ESTIMATION OF SODIUM AVAILABILITY IN FOOD IN SLOVENIA: RESULTS FROM HOUSEHOLD FOOD PURCHASE DATA FROM 2000 TO 2009

OCENA RAZPOLOŽLJIVOSTI NATRIJA V ŽIVILIH V SLOVENIJI: REZULTATI IZ RAZISKAVE O PORABI ŽIVIL V GOSPODINJSTVIH OD LETA 2000 DO LETA 2009

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Abstract

Introduction: *The main aim of the study was to estimate average daily sodium availability of Slovenian consumers based on the food purchase data for the period 2000-2009. The secondary aim was to look for food group contributors to sodium availability.*

Methods: *Food purchase records (Household Budget Survey) as well as country-specific reference values and food composition information were used to estimate mean sodium availability of purchased foods (grams of sodium/person/day - g Na/p/day) as well as food groups and foods with the largest contribution to the total sodium availability.*

Discussion and results: *The mean sodium availability of purchased foods decreased in the period 2000-2009 and was on average 2,104±132 mg Na/p/day, not accounting for ready-made meals, most semi-prepared foods and adding salt during cooking and at the table. The key food group contributors of sodium in Slovenia were breads and bakery products (35.0%), meat products (27.9%), processed vegetables (6.6%) and cheeses (5.3%).*

Conclusions: *Notwithstanding the smaller purchased quantities of higher-sodium foods (e.g. sausages, prosciutto, dry meat, pickled cucumbers) in comparison to larger purchased quantities of the medium-sodium foods (e.g. white bread, mixed bread, brown bread, milk, rolls), both food groups contribute significant amounts of sodium in the diets of Slovenians.*

Key words: household budget survey, sodium availability, sodium content, food groups

Izvirni znanstveni članek
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Izvleček

Uvod: *Glavni namen raziskave je bil ugotoviti razpoložljivost natrija v kupljenih živilih v Sloveniji. Osnovo so predstavljali podatki nacionalne raziskave o porabi v gospodinjstvih za obdobje 2000–2009. Sekundarni cilj raziskave je bil ugotoviti, katere skupine živil prispevajo k največji razpoložljivosti natrija v prehrani slovenskih porabnikov.*

Metode: *Za oceno povprečnega vnosa natrija (izraženega v gramih natrijevega klorida/oseba/dan – g osebo/Na/dan) v kupljenih živilih in glavnih skupinah živil so bili uporabljeni podatki o povprečni porabi živil v gospodinjstvih in podatki o hranilni sestavi živil.*

Razprava in rezultati: *Povprečna vrednost razpoložljivega natrija v kupljenih živilih se je v obdobju od leta 2000 do leta 2009 znižala in znaša v povprečju 2,104±132 mg natrija/osebo/dan. Pri tem niso bile upoštevane vrednosti vnosa pripravljenih in polpripravljenih obrokov ter dosoljevanje hrane pri mizi. Ugotovljeno je bilo, da so ključne skupine živil, ki prispevajo največje količine natrija v prehrani prebivalcev Slovenije, kruh in pekovski izdelki (35,0%), mesni izdelki (27,9%), konzervirana zelenjava (6,6%) in siri (5,3%).*

Zaključki: *Raziskava je pokazala, da k vnosu natrija v prehrani prebivalcev Slovenije znatno prispevajo živila, ki vsebujejo višje vrednosti natrija (npr. salame, pršut, sušeno meso, vložena zelenjava) in ki se jih v prehrani ljudi zaužije v nižjih količinah, in živila s srednjimi vrednostmi natrija (npr. bele in mešane vrste kruha, črni kruh), ki se jih porabi v večjih količinah.*

Ključne besede: anketa o porabi v gospodinjstvih, razpoložljivost natrija, vsebnost natrija, skupine živil

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1 INTRODUCTION

Sodium is a mineral nutrient essential for life in small quantities. For many years, concerns have been expressed that consumption levels of sodium are well above those needed for nutritional purposes, and that these are having an adverse effect on health, in particular increased high blood pressure leading to higher risk of cardiovascular diseases (1–2). Studies also indicate significant associations between high sodium intake and a variety of chronic conditions including type II diabetes (3), cataract (4), gastric cancer (5), kidney disease (6, 7) and osteoporosis (6, 8). A high salt intake may also be an important contributing factor in the development of obesity (9).

The prevalence of hypertension (blood pressure above 140/90 mmHg) in the Slovenian adult population (age 25 to 64 years) is high (39.6%) (10), making a reduction in salt intake a national priority for the prevention of cardiovascular disease.

WHO recommends a reduction in sodium intake to reduce blood pressure and risk of cardiovascular disease, stroke and coronary heart disease in adults. WHO recommends a reduction to <2 g/day sodium (5 g/day salt) in adults (11). In 2005, Slovenia adopted the recommendation for nutrients intake from Germany, Switzerland and Austria named The Reference Values for Nutrients Intake (D-A-CH). The Reference Values for Nutrient Intake create the basis on which diets are planned to match nutritional requirements with food intake. The minimum recommended value for daily sodium intake for adults in-line with D-A-CH recommendations amounts to 550 mg/day of sodium (1.4 g/day salt) (12). In developed countries, ingestion of sodium tends to exceed the recommended intake (13), with the largest proportion originating from processed foods: for example, in the United Kingdom and the USA, it has been estimated that 75% of sodium intake comes from processed or restaurant foods, 10–12% is naturally occurring in foods and the remaining 10–15% is from the discretionary use of salt in home-cooking or at the table (14). In the British Diet and Nutrition Survey, a number of key food groups were found to be the major contributors to total daily sodium intake from food among British adults. These included cereals and cereal products providing 35%, meat and meat products contributing 26% and milk and milk products 8% of sodium from food (15). In Slovenia, the average salt intake of the population, assessed by 24h urinary sodium excretion, is 11.3±4.9 g salt/d, significantly higher in men than in women (13.0±5.1 vs. 9.9±4.3 g salt/day respectively) (16).

The total salt intake of 2,581 Slovenian adolescents (aged 14 to 17 years) was 10.4±0.2 g salt/d, much higher than the upper WHO limit for adults. Moreover, boys ate more salt than girls (11.5±0.3 vs. 9.4±0.2 g salt/d $P < 0.001$). The main food sources of salt for adolescents were table salt (33%), bread (24%), salty snack products (10%) and meat products (8%) (17, 18). However, there is little information on exposure to sodium-rich foods in the general population of Slovenia (19-21).

There are various methods to estimate sodium intake in a population. While measurement of urinary sodium excretion is the most accurate method (22), other methods, i.e. different food consumption surveys (questionnaires or interviews), tend to underestimate sodium intake by approximately 16–22% (17, 18). Information about nutrient availability within a country can be collected using three different means: food balance sheets, household budget surveys (HBSs) and specifically designed individual food consumption surveys. Both food balance sheets and HBSs provide insight into food availability but do not assess food consumption at an individual level. Food consumption data collected in nutrition surveys could be used for estimating sodium intake where accurate data on the sodium content of local foods were available (23).

The objective of the present study was to estimate average daily sodium availability in purchased foods per Slovenian consumer based on the food purchase data from the HBSs for the period 2000-2009. The secondary aim was to establish a comprehensive food composition database to monitor the sodium content of foods in Slovenia.

2 METHODS

2.1 The Household Budget Survey sampling design

The sample frame is the Central Population register (CRP). The sample stratification was made with regard to 12 statistical regions and six types of settlements. The survey was harmonised with Eurostat's recommendations. By combining data of three consecutive years, more accurate estimates are obtained. Data from three years are calculated to the middle year, which is used as the reference year for the interpretation of published results. The survey is implemented on the basis of the Slovenian National Statistics Act (24) and the Annual Programme of Statistical Surveys.

The consumption of goods is collected by diaries that are kept by all household members for two consecutive weeks. HBS data used for calculations in the present survey contains 223 foods purchased in stores, food markets or produced at own garden/farm by an average 3,727 households a year. Average sample in the HBS consisted of 11–12% children (<11 years), 8–9% adolescents (11–18 years) and 78–80% adults (>18 years) from 12 Slovenian geographical regions.

The Slovenian representative sample of households was equally distributed throughout the year. A more detailed description of the HBS sampling design is available elsewhere (25). In the study, we used data from nine HBSs from the period 2000-2009.

2.2 Estimation of dietary sodium and salt availability

HBS foods were classified according to the international COICOP classification into seven food groups, 19 food categories and 242 food subcategories. Purchasing data and sodium values were provided for all food products within the following categories: grains and grain-based products, fresh and processed vegetables and fruits, starchy roots and tubers, legumes, nuts and seeds, dairy products, eggs and egg products, fresh and processed meats, poultry and fish, food for infants and small children, sugar and confectionary, snack food, edible oils, sauces and spreads, beverages and drinks. Based on the data on annual purchases in kilograms per person, provided by HBSs (25) and the sodium content of foods, we carried out the calculations to estimate the average sodium availability of purchased foods (SAPF) in Slovenian households for the period 2000–2009.

There were three sources from which we obtained information about food composition:

1. sodium content of purchased foods were derived from food product labels;
2. for fresh foods and unlabelled products, we applied generic data from national and European food composition tables, and
3. sodium content of purchased meat products and bread and bakery products were analysed at the National Institute of Public Health, in a laboratory accredited according to ISO 17025. Sodium content was calculated from the present and quantified salt in the products (26).

Data obtained from the second and last source were screened by the authors (CRH) for plausibility. The results were expressed in milligrams of sodium per person daily. Comparisons on distribution of the largest contributors to the total SAPF were carried out. For the conversion from sodium (Na) to salt (sodium chloride (NaCl)), a factor of 2.54 was used, NaCl (mg) = Na (mg) x 2.54.

2.3 Statistical analysis

Statistical analyses were performed using SPSS for Windows (16.0). Descriptive statistics were calculated for continuous variables and expressed as mean, standard error of mean and standard deviation.

3 RESULTS

3.1 Sodium availability from purchased foods in Slovene households for the period 2000–2009

Based on the HBS data, sodium contained in salt added at cooking/preparing meals and at the table, salt from ready-made meals and most semi-prepared foods were excluded from this survey.

Table 1 represents estimated household SAPF and salt availability (SA) based on household food purchases in Slovenia for the period 2000-2009. Sodium availability of purchased foods (SAPF) in Slovenian households decreased from 2,289 mg/p/day (year 2000) to 1,860 mg/p/day (year 2009). Thus, the average SAPF for the period 2000-2009 was 2,104±132 mg/p/day.

Table 1. Household SAPF and SA based on food purchases in Slovenian households for the period 2000–2009.
Tabela 1. Razpoložljivost natrija in soli v kupljenih živilih v Sloveniji, v obdobju od 2000 do 2009.

	2000	2001	2002	2003	2004	2005	2006	2007	2009	Mean/ Povprečje
Sodium/Natrij (mg/person/day)/ (mg/osebo/dan)	2,289	2,254	2,168	2,127	2,103	2,103	2,042	1,988	1,860	**2,104**
Salt*/Sol* (mg/person/day)/ (mg/osebo/dan)	5,814	5,725	5,508	5,405	5,343	5,340	5,186	5,049	4,723	**5,343**

* 1 mmol of sodium (Na) corresponds to 23.0 mg; NaCl (mg) = Na (mg) x 2.54/ 1 mmol Natrija (Na) ustreza 23.0 mg; NaCl (mg) = Na (mg) x 2.54

3.2 Sodium and salt availability by food groups

In Table 2, a distribution (mg sodium/person/day and % to total daily SAPF) of household SA between food groups with the largest contribution to SAPF is presented. The key food groups contributing to dietary sodium intake were breads and bakery products (761 mg Na/p/day; 35.0% of SAPF) and meat products (597 mg Na/p/day; 27.9% of SAPF), while processed vegetables (136 mg Na/p/day; 6.6%) and cheeses (110 mg Na/p/day; 5.3%) also contributed to the household SAPF.

Table 2. Food groups with largest[a] contribution to total daily SAPF in Slovenian households for the period 2000–2009.

Tabela 2. Skupine živil, ki prispevajo največje[a] količine natrija v gospodinjstvih v Sloveniji, v obdobju od 2000 do 2009.

Year/Leto	SAPF (mg Na/p[b]/day) (mg Na/p[b]/dan)	Contribution to SAPF/Količina natrija v kupljeni hrani	Bread and bakery products/ Kruh in pekovsko pecivo	Meat products[c] / Mesni izdelki[c]	Processed vegetables[d] / Konzervirana zelenjava[d]	Cheeses/ Siri
2000	2,289	**mg Na/p/day/ mg Na/o/dan**	947	599	115	97
		%	41.14	26.19	4.89	4.14
2001	2,254	**mg Na/p/day/ mg Na/o/dan**	883	622	115	103
		%	39.16	27.59	5.01	4.47
2002	2,168	**mg Na/p/day/ mg Na/o/dan**	826	594	119	103
		%	38.10	27.40	5.41	4.67
2003	2,127	**mg Na/p/day/ mg Na/o/dan**	763	608	126	110
		%	35.87	28.57	5.86	5.12
2004	2,103	**mg Na/p/day/ mg Na/o/dan**	728	593	135	114
		%	34.59	28.20	6.33	5.36
2005	2,103	**mg Na/p/day/ mg Na/o/dan**	673	618	153	120
		%	32.02	29.41	7.21	5.64
2006	2,042	**mg Na/p/day/ mg Na/o/dan**	624	611	162	116
		%	30.59	29.94	7.85	5.63
2007	1,988	**mg Na/p/day/ mg Na/o/dan**	648	532	162	114
		%	32.59	26.75	8.13	5.72
2009	1,860	**mg Na/p/day/ mg Na/o/dan**	570	496	155	123
		%	30.65	26.69	8.33	6.63
Mean/ Povprečje	**2,104**	**mg Na/p/day/ mg Na/o/dan**	**761**	**597**	**136**	**110**
		%	**34.97**	**27.86**	**6.63**	**5.32**

Estimated average salt availability/ Povprečna ocenjena razpoložljivost soli	**5,343***	**mg NaCl/p/dan/ mg Na/o/dan**	**1,933**	**1,517**	**345**	**278**

[a] Only food subcategories with the largest contribution to sodium availability are mentioned in the table; the remaining food categories are: pastry, other grain foods, milk and milk products (not cheeses), fresh vegetables, fresh and processed fruit, nuts, sweets, eggs, fresh meat, fresh fish and fish products, etc./ V tabeli so navedene podskupine živil, ki prispevajo k največji razpoložljivosti natrija; ostale kategorije živil so: peciva, ostali žitni izdelki, mleko in mlečni izdelki (razen siri), sveža zelenjava, sveže in konzervirano sadje, oreški, sladka živila, jajca, sveže meso, sveže ribe in ribji izdelki itd.

[b] p = person/o = oseba

[c] Included meat products: bacon, ham, cooked sausages and other sausage meat products, frankfurters (hot-dog)./ Vključeni mesni izdelki: svinjina, šunka, salame in ostali mesni izdelki, hrenovke (hot-dog).

[d] Included processed vegetables: sauerkraut, pickled turnip, canned vegetables (red pepper, mushrooms, olives, “ajvar” (salt based relish made from red pepper, eggplant and garlic), horseradish, corn), prepared potato products (frozen french-fries)/ Vključena konzervirana zelenjava: kislo zelje, kisla repa, konzervirana zelenjava (rdeča paprika, gobe, olive, »ajvar« (zelenjavni izdelek iz rdeče paprike, jajčevcev in česna), hren, koruza), predpripravljeni krompirjevi izdelki (zamrznjen pommes frittes)

[*] 1 mmol of sodium (Na) corresponds to 23.0 mg; NaCl (mg) = Na (mg) x 2.54/ 1 mmol of sodium (Na) ustreza 23.0 mg; NaCl (mg) = Na (mg) x 2.54

In addition, in the examined period the SA in bread and bakery products decreased and the SA in processed vegetables and cheeses increased slightly (Figure 1).

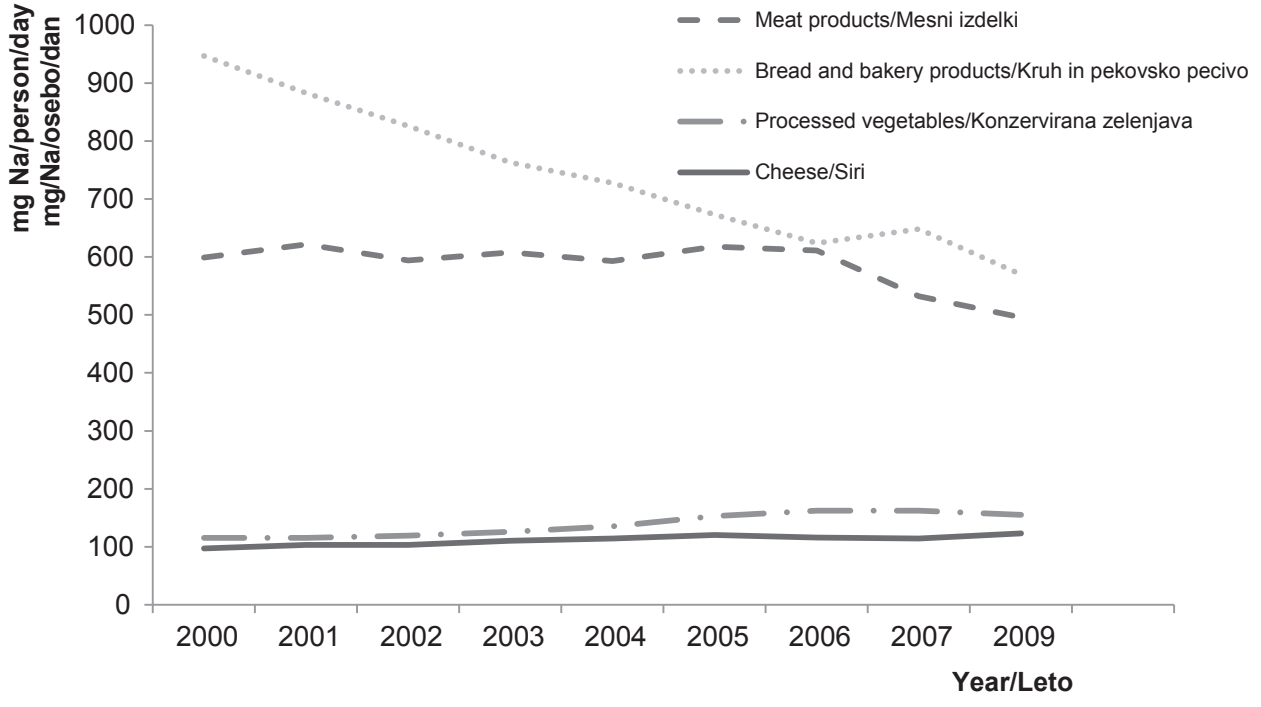

Figure 1. Average annual values in the period 2000-2009 for the SA of food groups with the largest contribution to total SAPF daily in Slovenian households.

Slika 1. Povprečne letne vrednosti natrija v živilih z največjo razpoložljivostjo natrija v gospodinjstvih v Sloveniji, v obdobju od 2000 do 2009.

3.3 Sodium and salt availability of foods according to their sodium content and purchased quantity

In Table 3 and 4, only foods with the highest contribution to total daily SAPF with confidence intervals are presented. To interpret their high contribution to total SAPF, these foods can be divided into three groups according to the other foods included: 1) foods with high sodium content and high purchased quantity, 2) foods with high sodium content and relatively low purchased quantity and 3) foods with relatively low sodium content and high purchased quantity. Based on this classification, various salamis and cheeses were included in the first group. In the second group with high sodium content, bacon, dry meat, prosciutto and various sausages were included. In the third group with high purchased quantity, foods like cow's milk, brown bread, mixed bread and white bread were included.

Table 3. Average SA of foods with the largest contribution to total SAPF in Slovenian households for the period 2000–2009.

Tabela 3. Povprečne vrednosti razpoložljivosti soli v skupinah živil, ki prispevajo največ k skupni razpoložljivosti natrija v gospodinjstvih v Sloveniji v obdobju od 2000 do 2009.

Food group/Skupine živil	Foods/Živila	Average sodium concentration (mg/100 g)*/Povprečna koncentracije natrija (mg/100 g)/	FSA 2012 target (mg/100 g)**/ FSA 2012 cilji (mg/100 g)**	Purchased quantities of foods (mg/pa/day)/ Količina kupljenih živil (mg/o/dan)	Average sodium availability in purchased quantities (mg Na/p/day)/Povprečna razpoložljivost natrija v kupljenih živilih (mg Na/o/dan)	Contribution to SAPF (%)/Prispevek k razpoložljivosti natrija v kupljeni hrani (v %)	Estimated salt availability (mg NaCl/p/day)/ Ocenjena razpoložljivost soli (mg NaCl/o/dan)
3	**White bread/Bel krih**	565	370	42,310	239	11.1	607
1	**Various salamis/različne salame**	839	700	14,368	200	9.3	508
1	**Cheeses/Siri**	694	215-750	15,790	110	5.1	279
3	**Brown Bread/Črn kruh**	455	370	19,490	89	4.1	225
2	**Dry meat/Sušene mesnine**	1800	1150	4,550	80	3.7	203
3	**Mixed bread (white and brown)/Mešane vrste kruha (beli in črni)**	506	370	15,100	76	3.5	194
2	**Prosciutto/Pršut**	2445	1150	2,430	60	2.8	152
3	**Cows milk (sterilized)/ Kravje mleko (sterilizirano)**	48	-	97,600	47	2.2	119
2	**Various sausages/ Različne klobase**	837	450	5,030	40	1.9	102
3	**Rolls/Pekovski izdelki**	531	370	8,120	40	1.9	102
	Frankfurters (hot-dog)/ Hrenovke	699	450	6,130	40	1.9	102

2	**Bacon/Slanina**	1770	1150	2,260	40	1.9	102
3	**Breakfast cereals/Žita za zajtrk**	460	300	6,130	30	1.4	76
	Pickled cucumbers/Kisle kumarice	960	200	2,840	30	1.4	76

* Sodium content is obtained from various food composition databases (Souci et al., 2005; Golob et al., 2006; Kaić-Rak & Antonić, 1990; Kulier, 1996; United States Department of Agriculture; Results at National Institute of Public Health)./ Podatki o vsebnosti natrija so pridobljeni iz različnih tabel hranilnih vrednosti živil (Souci et al., 2005; Golob et al., 2006; Kaić-Rak & Antonić, 1990; Kulier, 1996; United States Department of Agriculture; Rezultati Nacionalnega inštituta za javno zdravje).

[a] p = person/o = oseba

** http://www.food.gov.uk/news/pressreleases/2009/may/salttargets (Assessed in November 2011)./ http://www.food.gov.uk/news/pressreleases/2009/may/salttargets (Dosegljivo: November 2011).

Table 4. The confidence intervals for Bread and bakery product, Meat products, Processed vegetables and Cheeses over the time period of 2000-2009.

Tabela 4. Interval zaupanja za kruh in pekovske izdelke, mesne izdelke, konzervirano zelenjavo in sire v obdobju od 2000 do 2009.

Year/ Leto	Bread and bakery products/Kruh in pekovski izdelki			Meat products/ Mesni izdelki			Processed vegetables/ Konzervirana zelenjava			Cheeses*/ Siri*
		95% Confidence Interval of the Difference/ 95 % interval zaupanja			95% Confidence Interval of the Difference/ 95 % interval zaupanja			95% Confidence Interval of the Difference/ 95 % interval zaupanja		
	Mean/ povprečje	Lower/najnižja vrednost	Upper/najvišja vrednost	Mean/ povprečje	Lower/najnižja vrednost	Upper/najvišja vrednost	Mean/ povprečje	Lower/najnižja vrednost	Upper/najvišja vrednost	Mean/ povprečje
2000	40.94	2.78	79.11	35.26	11.02	59.51	9.19	3.09	15.29	97.00
2001	38.37	4.46	72.29	36.58	11.94	61.21	9.23	3.14	15.31	102.70
2002	35.92	6.11	65.72	34.96	10.52	59.40	9.59	3.06	16.12	102.70
2003	33.17	6.43	59.91	35.76	10.84	60.69	10.18	3.41	16.95	110.30
2004	31.63	7.00	56.25	34.89	10.55	59.23	10.87	3.96	17.77	114.10
2005	29.27	7.54	50.99	36.37	11.95	60.79	12.38	4.17	20.59	119.80
2006	27.15	7.85	46.45	35.96	11.33	60.58	13.08	3.87	22.28	116.00
2007	28.16	10.39	45.94	31.28	13.48	49.09	13.12	3.80	22.43	114.10
2009	24.77	8.27	41.28	29.21	11.38	47.03	12.58	3.81	21.36	123.30

* The confidence interval for Cheeses could not be calculated because the HBS data provided only the total sum of consumed cheeses per year./ Intervala zaupanja pri skupini sirov ni bilo možno določiti, saj podatki raziskave o porabi v gospodinjstvih opredeljujejo le skupno letno porabo sirov.

In comparison to other foods with much higher sodium content (e.g. salami, sausages, dry meat etc.), the highest contribution to SAPF was represented by white bread (239 mg Na/p/day; 11.1% of SAPF), since its purchased quantity was rather high (42 mg/p/day). It was similar with SA in brown bread (89 mg Na/p/day; 4.1% of SAPF), mixed bread (76 mg Na/p/day; 3.5% of SAPF), cow's milk (47 mg Na/p/day; 2.2% of SAPF) and rolls (40 mg Na/p/day; 1.9% of SAPF). Otherwise, foods with higher sodium content obviously contributed a large part of the daily SA as well; various salamis contributed 9.3% of SAPF (200 mg Na/p/day), cheeses 5.1% (110 mg Na/p/day), dry meat 3.7% (80 mg Na/p/day) and prosciutto 2.7% (60 mg Na/p/day), while various sausages, frankfurters (hot-dog) and bacon separately contributed 1.9% to SAPF (40 mg Na/p/day). Mixed bread contributed up to 3.5% to SAPF and was purchased in 15.10 g/p/day, while dry meat contributed almost the same 3.7% to SAPF but was purchased in only 4.55 g/p/day.

All food subcategories listed in Table 3 still have the sodium content above the FSA 2012 sodium reduction targets (27). In the 2009 HBS survey, in the food subcategory for bread and bakery products, only toast had a sodium content below the target, while other breads, rolls and breakfast cereals, meat products and processed vegetables and cheeses had sodium contents above the targets.

4 DISCUSSION

The present study indicates that the estimated average amount of sodium available for consumption based on the household food purchases in Slovenia was 2,104±132 mg/p/day (equivalent to ~5.3 g of salt per day). Regarding the contribution of particular food groups to total SAPF, we found that bread bakery products and meat products were the major sources of sodium from purchased foods. The consumption of bread and bakery products, representing one of the food groups that mainly contribute to total household SA, decreased in the period 2000-2009. A similar trend was noticed in meat products, whose purchase started decreasing after 2006, when Slovenia has started a nationwide program of population reduction of salt intake. According to the recommended maximum sodium limit of 2,000 mg per healthy adult daily (28), we estimated that bread and bakery products represent 35.0% (761 mg Na/day) of the recommended quantity and meat products 27.9% (597 mg Na/day). Despite the smaller purchased quantities of higher-sodium foods (e.g. sausages, prosciutto, dry meat, pickled cucumbers) in comparison to larger purchased quantities of the medium-sodium foods (e.g. white bread, mixed bread, brown bread, milk, rolls), both food groups contribute significant amounts of sodium in the diets of Slovenians. Therefore, these two food groups are estimated to represent almost 65% of the recommended daily intake of sodium. These estimates suggest the need for inclusion of these items in the reformulation targets for a population salt reduction strategy. Results from the present analysis indicate that food subcategories with the largest contribution to SAPF did not meet FSA 2012 Na reduction targets, and its adherence would lower the average salt intake if applied incrementally over the next ten years. Gradual, incremental reduction by 4% annually in the salt content of processed food can be achieved without consumers detecting the reduction (29).

A number of studies have been carried out to assess the sodium availability from purchased food. Sources of dietary sodium vary largely worldwide. The review of some compared European, Canadian and USA studies can be seen in Table 5.

The differences in dietary sodium availability between countries may be due to the variable selection of foods within food groups as well as sodium content of selected foods. Differences also depend on gender, age, cultural and socio-economic factors. As seen in a Canadian survey (33), there are different impacts of sodium content of foods and their quantity purchased by consumers on estimation of SAPF.

The average salt intake of the Slovenian population, assessed by 24h urinary sodium excretion, is 11.3±4.9 g salt/d, well above the WHO recommendations (5g). This may indicate that ready-made meals, most semi-prepared foods and added salt during cooking and at the table, which the present study does not account for, are important sources of salt in the diet as well as dietary habits. Since the comprehensive national salt reduction program started in 2010, we expect that daily salt consumption in all population groups will reduce in time, and the strategy should be combined with education and behavioural interventions. The CINDI study in Slovenia reported that the number of adults who never salted their ready meals at the table has increased in the period 2001 – 2008 from 41.4 to 50.8% (34), which is a positive change of dietary habits.

In 2012, we conducted a survey on the average salt content of randomly selected meals from several types of restaurants (fast food restaurants; Slovenian, Chinese, Mexican, Spanish and Italian restaurants). We found that analysed prepared meals (N - 35) contain on average from 0.7 to 1.9 g of salt per 100 g (35).

The strength of the present study is that we established a comprehensive food composition database to monitor the dietary sodium availability in Slovenia

Table 5. The outline of research on the sodium availability in food from various European countries.
Tabela 5. Pregled raziskav o razpoložljivosti natrija v hrani v Evropi.

Country/ Država	**Method/ Metoda**	**Main sodium sources/Glavni viri natrija**	**References/ Reference**	**Year of survey/ Leto raziskave**
Ireland/Irska	7-day estimated food record/7-dnevni prehranski vnos	970 mg/p/d (meat and fish)/ mg/o/d (meso in ribe) 840 mg/p/d (bread and rolls)/ mg/o/d (kruh in pekovsko pecivo) 270 mp/p/d (milk and milk products)/ mg/o/d (mleko in mlečni izdelki) 230 mg/p/d (soups, sauces, miscellaneous foods)/ mg/o/d (juhe, omake, ostala živila) 150 mg/p/d (pastries)/mg/o/d (slaščičarska peciva) 140 mg/p/d (breakfast cereals)/ mg/o/d (žita za zajtrk) 130 mg/p/d (vegetables and processed vegetables)/ mg/o/d (zelenjava in konzervirana zelenjava) 95 mg/p/d (savouries e.g. pizza, mixed pasta dishes)/ mg/o/d (pice, jedi iz testenin) 194 mg/p/d (other foods)/ mg/o/d (ostala živila)	Irish Universities Nutrition Alliance (Summary Report) (30)	2001
United States of Amerika (USA), United Kingdom/ Združene države Amerike (ZDA), Združeno kraljestvo	24-hour dietary recall/ Metoda jedilnika prejšnjega dne	1,180 mg/p/d (bread, cereals and grains) (UK)/mg/o/d (kruh, žita in žitni izdelki) (Združeno kraljestvo) 700 mg/p/d (processed red meat, poultry, eggs) (UK)/mg/o/d (konzervirano rdeče meso, perutnina, jajca) (Združeno kraljestvo) 170 mg/p/d (soups) (UK)/mg/o/d (juhe) (združeno Kraljestvo) 280 mg/p/d (processed vegetables) (UK)/mg/o/d (konzervirana zelenjava) (Združeno Kraljestvo 710 mg/p/d (bread, cereals and grains) (USA)/ mg/o/d (kruh, žita in žitni izdelki) (ZDA) 440 mg/p/d (processed red meat, poultry, eggs) (USA)/mg/o/d (konzervirano rdeče meso, perutnina, jajca) (ZDA) 300 mg/p/d (dairy products) (USA)/mg/o/d (mlečni izdelki) (ZDA) 260 mg/p/d (sauces, salad dressings) (USA)/mg/o/d (omake, polivke za solate) (ZDA)	Anderson et al. (31)	2010
Finland/ Finska	/	630 mg/p/d (from bread)/ mg/o/d (iz kruha) 1930 mg/p/d (meat and meat products)/mg/o/d (meso in mesni izdelki) 140 mg/p/d (cheeses)/mg/o/d (siri)	Mannisto et al. (32)	2003

with representative national HBS data. However, the study also has a number of limitations that should be considered when interpreting the findings. First, for determining the average sodium content in food subcategories we grouped a variety of food products that may vary in salt content, which is characteristically true for meat products. We applied food product labels and generic data from food composition tables; only a limited number of laboratory analyses were used for determining sodium content of foods. The original purpose of HBS data collection is to provide data on household total consumption as an input to national accounts. Therefore, the estimates on food consumption are quite limited and cannot fulfil the same needs as some other dietary recall surveys. The most important reason that we used the HBS data is that in Slovenia more detailed data have not yet been collected. The important weakness of our study using the HBS data is that households keep diaries for two weeks. According to the analyses performed during the last decade, the consumption during the second week is much lower than the consumption during the first week, which is an important response error. Furthermore, we acknowledge that our results of average sodium availability in purchased foods is only an estimation that we could use to monitor through the years to develop and evaluate the sodium reduction programs and not an estimation of salt intake on a personal level.

5 CONCLUSIONS

In summary, we have identified foods with the largest contribution to total SAPF in Slovenian households for the period 2000–2009 and estimated average sodium availability from purchased foods.

Our study indicates that a large proportion of the daily sodium intake of Slovenians (in total exceeding the daily recommended intake levels) comes from a limited group of food items. Furthermore, our estimates, taken together with our population assessment of salt intake (16), suggest that ready-made meals and most semi-prepared foods would be important contributors to total salt intake and that added salt during cooking and at the table might also contribute to a higher proportion of the daily salt intake than previously thought. The salt content of meals eaten away from home is generally assumed to even be higher than those prepared at home. These data provide clear evidence for an inclusion of these items in the priority list for reformulation. At the same time, our data suggest that an increase in consumer awareness may still be required to modify behavioural habits of discretionary use of salt.

To monitor the dietary sodium availability in Slovenia, representative national HBS data were used. Therefore, our study had some limitations and weaknesses, so proper nutritional surveys and similar studies in Slovenia are needed to upgrade them.

In Slovenia, we adopted the joint WHO/FAO recommendations that state that the population nutrient intake goal for salt should be less than 5 g/day. A national programme for reducing salt intake needs to be implemented through combined efforts of national campaigns and initiatives, involvement of industry to achieve reformulation of food production, intensive interventions and primary care or population prevention programmes as well as consumer education. The most important steps in reducing salt intake are developing labelling of the salt contents in foods to help consumers to choose foods with less salt (36). All effective strategies are encouraged to reach the upper recommended salt intake level, which is less than 5 g/day according to the World Health Organisation (11) and according to the Nutrition Action Plan for Slovenia (37). However, further analysis and monitoring are needed.

Total salt intake in Slovenian adults significantly exceeds the WHO upper limit. Therefore, it is clear that implementation of a national programme for reducing salt intake should also focus on collaboration with the food industry and on production of low-salt or reduced-salt foods.

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