Sentinel site assessment of household coverage of adequately iodized salt in Armenia using different complementary sources of data

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universal salt iodization (USI), monitoring, household coverage, adequately iodized salt, iodized salt standard, iodine deficiency disorders (IDD), FORTIMAS methodology.

Introduction

Iodization of edible salt is globally accepted as the primary intervention to ensure adequate iodine status among populations.[1, 2, 3, 4, 5, 7] It is currently estimated that 124 countries require iodization of at least some form of edible salt,[2] especially household salt. Since 1993, the number of countries considered iodine deficient has been reduced from 133 to 23.[6]

Over the last two decades, there has been remarkable progress towards the elimination of iodine deficiency disorders (IDD) and sustained optimum iodine nutrition in Armenia, largely attributed to the voluntary iodization of salt by Avan Salt Plant (ASP) in 1995, followed by mandatory implementation of the national universal salt iodization (USI) strategy since 2004.[8-12] The effectiveness of mandatory iodization of all edible salt in the country was first assessed based on a national survey on iodine nutrition and salt iodization in 2005. That survey showed that about 97% of households in Armenia used adequately iodized salt (containing ≥15 mg/kg iodine), and the national median urinary iodine concentration (mUIC) among 8-10 years old children (313 µg/L) was slightly above the WHO-recommended upper limit.[8,9] Therefore, the national regulatory standard was modified to reduce iodine content in salt from 50 ± 10 mg/kg to 40 ± 15 mg/kg at production, border entry points, and market level. Then, the attainment of the goal of elimination of iodine deficiency in Armenia was acknowledged by the Network for Sustained Elimination of Iodine Deficiency in 2006.[7]

The sustained widespread use of iodized salt was documented by the 2015 Armenia Demographic and Health Survey (DHS) which found that >99% of households in the country used salt containing ≥5 mg/kg iodine.[13] A national survey conducted in 2016-17 showed that iodine concentration in ~93% of household salt samples was within the national standard (mean iodine content of 35.5 mg/kg), and mUIC among school-age children was 243 µg/L, also well within the recommended range.[10,14]

Avan Salt Plant, the country's sole industrial-scale salt producer and a strong proponent of USI in Armenia, has continued supplying iodized salt for domestic consumption since the national iodization law went into effect. Edible iodized salt is also imported, mostly from Iran.

Avan Salt Plant
Credit: Amos Chapple

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Based on provisions of the national "Law on Food Safety" (2006), market level monitoring of the quality of iodized salt, which was previously carried out by the (former) State Food Safety Service (SFSS) of the Ministry of Agriculture from 2009 until 2019, has since been continued by the Food Safety Inspection Body (FSIB).[1]

From a public health perspective, WHO recommends that national surveys of household coverage of iodized salt and population iodine status be carried out every 3-5 years. However, the high cost of such surveys is a significant barrier to their regular implementation. Recent landscape assessments in 63 countries in Africa, South Asia, Eastern Europe and Central Asia, found that only 49% of the countries had data on household coverage of iodized salt that was less than 5 years old. Only 22% of the countries had data less than 5 years old mUIC[2] among their populations. Population mUIC data were more than 10 years old in 51% of the countries[15]

Experience has shown that it is unrealistic to expect ongoing external (or internal) funding every few years for costly, statistically representative national surveys of iodized salt coverage and/or population iodine status. To address this, IGN has supported the adaptation of the FORTIMAS[3] methodology as a much less costly program monitoring and surveillance approach that countries could implement to track the status of their salt iodization programs, without much external funding support

The FORTIMAS approach includes secondary analysis of data on production, imports and geographic distribution of industrially vs. non-industrially iodized salt. Such data may be provided by domestic producers and importers and/or available through relevant government authorities, such as the Food Control Agency, Ministry of Industry of Industry, Ministry of Economy, etc. That information is then triangulated with findings of primary data on household coverage of **adequately** iodized salt (containing ≥15 mg/kg iodine)[1] and iodine status among 1st trimester pregnant women, collected using **sentinel site**[4] and purposive (non-probabilistic) data collection methods. To assess the feasibility and utility of that approach in Armenia, IGN supported its "pilot" implementation in the country in 2023-24. Trials of the approach have also been recently supported by IGN in Sri Lanka and Tanzania. This article presents findings of secondary data on "expected" national population coverage of (any) iodized salt, and primary data on the rate of household coverage of **adequately** iodized salt in Armenia in 2023.

Material and methods

Design of the non-probabilistic data collection approach to assess the coverage of iodized salt and iodine status of 1st trimester pregnant women in Armenia first included the calculation of expected annual rate of population coverage of iodized salt in the country based on:

1. Total annual quantity of iodized salt available in the country (for use by households, commercial food catering businesses (e.g., public restaurants and canteens), and processed food production facilities (e.g., bakeries, snack food producers etc.).

2. Estimated average per capita **salt** consumption of 12.5 g/day.[5]

3. Annual national population size.[6]

As illustrated in *Figure 1*, data provided by the Avan Salt Plant and the Ministry of Economy show that annual trends in the overall quantity of domestically produced and imported iodized salt has been stable in Armenia during the past decade, and decreases in domestic production have been offset by increased imports. Thus, the annual rate of expected population coverage of iodized salt has remained stable over the same time period (*Figure 2*).

1 In July 2019, the Ministry of Agriculture was abolished; the Ministry of Economic Development and Investments was transformed into the Ministry of Economy with the agricultural sector in its structure. In addition, the SFSS was transformed into the **Food Safety Inspection Body (FSIB)** under the Government of the Republic of Armenia.

2 The main indicator of iodine status of a population[5]

3 www.smarterfutures.net/fortimas; accessed 6 March 2024.

4 "Sentinel site" refers to a community (a large town or a district) within a region, purposively selected, based on its "expected" rate of **population coverage** of (adequately) iodized salt, where household salt samples and urine samples of (1st trimester) pregnant women could be feasibly collected for testing to "confirm" adequate (or inadequate) rate of household **coverage** of **adequately** iodized salt and **median urinary iodine** concentration among pregnant women.

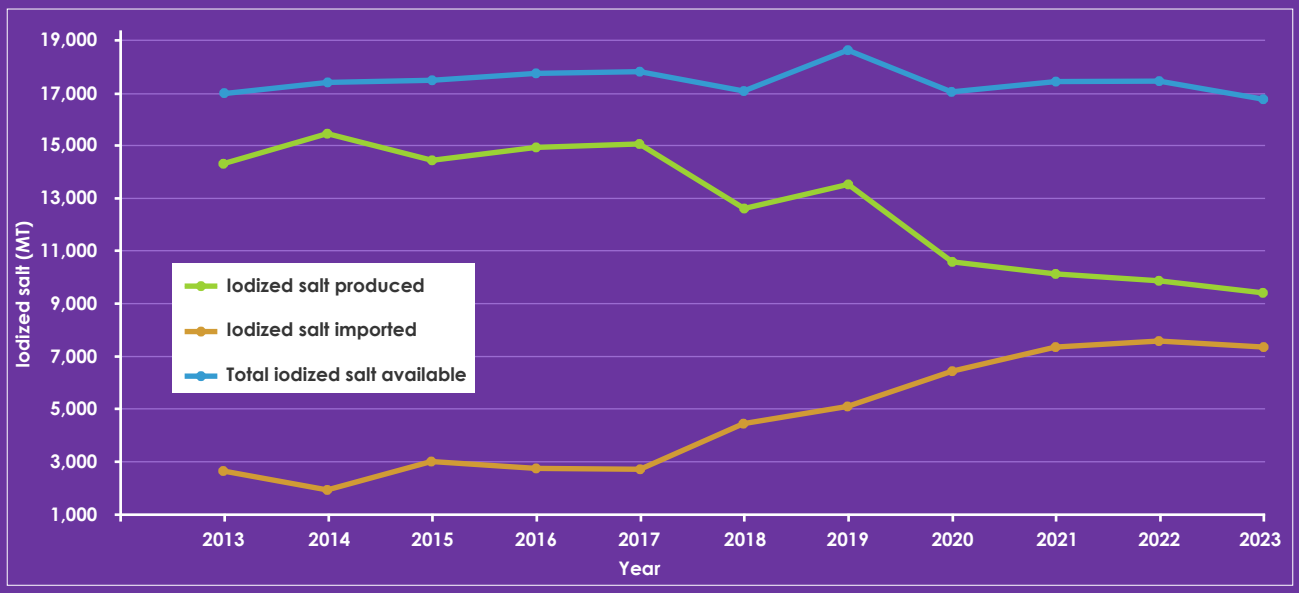
5 Global Fortification Data Exchange (GFDx) – www.fortificationdata.org/country-fortification-dashboard/?alpha3_code=ARM&lang=en; accessed 10 March 2024.

6 Source: www.macrotrends.net/global-metrics/countries/ARM/armenia/population; accessed 5 March 2024.

It should be noted that the consistently higher than 100% "expected" population coverage of iodized salt in Armenia over time may in part be due to an actual higher per capita intake of salt than 12.5 g/day, some inaccuracies in the annual quantities of iodized salt production and imports, and/or unknown amounts of the iodized salt that is not consumed during a given year.

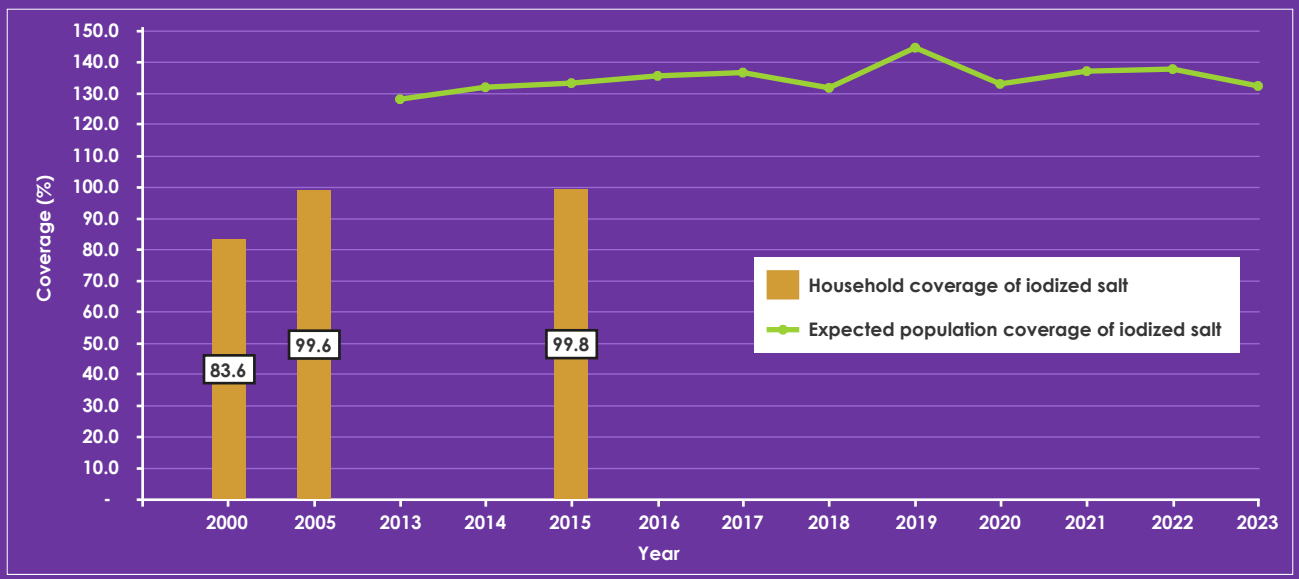
Household coverage of iodized salt, as a proxy measure of the population's overall access to, and intake of, dietary iodized salt in Armenia, has been assessed through nationally representative surveys, including three rounds of DHS, the last two of which were conducted after iodization was mandated in 2004 (*Figure 2*). The 2015 DHS found that 99 to 100 percent of households in each region (or Marz) used (any) iodized salt.[14]

Figure 1: Trends in annual quantities of domestic vs. imported vs. total iodized salt available in Armenia from 2013-2023.*



*Based on reported data from Avan Salt Plant and Armenia Ministry of Economy, on quantities of domestically produced and imported iodized salt, respectively.

Figure 2: Trends in annual rates of **expected population coverage*** *vs.* **assessed household coverage**** *of iodized salt in Armenia: 2000 through 2023.*



*Based on data from Avan Salt Plan and Armenia Ministry of Economy on annual quantities of production and imports of iodized salt: 2013-2023.

**Based on findings of nationally representative Demographic and Health Surveys implemented in Armenia in 2000, 2005 and 2015.

Figure 3: Marzes (Regions) in Armenia (in grey shade) where sentinel site data on household coverage of iodized salt were collected through elementary schools as "data collection points."

Armenia FORTIMAS Sentinel Sites		
Code	**Marz**	**Sentinel Sites**
1	Yerevan	Nork district
2	Yerevan	Erebuni district
3	Yerevan	Malatia district
4	0	Echmiadzin city
5	Ararat	Ararat city
6	Kotayk	Abovyan city
7	Shirak	Gyumri city

Based on all the above information, and the feasibility to quickly recruit the required number of 1st trimester pregnant women through their largest antenatal care facilities, Nork, Erebuni, and Malatia districts in Yerevan (capital) region, and cities of Echmiadzin, Ararat, Abovyan, Gyumri in Armavir, Ararat, Kotayk and Shirak regions respectively, were purposively selected as sentinel sites for primary data collection (*Figure 3*). A public elementary school (located within the catchment area of the selected antenatal care facility) was selected in each of those communities (i.e. a total of 7 schools) for data collection on household use of iodized salt.

To estimate overall household coverage of iodized salt in the country in 2023, a total of 210 students, 30 sixth graders from each of the selected elementary schools, were recruited to bring 30 – 40 gm of table/kitchen salt from their homes (household salt). Each student was provided a small (5 x 7 cm) zip-lock plastic bag labelled with the predesignated identification codes of the selected school (i.e., data collection point) and the student who brought the sample. Upon collection at the school, the relevant information was recorded in a formal reporting form, which together with the samples were transported to the ASP laboratory for testing of iodine content. That laboratory routinely determines iodine levels in food-grade salt, using a validated quantitative assessment tool - iodometric titration (GOST R 51575). In addition, a copy of the household salt collection form was kept at the Armenia National Institute of Health (NIH) in Yerevan.

Results and Discussion

Each of the 210 household salt samples were tested for iodine content within 8 to 14 days of collection; about 41% in less than 10 days, the rest were tested within 10-14 days. Nearly 6% of the salt samples were non-iodized, and of those, 11 were from households in Shirak, while one was from a household in Yerevan (data not shown) (*Table 1*). Although the 30 household salt samples collected in Shirak were not enough to adequately estimate household coverage in that region, the finding that 11 of 30 salt samples collected in its largest district were not iodized, is nevertheless of concern because only 1 of the 199 salt samples from the other 6 sentinel sites was found to contain no iodine. Further assessment of iodized salt marketed in Shirak may be warranted to better understand the reason for the unusually high rate of non-iodized salt that was found.

Table 1: Ranges of iodine level in household salt in Armenia in 2023.

Salt iodine level (mg/kg)	Salt samples (N)	Prevalence (%)
0.0	12	5.7
10 – 14.9	4	2.0
≥15	194	92.4
Total samples tested	210	100.0

In contrast, only 2% of all the household salt samples from the 7 sentinel sites contained <15 mg/kg iodine, while over 92% were found to be adequately iodized (containing ≥15 mg/kg iodine based on global public health guidance) (*Table 1*). Furthermore, among the 198 salt samples found to be iodized, a mean iodine concentration of 32.8 mg/kg was within the national regulatory standard of 40 ± 15 mg/kg (data not shown).

Using the categories of edible salt falling within vs. outside the national iodization standard, as used by the FSIB for regulatory monitoring of food-grade salt in the commercial sector in Armenia, nearly 23% of the household salt samples from the sentinel sites fell "outside standard" (*Table 2*). Furthermore, among those salt samples, only 1% contained >55 mg/kg iodine, while about 17% contained <25 mg/kg iodine (data not shown). In comparison, a recent analysis of data on iodine content of salt samples collected from various market sources in Armenia and tested by the FSIB in 2023, found that the iodine content of about 31% of those salt samples fell "outside standard."[16]

In summary, given the findings of complementary information that indicate consistently high expected population coverage of iodized salt, and its assessed household coverage via statistically representative surveys, during the past decade (*Figures 1* and *2*), our finding of about 92% household coverage of adequately iodized salt (containing ≥15 mg/kg iodine) in Armenia in 2023 appears to be quite reliable. The is particularly important because the cost of this pilot implementation of the FORTIMAS approach as an initial round of annual iodized salt program monitoring and surveillance in Armenia was only a fraction of that of a typical nationally representative survey of household iodized salt coverage and population iodine status. **As the Armenia NIH has now developed the overall framework of an "Armenia FORTIMAS System" including the collection of sentinel site data on household coverage of iodized salt and mUIC among 1st trimester pregnant women, we estimate that they could annually carry out the overall data collection and analysis approach summarized above, over the next ten years at about the same current cost as one "typical" nationally representative household iodized coverage and population iodine status survey.**

Table 2: The proportion of household salt samples with iodine content outside standard. Armenia, 2023.*

Salt iodine level	Salt samples (N)	Prevalence (%)
Outside standard	48	22.9
Within standard	162	77.1
Total samples tested	210	100.0

*Defined as salt with 40 ± 15 mg/kg iodine content.

Implementing the methodology during a site visit in Armenia © IGN

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