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## Nodular Lesions of the Thyroid in an Area of High Background Radiation in Coastal Kerala, India\*

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An epidemiological study of the nodular lesions of the thyroid was carried out in a population living in an area of high background radiation in coastal Kerala. The results were compared with the results of a similar study carried out in a comparable population living in an identical coastal strip without high background radiation. A sample of the nodular lesions from both the study and control area was surgically resected and histopathologically examined. The results did not reveal any high incidence of nodular lesions or neoplasms in the area with high background radiation.

### Introduction

Nodular lesions and neoplasma can occur in the human thyroid on exposure to ionising radiations (Conrad and Hickling, 1965; Simpson *et al.*, 1955, 1957). Most of these result from acute exposures of hundreds or thousands of R caused by iatrogenic factors of fall-out following atomic explosions. However, the effect of chronic low grade exposure of the type that occurs in an environment of high natural radiation on the human thyroid is not known. It has been reported that thyroid neoplasms have high prevalence rates in Kerala State (Report to the I.C.M.R., 1967) in India. A good proportion of these appear to come from the Quilon district of the State, which has a coastal belt of high background radiation known as the Chavara-Neendakara area (Map). The soil of this area contains monazite, a mineral sand containing radioactive thorium. The background radiation in this area has been estimated to be over 1500 mR/year (W.H.O., 1959; Ponnunni Kartha, 1968).

In order to test the possibility that high natural radiation may induce nodular lesions and/or neoplasma in the thyroids of the people living in this area, we made an epidemiological study with the following objectives: (1) To estimate the prevalence of nodular lesions of the thyroid and to establish their clinical characteristics in a representative sample of the population living in the radiation area, as well as in a control population which is comparable, but not exposed to high background radiation.

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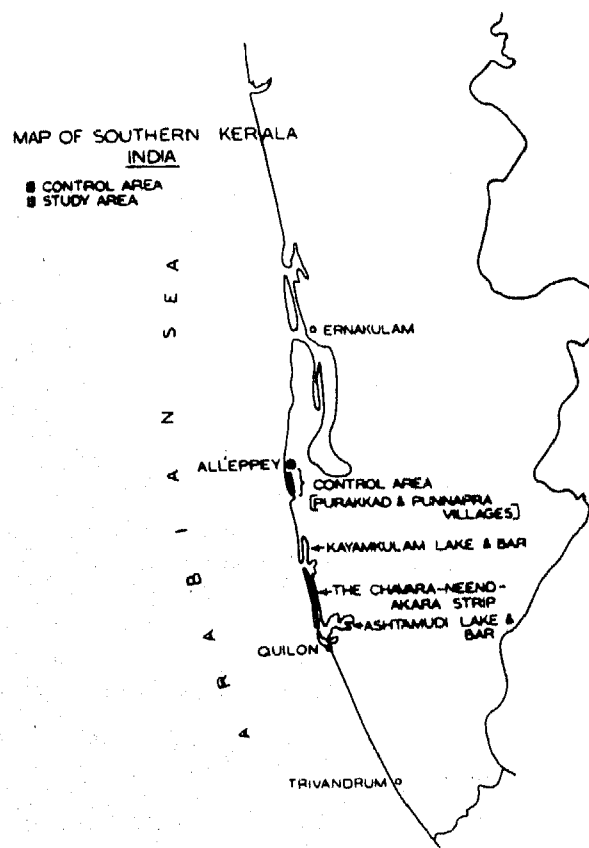
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(2) To establish the pathological identity of a sample of the detected lesions by surgery. We report the results of the study in this communication.

### Material and Methods

A geographically well defined southern part of the Chavara-Neendakara area (Map) with a population of over 12,000 was selected as the study area. This area has been shown to have the highest radiation exposure risk in the entire coastal strip (Gopal Ayengar *et al.*, 1972). An identical coastal strip of the Purakkad village in Alleppey district (Map), where the background radiation has been shown to be normal (Gopal Ayengar *et al.*, 1972), was selected as the control area for the study. This area had a population of about 6,000 in 1,000 households.

Map of Southern Kerala showing study and control areas.



Each household in the study and control area, was visited by a team comprising the clinical investigator and local health auxiliaries for collection of demographic data and examination of the members of the household for thyroid swellings. Repeated house visits were made to ensure examination of all members. Demographic and clinical data were collected with the aid of a predesigned proforma.

Subjects detected to have thyroid swellings were given follow-up cards and were requested to come for detailed clinical evaluation and follow-up studies. All the thyroid swellings detected, neoplastic or non-neoplastic, were recorded as positive findings. They were clinically categorised as solitary nodule, multinodular goitre and diffuse goitre. A solitary nodule was arbitrarily defined as a discretely palpable single nodule, more than 0.5 cm. in diameter, in relation with any one of the lobes of the thyroid or the isthmus, with the remaining gland either impalpable or normally palpable. A multinodular goitre was defined as a diffusely enlarged gland with more than one discrete nodule palpable. A uniform soft enlargement of the gland with no nodularity or palpable variation in consistency was categorised as diffuse goitre. The functional status of the gland was assessed clinically. Provisional clinical diagnosis of cancer of the thyroid was made in such thyroid swellings which were of relatively recent origin, with rapid rate of growth, presence of regional lymph adenopathy, pressure symptoms and the presence of clinical evidence of metastatic disease. Patients with nodular lesions of the thyroid were persuaded to undergo operative treatment. Those who were willing were operated at the Medical College Hospital, Trivandrum. The clinical investigator was present at surgery for observing the gland personally at operation. The resected specimens were fixed and processed for histopathological study according to standard techniques.

### Results

**Demographic and epidemiological features :** The study area had a population of 12,936 while the control area had a population of 5,938.

**Age, sex and religion :** Table I gives the age-sex structure of the study and control populations. The populations were comparable in this regard. Hindus constituted 72 per cent of the study population, while Christians and Muslims constituted 26 and 2 per cent, respectively. In the control population, Hindus constituted 60 per cent while Christians and Muslims constituted 25.8 and 14.2 per cent, respectively.

**Living habits :** Both the study and control populations live predominantly in three types of houses, viz. type I with brick or clay-stone walls and tiled roof; type II with wooden walls and thatched roof and type III, thatched huts built directly on the sands. Majority of the people in both areas lived in type III houses. The floor area of these huts did not exceed 200 sq. ft. and there was much overcrowding and poor ventilation. Hence, except in monsoon months, the people spent most hours of the day and night working and sleeping in the open on the fine beach sands. Their daily habits were similar in both the study and control areas.

Table I. Age-sex structure of the study and control populations.

Age (yrs.)	Study population						Control population					
	Males		Females		Both sexes		Males		Females		Both sexes	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
1	201	3.04	200	3.16	401	3.10	79	2.65	96	3.31	175	2.98
1-4	792	11.97	705	11.15	1497	11.57	324	10.87	327	11.28	651	11.07
5-9	876	13.24	899	14.22	1775	13.72	432	14.49	388	13.39	820	13.95
10-14	965	14.59	939	14.86	1904	14.72	402	13.49	307	10.59	709	12.06
15-19	837	12.65	856	13.54	1693	13.09	368	12.34	367	12.66	735	12.50
20-29	977	14.77	862	13.64	1839	14.22	423	14.19	478	16.49	901	15.33
30-39	689	10.42	729	11.53	1418	10.96	333	11.17	369	12.73	702	11.94
40-49	573	8.66	532	8.42	1105	8.54	294	9.86	264	9.11	558	9.49
50-59	401	6.06	325	5.14	726	5.61	185	6.21	153	5.28	338	5.75
50-69	215	3.25	185	2.90	398	3.08	107	3.59	97	3.35	204	3.47
70 and above	89	1.34	91	1.44	180	1.39	34	1.14	52	1.79	86	1.46
Total	6615	100	6321	100	12936		2984	100	2898	99.98	5879	

Table II. Prevalence of thyroid swellings in study and control population.

Category	Study population prevalence per thousand population	Control population prevalence per thousand population
1. All thyroid swellings	13	14
2. All nodular swellings	11.4	12
3. Uninodular swellings	8.8	9

**Consanguinity :** While consanguinity was a religious offence among the Christians of the study and control population, first cousin marriages were not uncommon among the Hindus and Muslims of both the areas. In the study area, first cousin marriages were reported in 12 per cent of the families in the present generation, while in the control area, they were elicited in 15 per cent of the families.

**Diet, occupation and socio-economic status :** The dietary habits of the two populations were closely similar. The main source of calories was carbohydrates from tapioca

(*Manihot utilissima*) and rice. The protein source was mainly from fish in both the populations. Fishing and fish trading formed the main occupation of both the populations. Average family income did not exceed Rs. 1,200 per year and the bulk of both the populations was backward socio-economically.

**Duration of stay and migration :** During the study, special care was taken to elicit the details of migration into and out of the area of study and duration of stay. Also, special inquiries were made to see whether there was any migration from the study to the control area and *vice versa*. Over 95 per cent of the families have been residents of the respective areas for many generations and it was exceptional to see families moving into or out of these areas.

**Clinical observations :** Table II gives the overall prevalence of thyroid swellings in the study and control populations. Table III gives the age and sex specific prevalence of various clinical types of thyroid swellings encountered in the study and control populations. There was no significant difference between the two. Analysis of prevalence of thyroid swellings, in relation to religion and house types, did not reveal any significant association with these factors in the control and study populations.

Thirty-three persons with nodular lesions of the thyroid from the study area and 3 from the control area were persuaded to undergo surgery. Twenty-three of the 26 solitary nodules operated from the study area were pathologically adenomas. Most of the adenomas were well differentiated, containing varying amounts of colloid. The remaining three solitary nodules from the study area turned out, on histology, to be multinodular colloid goitre. Of the 7 multinodular goitres operated from the study area, one showed thyroiditis, while the remaining were nodular colloid goitre. None of the operated specimens showed malignant lesion histopathologically.

### Discussion

The role of radiation in the genesis of thyroid neoplasms has been attracting the attention of many investigators during the past two decades. Experimental and clinical studies have conclusively demonstrated that exposure to radiation of varying magnitude can produce nodular lesions of the thyroid, mostly neoplasms, in animals and men. It has also been shown that in man exposure to a dose ranging between 20 and 1225 R produces a dose-dependent linear response in terms of emergence of nodular lesions without any threshold phenomena (Hempelmann, 1968). However, there is no information about the radiobiological response of the human thyroid to the cumulative impact of a chronic low grade exposure from an environment of high natural radioactivity as encountered in the coastal radiation belt of Kerala.

A sample survey of exposure risk in the area of the present study has shown that the average radiation exposure inside the types I and II houses is 1500 mR/year while inside type III houses it is estimated to be over 3000 mR/year (Ponnuni Kartha, 1968). Recently, it has also been shown that the personal exposure involved in the study area is the highest in the whole radiation belt, and that it is closely similar to

Table III. Prevalence of thyroid swellings according to age and sex in the study and control populations\*.

Age yrs.	Study population						Control population									
	Solitary nodules		Multinodular goitre		Diffuse goitre		All thyroid swellings		Solitary nodules		Multinodular goitre		Diffuse goitre		All thyroid swellings	
	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F
<1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1-4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5-9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10-14	0	1.1	0	0	0	0	0	0	1.1	0	0	0	0	0	0	0
15-19	0	4.7	0	0	0	0	1.2	0	5.8	0	0	0	0	0	0	0
20-29	0	11.6	0	2.3	0	3.5	0	17.4	2.4	6.3	0	2.1	0	6.3	2.4	14.6
30-39	0	20.6	0	9.6	0	13.7	0	43.9	0	40.6	0	10.8	0	16.3	0	67.7
40-49	3.5	58.3	0	15.0	0	9.4	3.5	82.7	3.4	34.1	0	26.5	0	3.8	3.4	64.4
50-59	2.5	80.0	2.5	30.8	2.5	0	7.5	110.8	0	91.5	10.8	19.6	0	0	10.8	111.1
60+	9.8	80.3	3.3	14.6	0	7.3	13.2	102.2	14.2	73.8	0	46.9	0	0	14.2	134.2

\*Prevalence expressed per thousand population.

the household exposure profiles (Gopal Ayengar *et al.*, 1972). However, the true dose of radiation to the thyroid glands of persons living in this environment is not yet determined. The epidemiological features described, however, point to the possibility that considerable exposure is taking place, even after making allowances for the shielding effect of skin and subcutaneous tissue. The possibility of incorporation of radioactive trace elements into the thyroid of the people living in this area should also be considered.

The overall prevalence of thyroid swellings as shown in Table III in the study area was 13 per thousand; 68 per cent of these belonged to the clinical category of solitary nodules. Multinodular swellings constituted another 20 per cent, while the remaining 12 per cent were diffuse goitre. The prevalence of nodular lesions, in general of the thyroid in the study population was 11.4 per thousand. This is similar to the prevalence of nodular lesions in the general population reported in the literature (Vander *et al.*, 1954; Seed, 1963). The prevalence of nodular lesions in the control and study populations of the present study was closely similar. The age and sex specific prevalence of nodular lesions of the thyroid was also similar in the control and study populations. The maximum prevalence of nodular lesions was seen in females in 5th and 6th decades, both in the study and control population. Nodular lesions seen in the 4th, 5th, and 6th decades of life are stated to be largely benign as contrasted to the nodular lesions seen in the early and very late decades of life, where the likelihood of such lesions harbouring malignancy is much greater (Liachty *et al.*, 1965). Moreover, nodular lesions of the thyroid tend to increase in prevalence with age, with the maximum prevalence in the middle and late decades of life. However, in radiation-induced neoplastic nodular lesions of the thyroid, a majority of the patients are known to belong to the first 3 decades of life (Pifer *et al.*, 1968). This is so because the rapidly growing thyroids of children are most susceptible to the radiation-induced changes.

It appeared highly improbable that the nodular lesions encountered in the study area are induced by high background radiation. This conclusion is based on the following findings of the present study:

There were no significant differences between the observed prevalence of nodular lesions of the thyroid in the study and control populations. Also, there were no significant differences in age and sex specific prevalence of the nodular lesions between the study and control population. Both the populations showed the same trend of increasing prevalence of nodular lesions with age, predominantly in females as in other parts of the world. There was no aggregation of nodular lesions in younger age groups, nor was there any levelling off of the differential sex-related prevalence in the radiation area. Furthermore, in the radiation area, there was no preferential aggregation of nodular lesions among the hut dwellers, in whom the exposure risk is considered to be double that of the people who lived in types I and II houses. Histological examination of none of the resected specimens showed any cancer. However, it was interesting that 23 of the 26 solitary nodules operated from the study area and all the 3 solitary nodules operated from the control area were pathologically adenomas. This



gives the impression that a majority of the solitary nodules encountered in coastal Kerala are probably true adenomas.

#### References

- Conrad, F.A. and Hickling, A. 1965. Medical findings in Marshallese people exposed to fall-out radiation : Results from a 10-year study. *JAMA* 192, 457-459.
- Conrad, R.A., Rall, J.E. and Sutow, W.W. 1966. Thyroid nodules as a late sequela of radioactive fall-out. *N Eng J Med* 294, 1391-1399.
- Gopal Ayenger, A.R., Sundaram, K., Mistry, K.B., Sunta, C.M., Nambi K.S.V. and Kathuria, S.P. 1972. Evaluation of the long-term effects of high background radiation on selected population groups on Kerala coast. In : *Peacefulness of Atomic Energy*, Vol. II United Nations. I.A.E. Vienna.
- Hempelmann, L.H. 1968. Risk of thyroid neoplasms after irradiation in childhood. *Science* 160, 159-163.
- Liechty, R.D., Graham, M. and Freemayer, P. 1965. Benign solitary thyroid nodules. *Surgery Gynecol Obstet* 121, 571-573.
- Pifer, J.W., Hempelmann, L.J., Dodge, H.J. and Hodges, F.J. 1968. Neoplasms in the Ann. Arbor. Series of Thymus irradiated children. *Am J Roentgenol Radium Ther Nucl Med* 103, 13-18.
- Ponnumni Kartha, K.I. 1968. Background : Radiation in the coastal (Monazite) areas of Kerala (South India). *Health Phys* 15, 368-369.
- Report to the Indian Council of Medical Research from the Research Cell (I.C.M.R.), Medical College Trivandrum, 1967.
- Simpson, C.L., Hempelmann, L.J. and Fuller, L.M. 1955. Neoplasia in children treated with x-rays in infancy for thymic enlargement. *Radiology* 64, 840-845.
- Simpson C.L. and Hempelmann, L.H. 1957. Association of tumours and roentgenray treatment of thorax in infancy. *Cancer* 10, 42-56.
- Seed L. 1963. In *Applied Seminar on Measurement of Thyroid and Parathyroid Function*. Proceedings of 3rd Applied Seminar of Association of Clinical Scientists. Chapter 16, 133-142, Edited by F.W. Sunderman and F.W. Sunderman (Jr.), Lippincott.
- Vander, J.B., Gaston, E.A. and Dawber, J.A. 1954. Significance of solitary non-toxic thyroid nodule. *N Engl J Med* 251, 970-973.
- W.H.O. 1959. *Effect of Radiation of Human Heredity*. Technical Report Series No. 166.

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