Iodine deficiency can be effectively and inexpensively prevented by iodizing all salt for human and animal consumption, known as Universal Salt Iodization (USI). Since the early 1990s, a global effort has resulted in a large increase in the percentage of the world’s population consuming adequately iodized salt (considered to be salt with ≥15 mg of iodine per kg), from <20% in 1990 (1) to 75% in 2014 (2).

National point estimates of household salt coverage were helpful to track progress after the initial implementation of salt iodization in the early 1990s. However, they may not provide sufficient resolution to assess the quality of salt iodization in the country or tell us why iodization has reached a plateau at levels well below 70% in some countries and subnational areas. Within-country disparities in household coverage of adequately iodized salt, particularly based on socioeconomic status (SES) and residence type (urban vs. rural), have been highlighted before (3,4).

This review summarizes recent household iodized salt coverage data from 8 countries that were part of the GAIN-UNICEF USI Partnership Project during 2013-2015 (Bangladesh, Ethiopia, Ghana, India, Indonesia, Niger, the Philippines, and Senegal), together with data from 2 national Fortification Assessment Coverage Toolkit surveys (5) in Tanzania and Uganda in 2015. Included in the study were cross-sectional multistage cluster household surveys using a stratified design and a probability proportional to size methodology, and measuring iodine content in salt with quantitative methods.

Progress towards USI: programmatic challenges
Although all 10 countries mandate salt iodization to some extent, and 8 countries include iodization of salt used by the processed food industry in their legislation, this is not always recognized, enforced, or monitored in the same way as household salt. In 2 countries, ≥80% of nationally available salt is sourced from large- or medium-scale domestic producers (India) or salt iodization processors (the Philippines). In Uganda and Niger, almost all salt is imported. However, in Uganda, the import supply chain is highly consolidated (from Kenya), whereas salt sourced by Niger is from a much more fragmented supply chain (from Ghana, Senegal, Algeria, and other countries).

Salt industry consolidation and technical capacity
Access to adequately iodized salt varies considerably between countries: from 6.2% in Niger to 97.0% in Uganda. Considerable national progress has been achieved in Uganda and India, but also in Ethiopia, where household coverage with any iodized salt was previously less than 16% (6). But only Uganda has achieved USI (≥90% household coverage with adequately iodized salt), both nationally and sub-nationally, in urban and rural areas. In 5 of the 10 countries, more than 50% of the population remains at risk of iodine deficiency because of limited access to adequately iodized salt (<50% national household coverage in Ethiopia, Ghana, Niger, the Philippines, and Senegal) (Figure 1).
In general, national and subnational areas found to have higher coverage were associated with a higher level of industrial consolidation and mechanization of the salt supply (i.e., India, Uganda, and urban areas of Bangladesh and Tanzania). In line with this, national survey reports for Bangladesh, Senegal, and Ghana indicate that subnational strata representing areas of extensive small-scale salt production had particularly low coverage of adequately iodized salt (<26% of households). This is suggested to be the result of lower technical capacity of small-scale producers to iodize salt, and the increased challenges to establish effective quality assurance and regulatory monitoring of iodization in areas of widespread artisanal salt production.

**Type of residence and socioeconomic status**

The findings of lower access to adequately iodized salt in rural and lower-SES populations is in agreement with previous reports (3, 4). Coverage with adequately iodized salt was found to be significantly higher in urban than in rural households in most countries: Bangladesh (68.9% vs. 44.3%), India (86.4% vs. 69.8%), Indonesia (59.3% vs. 51.4%), the Philippines (31.5% vs. 20.2%), Senegal (53.3% vs. 19.0%), Tanzania (89.2% vs. 57.6%). A difference was also seen in Ethiopia (30.6% vs. 23.8%). Conversely, in Niger, coverage in urban households was slightly lower than in rural households (4.5% vs. 8.0%).

The methodology to assess poverty and SES varied between countries. In Bangladesh, Ghana, India, Senegal, Tanzania, and Uganda, modules were included to calculate the Multidimensional Poverty Index (MPI) score (7). Wealth indexes based on the type of composite indicators used in Demographic and Health Surveys were modified to define SES indicators in Indonesia and the Philippines. Composite indicators of wealth were not available in Ethiopia and Niger. The national percentage of households categorized as vulnerable to poverty (by MPI) varied from 24.5% in India to 57.1% in Senegal (Figure 2). In Indonesia and the Philippines, respectively 14.5% and 22.3% of households were categorized as being in the lowest wealth quintile, and 20.3% and 16.9% were categorized as being in the highest wealth quintile. In 7 of 8 countries with data (i.e., all except Uganda), household coverage of adequately iodized salt was significantly higher in high-SES than in low-SES households in Bangladesh (58.8% vs. 39.7%), Ghana (36.2% vs. 21.5%), India (80.6% vs. 70.5%), Indonesia (59.9% vs. 45.6%), the Philippines (39.4% vs. 17.3%), Senegal (50.7% vs. 27.6%) and Tanzania (80.9% vs. 51.3%). The largest difference was in the Philippines and Senegal, where the wealthiest households were around twice as likely to have access to adequately iodized salt as the poorest households.
**Understanding the inequities in access to iodized salt**

Access to adequately iodized salt at the household level is generally dependent on 2 factors: product availability and affordability. Differences in access reported here by residence type and SES could be the result of one or both of these factors. Further analysis of retail availability and pricing of quality-assured iodized salt, and of consumer purchasing practices (e.g., packaged instead of loose salt or vice versa, etc.) would be required to understand which factors play a role. It is important to note that the aim of USI is to ensure quality-assured iodization of all salt for human and animal consumption, regardless of grain type and packaging. When USI is fully implemented, as demonstrated in Uganda, access to adequately iodized salt would become equitable, regardless of consumer preferences and affordability.

These findings also confirm that the previously identified challenges related to strengthening regulatory monitoring and enforcement of legislation have not been fully ameliorated. This strategy remains as a recommended focus to accelerate progress toward achieving and sustaining optimal iodine status through USI, both nationally and sub-nationally. These challenges remain particularly important in small-scale salt-producing regions.

**Implications for national strategies**

This review provides important insights to guide future national strategies to achieve USI. For example, in Ghana and the Philippines, the relative difference in household access was much more pronounced by SES than by residence type, suggesting that adequately iodized salt, inadequately iodized salt, and that with no added iodine may all have been readily available in both urban and rural areas. It could be hypothesized that lower-SES households generally have greater access to lower-priced, lower-quality iodized salt. In some cases, this may potentially be salt sourced at the point of production, before any iodization step has taken place, as indicated in the survey reports for Bangladesh, Ghana, and Senegal. In Bangladesh, Senegal, and Tanzania, the level of notable disparity in coverage by residence type that is similar to that by SES could suggest that availability of adequately iodized salt (typically packaged and more expensive in these countries) is linked to urban residence.

**Not just household salt**

In an environment of increasing consumption of processed foods, condiments, and foods prepared outside the home, there are many other dietary sources of (potentially iodized) salt, particularly in urban areas, where diets tend to be more diversified. As a result, there are increasing international calls for a re-evaluation of the use of household coverage with adequately iodized salt as the sole indicator to measure national progress toward optimal iodine status through USI. Other major sources of dietary salt should be considered when making any assumptions about the adequacy of population iodine intake from USI. For example, in the Ghana and Senegal surveys, the outcome from additional food consumption modules suggests that, if all bouillon was produced with adequately iodized salt, it would contribute significantly to iodine intake across population groups in both countries, including in areas with poor access to adequately iodized household salt.

**References**