THE SITUATION OF URINARY IODINE CONCENTRATION (UIC) AMONG SCHOOL AGE CHILDREN, WOMEN AT REPRODUCTIVE AGE AND PREGNANT WOMEN IN INDONESIA: THE ANALYSIS OF RISKESDAS 2013

Status Iodium Anak Sekolah, Wanita Usia Reproduktif dan Wanita Hamil di Indonesia: Analisis Data Riskesdas 2013

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ABSTRACT

Iodine Deficiency Disorders (IDD) are the leading cause of goiter, cretinism, developmental delays and other health problems. Iodine deficiency is an important public health issue as it is a preventable cause of intellectual disability. While elimination of iodine deficiency is imperative, it should be noted that excessive intake of iodine can also lead to adverse health effects. This paper analyzed the iodine status using median urinary iodine concentration (MUIC) of school age children (SAC), women of reproductive age (WRA), and pregnant women (PW) who live in the same household from Riskesdas 2013. The total number of households included in the analysis was 13,811 households, from which 6,149 SAC (aged 6 – 12 years), 13,218 WRA (aged 15-49 years), and 578 PW (aged 15-49 years) were enumerated. The national MUIC of SAC, WRA and PW was in the normal range indicated that the iodine status was adequate using WHO epidemiological criteria. Iodine status in some sub-populations indicated deficiency, however, in terms of geographic characteristics people who live in the urban has better iodine status compared to rural areas. Similarly, populations in richer economic quintiles had better iodine status. Only pregnant women in the 1st and 2nd quintile were deficient. Almost all regions in Indonesia showed the MUIC was in the normal adequate range, except NTT, NTB, Maluku-Papua, and East Java for pregnant women who tend to have lower MUIC (<150 µg/L). The status of iodized salt at the household was detected using both Rapid Test Kit/RTK as well as Titration. The result demonstrated a strong association between salt iodine level and iodine status. The MUIC for all three groups were lower when the iodine content in salt was lower, then increased when the levels of iodine content in salt increased. The iodine status of pregnant women consuming non-iodized salt was inadequate. The detrimental effect of iodine deficiency on the mental and physical development of children as well as on the women of reproductive age has been recognized. Indonesia still needs the salt iodization program to keep the iodine status in the normal range. In particular coverage with adequately iodized salt needs to be improved in order to improve the iodine status of pregnant women. For the prevention of Iodine disorders (insufficient), monitoring should be undertaken in regular basis to assess the MUIC, especially for pregnant women.

Keywords: MUIC, School age children, women reproductive age, pregnant women

ABSTRAK

One of the major nutrition problems in Indonesia is Iodine Deficiency Disorders (IDD). The human body requires only small amounts of iodine to be consumed, but it has important roles and functions. Iodine deficiency is a condition when there is insufficient iodine in the diet, and lead to goiter or cretinism in its most severe forms, but also results in developmental delays and other health problems. Iodine deficiency is an important public health issue as it is a preventable cause of intellectual disability.

High intakes of iodine can cause some of the same symptoms as iodine deficiency - including goiter, elevated TSH level, and hyperthyroidism, because excess iodine inhibits thyroid hormone synthesis and thereby increases TSH stimulation, which can cause goiter. Iodine-induced hyperthyroidism can also result from high iodine intakes, usually when iodine is introduced in areas that had long been endemic for iodine deficiency.

Indonesia has made an effort to reduce iodine deficiency, particularly through the use of iodized salt in the daily diet. The effort to track this program and coverage of households with iodized salt in Indonesia has been implemented since 1998, included on an annual basis as part of the National Socio-Economic Survey (Susenas) through 2003, and subsequently in 2007 and 2013 through National Basic Health Research (Riskesdas). Both data collection were using the same Rapid test kit (RTK). There was 65.2 per cent households consumed iodized salt in 1998 and reached 73.2 per cent in 2003, but it was down to 62.3 per cent in 2007 and increased again to 77.1 per cent in 2013.

National surveys on the iodine status have been carried out in 2003, and as part of Riskesdas in 2007 and 2013, which suggest that the iodine status of the population was optimal at national level. Data from Riskesdas 2007 on school age children showed optimal iodine status with Median Urinary Concentration (MUIC) of 224 μg/L.

The data from the Riskesdas 2013 were further analyzed in order to better understand the iodine status of Indonesian population. This paper presents data on the iodine status of three distinct age groups; school age children, women of reproductive age and pregnant women, and matched these individuals within households where possible.

Methods

The primary data source for the analysis was Riskesdas 2013, which was designed as a cross sectional survey. The population was all households in the entire country of Indonesia having equal probability of being included. The sample of households and household members in this survey was designed to provide

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* Both Susenas and Riskesdas are the national surveys, which sampling frame has designed by Central bureau of statistic/CBS using selected census block.
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Data Analysis

To answer the research questions, the data of urinary iodine concentration (UIC) were analysed using the median value and observation based on the category of each population groups for UIC data:

- **SAC and WRA:**
  a. UIC less than 100 µg/L as insufficient iodine intake;
  b. UIC between 100 – 299 µg/L as adequate, and
  c. UIC equal and greater than 300 µg/L as excessive;

- **Pregnant women:**
  a. UIC less than 150 µg/L as insufficient iodine intake,
  b. UIC between 150-499 µg/L as adequate (that is combination of 150-249 µg/L as adequate and 250-499 µg/L as more than adequate, while
  c. UIC equal and greater than 500 µg/L as excessive iodine intake.

Category for place or residence was urban and rural, and category for socio-economic status:

- **Q1**-lowest economic status (poorest)
- **Q2**-low economic status
- **Q3**-middle economic status,
- **Q4**-middle high economic status,
- **Q5**-highest economic status (richest)

Category for regions consist of 9 grouped into Sumatera, Kalimantan, Sulawesi, West Java – Banten, Central Java, East Java, Jakarta-Bali, DIY, NTB-NTT, Maluku-Papua. And also the observation of MUIC has categorized the regions into two: Salt Production Provinces (West Java, Central Java, East Java, South Sulawesi, NTB, and NTT), and other provinces as Non Salt Production.

<table>
<thead>
<tr>
<th>Total Samples</th>
<th>Median UIC</th>
<th>RTK's test</th>
<th>Titration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pregnant women</td>
<td>578</td>
<td>575</td>
<td>484</td>
</tr>
<tr>
<td>Women Reproductive Age</td>
<td>13218</td>
<td>13146</td>
<td>11164</td>
</tr>
<tr>
<td>School children</td>
<td>6149</td>
<td>6116</td>
<td>5142</td>
</tr>
<tr>
<td>Total</td>
<td>19945</td>
<td>19837</td>
<td>16790</td>
</tr>
</tbody>
</table>
The analysis also observed the situation of MUIC in terms of testing iodine level for each group (SAC, WRA, and PW) and iodized salt at household level using Rapid Test Kit (RTK) as well as Titration. The category for RTK’s test (semi quantitative) was divided into three colorbased iodine test: Adequate, Inadequate, No-Iodine. For the purpose of the analysis, the RTK was classified into two: Iodized and Non-iodized. For titration was divided into four: Non-iodized (0-4.9 ppm); inadequate iodized (5.0-17.9 ppm), adequate iodized (18.0 – 49.9 ppm), and over-iodized (≥50 ppm). In all analyses the data were weighted by sample proportion of the population, and the analysis used SPSS-IBM Version 21 with bootstrapping for the value of UIC for each observation to see the median (lower, upper), and interquartile range (IQR).

The number of minimum samples observed for all categories mentioned above should be at least 125. The term of UIC used in this analysis was based on urine sample that was collected at only one spot of time that was in the morning (between 8 – 11 am). This analysis was part of Riskesdas data collection 2013, which has informed consent obtained from all households and the member of households before enrollment.

RESULTS

The following analysis has observed the MUIC based on 2 comparisons: (i) Geographic characteristics: Urban-rural, socio-economic status, regions, and salt production areas; (ii) Household Iodized Salt levels: RTK and Titration.

Geographic characteristics

It was presented at Figure 1 that the National level of iodine status of SAC, WRA, and Pregnant women was just sufficient: 215, 189, and 169 µg/L respectively. The median of UIC for all groups of population were varied by place of residence and socio-economic status. People who live in rural were likely to have lower median of UIC than urban population. People who were classified as lower quintile also tend to have lower median value of UIC compared to higher quintiles. Comparing with WHO criteria\(^\text{a}\) for SAC, WRA, and pregnant women, only pregnant women who were classified as 1st and 2nd quintile are insufficient.

Table 1 presented the analyses using bootstrapping to observe the Mean UIC as well as Interquartile range (IQR) for each group based on characteristics. The Median UIC of SAC and WRA indicated that iodine status was adequate nationally, in both urban and rural areas, on all regions and for all economic quintiles. However, iodine status was lower in rural areas, amongst poorer quintiles and in the regions of NTB-NTT, Maluku + Papua, Sulawesi, and Sumatera.

It was a little bit problem for presenting the pregnant women data due to a small sample size (<125),\(^\text{b}\) the MUIC showed lower than 150 µg/L for socio-economic levels (Q1, Q2), and in the regions of East Java, NTB-NTT, and Maluku-Papua. The value of IQR in almost all categories was outside of the range of 150 – 249 µg/L, except for the region of East Java, and by place of residence (urban, rural), and as expected urban was better than rural. The wide interquartile range (IQR) value was shown only in the NTB – NTT that was 64.0 to 488 µg/L.

Level of Household Iodized Salt: RTK and Titration

Table 2 presented the analyses using bootstrapping to observe the Median UIC as well as Interquartile range (IQR) for each group based on household iodized salt level for both semi quantitative and titration methods.

Comparison of MUIC value for the three group of population (SAC, WRA, and PW) – which figuring the household iodized salt level based on RTK – showed that there was no significant different between iodized and non-iodized, except for pregnant women.

However, result of Titration for MUIC of the three group of population (SAC, WRA, and PW) has provided more clear patterns. The MUIC for all groups tend to be lower for the non-iodized salt (<5ppm) and then increase as the level of iodized salt increase. All MUIC values were within the normal range for SAC, WRA, and PW, except for pregnant women from the group non-iodized salt (MUIC: 114.0; 86.1 – 139.5 µg/L).

There was interesting finding on the result of titration. It was shown that iodine status of SAC and WRA was adequate in the population consuming non-iodized salt. This implies iodine

\(^\text{a}\) WHO criteria for defining iodine sufficiency: median UIC: 150-249 µg/L for pregnant women, 100-199 µg/L for SAC and WRA.

\(^\text{b}\) It was a potential problem for presenting the pregnant women data due to a small sample size (<125).
intake from sources other than household salt. Highest iodine status was in those consuming over-iodized salt, however it was found that a very small proportion of households had over-iodized salt. On the other hand iodine status was lower in households with inadequately iodized salt and almost half has inadequately iodized salt.

Table 3 presented the comparison of the iodine status of SAC, WRA, and PW by all level of socio-economic status (Q1 to Q5). The median value of UIC was consistent for three groups of population. It was shown that people who were classified as lower iodine status in the household using non-iodized salt and gradually increased in the household using inadequate, adequate, and over-iodized salt.

DISCUSSION

Iodine is one of the essential micronutrient required for normal human growth and development. The iodine deficiency as a result mainly from geographical rather than social and economic conditions. The long-term national efforts to control and eradicate IDD with iodized salt in Indonesia indicating the sufficient level of iodine status of the people that represented by SAC, WRA and PW. Only in the some areas, especially for the poorest and the poor (Q1, Q2), in the region of NTB-NTT as well as Maluku-Papua for pregnant women required more attention to prevent fetal development.

Based on the result of titration, the presence of iodine in salt in the household was related to a higher MUIIC among School Age Children, Women at Reproductive Age, and Pregnant Women compared to the households without access to iodized salt. However, the use of RTK to determine the presence of iodine in salt in the households need to be evaluated for the future purpose of monitoring.

The study also noted the wide range of interquartile value, such as in the group of pregnant women in the region of NTB-NTT (64.0 – 488.0). This need to be evaluated in terms of deficient or excessive of iodine status, which cannot be eliminated by changing dietary habits. Based on the assessment above, double burden for iodine issues in Indonesia still cannot be determined. Besides iodine deficiency, a variety of other environmental and geographic characteristics, economic status factors operate to iodine problems, which is related to thyroid dysfunctions.

Iodine deficiency remains the single cause of preventable brain damage and mental retardation. The insufficient iodine among pregnant women can cause the fetus cannot produce enough thyroxin and fetal growth is retarded. For Indonesia the case of insufficient iodine is only found among pregnant women of the lowest first and second quintiles. Meanwhile, the excessive iodine is not likely to occur for both school aged children and also women of reproductive age.
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<table>
<thead>
<tr>
<th>Geographical characteristics</th>
<th>School Age Children</th>
<th>Women at Reproductive Age</th>
<th>Pregnant Woman</th>
</tr>
</thead>
<tbody>
<tr>
<td>National</td>
<td>Median (Lower; Upper)</td>
<td>Interquartile range</td>
<td>Interquartile range</td>
</tr>
<tr>
<td>1780 - 1980</td>
<td>180.0 (174.0; 194.0)</td>
<td>176.0 - 194.0</td>
<td>132.0 - 194.0</td>
</tr>
<tr>
<td>1950 - 2150</td>
<td>192.0 (186.0; 198.0)</td>
<td>186.0 - 198.0</td>
<td>156.0 - 198.0</td>
</tr>
<tr>
<td>2120 - 2320</td>
<td>208.0 (202.0; 214.0)</td>
<td>202.0 - 214.0</td>
<td>166.0 - 214.0</td>
</tr>
<tr>
<td>2290 - 2490</td>
<td>224.0 (218.0; 230.0)</td>
<td>218.0 - 230.0</td>
<td>172.0 - 230.0</td>
</tr>
<tr>
<td>2460 - 2660</td>
<td>242.0 (236.0; 248.0)</td>
<td>236.0 - 248.0</td>
<td>180.0 - 248.0</td>
</tr>
</tbody>
</table>

Table 1

Comparison of MC (µg/L) by Geographical Characteristics among School Age Childen, Women at Reproductive Age, and Pregnant Women, 2013

- N Median (Lower; Upper) Interquartile range
- N Median (Lower; Upper) Interquartile range
- N Median (Lower; Upper) Interquartile range
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### Table 2: Comparison of MUIC (µg/L) among School Age Children, Women at Reproductive Age, and Pregnant Women by Household's Iodized Salt Test, 2013

<table>
<thead>
<tr>
<th>Segment</th>
<th>School Age Children</th>
<th>Women at Reproductive Age</th>
<th>Pregnant Women</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Median (Lower; Upper)</td>
<td>Interquartile Range</td>
<td></td>
</tr>
<tr>
<td>Test for HH's Iodized salt</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Semi-quantitative</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Iodized</td>
<td>237.5 (221.0; 250.0)</td>
<td>101 (86.0; 116.0)</td>
<td></td>
</tr>
<tr>
<td>Non-Iodized</td>
<td>186.0 (173.0; 192.0)</td>
<td>170 (157.0; 174.0)</td>
<td></td>
</tr>
<tr>
<td>Titration</td>
<td>162.0 (144.0; 178.0)</td>
<td>132 (115.0; 149.0)</td>
<td></td>
</tr>
<tr>
<td>Inadequate iodized</td>
<td>202.0 (195.0; 207.0)</td>
<td>180 (167.0; 184.0)</td>
<td></td>
</tr>
<tr>
<td>Adequate iodized</td>
<td>237.0 (210.0; 255.0)</td>
<td>208 (192.0; 225.0)</td>
<td></td>
</tr>
<tr>
<td>Over-iodized</td>
<td>281.0 (266.0; 306.0)</td>
<td>237 (221.0; 253.0)</td>
<td></td>
</tr>
<tr>
<td>Non-iodized</td>
<td>153.0 (147.0; 157.5)</td>
<td>146 (141.0; 152.0)</td>
<td></td>
</tr>
<tr>
<td>Inadequate iodized</td>
<td>170.5 (166.0; 175.0)</td>
<td>159 (153.0; 165.0)</td>
<td></td>
</tr>
<tr>
<td>Adequate iodized</td>
<td>211.0 (206.0; 217.0)</td>
<td>200 (194.0; 206.0)</td>
<td></td>
</tr>
<tr>
<td>Over-iodized</td>
<td>222.0 (206.0; 238.0)</td>
<td>209 (203.0; 215.0)</td>
<td></td>
</tr>
<tr>
<td>Non-iodized</td>
<td>132.0 (112.5; 154.0)</td>
<td>123 (115.0; 131.0)</td>
<td></td>
</tr>
<tr>
<td>Inadequate iodized</td>
<td>165.0 (146.5; 184.0)</td>
<td>146 (138.0; 154.0)</td>
<td></td>
</tr>
<tr>
<td>Adequate iodized</td>
<td>189.0 (163.5; 209.0)</td>
<td>177 (169.0; 185.0)</td>
<td></td>
</tr>
<tr>
<td>Over-iodized</td>
<td>238.0 (222.0; 254.0)</td>
<td>225 (217.0; 233.0)</td>
<td></td>
</tr>
</tbody>
</table>

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Table 3

Comparison of MUIC (µg/L) among School Age Children, Women at Reproductive Age, and Pregnant Women by Household's Iodized Salt using Titration and Socio-Economic Status, 2013

<table>
<thead>
<tr>
<th>Quintile</th>
<th>Non-Iodized</th>
<th>Inadequate Iodized</th>
<th>Adequate Iodized</th>
<th>Over-iodized</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quintile 1</td>
<td>835</td>
<td>413</td>
<td>302</td>
<td>29</td>
</tr>
<tr>
<td>Quintile 2</td>
<td>996</td>
<td>458</td>
<td>398</td>
<td>40</td>
</tr>
<tr>
<td>Quintile 3</td>
<td>1133</td>
<td>509</td>
<td>506</td>
<td>40</td>
</tr>
<tr>
<td>Quintile 4</td>
<td>1217</td>
<td>533</td>
<td>547</td>
<td>51</td>
</tr>
<tr>
<td>Quintile 5</td>
<td>961</td>
<td>408</td>
<td>462</td>
<td>43</td>
</tr>
</tbody>
</table>

Note: The table provides a comparison of urinary iodine concentration (µg/L) among different groups of individuals based on their household's iodized salt usage and socio-economic status. The data is collected through titration tests.
CONCLUSION AND RECOMMENDATION

Conclusion
The detrimental effect of iodine deficiency on the mental and physical development of children as well as on the women of reproductive age has been recognized. Deficiency in pregnancy is particularly detrimental as it impact upon the unborn child. In Indonesia, the median urinary iodine concentration is in the normal range nationally, but some sub-populations in particular pregnant women remain deficient.

Recommendation
For the prevention of Iodine disorders, it is recommended that coverage of adequately iodized salt need to be improved in order to ensure adequate iodine status for all sub-populations. It is also recommended to regularly monitor the iodine status of all three groups in order to ensure optimal iodine status including the avoidance of both iodine deficiency and excess.

It would be appropriate if Indonesia continues to tackle the large proportion of inadequately iodized salt as well as continues to identify the additional source of iodine intake that would contribute to the optimal iodine status.

ACKNOWLEDGEMENT
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