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Original Article

Assessment of iodine supplementation program on thyroid function in Sudan

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ABSTRACT

The aim of this Study is to investigate whether the Iodine Supplementation Programme is successful or not. This Programme was implemented in Nyala to treat the Iodine deficiency. In this Study Nyala was selected to act as (a study area), due to the history of Iodine deficiency of this region, while Khartoum was selected to act as (a control area). 2000 samples were collected from Khartoum versus 450 samples from Nyala. Thyroxine (T_4) and triiodothyronine (T_3) levels in two regions were measured and performed by using radioimmunoassay (RIA), also the immunoradiometric assay (IRMA) used for measurement of thyroid stimulating hormone (TSH). The obtained results analyzed by using Statistical Package for Social Sciences (SPSS). (Coherent retrospective) used to determine differences between the study groups. The results of this study showed, there was no significant difference between the mean serum concentrations of T3 and TSH for Khartoum and Nyala. T4of Khartoum (117.93 ± 42.797) nmol/L and the mean serum T4 of Nyala (114.54 ± 45.526) nmol/L, the (P-value = 0.133).T3for Khartoum (1.8040 ± 0.99047) nmol/L and T3of Nyala (1.7307 ± 0.96508) nmol/L, the (P-value = 0.153). TSH for Khartoum (1.4480 ± 0.95807)mIU/Land the mean serum TSH of Nyala (1.4553 ± 1.0244) mIU/L, the (P-value = 0.885). The study showed a clear observation of improvement of hypothyroidism cases in Nyala while the ratio decreased from 64.09% to 0.6%. All the results were carried out according to normal range of Sudanese. The conclusion from this study the iodine supplementation programme is successful. The study recommends rising the health awareness among people by explain the severity of iodine deficiency, and continue in iodine supplementation programme, also establishment of monitoring system including monitoring the presence of iodized diets (sugar, salt, oils, and bread) in the markets. Finally, further studies are needed in other parts of Sudan to assess the size of iodine deficiency problem.

1. Introduction

It is estimated that 2 billion people in the general population have insufficient iodine intake [8]. Iodine deficiency has many antagonistic health effects, which jointly are termed iodine deficiency disorders (IDD). These disorders results from poor manufacturing of thyroid hormones due to unsatisfactory amount of iodine. The main concern of the IDD is goiter [10·25,26]. The prevalence of goiter is higher in women than in men [18].In many people with a goiter, the goiter does not affect the amount of thyroxine (T4) or triiodothyronine [20] that they make, while in some people, the goiter is associated with an abnormality of thyroid function. Goiter is caused by many factors for example, consumption of pearl millet particularly in western Sudan, which is considered as a main crop. Pearl millet contains thiocyanate (SCN) which competes with iodine in thyroid gland, also the deficiency of vitamin A affected in thyroid gland [4]. The endemicity of goiter in Sudan was studied early by many researchers. In 1967 Kambal conducted an extensive survey included 17470 people in Darfur [16]. reported that 57% were goitrous and 18.5% of these had large goiter. The frequency of endemic goiter among school children in Darfur was 85% [13]. Another survey was a comparison between the effects of thyroxine versus iodine in the treatment of simple goiter [3] The study showed the overall prevalence of goiter in population was 22.3%. Another study was performed to study the effect of

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Table 1
Percentages of Subjects According to the normal range of Thyroid hormones and Mean serum Concentration for each level in Khartoum group:(N = 2000).

Hormone (Normal Range)\1	Normal level (%) (Mean ± SD)	High level (%) (Mean ± SD)	Low level (%) (Mean ± SD)
(T_4) 50–160) nmol/L\1	78.5 (108.98 ± 24.209)\1	20.9 (202.00 ± 35.373)\1	0.6 (24.77 ± 14.285)\1
(T_3) 0.8–3.0) nmol/L\1	79.5 (1.6081 ± 0.56253)\1	19.8 (4.2573 ± 1.17770)\1	0.7 (0.4939 ± 0.19792)\1
TSH (0.5–5)mIU/L	45.8 (1.5312 ± 0.87302)\1	53.4 (2.575 ± 2.785)\1	0.7 (0.2570 ± 0.10148)\1

iodine supplementation in a goiter endemic area [6,4]. reported the percentages of the hypothyroidism in Nyala and Khartoum were 64.09% and 14.5% respectively. The last study of goiter reported by Ref. [17], this study was conducted in six secondary schools girls in Nyala – South Darfur state. The results showed that prevalence rate of goiter grade 2were 41% among the secondary school. Iodine deficiency is a serious and complicated problem and endemic in many developing countries but the endemicity is more in countries which suffering from other problems and crisis such as civil wars and poverty like Sudan. Its influence extend to all people: Pregnants, Adults and Fetus [21].In last two decades a programme of iodine supplementation in western Sudan is running [2], and this study aiming to assess the role of this program in correcting iodine deficiency in the region.

2. Materials and methods

The study was conducted between January and May 2016 in Nyala city western Sudan in Darfur region. Nyala is a town about (1700) km from Khartoum with one million inhabitants. Venous blood samples (2000 and 450 samples from Khartoum and Nyala respectively) were collected and allowed to clot in plain tubes, and the serum stored at (−20C) until analyzed in Elsafwa laboratory for measurement of serum thyroid stimulating hormone, triiodothyroxine and thyroxin using Radioimmunoassay gamma counter (Riostad, Germany) and kits provided by Beijing Isotope Nuclear Electronic Co., Beijing, China. Data were entered into computer using Statistical Package for Social Sciences (SPSS) software version (20; SPSS Inc., Chicago, IL). The mean and the standard deviation were carried out.Data of the two groups (study and control) were presented as mean ± standard deviations (SD).One −sample test was used to check the normality of data.(Student T-test) was used to determine the significance difference between variables after ensure that all data were normally distributed. Parameters with P-value less than or equal to 0.05 were considered to be significant. Pearson bivariate correlation was used to correlate between hormones. The study received ethical clearance from the Research Board at the Sudan Federal Ministry of Health.

3. Results

There was no significant difference between the mean serum concentration of T4 for Khartoum region and the mean serum For Nyala (P = 0.133) as shown in Table 3. There was no significant difference as well between the mean serum concentration of T3 for Khartoum region and the mean serum of Nyala (P = 0.153) as shown in Table 4. There was no significant difference between the mean serum concentration of TSH for Khartoum region and the mean serum of Nyala (P = 0.885) as shown in Table 5. There was strong + ve correlation between HighT_4 and TSH in (Khartoum and Nyala) case groups (r = 0.036, 0.186) respectively as shown in Tables 1 and 2 respctively. There was weak + ve correlation between Low T_4 and related TSH in (Khartoum and Nyala) case groups (r = 0.149, 7.385E-4) respectively as shown in figures (3 and 4) respectively.

4. Conclusion

In the current study, the obtained results showed that the hormones concentrations in Nyala are closely similar to those of Khartoum showed Tables 1 and 2. The percentages of subjects that have low T_4 in two regions (Khartoum as a control area) and (Nyala as study area) are the same (0.6%), Low T_4 indicated hypothyroidism. There were several studies conducted in Sudan concerning thyroid function For example a comprehensive survey study of [4,14] reported that the percentages of hypothyroidism (Low T_4 Low T_3) in Nyala and Khartoum were 64.09% and 14.5% respectively, also [5]mentioned the percentages of hypothyroidism 45% and 26% in western and central Sudan respectively. The percentage of hypothyroidism in current study is only 0.6% with amazing decrease comparing to the previous mentioned studies. (Omer, 2009) Study showed that 3% of the subjects were complaining of hyperthyroidism (High T_4High T_3), and 5% were complaining of hypothyroidism [7]. Study showed that 13.7% of the study population had hyperthyroidism while 3.9% of the subjects hypothyroidism.

In the current study the results showed there was no significant difference between the serum concentration of T_4 for Khartoum region and that of Nyala, the mean serum was (117.93 ± 42.797) and (114.54 ± 45.526) nmol/L respectively and the (P-value = 0.133), this due to the similarity of percentages of T_4 in the two regions as shown in Tables 3 and 4 Also there was no significant difference between the mean serum concentration of T_3 for Khartoum and the mean serum of Nyala (1.8040 ± 0.99047) and (1.7307 ± 0.96508) nmol/L respectively and the (P-value = 0.153),.Also there was no significant difference between the mean serum concentration of TSH for Khartoum and that of Nyala (1.4480 ± 0.95807) mIU/L and (1.4553 ± 1.02440) mIU/L respectively and (P-value = 0.885), although the percentage of the subjects who have normal range in Nyala 64.8% was higher than the subjects who have normal range in Khartoum45.8%, but this was balanced by the high percentage of low TSH in Nyala Cases1.3% Compared with those of Khartoum 0.7%, this Explain why there was no difference between the two means of TSH in two regions.

High T_4 and high T_3 in Khartoum was 20.9% and 19.8% respectively and the Low T_4 and Low T_3 was 0.6% and 0.7% respectively, also in Nyala the percentages are similar to Khartoum, this agree

Table 2
Percentages of Subjects According to the normal range of Thyroid hormones and Mean serum Concentration for each level in Nyala group:(N = 449).

Hormone (Normal Range)\1	Normal level (%) (Mean ± SD)	High level (%) (Mean ± SD)	Low level (%) (Mean ± SD)
(T_4) 50–160) nmol/L\1	77.3 (104.38 ± 25.152)\1	22.0 (206.00 ± 39.360)\1	0.6 (25.42 ± 12.350)\1
(T_3) 0.8–3.0) nmol/L\1	79.9 (1.5323 ± 0.53466)\1	19.7 (4.1297 ± 1.31717)\1	0.5 (0.5286 ± 0.22887)\1
TSH (0.5–5)mIU/L	64.8 (1.5441 ± 0.88402)\1	33.9 (1.4553 ± 1.02440)\1	1.3 (0.2733 ± 0.11160)\1

Table 3
Mean Level of Thyroxine (T4) For Khartoum vs. Nyala.

Region	N	Mean ± SD	P-value
Khartoum	2000	117.93 ± 42.797 nmol/ L	0.133
Nyala	450	114.54 ± 45.526 nmol/ L	

Table 4
Mean Level of Triiodothyronine (T3) For Khartoum vs. Nyala.

Region	N	Mean ± SD	P-value
Khartoum	2000	1.8040 ± 0.99047 nmol/ L	0.153
Nyala	450	1.7307 ± 0.96508 nmol/ L	

Table 5
Mean Level of Thyroid Stimulating Hormone (TSH) For Khartoum vs. Nyala.

Region	N	Mean ± SD	P-value
Khartoum	1995	1.4480 ± 0.95807 mIU/ L	0.885
Nyala	441	1.4553 ± 1.02440 mIU/ L	

with what found by Laurence et al. [19] that T_4 is elevated with T_3 and vice versa. The percentages of High TSH in Khartoum 53.4% and in Nyala 33.9% showed that the response of TSH for treatment (Thyroxine) is taking more time to improve.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.dsx.2018.11.036.

References

[2] Abdelmonim M, Elnour H, Amal. Endemic goiter in the Sudan despite long-standing programme for control of iodine deficiency disorders. Bulletin ofWHO 2010;89:121–6. 2011.
[3] Abdelmonim MH. Studies on simple goiter in Omdurman. Master Dissertation. Sudan: Khartoum University; 1993.
[4] Abdelmonim MH. Studies on simple goiter Epidemiology and A etiology in Sudan. PhD Dissertation. Sudan Academy of Science; 2008.
[5] Abdurrahman AA. Urinary iodine levels in sudanese patients with thyroid disorder s. Khartoum. Sudan: Master thesis; 2005.
[6] Babiker E,N. Iodine supplementation in a goiter endemic area. Sweden: Doctor Degree in Medical Science Uppsala University; 1996.
[7] Dafalla E. Assessment of thyroid hormones level in thyroid patients using radioimmunoassay (RIA). Master Dissertation. Sudan University of Science and Technology; 2010.
[8] De Benoist B, Mc Lean E, Anderson M, Rogers L. Iodine deficiency in 2007: global progress since 2003. Food Nutr Bull 2008;29(3):195–202.
[10] Dunn JT. Iodine deficiency and its elimination by iodine supplementation. In: Braverman L, editor. Diseases of the thyroid (2nded). Totowa: Human press; 2003. p. 329–46.
[13] Elnour L, Habraeus M, Eltom M. Endemic goiter with iodine sufficiency: possible role for the consumption of pearl millet in the etiology of endemic goiter. Am J Clin Nutr 2000;71:59–66.
[14] Eltom A, Eltom M, Idris M, Gebre-Medhin M. Thyroid Function in the newborn in relation to maternal thyroid status during Labour in amild iodine deficiency endemic area in Sudan. Clin Endocrinol 2001;55:485–90.
[16] Kambal A. Endemic goiter in Darfur, Sudan. M.S.thesis. Sudan: Khartoum University; 1969.
[17] Khalid M Osman. Goiter among secondary schools girls: prevalence and associated factors in Nyala. Master Dissertation. University of Khartoum; 2010.
[18] Knudsen N, Laurberg P, Perrild H, Bulow I, Ovesen L, Jorgensen T. Risk factor for goiter and thyroid nodules. Thyroid 2002;12(10):879–88.
[19] Laurence DM, Spencer CA. LMPG: laboratory support for the diagnosis and monitoring of thyroid disease. USA): National Academy of Clinical Biochemistry; 2002.
[20] Mastorakos G, Nezi M, Papadopoulos C. The iodine deficiency disorders. Available at, WWW.Thyroidmanager.org/ Chapter20/20-frame.htm. [Accessed 17 June 2007].
[21] Navnit K Grewal. Iodine status and thyroid function among lactating women in saharawi refugee camps ,Algeri.Masterthesis. Norway: Akershus University College; 2011.
[25] Zimmermann MB. Iodine deficiency. Endocr Rev 2009;30(4):376–408.
[26] Zimmermann MB, Jooste PL, Pandav CS. Iodine deficiency disorders. Lancet 2008;372:1251–62.