GOITER IN THE COASTAL AREAS (Case Study In Pati Regency) : An Ecological Nutrition Problem ?

Mohammad Sulchan[1]

Abstract

Iodine deficiency disorders (IDD) including goiter is still considered as one of the major nutritional problems in Indonesia, including in Central Java. Theoritically, IDD is usually and widely reported to be found in high mountain areas, where the iodine content in soil and water usually low. Eventhough iodine supplementation and salt fortification with iodine program have been done widely, the result of the program has not shown to be optimum. But, in fact, it has been reported that endemic goiter areas have spreaded widely into low land and coastal areas.

The importance of iodine deficiency in goitrogenesis and the prevention and treatment of endemic goiter by iodine supplementation are firmly established. However, epidemiologic and experimental evidence revealed that environmental phenomenons may be responsible for many goiters. Several categories of naturally occurring and anthropogenic antithyroid agents may enter the water, air, and food exposure pathways, becoming important environmental goitrogenic factors in areas. Their effects may be additive to those of iodine deficiency, making the intensity of the manifestations of iodine deficiency disorders (IDD) more severe. Their presence should be considered particularly in areas where the features of IDD persist despite adequate iodine prophylaxis.

The primary objective of this report was to determine and summarize if the prevalence of goiter in low land and coastal areas has changes over the period 1995-1996 to 2003. The prevalence tended to be higher and a new "endemic goiter area" was found.

Goiter appears to be a mild to moderate public health problem in low land as well as costal areas. The prevalence and severity of goiter was more severe compared to the previous decade. The change may be due to ecological phenomenon like eroded flood,which may have potentially goitrogenic and adverse effect on the imbalancy of macro-micro elements in soils. In order to have an effective program, the regular monitoring of iodine content and other macro and micronutrient (such as selenium and plumbum) content in the environment (soil, water, food) is essential.

Introduction

Iodine deficiency disorders (IDD) include goiter is still considered as one of the major nutritional problems in Indonesia, including in Central Java. Theoritically, IDD is usually and widely reported to be found in high mountain areas, where the iodine content in soil and water usually low. Eventhough, iodine supplementation and salt fortification with iodine

[1] Nutrition Department. Medical Faculty Diponegoro University email : s2gizimas_undip@yahoo.com

program have been done widely, the results of the program has not shown to be optimum. But, in fact, it has been reported that endemic goiter areas have spreaded widely into low land areas, and coastal areas.

Not less than 5 % of total world population is affected by goiter, many of them with its associated disorders, constituting a public health problem of major populations. There are large variety and number of naturally occuring and man made compounds which have antithyroid and goitrogenic effect and therefore, may produce deleterious effects in thyroid gland and function. [1]

The importance of iodine deficiency in goitrogenesis and the prevention and treatment of endemic goiter by iodine supplementation are firmly established. However, epidemiologic and experimental evidence revealed that environtmental phenomenons may be responsible for many goiters. Several categories of naturally occurring and anthropogenic antithyroid agents may enter the water, air, and food exposure pathways, becoming important environmental goitrogenic factors in areas. Their effects may be additive to those of iodine deficiency, making the intensity of the manifestations of iodine deficiency disorders (IDD) more severe. Their presence should be considered particularly in areas where the features of IDD persist despite adequate iodine prophylaxis. [1,2]

In order to improve health nutritional (iodine) status of the community, many programmes have been designed and carried out by the Indonesian government (Kanwil Depkes Prop Jateng) collaborated with the World Bank – CHN3, and also to evaluated the effectiveness of this program in terms of efficacy, cost and impact.

In response to this problems, in 1995 an assesment was conducted, namely IDD mapping in Central Java. Then, the follow up study was conducted again in 1999, followed by an evaluation program which carried out in 2003. Based on data resulted from these series of observation, analysis could be done.

The primary objective of this report was to determine and to summarize if the prevalence of goiter in low land and coastal areas has changed over the period 1995-1996 to 2003. The goiter tended to be more prevalence and a new "endemic goiter area" was formed.

The design was three cross-sectional prevalence survey in some rural areas which were conducted 8 years apart. The studies were conducted in 3 districts of Pati regency which were chosen using a geographical, stratified random selection of villages, representation of high land, low land and coastal areas. All areas of study sited down stream along the Tayu river, from Muria mountain (include Gunung Wungkal sub district), across Trangkil subdistrict (as a low land) and Tayu sub district (as a costal areas) to terminate in Java sea. Villages of Pesagen, Gajihan, and Giling represent a highland areas; villages of Karang Legi, Ketanen, and Trangkil represent a lowland areas. Villages Pakis, Tendas, and Kedungsari represent a coastal areas. Data and information gathered at the areas level are analyzed, descriptively and comparatively, then presented in tables and figures, and discussed comprehensively, later on.

Prevalence Of Goitre

It is important to recognize that goiter afflicts about 200 million people in the world, many of them are in Indonesia. In all but 4 percents of theses cases, caused by iodine deficiency. Eight million or 4 percents of these, may have goiter because they regularly eat excessive amount of foods that contain antithyroid substance, i.e goitrogen, pollutants, where the effect is not counteracted by dietary iodine.

A total of 302 school children in the nine villages were surveyed and analyzed. The age and sex distribution of the study children is given in Table 1.

The result of the analysis situation shows the changes in goiter prevalence during the period

(figure 1.)

Table 1. Age and sex distribution of the study children

Age (years)	No male	No female	Total (%)
6 – 8	26	31	57
> 8 – 10	110	105	215
> 10 – 12	14	16	30
Total (%)	150 (49)	152 (51)	302

The changing prevalence and its severity of Goiter, is shown in figure 1. The total goiter rate in the highland (Gunung Wungkal district), was relatively constant 48.3 % in 1995, decrease by 36.3% in 1998 and increase lightly by 36.85. These prevalences were categorized as severe endemic areas. The grading of severity of IDD as a public health is based on the criteria recommended by WHO/ UNICEF/ ICCIDD. [3-5]

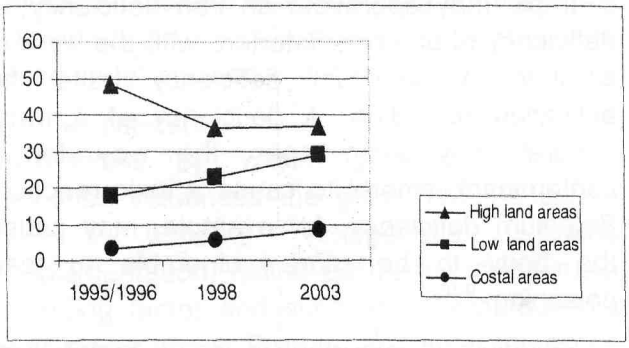

Figure I. The prevalence of Goiter among school children by different areas.

Table 2. The Severity of problem of Goiter

	The severity of problem		
	1995	1998	2003
High land	severe	severe	severe
Low land	mild	moderate	moderate
Coastal	normal	mild	mild

In low land areas, Trangkil sub district was categorized as a mild-endemic areas at the beginning (1995), with the TGR of 17.6%, then increase slightly to 20.8% in 1998, and then increase significantly to 28.9%. The last-two observation could be categorized as a moderate endemic areas. Tayu sub district (coastal areas respectively) revealed a tendency to increase with the prevalence and its severity from 3.3. % (normal) in 1995, to 5.8% (mild) in 1998 and to 8.5% (mild) in 2003.

The Distribution Of Urinary Iodine Levels

In contrast, this figures is not in agreement with the level of urinary iodine excretion, as shown in Table 3. It has been understood that the concept of Iodine Deficiency Disorders (IDD) is not identical to endemic goiter. In general, the prevalence of goiter in a population gives information about a regional historical status with respect to iodine deficiency. Urinary iodine estimation is more objective and less prone to observation errors. It gives information about the current status of iodine levels in population. [3-5]

Table 3.

Median, Level of UEI < 100 ug/l and < 50 ug/l

	UEI Median (ug/l)	UEI < 100 ug/l (%)	UEI < 50 ug/l (%)
High land			
- Pesagen	135	45.5	18.2
- Gajihan	160	41.6	16.7
- Giling	117	40.1	15.2
Low land			
- Karang Legi	122	45.5	20.1
- Ketanen	109	41.6	13.6
- Trangkil	177	40.1	9.0
Coastal			
- Pakis	115	40.1	12.6
- Tendas	128	35.5	18.4
- Kd. Sari	98	50.0	28.2

According to the median level and the percentage of urinary iodine excretion (UIE), the study revealed that the median level of UIE level in high, low, and costal areas are 138.0, 1220, and 115.0 µg/l, respectively the percentage of UIE level under 100 ug/l are 41.8, 31.0 and 40.6 % respectively. According to the findings of these studies in general, performance is not so bad, as the UEI median are mostly higher than 100 µg/l, except in Kedungsari (costal area).

Table 4. Means value and percentage of TSH (pregnant woman) over 5 ug/l

	Concentration of TSH (pregnant women)	
	Mean value	Conc > 5 ug/l
High land		
- Pesagen	1.41	
- Gajihan	1.43	4.8 %
- Giling	1.09	
Low land		
-Karang Legi	1.37	
- Ketanen	1.46	5.0 %
- Trangkil	1.49	
Coastal		
- Pakis	0.96	
- Tendas	0.80	9.5 %
- Kd. Sari	1.43	

It is well known that the hypothalamus regulated thyroid stimulating hormone (TSH).In iodine deficiency, thyroid hormone production declines and the body responds by secreting more TSH as an attempt to accelerate iodine uptake by the thyroid gland. If a deficiency persists the cells of the thyroid gland enlarge, so as to trap as much iodine as possible. Based on "hypothyroid phase" cut of points, TSH concentration more than 5 ug/l, it is shown that the prevalence of high TSH were only 4.8%, 5.0% and 9.5% in highland, lowland and coastal areas respectively.[3-5]

Household Receiving Iodized

The coverage of household receiving iodized salt seems to be constant in each area, approximately 56.2% -58.6% in highland area, 40.6% - 44.7% in lowland and 37.6% -39.2% in costal area.

Data from highland areas for the year 1995 to 2003 showed that the high of household receiving iodine salt was than 50%, which the other areas lower than 50%. Varying numbers did not result in clearly different in series of observations.

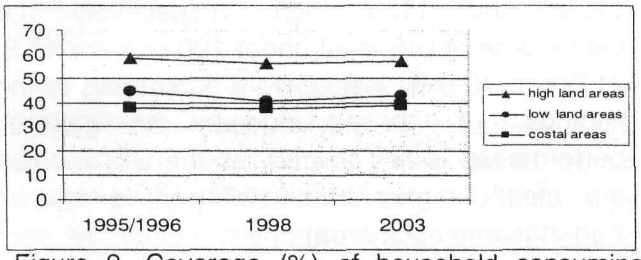

Figure 2. Coverege (%) of household consuming iodined-salt

Ecological Factors

It has been reported that endemic goiter areas have spreaded widely into lowland and coastal areas. The disagreement concerning the prevalence of goiter in costal areas may be due to the ecological phenomenon. In fact during this period and one decade before the regions sufferred from eroded flood (banjir bandang) which led the new environment with the imbalancy of micro minerals in soil. Periodically, acute eroded flood occurred in the eastern part of Muria mountain during the last 10 year. The frequency of eroded flood was about 2-3 times yearly. [7,8]

Moreover, interactions among the trace minerals in soils are common. At other times, in ecological setting (i.e. iodium in soil) interactions lead to nutrient imbalances. An excess of one may cause a deficiency of another. A slight manganese overload, for example may aggravate an iron deficiency. A deficiency of one may interfere with the work of another. A selenium deficiency halts the activation of iodine. A deficiency of a trace mineral may even open the way for a contaminant mineral to cause a toxic reaction. Selenium deficiency, for example, may cause the body to be more vulnerable to lead poisoning. [9,10]

Selenium is important in iodine metabolism because of its presence in one enzime responsible for forming active T_3 from thyrogoabulin started in the thyroid gland. Dietary selenium interact with iodine, leading to the activities of the seleno enzymes, selenium: dependent glutathion perioxidase and type I deiodinase (DI-I), which involved in changing thyroid hormon thyroxine (T_4) to triiodo thyronine (T_3). Selenium deficiency can be spuriously affected, resulting in goiter. The discovery of selenium function in thyroid hormone metabolism has an important implication to the interpretation of the effects of selenium deficiency on goiter.

Endemic goiter is mainly due to iodine deficiency. In rare instances, other factors, such

as goitrogens including excessive amounts of iodine, pollutants, heavy metals may be the underlying cause. For all these conditions other additional factors have been sought, if not as primary causes, at least as a contributing factor interact with the environment or ecological iodine deficiency or modify the response of the individual. Ecological factors are of undoubted importance. New soils formed after eroded flood, i.e, those subjected to intense erotion and sedimentation, contain less iodine and are associated with endemic goiter. In an extensive study of endemic goiter in Grece, 16 out of 18 goiter villages were located on land which were eroded from flood. The soils in the endemic areas were eroded and contained (significanty) less carbonate and exchangeable cations. On soils where the drinking water come from superficial sources, the iodonw content and cammonly polluted by heavy metal, like mercury and plumbum. It is well known that Pb is determined as one of antiblocking agents which will inhibit iodium utilization by thyroid glands which them resulting in goiter. [7-10]

The differences may be pertinent to the mechanism by which geologic (ecologic) formation influences the goiter prevalence. In areas without exogenous iodine supplementation, Iodine deficiency is the main offending factor and such areas are found in poor iodine areas. Poor iodine soil in the areas have iodine grown reflected on the locally grown foods. Iodine supplementation does not reduce iodine deficiency, the primary role may be caused by geologic/ecologic factor, as evidently shown areas in Tayu. It is assumed that geo-logic/ecologic factor are secondary important by affecting the iodine or goitrogen concentration in the water, the food, or both. It should be noted that the water in the goitrous areas comes from superficial sources, which differs in several respects from that is from the non goitrous regions. It includes a low concentration of various elements (Zn, Mg, Ca, Fe) if any of these factors is important in goitrogenesis which then may affect the prevalence of endemic goiter.[10-14] Another mechanism by which the soil may affect the prevalence of endemic goiter is by the capacity to absorb iodine, making it less available for the plants. [13-14]

The distribution of iodine in earth's crust is uneven and the ecological activity has removed iodine rich soil in many areas by eradicated flood, and this effect may be intensified by heavy runoffs from rains. The mountain areas, notably Muria mountain, are particularly deficient in iodine. On the other hand, plants and animals, as well as humans, obtain their iodine mainly from water and soil. Further, the food raised on these areas will not provide adequate iodine for human needs.

Goiter from iodine excess can occur in natural setting. In Hokkaido, Japan, ingestion of iodine rich seaweed produces "coastal goiter", with high urinary excretions of iodine. Restriction of kelp in the diet decreases the goiter prevalence. Similarly, the use of kelp salt in two coastal villages in China resulted in high urinary iodine excertion (from 1500 to 2000 ug/g creatinine daily) and goiter. In Shanxi, China, drinking water from shallow wells had a very high iodine concentration (533 ug/l), which resulted in a high urinary iodine excretion (2428 ug/l creatinine), a goiter prevalence of 32.5%, and elevated serum TSH levels. In this example, iodine excess was attributed to its accumulation in interior catchments after flooding. In rats, excessive: iodine inhibits iodination of thyroglobulin and subsequent iodo thryonine synthesis (the Wolff Chaikoff effect) [8,12]

Conclusion

- Goiter appears to be a mild to moderate public health problem in low land as well as costal areas.

- Ecological factors like eroded floods are important especially in coastal endemic goiter area.

- In order to have an effective program, the regular monitoring of iodine content and other micronutrient (like selenium) in the environment (soil, water, food) is essential.

Reference

1. Dunn. JT, Pretell EA, Daza DH and Viteri FE. To ward the eradication of endemic goiter, Cretinism and Iodine Deficiency Pan American Health Organisation, Washington DC, 1986.
2. Hetzel BS, Dunn JT, and Stanbury JB, The prevention and control of iodine deficiency disorders, Elsevier, Asterdam, 1987
3. Suharyo dkk (Tim GAKI FK Undip/ Kanwil Depkes Prop Jawa Tengah). Pemetaan GAKY di Jawa Tengah (1996), FK Undip.
4. Dinkes Prop Jawa Tengah, Laporan Evaluasi Program Penanggulangan GAKY di daerah endemic di Jawa Tengah tahun 2007. Proyek Perbaikan Gizi Masyarakat Prop. Jawa Tengah, 2004
5. Muis SF, Sulchan M, Hertanto WS. Pengetahuan, Ketersediaan, dan Konsumsi Bahan Makanan tinggi iodium di tingkat keluarga, Media Medika Indonesia (1999) 34 (2) 79-85
6. Whitney EN, Rolfess SR. Understanding Nutrition. 10 th.ed. Wadsworth, Belmont CA, USA, 2006, 443-447
7. Dunn. JT, Iodine Deficiency and Excess as envirmmental goitrogens in Gaitan E (eds) Enviromental Goitrogenesis. CRS Press Inc, Boca Raton, Florida, 1989, 140-146
8. Suzuki H, Eticologi of endemic goiter and iodine excess in endemic goiter and endemic cretinism, Stanbury JB and Hetzel BS, Eds, Jhon Wiley & Sons, Now York, 1908, 237.
9. Xian-yi, Ti-zhang L, et al, Endemic goiter due to iodine rich salt and its picked vegetables Clin. Med J, 97 (545), 1984.
10. Adrian M, Wiryatmadi B, dan Gunanti IR. Identifikasi Gondok di daerah pantai : sutatu gangguan akibat kekurangan yodium, Jornal GAKI Indonesia (2002) 3 (1) : 17-30
11. Triyono, Gunarti IR, Identifikasi faktor yang diduga berhubungan dengan kejadian gondok pada anak SD di daerah dataran rendah.Jurnal GAKY Indonesia 2004 : 3 (1-3). 1-18
12. Gaitan E, Lindsay RH, Cooksey. RC, Goiter endemias attributed to clinical chemical and bacterial pollutan of water supplies, in Gaitan E (Eds). Enviromental goitrogenesis. CRC Press Inc. Boca Raton, Florida, 1989, 207-233.
13. Hotz CS, Fitzpatrick DW, Trick KD, and Abbe MR. Dietary Iodine and Selenium Interact to effect thyroid hormone metabolism of rats. J of Nutr 127 (6). 1997; 1214-1218.
14. Arthur JR, Nicol F. and Beckett GJ. Selenium deficiency, thyroid hormone metabolism and thyroid hormone deiodinases. Am J. Clin Nutr, (57) 1993, z365 -239 s.
15. Pandav CS, Rasheed M, Solihl I, Saeed M, Shohuud M, Awal, A Anand K and Shreshto R. Iodine deficiency disorders in the Maldives. A public health problem. Asia Pasific J Clin Nutr (1999) 8 (1), 9-12.
16. Masrul. M, Chongsuvivatwong V, and Geater AF Factors associated with coverage of iodine deficiency disorders by control programs in an endemic area in West Sumatra Indonesia, Asia Pasific J Clin Nutr (1999) 8 (1): 13-18
17. Kapil U, Karmaker MG, Goindi G, and Neyer D, Iodine content of salt in the Union territory of Andaman and Nicobor Islands, India. Asia Pasific J Clin Nutr (1997) 6 (2) : 95