Research Article

Determination of Goiter Prevalence and Iodine Deficiency in basic school children, Almatama locality

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Abstract

The aim of this study is to asses the goiter incidence and iodine deficiency. 590 basic school student (295 Male 295females) were randomly selected from three zones of Almatamma locality; Almatama, Elnorab, and Wed-Hamed. The study was done via a survey which included clinical assessments of students' thyroid glands (goiter), a questionnaire and laboratory investigations for the urinary iodine execration. The study revealed that the prevalence of goiter was 5.2% in Al-Matamma locality. The most prevalent goiter was visible goiter 1A and 1B (4.5%). Only (0.7%) of goitrous pupils either had G2 or G3 stage of goiter. The prevalence of goiter shown in the Almatama is lower than reported ones by many previous studies such as Ahmed (2015) in Shendi (14.6%) on the east side of the River Nile**.** The incidence of iodine deficiency in the elementary school students showed that most of the students had mild iodine deficiency (58%), followed by moderate deficiency (22.4%) and (3.6%) had severe ID. The association between iodine deficiency and school zone was statistically significant. Most of the students with severe and moderate iodine deficiency belonged to Alnorab zone (29%) followed by Almatamma zone (23 %)**.**

Keywords: ***Goiter, thyroid gland, urine iodine, iodine deficiency.***

1. Introduction

Iodine is a mineral naturally found in the ocean waters and the earth's soil. It is essential in the human body but required in small amounts. Moreover, the iodine required in the body is derived from the food taken.The thyroid glands in the human body depend on iodine in order to produce its hormones. Thyroid glands triggers the body cells to perform and function at a specific rate. The way of the thyroid gland functions affect the body's

general wellness. The glands produce hormones that control the body's metabolism. The thyroid hormones are responsible for regulating essential body functions such as cholesterol levels, breathing, central and peripheral nervous system, body temperature, and the menstrual cycle. The cases where iodine is missing in the body, the body system will make the thyroid strain. It is important to note that when the thyroid gland has challenges synthesizing the thyroid hormone, it becomes large. The main reason behind its enlargement is to compensate for the limited production of hormones, when the thyroid gland works harder result in enlarges. This condition makes the neck swell. Goiter is another name for thyroid gland enlargement. The swelling of the neck is always the most apparent sign of iodine deficiency. Goiter is a sign showing a deficiency of iodine in the human body. Iodine deficiency is not the only factor that causes goiter, thereare many other factors that cause it. Moreover, iodine deficiency doesn't always result in endemic goiter (Benoist, *et al*., 2008).

Childhood mortality, reproductive failure, mental retardation, and brain damage are the most serious consequences of iodine deficiency. There are other problems that are brought by iodine deficiency. These problems are reproductive failure, brain damage, childhood mortality, and mental retardation. In general iodine deficiency has effects on the living standard among the people. Iodine deficiency ends up affecting the social-economic development of a community (Laurberg, *et al*., 2010) Iodine deficiency-related problems are experienced worldwide. Nile River State, El Matamma locality in Sudan, is not an exception. El matamma has a rising number of patients with thyrodism. The increasing number of these cases drew my attention towards this research to determine the goiter prevalence iodine Deficiency among

basic school children of El Matama Locality, Nile River State, Sudan.

2. Materials

2.1. Sampling

Random sampling technique was used to select the sample. Elmatama locality was divided in three geographical regions namely Alnorab (north), Wed Hamid in (south), and Almatama (middle) . From each zone, two schools (male and female) were selected for this study from each school Alnorab(113,112), Wed Hamid(85,86), Elmatama(101,103) were selected randomly. The selection of children in this study was done after agreement of their parents.

2.2. Reagents

- Potassium chlorate (KClO3).
- Sodium chloride (Na Cl).
- Sulfuric acid (H_2SO_4).
- Ceric ammonium sulfate (Ce $(NH_4)_4$ $(SO_4)_4$. 2H2O).
- Deionized water (H_2O).
- Potassium iodate (KlO_3).
- Chloric acid solution.
- Arsenious acid sulfate solution.
- Ceric ammonium sulfate solution.
- Standard iodine solution.

2.3. Aqueipment and apparatus

- Vented fume hood with perchloric acid trap.
- Thermometer.
- Test tubes (13mm × 100mm).
- Reagent flasks and bottles.
- Pipettes.
- Titration vessel: conical flask 250 ml
- Beaker 400 ml.
- Magnetic stirrer.
- Pipettes, volumetric.
- Burettes.
- Pipettes
- Volumetric flask
- Conical flasks
- Measuring cylinder

3. Methods

3.1. Clinical assessment for goiter

A clinical assessment for goiter was done by a team of physicians doctors. The thyroid gland was examined by palpation method according to criteria recommended by the World Health Organization (WHO,1997) and International Council for the Control of Iodine Deficiency Disorder (ICCIDD,

1990). According to this criteria, goiter is classified as follows:

- 0: No goiter
- Grade1A: Thyroid lobes larger than ends of thumbs.
- Grade1B: Thyroid enlarged, visible with head titled back.
- Grade 2: Thyroid enlarged, visible with neck in normal position.
- Grade 3: Thyroid greatly enlarged, visible from 10 meters.

Grade 2 and grade 3 are collectively called visible goiter.

3.2. Laboratory investigations:

3.2.1. Urine iodine concentration test

Iodine in urine was used as a marker for status assessment of iodine deficiency disorder (IDD). The following values serve as guide for IDD status (WHO, 2001):

- Severe: < 2µg/dl;
- Moderate: 2 - 4.9 µg/dl
- Mild: 5-10 µg/dl
- Normal: >10 µg/dl

3.2.1.1. Sample collection

Urine samples from study students were collected. A few drops of formalin were added to each urine sample and it was kept refrigerated until transferred to the lab for determine the urinary iodine excretion.

3.2.1.2. Principle of test

The urine is digested in strong acid at high temperature; after wards iodine acts as a catalyzing agent to accelerate the color change of ammonium sulfate with arsenic acid. The rapidity of the change in color depends on the iodine concentration. Assessment of the color intensity and the iodine content, comparing to standard solution with known iodine content was performed with colorimeter. This reaction, which is called the Sandell-Kolthoff reaction (1973), has been diagramed as follows:

$$2Ce^{+4} \xrightarrow{\quad + \quad} 2I^{-}2Ce^{+3} + I_2$$

$$I_2 \xrightarrow{\quad + \quad} As^{+3}As^{+5} + 2I^{-}$$

The ceric ion has a yellow color, while the cerous is colorless (karmarker, *et al.,*1986)

Procedure of test

Firstly, each urine samples were shaked vigorously for even distribution of any suspension. 250µ1 was pipetted from the urine sample into a 13×100 mm test tube. Another blank (250µ1of water) was also prepared in 13×100 mm test tube. A set of iodine standard (250µ1 for each tube) at different concentrations were also prepared including 2, 5, 10 and 15 µg/dl. To each tube containing urine sample, blank and standards chloric acid solution was added (total 750 µl), then mixed gently and heated for 50 – 60 minutes in a heating block at 115 C ^{0}. After cooling to room temperature about 3.5 ml of arsenious acid solution was added to each tube and mixed by inversion and kept for 15 minutes at the same temperature. Ceric ammonium sulfate (350 µ1) was added quickly to each tube and mixed well using vortex. fter 20 minutes of addition of ceric ammonium sulfate, the absorbance for each sample was measured at 450 nm using colorimeter.

Iodine concentration of each standard against its absorbance reading was plotted to draw a standard curve. Iodine concentration for each sample was determined in g/dl from standard curve, using the sample absorbance.

3.3. Questionnaire

Containing information about the demography, nutrition, source of drinking water, usage of iodine salt, and the student school performance.

4. Results

4.1. Goiter prevalence

Clinical assessments of the study sample for goiter were showed that the majority of students (94.7%) did not have a palpable goiter. The most prevalent form was visible goiter (grade 1A and grade 1B) seen in (4.5%). Only (0.7%) either had G2 or G3 stage of goiter. Figure (1) shows that

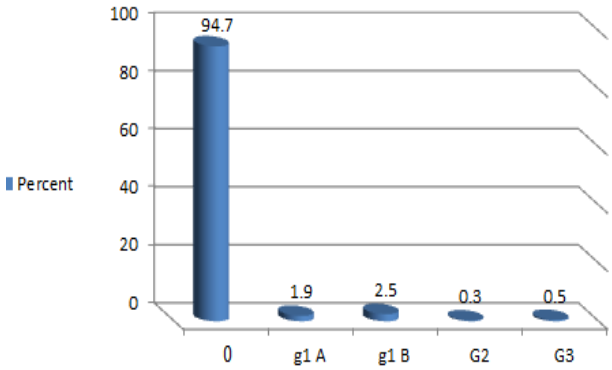


Figure (1): distribution of goiter in the study sample

4.2. Iodine deficiency disorders

Our study results reflected high percent of study sample (84%) were suffering form of iodine deficiency while the remaining (16.1%) were found to be adequate ID. Table (1) illustrate that.

Table (1): Distribution of iodine deficiency in study participants

Classification of Iodine deficiency	*Percent (%)*
Severe ID	***3.6***
Moderate ID	***22.4***
Mild ID	***58.0***
Adequate	***16.0***
Total	***100***

5. Discussion

5.1. Goiter assessment

The prevalence of goiter shown in the Elmatama is lower than many studies conducted in different zones of Sudan such as Ahmed (2015) in Shendi (14.6%), Abdel Monim et al.,(1968) in Port Sudan (13.5%), Eltom, et al, (1984) in Darfur (85%) and Abdel Rahim (2005) in Kosti, Rabak and Jebel Awlia areas (53%). This difference in percentage of goiter incidence may be atriutted to variation in the foodstuffs consumption according to nutritional culture.

Urinary iodine excretion is the most important marker for assessing the iodine deficiency in any population, due to the effective clearance of this element by the kidneys (Medani, et al, 2011). Investigation of the urinary iodine excretion of present study sample showed most of them had mild iodine deficiency (58%), followed by (22.4%) were moderate and (3.6%) were severe ID. These results were better compared with results conducted by Ahmed (2015) on Shendi basic school children which 18.9%, 19.3% and 69.9% were severe, moderate and mild iodine deficiency respectively. Iodine deficiency is much higher than the physical goiter assessment is consistent with findings by Medani, et al, (2011) where goiter prevalence and urinary iodine concentration showed no correlation with each other. Other authors have cited additional goitrogenic factors such as anemia and low vitamin A levels, besides insufficient iodine to have a role (Elnour, et al., 2000).

The comparison of urinary iodine concentration according to WHO scales between both sexes showed that female (54 %) were more affected by iodine deficiency than male (46 %). In addition

all three categories of the iodine deficiency, the ratios of females were higher than males (severe 4% vs 3%, moderate 30% vs 23% and mild 65%.vs 73%). In a recently published study done in Shendi region 26.9% of females were suffering from iodine deficiency, 10.8% of them had severe iodine deficiency, 19.3% of them had moderate iodine deficiency and 69.9% of them had mild iodine deficiency. While 19.9% of males were suffering from iodine deficiency, 8.8% of them had severe iodine deficiency, 20.6% of them had moderate iodine deficiency and 70.6% had mild iodine deficiency (Ahmed, 2015). Student age also was found to be an important factor in prevalence of iodine deficiency, students between the age of 7-9 years were most commonly affected by iodine deficiency. The highest prevalence for all categories was seen at 9 years of age. This results were similar have seen in the study in the Shendi region (Ahmed, 2015). Although the prevalence of iodine deficiency is higher in Elmatama as compared to Shendi region, but a smaller percent was suffer from severe deficiency, this could be explained due to better nutritional intake and free goitrogenic in Elmatama area.

8. Conclusion and Recommendations:

The incidence of iodine deficiency in the elementary school students showed that most of the students had mild iodine deficiency (58%), moderate (22.4%) and (3.6%) had severe ID. The association between iodine deficiency and school zone was statistically significant. Most of the students with severe and moderate iodine deficiency belonged to Alnorab zone (29%).

Iodine Deficiency Disorders (IDD) are one of the biggest public health problems in Sudan. Children are a vulnerable group at risk of developing goiter and iodine deficiency, hence require special initiatives to avoid iodine deficiency. Based on the robust information obtained from this study, following recommendations are suggested;

- An assessment of existing IDD control programs is needed and strong consideration should be given to implement universal salt iodization program.
- School students and their parents should receive health education to ensure use of iodized salt.

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