Journal Health Care and Dietetics
Volume 1 No 1 (2025): 009-000
E-ISSN: 000-000 (Online)
Published by Media Publikasi Indonesian Scholar
Journal homepage: https://journalmpci.com/index.php/jhcd
DOI:

Urinary Iodine Concentration and Height of Primary School Children were Better in Non-Endemic Areas of Iodine Deficiency Disorder: Cross-Sectional Study

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ABSTRACT

Background and Objectives: Height of school children is an outcome of linear growth, which is influenced by iodine intake as measured by urinary iodine concentration (UIC). This study was aimed to assess differences in UIC and height of primary school children in areas with previously iodine deficiency disorders (IDD) and non-endemic areas of iodine deficiency disorders (NIDD). Methods and Study Design: Study was conducted in two districts: Enrekang and Majene. Data analyses were performed using independent t-test and multivariate regression. Results. School children were similar in age group between areas, but different in sex. In addition, parents' education and occupation were also different between areas. The median UIC was lower in IDD compared to NIDD areas (147 vs. 194 µg/L and 168 vs. 214 ug/L, both p<0.05, respectively for Enrekang and Majene). In addition, the height of school children was lower in IDD compared to NIDD in Enrekang (126.7 vs. 129.2 cm, p=0.004), but did not differ in Majene (126.5 vs. 125.9 cm, p=0.521). Height-for-age z-scores (HAZ) were not different between areas in both districts (p>0.05). Furthermore, multivariate analyses found that mean HAZ was not correlated with IUC and not different between areas. Conclusion. We conclude that median UIC was lower in NIDD areas but mean HAZ was not.

ARTICLE INFO

CROSS SECTIONAL STUDY

Submitted: 8 November 2025
Accepted: 10 December 2025

Keywords:

urinary iodine, salt consumption, children

Key Messages:

- Iodine Urine Concentration of school age at a national scale has been identified since 2013 and based on this result, Indonesia is declared to have no problems with iodine intake and iodine deficiency disorders and is known to consume rich iodized salt.
- Since 2013, there are no longer categories of IDD and Non IDD areas, because it is believed that the intake of Iodine is sufficient.
- The height of Primary school students in Indonesia is lower than the Reference.

INTRODUCTION

Stunting in Primary school students is dependent on their exposure to iodine intake and related height status.[1 2] Persistent stunting in children under five and Primary school age, in Enrekang (South Sulawesi) and Majene (West Sulawesi), addressing to Iodine Deficiency Disorders (IDD).[3] The IDD in pregnancy is serious problem and affects babies born in Indonesia and the associated with optimum height and intelligence (school students aged 7-12).[4 5] and also influenced by many variables (socioeconomic factors, access to health services, quality of sanitation and intake of macro and micronutrients (Iodine) immediately after birth to Primary school age (7-12 years).[6 7]

The GAP study on the status of urine iodine in primary school students. Urine Iodine Status is a parameter of the adequacy of iodine consumption 7. The phenomenon of persistent stunting, is suspected to be strongly correlated with iodine status. Height growth can be observed rapidly in the first two years of age, but small trajectory in the past age of 2 years until puberty increases in height and consistency.8

This study aimed to analyze the association between IUC and by endemic areas, mean height of students, to measure consumption iodized salt in IDD and NIDD areaS.

METHOD

The design of this study was cross-sectional in IDD and NIDD endemic areas. Location in Enrekang Districts (South Sulawesi) and Majene Districts (West Sulawesi), relevant date on June-August 2022. The population is school-age children (age 7-12 years. The IDD endemic area in Enrekang Districts is Baraka, Buntu Batu, Maluwa , while the NIDD is Alla. The IDD endemic sub-district in Majene districts is Malunda and Ulumunda, while NIDD is Banggae.

Procedure

The anthropometric assessment and salt samples were 963 units. The inclusion criteria (1) children aged 7-12 years (2) Be at school on data collection (3) Have data information related to weight at birth. Iodine Urine Concentration inclusion criteria : (1) Children who are healthy (2) Urine sample that is less than 30 ml. This study used a design of two-stage cluster sampling. A total of 30 clusters were selected from each district where 15 clusters (schools) were taken from one sub-district and from each cluster a sample was chosen randomly. To consider the possibility of dropping out or missing data by 10%, the total samples size is 23 (see Figure 1)9, Two-stage cluster sampling would be carried out in this study with primary schools as the cluster. Data collection through questionnaires use the KOBO application and it has been filled in will automatically be sent to the server in the Department of Nutrition, Hasanuddin University. Measurement of weight and height: body weight and height will use the Seca brand of scales and height measuring devices available at the District health office. Before used, all instruments would be standardized. The measurement procedure following the standard procedure by WHO. Urine collection was carried out in the morning (8-10 hours). Each subject required a urine sample of at least 30 ml, filled in a 50 ml volume bottle. Officers provide containers that have been prepared for school children who have completed anthropometric measurements.

Data Analysis

IUC was measured using the method Acid Digestion with ammonium solution in the laboratory of BP GAKI Magelang.. Criteria for IUC is low (<100 µg /L), normal (100-200 µg /L) and excess (>200 µg /L). The age group is divided into two, 7-9 y and 10-12 y. Salt quality criteria, grouped into 3 categories based on iodine content qualitatively, namely category 1 (0-6 ppm), II (7-30 ppm) and III (> 30 ppm). IDD area is an area that has a Total Goitre Rate (TGR) prevalence of thyroid enlargement >= 30% in the results of the 2003 goitre survey. NIDD area is a TGR <30% of the population. Differences in height with median values based on age group, endemicity and district.. The association of UC with endemic status was used the chi square test. Analysis of the mean height of children based on age group, endemicity, and district factors used ANOVA.

Research Ethics

This research obtained ethical approval from the Health Research Ethics Commission, Faculty of Medicine, Hasanuddin University on March 22, 2022, with SK number: 137/UN4.6.4.5.31/PP36/2022.

RESULTS

Subject Characteristics

The characteristics of the subjects in this study can be shown in the supplementary file 1, that the education level of fathers in the IDD areas of Enrekang Districts is mostly high school graduates as well as in NIDD. In Majene Districts, most of them graduated from junior high school in both IDD and NIDD. An association was found between the status of the IDD area and the status of the IUC see Table 1.

Mean Height and Endemicity IDD

The mean height of students in Enrekang Districts is significantly different (p=0.004) between IDD areas and NIDD areas (see Figure 2). This difference was detected in the age group 7-9 years (p=0.033) but was not detected in the age group 10-12 years (p=0.801).

Consumption Habits and Quality of Household Iodized Salt

Consumption of poor quality salt in IDD endemic areas is higher than in non-endemic IDD areas in Enrekang, but in Majene the quality of salt consumption is poor in both regions. In total, in Enrekang, the quality of consumption of indium-poor salt reached 58.3%, while in Majene it was 91% (supplementary 2)

DISCUSSIONS

Main Finding

The results of the study on IUC show that in the IDD endemic area the percentage of IUC categories 1, and 2 (poor) in Enrekang and Majene, respectively 24.8% and 22.3%, is significantly different from the NIDD. The median IUC in the IDD and NIDD endemic areas in Enrekang was 147 and 194, respectively, while in Majene it was 168 and 214. The results of this study are an increase in the mean height of primary school students (7-12 years) from 2007, 2013, and 2018 for boys and girls in Enrekang and Majene. The quality of consumption of iodized salt categories 1 and 2 (<30 ppm iodine) is higher in the IDD area compared to NIDD in Enrekang, this is known to be poor, but the quality of consumption of iodized salt is poor in status in IDD and NIDD areas in Majene.

Another piece of evidence in this study is that the IUC status in Majene is better than in Enrekang, although both still have a lower percentage of IUC status in each IDD area. Household salt consumption in the IDD area when combined categories 1 and 2 is still very high reaching 60.6%, this is evidence that the quality of salt used in households is very poor in the IDD area, especially in Enrekang. Meanwhile, in Majene, both IDD and NIDD areas have the same poor quality of salt consumed by households. The evidence from this study can be explained that low UIC is associated with low-quality iodine intake both in food and consumption of iodized salt.12 Studies in Canada found that diet quality, use of table salt, cooking methods, and salt storage significantly improved IUC.13

The results of this study are different from the results of this study, which are lower than the 2013 Basic Health Research study in Indonesia where the median IUC was found to be 223 µg/L 14. Also lower than the study report from Fiji (2009)15 reported IUC at school age of 237 µg/L. However, the reported results of this study are higher than the results of the study in Mongolia (2011) of 171 µg/L 16. A study in Australia in 2016 reported the UIC at school age of 175 µg/L 17 and in New Zealand (2011) it was 113 µg /L 18 19. The study report from the Philippines is 168 µg/L.20 So based on several studies above IUC in Enrekang and Majene, especially the IDD area, is still a problem that needs a solution.

The difference in the effect of IDD on height in Enrekang and Mejene was found because these two regions even had a history of IDD in 2007, but there were different changes in socio-economic dynamics. Geographically, Enrekang has lower access to transportation than Majene. Urbanization in Majene is more active than in Enrekang, this is due to the regional autonomy status imposed in Indonesia. Majene became the second largest city in West Sulawesi after separating from South Sulawesi in 2006. Meanwhile, Enrekang's status has remained the same since 2003. The effects of regional development have caused Majene to no longer seriously distinguish the determinants of the nutritional status of children under five, including the determinants of stunting. Access to health services is in a shorter and faster span of control than the span of control for access to health services in Enrekang, South Sulawesi.

Enrekang is mountainous or entirely inland, while Majene is predominantly a coastal area. This is the cause of the difference in IUC. According to the results of a study report in Zhejiang, an eastern province of China the IUC is 188.5 µg/L (inland area) and 128,5 µg/L (the coast area).21 In China, although coastal areas have high sources of iodine, low consumption of iodized salt causes the UIC to be lower than inland. Inland residents have a good way of consuming iodized salt. Another study reported in FIJI, that knowledge about the benefits of iodized salt in primary school students and parents is poor, reaching 78.6%, then they improve their iodized salt literacy and are finally able to eliminate IDD.15

The results proved that the mean height was worse in the IDD area than in the NIDD area and this occurred in Enrekang in the 7-9 year age group as well as if the endemic status was not distinguished. In Majene the condition is different where there is no significant difference in mean height according to IDD and NIDD status. The mean height of 7-9 years old in Enrekang is in IDD and NIDD, 120.7 cm and 122.7 cm, respectively. The mean height of 7-9 years old in Mejene is IDD and NIDD 122.8 cm and 120.9 cm, respectively. Evidence that the two regions have different characteristics even though they have the same history of IDD. Compare with optimum growth standard. At the age of 6 years, girls have a potential height of 114 cm and at the age of 12 it reaches 148 cm. (22) These are ideal conditions if a child has an environment that supports optimum growth. (23). The mean height of Indonesian children is still lower than the WHO Reference. Optimum height is also influenced by hormones that intervene with protein intake.24 It should be optimized in Majene because there are so many sources of fish animal protein.

In this study, it was also found that the percentage of low iodine intake based on IUC parameters <100 g/L in the IDD area was 24.8% and in Majene 22.3%. In this condition, it can be called iodine deficiency status.25 Indonesia, although the national level has been declared free of IDD problems, 26 this study still found fact that the percentage of primary school students with iodine insufficiency reached 20% in Erekang and Majene.

The consumption of iodized salt in IDD is poor. This is the trigger for the low IUC which is low. So it is clear that there needs to be a policy to regulate the use of quality salt in households. The policy direction should be to improve the quality of iodized salt because it is used less every day, 27 In addition, it should be noted that drinking water also has potential as a source of iodine .28

CONCLUSION

There is an association between IUC and the IDD areas in Enrekang and Majene. The median IUC is better in the NIDD areas. The height of primary school students is better in the NIDD area in Enrekang, while in Majene is no difference between both in IDD endemic area and NIDD. The habit of consuming iodized salt is poor quality in the IDD area

Declaration of Conflicting Interests

The researcher admits that there is no conflict of interest in this study.

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Tabel 1. Associations Status Area of IDD and Iodine Urine Concentration by District

District	Areas	Iodine Urine Concentration (IUC) status			P Value
		Low	Normal	Excess	
Enrekang	IDD	62(24,8)	172 (68,8)	16(6,4)	0,000
	NIDD	30(12,0)	182(73,1)	37(14,9)	
Majene	IDD	47(22,3)	137(64,9)	27 (12,8)	0,001
	NIDD	33(13,0)	162(64,0)	58(22,9)	

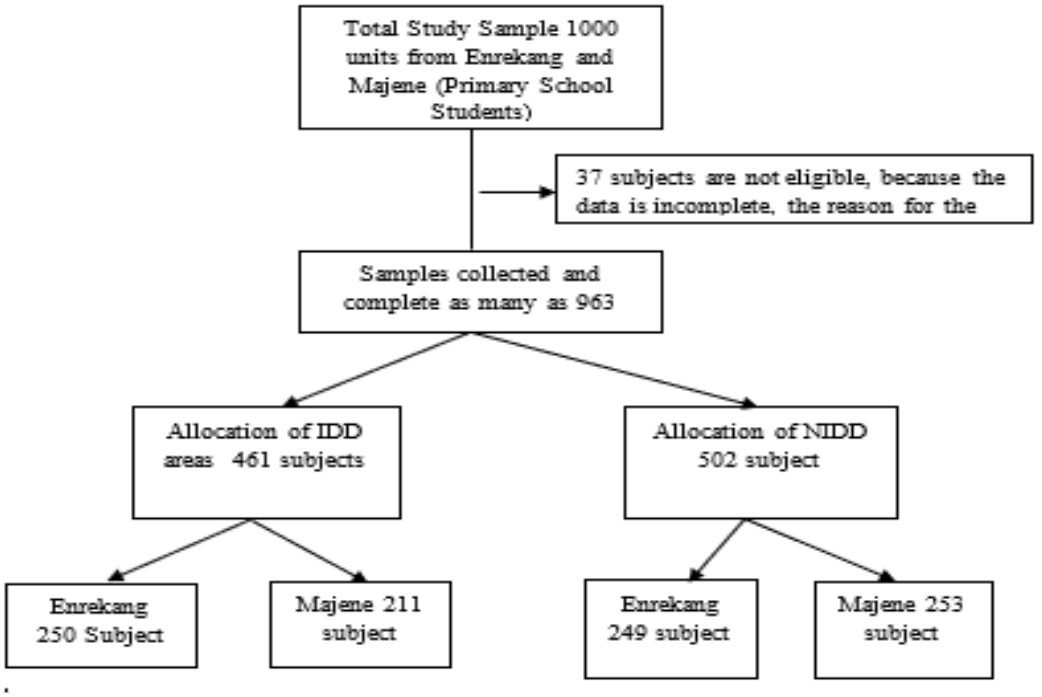

Figure 1 : Distribution of subjects by IDD endemic and NIDD areas in Erekang and Majene

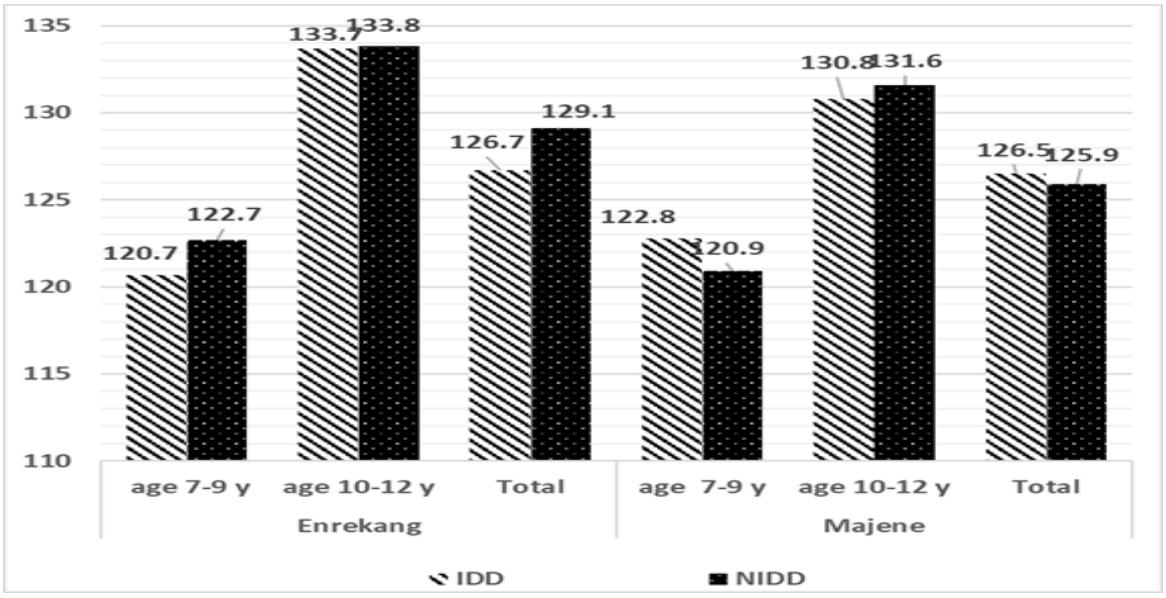

Figure 2. Mean Height (cm) of Primary School Students by Age and Endemicity in Enrekang and Majene