Z Lebensm Unters Forsch A (1999) 208:230–232

ORIGINAL PAPER

Dražigost Pokorn · Marjan Dermelj · Vekoslava Stibilj
Barbara Gregorič

Iodine in daily diet samples from some old people's homes in Slovenia

Received: 14 April 1998

Abstract In July 1992 we collected samples of daily meals in 51 old people's homes in the Republic of Slovenia to establish their iodine contents. The average content found was 79.6 ± 31.9 μg of iodine in the daily meal, or 0.212 ± 0.083 mg iodine kg^{-1} dry substance. In only 15 cases of 51 analysed samples, did the quantity of iodine exceed two thirds of the recommended daily intake of iodine, i.e. more than 100 μg.

Key words Iodine · Diet · Old people's homes

Introduction

Slovenia belongs to the Alpine region where goitre is endemic and a lack of iodine in water and food is characteristic. The most important factor for the appearance of goitre is a chronic lack of iodine in food [1], but in spite of iodine prophylaxis, which has been performed since 1953 [2], the 10% prevalence of goitre in Slovenia has not decreased [3].

The study of endemic goitre in Slovenia was initiated in the period between the two wars [4, 5], long before the introduction of iodine prophylaxis, i.e. the compulsory addition of 10 mg KI kg^{-1} edible salt. Bonač [6] and Bebler et al. [7] reported that goitre had decreased after the introduction of iodine prophylaxis in Slovenia.

Based on recommendations of the World Health Organization (WHO) [8], the iodine intake must be high enough so that the quantity of iodine excreted in urine is 150–300 μg/day. A study, performed with a small group of pupils from Ljubljana, showed that the quantity of excreted iodine had a mean value of 62 μg/day, which confirmed the assumption that the iodine intake of pupils was too low [9]. In 1991, goitre was found in 15–18% of pupils [10].

Recommended daily quantities of iodine change with age, sex and physiological condition (e.g. breast feeding, pregnancy). The recommended dietary allowance (RDA) for adults aged over 51 years is 150 μg day^{-1} for males and 175 μg day^{-1} for females [11].

Until now, the content of iodine in the daily meals of adults and children in Slovenia has not been researched. Thus, it is not known if the cause for the high prevalence of goitre in Slovenia is mainly external, i.e. the iodine deficiency in food and water.

The aim of our research work has been the ascertainment of iodine content in the food consumed in all old people's homes in the Republic of Slovenia (Fig. 1).

Our work included ascertainment of the energetic value of the food, and its contents of proteins, fats, carbohydrates, dietary fibres and of salt. The nutrient and energy composition of these meals was found to be appropriate to the ages of the consumers. In spite of the well-balanced energy and nutrient composition of the meals, it has been asserted that the mean quantities of Ca, Mg, Cu, Zn, Mn, Cr, and Se were far below the RDA in the 51 daily meals [12, 13].

Materials and methods

Total daily diets for the dietary observation were obtained in advance from each institution situated in different parts of Slovenia. Total daily menus were calculated by taking the total amount of all foods and beverages served in one weekend. All daily diets were taken in July 1992. A composite sample of total daily diet from old people's homes was milled, frozen at –24 °C and then lyophilized. The frozen dried samples were milled in an agate mill (to avoid contamination), stored in plastic bottles and washed before use with dilute nitric acid (1:1).

Iodine concentrations in diets were determined in duplicate by neutron activation analysis as described elsewhere [14].

Irradiation of samples and standards. Depending on the quantity of iodine in the sample, homogenized and lyophilized samples

D. Pokorn (✉) · B. Gregorič
Medical Faculty, Institute of Hygiene, University of Ljubljana, SI-1000 Ljubljana, Slovenia

M. Dermelj · V. Stibilj
J. Stefan Institute, SI-1000 Ljubljana, Slovenia

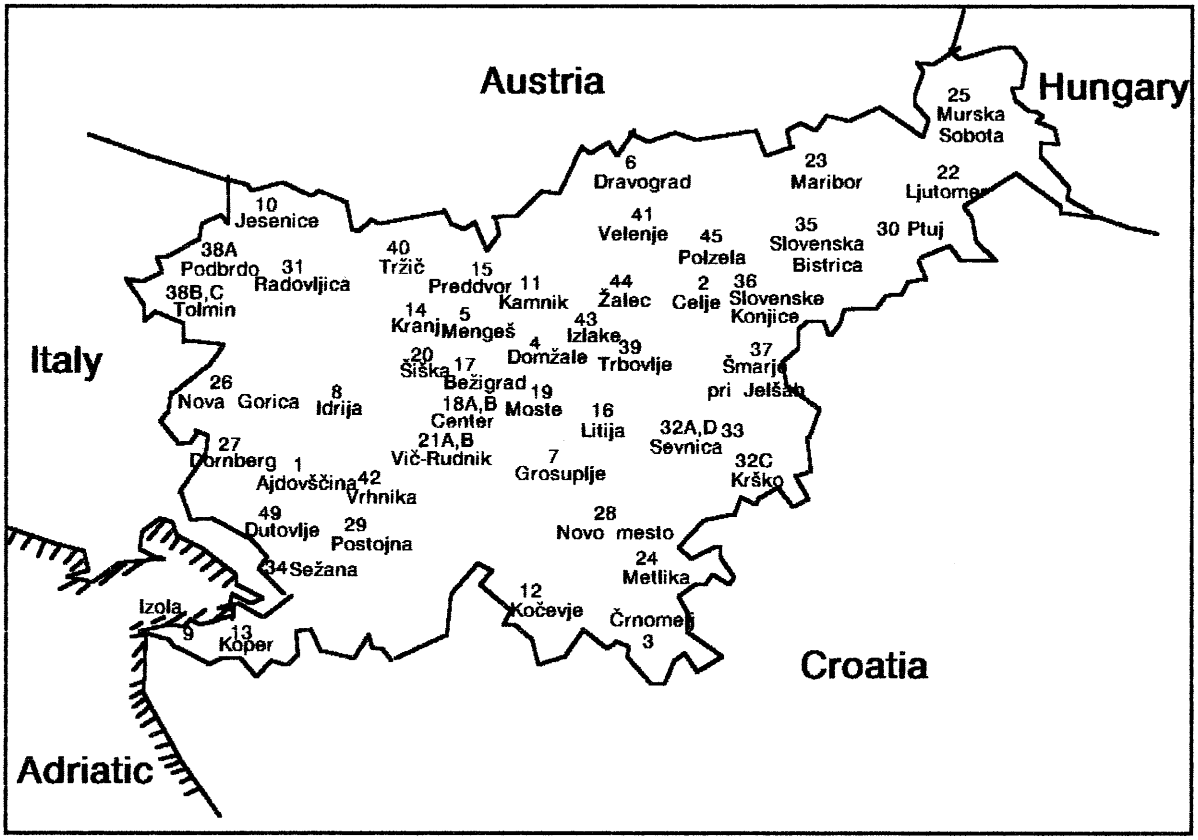

Fig. 1 Old people's homes in the Republic of Slovenia

(50–400 mg) and an appropriate aliquot of standard solution (10 mg kg^{-1} of I^- in a 5% solution of NH_3) were sealed in plastic tubes and irradiated simultaneously for approximately 1–25 min in the pneumatic transfer system of our TRIGA Mark II Reactor (Westing House, USA) at a neutron (n) fluence of 4×10^{12} n cm^{-2} s^{-1}.

Radiochemical separation of ^{128}I. The separation procedure employed for this purpose was based on combustion of the sample in the presence of a carrier (50 mg g^{-1} I^-) in an oxygen atmosphere (4 l Schöninger flask) followed by double extraction of I_2 with CCl_4 after the use of classical redox reactions with $NaNO_2$ and Na_2SO_3 in H_2SO_4 medium. The isolation procedure for ^{128}I took about 20 min.

Measurement of γ activity. The γ activity of the isolated ^{128}I nuclide [$^{127}I(n,\gamma)^{128}I$, ($t_{1/2}$ = 25 min, E = 0.443 MeV)] was measured with a coaxial HP Ge detector connected to a 4096 channel Canberra 90 analyser, or a well-type HP Ge detector.

Chemical yield. The chemical yield, which was mostly in the range 80–95% was determined spectrophotometrically for each sample from the absorption of the elemental iodine carrier in CCl4 at 517 nm after the γ-activity measurement.

Results and discussion

The accuracy and reproducibility of the analytical procedure was examined with an analysis of reference and certified reference samples (Table 1). Determination of iodine within the microgram and nanogram concentration range is an extremely demanding task because of decomposition of the samples, the volatility of iodine, contamination and the blind value of the sample. This is probably one of the reasons why there are only few certified biological materials available for iodine that could be used for examination of the reliability of obtained results with different methods [15].

Daily meals with a correct nutritional and energy composition, prepared in kitchens of Slovenian homes for elderly people and which also contained their own nutrients, especially fruits and vegetables, had on average 79.6 ± 31.9 μg iodine (Table 2). Only one meal contained more than 150 μg iodine. Thirty-five analysed samples contained less than two thirds of the RDA (100 μg for an adult male).

Table 1 Results for iodine in some reference and certified reference samples. *n* Number of determinations

Sample	n	Iodine (μg g^{-1})	Certified and literature value
Non-fat milk powder NIST 1549	6	3.37 ± 0.09	3.38 ± 0.02
Oyster tissue NIST 1566 a	6	4.61 ± 0.17	4.46 ± 0.42
Total diet NIST 1548	4	0.400 ± 0.014	0.373 ± 0.022[a]

[a] Literature value [15]

Table 2 Iodine contents in 51 total daily diets from old people's homes in Slovenia

mgI kg $^{-1}$	On dry basis[a]	μgI per meal[b]	μgI per 1000 kcal (4,2 MJ)
Average	0.212 ± 0.083	79.53 ± 31.92	48.54 ± 18.82
Median	0.192	69.35	45.05
Minimum	0.110	31.15	18.89
Maximum	0.448	165.53	98.75

[a] Result for I (total diet National Institute of Standard and Technology (NIST) Standard Reference Material (SRM) 1548) in reference and certified reference materials: 0.383 ± 0.035 mgI kg $^{-1}$; certified or Reference value: 0.3
[b] Numbers of those with intake above or below RDA (150 μgI) or two-thirds RDA (100 μgI) above RDA 1; below RDA, 50; above ⅔ RDA, 15; below ⅔ RDA, 35

Table 3 Values for iodine in International Atomic Energy Agency (IAEA) daily diet samples from different countries and comparison with Slovenia (mgI kg $^{-1}$ dry weight) [15]

Country	Number of diet samples	Range	Mean	Median
Brazil	9	0.282–0.633	0.48	0.49
China	11	0.045–6.333	0.76	0.16
Italy	19	0.062–0.456	0.18	0.18
Japan	5	0.088–7.650	1.97	0.55
Slovenia	*51*	*0.110–0.448*	*0.21*	*0.19*
Spain	20	0.150–1.960	0.44	0.46
Sweden	5	0.084–0.540	0.21	0.16
Thailand	8	0.057–0.187	0.11	0.11
Turkey	6	0.065–0.337	0.17	0.16

In the daily meals of adult Englishmen 220 ± 50 μg iodine was found, and in the United States 238–738 μg per day, whilst in Japan the average was 300 μg–10 mg/day, due to their high consumption of sea food [16].

Such a low quantity of iodine in daily meals for elderly people in Slovenia can be attributed to a less frequent inclusion of sea food in the diet. On average, sea food is included in the diet once a week. A Slovenian consumes only 3.8 kg fish year^{-1} [17]. The low content of iodine in daily meals for elderly people in homes may also be a consequence of decreased consumption of iodine-enriched edible salt and/or of salt-free diets, and especially of too low a quantity of iodine in the iodine-enriched salt used in Slovenia (8 mg iodine kg^{-1} salt or 10 mg KI kg^{-1} salt). Table 3 shows the iodine contents in daily meals for eight countries [15]. A comparison of our results with the results for other countries partly confirms our assumption.

If the above-mentioned nutritional facts and the relatively high prevalence of goitre in Slovenia are taken into account, it can be assumed that dietary intake in Slovenia lacks iodine, even though iodine-enriched edible salt is used. This could be the main reason for the increase in endemic goitre in Slovenia and/or of all disorders connected with iodine deficiency in daily meals. Higher fish consumption and the use of iodine-enriched foods, especially of adequtely iodine-enriched salt, could form an important part of goitre prophylaxis in Slovenia. Addition of 10 mg KI kg^{-1} salt or approximately 8 mg iodine kg^{-1} salt is not sufficient for goitre prophylaxis in Slovenia. Based on data provided by WHO/NUT [18] and the assumption that the mean daily consumption of salt is approximately 10 g, we assume that at least 20–40 mg iodine should be added per 1 kg salt for a successful goitre prophylaxis in Slovenia.

References

1. World Health Organisation (1994) Indicators for assessing iodine deficiency disorders and their control through salt iodization. WHO/NUT 6:1–55
2. Anon (1953) Regulation on iodine prophylaxis (in Slovene) Uradni list FLRJ No. 43
3. Porenta M, Hojker S, Avčin J, Budihna N (1993) Endemic goitre in Slovenia. Radiol Oncol 27 [Suppl 6]:46S–50 S
4. Guzelj V (1934) Operative techniques for goitre: a statistical survey (in Slovene). Zdrav Vestn 7:281–283
5. Černič M (1936) Five years of goitre in Maribor (in Slovene) Zdrav Vestn 8:185–187
6. Bonač I (1959) Endemic goitre in Slovenia. First Yugoslavian Symposium on Endemic Goitre (in Serbo-Croat). Komnis, Belgrade, pp 81–91
7. Bebler D, Bonač I, Ragazzi V (1962) The spread of endemic goitre in the republic of Slovenia and the success of prophylaxis (in Slovene). Zdrav Var 2:6–14
8. Horster FA (1986) Inform Arzt 14:1–6
9. Hojker S, Avčin J, Pisanski M (1991) Thyropathy in women and children (in Slovene). Research report. Ministry of Science and Technology, Llubljana
10. Hojker S, Kladnik S, Pavlin K, et al (1983) Thyroid gland: related hormones (in Slovene). Research report. Ministry of Science and Technology, Llubljana
11. Food and Nutrition Board, National Academy of Sciences-National Research Council. Recommended Dietary Allowances, 10th edn. National Academy Press Washington, DC
12. Pokorn D, Stibilj V, Dremelj M, Gregorič B, Štupar J (in press) Curr Status Future Trends Anal Food Chem
13. Pokorn D, Gregorič B, Homar M, Martinčič V (1996) Zdrav Vestn 65:691–693
14. Dremelj M, Šlejkovec Z, Byrne AR, Stegnar P, Stibilj V, Rossbach M (1990) Fresenius J Anal Chem 338:559–561
15. Dremelj M, Stibilj V, Stekar J, Byrne AR (1991) Fresenius J Anal Chem 340:258–261
16. Hetzel BS, Maberly GF (1986) In: Mertz W (ed) Trace elements in human and animal nutrition, 5th edn. APP, London, pp 139–208
17. Čepin S, Čepon M, Šalehar A, Kompan D, et al (1996) Trends in food production from animal sources in Slovenia. Book of Abstract. 1st Slovenian Congress on Food and Nutrition, Bleds pp 130
18. WHO (1996) Recommended iodine levels in salt and guidelines for monitoring their adequacy and effectiveness. WHO/NUT 13:1–9