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Rachel Paige Greenwald April 14th, 2020

Alignment of Iodization Requirements in Countries with Mandatory or Voluntary Salt Fortification to the World Health Organization Recommendations

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Abstract

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Objective

Compare salt fortification standards of countries with mandatory or voluntary salt fortification to World Health Organization (WHO) recommendations for salt fortification.

Methods

For countries with mandatory or voluntary salt fortification, data were downloaded from the Global Fortification Data Exchange (GFDx) regarding iodine amounts and iodine compounds to be added to salt per the country standard, legislation scope, and national salt intake quantities. Data were then compared to current WHO recommendations and the WHO recommendation available at the time the standards were issued. For iodine amounts in standards, countries were classified as lower than the range, within the range, or greater than the range of the current WHO recommendations, or lower than, equal to, or greater than the range for WHO recommendations available at the time the standards were issued. For iodine compounds in standards, countries were classified as all of the compounds in the country's standard are WHO-recommended compounds, there are both WHO-recommended compounds and not recommended compounds, or all of the compounds in the country's standard are not WHO-recommended compounds.

Findings

Of the 117 countries with mandatory salt fortification included in the analysis, 82% of countries' iodine amounts in salt standards were greater than the range indicated by current (2014) WHO recommendations. Of the 16 countries with voluntary salt fortification included in the analysis, 81% of countries' iodine amounts in salt standards were greater than the range indicated by current (2014) WHO recommendations. The majority of countries' iodine compounds specified in their standards were only WHO-recommended compounds. Additionally, the majority of countries with mandatory or voluntary salt fortification iodine amounts specified in their standards exceeded the WHO recommendations available at the time their standards were issued.

Conclusion

Countries for which their standards do not follow WHO recommendations may want to review if they have pertinent data to support their current standards or if following WHO recommendations may improve the effectiveness of salt iodization in their countries for achieving optimal iodine status.

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Introduction

Background

Food fortification is a public health strategy used to prevent and control micronutrient deficiencies among populations. Iodine deficiency is one of the most common micronutrient deficiencies. The most common micronutrient deficiencies are iron, folate, vitamin A, zinc, and iodine deficiency.[1] Iodine is essential for the production of thyroid hormones, which regulate metabolism. As iodine cannot be produced by the body, it must be consumed regularly through the diet in sufficient quantities for hormone production. Lack of iodine therefore causes a range of disorders, including infant mortality, goiter, cognitive impairment and neurological disorders, collectively known as iodine deficiency disorders (IDD).[2] The recommended daily intake of iodine is 90 µg for children less than 6 years of age, 120 µg for children aged 6-12 years, 150 µg for adolescents and adults aged above 12 years, and 250 µg for pregnant and lactating women. If a person's iodine intake falls below the recommended daily intake, iodine deficiency can occur.[3] The most visible effect of iodine deficiency in children and adults is goiter, the enlargement of the thyroid.[4] Iodine deficiency can be especially detrimental to pregnant women because a lack of iodine in the diet of pregnant women can cause the mother and consequently, the fetus, to become iodine deficient. Iodine deficiency can severely impair the brain and physical development of the fetus and cause irreversible cognitive deficits in children.[2]

In 1994, the World Health Organization (WHO) and the United Nations Children's Fund (UNICEF) recommended the fortification of food grade salt with iodine (i.e., salt iodization) as the main strategy to achieve elimination of IDD.[5] Salt is considered a suitable vehicle for fortification because salt is generally consumed by everyone, technology for salt iodization is simple to implement, salt production usually occurs in a few geographical areas worldwide, salt iodization is inexpensive (0.2-0.3 US cents/kg), and salt iodization does not affect the color, taste, or odor of salt.[6] The United States and Switzerland first started to add iodine to salt in the 1920s.[7] Earlier studies indicated that iodine consumption decreased the prevalence of goiter and were the reasoning behind adding iodine to salt to decrease the prevalence of iodine deficiency in the United States. Iodine deficiency was highly prevalent in certain regions in the United States, such as the Great Lakes, Appalachians, and the Northwestern regions. Salt iodization was successful in reducing iodine deficiency in these regions. However, iodine deficiency continued to be a major public health issue globally. In 1990, the United Nations World Summit for Children recognized the importance to combat iodine deficiency by adopting the goal of eliminating iodine deficiency.[8] Between 1993 and 2019, the number of countries classified as having insufficient iodine intake decreased from 113 to 21.[9] As a result of salt iodization, many countries have successfully eradicated IDD or effectively controlled IDD prevalence.[10] In 2014, the WHO evaluated the effect of iodized salt in preventing IDD and concluded that iodized salt was effective in reducing the risk of goiter, cretinism, low cognitive function and iodine deficiency.[4]

Fortification of any food, including salt, can be either mandatory or voluntary. Mandatory fortification requires manufacturers to add nutrient(s) to specified foods, whereas voluntary fortification of salt allows manufacturers to add nutrient(s) to specified foods. Evidence shows that mandatory fortification is more effective than voluntary fortification to attain optimal health outcomes.[11] Mandatory fortification impacts a higher proportion of the targeted population and distributes added nutrients more equitably than voluntary fortification. For instance, Australia enacted voluntary fortification of wheat flour with folic acid in 1995 and in 2009, switched to mandatory fortification.[12] The birth prevalence of neural tube defects decreased among indigenous women in Australia after the transition from voluntary fortification to mandatory fortification, showing the effectiveness of mandatory fortification compared to voluntary fortification in improving desired health outcomes.

WHO, ICCIDD (The International Council for the Control of Iodine Deficiency Disorders; now known as the Iodine Global Network, or IGN) and UNICEF, released recommendations for the amounts of iodine in fortified salt in 1994[5] (**Table 1**) and 1996[13] (**Table 2**), and in 2014 WHO released updated recommendations[14] (**Table 3**); all are hereafter referred to as 'WHO recommendations'. The first recommendations were issued after UNICEF and WHO recommended universal salt iodization as the main strategy to achieve elimination of iodine deficiency disorders in 1994.[5] The 1994 WHO recommendations suggested different iodization amounts depending on weather, salt intake, location in the distribution chain (i.e., factory, retail, household), and packaging. Weather and packaging were considered because they influence iodine losses; salt intake was considered because salt is the vehicle for iodine

fortification and location in the distribution chain was relevant because of expected iodine losses along the chain. They assumed iodine losses between 20%-50% between production and consumption and that average salt intakes were between 5-10 g per person per day.

The 1996 recommendations were issued to reduce the amounts of iodine provided by iodized salt to reduce the risk of iodine-induced hyperthyroidism and also to take into consideration revised assumptions about iodine losses from iodized salt.[13] The 1996 recommendations assumed iodine losses of 40% (i.e., 20% between production and household and 20% during cooking before consumption) and average per capita salt intake of 10 g per day. Further, they provided one global range for iodine amounts in salt, with the caveat that the lower end of the range be applied if salt used in processed food was included in the scope of legislation, in addition to household salt. The 1996 recommendations were considerably simpler than the 1994 recommendations – they did not suggest different amounts of iodine depending on packaging, position in the supply chain or weather and therefore were easier to translate into enforceable national standards. They did however mention salt used in processed food for the first time.

The current WHO recommendations (2014) provide iodine amounts for different quantities of salt intake, based on assumptions of losses (i.e., 30% from production to household before consumption) and bioavailability (i.e., 92% iodine bioavailability), and suggest a range of +/-10% for production level variation.[14] The 2014 recommendations emphasized in particular, that salt iodization amounts should take into consideration salt intakes. Another key feature of the 2014

recommendations was that they assumed that all salt for processed food was to be iodized - reflecting a growing recognition that this salt has the potential to contribute significantly to salt intake. The salt intake quantities include both household (i.e., table) salt and salt used in processed foods. Even though the WHO has released guidelines to reduce intake of salt,[15] the 2014 recommendations recognize that strategies for reducing salt and iodizing salt can coexist because the WHO provides iodine amounts for different quantities of salt intake.

This study aimed to compare iodine requirements, stated in country standards, in countries with mandatory or voluntary salt iodization with WHO fortification recommendations. As of 23 September 2019, 128 countries have mandatory fortification of salt while 21 countries have voluntary fortification.[16] Of these 149 countries with either mandatory or voluntary fortification, 134 countries have national salt standards indicating iodine amounts in salt at production or import level. For these countries, the amount of iodine indicated in the standards falls between 5-100 mg/kg.[17] Salt standards in eighteen and two countries indicate amounts of fluoride and iron, respectively, in addition to iodine. The iodine compounds allowed in national standards for fortified salt include potassium iodate, potassium iodide, sodium iodate, sodium iodide, calcium iodate, calcium iodide, and algae iodate. Even though a few countries include other micronutrients in their salt fortification programs, the scope of this review was iodine because there are only WHO recommendations on salt fortification with iodine. Some countries also have standards for the amount of iodine that should exist in fortified salt at the retail or household level. The 1996 and 2014 WHO recommendations only suggest amounts of iodine

that should be present at production/import level. Therefore, we did not review the amounts indicated for retail or household levels.

Objectives

The goal of this study was to compare country iodine fortification requirements for salt indicated in salt standards with WHO recommendations in countries with mandatory or voluntary fortification of salt. The first objective was to analyze if current country iodine fortification requirements indicated in salt standards follow current (2014) WHO recommendations, taking into consideration salt intake quantities. The second objective was to analyze if current country iodine fortification requirements indicated in salt standards followed WHO recommendations available at the time the standards were issued. For this objective, we used the 1994, 1996 or 2014 WHO recommendations.

Some countries revised their salt iodization requirements in salt standards since the start of their program. This analysis only considered current salt standards, as these are currently in effect. The Global Fortification Data Exchange (GFDx) is a public database that was the source of data for this project. As of September 23, 2019, of the 128 countries with mandatory salt fortification legislation, the GFDx did not have current standards from 10 of them: Haiti (no standards issued yet) and nine Common Market for Eastern and Southern Africa (COMESA) countries. Although a COMESA regional standard for food grade salt requires iodization and the establishment of iodine amount by national health authorities,[18] the GFDx has not been able to

obtain national standards from nine of the COMESA countries.[19] The GFDx has standards from the remaining 118 countries that mandate the fortification of salt with iodine (**Table 4**). For the 118 mandatory countries, current salt iodization standards were issued before 1994 in five countries, in 1994 or 1995 in six countries and between 1996 and 2013 in 89 countries. Since the 2014 WHO recommendations were released, 18 countries issued their current standards. Of the 21 countries with voluntary legislation, the GFDx has standards from 16 countries indicating amounts of iodine in salt (**Table 4**). Current salt iodization standards were issued before 1994 in three of those countries, in 1994 or 1995 in zero countries and between 1996 and 2013 in seven countries. Since the 2014 WHO recommendations were released, six countries issued their current standards.

The authors are not aware of any comparison study of countries' salt iodization standards to WHO recommendations that has been completed to date.

Table 1. The 1994 WHO salt fortification recommendations,[5] for iodine amount expressed in parts per million (ppm).[a,b,c]

Climate and daily salt consumption (g/person)	Requirement at factory outside the country		Requirement at factory inside the country		Requirement at retail sale (shop/market)		Requirement at household level
	Packaging						
	Bulk (sack)	Retail pack (<2 kg)	Bulk (sack)	Retail pack (<2 kg)	Bulk (sack)	Retail pack (<2 kg)	
Warm moist							
5 g	100	80	90	70	80	60	50
10 g	50	40	45	35	40	30	25
Warm, dry or cool moist							
5 g	90	70	80	60	70	50	45
10 g	45	35	40	30	35	25	22.5
Cool dry							
5 g	80	60	70	50	60	45	40
10 g	40	30	35	25	30	22.5	20

G: gram; Kg: kilogram.

[a] These WHO recommendations suggest only potassium iodate is recommended as the iodine compound for salt fortification.[5]

[b] "N.B 168.6 mg of KIO_3 contains 100 mg of iodine".[5]

[c] "N.B These are indicative initial levels, which should be adjusted in the light of urinary iodine measurement".[5]

Table 2. The 1996 WHO salt fortification recommendations,[13] for iodine amount expressed in mg/kg.[a]

"Taking into account the following revised assumptions, which are based on new information: • Iodine lost from salt is 20% from production to household, • Another 20% is lost during cooking before consumption, • Average salt intake per capita is 10/g/day, In order to provide 150 μg/day of iodine via iodized salt, iodine concentration in salt at the point of production should be within the range of 20-40 mg of iodine (or 34-66 mg potassium iodate) per kg of salt. When all salt used in processed food is iodized, the lower limit (20 mg) is recommended. Under these circumstances, median urinary iodine levels will vary from 100-200 μg/l".[13]

[a] These WHO recommendations suggest only potassium iodate is recommended as the iodine compound for salt fortification.[13]

Table 3. The 2014 WHO salt fortification recommendations,[14] expressed in parts per million (ppm).

Suggested concentrations for the fortification of food-grade salt with iodine.	
Estimated salt consumption[a], g/day	**Average amount of iodine to add, ppm salt (RNI + losses[b])**
3	65
4	49
5	39
6	33
7	28
8	24
9	22
10	20
11	18
12	16
13	15
14	14

G: gram; Ppm: parts per million; RNI: recommended nutrient intake.

"[a] This includes consumption as table salt as well as salt from processed foods.

[b] This fortification concentration was calculated based on the mean recommended nutrient intake of 150 µg iodine/day + 30% losses from production to household level before consumption, and a 92% iodine bioavailability. Losses depend on the iodization process, the quality of salt and packaging materials and the climatic conditions. Losses could vary widely and this table presents the value considering 30% losses. The monitoring of urinary iodine concentrations will allow adjustment of the selected fortification concentrations.
RNI: recommended nutrient intake, is the daily intake, set at the estimated average requirement plus 2 standard deviations, which meets the nutrient requirements of almost all apparently healthy individuals in an age- and sex-specific population group".
Although iodate is more stable, either potassium iodate (KIO_3) or iodide (KI) can be used.[c]
Iodide may be used for dry, low crystal size and washed or refined salts. While iodate can be used alone and in any type of salt quality, iodide is used in very good quality salt and cannot be added alone. Therefore, some salt producers add sodium carbonate or sodium bicarbonate when they iodize salt, to increase alkalinity, and sodium thiosulfate or dextrose to stabilize potassium iodide. Without a stabilizer, potassium iodide may be oxidized to iodine and lost by volatilization from the product.
An estimated additional variability of ±10% during iodization procedures could be considered at the production site for use in quality control and assurance procedures. This variability depends on the iodization methods used and quality assurance system in place.
Shaded areas correspond to the WHO salt reduction guideline".[14]

[c] These WHO recommendations suggest potassium iodate or potassium iodide are recommended as the iodine compounds for salt fortification.[14]

Table 4. Number of countries with mandatory or voluntary salt iodization and for which the Global Fortification Data Exchange (GFDx) has the current standard, the year the current salt iodization standards were issued, and the respective year of applicable WHO salt iodization recommendations.[a]

Year current salt iodization standards were issued	Number of mandatory countries	Number of voluntary countries	Year of applicable WHO salt iodization recommendations for objective 1[b]	Year of applicable WHO salt iodization recommendations for objective 2[c]
1993 or earlier	5	3	2014	NA[d]
1994-1995	6	0	2014	1994
1996-2013	89	7	2014	1996
2014-present (23 September 2019)	18	6	2014	2014
Total	118	16		

[a] Data obtained from the Global Fortification Data Exchange.[16]

[b] The first objective was to analyze if current country standards follow current (2014) WHO recommendations for iodine amounts and compounds, taking into consideration salt intake quantities.

[c] The second objective was to analyze if current country standards followed WHO recommendations available at the time the standards were issued, i.e., using the 1994, 1996 or 2014 recommendations.

[d] There are no applicable WHO salt iodization recommendations for the countries with standards issued prior to 1994 because no WHO salt iodization recommendations existed at the time.

Methods

This project was submitted to the Emory University Institutional Review Board. Since no human subjects were involved in the project, no review was needed by the board.

Definitions

Salt can be categorized into food grade or edible salt and industrial or non-food salt.[20] Food grade/edible salt includes salt for animals and humans. Salt for humans includes table or household salt and salt for food processing. Household/table salt refers to the salt used by households for cooking or at the table. It is usually sold in retail packs, although it can be sold loose. Hereafter, we will refer to household/table salt as household salt. Salt for food processing is the salt used in the commercial production of processed foods such as bread, cheese, processed meats and fish, convenience foods such as instant noodles, snacks, and condiments such as bouillon cubes, soy sauce and fish sauce. It is often more refined, of higher quality and sold in bulk.

Study Design

This study was a document review of salt iodization requirements indicated in country salt standards and WHO salt iodization recommendations. The Strengthening the Reporting of

Observational studies in Epidemiology (STROBE) guidelines were followed.[21] The STROBE guidelines provide recommendations for a reliable and accurate observational study. Data for this analysis were taken from the GFDx, which is a public database that acquires data from annual fortification surveys, literature reviews, and regional and national contacts.[22] The following data were downloaded from the GFDx for each country with legislation for mandatory or voluntary fortification and with salt standards, and compiled into an Excel database: country name, whether salt fortification is mandatory or voluntary, whether the country has a standard for iodine amounts in salt, year the current standard was issued, mid-point amount of iodine to be added to salt per the country standard in milligrams/kilogram, iodine compounds allowed to be added to salt per the country standard, whether country legislation or standards apply to household salt, whether country legislation or standards apply to salt used in food processing, and national-level salt consumption in 1990 and 2010 in grams/capita/day. (**Appendix Table 12**)**.** The GFDx obtained salt intake data from a study conducted by Powles et al.[23] The study was a systematic analysis of 24-hour urinary sodium and dietary sodium surveys of countries between 1980 and 2010.

Iodine requirements in national salt standards are usually expressed as allowed or expected ranges of iodine or a minimum. GFDx recorded the calculated mid-point of the range or the single amount indicated in the standard if no range was provided. For this project, we analyzed if the calculated mid-point of iodine requirements in the GFDx fell within the range (for 1994 and 2014 WHO recommendations) or was equal (for 1996 WHO recommendations) to the

amount of iodine recommended by WHO (**Appendix Table 13, Appendix Table 14, Appendix Table 15**).

The following data were obtained from WHO recommendations on salt: amount of iodine that should be added based on the 1994 recommendation in milligrams/kilogram for different quantities of salt intake, amount of iodine that should be added based on the 1996 recommendation in milligrams/kilogram, amount of iodine that should be added based on the 2014 recommendation in milligrams/kilogram for different quantities of salt intake, iodine compounds that should be used for salt fortification based on the 1994 recommendations, iodine compounds that should be used for salt fortification based on the 1996 recommendations, and iodine compounds that should be used for salt fortification based on the 2014 recommendations (**Appendix Table 12, Appendix Table 13**).

Objective 1: Alignment of current country iodine fortification requirements with current (2014) WHO recommendations, taking into consideration salt intake quantities

The 2014 WHO recommendations for iodine amounts varied based on salt intake quantities (**Table 3**). The GFDx has salt intake data for most countries for 1990 and 2010.[23] For objective 1, which compared salt fortification requirements in current salt standards with WHO 2014 recommendations, regardless of when the national standards were issued, we used the most recent (2010) salt intake data. The 2014 recommendations state the amount of iodine that should be present at production level or point of import and advise additional estimated

variability of +/-10% i.e., if salt intake is 10 g, it is recommended to add 20 mg iodine/kg salt at production +/- 10% or 18-22 mg/kg. Thus, the recommended range for each quantity of salt intake was calculated and used in the analysis. For each quantity of salt intake, if the decimal was between 0.01-0.49, we rounded down. If the decimal was between 0.50-0.99, we rounded up. For example, if salt intake for a country was 7.65 grams/capita/day, we rounded up to 8 grams/capita/day and used the respective WHO recommendation. We classified each country into one of the following categories, taking into account salt intake: the mid-point amount of iodine indicated in a country's standard is *(i) within the range, (ii) greater than the range, or (iii) less than the range* compared with the 2014 WHO recommendations.

Additionally, the 2014 WHO recommendations state that potassium iodate (KIO_3) or potassium iodide (KI) can be used in salt fortification. We compared current country salt standards to WHO recommendations for iodine compounds. We classified each country into one of the following categories: all of the compounds in the country's standard are WHO-recommended compounds, there are both WHO-recommended and not recommended compounds in the country's standard, or all of the compounds in the country's standard are not WHO-recommended compounds.

Examples of comparisons of iodine amounts in national salt standards in three countries with the 2014 WHO recommendations for iodine amount in salt are noted in **Table 5**. For instance, Kenya has mandatory salt fortification. The mid-point amount of iodine to be added to salt per the country standard is 40 mg/kg. Salt intake for Kenya is 3.76 grams/capita/day; therefore,

2014 WHO recommendations indicate the addition of 49 mg/kg at production +/- 10% or 44.1-53.9 mg/kg. Thus, the amount of iodine indicated in Kenya's standard is less than the 2014 WHO recommendations. Examples of how the country's current fortification requirement compares to 2014 WHO recommendations for iodine compounds are noted in **Table 6**. For example, as Kenya has specified potassium iodate in its standard, the assessment is that "All of the compounds in the country's standard are WHO-recommended compounds".

Objective 2: Alignment of current country standards with WHO recommendations available at the time standards were issued, taking into consideration salt intake quantities (1994, 1996 or 2014 WHO recommendations)

In Objective 2, we compared current country salt standards to the WHO recommendations applicable at the time the current standards were issued i.e., the 1994, 1996, or 2014 WHO recommendations. If a country's current standards were issued prior to 1994, before there were any WHO recommendations, we did not compare them to any recommendations because there were no applicable recommendations available at the time.

1994 WHO recommendations

The 1994 WHO recommendations have three categories for recommended amounts of iodine in salt depending on the level of production or distribution: requirement at factory outside the country, requirement at factory inside the country, and requirement at retail sale

(shop/market) (**Table 1**). We used the requirement at factory inside the country because national standards apply at point of domestic production or point of import. The 1994 recommendations also suggest different iodine amounts for bulk packaging and retail packaging. Since national standards generally apply for all available packaging, we combined both to indicate the recommended range. Similarly, for the climate assumptions in the 1994 WHO recommendations, we combined each category because weather is likely to be variable within a country throughout the year and the analysis does not attempt to categorize countries by the weather conditions noted in the WHO recommendations. For example, the lowest amount of iodine for 5 grams of daily salt consumption, across all climate categories and all packaging is 50 parts per million (ppm) and the highest value is 90 ppm, where parts per million is the same as milligram/kilogram. Therefore, the range of iodine recommended for 5 grams of daily salt consumption is 50-90 ppm. The range for 10 grams of daily salt consumption is 25-45 ppm.

Using the 1994 WHO recommendations for 5 and 10 grams, we calculated the range of iodine to be added for salt intakes from 3-14 grams/capita/day to be consistent with the 2014 WHO recommendation (**Table 7**). As this analysis was completed for all countries with current salt standards issued in 1994 or 1995, we used 1990 estimates for salt intake.[23]

We classified each country into one of the following categories, taking into account salt intake: the amount of iodine indicated in a country's standard is *(i) within the range, (ii) greater than the range, or (iii) less than the range* compared with the 1994 WHO recommendations.

Additionally, the 1994 WHO recommendations state that potassium iodate (KIO_3) can be used in salt fortification. We classified each country into one of the following categories: all of the compounds in the country's standard are WHO-recommended compounds, there are both WHO-recommended and not recommended compounds in the country's standard, or all of the compounds in the country's standard are not WHO-recommended compounds.

Examples of comparisons of iodine amounts in national salt standards in three countries with the calculated recommended range of the 1994 WHO recommendation are noted in **Table 8**. For example, Central African Republic has mandatory salt fortification; the current standard was issued in 1995. The mid-point amount of iodine to be added to salt per the country standard is 40 mg/kg. Salt intake for Central African Republic from 1990 is 6.99 grams/capita/day; therefore, 1994 WHO recommendations indicate the addition of 35.71-64.29 mg/kg of iodine at production (**Table 7**). Thus, the amount of iodine indicated in Central African Republic's standard is within the range of the 1994 WHO recommendation. Examples of how three countries' current fortification standards compare to 1994 WHO recommendations for iodine compounds are noted in **Table 9**. For example, as Zambia has potassium iodide in its standard, the assessment is that "All of the compounds in the country's standard are not WHO-recommended compounds".

1996 WHO recommendations

For the 1996 WHO recommendations, the recommended amount of iodine in salt is between 20-40 ppm, assuming 10 grams/capita/day of salt consumption (**Table 2**). The 1996 WHO recommendations do not vary based on the country's salt consumption; they assume salt consumption of 10 grams/capita/day. However, the scope of the legislation is taken into account; WHO recommends the lower end of the recommended range of iodine when the scope includes both household and processed food salt, rather than household salt only.[7] Therefore, if a country's legislation scope included both processed food salt and household salt, we used 20 ppm as the amount of iodine recommended by WHO. If a country's legislation scope included only processed food salt **or** only household salt, we used 20-40 ppm as the amount of iodine recommended by WHO. As the GFDx does not have data on the scope for countries with voluntary fortification, the comparison between salt standards and WHO recommendations for iodine amounts was only conducted for countries with mandatory fortification.

We classified each country into one of the following categories <u>if the country's legislation scope applied to household salt and processed food salt</u>: the amount of iodine indicated in a country's standard is *(i) equal to, (ii) greater than, or (iii) less than* compared with the 1996 WHO recommendations of 20 ppm.

We classified each country into one of the following categories <u>if the country's legislation scope applied to only household salt or only to processed food salt</u>: the amount of iodine indicated in

a country's standard is *(i) within the range, (ii) greater than the range, or (iii) less than the range* compared with the 1996 WHO recommendations of 20-40 ppm.

Additionally, the 1996 WHO recommendations state that potassium iodate (KIO_3) can be used in salt fortification. We classified each country into one of the following categories: all of the compounds in the country's standard are WHO-recommended compounds, there are both WHO-recommended and not recommended compounds in the country's standard, or all of the compounds in the country's standard are not WHO-recommended compounds.

Examples of comparisons of iodine amounts in national salt standards in three countries with the 1996 WHO recommendations are noted in **Table 10**. For example, India has mandatory salt fortification with a standard issued in 1998. The country's standard applies only to household salt; therefore, we used the range of 20-40 ppm for the analysis. The mid-point amount of iodine to be added to salt per the country standard is 25 mg/kg. Thus, the amount of iodine indicated in India's standard is within the range of the 1996 WHO recommendations. Examples of how three countries' current fortification standards compare to 1996 WHO recommendations for iodine compounds are noted in **Table 11**. For example, as Bulgaria has potassium iodate in its standard, the assessment is that "All of the compounds in the country's standard are WHO-recommended compounds".

2014 WHO recommendations

The results from Objective 1 were used for countries with salt iodization standards issued in 2014 or later.

Percentage of WHO recommendations met

The percentage of WHO recommendations met were calculated for the minimum and maximum amount of iodine to be added to salt per the WHO recommendations by dividing the amount of iodine indicating in the country's standard by the amount of iodine indicated in the WHO recommendations (**Appendix Table 13, Appendix Table 14**).

Table 5. Required iodine amounts in salt from current country standards, calculation of 2014 WHO-recommended range of iodine in salt, and analysis of standard alignment with 2014 WHO recommendation for three country examples.

Country	Salt fortification is mandatory or voluntary[a]	Average salt consumption in 2010 in grams/capita/day[b]	Mid-point amount of iodine to be added to salt per the country standard, in milligrams/ kilogram[a]	Calculation of WHO recommendation for iodine in milligrams/kilogram, for country's salt intake quantity[c]	Assessment of standard alignment with 2014 WHO recommendations
Kenya	Mandatory	3.76	40	49 +/- 10% (44.1-53.9)	Less than the WHO-recommended range
Costa Rica	Mandatory	8.08	45	24 +/- 10% (21.6-26.4)	Greater than the WHO-recommended range
Australia	Mandatory	8.69	45	22 +/- 10% (19.8-24.2)	Greater than the WHO-recommended range

[a] Data obtained from the Global Fortification Data Exchange (GFDx).[17]

[b] Data obtained from Powles.[23]

[c] Data obtained from the 2014 WHO recommendations.[14]

Table 6. Alignment of required iodine compounds in country salt standards with 2014 WHO recommendations (potassium iodate and potassium iodide) for three country examples.

Country	Compound(s) in salt standard[a]	Assessment of alignment
Kenya	Potassium iodate	All of the compounds in the country's standard are WHO-recommended compounds
Venezuela	Potassium iodate, Potassium iodide	All of the compounds in the country's standard are WHO-recommended compounds
Australia	Potassium iodate, Potassium iodide, Sodium iodate, Sodium iodide	There are both WHO-recommended and not recommended compounds in the country's standard

[a] Data obtained from the Global Fortification Data Exchange (GFDx).[17]

Table 7. Calculated range of iodine to be added to salt through fortification for salt intakes from 3-14 grams/capita/day from 1994 WHO recommendations for 5 and 10 grams salt intakes.[a]

Salt intake (grams/capita/day)	Minimum iodine addition (ppm)	Maximum iodine addition (ppm)
3	83.33	150.00
4	62.50	112.50
5	**50.00**	**90.00**
6	41.67	75.00
7	35.71	64.29
8	31.25	56.25
9	27.78	50.00
10	**25.00**	**45.00**
11	22.73	40.91
12	20.83	37.50
13	19.23	34.62
14	17.86	32.14

Ppm: parts per million.

[a] We used the bolded values (50.00 to 90.00 ppm and 25.00 to 45.00 ppm)[5] to calculate the range of iodine to be added for salt intakes from 3-14 grams/capita/day to be consistent with the 2014 WHO recommendations.[14]

Table 8. Required iodine amounts in salt from current country standards, calculated WHO-recommended range of iodine in salt, and analysis of standard alignment with 1994 WHO recommendations for three country examples.

Country	Is salt fortification mandatory or voluntary[a]	Year the current salt standard was issued[a]	Average salt consumption in 1990 in grams/capita/day[b]	Mid-point amount of iodine to be added to salt per the country standard, in milligrams/ kilogram[a]	Calculation of WHO recommendation for iodine in milligrams/kilogram, for country's salt intake quantity[c]	Assessment of standard alignment with 1994 WHO recommendation
Cameroon	Mandatory	1995	5.26	100	50.00-90.00	Greater than the WHO-recommended range
Chad	Mandatory	1994	7.30	65	35.71-64.29	Greater than the WHO-recommended range
Central African Republic	Mandatory	1995	6.99	40	35.71-64.29	Within the WHO-recommended range

[a] Data obtained from the Global Fortification Data Exchange (GFDx).[17]

[b] Data obtained from Powles.[23]

[c] Data obtained from 1994 WHO recommendations.[4]

Table 9. Alignment of required iodine compounds in country salt standards with 1994 WHO recommendations (potassium iodate) for three country examples.

Country	Year the current standard was issued	Compound(s) in salt standard[a]	Assessment of alignment
Chad	1994	Potassium Iodate	All of the compounds in the country's standard are WHO-recommended compounds
Zambia	1994	Potassium Iodide	All of the compounds in the country's standard are not WHO-recommended compounds
Central African Republic	1995	Potassium Iodate, Potassium Iodide, Calcium Iodate	There are both WHO-recommended compounds and not recommended compounds in the country's standard

[a] Data obtained from Global Fortification Data Exchange (GFDx).[17]

Table 10. Required amount of iodine in salt from current country salt standards and analysis of standard alignment with the 1996 WHO recommendation for three country examples.

Country	Is salt fortification mandatory or voluntary[a]	Year the current standard was issued[a]	Mid-point amount of iodine to be added to salt per the country standard, in milligrams/ kilogram[a]	Does the country's legislation/ standard apply to household salt?[a]	Does the country's legislation/ standard apply to salt used in food processing?[a]	WHO recommendation that applies to country, in milligrams/ kilogram[b]	Assessment of standard alignment with 1996 WHO recommendation
India	Mandatory	1998	25	Yes	No	20-40	Within the WHO-recommended range
Mexico	Mandatory	2003	30	Yes	Yes	20	Greater than the WHO-recommended range
Slovenia	Mandatory	1998	19	Yes	No	20-40	Less than the WHO-recommended range

[a] Data obtained from Global Fortification Data Exchange (GFDx).[17]

[b] Data obtained from 1996 WHO reccomendations.[13]

Table 11. Alignment of required iodine compounds in country salt standards with 1996 WHO recommendations (potassium iodate) for three country examples.

Country	Year the current standard was issued	Compound(s) in salt standard[a]	Assessment of alignment
Mexico	2003	Potassium Iodate, Potassium Iodide, Sodium Iodate, Sodium Iodide	There are both WHO-recommended compounds and not recommended compounds in the country's standard
Bulgaria	2001	Potassium Iodate	All of the compounds in the country's standard are WHO-recommended compounds
Austria	1999	Potassium Iodate, Potassium Iodide	There are both WHO-recommended compounds and not recommended compounds in the country's standard

[a] Data obtained from Global Fortification Data Exchange (GFDx).[17]

Results

Participants

As of 23 September 2019, 128 countries had mandatory iodine fortification of salt as per the GFDx and 21 countries had voluntary fortification of salt.[16] Countries were not included in the analysis if the GFDx did not have a salt standard for them, or if their standard does not specify iodine amounts or iodine compounds. Thus 118 countries with mandatory fortification and 16 countries with voluntary fortification were included in the analysis of iodine amounts in salt standards. One hundred and eight countries with mandatory fortification and 14 countries with voluntary fortification were included in the analysis of iodine compounds in salt standards. The countries were subdivided based on the year their standards were issued and the applicable WHO recommendation (**Figure 1, Figure 2**).

Main results

Results for Objective 1 for countries with mandatory legislation of salt fortification

Of the 118 countries with mandatory fortification and a salt standard, one did not have salt intake and was excluded from the assessment of standard alignment with the 2014 WHO recommendation. Of these 117 countries, 82% of countries' iodine amounts in salt standards were greater than the range indicated by the 2014 WHO recommendations (**Figure 3, Appendix**

Table 4). Of the 108 countries with mandatory fortification and specification of iodine compounds in salt standards, 75% of countries' standards included only WHO-recommended compounds (**Figure 4, Appendix Table 4**). No country's standard for salt had only not WHO-recommended iodine compounds.

Results for Objective 2 for countries with mandatory legislation of salt fortification

1994 WHO recommendations

Six countries had current mandatory salt standards issued after the 1994 WHO recommendations and before the 1996 WHO recommendations were issued (i.e., 1994-1995). Three of the countries' iodine amounts in salt standards were greater than the range indicated by the 1994 WHO recommendations, two countries were lower than the WHO-recommended range, and one country had standards with the iodine amount within the range **(Figure 3, Appendix Table 4)**. 50% of countries' standards included only the WHO-recommended compounds and 33% included both the WHO-recommended compound and not recommended compounds (**Figure 4, Appendix Table 4**). One country's standard had only not WHO-recommended iodine compounds.

1996 WHO recommendations

Eighty-three countries had mandatory salt standards issued after the 1996 WHO recommendations and before the 2014 WHO recommendations were issued (i.e., 1996-2013) with a legislation scope that applied to both household and processed salt. Ninety-three percent of countries' iodine amounts in salt standards were greater than the 1996 WHO recommendations (**Figure 3, Appendix Table 4**). No country's iodine amount in salt standards was equal to the 1996 WHO recommendations.

Six countries had standards issued from 1996 to 2013, with a legislation scope that applied to household salt only; none applied to processed food salt only. Three of the countries had iodine amounts in salt standards that were lower than the range indicated by the 1996 WHO recommendations, two countries were within the range, and one country was greater than the range (**Figure 3, Appendix Table 4**).

Of the 80 countries with mandatory fortification and specification of iodine compounds in salt standards, 48% of countries' standards included only the WHO-recommended compounds and 51% included both the WHO-recommended compound and not recommended compounds (**Figure 4, Appendix Table 4**). One country's standard had only not WHO-recommended iodine compounds.

2014 WHO recommendations

Among the 17 countries with mandatory standards issued since the current applicable 2014 WHO recommendations were issued and with available salt intake data, 88% of countries' iodine amounts in salt standards were greater than the range indicated by the 2014 recommendations (**Figure 3, Appendix Table 4**). Seventy-one percent of the countries' standards included only WHO-recommended compounds (**Figure 4, Appendix Table 4**).

Results for Objective 1 for countries with voluntary legislation of salt fortification

For the 16 countries with voluntary fortification and a salt standard indicating iodine amounts, 81% of the countries' iodine amounts were greater than the range indicated by the 2014 WHO recommendations (**Figure 3, Appendix Table 5**). Additionally, 64% of the countries' standards for salt had both WHO-recommended and not recommended compounds **(Figure 4, Appendix Table 5**). No country's standard for salt had only not WHO-recommended iodine compounds.

Results for Objective 2 for countries with voluntary legislation of salt fortification

1994 WHO recommendations

No countries issued voluntary fortification standards in 1994 or 1995.

1996 WHO recommendations

As the GFDx does not include information on scope for countries with voluntary fortification, it was not possible to undertake comparison of national standards with 1996 recommendations for iodine amount. The 1996 recommendations were applicable for 7 countries with standards issued from 1996 to 2013. We were able to assess the alignment of iodine compounds with the 1996 WHO recommendation since the scope was not needed to make this comparison. Seventy-one percent of the countries' standards included both the WHO-recommended and not recommended compounds (**Figure 4, Appendix Table 5**). The remainder of the countries' standards had only not WHO-recommended iodine compounds.

2014 WHO recommendations

Six countries with voluntary fortification had standards issued since the current applicable 2014 WHO recommendations. Eighty-three percent of the countries' iodine amounts in salt standards were greater than the range indicated by the 2014 WHO recommendations (**Figure 3, Appendix Table 5**). Only one country's iodine amount in salt standards was lower than the range and none of the countries was within the range indicated by the 2014 WHO recommendations.

Among the four countries with voluntary fortification and a salt standard specifying iodine compounds issued since the current applicable 2014 WHO recommendations, 75% of the countries' standards included only WHO-recommended compounds (**Figure 4, Appendix Table**

5). One country's standard included both WHO-recommended and not recommended compounds.

Percentage of 2014 WHO recommendations met

Most countries with mandatory or voluntary salt fortification had iodine levels that were higher than the minimum or maximum amount of iodine to be added to salt per the 2014 WHO recommendations by 1%-150% (**Appendix Figure 1, Appendix Figure 2, Appendix Table 3**).

Potential factors influencing results

We looked at five potential factors that could explain why countries are not following current (2014) WHO recommendations: World Bank income status, official language of countries, the year countries' standards were issued, and the presence of government protocols for external and import monitoring. We compared these five factors to the results from objective 1, alignment of current country iodine fortification requirements with current (2014) WHO recommendations. There is no relationship between any of these factors and whether countries were in alignment with WHO recommendations, except for World Bank income level and iodine compounds (**Appendix Table 6, Appendix Table 7, Appendix Table 8, Appendix Table 9, Appendix Table 10**).

Without taking into account World Bank income level, the year the country's standard was issued, whether WHO recommendations were available in the country's official language,

whether government protocols for external and import monitoring are present, the trend was for most countries to be in the "greater than the WHO-recommended range" for iodine amount (**Figure 3**). This trend remained when countries were classified according to World Bank income level (**Appendix Table 6**), year the country's standard was issued (**Appendix Table 7**), whether WHO recommendations are available in the country's official language (**Appendix Table 8**), and whether government protocols are present for external monitoring (**Appendix Table 9**) or import monitoring (**Appendix Table 10**).

For use of WHO-recommended iodine compounds, World Bank income level did seem to make a difference: for high income countries, most tended to have both WHO-recommended and not WHO-recommended compounds as opposed to having all WHO-recommended compounds (**Appendix Table 6**). For high income countries, this was opposite to what was observed for countries regardless of World Bank income level (**Figure 4**) and to what was observed for low, lower middle and upper middle income countries (**Appendix Table 6**). The trend for most countries to be classified as "all of the compounds in the country's standard are WHO-recommended compounds was observed in most countries (**Figure 4**) even when countries were classified for the year the country's standard was issued (**Appendix Table 7**), whether WHO recommendations are available in the country's official language (**Appendix Table 8**), whether government protocols are present for external monitoring (**Appendix Table 9**) or import monitoring (**Appendix Table 10**).

Figure 1. Flowchart of countries with mandatory salt fortification included in the assessment of alignment of iodine amounts and iodine compounds in standards with 2014 WHO recommendations for salt fortification per objective 1 and with 1994, 1996, and 2014 WHO recommendations for salt fortification per objective 2. Objective 1 was to analyze if current country standards follow current (2014) WHO recommendations for iodine amounts and compounds, taking into consideration salt intake quantities. Objective 2 was to analyze if current country standards followed WHO recommendations available at the time the standards were issued: the 1994, 1996 or 2014 WHO recommendations.

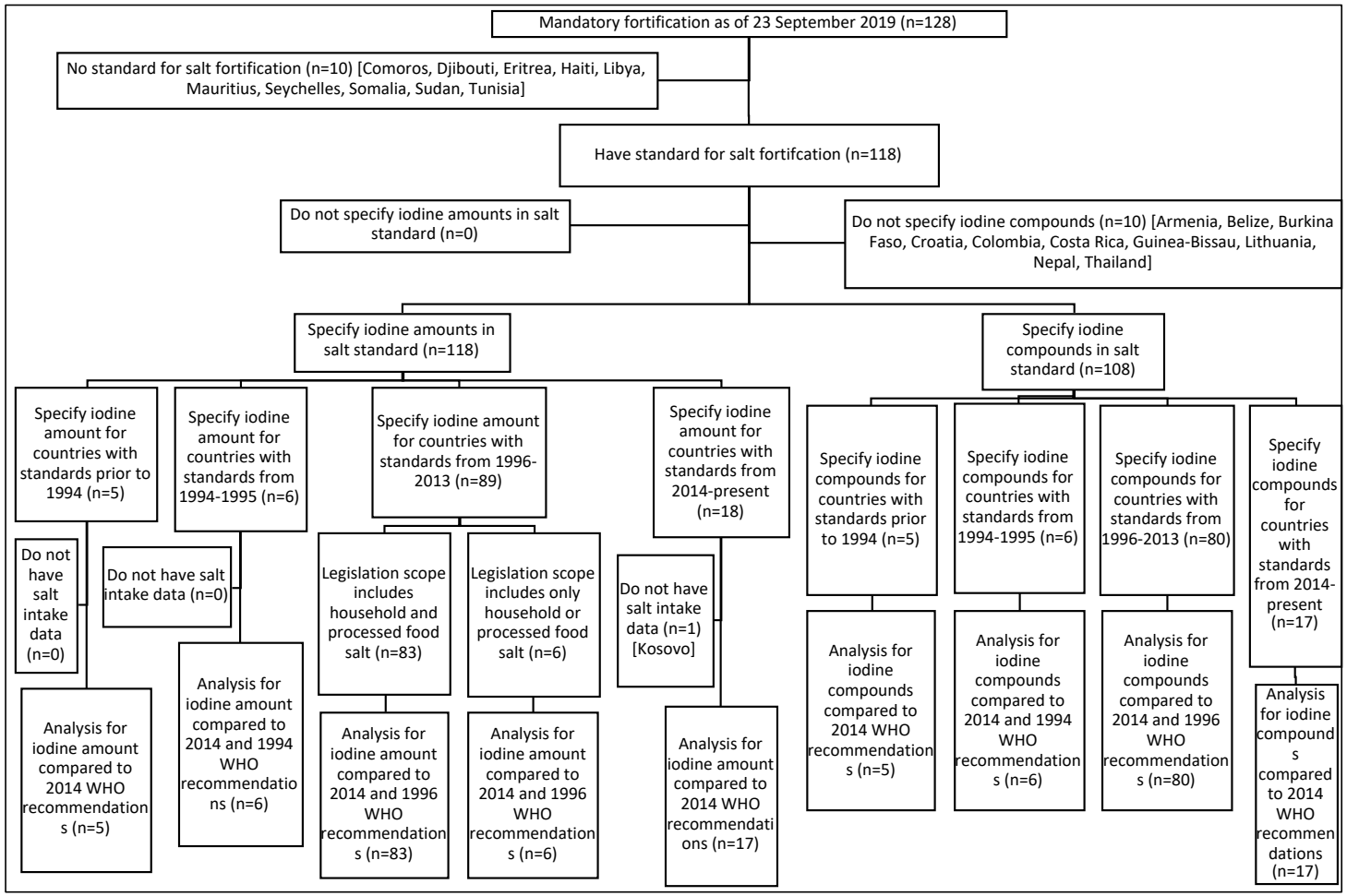


Figure 2. Flowchart of countries with voluntary salt fortification included in the assessment of alignment of iodine amounts and iodine compounds in standards with 2014 WHO recommendations for salt fortification per objective 1 and with 1994, 1996, and 2014 WHO recommendations for salt fortification per objective 2. Objective 1 was to analyze if current country standards follow current (2014) WHO recommendations for iodine amounts and compounds, taking into consideration salt intake quantities. Objective 2 was to analyze if current country standards followed WHO recommendations available at the time the standards were issued: the 1994, 1996 or 2014 WHO recommendations.

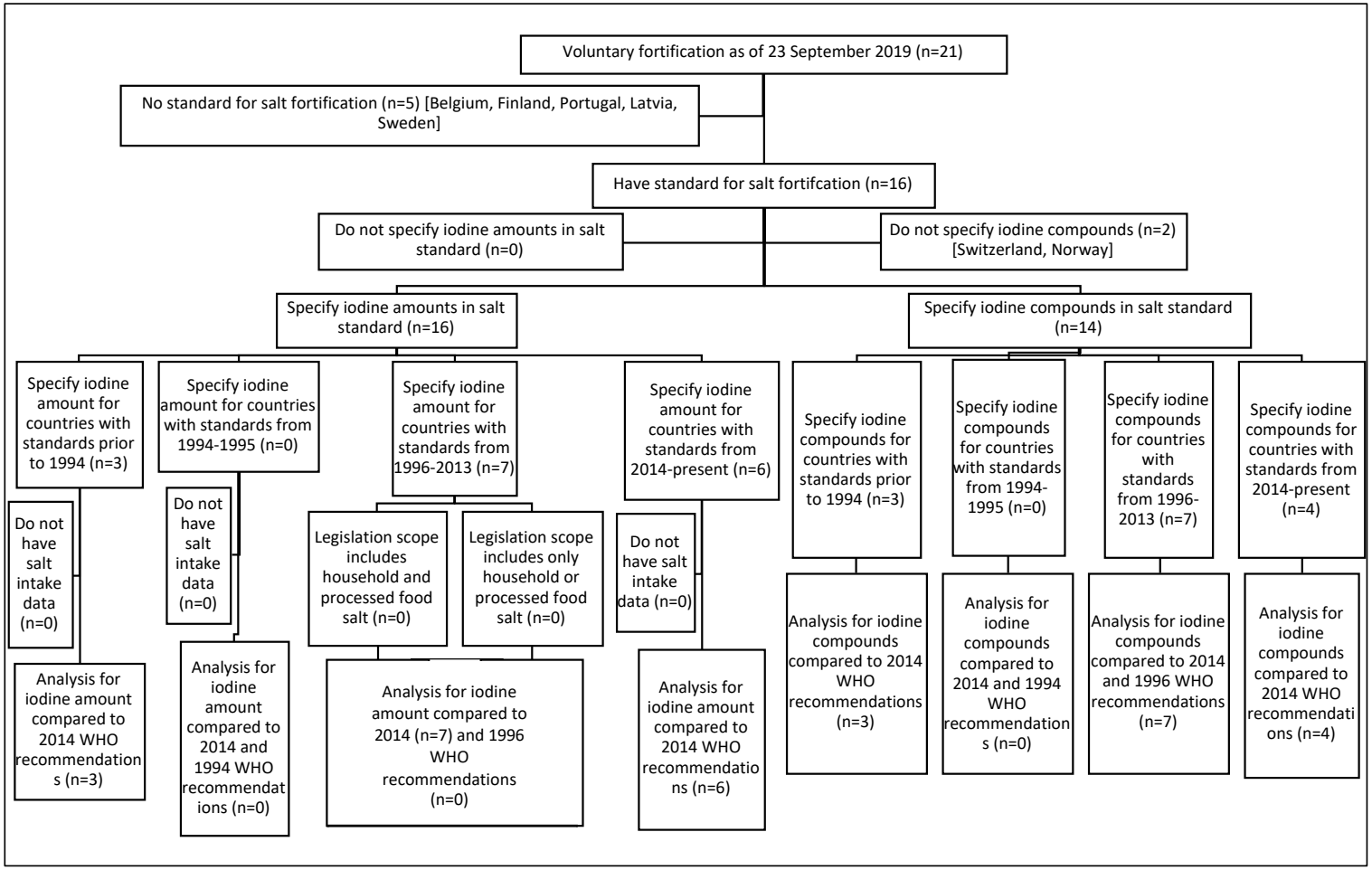


Figure 3. Analysis of the alignment of iodine amounts in salt standards from countries with mandatory or voluntary fortification with WHO recommendations. No assessment for objective 2 was conducted on the countries with standards issued prior to 1994 because no WHO salt iodization recommendations existed at the time. No countries with voluntary fortification and a salt standard indicating iodine amounts had standards issued in 1994 or 1995. No assessment for objective 2 was conducted on the countries with voluntary fortification and standards issued between 1996 and 2013 because the GFDx does not include information on legislation scope for countries with voluntary fortification.

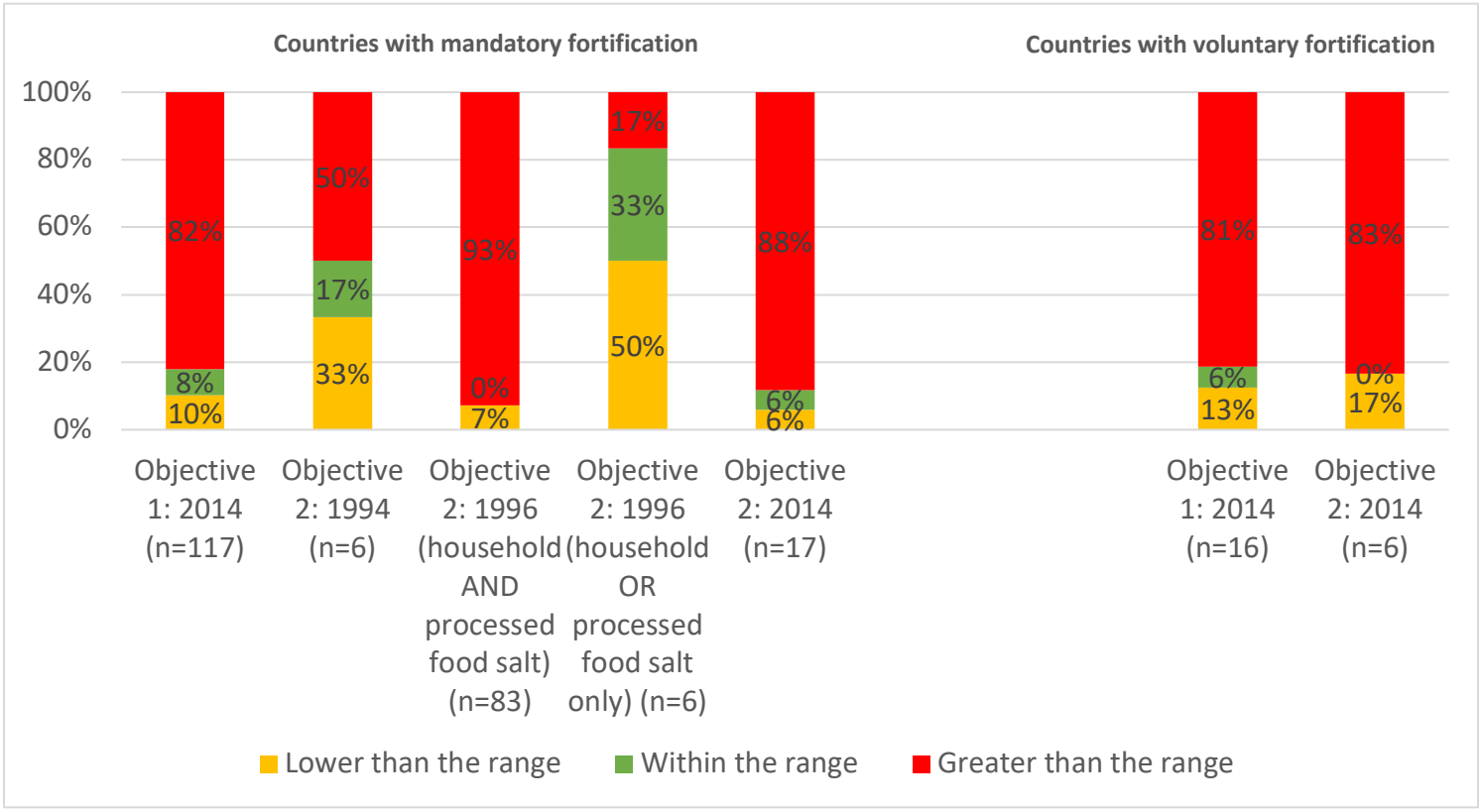
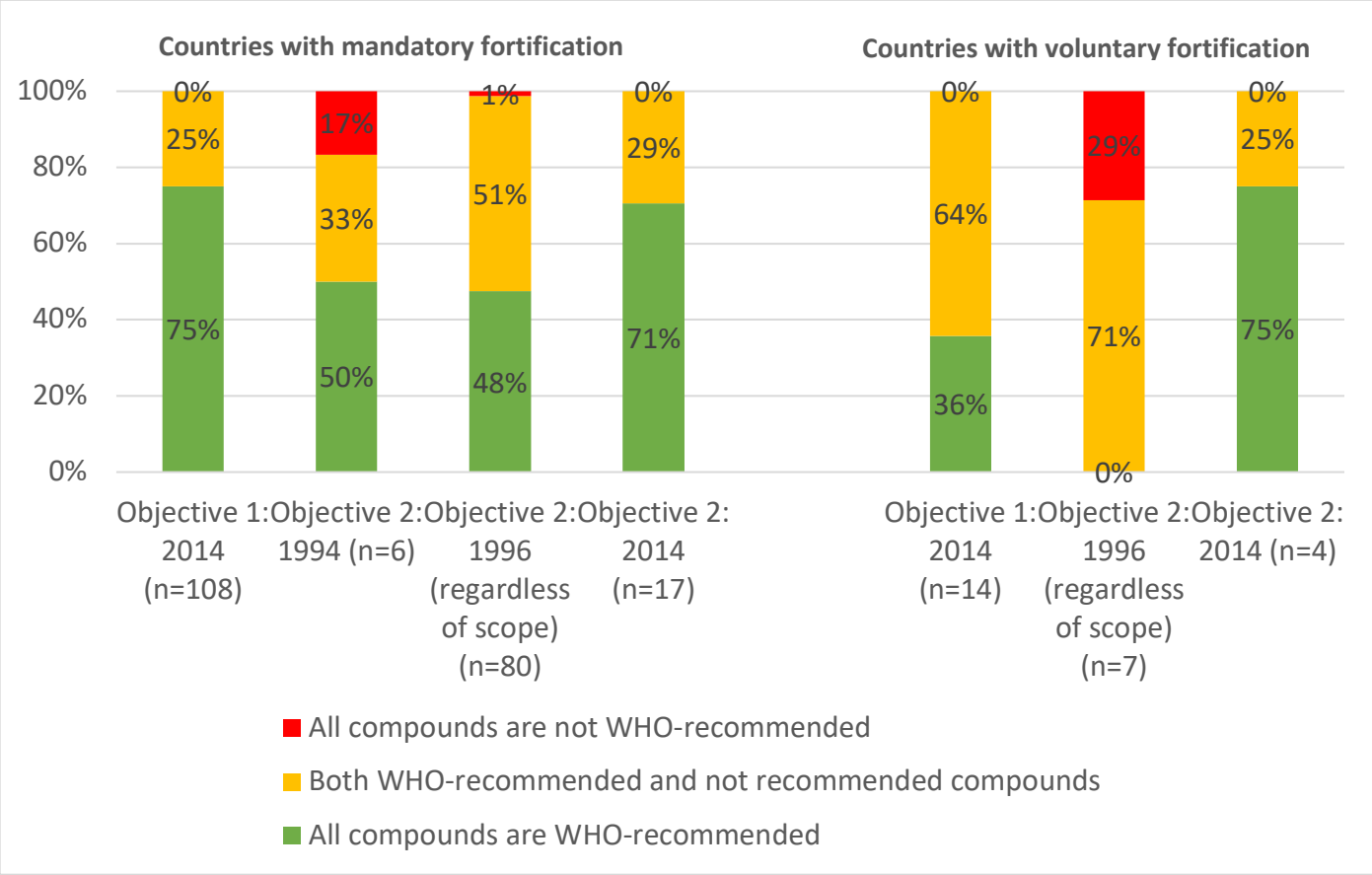


Figure 4. Analysis of the alignment of iodine compounds in salt standards from countries with mandatory or voluntary fortification with WHO recommendations. No assessment for objective 2 was conducted on the countries with standards issued prior to 1994 because no WHO salt iodization recommendations existed at the time. No countries with voluntary fortification and a salt standard indicating iodine amounts had standards issued in 1994 or 1995.



Discussion

Key Results

There were 133 countries with either mandatory or voluntary salt fortification, that also had national salt standards indicating required iodine amounts in salt at production or at import level and had salt intake data available; the majority of countries' standards for iodine amounts are higher than those recommended by WHO. Among the 108 countries with mandatory fortification, the majority of countries' standards include only WHO-recommended compounds. However, among the 14 countries with voluntary fortification, the majority of countries' standards include both WHO-recommended and not recommended compounds.

The majority of current country standards for mandatory or voluntary fortification specifying the amount of iodine to be added to salt did not follow the applicable WHO recommendation available at the time the standards were issued i.e., the 1994, 1996 or 2014 WHO recommendations. Similar to the results for objective 1, most of countries' iodine amounts in salt standards were greater than those indicated by applicable WHO recommendations. The only exception to this trend was among the six countries with mandatory fortification and standards issued after the 1996 WHO recommendations and before the 2014 WHO recommendations, with a legislation scope that applied to household salt only. Half of the

countries had iodine amounts in salt standards that were lower than those recommended by WHO.

Additionally, in relation to iodine compounds, half of the countries with mandatory fortification that issued standards after the 1994 WHO recommendations and before the 1996 WHO recommendations included only WHO-recommended compounds. No countries with voluntary fortification had standards issued after the 1994 WHO recommendations and before the 1996 WHO recommendations. Similar to the results for iodine compounds of the comparison of countries with the applicable 1994 WHO recommendations, most of the countries with mandatory or voluntary fortification and with standards issued after the 1996 WHO recommendations and before the 2014 WHO recommendations were not in alignment with the applicable 1996 WHO recommendations. For countries with mandatory fortification with standards issued after the 1996 WHO recommendations and before the 2014 WHO recommendations, around half of the countries' standards included both WHO-recommended and not recommended compounds, while the other half of countries' standards included only WHO-recommended compounds. For the seven countries with voluntary fortification and with standards issued after the 1996 WHO recommendations and before the 2014 WHO recommendations, the majority of countries' standards included both WHO-recommended and not recommended compounds. This differs from the comparison of countries with mandatory or voluntary fortification and standards issued since the 2014 WHO recommendations with the current 2014 WHO recommendations. Current country standards for mandatory or voluntary fortification with standards issued since the current 2014 WHO recommendations mirrored the

results observed for objective 1, most of countries' standards included only WHO-recommended compounds.

Interpretation

While there is no information available on why countries did not follow WHO recommendations, there are several potential reasons, based upon the authors' knowledge of salt iodization programs and the information or process used to develop standards in countries. One explanation is that varied methods are used to disseminate and promote WHO recommendations and it is possible that key national stakeholders are not always aware that WHO recommendations for salt iodization exist. Additionally, this analysis found that in most instances, national standards for iodine content in salt are higher than WHO recommendations. This may reflect information or a belief in countries that iodine losses from iodized salt are higher than the assumptions made by WHO in developing the iodine recommendations. Iodine losses are known to be higher in poorer quality salt and in the 1990s, there was significant concern about iodine losses from poorer quality salt.[24,25] In the 2014 WHO recommendations, some of the assumptions were changed, such as potential iodine losses. Specifically, between the 1994 and the 2014 WHO recommendations, the amount of iodine assumed to be lost from iodized salt declined from 50% to 30%. As a result, the recommended amount of iodine declined from 22.5 to 50 ppm in 1994 to 18 to 22 ppm in 2014. It is possible that country stakeholders were not aware of the changes in estimated iodine losses from the 1994 to the

2014 WHO recommendations or had contrary national estimates, which would explain why many national standards for iodine content in salt are higher than WHO recommendations. A third potential reason, in particular for countries that have revised the iodine amounts in their salt standards, is that countries looked at urinary iodine levels and iodized salt coverage to set iodine levels, rather than WHO recommendations for standards. If, for example, a country recorded continued low iodine status despite high coverage with iodized salt, it might conclude it was necessary to add more iodine to the salt to get a better impact on iodine status.

Even though most countries' national standards for iodine amount to be added to salt were not in alignment with WHO recommendations, most countries' national standards included only WHO-recommended compounds. The WHO-recommended compounds are stable and safe compounds to use in fortification.[3] If countries are not using WHO-recommended compounds, their salt iodization program may not be as effective than if they used WHO-recommended compounds.

Non-communicable diseases, such as heart disease and stroke, cancers, diabetes, and chronic respiratory diseases are a major and growing cause of death.[26] As hypertension is a major risk factor for cardiovascular disease[27] and salt is a major cause of hypertension, WHO released guidelines recommending reducing the intake of salt to decrease the prevalence of noncommunicable diseases.[15] If people reduce their intake of salt and countries do not adjust the iodine amounts required in salt accordingly, over time fortified salt might not provide sufficient iodine and IDD may resurface. Fortunately, the current 2014 WHO salt fortification

recommendations takes into account WHO's salt reduction guidelines. Since the 2014 WHO recommendations provide a range of salt intake quantities and corresponding amounts of iodine to add to salt, the amount of iodine added to salt can be adjusted to align with any reduction of national salt intake quantities. The 2014 WHO recommendations state that salt reduction and salt iodization are compatible, and that monitoring salt intake and iodine intake is needed to establish a successful salt iodization program.[14]

Generalizability

A previous study compared wheat and maize flour fortification standards of countries with mandatory fortification to WHO fortification recommendations for nutrient amounts and fortification compounds for up to ten nutrients.[28] Two nutrients were added to the most number of countries' wheat flour fortification standards: iron (n=56) and folic acid (n=41). The study found that in most of the countries with mandatory fortification of wheat flour only, standards were lower than WHO recommendations for iron amount and exceeded WHO recommendations for folic acid amount. However, for most of the countries with mandatory fortification of wheat flour only or both wheat and maize flours, standards included a WHO-recommended compound for iron and folic acid. The results were similar to our results in that most countries' standards included a WHO-recommended compound and that iodine amounts to be added to salt did not align with WHO recommendations. Most countries' standards for iodine amounts to be added to salt exceeded WHO recommendations, similar to the results for

folic acid. This similarity in results indicates that countries might not be following WHO recommendations for other nutrients besides iodine and for other foods besides salt. To our knowledge, these studies on wheat and maize flour and salt are the first analyses of food fortification alignment with WHO fortification recommendations.

Another study calculated the potential intake of iodine through salt fortified to country standards and compared the potential intake of iodine to the estimated average requirement (EAR) for women of reproductive age and tolerable upper intake levels (UL).[29] The study found that of 130 countries that included iodine in their salt standards, potential iodine consumption on average was 0.34 mg/capita/day and 77.69% of countries achieved greater than 150% of EAR. These results are in alignment with our results, as we found that most countries' standards for iodine amounts to be added to salt exceeded WHO recommendations and therefore it was expected to see high iodine consumption and a high EAR. However, 100% of countries potentially achieved less than 100% of UL, indicating that individuals are not consuming too much iodine to cause adverse health effects.

We excluded from this study 15 countries with mandatory or voluntary salt fortification for which the GFDx was not able to obtain standards. Most of the countries excluded are COMESA countries. Amongst the majority of COMESA countries that we do have standards for iodine amounts exceed WHO recommendations and their standards include only WHO-recommended compounds. Assuming that the excluded countries follow the same trend as the COMESA

countries we do have standards for, they are not in alignment with WHO recommendations for iodine amounts but are in alignment with fortification compounds.

Strengths and Limitations

A strength of this study is that our data came from the GFDx, which has comprehensive data on food fortification and includes information from all countries regardless of the language of fortification documents.[30] Another strength is that the study not only compared countries' standards to current WHO recommendations, but also to ones applicable at the time standards were issued, taking into account assumptions made by WHO at the time. Lastly, a strength of this study is that we calculated the percentage of WHO recommendations met for the minimum and maximum amount of iodine to be added to salt per the WHO recommendations (**Appendix Table 1, Appendix Table 2**). This calculation allowed us to see how close or how far countries' salt standards for iodine amounts were to the WHO recommendations. This study also has some limitations. First, the study does not take into consideration the implementation or enforcement of the national salt standards in these countries because there are little such data available. Without these data, we are unable to analyze the extent to which companies are complying with salt standards at production or import level. Second, we are reliant on Powles' data on salt intake when comparing iodine amounts to the WHO recommendations that take into account salt intake. While Powles' study is a systematic analysis, data were estimated for some countries with missing or limited data. If Powles' estimates are not reflective of actual

national salt intake, our assessment of the alignment of national standards with WHO recommendations may be incorrect. Third, while the GFDx makes every effort to keep its data up to date and to correct any misinformation, it is possible that the GFDx may not have the most recent salt standard for every country.

Future Directions

The next step for this study is to extend the analysis by comparing our results with nationally representative urinary iodine status data. The data are not ready from the IGN and we plan on incorporating this into the study on a later date. We want to see if having iodine amounts in salt standards that are greater than or less than WHO recommendations is associated with excess or deficient iodine status, respectively.

For this analysis, we will be using the results of objective 1, household iodized salt coverage data compiled by UNICEF and included in the GFDx,[31] and iodine status data compiled from from IGN's Global Scorecard and WHO's Vitamin and Mineral Nutrition Information System.[10,32] An example of the table that will be created comparing iodine status to the results of objective 1 is noted in **Appendix Table 11.**

Iodine status data are most commonly available for the following population groups: school age children, adults or non-pregnant women of reproductive age, and pregnant women.[10] Our target population is school children because there is more data for this group and the evidence

base for the public health interpretation of iodine status in school children is stronger compared to non-pregnant women of reproductive age.[32] If iodine status data are not available for school children, we will use women of reproductive age as an alternative. If data for women of reproductive age are not available, we will not conduct the analysis for that country. We will not be using iodine status data of pregnant women because they have greater iodine requirements than the general population.[3]

Comparing iodine status with standards for the required amount of iodine in salt assumes existing legislation and standards are being complied with. We will include in the analysis data on household coverage of iodized salt among all households surveyed as a proxy indicator that salt iodization legislation and standards are being implemented. While the global target for adequate implementation of salt iodization to eliminate iodine deficiency is greater than 90% of households with adequately iodized salt,[3] these data are not readily available because it is complicated to collect data on households with adequately iodized salt. UNICEF currently collects data on "household consumption of salt with any iodine (>0 ppm)" and does not collect data on "salt with adequate iodine (>15 ppm)".[31] Therefore, we will use data on the proportion of households with salt fortified with "any level of iodine" and will use a cut-off of greater than 70% of households as an indication that the majority of edible salt in a country is being iodized.

We will identify countries with both iodine status data for school children and data on the household coverage of fortified salt. We will use data from household coverage reports that were published one to five years before the publication of the applicable iodine status data.

Conclusion

In conclusion, this study found that the amount of iodine required in salt standards of the majority of countries did not follow WHO recommendations. In most countries, the amount of iodine specified to be added to salt in standards exceeded WHO recommendations. On the other hand, the majority of countries did use the WHO-recommended iodine compounds for salt fortification. WHO recommendations are intended to make salt fortification efforts as safe and effective as possible, taking various assumptions and available evidence into account. Those countries whose current standards do not align with current WHO recommendations, may wish to review them. These countries should consider amending their standards to follow more closely the WHO recommendations, particularly if they do not have other, more pertinent information to justify not following the WHO recommendations.

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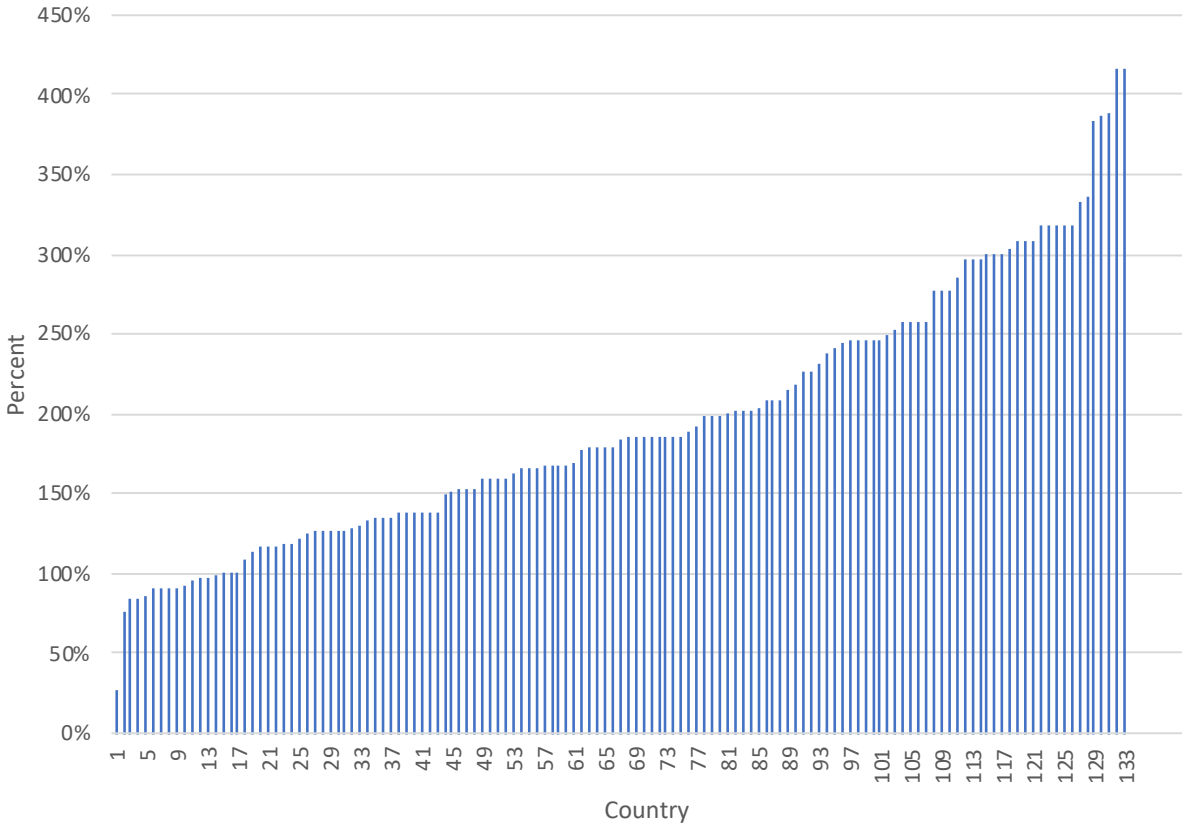
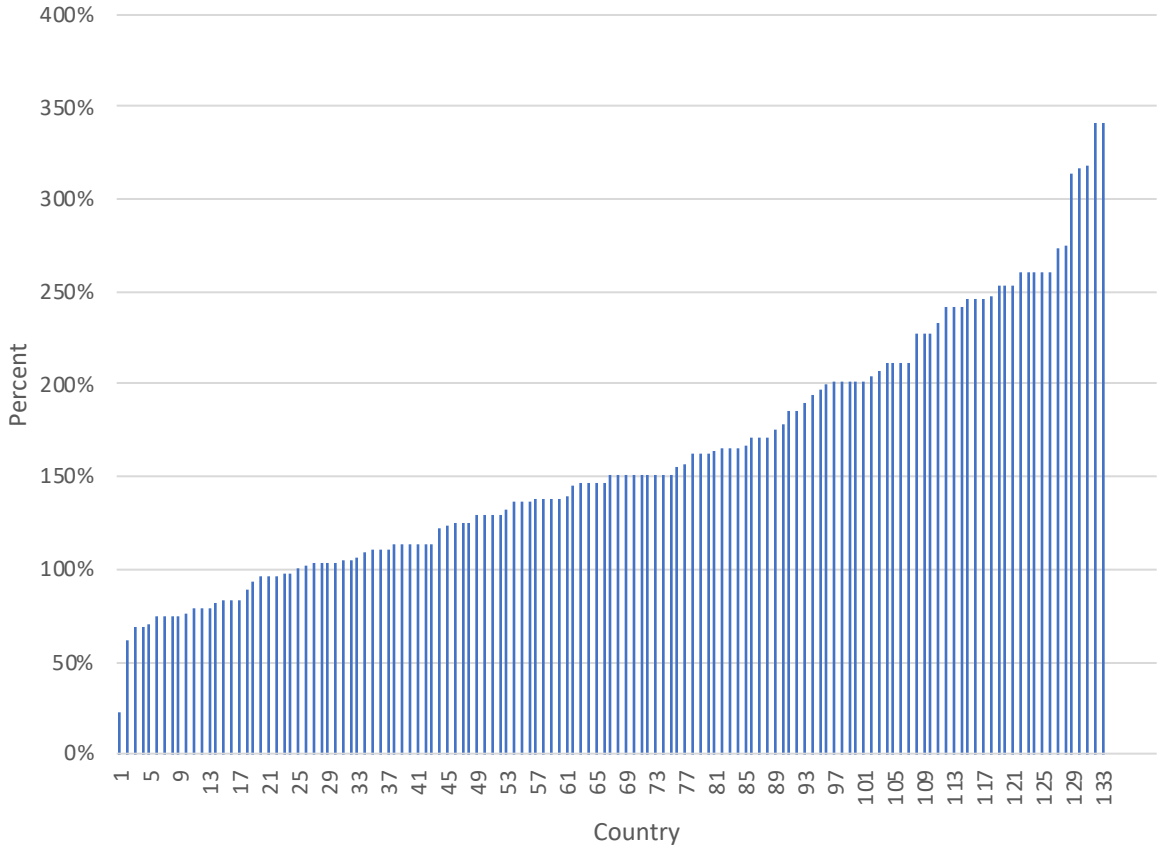
Appendix Figure 1. Percentage of the minimum amount of iodine to be added to salt met per the 2014 WHO recommendations for all countries (n=133) with mandatory or voluntary fortification of salt.



Appendix Figure 2. Percentage of the maximum amount of iodine to be added to salt met per the 2014 WHO recommendations for all countries (n=133) with mandatory or voluntary fortification of salt.



Appendix Table 1. Percentage of the minimum and maximum amount of iodine to be added to salt met per the 1994, 1996, and 2014 WHO recommendations for countries with mandatory fortification.

Year of applicable WHO recommendation	Percentage of WHO recommendations met Median Mean Range
Objective 1	
Comparison to minimum 2014 WHO recommended amount	179% 192% (76%, 341%)
Comparison to maximum 2014 WHO recommended amount	146% 157% (62%, 314%)
Objective 2	
Comparison to minimum 1994 WHO recommended amount	164% 152% (92%,200%)
Comparison to maximum 1994 WHO recommended amount	91% 85% (51%,111%)
Comparison to 1996 WHO recommended amount (household and processed food salt)[a]	200% 197% (75%,450%)
Comparison to minimum 1996 WHO recommended amount (household or processed food salt)[b]	124% 148% (95%,250%)
Comparison to maximum 1996 WHO recommended amount (household or processed food salt)[b]	62% 74% (48%,125%)
Comparison to minimum 2014 WHO recommended amount	179% 185% (84%,349%)
Comparison to maximum 2014 WHO recommended amount	146% 152% (69%,318%)

[a] If a country's legislation scope included both processed food salt and household salt, we used 20 ppm as the amount of iodine recommended by WHO according to the 1996 WHO recommendations. Therefore, this comparison was only conducted using 20 ppm as the recommended amount.

[b] If a country's legislation scope included only processed food salt or only household salt, we used 20-40 ppm as the amount of iodine recommended by WHO according to the 1996 WHO recommendations. Therefore, this comparison was conducted using 20-40 ppm as the recommended amount.

Appendix Table 2. Percentage of the minimum and maximum amount of iodine to be added to salt met per the 1994, 1996, and 2014 WHO recommendations for countries with voluntary fortification.

Year of applicable WHO recommendation	Percentage of WHO recommendations met Median Mean Range
Objective 1	
Comparison to minimum 2014 WHO recommended amount	242% 218% (28%, 236%)
Comparison to maximum 2014 WHO recommended amount	198% 178% (23%,316%)
Objective 2	
Comparison to minimum 1994 WHO recommended amount[a]	0% 0% (0%,0%)
Comparison to maximum 1994 WHO recommended amount[a]	0% 0% (0%,0%)
Comparison to 1996 WHO recommended amount (household and processed food salt)[b]	NA[d]
Comparison to minimum 1996 WHO recommended amount (household or processed food salt)[c]	NA[d]
Comparison to maximum 1996 WHO recommended amount (household or processed food salt)[c]	NA[d]
Comparison to minimum 2014 WHO recommended amount	198% 197% (28%,386%)
Comparison to maximum 2014 WHO recommended amount	162% 161% (23%,316%)

NA: not applicable.

[a] No countries with voluntary fortification and a salt standard indicating iodine amounts had standards issued in 1994 or 1995.

[b] If a country's legislation scope included both processed food salt and household salt, we used 20 ppm as the amount of iodine recommended by WHO according to the 1996 WHO recommendations. Therefore, this comparison was only conducted using 20 ppm as the recommended amount.

[c] If a country's legislation scope included only processed food salt or only household salt, we used 20-40 ppm as the amount of iodine recommended by WHO according to the 1996 WHO recommendations. Therefore, this comparison was conducted using 20-40 ppm as the recommended amount.

[d] As the Global Fortification Data Exchange (GFDx) does not include information on scope for countries with voluntary fortification, it was not possible to undertake comparison of national standards with 1996 recommendations for iodine amounts.

Appendix Table 3. Percentage of the minimum and maximum amount of iodine to be added to salt met per the 2014 WHO recommendations for all countries with mandatory or voluntary fortification.

Percentage of 2014 WHO recommendations met	Number of countries that met the minimum iodine amount to add to salt according to the 2014 WHO recommendations	Number of countries that met the maximum iodine amount to add to salt according to the 2014 WHO recommendations
Less than 50%	1 (1%)	1 (1%)
Between 50% and 100%	13 (10%)	24 (18%)
Between 101% and 150%	30 (23%)	41 (31%)
Between 151% and 200%	36 (27%)	30 (23%)
Between 201% and 250%	22 (17%)	22 (17%)
Between 251% and 300%	13 (10%)	10 (8%)
Between 301% and 350%	14 (11%)	5 (4%)
Between 351% and 400%	3 (2%)	0 (0%)
Over 400%	1 (1%)	0 (0%)
Total number of countries	133 (~100%)[a]	133 (~100%)[a]

[a] Total does not equal 100% due to rounding.

Appendix Table 4. Analysis of the alignment of iodine requirements in salt standards from countries with mandatory fortification with WHO recommendations.

Year of applicable WHO recommendation	Assessment of alignment of iodine amounts in salt standards with WHO recommendations, n (%)				Assessment of alignment of iodine compounds in salt standards with WHO recommendations, n (%)			
	Lower than the range	Within the range	Greater than the range	Total countries in analysis	All of the compounds in the country's standard are WHO recommended compounds	There are both WHO recommended and not recommended compound in the country's standards	All of the compounds in the country's standard are not WHO recommended compounds	Total countries in analysis
Objective 1								
2014	12 (10%)	9 (8%)	96 (82%)	117[a] (100%)	81 (75%)	27 (25%)	0 (0%)	108 (100%)[b]
Objective 2								
Prior to 1994[c]	NA	NA	NA	NA	NA	NA	NA	NA
1994	2 (33%)	1 (17%)	3 (50%)	6 (100%)	3 (50%)	2 (33%)	1 (17%)	6 (100%)
1996 (household and processed food salt)[d]	6 (7%)	0 (0%)	77 (93%)	83 (100%)	38 (48%)	41 (51%)	1 (1%)	80 (100%)
1996 (household or processed food salt only)[d]	3 (50%)	2 (33%)	1 (17%)	6 (100%)				
2014	1 (6%)	1 (6%)	15 (88%)	17[a] (100%)	12 (71%)	5 (29%)	0 (0%)	17 (100%)

NA: not applicable.

[a] One country with mandatory fortification and salt standards did not have salt intake data; it was excluded from the 2014 analysis for Objective 1 and Objective 2.

[b] Of the 118 countries with mandatory fortification, 108 countries had a standard indicating iodine compounds.

[c] No assessment for objective 2 was conducted on the five countries with standards issued prior to 1994 because no WHO salt iodization recommendations existed at the time.

[d] Household salt refers to the salt used for cooking or at the table. Processed food salt refers to salt use in the commercial production of processed foods such as salty condiments, bread, cheese, convenience foods etc. WHO recommends the lower end of the recommended range of iodine when the scope includes both household and processed food salt. None of the countries in this analysis only require the fortification of salt used in processed food.

Appendix Table 5. Analysis of the alignment of iodine requirements in salt standards from countries with voluntary fortification with WHO recommendations.

Year of applicable WHO recommendation	Assessment of alignment of iodine amounts in standards with WHO recommendations, n (%)				Assessment of alignment of iodine compounds in standards with WHO recommendations, n (%)			
	Lower than the range	Within the range	Greater than the range	Total countries in analysis	All of the compounds in the country's standard are WHO recommended compounds	There are both WHO recommended and not recommended compound in the country's standards	All of the compounds in the country's standard are not WHO recommended compounds	Total countries in analysis
Objective 1								
2014	2 (13%)	1 (6%)	13 (81%)	16 (100%)	5 (36%)	9 (64%)	0 (0%)	14 (100%)[a]
Objective 2								
Prior to 1994[b]	NA	NA	NA	NA	NA	NA	NA	NA
1994[c]	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
1996 (household and processed)[d,e]	NA	NA	NA	NA	0 (0%)	5 (71%)	2 (29%)	7 (100%)
1996 (household or processed only)[d,e]	NA	NA	NA	NA				
2014	1 (17%)	0 (0%)	5 (83%)	6 (100%)	3 (75%)	1 (25%)	0 (0%)	4 (100%)

NA: not applicable.

[a] Of the 16 countries with voluntary fortification, 14 countries had a standard indicating iodine compounds.

[b] No assessment for objective 2 was conducted on the three countries with standards issued prior to 1994 because no WHO salt iodization recommendations existed at the time.

[c] No countries with voluntary fortification and a salt standard indicating iodine amounts had standards issued in 1994 or 1995.

[d] Household salt refers to the salt used for cooking or at the table. Processed food salt refers to salt use in the commercial production of processed foods such as salty condiments, bread, cheese, convenience foods etc. WHO recommends the lower end of the recommended range of iodine when the scope includes both household and processed food salt. None of the countries in this analysis only require the fortification of salt used in processed food.

[e] As the Global Fortification Data Exchange (GFDx) does not include information on scope for countries with voluntary fortification, it was not possible to undertake comparison of national standards with 1996 recommendations for iodine amounts.

Appendix Table 6. World Bank Income Level of countries with mandatory or voluntary fortification compared to the analysis of iodine requirements in salt standards from countries with mandatory or voluntary fortification with current (2014) WHO recommendations.[a]

	Assessment of alignment of iodine amounts in standards with WHO recommendations, n (%)				Assessment of alignment of iodine compounds in standards with WHO recommendations, n (%)			
World Bank Income Level	**Less than the WHO-recommended range**	**Within the WHO-recommended range**	**Greater than the WHO-recommended range**	**Total number of countries**	**All of the compounds in the country's standard are WHO-recommended compounds**	**There are both WHO-recommended and not recommended compounds in the country's standard**	**All of the compounds in the country's standard are not WHO-recommended compounds**	**Total number of countries**
Low income	3 (21%)	3 (30%)	40 (37%)	46 (35%)	35 (41%)	7 (19%)	0 (0%)	42 (34%)
Lower middle income	3 (21%)	0 (0%)	29 (27%)	32 (24%)	25 (28%)	7 (19%)	0 (0%)	32 (26%)
Upper middle income	3 (21%)	5 (50%)	19 (17%)	27 (20%)	18 (21%)	6 (17%)	0 (0%)	24 (20%)
High income	5 (36%)	2 (20%)	19 (17%)	26 (20%)	7 (8%)	15 (42%)	0 (0%)	22 (18%)
NA	0 (0%)	0 (0%)	2 (2%)	2 (2%)	1 (2%)	1 (3%)	0 (0%)	2 (2%)
Total number of countries	14 (~100%)[b]	(100%)	109 (100%)	133 (~100%)[b]	86 (100%)	36 (100%)	0 (100%)	122 (100%)

NA: not applicable.

[a] Data for World Bank Income Level obtained from the World Bank.[33]

[b] Total does not equal 100% due to rounding.

Appendix Table 7. Year countries' standard were issued compared to the analysis of iodine requirements in salt standards from countries with mandatory or voluntary fortification with current (2014) WHO recommendations.

	Assessment of alignment of iodine amounts in standards with WHO recommendations, n (%)				Assessment of alignment of iodine compounds in standards with WHO recommendations, n (%)			
Year country's standard was issued	**Less than the WHO-recommended range**	**Within the WHO-recommended range**	**Greater than the WHO-recommended range**	**Total number of countries**	**All of the compounds in the country's standard are WHO-recommended compounds**	**There are both WHO-recommended and not recommended compounds in the country's standard**	**All of the compounds in the country's standard are not WHO-recommended compounds**	**Total number of countries**
No WHO recommendations existed	0 (0%)	2 (20%)	6 (6%)	8 (6%)	4 (5%)	4 (11%)	0 (0%)	8 (7%)
WHO recommendations existed	11 (79%)	7 (70%)	83 (76%)	101 (76%)	67 (78%)	26 (72%)	0 (0%)	93 (76%)
Current WHO recommendations existed	3 (21%)	1 (10%)	20 (18%)	24 (18%)	15 (17%)	6 (17%)	0 (0%)	21 (17%)
Total number of countries	14 (100%)	10 (100%)	109 (100%)	133 (100%)	86 (100%)	36 (100%)	0 (0%)	122 (100%)

Appendix Table 8. Official language of countries with mandatory or voluntary fortification compared to the analysis of iodine requirements in salt standards from countries with mandatory or voluntary fortification with current (2014) WHO recommendations.[a]

	Assessment of alignment of iodine amounts in standards with WHO recommendations, n (%)				Assessment of alignment of iodine compounds in standards with WHO recommendations, n (%)			
2014 WHO recommendations are available in the country's official language	**Less than the WHO-recommended range**	**Within the WHO-recommended range**	**Greater than the WHO-recommended range**	**Total number of countries**	**All of the compounds in the country's standard are WHO-recommended compounds**	**There are both WHO-recommended and not recommended compounds in the country's standard**	**All of the compounds in the country's standard are not WHO-recommended compounds**	**Total number of countries**
Yes	6 (43%)	1 (10%)	21 (19%)	28 (21%)	20 (23%)	7 (19%)	0 (0%)	27 (22%)
No	8 (57%)	9 (90%)	84 (77%)	101 (76%)	64 (74%)	27 (75%)	0 (0%)	91 (75%)
No official language	0 (0%)	0 (0%)	2 (2%)	2 (2%)	1 (1%)	1 (3%)	0 (0%)	2 (2%)
Unknown	0 (0%)	0 (0%)	2 (2%)	2 (2%)	1 (1%)	1 (3%)	0 (0%)	2 (2%)
Total number of countries	14 (100%)	10 (100%)	109 (100%)	133 (~100%)[b]	86 (~100%)[b]	36 (100%)	0%	122 (~100%)[b]

[a] Data for countries' official language obtained from the Central Intelligence Agency (CIA) World Factbook.[34]

[b] Total does not equal 100% due to rounding.

Appendix Table 9. External monitoring protocol of countries with mandatory or voluntary fortification compared to the analysis of iodine requirements in salt standards from countries with mandatory or voluntary fortification with current (2014) WHO recommendations.[a]

	Assessment of alignment of iodine amounts in standards with WHO recommendations, n (%)				Assessment of alignment of iodine compounds in standards with WHO recommendations, n (%)			
External monitoring protocol present	**Less than the WHO-recommended range**	**Within the WHO-recommended range**	**Greater than the WHO-recommended range**	**Total number of countries**	**All of the compounds in the country's standard are WHO-recommended compounds**	**There are both WHO-recommended and not recommended compounds in the country's standard**	**All of the compounds in the country's standard are not WHO-recommended compounds**	**Total number of countries**
Yes	2 (14%)	1 (10%)	12 (11%)	15 (11%)	9 (10%)	3 (8%)	0 (0%)	12 (10%)
Unknown	8 (57%)	6 (60%)	76 (70%)	90 (68%)	61 (71%)	23 (64%)	0 (0%)	84 (69%)
Not applicable	4 (29%)	3 (30%)	21 (19%)	28 (21%)	16 (19%)	10 (28%)	0 (0%)	26 (21%)
Total number of countries	14 (100%)	10 (100%)	109 (100%)	133 (100%)	86 (100%)	36 (100%)	0 (0%)	122 (100%)

[a] Data for countries' presence of external monitoring protocols obtained from the Global Fortification Data Exchange (GFDx).[35]

Appendix Table 10. Internal monitoring protocol of countries with mandatory or voluntary fortification compared to the analysis of iodine requirements in salt standards from countries with mandatory or voluntary fortification with current (2014) WHO recommendations.[a]

	Assessment of alignment of iodine amounts in standards with WHO recommendations, n (%)				Assessment of alignment of iodine compounds in standards with WHO recommendations, n (%)			
Internal monitoring protocol present	**Less than the WHO-recommended range**	**Within the WHO-recommended range**	**Greater than the WHO-recommended range**	**Total number of countries**	**All of the compounds in the country's standard are WHO-recommended compounds**	**There are both WHO-recommended and not recommended compounds in the country's standard**	**All of the compounds in the country's standard are not WHO-recommended compounds**	**Total number of countries**
Yes	0 (0%)	0 (0%)	14 (13%)	14 (11%)	8 (9%)	2 (6%)	0 (0%)	10 (9%)
Unknown	14 (100%)	10 (100%)	95 (87%)	119 (90%)	78 (91%)	34 (94%)	0 (0%)	112 (92%)
Not applicable	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Total number of countries	14 (100%)	10 (100%)	109 (100%)	133 (~100%)[b]	86 (100%)	36 (100%)	0 (0%)	122 (100%)

[a] Data for countries' presence of internal monitoring protocols obtained from the Global Fortification Data Exchange (GFDx).[35]

[b] Total does not equal 100% due to rounding.

Appendix Table 11. Example table of iodine status of countries with mandatory or voluntary salt fortification compared to the analysis of iodine amounts in salt standards from countries with mandatory or voluntary fortification with current (2014) WHO recommendations.

Iodine status	**Less than the WHO-recommended range**	**Within the WHO-recommended range**	**Greater than the WHO-recommended range**
Inadequate iodine status	n=x	n=x	n=x
Adequate iodine status	n=x	n=x	n=x
Excess iodine status	n=x	n=x	n=x
Total number of countries	n=x	n=x	n=x

Appendix Table 12. Table containing the name of the countries included in the analysis, amount of iodine indicated in the countries' standard, iodine compounds indicated in the countries' standard, whether fortification is mandatory or voluntary, year of the countries' standard, legislation scope, salt intake data, the minimum amount of iodine to be added to salt per the 1994 WHO recommendations, and the maximum amount of iodine to be added to salt per the 1994 WHO recommendations.

country_name	level_iodine_s	compound_iodine_s	mandatory_fortification_s	voluntary_fortification_s	fortification_standard_s	standard_year_s	legislation_scope_uses_s__household	legislation_scope_uses_s__processed food	legislation scope_Household and processed food or household or processed food	food_intake_s 1990	food_intake_s_2010 rounded	Minimum amount of iodine to be added per 1994 WHO recommendations	Maximum amount of iodine to be added per 1994 WHO recommendations
Afghanistan	40	Potassium Iodate	1	2	1	2014	1	1		8.36318	8.6		
Albania	50	Potassium	1	2	1	2008	1	1	1	8.82074	9.3		

		Iodate, Potassium Iodide											
Algeria	40	Potassium Iodate	1	2	1	1990	1	1		9.93922	10.9		
Angola	40	Potassium Iodate	1	2	1	2006	1	1	1	6.25332	6.3		
Argentina	30	Potassium Iodate	1	2	1	1967	1	0		7.65142	7.6		
Armenia	40	Unspecified	1	2	1	2001	1	1	1	12.30328	12.5		
Australia	45	Potassium Iodide, Potassium Iodate, Sodium Iodide, Sodium Iodate	1	2	1	2016	0	1		8.59196	8.7		
Austria	17.5	Potassium Iodate, Potassium Iodide	1	2	1	1999	1	1	1	9.88838	10.0		

Azerbaijan	40	Potassium Iodate, Potassium Iodide	1	2	1	2001	1	1	1	11.5661	12.9		
Bahrain	27.5	Potassium Iodide, Potassium Iodate, Sodium Iodide, Sodium Iodate	1	2	1	2012	1	1	1	11.1848	13.7		
Bangladesh	35	Potassium Iodate, Potassium Iodide, Calcium Iodate	1	2	1	2007	1	1	1	9.35456	9.0		
Belarus	40	Potassium Iodate, Potassium Iodide	1	2	1	2008	1	1	1	10.168	11.1		

Belize	40	Unspecified	1	2	1	2007	1	1	1	6.78714	6.7		
Benin	45	Potassium Iodate	1	2	1	2013	1	1	1	7.27012	7.2		
Bolivia, Plurinational State of	60	Potassium Iodate	1	2	1	2013	1	1	1	8.92242	9.1		
Bosnia and Herzegovina	25	Potassium Iodate	1	2	1	2004	1	1	1	8.28692	8.8		
Brazil	30	Potassium Iodate	1	2	1	2013	1	1	1	9.88838	10.4		
Brunei Darussala	32.5	Potassium Iodate, Potassium Iodide, Sodium Iodide, Sodium Iodate	2	1	1	2001	0	0	2	11.1848	11.2		

Bulgaria	25	Potassium Iodate	1	2	1	2001	1	1	1	9.22746	9.2		
Burkina Faso	65	Unspecified	1	2	1	2003	1	1	1	7.39722	7.3		
Burundi	40	Potassium Iodate	1	2	1	2013	1	1	1	4.11804	4.4		
Cambodia	40	Sodium Iodate, Potassium Iodate, Potassium Iodide	1	2	1	2007	1	1	1	11.54068	11.2		
Cameroon	100	Potassium Iodate	1	2	1	1995	1	1		5.26194	5.3	50	90
Canada	77	Potassium Iodide	1	2	1	2017	1	0		9.0241	9.4		
Cape Verde	30	Potassium Iodide	1	2	1	2004	1	1	1	7.60058	8.3		
Central African Republic	40	Potassium Iodate, Potassium Iodide, Calciu	1	2	1	1995	1	1		6.9905	7.1	35.71	64.29

		m Iodate											
Chad	65	Potassium Iodate	1	2	1	1994	1	1		7.29554	7.3	35.71	64.29
Chile	40	Potassium Iodate, Potassium Iodide, Sodium Iodide, Sodium Iodate	1	2	1	1996	1	1	1	7.09218	7.1		
China	26.5	Potassium Iodate, Potassium Iodide, Algae Iodate	1	2	1	2011	1	1	1	11.23564	12.3		
Colombia	75	Unspecified	1	2	1	1996	1	1	1	10.47304	10.4		
Congo	30	Potassium Iodate	1	2	1	2004	1	1	1	5.8466	5.7		
Costa Rica	45	Unspecified	1	2	1	2001	1	1	1	7.57516	8.1		

Cote d'Ivoire	65	Potassium Iodate	1	2	1	2001	1	1	1	7.06676	7.1		
Croatia	19	Unspecified	1	2	1	2011	1	1	1	8.2615	9.4		
Czech Republic	27	Potassium Iodate, Potassium Iodide, Sodium Iodate, Sodium Iodide	2	1	1	2016	0	0		9.50708	10.1		
Democratic Republic of the Congo	40	Potassium Iodate	1	2	1	2003	1	1	1	5.77034	6.2		
Denmark	20	Potassium Iodate, Potassium Iodide, Sodium	1	2	1	2019	1	1		8.97326	8.3		

		Iodate, Sodium Iodide											
Ecuador	30	Potassium Iodate	1	2	1	2010	1	1	1	7.32096	7.7		
Egypt	30	Potassium Iodide	1	2	1	2015	1	0		9.22746	9.4		
El Salvador	65	Potassium Iodate, Potassium Iodide	1	2	1	2005	1	1	1	8.10898	8.1		
Eswatini	50	Potassium Iodate	1	2	1	1997	1	1	1	6.68546	6.4		
Ethiopia	30	Potassium Iodate, Potassium Iodide, Sodium Iodate, Sodium Iodide	1	2	1	2017	1	1		5.8466	5.8		
Fiji	25	Potassium Iodate,	1	2	1	2008	1	1	1	7.32096	7.3		

		Potassium Iodide, Sodium Iodate, Sodium Iodide											
France	17.5	Potassium Iodide, Sodium Iodide, Sodium Iodate, Potassium Iodate	2	1	1	2007	0	0	2	9.4054	9.6		
Gabon	30	Potassium Iodate	1	2	1	2004	1	1	1	4.90606	5.1		
Gambia	40	Potassium Iodate, Potassium Iodide	1	2	1	2006	1	1	1	7.72768	7.8		
Georgia	40	Potassium Iodate, Potassi	1	2	1	2014	1	1		12.02366	13.5		

		um Iodide											
Germany	20	Potassium Iodate, Sodium Iodate	2	1	1	1993	0	0		8.7699	9.0		
Ghana	50	Potassium Iodate, Potassium Iodide, Calcium Iodate, Calcium Iodide, Sodium Iodate, Sodium Iodide	1	2	1	2006	1	1	1	6.20248	6.0		
Greece	50	Potassium Iodide, Potassium Iodate, Sodium	2	1	1	1987	0	0		9.0241	9.6		

		Iodide, Sodium Iodate											
Guatemala	40	Potassium Iodate, Potassium Iodide	1	2	1	2004	1	1	1	7.27012	7.5		
Guinea	45	Potassium Iodate	1	2	1	2013	1	1	1	6.88882	7.0		
Guinea-Bissau	90	Unspecified	1	2	1	2004	1	1	1	7.47348	7.7		
Honduras	83	Potassium Iodate, Calcium Iodate	1	2	1	1960	1	1		7.32096	7.5		
Hungary	19	Potassium Iodate, Potassium Iodide	1	2	1	2013	1	0	2	10.87976	10.8		
India	25	Potassium Iodate	1	2	1	2018	1	1		9.60876	9.5		

Indonesia	18	Potassium Iodate	1	2	1	2010	1	1	1	8.71906	8.5		
Italy	33	Potassium Iodate, Potassium Iodide	1	2	1	1995	1	1		10.95602	11.2	22.73	40.91
Jordan	30	Potassium Iodate, Potassium Iodide, Sodium Iodate, Sodium Iodide	1	2	1	2012	1	0	2	8.99868	10.5		
Kazakhstan	40	Potassium Iodate, Potassium Iodide	1	2	1	2003	1	1	1	12.50664	12.5		
Kenya	40	Potassium Iodate	1	2	1	2013	1	0	2	3.63506	3.8		
Kiribati	25	Potassium Iodate, Potassi	1	2	1	2016	1	1		5.54156	5.6		

		um Iodide, Sodium Iodate, Sodium Iodide											
Kosovo	35	Potassium iodate	1	2	1	2008	1	1	1				20
Kuwait	27.5	Potassium Iodide, Potassium Iodate, Sodium Iodide, Sodium Iodate	1	2	1	2012	1	1	1	9.30372	9.9		
Kyrgyzstan	40	Potassium Iodate, Potassium Iodide	1	2	1	2012	1	1	1	12.93878	13.7		
Lao People's Democrat	50	Potassium Iodate, Sodiu	1	2	1	2004	1	1	1	11.64236	11.3		

ic Republic		m Iodate											
Lebanon	41.5	Potassium Iodate	1	2	1	2016	1	0		6.6092	8.0		
Lesotho	50	Potassium Iodate	1	2	1	1999	1	1	1	6.76172	6.7		
Liberia	50	Potassium Iodate	1	2	1	2014	1	1		6.71088	6.8		
Lithuania	30	Unspecified	1	2	1	2015	0	1		9.1512	10.3		
Macedonia, former Yugoslav Republic	25	Potassium Iodate	1	2	1	1999	1	1	1	8.3886	9.9		
Madagascar	50	Potassium Iodate	1	2	1	2014	1	1		5.4653	5.6		
Malawi	54	Potassium Iodate	1	2	1	1998	1	1	1	4.14346	4.2		
Malaysia	25	Potassium Iodide, Sodiu	1	2	1	1985	1	1		8.69364	9.1		

		m Iodide											
Mali	50	Potassium Iodate	1	2	1	1999	1	1	1	8.15982	8.0		
Mauritania	65	Potassium Iodate, Potassium Iodide	1	2	1	2004	1	1	1	7.8802	7.5		
Mexico	30	Potassium Iodate, Potassium Iodide, Sodium Iodate, Sodium Iodide	1	2	1	2003	1	1	1	6.88882	7.0		
Moldova, Republic of	27.5	Potassium Iodate, Potassium Iodide, Sodium Iodide, Sodiu	1	2	1	2011	1	1	1	9.12578	10.0		

		m Iodate											
Mongolia	18	Potassium Iodate	1	2	1	2001	1	1	1	13.16756	13.1		
Morocco	30	Potassium Iodate	1	2	1	2009	1	1	1	10.06632	11.0		
Mozambique	40	Potassium Iodate	1	2	1	2016	1	1		5.41446	5.7		
Myanmar	50	Potassium Iodate	1	2	1	2011	0	0	2	11.59152	11.4		
Namibia	65	Potassium Iodate	1	2	1	1994	1	0		6.58378	6.7	35.71	64.29
Nepal	50	Unspecified	1	2	1	2001	1	1	1	9.83754	9.9		
Netherlands	65	Potassium Iodide, Sodium Iodide, Sodium Iodate, Potassium Iodate	2	1	1	2008	0	0	2	8.74448	8.4		
New Zealand	45	Potassium Iodide,	1	2	1	2015	0	1		8.31234	8.7		

		Potassium Iodate, Sodium Iodide, Sodium Iodate											
Nicaragua	46.5	Potassium Iodate, Potassium Iodide	1	2	1	2010	1	1	1	8.0073	8.2		
Niger	45	Potassium Iodate	1	2	1	2014	1	1		7.90562	7.4		
Nigeria	50	Potassium Iodate	1	2	1	2004	1	1	1	7.14302	7.2		
Norway	5	Unspecified	2	1	1	2016	0	0		9.32914	9.7		
Oman	27.5	Potassium Iodide, Potassium Iodate, Sodium Iodide, Sodiu	1	2	1	2012	1	1	1	8.56654	9.6		

		m Iodate											
Pakistan	30	Potassium Iodide, Sodium Iodide, Calcium Iodate	2	1	1	2008	0	0	2	10.24426	9.9		
Palestine Occupied Territory	45	Potassium Iodate, Sodium Iodate	1	2	1	2013	1	1	1	8.41402	9.8		
Panama	40	Potassium Iodate, Potassium Iodide	1	2	1	2001	1	1	1	8.5157	8.6		
Papua New Guinea	55	Potassium Iodate	1	2	1	2007	1	1	1	6.2279	6.2		
Paraguay	30	Potassium Iodate	1	2	1	2014	1	1		10.19342	11.0		
Peru	35	Potassium Iodate	1	2	1	2006	1	1	1	7.7531	7.8		

Philippines	50	Potassium Iodate	1	2	1	2013	1	1	1	10.72724	10.9		
Poland	23	Potassium Iodate, Potassium Iodide	1	2	1	2010	1	1	1	9.71044	9.8		
Qatar	27.5	Potassium Iodide, Potassium Iodate, Sodium Iodide, Sodium Iodate	1	2	1	2012	1	1	1	8.97326	10.7		
Romania	30	Potassium Iodate, Potassium Iodide	1	2	1	2009	1	1	1	9.58334	10.5		
Russian Federation	40	Potassium Iodate	2	1	1	2018	0	0		9.45624	10.6		

Rwanda	40	Potassium Iodate	1	2	1	2013	1	1	1	3.86384	4.1		
Sao Tome and Principe	60	Potassium Iodate	1	2	1	1996	1	1	1	6.02454	6.0		
Saudi Arabia	27.5	Potassium Iodide, Potassium Iodate, Sodium Iodide, Sodium Iodate	1	2	1	2012	1	1	1	7.57516	8.1		
Senegal	45	Potassium Iodate	1	2	1	2012	1	1	1	7.57516	8.0		
Serbia	15	Potassium Iodate, Potassium Iodide	1	2	1	2005	1	1	1	8.15982	9.3		
Sierra Leone	100	Potassium Iodide, Potassi	2	1	1	2010	0	0	2	6.40584	6.4		

		um Iodate, Sodium Iodide, Sodium Iodate											
Singapore	32.5	Potassium Iodate, Potassium Iodide, Sodium Iodide, Sodium Iodate	2	1	1	2006	0	0	2	12.78626	13.1		
Slovakia	19	Potassium Iodate, Potassium Iodide	1	2	1	2005	1	1	1	9.25288	10.8		
Slovenia	19	Potassium Iodate, Potassium Iodide	1	2	1	1998	1	0	2	9.83754	10.8		
Solomon	25	Potassium	1	2	1	2010	1	1	1	5.74492	5.9		

Islands		Iodide, Potassium Iodate, Sodium Iodide, Sodium Iodate											
South Africa	50	Potassium Iodate	1	2	1	2007	1	1	1	6.12622	6.3		
Spain	60	Potassium Iodate, Potassium Iodide	2	1	1	1983	0	0		9.45624	10.2		
Sri Lanka	22.5	Potassium Iodate, Potassium Iodide, Calcium Iodate	1	2	1	2005	1	1	1	9.96464	9.8		
Switzerland	25	Unspecified	2	1	1	2014	0	0		9.25288	9.2		
Tajikistan	40	Potassium	1	2	1	2001	1	1	1	12.78626	13.7		

		Iodate, Potassium Iodide											
Tanzania, United Republic of	40	Potassium Iodate	1	2	1	2013	1	1	1	7.14302	7.0		
Thailand	30	Unspecified	1	2	1	2011	1	1	1	13.29466	13.5		
Togo	45	Potassium Iodate	1	2	1	2017	1	1		7.14302	7.1		
Trinidad and Tobago	61.45	Potassium Iodide	2	1	1	2003	0	0	2	6.9905	7.4		
Turkey	19.5	Potassium Iodate	1	2	1	2013	1	0	2	9.55792	10.4		
Turkmenistan	40	Potassium Iodate, Potassium Iodide	1	2	1	2001	1	1	1	12.9642	13.8		
Uganda	40	Potassium Iodate	1	2	1	2013	1	1	1	4.9569	5.4		

Ukraine	40	Potassium Iodate, Potassium Iodide	2	1	1	2015	0	0		9.7867	10.7		
United Arab Emirates	27.5	Potassium Iodide, Potassium Iodate, Sodium Iodide, Sodium Iodate	1	2	1	2012	1	1	1	8.6428	9.3		
United States of America	76.5	Potassium Iodide	2	1	1	2016	0	0		8.74448	9.2		
Uruguay	30	Potassium Iodate	1	2	1	1990	1	1		7.04134	6.9		
Uzbekistan	40	Potassium Iodate, Potassium Iodide	1	2	1	2001	1	1	1	13.57428	14.3		

Venezuela, Bolivarian Republic of	55	Potassium Iodate, Potassium Iodide	1	2	1	2000	1	1	1	8.56654	9.0		
Viet Nam	30	Potassium Iodate	1	2	1	2011	1	1	1	11.38816	11.7		
Yemen	37.5	Potassium Iodate	1	2	1	2003	1	1	1	8.31234	8.6		
Zambia	38.45	Potassium Iodide	1	2	1	1994	1	1		5.77034	5.8	41.67	75
Zimbabwe	40	Potassium Iodate	1	2	1	2000	1	1	1	7.77852	7.9		

Appendix Table 13. Table containing the name of the countries included in the analysis, amount of iodine to be added to salt per the 1996 WHO recommendations depending on legislation scope, amount of iodine to be added to salt per the 2014 WHO recommendations, iodine compounds to be added to salt per the 1996 WHO recommendations, iodine compounds to be added to salt per the 2014 WHO recommendations, percentage met for the minimum and maximum amount of iodine to be added to salt per the 1994 WHO recommendations, and the analysis of countries' standards with the amount of iodine to be added to salt with the 1996 WHO recommendations.

country_name	Amount of iodine to be added per 1996 WHO recommendations;if a country's legislation scope applies to household salt and processed food salt	Minimum amount of iodine to be added per 1996 WHO recommendations;if the country's legislation scope applies to only household salt or only to processed food salt	Maximum amount of iodine to be added per 1996 WHO recommendations;if the country's legislation scope applies to only household salt or only to processed food salt	Amount of iodine to be added per 2014 WHO recommendations	WHO 2014 Recommendation - 10%	WHO 2014 Recommendation + 10%	Iodine compounds to be added per 1994 WHO recommendations	Iodine compound to be added per 1996 WHO recommendations	Iodine compounds to be added per 2014 WHO recommendations	Percentage of minimum 1994 WHO recommendations met	Percentage of maximum 1994 WHO recommendations met	Analysis of amount of iodine per 1996 WHO recommendations

Afghanistan				22	19.8	24.2			Potassium iodate, potassium iodide			
Albania	20	20	40	22	19.8	24.2		Potassium iodate	Potassium iodate, potassium iodide			greater than the recommendation
Algeria				18	16.2	19.8			Potassium iodate, potassium iodide			
Angola	20	20	40	33	29.7	36.3		Potassium iodate	Potassium iodate, potassium iodide			greater than the recommendation
Argentina				24	21.6	26.4			Potassium iodate, potassium iodide			
Armenia	20	20	40	15	13.5	16.5		Potassium iodate	Potassium iodate, potassiu			greater than the recomm

									m iodide			endation
Australia				22	19.8	24.2			Potassium iodate, potassium iodide			
Austria	20	20	40	20	18	22		Potassium iodate	Potassium iodate, potassium iodide			less than the recommendation
Azerbaijan	20	20	40	15	13.5	16.5		Potassium iodate	Potassium iodate, potassium iodide			greater than the recommendation
Bahrain	20	20	40	14	12.6	15.4		Potassium iodate	Potassium iodate, potassium iodide			greater than the recommendation
Bangladesh	20	20	40	22	19.8	24.2		Potassium iodate	Potassium iodate, potassium iodide			greater than the recommendation

Belarus	20	20	40	18	16.2	19.8		Potassium iodate	Potassium iodate, potassium iodide			greater than the recommendation
Belize	20	20	40	28	25.2	30.8		Potassium iodate	Potassium iodate, potassium iodide			greater than the recommendation
Benin	20	20	40	28	25.2	30.8		Potassium iodate	Potassium iodate, potassium iodide			greater than the recommendation
Bolivia, Plurinational State of	20	20	40	22	19.8	24.2		Potassium iodate	Potassium iodate, potassium iodide			greater than the recommendation
Bosnia and Herzegovina	20	20	40	22	19.8	24.2		Potassium iodate	Potassium iodate, potassium iodide			greater than the recommendation
Brazil	20	20	40	20	18	22		Potassium iodate	Potassium iodate, potassiu			greater than the recomm

									m iodide			endatio n
Brunei Darussal a	20	20	40	18	16.2	19.8		Potassiu m iodate	Potassiu m iodate, potassiu m iodide			
Bulgaria	20	20	40	22	19.8	24.2		Potassiu m iodate	Potassiu m iodate, potassiu m iodide			greater than the recomm endatio n
Burkina Faso	20	20	40	28	25.2	30.8		Potassiu m iodate	Potassiu m iodate, potassiu m iodide			greater than the recomm endatio n
Burundi	20	20	40	49	44.1	53.9		Potassiu m iodate	Potassiu m iodate, potassiu m iodide			greater than the recomm endatio n
Cambod ia	20	20	40	18	16.2	19.8		Potassiu m iodate	Potassiu m iodate, potassiu m iodide			greater than the recomm endatio n

Cameroon				39	35.1	42.9	Potassium iodate		Potassium iodate, potassium iodide	200%	111%	
Canada				22	19.8	24.2			Potassium iodate, potassium iodide			
Cape Verde	20	20	40	24	21.6	26.4		Potassium iodate	Potassium iodate, potassium iodide			greater than the recommendation
Central African Republic				28	25.2	30.8	Potassium iodate		Potassium iodate, potassium iodide	112%	62%	
Chad				28	25.2	30.8	Potassium iodate		Potassium iodate, potassium iodide	182%	101%	
Chile	20	20	40	28	25.2	30.8		Potassium iodate	Potassium iodate, potassiu			greater than the recomm

									m iodide			endation
China	20	20	40	16	14.4	17.6		Potassium iodate	Potassium iodate, potassium iodide			greater than the recommendation
Colombia	20	20	40	20	18	22		Potassium iodate	Potassium iodate, potassium iodide			greater than the recommendation
Congo	20	20	40	33	29.7	36.3		Potassium iodate	Potassium iodate, potassium iodide			greater than the recommendation
Costa Rica	20	20	40	24	21.6	26.4		Potassium iodate	Potassium iodate, potassium iodide			greater than the recommendation
Cote d'Ivoire	20	20	40	28	25.2	30.8		Potassium iodate	Potassium iodate, potassium iodide			greater than the recommendation

Croatia	20	20	40	22	19.8	24.2		Potassium iodate	Potassium iodate, potassium iodide			less than the recommendation
Czech Republic				20	18	22			Potassium iodate, potassium iodide			
Democratic Republic of the Congo	20	20	40	33	29.7	36.3		Potassium iodate	Potassium iodate, potassium iodide			greater than the recommendation
Denmark				24	21.6	26.4			Potassium iodate, potassium iodide			
Ecuador	20	20	40	24	21.6	26.4		Potassium iodate	Potassium iodate, potassium iodide			greater than the recommendation
Egypt				22	19.8	24.2			Potassium iodate, potassiu			

									m iodide			
El Salvador	20	20	40	24	21.6	26.4		Potassium iodate	Potassium iodate, potassium iodide			greater than the recommendation
Eswatini	20	20	40	33	29.7	36.3		Potassium iodate	Potassium iodate, potassium iodide			greater than the recommendation
Ethiopia				33	29.7	36.3			Potassium iodate, potassium iodide			
Fiji	20	20	40	28	25.2	30.8		Potassium iodate	Potassium iodate, potassium iodide			greater than the recommendation
France	20	20	40	20	18	22		Potassium iodate	Potassium iodate, potassium iodide			

Gabon	20	20	40	39	35.1	42.9		Potassium iodate	Potassium iodate, potassium iodide			greater than the recommendation
Gambia	20	20	40	24	21.6	26.4		Potassium iodate	Potassium iodate, potassium iodide			greater than the recommendation
Georgia				14	12.6	15.4			Potassium iodate, potassium iodide			
Germany				22	19.8	24.2			Potassium iodate, potassium iodide			
Ghana	20	20	40	33	29.7	36.3		Potassium iodate	Potassium iodate, potassium iodide			greater than the recommendation
Greece				20	18	22			Potassium iodate, potassiu			

									m iodide			
Guatemala	20	20	40	24	21.6	26.4		Potassium iodate	Potassium iodate, potassium iodide			greater than the recommendation
Guinea	20	20	40	28	25.2	30.8		Potassium iodate	Potassium iodate, potassium iodide			greater than the recommendation
Guinea-Bissau	20	20	40	24	21.6	26.4		Potassium iodate	Potassium iodate, potassium iodide			greater than the recommendation
Honduras				24	21.6	26.4			Potassium iodate, potassium iodide			
Hungary	20	20	40	18	16.2	19.8		Potassium iodate	Potassium iodate, potassium iodide			less than the range
India				20	18	22			Potassium			

									iodate, potassium iodide			
Indonesia	20	20	40	22	19.8	24.2		Potassium iodate	Potassium iodate, potassium iodide			less than the recommendation
Italy				18	16.2	19.8	Potassium iodate		Potassium iodate, potassium iodide	145%	81%	
Jordan	20	20	40	18	16.2	19.8		Potassium iodate	Potassium iodate, potassium iodide			within the range
Kazakhstan	20	20	40	15	13.5	16.5		Potassium iodate	Potassium iodate, potassium iodide			greater than the recommendation
Kenya	20	20	40	49	44.1	53.9		Potassium iodate	Potassium iodate, potassium iodide			within the range

Kiribati				33	29.7	36.3			Potassium iodate, potassium iodide			
Kosovo	20	40	matching error	#VALUE!	#VALUE!	Potassium iodate	Potassium iodate, potassium iodide					
Kuwait	20	20	40	20	18	22		Potassium iodate	Potassium iodate, potassium iodide			greater than the recommendation
Kyrgyzstan	20	20	40	14	12.6	15.4		Potassium iodate	Potassium iodate, potassium iodide			greater than the recommendation
Lao People's Democratic Republic	20	20	40	18	16.2	19.8		Potassium iodate	Potassium iodate, potassium iodide			greater than the recommendation
Lebanon				24	21.6	26.4			Potassium iodate, potassiu			

									m iodide			
Lesotho	20	20	40	28	25.2	30.8		Potassium iodate	Potassium iodate, potassium iodide			greater than the recommendation
Liberia				28	25.2	30.8			Potassium iodate, potassium iodide			
Lithuania				20	18	22			Potassium iodate, potassium iodide			
Macedonia, former Yugoslav Republic	20	20	40	20	18	22		Potassium iodate	Potassium iodate, potassium iodide			greater than the recommendation
Madagascar				33	29.7	36.3			Potassium iodate, potassium iodide			

Malawi	20	20	40	49	44.1	53.9		Potassium iodate	Potassium iodate, potassium iodide			greater than the recommendation
Malaysia				22	19.8	24.2			Potassium iodate, potassium iodide			
Mali	20	20	40	24	21.6	26.4		Potassium iodate	Potassium iodate, potassium iodide			greater than the recommendation
Mauritania	20	20	40	24	21.6	26.4		Potassium iodate	Potassium iodate, potassium iodide			greater than the recommendation
Mexico	20	20	40	28	25.2	30.8		Potassium iodate	Potassium iodate, potassium iodide			greater than the recommendation
Moldova, Republic of	20	20	40	20	18	22		Potassium iodate	Potassium iodate, potassiu			greater than the recomm

									m iodide			endation
Mongolia	20	20	40	15	13.5	16.5		Potassium iodate	Potassium iodate, potassium iodide			less than the recommendation
Morocco	20	20	40	18	16.2	19.8		Potassium iodate	Potassium iodate, potassium iodide			greater than the recommendation
Mozambique				33	29.7	36.3			Potassium iodate, potassium iodide			
Myanmar	20	20	40	18	16.2	19.8		Potassium iodate	Potassium iodate, potassium iodide			greater than the range
Namibia				28	25.2	30.8	Potassium iodate		Potassium iodate, potassium iodide	182%	101%	

Nepal	20	20	40	20	18	22		Potassium iodate	Potassium iodate, potassium iodide			greater than the recommendation
Netherlands	20	20	40	24	21.6	26.4		Potassium iodate	Potassium iodate, potassium iodide			
New Zealand				22	19.8	24.2			Potassium iodate, potassium iodide			
Nicaragua	20	20	40	24	21.6	26.4		Potassium iodate	Potassium iodate, potassium iodide			greater than the recommendation
Niger				28	25.2	30.8			Potassium iodate, potassium iodide			
Nigeria	20	20	40	28	25.2	30.8		Potassium iodate	Potassium iodate, potassiu			greater than the recomm

									m iodide			endatio n
Norway				20	18	22			Potassiu m iodate, potassiu m iodide			
Oman	20	20	40	20	18	22		Potassiu m iodate	Potassiu m iodate, potassiu m iodide			greater than the recomm endatio n
Pakistan	20	20	40	20	18	22		Potassiu m iodate	Potassiu m iodate, potassiu m iodide			
Palestin e Occupie d Territor y	20	20	40	20	18	22		Potassiu m iodate	Potassiu m iodate, potassiu m iodide			greater than the recomm endatio n
Panama	20	20	40	22	19.8	24.2		Potassiu m iodate	Potassiu m iodate, potassiu m iodide			greater than the recomm endatio n

Papua New Guinea	20	20	40	33	29.7	36.3		Potassium iodate	Potassium iodate, potassium iodide			greater than the recommendation
Paraguay				18	16.2	19.8			Potassium iodate, potassium iodide			
Peru	20	20	40	24	21.6	26.4		Potassium iodate	Potassium iodate, potassium iodide			greater than the recommendation
Philippines	20	20	40	18	16.2	19.8		Potassium iodate	Potassium iodate, potassium iodide			greater than the recommendation
Poland	20	20	40	20	18	22		Potassium iodate	Potassium iodate, potassium iodide			greater than the recommendation
Qatar	20	20	40	18	16.2	19.8		Potassium iodate	Potassium iodate, potassiu			greater than the recomm

									m iodide			endatio n
Romani a	20	20	40	18	16.2	19.8		Potassiu m iodate	Potassiu m iodate, potassiu m iodide			greater than the recomm endatio n
Russian Federati on				18	16.2	19.8			Potassiu m iodate, potassiu m iodide			
Rwanda	20	20	40	49	44.1	53.9		Potassiu m iodate	Potassiu m iodate, potassiu m iodide			greater than the recomm endatio n
Sao Tome and Principe	20	20	40	33	29.7	36.3		Potassiu m iodate	Potassiu m iodate, potassiu m iodide			greater than the recomm endatio n
Saudi Arabia	20	20	40	24	21.6	26.4		Potassiu m iodate	Potassiu m iodate, potassiu m iodide			greater than the recomm endatio n

Senegal	20	20	40	24	21.6	26.4		Potassium iodate	Potassium iodate, potassium iodide			greater than the recommendation
Serbia	20	20	40	22	19.8	24.2		Potassium iodate	Potassium iodate, potassium iodide			less than the recommendation
Sierra Leone	20	20	40	33	29.7	36.3		Potassium iodate	Potassium iodate, potassium iodide			
Singapore	20	20	40	15	13.5	16.5		Potassium iodate	Potassium iodate, potassium iodide			
Slovakia	20	20	40	18	16.2	19.8		Potassium iodate	Potassium iodate, potassium iodide			less than the recommendation
Slovenia	20	20	40	18	16.2	19.8		Potassium iodate	Potassium iodate, potassiu			less than the range

									m iodide			
Solomon Islands	20	20	40	33	29.7	36.3		Potassium iodate	Potassium iodate, potassium iodide			greater than the recommendation
South Africa	20	20	40	33	29.7	36.3		Potassium iodate	Potassium iodate, potassium iodide			greater than the recommendation
Spain	20	20	40	20	18	22			Potassium iodate, potassium iodide			
Sri Lanka	20	20	40	20	18	22		Potassium iodate	Potassium iodate, potassium iodide			greater than the recommendation
Switzerland				22	19.8	24.2			Potassium iodate, potassium iodide			

Tajikistan	20	20	40	14	12.6	15.4		Potassium iodate	Potassium iodate, potassium iodide			greater than the recommendation
Tanzania, United Republic of	20	20	40	28	25.2	30.8		Potassium iodate	Potassium iodate, potassium iodide			greater than the recommendation
Thailand	20	20	40	14	12.6	15.4		Potassium iodate	Potassium iodate, potassium iodide			greater than the recommendation
Togo				28	25.2	30.8			Potassium iodate, potassium iodide			
Trinidad and Tobago	20	20	40	28	25.2	30.8		Potassium iodate	Potassium iodate, potassium iodide			
Turkey	20	20	40	20	18	22		Potassium iodate	Potassium iodate, potassiu			less than the range

									m iodide			
Turkmenistan	20	20	40	14	12.6	15.4		Potassium iodate	Potassium iodate, potassium iodide			greater than the recommendation
Uganda	20	20	40	39	35.1	42.9		Potassium iodate	Potassium iodate, potassium iodide			greater than the recommendation
Ukraine				18	16.2	19.8			Potassium iodate, potassium iodide			
United Arab Emirates	20	20	40	22	19.8	24.2		Potassium iodate	Potassium iodate, potassium iodide			greater than the recommendation
United States of America				22	19.8	24.2			Potassium iodate, potassium iodide			
Uruguay				28	25.2	30.8			Potassium			

									iodate, potassium iodide			
Uzbekistan	20	20	40	14	12.6	15.4		Potassium iodate	Potassium iodate, potassium iodide			greater than the recommendation
Venezuela, Bolivarian Republic of	20	20	40	22	19.8	24.2		Potassium iodate	Potassium iodate, potassium iodide			greater than the recommendation
Viet Nam	20	20	40	16	14.4	17.6		Potassium iodate	Potassium iodate, potassium iodide			greater than the recommendation
Yemen	20	20	40	22	19.8	24.2		Potassium iodate	Potassium iodate, potassium iodide			greater than the recommendation
Zambia				33	29.7	36.3	Potassium iodate		Potassium iodate, potassium iodide	92%	51%	

Zimbabwe	20	20	40	24	21.6	26.4		Potassium iodate	Potassium iodate, potassium iodide			greater than the recommendation

Appendix Table 14. Table containing the name of the countries included in the analysis, analysis of countries' standards with iodine compounds to be added to salt with the 1994 WHO recommendations, percentage met for the minimum and maximum amount of iodine to be added to salt per the 1996 WHO recommendations according to legislation scope, analysis of countries' standards with iodine compounds to be added to salt with the 1996 WHO recommendations, percentage met for the minimum and maximum amount per the 2014 WHO recommendations, and the analysis of countries' standards with the amount of iodine to be added to salt with the 2014 WHO recommendations.

country_name	Analysis of iodine compounds to be added per 1994 WHO recommendations	Percentage of minimum 1996 WHO recommendations met if scope is hh or processed	Percentage of maximum 1996 WHO recommendations met if scope is hh or processed	Percentage of 1996 WHO recommendations met for countries with a legislation scope applies to household salt and processed salt	Analysis of iodine compounds to be added per 1996 WHO recommendations	Percentage of minimum 2014 WHO recommendations met	Percentage of maximum 2014 WHO recommendations met	Analysis of amount of iodine per 2014 WHO recommendations
Afghanistan						202%	165%	greater than the range
Albania				250%	There are both WHO recommended and not recommended compounds in the country's standard	253%	207%	greater than the range
Algeria						247%	202%	greater than the range

Angola				200%	The compound in the country's standard is the WHO recommended compound	135%	110%	greater than the range
Argentina						139%	114%	greater than the range
Armenia				200%	The compounds are missing from the country's standard	296%	242%	greater than the range
Australia						227%	186%	greater than the range
Austria				88%	There are both WHO recommended and not recommended compounds in the country's standard	97%	80%	less than the range
Azerbaijan				200%	There are both WHO recommended and not recommended compounds	296%	242%	greater than the range

					in the country's standard			
Bahrain				138%	There are both WHO recommended and not recommended compounds in the country's standard	218%	179%	greater than the range
Bangladesh				175%	There are both WHO recommended and not recommended compounds in the country's standard	177%	145%	greater than the range
Belarus				200%	There are both WHO recommended and not recommended compounds in the country's standard	247%	202%	greater than the range

Belize				200%	The compounds are missing from the country's standard	159%	130%	greater than the range
Benin				225%	The compound in the country's standard is the WHO recommended compound	179%	146%	greater than the range
Bolivia, Plurinational State of				300%	The compound in the country's standard is the WHO recommended compound	303%	248%	greater than the range
Bosnia and Herzegovina				125%	The compound in the country's standard is the WHO recommended compound	126%	103%	greater than the range
Brazil				150%	The compound in the country's standard is the WHO recommended compound	167%	136%	greater than the range

Brunei Darussala					There are both WHO recommended and not recommended compounds in the country's standard	201%	164%	greater than the range
Bulgaria				125%	The compound in the country's standard is the WHO recommended compound	126%	103%	greater than the range
Burkina Faso				325%	The compounds are missing from the country's standard	258%	211%	greater than the range
Burundi				200%	The compound in the country's standard is the WHO recommended compound	91%	74%	less than the range
Cambodia				200%	There are both WHO recommended and not	247%	202%	greater than the range

					recommended compounds in the country's standard			
Cameroon	All of the compounds in the country's standard are WHO-recommended compounds					285%	233%	greater than the range
Canada						389%	318%	greater than the range
Cape Verde				150%	All of the compounds in the country's standard are not WHO recommended compounds	139%	114%	greater than the range
Central African Republic	There are both WHO recommended and not recommended compounds in the					159%	130%	greater than the range

	country's standard							
Chad	All of the compounds in the country's standard are WHO-recommended compounds					258%	211%	greater than the range
Chile				200%	There are both WHO recommended and not recommended compounds in the country's standard	159%	130%	greater than the range
China				133%	There are both WHO recommended and not recommended compounds in the country's standard	184%	151%	greater than the range
Colombia				375%	The compounds are missing	417%	341%	greater than the range

					from the country's standard			
Congo				150%	The compound in the country's standard is the WHO recommended compound	101%	83%	within the range
Costa Rica				225%	The compounds are missing from the country's standard	208%	170%	greater than the range
Cote d'Ivoire				325%	The compound in the country's standard is the WHO recommended compound	258%	211%	greater than the range
Croatia				95%	The compounds are missing from the country's standard	96%	79%	less than the range
Czech Republic						150%	123%	greater than the range
Democratic Republic				200%	The compound in the country's	135%	110%	greater than the range

of the Congo					standard is the WHO recommended compound			
Denmark						93%	76%	less than the range
Ecuador				150%	The compound in the country's standard is the WHO recommended compound	139%	114%	greater than the range
Egypt						152%	124%	greater than the range
El Salvador				325%	There are both WHO recommended and not recommended compounds in the country's standard	301%	246%	greater than the range
Eswatini				250%	The compound in the country's standard is the WHO recommended compound	168%	138%	greater than the range
Ethiopia						101%	83%	within the range

Fiji				125%	There are both WHO recommended and not recommended compounds in the country's standard	99%	81%	less than the range
France					There are both WHO recommended and not recommended compounds in the country's standard	97%	80%	less than the range
Gabon				150%	The compound in the country's standard is the WHO recommended compound	85%	70%	less than the range
Gambia				200%	There are both WHO recommended and not recommended compounds	185%	152%	greater than the range

					in the country's standard			
Georgia						317%	260%	greater than the range
Germany						101%	83%	within the range
Ghana				250%	There are both WHO recommended and not recommended compounds in the country's standard	168%	138%	greater than the range
Greece						278%	227%	greater than the range
Guatemala				200%	There are both WHO recommended and not recommended compounds in the country's standard	185%	152%	greater than the range
Guinea				225%	The compound in the country's standard is the WHO	179%	146%	greater than the range

					recommended compound			
Guinea-Bissau				450%	The compounds are missing from the country's standard	417%	341%	greater than the range
Honduras						384%	314%	greater than the range
Hungary		95%	48%		There are both WHO recommended and not recommended compounds in the country's standard	117%	96%	within the range
India						139%	114%	greater than the range
Indonesia				90%	The compound in the country's standard is the WHO recommended compound	91%	74%	less than the range
Italy	There are both WHO recommended and not recommende					204%	167%	greater than the range

	d compounds in the country's standard							
Jordan		150%	75%		There are both WHO recommended and not recommended compounds in the country's standard	185%	152%	greater than the range
Kazakhstan				200%	There are both WHO recommended and not recommended compounds in the country's standard	296%	242%	greater than the range
Kenya		200%	100%		The compound in the country's standard is the WHO recommended compound	91%	74%	less than the range
Kiribati						84%	69%	less than the range

Kosovo		175%	The compound in the country's standard is the WHO recommended compound	#VALUE!	#VALUE!	202%	165%	
Kuwait				138%	There are both WHO recommended and not recommended compounds in the country's standard	153%	125%	greater than the range
Kyrgyzstan				200%	There are both WHO recommended and not recommended compounds in the country's standard	317%	260%	greater than the range
Lao People's Democratic Republic				250%	There are both WHO recommended and not recommended compounds	309%	253%	greater than the range

					in the country's standard			
Lebanon						192%	157%	greater than the range
Lesotho				250%	The compound in the country's standard is the WHO recommended compound	198%	162%	greater than the range
Liberia						198%	162%	greater than the range
Lithuania						167%	136%	greater than the range
Macedonia, former Yugoslav Republic				125%	The compound in the country's standard is the WHO recommended compound	139%	114%	greater than the range
Madagascar						168%	138%	greater than the range
Malawi				270%	The compound in the country's standard is the WHO recommended compound	122%	100%	greater than the range
Malaysia						126%	103%	greater than the range

Mali				250%	The compound in the country's standard is the WHO recommended compound	231%	189%	greater than the range
Mauritania				325%	There are both WHO recommended and not recommended compounds in the country's standard	301%	246%	greater than the range
Mexico				150%	There are both WHO recommended and not recommended compounds in the country's standard	119%	97%	within the range
Moldova, Republic of				138%	There are both WHO recommended and not recommended compounds	153%	125%	greater than the range

					in the country's standard			
Mongolia				90%	The compound in the country's standard is the WHO recommended compound	133%	109%	greater than the range
Morocco				150%	The compound in the country's standard is the WHO recommended compound	185%	152%	greater than the range
Mozambique						135%	110%	greater than the range
Myanmar		250%	125%		The compound in the country's standard is the WHO recommended compound	309%	253%	greater than the range
Namibia	All of the compounds in the country's standard are WHO-recommende					258%	211%	greater than the range

	d compounds							
Nepal				250%	The compounds are missing from the country's standard	278%	227%	greater than the range
Netherlands					There are both WHO recommended and not recommended compounds in the country's standard	301%	246%	greater than the range
New Zealand						227%	186%	greater than the range
Nicaragua				233%	There are both WHO recommended and not recommended compounds in the country's standard	215%	176%	greater than the range
Niger						179%	146%	greater than the range
Nigeria				250%	The compound in	198%	162%	greater than the range

					the country's standard is the WHO recommended compound			
Norway						28%	23%	less than the range
Oman				138%	There are both WHO recommended and not recommended compounds in the country's standard	153%	125%	greater than the range
Pakistan					All of the compounds in the country's standard are not WHO recommended compounds	167%	136%	greater than the range
Palestine Occupied Territory				225%	There are both WHO recommended and not recommended compounds in the	250%	205%	greater than the range

					country's standard			
Panama				200%	There are both WHO recommended and not recommended compounds in the country's standard	202%	165%	greater than the range
Papua New Guinea				275%	The compound in the country's standard is the WHO recommended compound	185%	152%	greater than the range
Paraguay						185%	152%	greater than the range
Peru				175%	The compound in the country's standard is the WHO recommended compound	162%	133%	greater than the range
Philippines				250%	The compound in the country's standard is the WHO	309%	253%	greater than the range

					recommended compound			
Poland				115%	There are both WHO recommended and not recommended compounds in the country's standard	128%	105%	greater than the range
Qatar				138%	There are both WHO recommended and not recommended compounds in the country's standard	170%	139%	greater than the range
Romania				150%	There are both WHO recommended and not recommended compounds in the country's standard	185%	152%	greater than the range

Russian Federation						247%	202%	greater than the range
Rwanda				200%	The compound in the country's standard is the WHO recommended compound	91%	74%	less than the range
Sao Tome and Principe				300%	The compound in the country's standard is the WHO recommended compound	202%	165%	greater than the range
Saudi Arabia				138%	There are both WHO recommended and not recommended compounds in the country's standard	127%	104%	greater than the range
Senegal				225%	The compound in the country's standard is the WHO recommended compound	208%	170%	greater than the range

Serbia				75%	There are both WHO recommended and not recommended compounds in the country's standard	76%	62%	less than the range
Sierra Leone					There are both WHO recommended and not recommended compounds in the country's standard	337%	275%	greater than the range
Singapore					There are both WHO recommended and not recommended compounds in the country's standard	241%	197%	greater than the range
Slovakia				95%	There are both WHO recommended and not	117%	96%	within the range

					recommended compounds in the country's standard			
Slovenia		95%	48%		There are both WHO recommended and not recommended compounds in the country's standard	117%	96%	within the range
Solomon Islands				125%	There are both WHO recommended and not recommended compounds in the country's standard	84%	69%	less than the range
South Africa				250%	The compound in the country's standard is the WHO recommended compound	168%	138%	greater than the range

Spain						333%	273%	greater than the range
Sri Lanka				113%	There are both WHO recommended and not recommended compounds in the country's standard	125%	102%	greater than the range
Switzerland						126%	103%	greater than the range
Tajikistan				200%	There are both WHO recommended and not recommended compounds in the country's standard	317%	260%	greater than the range
Tanzania, United Republic of				200%	The compound in the country's standard is the WHO recommended compound	159%	130%	greater than the range
Thailand				150%	The compounds are missing	238%	195%	greater than the range

					from the country's standard			
Togo						179%	146%	greater than the range
Trinidad and Tobago					All of the compounds in the country's standard are not WHO recommended compounds	244%	200%	greater than the range
Turkey		98%	49%		The compound in the country's standard is the WHO recommended compound	108%	89%	within the range
Turkmenistan				200%	There are both WHO recommended and not recommended compounds in the country's standard	317%	260%	greater than the range
Uganda				200%	The compound in the country's	114%	93%	within the range

					standard is the WHO recommended compound			
Ukraine						247%	202%	greater than the range
United Arab Emirates				138%	There are both WHO recommended and not recommended compounds in the country's standard	139%	114%	greater than the range
United States of America						386%	316%	greater than the range
Uruguay						119%	97%	within the range
Uzbekistan				200%	There are both WHO recommended and not recommended compounds in the country's standard	317%	260%	greater than the range
Venezuela, Bolivarian				275%	There are both WHO recommende	278%	227%	greater than the range

Republic of					d and not recommended compounds in the country's standard			
Viet Nam				150%	The compound in the country's standard is the WHO recommended compound	208%	170%	greater than the range
Yemen				188%	The compound in the country's standard is the WHO recommended compound	189%	155%	greater than the range
Zambia	All of the compounds in the country's standard are not WHO-recommended compounds					129%	106%	greater than the range
Zimbabwe				200%	The compound in the country's standard is	185%	152%	greater than the range

					the WHO recommended compound			

Appendix Table 15. Table containing the name of the countries included in the analysis, analysis of iodine compounds to be added to salt with the 2014 WHO recommendations, the World Bank Income calendar year used, the World Bank Income status applicable to the year of the country's standard, whether the 2014 WHO recommendations are available in the country's official language, the presence of an external monitoring protocol, and the presence of an internal monitoring protocol.

country_name	Analysis of iodine compounds to be added per 2014 WHO recommendations	World bank income calendar year used	World bank income status applicable to the year of the country's standard	The 2014 WHO recommendations are available in the country's official language	External monitoring protocol present	Internal monitoring protocol present
Afghanistan	All of the compounds in the country's standard are WHO recommended compounds	2014	Low income	No	Unknown	Unknown
Albania	All of the compounds in the country's standard are WHO recommended compounds	2008	Lower middle income	No	Unknown	Unknown
Algeria	All of the compounds in the country's standard are WHO recommended compounds	1990	Lower middle income	No	Unknown	Unknown
Angola	All of the compounds in the country's standard are WHO recommended compounds	2006	Lower middle income	No	Not applicable	Not applicable
Argentina	All of the compounds in the country's standard are WHO recommended compounds	1987	Upper middle income	No	Unknown	Unknown
Armenia	The compounds are missing from the country's standard	2001	Low income	No	Unknown	Unknown

Australia	There are both WHO recommended and not recommended compounds in the country's standard	2016	High income	No official language	Unknown	Unknown
Austria	All of the compounds in the country's standard are WHO recommended compounds	1999	High income	No	Unknown	Unknown
Azerbaijan	All of the compounds in the country's standard are WHO recommended compounds	2001	Low income	No	Unknown	Unknown
Bahrain	There are both WHO recommended and not recommended compounds in the country's standard	2012	High income	No	Not applicable	Not applicable
Bangladesh	There are both WHO recommended and not recommended compounds in the country's standard	2007	Low income	No	Unknown	Unknown
Belarus	All of the compounds in the country's standard are WHO recommended compounds	2008	Upper middle income	No	Unknown	Unknown
Belize	The compounds are missing from the country's standard	2007	Upper middle income	Yes	Not applicable	Not applicable
Benin	All of the compounds in the country's standard are WHO recommended compounds	2013	Low income	No	Unknown	Unknown

Bolivia, Plurinational State of	All of the compounds in the country's standard are WHO recommended compounds	2013	Lower middle income	No	Yes	Yes
Bosnia and Herzegovina	All of the compounds in the country's standard are WHO recommended compounds	2004	Lower middle income	No	Not applicable	Not applicable
Brazil	All of the compounds in the country's standard are WHO recommended compounds	2013	Upper middle income	No	Unknown	Unknown
Brunei Darussala	There are both WHO recommended and not recommended compounds in the country's standard	2001	High income	No	Unknown	Unknown
Bulgaria	All of the compounds in the country's standard are WHO recommended compounds	2001	Lower middle income	No	Unknown	Unknown
Burkina Faso	The compounds are missing from the country's standard	2003	Low income	No	Unknown	Unknown
Burundi	All of the compounds in the country's standard are WHO recommended compounds	2013	Low income	Yes	Not applicable	Not applicable
Cambodia	There are both WHO recommended and not recommended compounds in the country's standard	2007	Low income	No	Yes	Yes

Cameroon	All of the compounds in the country's standard are WHO recommended compounds	1995	Low income	Yes	Not applicable	Not applicable
Canada	All of the compounds in the country's standard are WHO recommended compounds	2017	High income	Yes	Unknown	Unknown
Cape Verde	All of the compounds in the country's standard are WHO recommended compounds	2004	Lower middle income	No	Yes	Yes
Central African Republic	There are both WHO recommended and not recommended compounds in the country's standard	1995	Low income	No	Unknown	Unknown
Chad	All of the compounds in the country's standard are WHO recommended compounds	1994	Low income	No	Not applicable	Not applicable
Chile	There are both WHO recommended and not recommended compounds in the country's standard	1996	Upper middle income	No	Unknown	Unknown
China	There are both WHO recommended and not recommended compounds in the country's standard	2011	Upper middle income	No	Unknown	Unknown
Colombia	The compounds are missing from the country's standard	1996	Lower middle income	No	Unknown	Unknown

Congo	All of the compounds in the country's standard are WHO recommended compounds	2004	Low income	No	Not applicable	Not applicable
Costa Rica	The compounds are missing from the country's standard	2001	Upper middle income	No	Unknown	Unknown
Cote d'Ivoire	All of the compounds in the country's standard are WHO recommended compounds	2001	Low income	No	Unknown	Unknown
Croatia	The compounds are missing from the country's standard	2011	High income	No	Unknown	Unknown
Czech Republic	There are both WHO recommended and not recommended compounds in the country's standard	2016	High income	No	Unknown	Unknown
Democratic Republic of the Congo	All of the compounds in the country's standard are WHO recommended compounds	2003	Low income	No	Not applicable	Not applicable
Denmark	There are both WHO recommended and not recommended compounds in the country's standard	2019	High income	No	Not applicable	Not applicable
Ecuador	All of the compounds in the country's standard are WHO recommended compounds	2010	Upper middle income	No	Unknown	Unknown
Egypt	All of the compounds in the country's standard	2015	Lower middle income	No	Unknown	Unknown

	are WHO recommended compounds					
El Salvador	All of the compounds in the country's standard are WHO recommended compounds	2005	Lower middle income	No	Unknown	Unknown
Eswatini	All of the compounds in the country's standard are WHO recommended compounds	1997	Lower middle income	Yes	Not applicable	Not applicable
Ethiopia	There are both WHO recommended and not recommended compounds in the country's standard	2017	Low income	No	Unknown	Unknown
Fiji	There are both WHO recommended and not recommended compounds in the country's standard	2008	Upper middle income	Yes	Yes	Yes
France	There are both WHO recommended and not recommended compounds in the country's standard	2007	High income	No	Unknown	Unknown
Gabon	All of the compounds in the country's standard are WHO recommended compounds	2004	Upper middle income	No	Unknown	Unknown
Gambia	All of the compounds in the country's standard are WHO recommended compounds	2006	Low income	Yes	Not applicable	Not applicable

Georgia	All of the compounds in the country's standard are WHO recommended compounds	2014	Lower middle income	No	Not applicable	Not applicable
Germany	There are both WHO recommended and not recommended compounds in the country's standard	1993	High income	No	Unknown	Unknown
Ghana	There are both WHO recommended and not recommended compounds in the country's standard	2006	Low income	No	Unknown	Unknown
Greece	There are both WHO recommended and not recommended compounds in the country's standard	1987	Upper middle income	No	Unknown	Unknown
Guatemala	All of the compounds in the country's standard are WHO recommended compounds	2004	Lower middle income	No	Unknown	Unknown
Guinea	All of the compounds in the country's standard are WHO recommended compounds	2013	Low income	No	Unknown	Unknown
Guinea-Bissau	The compounds are missing from the country's standard	2004	Low income	No	Yes	Yes
Honduras	There are both WHO recommended and not recommended	1987	Lower middle income	No	Unknown	Unknown

	compounds in the country's standard					
Hungary	All of the compounds in the country's standard are WHO recommended compounds	2013	Upper middle income	No	Not applicable	Not applicable
India	All of the compounds in the country's standard are WHO recommended compounds	2018	Lower middle income	No	Unknown	Unknown
Indonesia	All of the compounds in the country's standard are WHO recommended compounds	2010	Lower middle income	No	Unknown	Unknown
Italy	All of the compounds in the country's standard are WHO recommended compounds	1995	High income	No	Unknown	Unknown
Jordan	There are both WHO recommended and not recommended compounds in the country's standard	2012	Upper middle income	No	Yes	Yes
Kazakhstan	All of the compounds in the country's standard are WHO recommended compounds	2003	Lower middle income	No	Yes	Yes
Kenya	All of the compounds in the country's standard are WHO recommended compounds	2013	Low income	Yes	Unknown	Unknown
Kiribati	There are both WHO recommended and not recommended	2016	Lower middle income	Yes	Not applicable	Not applicable

	compounds in the country's standard					
Kosovo	All of the compounds in the country's standard are WHO recommended compounds	2008	Lower middle income	No	Unknown	Unknown
Kuwait	There are both WHO recommended and not recommended compounds in the country's standard	2012	High income	No	Unknown	Unknown
Kyrgyzstan	All of the compounds in the country's standard are WHO recommended compounds	2012	Low income	No	Unknown	Unknown
Lao People's Democratic Republic	There are both WHO recommended and not recommended compounds in the country's standard	2004	Low income	No	Unknown	Unknown
Lebanon	All of the compounds in the country's standard are WHO recommended compounds	2016	Upper middle income	No	Unknown	Unknown
Lesotho	All of the compounds in the country's standard are WHO recommended compounds	1999	Low income	Yes	Unknown	Unknown
Liberia	All of the compounds in the country's standard are WHO recommended compounds	2014	Low income	Yes	Not applicable	Not applicable

Lithuania	The compounds are missing from the country's standard	2015	High income	No	Not applicable	Not applicable
Macedonia, former Yugoslav Republic	All of the compounds in the country's standard are WHO recommended compounds	1991		No	Not applicable	Not applicable
Madagascar	All of the compounds in the country's standard are WHO recommended compounds	2014	Low income	No	Unknown	Unknown
Malawi	All of the compounds in the country's standard are WHO recommended compounds	1998	Low income	Yes	Not applicable	Not applicable
Malaysia	There are both WHO recommended and not recommended compounds in the country's standard	1987	Lower middle income	No	Unknown	Unknown
Mali	All of the compounds in the country's standard are WHO recommended compounds	1999	Low income	No	Unknown	Unknown
Mauritania	All of the compounds in the country's standard are WHO recommended compounds	2004	Low income	No	Unknown	Unknown
Mexico	There are both WHO recommended and not recommended compounds in the country's standard	2003	Upper middle income	No	Unknown	Unknown

Moldova, Republic of	There are both WHO recommended and not recommended compounds in the country's standard	2011	Lower middle income	No	Not applicable	Not applicable
Mongolia	All of the compounds in the country's standard are WHO recommended compounds	2001	Low income	No	Unknown	Unknown
Morocco	All of the compounds in the country's standard are WHO recommended compounds	2009	Lower middle income	No	Unknown	Unknown
Mozambique	All of the compounds in the country's standard are WHO recommended compounds	2016	Low income	No	Unknown	Unknown
Myanmar	All of the compounds in the country's standard are WHO recommended compounds	2011	Low income	Unknown	Unknown	Unknown
Namibia	All of the compounds in the country's standard are WHO recommended compounds	1994	Lower middle income	Yes	Unknown	Unknown
Nepal	The compounds are missing from the country's standard	2001	Low income	No	Yes	Yes
Netherlands	There are both WHO recommended and not recommended compounds in the country's standard	2008	High income	No	Unknown	Unknown

New Zealand	There are both WHO recommended and not recommended compounds in the country's standard	2015	High income	Yes	Unknown	Unknown
Nicaragua	All of the compounds in the country's standard are WHO recommended compounds	2010	Lower middle income	No	Unknown	Unknown
Niger	All of the compounds in the country's standard are WHO recommended compounds	2014	Low income	No	Unknown	Unknown
Nigeria	All of the compounds in the country's standard are WHO recommended compounds	2004	Low income	Yes	Yes	Yes
Norway	The compounds are missing from the country's standard	2016	High income	No	Yes	Yes
Oman	There are both WHO recommended and not recommended compounds in the country's standard	2012	High income	No	Unknown	Unknown
Pakistan (would change if column t changes from 2 to 1)	There are both WHO recommended and not recommended compounds in the country's standard	2008	Lower middle income	Yes	Not applicable	Not applicable
Palestine Occupied Territory	There are both WHO recommended and not recommended			Unknown	Not applicable	Not applicable

	compounds in the country's standard					
Panama	All of the compounds in the country's standard are WHO recommended compounds	2001	Upper middle income	No	Unknown	Unknown
Papua New Guinea	All of the compounds in the country's standard are WHO recommended compounds	2007	Low income	Yes	Yes	Yes
Paraguay	All of the compounds in the country's standard are WHO recommended compounds	2014	Upper middle income	No	Yes	Yes
Peru	All of the compounds in the country's standard are WHO recommended compounds	2006	Lower middle income	No	Unknown	Unknown
Philippines	All of the compounds in the country's standard are WHO recommended compounds	2013	Lower middle income	Yes	Yes	Yes
Poland	All of the compounds in the country's standard are WHO recommended compounds	2010	High income	No	Unknown	Unknown
Qatar	There are both WHO recommended and not recommended compounds in the country's standard	2012	High income	No	Not applicable	Not applicable
Romania	All of the compounds in the country's standard	2009	Upper middle income	No	Unknown	Unknown

	are WHO recommended compounds					
Russian Federation	All of the compounds in the country's standard are WHO recommended compounds	2018	Upper middle income	No	Unknown	Unknown
Rwanda	All of the compounds in the country's standard are WHO recommended compounds	2013	Low income	Yes	Unknown	Unknown
Sao Tome and Principe	All of the compounds in the country's standard are WHO recommended compounds	1996	Low income	No	Unknown	Unknown
Saudi Arabia	There are both WHO recommended and not recommended compounds in the country's standard	2012	High income	No	Unknown	Unknown
Senegal	All of the compounds in the country's standard are WHO recommended compounds	2012	Lower middle income	No	Unknown	Unknown
Serbia	All of the compounds in the country's standard are WHO recommended compounds	2006	Upper middle income	Yes	Unknown	Not applicable
Sierra Leone	There are both WHO recommended and not recommended compounds in the country's standard	2010	Low income	Yes	Not applicable	Unknown
Singapore	There are both WHO recommended and not	2006	High income	No	Unknown	Not applicable

	recommended compounds in the country's standard					
Slovakia	All of the compounds in the country's standard are WHO recommended compounds	2005	Upper middle income	No	Not applicable	Unknown
Slovenia	All of the compounds in the country's standard are WHO recommended compounds	1998	High income	Yes	Unknown	Not applicable
Solomon Islands	There are both WHO recommended and not recommended compounds in the country's standard	2010	Lower middle income	Yes	Not applicable	Unknown
South Africa	All of the compounds in the country's standard are WHO recommended compounds	2007	Upper middle income	No	Unknown	Unknown
Spain	All of the compounds in the country's standard are WHO recommended compounds	1987	High income	No	Unknown	Unknown
Sri Lanka	There are both WHO recommended and not recommended compounds in the country's standard	2005	Lower middle income	No	Unknown	Unknown
Switzerland	The compounds are missing from the country's standard	2014	High income	No	Unknown	Unknown
Tajikistan	All of the compounds in the country's standard	2001	Low income	Yes	Unknown	Unknown

	are WHO recommended compounds					
Tanzania, United Republic of	All of the compounds in the country's standard are WHO recommended compounds	2013	Low income	No	Unknown	Unknown
Thailand	The compounds are missing from the country's standard	2011	Upper middle income	No	Unknown	Unknown
Togo	All of the compounds in the country's standard are WHO recommended compounds	2017	Low income	Yes	Unknown	Unknown
Trinidad and Tobago	All of the compounds in the country's standard are WHO recommended compounds	2003	Upper middle income	No	Unknown	Unknown
Turkey	All of the compounds in the country's standard are WHO recommended compounds	2013	Upper middle income	No	Unknown	Unknown
Turkmenistan	All of the compounds in the country's standard are WHO recommended compounds	2001	Lower middle income	Yes	Unknown	Yes
Uganda	All of the compounds in the country's standard are WHO recommended compounds	2013	Low income	No	Yes	Unknown
Ukraine	All of the compounds in the country's standard are WHO recommended compounds	2015	Lower middle income	No	Unknown	Not applicable

United Arab Emirates	There are both WHO recommended and not recommended compounds in the country's standard	2012	High income	No official language	Not applicable	Unknown
United States of America	All of the compounds in the country's standard are WHO recommended compounds	2016	High income	No	Unknown	Unknown
Uruguay	All of the compounds in the country's standard are WHO recommended compounds	1990	Upper middle income	No	Unknown	Unknown
Uzbekistan	All of the compounds in the country's standard are WHO recommended compounds	2001	Low income	No	Unknown	Yes
Venezuela, Bolivarian Republic of	All of the compounds in the country's standard are WHO recommended compounds	2000	Upper middle income	No	Yes	Unknown
Viet Nam	All of the compounds in the country's standard are WHO recommended compounds	2011	Lower middle income	No	Unknown	Unknown
Yemen	All of the compounds in the country's standard are WHO recommended compounds	2003	Low income	Yes	Unknown	Not applicable
Zambia	All of the compounds in the country's standard are WHO recommended compounds	1994	Low income	Yes	Not applicable	Unknown

Zimbabwe	All of the compounds in the country's standard are WHO recommended compounds	2000	Low income	No	Unknown	Unknown