

Iodization success in Sierra Leone makes women iodine sufficient

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Sierra Leone's modern history has been overshadowed by a brutal civil war which ended in 2002. Although the country has experienced substantial economic growth in recent years, the ruinous effects of the unrest continue to be felt. According to a World Bank report, stunting and malnutrition are rife, and UNICEF estimates that 45% of households do not consume iodized salt, leaving children unprotected from iodine deficiency disorders. More recently, the 2014 Ebola outbreak overburdened the weak healthcare infrastructure, leading to a humanitarian crisis situation and a negative spiral of weaker economic growth. Salt iodization has been a recent public health success which stands out clearly against this backdrop.

Previous iodine status estimates are out of date

In the vast majority of West African countries, including Sierra Leone, data on iodine status are mostly from the early 2000's. Sierra Leone's most recent nationally-representative data were collected in 2003 (1). In that survey, the median urinary iodine concentration (UIC) in school-children was 158 µg/L, which is considered adequate. However, important differences across the districts were reported, with the districts in the Northern region having lower median UICs. In addition, the net primary school enrolment ratio in the period 2008–2012 was about 75%, and it was likely even lower in 2003. Consequently, the UIC estimate from the 2003 survey may have been an overestimate because children not attending school were excluded.

Dramatic improvement in iodized salt coverage

In 1994, the Government mandated that all salt imported to Sierra Leone be iodized at 35 mg/kg (7). Since then, assessments have reflected a steady increase in the proportion of iodized salt, from 23% in 2000 to 80% in 2013 (2,3). However, these assess-

ments provide only qualitative information which cannot estimate whether iodization levels are adequate. The 2013 Sierra Leone Micronutrient Survey (SLMS) quantitatively measured salt iodine content and household coverage of adequately iodized salt. The survey also measured the iodine status of Sierra Leonean pregnant women, non-pregnant non-lactating women, and non-pregnant lactating women.



Iodized salt in Sierra Leone improves the iodine status of all women irrespective of their socio-economic status

The SLMS was a cross-sectional household survey with PPS cluster sampling. From the randomly selected households, all pregnant women were enrolled, and a proportion of non-pregnant women. To produce maps of iodine deficiency, median iodine concentrations for non-pregnant non-lactating and lactating women were calculated at the cluster level. The proportion of women with UIC less than and equal to or greater to 100 µg/L in each cluster was calculated to illustrate areas of iodine deficiency, sufficiency, and excess.

Results

The median household size was 5.5 members, 60.4% of households were located in rural areas, 72.7% were male-headed, 99.8% used “natural” cooking fuel (e.g., charcoal or wood), 62.2% had “unimproved” sanitation facilities, and 76.5% drank safe water. The mean age of non-pregnant women was 27.7 years and of pregnant women was 23.4 years. No formal school attendance was reported by 55.5% of non-pregnant and 52.8% of pregnant women. In addition, 68.6% of non-pregnant and 79.8% of pregnant women were illiterate as measured by a simple reading test administered during the interview.

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The vast majority (87.0%) of salt collected was not in the original package. Despite this fact, the proportion of salt samples which were adequately iodized was quite high: 80.7% (95% CI: 73.1, 86.5). But the country has not yet achieved universal salt iodization (at least 90% coverage of adequately iodized salt). As shown on the interpolated map of iodized salt coverage, relatively small areas with substantially lower coverage bring the overall coverage down (*Figure 1*).

Most of the areas with low-coverage are coastal zones, where the population harvests the salt without subsequent salt iodization. Salt continues to be harvested on a small scale in Sierra Leone, and the majority of table salt is imported. While the main salt producers in West Africa are Senegal and Ghana, it appears from trade figures that 75% of the salt imported to Sierra Leone originates from India. But this estimate is based on trade figures rather than a comprehensive market assessment, so variations may be expected. That said, the quality of imported iodized salt appears to have improved over the past decade. The Sierra Leone Standards Bureau enacted legislation in 2011 defining standards for imported iodized salt and establishing a monitoring system.

FIGURE 1 Geographic distribution of coverage of adequately iodized salt (≥ 15 mg/kg), Sierra Leone, 2013.

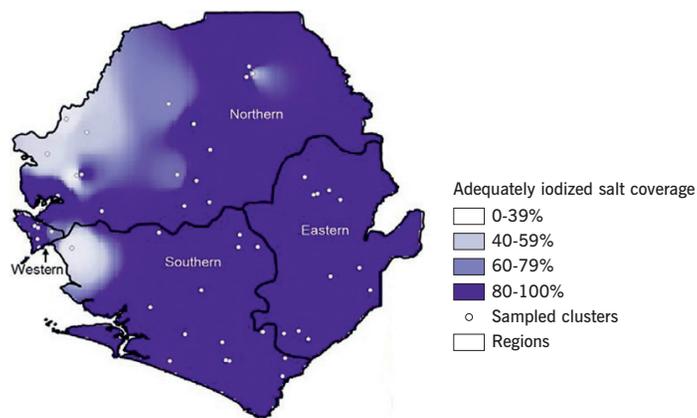
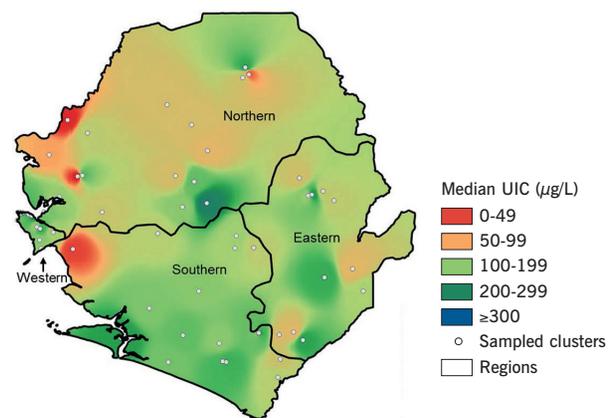


FIGURE 2 Geographic distribution of median urinary iodine concentrations among non-pregnant women aged 15–49 years, Sierra Leone, 2013.



In general, urban and wealthier households had a higher coverage of adequately iodized salt than rural and poorer households. Only 27.3% of all responding women reported ever having heard about iodized salt, and among these women 31.4% were able to name the benefits of iodized salt (prevention of goiter or iodine deficiency, improvement of health or intelligence).

Pregnant women

The median UIC among pregnant women in Sierra Leone is 175.8 $\mu\text{g/L}$, which is considered adequate. Because the SLMS was a household-based survey, the sample of pregnant women is small, and the analysis of sub-groups may have limited use. Nonetheless, for several sub-groups, such as women age 25–34 years of age, rural women, women in the Northern region, women who have never attended school, women in the lowest and highest wealth quintiles, and women living in households without adequately iodized salt, the median UIC are below the threshold for adequate iodine status. Pregnant women living in households with adequately iodized salt had significantly higher UICs than women in households with inadequately iodized salt. Although not statistically significant, the median UIC progressively increases with educational level. By contrast, there is no such progressive change in median UIC with wealth index or age.

Non-pregnant women

At the national level, the median UICs indicate adequate iodine status for both non-lactating non-pregnant women (medi-

an UIC=203.3 $\mu\text{g/L}$) and lactating non-pregnant women (median UIC=175.6 $\mu\text{g/L}$). In contrast to pregnant women, the median UICs in nearly all subgroups were substantially above the threshold of 100 $\mu\text{g/L}$ which defines iodine sufficiency in these groups. Only lactating women residing in households where salt was inadequately iodized had a UIC below 100 $\mu\text{g/L}$. And like pregnant women, non-pregnant women living in households with adequately iodized salt had substantially higher UICs than women in households without adequately iodized salt. In contrast to pregnant women, and probably due to the larger sample size, UIC was also associated with age, urban residence, region of residence, educational level, and household wealth. In non-lactating women, there was a progressive increase in UIC with educational level and household wealth, but not with age.

Figure 2 shows the geographic distribution of median UICs. A comparison with Figure 1 shows considerable overlap between the levels of coverage with adequately iodized salt and median UIC, demonstrating a positive association between consumption of iodized salt and iodine sufficiency. With the exception of the Western region (with the capital city), poorer coverage with iodized salt and lower median UICs are concentrated in western parts of Sierra Leone.

Iodized salt is an equitable solution to iodine deficiency

An important finding in this study was that differences in iodine status between subgroups were much smaller in house-

holds with adequately iodized salt, which implies that provision of iodized salt acts as an equalizer. For example, in households with inadequately iodized salt, the UIC for women in rural households was below the 100 $\mu\text{g/L}$ cut-off for adequacy, and the UIC in urban women demonstrated iodine sufficiency. When adequately iodized salt was used, both urban and rural women demonstrated iodine sufficiency, and the UIC difference between urban and rural women was substantially lower. This shows that, even with the persistence of other dietary and non-dietary risk factors for iodine deficiency, these risks are largely mitigated by provision of iodized salt, which leads to much greater equity in iodine status throughout the population of non-pregnant Sierra Leonean women. And crucially, it highlights the importance of extending the coverage of adequately iodized salt to the remaining 20% of households, especially to the most disadvantaged households in which UIC is the lowest.

References

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