PROCESS FACTORS INFLUENCING THE SUPPLY OF IODISED SALT TO HOUSEHOLDS IN SOUTH AFRICA

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Abstract

Several factors playing a role in the supply of adequately iodised salt to households have been investigated in South Africa after the introduction of mandatory iodisation of salt at a higher iodine concentration than before. The iodine concentration studied quantitatively (titration method) at the retail level in 48 magisterial districts over a five year period showed an initial improvement followed by signs of backsliding necessitating an investigation at the production sites. Wide variation was found in the iodine concentration, determined by means of the titration method, of iodised salt at the production sites mainly due to a lack of internal monitoring. An educational campaign and providing training in the titration method to all salt producers improved the accuracy of salt iodisation. In two national studies, in 1998 and 2005, the coverage of adequately iodised salt (>15 ppm, titration) at the household level improved from 62.4% to 76.9% and identified reasons for not achieving the goal of 90%. The iodine concentration in drinking water was low in 7 of the 9 provinces, slightly elevated in one province and greatly elevated in another province. Despite no legal requirement to use iodised salt in processed foods, a significant amount of iodine was found in the processed foods of a third of the food companies included in a study. Nationally, the knowledge of iodine nutrition was low amongst the general population, particularly amongst low socio-economic groups.
This model of investigating the process factors involved in the supply of adequately iodised salt to households showed a progressive improvement over recent years and identified weaknesses requiring targeted intervention.

Introduction

Optional iodisation of household salt was introduced in South Africa in 1954 and salt iodisation was made mandatory at a higher level than before at 40 to 60 ppm in 1995 to eliminate iodine deficiency and endemic goiter that existed in the country in early years. Because of technological difficulty to achieve the required iodine concentration in salt, the regulation was revised to a level of 35 to 65 ppm in 2006. Only table salt is iodised and it is not legally required that agricultural salt or salt used in the production of processed foods is iodised. The regulatory environment therefore created the framework or the boundaries within which the salt iodization programme operates in the country.

Impact of mandatory iodisation of salt

Remarkable progress in the elimination of iodine deficiency was seen in South Africa in several studies since the introduction of mandatory iodisation at an elevated iodine concentration (1). The mean iodine content of table salt at the retailer level increased significantly from 14 to 33 ppm in one year, but was accompanied by wide variation in iodine concentrations. As a consequence a dramatic shift occurred, also within one year, in the distribution of urinary iodine values from deficient to sufficient concentrations in four communities (2). The goitre rates in these children, measured by palpation, remained unchanged after a year confirming

the slow regression of the thyroid size after increasing the iodine intake in iodine deficient children.

Median urinary iodine concentrations in a national IDD survey (n=8524) conducted in 1998 was 177 µg/L and showed that optimal iodine nutrition (median urinary iodine 100-199µg/L) existed at the national, as well as at the provincial level in 7 of the 9 provinces, with the other 2 provinces displaying more than adequate iodine intakes (3). However, based on urinary iodine concentrations, 16% of 179 schools included in the study had indications of persisting iodine deficiency and high goitre rates assessed by palpation were observed in a sub-sample of 49 schools. The survey therefore showed that aggregated national and provincial urinary iodine data may mask pockets of persisting iodine deficiency, as was later confirmed in rural schools in the Limpopo Province. In a follow up national survey in 2005 the median urinary iodine concentration was 215 µg/L in children and 177 µg/L in adult women (4).

High median urinary iodine concentrations found in children living in the Northern Cape Province in both the 1998 and 2005 surveys indicated more than adequate iodine intake in this province, most likely as a result of a combination of the salt iodisation programme and abundant iodine in the environment.

Process factors influencing the supply of iodised salt

For the efficient management of a national salt iodisation programme and to enhance the sustainability of such a programme, a good understanding of the process factors influencing the supply of iodised salt to households is essential. Ultimately these factors will jointly determine the impact on iodine status of the population. Process factors could be defined as all those factors operating in the supply chain, from the production stage to the consumption stage, which could influence the delivery of adequately iodised salt to the consumer. Programme managers in any country with a salt iodisation programme should be aware of these process factors and should collect data on most if not all of the factors relevant for a specific country. These factors may vary from country to country, but several of the factors are expected to be universal in most countries.

Since the introduction of mandatory salt iodisation in South Africa, a range of different studies addressing different process factors were conducted over a number of years, each of which had a specific aim. Jointly these various studies provided the pieces of information that filled the picture of process factors influencing the supply of adequately iodised salt to households countrywide. The process factors investigated are discussed below.

Iodine in household salt: National surveys in 1998 and 2005 on nationally and provincially representative samples of households were carried out to investigate the iodine content of household salt by means of the titration method (4,5). These were probably the first national surveys using the quantitative titration method instead of the rapid test kit method to estimate the iodine content of household salt. In 1998 the data showed that 95,4% of households in South Africa used salt regularly and 2,9% occasionally, providing confirmation that salt is an effective fortification vehicle penetrating virtually all households in the country.

Coverage data from the 1998 study showed that 86,4% of households used salt containing any amount of iodine and 62,4% used adequately iodised salt containing 15 ppm or more iodine, with considerable variation amongst the provinces (5). The Eastern Cape Province with a coverage of 77% of households came closest to the international goal of 90% of households using adequately iodised salt while less than half of households in the 3 northern provinces used adequately iodised salt. One of the reasons for this weakness in the salt iodisation programme was the substantial percentage of households in the northern provinces using non-iodised repackaged agricultural salt or non-iodised salt obtained directly from the producers. Another likely reason was under-iodisation of salt occurring at the production sites.

An intervention programme consisting of distributing educational material, a workshop and assistance with internal monitoring helped salt producers towards more accurate salt iodisation. Another national survey in 2005 showed that this intervention resulted in higher mean and median iodine concentrations in household salt and the coverage of adequately iodised salt (>15 ppm) increased nationally from 62.4% in 1998 to 76.9% in 2005 (4). The complication in South

Africa was that rural people at the lower end of the socio-economic spectrum were more likely to suffer the consequences of using under-iodised salt because more of them used agricultural salt than did people in the higher socio-economic categories (5).

Iodine in retailer salt: Although not appropriate for law enforcement, monitoring the iodine concentration in retailer salt provides a quick and easy indication of the accuracy of the iodisation process at the production level. A follow up study of the iodine in retailer salt in 48 sentinel towns situated in 3 of the 9 provinces of the country shortly before the introduction of mandatory iodisation at an elevated iodine concentration and again after 1, 3 and 5 years found a relapse in the long term after an initial increase in iodine concentration (6). In this study the mean iodine concentration increased from 14 ppm to 33 ppm after one year and then to 42 ppm after 3 years, but backslided to 33 ppm after 5 years. This was a timeous public health warning to assess the accuracy of salt iodisation at all the production sites in South Africa.

Iodine in salt at the production sites: In view of the substantial under-iodisation as well as the considerable variation in iodine concentration observed in retail and household salt (5,6), the iodine content of salt and the knowledge regarding iodine nutrition of managers were assessed at all the production sites in the country in 2001. Of the 204 salt samples collected at 12 producers and analysed by titration, 34,8% contained less than 20 ppm of iodine and 57,9% less than the legally required amount of 40 to 60 ppm. Additionally, shortcomings existed in their knowledge of health aspects of salt iodisation and at least a third of the producers, mostly small and medium sized producers, had no means of internal monitoring (7).
In response to the need for support on iodine matters, the South African IDD Network, established in 2002 as a coalition of active role players in the salt iodisation programme, initiated an iodine educational programme for salt producers. This programme consisted of personal visits and feedback on their results to the salt producers, regular mailings of literature on iodine nutrition and a workshop to strengthen their commitment to salt iodisation. Re-assessment of the salt producers' salt in 2005 showed a marked shift in the distribution of iodine values towards higher concentrations, with markedly less under-iodisation accompanied by an increase in over-iodisation (1). The under-iodisation originated from producers not using titration or an equivalent quantitative method for internal quality control, and the over-iodisation resulted from overcorrection of the iodine concentration during the iodisation process and, again, insufficient monitoring.
To assist the salt industry in overcoming these problems of over-and under-iodisation, the South African IDD Network assisted salt producers without facilities to set up titration laboratories at their salt plants, and reviewed the analytical methodology of the other producers to standardize and optimize the laboratory methods during 2006 and 2007. Since all salt producers are currently equipped and trained to determine the iodine concentration of salt quantitatively, and external monitoring of the accuracy of salt iodine analyses was done at the end of 2007, it is believed that the accuracy of salt iodisation will improve in the whole industry.

Iodine in drinking water: The concentration of iodine in drinking in the 2005 national survey was generally below 23 µg/L in 7 of the 9 provinces. However, in two provinces substantial amounts of iodine of 64 and 196 µg/L were found. These concentrations probably impacted on the iodine status of the people living in these provinces emphasizing the importance of the iodine in drinking water as a potential factor contributing to the daily iodine intake in areas with high iodine concentration in the water (4).

Iodine in processed foods: Table salt is not the only vehicle for iodine because elsewhere in the world iodine is also added to salt for the bread baking industry, animal food, processed meat, fish sauce, drinking or irrigation water. Iodine in milk in the USA and Europe is derived from iodophors i.e. iodine containing detergents used in the dairy industry (8,9). It is not mandatory to use iodised salt for the production of processed food in South Africa, and most producers use non-iodised salt in their products to prevent unwanted effects of iodine on the properties of their product, for health reasons and financial considerations (10). Despite these fears substantial amounts of iodine, 39-69 ppm, were found in the salt of one third (4 out

of 12) of manufactures of bread, margarine and flavourants of salty snacks in South Africa. Processed foods may therefore provide variable but significant amounts of iodine to the food chain in South Africa.

Sources of household salt: As in many other countries, marketing of non-iodised salt through unconventional distribution channels is one of the factors weakening the national salt iodisation programme in South Africa. In a national survey it emerged that 78% of households obtain their table salt from typical food stores distributing iodised salt (11). However, in the nine provinces between 8 and 37% of households used unconventional sources, distributing mainly non-iodised salt, to obtain their household salt. These alternative sources include distributors of agricultural salt, small general dealer shops called spaza shops in peri-urban and rural townships, street vendors and salt sachets placed in the packaging of maize meal bags. Countrywide around 30% of low socio-economic households obtain their salt from unconventional sources compared to less than 5% in high socio-economic households, emphasizing the vulnerability of low socio-economic groups to the use of non-iodised salt and the threat of unconventional distribution channels to the salt iodisation programme.

Knowledge of iodine nutrition: Knowledge of iodine nutrition is a process indicator often neglected in salt iodisation programmes because of the usual emphasis placed on iodine in salt and its impact on iodine and goitre status. From the limited information available on this topic, it appears that the knowledge level of iodine nutrition varies from very low in a country like India to levels where people are well informed, such as in Iran. In Iran literate women were more likely to use iodized salt in the household than illiterate women.

In South Africa a national study assessing the knowledge of iodine nutrition on 2164 adults, representing the full range of socio-economic strata, only 15% of respondents correctly identified iodized salt as the primary dietary source of iodine, 16% knew the thyroid gland needs iodine for its functioning, and a mere 4% considered brain damage as the most important health consequence of iodine deficiency (12). This situation was even worse in low socio-economic households where respondents were considerably less informed about aspects of iodine nutrition compared to high socio-economic households.

The low level of knowledge about iodine nutrition amongst South African adults suggests that the international message about brain damage resulting from iodine deficiency has not been conveyed successfully to the consumer level in this country. Neither is it likely that consumers will choose or demand iodised salt for the benefit of children and women.

Moreover, a number of factors like the under iodization of salt by producers, the domestic use of non-iodized agricultural salt, consumers obtaining non-iodized cheap salt directly from producers, informal repackaging for household use of non-iodized salt, and a variety of other malpractices, may weaken mandatory salt iodization programs in any country. A thorough knowledge of iodine nutrition and of IDD, from the program manager to the consumer, is likely to counteract these weakening factors to a large extent. These are also the factors responsible for not achieving the goal of 90% of households using adequately iodized salt. Improving the knowledge levels of all involved in the supply of iodized salt to the consumer may bring us closer to the goal, and may sustain a successful program.

Intervention improved the knowledge level of South African salt producers, but a complicating factor was the turnover in managers seen in the salt industry. Over time a turnover in all role players is inevitable, making continuous iodine education indispensable. One of the biggest stumbling blocks in the implementation of a successful national salt iodization program is the inadequate education and lack of iodine knowledge of those involved. Dunn referred to the inadequate education as one of the seven deadly sins in confronting endemic iodine deficiency (13). For an iodization program to be successful and sustainable, he emphasized that it is essential for all role players involved to have a thorough knowledge of the importance of iodine deficiency, its consequences, and the means for its sustainable correction.

Conclusion

Information on the factors influencing the supply of iodised salt to households was

collected step by step to eventually create a picture of the successful and less successful process factors operating in the country. The process factors investigated were:

- Iodine in household salt
- Iodine in retailer salt
- Iodine in salt at the production sites
- Iodine in drinking water
- Iodine in processed foods
- Sources of household salt
- Knowledge of iodine nutrition

One of the benefits of this approach is that it provides quantitative information to health authorities and the salt industry particularly in areas requiring intervention. Because of interventions based on the information generated by these studies, marked improvements in crucial process indicators have been achieved which in turn lead to a further improvement in the household coverage of adequately iodised salt and in the iodine status of the population.

The profile of process factors may differ from country to country. Process factors not included above, and which may play an important role, include factors such as the iodine content of imported salt, the iodine content of milk and other dairy products, the iodine content of salt used for animal nutrition, and the iodine content of micronutrient supplements for pregnant women. Because of the possible variation in process factors in different countries, the collection of data on process factors should be well planned and relevant for any specific country.

References

1. Jooste PL, Zimmermann MB. Progress towards eliminating iodine deficiency in South Africa. S Afr J Clin Nutr 2008;21:8-14.
2. Jooste PL, Weight MJ, Lombard CJ. Short-term effectiveness of mandatory iodization of table salt, at an elevated iodine concentration, on the iodine and goiter status of schoolchildren with endemic goiter. Am J Clin Nutr. 2000;71:75-80
3. Immelman R, Towindo T, Kalk WJ, Paiker J, Makuraj S, Naicker J, Omar S. Report of the South African Institute for Medical Research on the Iodine Deficiency Disorder Survey of Primary School Learners for the Department of Health, South Africa. South African Institute for Medical Research, 2000.
4. Labadarios D, Swart R, Maunder EMW, Kruger HS, Gerike GJ, Kuzwayo PMN, Ntsie PR, Steyn NP, Schloss I, Dhansay MA, Jooste PL, Dannhauser A, Nel JH, MolefeD, Kotze TVW. Executive summary of the National Food Consumption Survey Fortification Baseline (NFCS-FB-1) South Africa, 2005. S Afr J Clin Nutr 2008;21(3)(Suppl 2):245-300.
5. Jooste PL, Weight MJ, Lombard CJ. Iodine concentration in household salt in South Africa. WHO Bull 2001;79:534-540.
6. Jooste PL. Monitoring the effect of introducing mandatory iodisation at an elevated iodine concentration on the iodine content of retailer salt after 1, 3 and 5 years in South Africa. Int J of Food Sci Nutr 2004; 55: 555-559.
7. Jooste PL. Assessment of the iodine concentration in table salt at the production stage in South Africa. WHO Bull 2003;81:517-521.
8. Pearce EN, Pino S, He X, Bazrafshan HR, Lee SL, Braverman LE. Sources of dietary iodine: bread, cows' milk, and infant formula in the Boston area. J Clin EndocrinolMetab 2004;89:3421-3424.
9. Haldimann M, Alt A, Blanc A, Blondeau K. Iodine content of food groups. J Food Comp and Anal 2005;18:461-471.
10. Harris MJ, Jooste PL, Charlton KE. The use of iodised salt in the manufacturing of processed foods in South Africa: bread and bread pre-mixes, margarine, and flavourants of salty snacks. Int J Food Sci Nutr 2003;54:13-19.
11. Jooste PL. Sources of household salt in South Africa. Asia Pac J Clin Nutr 2005;14:159-162.

12. Jooste PL, Upson N, Charlton KE. Knowledge of iodine nutrition in the South African adult population. Public Health Nutr 2005;8:382-386.

13. Dunn JT. Seven deadly sins in confronting endemic iodine deficiency, and how to avoid them. J Clin Endocrinol Metab 1996;81:1332-1335.

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