препознавање јона хлорида. Садржај соли израчунат је према формули: $\%NaCl = ml AgNO_3 \times 0,05844 \times 5 \times 100/g$ контролисаног узорка. Стандардне методе примењене су за утврђивање садржаја беланчевина, масти, пепела и воде. Добијени резултати коришћени су за израчунавање енергетске вредности оброка. Израчунат је просечан садржај соли у целодневном оброку, појединачним оброцима и у 100 *kcal* сваког оброка. За утврђивање статистички значајне разлике у садржају соли у појединим оброцима примењен је Студентов *t*-тест.

Резултати Садржај соли у просечном целодневном оброку био је 5,2±1,7 *g* (*CV* 31,7%), у доручку 1,5±0,6 *g* (*CV* 37,5%), у ручку 3,5±1,59 *g* (*CV* 46,1%), а у ужини 0,3±0,4 *g* (*CV* 163,3%). Садржај соли у 100 *kcal* просечног доручка био је 0,4±0,1 *g* (*CV* 29,5%), ручка 0,7±0,2 *g* (*CV* 27,8%) и ужине 0,1±0,2 *g* (*CV* 145,2%). Садржај соли у појединачним оброцима, као и у 100 *kcal* појединачних оброка, био је статистички значајно различит ($p<0,01$).

Закључак Просечан садржај соли у контролисаним узорцима целодневних оброка намењених деци у вртићу био је већи од међународно прихваћеног популационог нутритивног циља за дневни унос соли. Главни извор соли био је ручак, оброк који се, осим хлеба, припрема у вртићу.

Кључне речи: садржај соли; деца; храна; вртић

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