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Feasibility of thyroid ultrasonography in field studies in a developing country, Ghana.

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Summary

This study was carried out to determine the feasibility of using ultrasonography for goitre estimation in the field situation. It is a cross sectional study that was conducted using community based cluster sample. Thyroid sonography was performed on 112 randomly selected school children aged 10-15 years from two districts in the Greater Accra area of Ghana, using normative values for thyroid volume recommended by WHO/ICCIDD. The mean age of all subjects was 13.5 years ± 0.13 SEM. The male to female ratio was 1 : 1. The mean height and weight of the children were 1.5 metres ± 0.9 SEM and 38.1 Kg ± 0.7 SEM, respectively. The mean body surface area was 1.27 m^2 ± 0.2. There were no significant gender differences in their ages (13.6yrs ± 0.2 SEM, 13.4yrs ± 0.1 SEM, respectively) and height (1.50m ± 1.6 SEM, 1.46m ± 1.7 SEM, respectively). The girls (40.0kg ± 1.2 SEM) weighed more than the boys (35.6kg ± 1.1). The mean and median urinary iodine concentration were 82.4 ± 8.5 SEM and 67.9 ug/l, respectively. All the children examined had normal thyroid sonogram. The thyroid volumes ranged from 3.6 ml to 15.3ml. The mean thyroid volume was 7.0ml ± 0.2 SEM and the thyroid volume was higher in the girls (7.5ml ± 0.3 SEM) than the boys (6.5ml ± 0.2 SEM). The criteria of thyroid volume per age and sex yielded a goitre prevalence of 1.8 %. In contrast, the criteria of thyroid volume by surface area yielded a goitre prevalence of 8 %. Our study has shown that it is feasible to employ ultrasonography for field studies to determine goitre prevalence in school children in a developing country such as Ghana. However, the best criteria for goitre in children in Ghana, requires to be confirmed in future studies.

Keywords: *IDD, goitre, thyroid volume, ultrasonography, school children, iodine deficiency disorders, African, Ghanaian.*

Résumé

Cette étude croisée était faite pour déterminer la faisabilité de l'ultrasonographie pour l'utilisation de la goitre dans les communautés. La sonographie de la thyroide était faite sur 112 écoliers choisi au hazard et agés de 10-15 ans dans 2 districts d'Acrra au Ghana utilisant les valeurs normatiques pour le volume de la thyroide recommendé par l'OMS(ICGDP). La moyenne d'age était de 13.5± 0.13 ans. La proportion male et femele était de 1 :1. la taille moyenne et le poids moyen étaient de 1.5±0.9 m et 38±0.7 kg respectivement. La surface moyenne du corps était de 1.27±0.2M2. Il n'y avait pas de difference significante entre gendre et l'age (13.6±0.2years ; 13.4±0.1ans) et au poids (1.50±1.6m ; 1.46 ±1.7m). Le critére de volume de la thyroide par age et sexe produisait une prevalence de goitre de 1.8 contrairement par rapport a la surface de corps de 8%. Tous les enfants examinés avaient un sonogramme de la thyroide normale, Les volumes de thyroides variaient entre 3.6-15.3 ml . le volume moyen de la thyroide était de 7.0±0.2 ml . ceci était plus élevé chez les filles (7.51±0.3ml qu'aux garcons(6.5±0.2ml). Cette étude montarit l'usage de l'ultrasonographie sur le terrain pour déterminer la prevalence de la goitre parmi les écoliers en pays sous – developés comme le ghana. Cependant, la confirmation de la goitre demande d'études plus approfondies.

Introduction

Iodine deficiency disorders (IDD) represents the varied spectrum of effects of iodine deficiency on growth and development and they include, endemic goitre, endemic cretinism, impaired mental function, increased stillbirths, perinatal and infant mortality [1]. They constitute a major public health problem with considerable morbidity and socioeconomic cost [2-4]. Recent reports from various parts of Africa suggest that IDD is widespread [5-7].

School age children are a convenient and useful target group for IDD surveillance because of their combined high vulnerability, usefulness and easy accessibility for surveys. They are however less representative, as children not attending school are not represented which may result in biased goitre estimates [8]. Palpation of the neck which is the most widely used method for goitre estimation in surveys, is less reliable in children. Ultrasonography provides a more precise measurement of thyroid volume compared with palpation. [9,10]. Ultrasonography therefore provides a fairly accurate means of evaluating and monitoring IDD in communities. Several developing countries are embarking on programmes to control and eradicate IDD. Ultrasonography of the thyroid could facilitate the accurate monitoring of such interventions. Thyroid sonography could also be employed in the setting of primary health assessment of school children and form

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part of school age screening programmes in IDD endemic areas in developing countries. The cost of an ultrasound study may however, hinder its widespread adoption and use as an IDD assessment and monitoring tool in developing countries most of which have relatively low GNP. We present a report on the use of ultrasonography in a community setting in Ghana. To the best of our knowledge this is the first study of its kind to employ sonography in field studies to determine goitre prevalence in school children in a non-endemic area in the West African sub-region.

Methods and procedures

Study design and population

A community-based, cluster sampling design and cross-sectional study was carried out in school children, aged 10 to 15 years, from the coastal districts, Tema and Dangbe-East, of southern Ghana.

Sample size

Using an expected goitre prevalence of 10 % and worst acceptable prevalence of 2 % and confidence interval of 95%, the Statcalc function of Epinfo (Centre for Disease Control, Atlanta, Georgia, USA and World Health Organization, Geneva, Switzerland), gave a sample size of 54. Multiplying by the maximum design factor of 2 for cluster sampling yielded a final sample size of 108.

Sampling frame

Three electoral enumeration areas from the Tema District and one electoral enumeration area in Dangbe-East District were randomly selected and one school randomly selected per enumeration area. From the four schools, 112 school children were randomly selected.

Methods

The height of subjects was measured with a stadiomter to the nearest centimetre. Weight was measured to the nearest 0.1kg in subjects wearing light clothing. Portable ultrasound equipment, Philips SDR 1200 (Philips, Netherlands), with a 5 MHz transducer, was employed for the assessment of thyroid echo structure and volume. A cross sectional image of the thyroid was obtained with the aid of ultrasonic gel and the maximal width (W) and depth (D) of each lobe of the thyroid were measured in millimetres. Additionally, a longitudinal scan of each lobe of the thyroid was obtained and the length (L) of each lobe was measured in millimetres. Thyroid volumes were calculated from the ellipsoid model formula [11]:

Total Thyroid Volume = [(W x D x L) right lobe + (W x D x L) left lobe] x 479 ml .

On account of limited resources, urinary iodine estimation was possible for only a subset of subjects. Every other child examined provided 20ml of spot urine which was preserved with 0.1ml of concentrated acetic acid and stored at -20° C until analysis. Urinary iodine was determined by a modified Sandell-Kolthoff reaction.

Data analysis

Presence of goitre was determined using the criteria of Delange *et al*, which have been endorsed by the World Health Organization (WHO) and the International Council for Control of Iodine Deficiency Disorders (ICCIDD) [11,12]. Epinfo version 6 was used to calculate the means and standard error of means (SEM). The student t-test was used to compare differences between means. SPSS was used for bivariate analysis.

Results

The mean age of subjects was 13.5 years ± 0.1 SEM. The male : female ratio was 1 : 1. Table 1 shows the mean characteristics and goitre prevalence of the study population by gender. The mean height and weight of the children were 1.5 metres ± 0.9 SEM and 38.1 kg ± 0.7 SEM, respectively. There were no significant gender differences with respect to age and height. The girls weighed more than the boys (Table 1).

Table 1: Characteristics (mean SEM) of school of children from the Tema and Dangbe-East Districts of Greater Accra Region Ghana.

Parameter	Female n = 55	Male n =57	All
Mean age (y)	13.6±0.2	13.4±0.1	13.5±0.1
Mean height (m)	1.50±1.6	1.46±1.7	1.5 0.9
Mean weight (kg)	40.0±1.2	35.6±1.1*	38.1 0.7
Urinary iodine (µg/L); n-55	84.0±15.0	81.0±9.2	82.4 8.5
Mean thyroid volume (ml)	7.5±0.1	6.5±0.2*	7.0 0.2
Goitre (%) per age and sex# (Delange *et al*).			1.80%
Goitre (%) per body surface area# (Delange *et al*)			8%
Goitre (%) per age and sex! (Gutekunst *et al*.)			11.60%

* *P<0.05*
\# *Ref. 11,12*
! *Ref. 9*

All children examined had normal thyroid sonograms. Thyroid volumes ranged from 3.6 ml to 15.3ml with a mean and median thyroid volumes of 7.0 ml ± 0.2 SEM and 6.6 ml respectively. Thyroid volumes were higher in the girls than the boys (Table 1). Using the WHO and ICCIDD recommended criteria of thyroid volume per age and sex for iodine replete European children [11,12], 1.8% of subjects had increased thyroid volume. However, when the recommended criteria for thyroid volume and body surface area [11,12] were employed, 8% of the children had goitre. The older Gutekunst et al., (9) criteria gave an even higher prevalence rate of goitre (11.6%).

Urinary iodine levels ranged from 0.7-281.1 ug/l with a mean and median of 82.4 ± 8.5 and 67.9ug/l, respectively. Figure1 shows the distribution of urinary iodine concentration in a subset of children who provided urine for analysis. Of the fifty five children who had their urine analysed for urinary iodine, only one subject had urinary iodine level less than 10ug/l. The Pearson's correlation coefficient for thyroid volume and urinary iodine concentration was -0.128 at 2-tailed significance of 0.35.

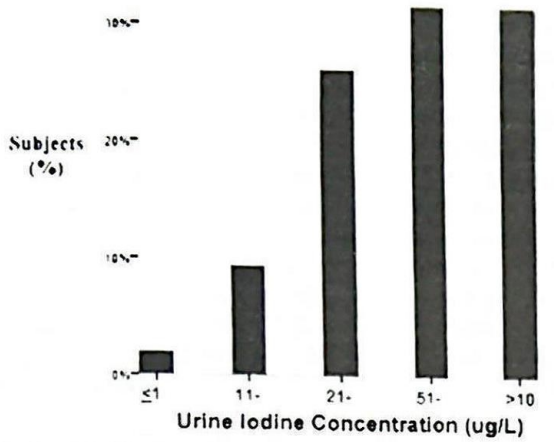

Fig. 1: Distribution of urinary iodine concentration

Discussion

Sonography is a practical and accurate tool for evaluating the size and the morphology of the thyroid gland. In our study all the children had normal thyroid echo texture on sonography. Using the criteria of Delange et al., endorsed by WHO/ICCID, we found a goitre prevalence of 1.8% when we employed the age and sex indices with respect to thyroid volume [11,12]. However when goitre prevalence was estimated using the recommended upper normal limits of thyroid volume, calculated according to body surface area [11,12], 8% of the children had increased thyroid volume. This later criteria had been recommended because of the possible differences in body development between children of the same age in different countries [11,12]. It must be noted that Tema and Dangbe-East are coastal districts with mean urinary iodine excretion greater than 5?g/l [13] and presumably with normal iodine intake. It must be noted that only one out of fifty five of our subjects who had their urinary iodine measured had iodine excretion of less than 10 ug/l. The criteria employing surface area to determine thyroid volume appears therefore to be inappropriate for Ghanaian children. It appears that currently, the criteria of thyroid volume by age and sex as recommended by Delange et al. and WHO/ICCIDD may be the most appropriate standard for determining the presence of goitre in Ghanaian children. Further studies are however needed to confirm our findings in other populations in the West African sub-region. The Gutekunst et al. (9) criteria led to an unacceptably high prevalence of goitre (11.6%) and thus appear unsuitable for thyroid volume evaluation in Ghanaian children.

In conclusion, our study has shown that it is feasible to employ ultrasonography for field studies to determine goitre prevalence in school children in a developing country such as Ghana. Sonography has great potential for accurate characterisation of goitre prevalence in Ghanaian school children and may facilitate monitoring of the national iodisation programme. However, the two recommended criteria for goitre estimation by WHO/ICCID gave differing results in our subjects. The best criteria for goitre determination in children in Ghana therefore require to be confirmed in future studies.

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