Bull. Org. mond. Santé
Bull. World Hlth Org. } 1953, 9, 275-281

THE PROBLEM OF GOITRE PREVENTION IN INDIA

V. RAMALINGASWAMI, M.D., D.Phil.

Pathologist, Nutrition Research Laboratories,
Indian Council of Medical Research,
Coonoor, South India

Manuscript received in May 1953

SYNOPSIS

Endemic goitre continues to be prevalent in the entire northern submontane region of the Indian subcontinent. Although its etiology is complex, its prevention can be simply and effectively achieved by increasing the iodine intake of the population. The best way of ensuring a continual supply of iodine is by iodization of salt. Indian salt, however, is obtained mostly by solar evaporation of sea water or inland salt water, and is coarse and moist; it is consequently difficult to iodize uniformly. It is also likely that, under the conditions of storage and climate that prevail in India, the loss of iodine from salt iodized with iodide is considerable. The author recommends the iodization of all cooking salt used in the goitrous areas of India with 1 part of iodide to 100,000 parts of salt.

Introduction

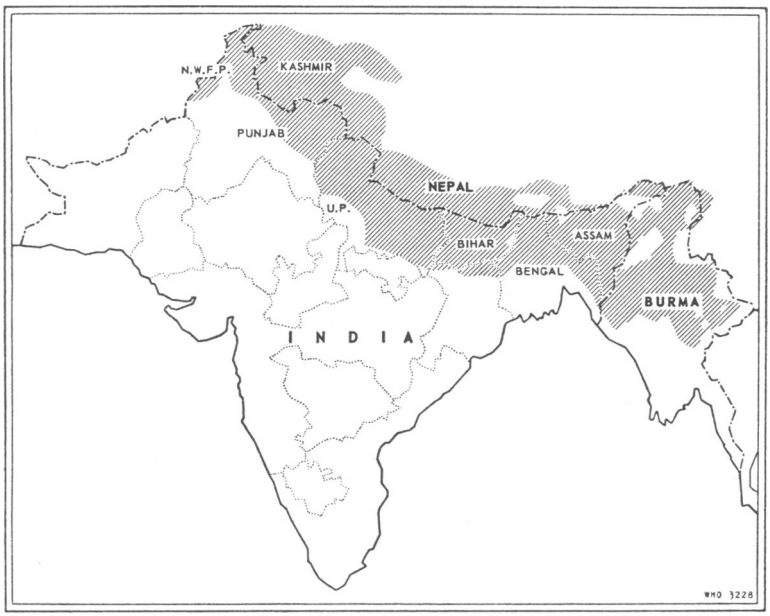
Endemic goitre, associated with cretinism, deaf-mutism, and various other grades of physical and mental deterioration, continues to be prevalent in certain regions in India. While the disease has been almost completely eradicated in many Western countries, its prevention in India and other underdeveloped countries is beset with many technical problems. Its etiology and pathogenesis have still to be clarified. In this communication, the prevalence of endemic goitre in India is described first, followed by a brief recapitulation of its etiology from the point of view of prevention ; finally, attention is drawn to some of the problems connected with the use of mass methods of prophylaxis such as the iodization of salt.

Prevalence of Endemic Goitre in India

The southern slopes of the Hindu Kush and the Himalayas, covering a distance of over 1,500 miles (2,400 km) and comprising the northern parts of Kashmir, Punjab, Uttar Pradesh (formerly the United Provinces), Bihar,

Bengal, and Assam are probably the world's most classical areas of endemic goitre (see fig. 1). Pioneer work, both in the field and in the laboratory, on the etiology of this type of goitre was done by Sir Robert McCarrison. In 1917, McCarrison estimated that there were probably some five million persons affected with goitre in India.[5] He recorded the fact that in some villages it was hard to find a man, woman, or child not suffering from goitre. In some Himalayan villages, McCarrison found that 60% of infants still at breast had goitre. Some years later, Stott and his colleagues, working in Uttar Pradesh, found a close association between endemic goitre and congenital deaf-mutism.[8] From the census figures for 1911, they calculated that there were 25,000 deaf-mutes in the United Provinces alone.

FIG. 1. APPROXIMATE DISTRIBUTION OF ENDEMIC GOITRE IN INDIA, 1915 *



N.W.F.P. — North West Frontier Provinces
U.P. — United Provinces
* Based on the map by McCarrison [4]

Recent years have witnessed a marked decline of interest in the Indian endemic despite its continued prevalence. Few accounts of it are to be found in the regular scientific journals published during the past 15 years. Nevertheless, the reports of the public-health authorities in the affected States since 1940 show clearly that hospital attendance of cases with goitre

runs into several thousands, as is illustrated in table I and the following tabulation, which gives the hospital returns for cases of endemic goitre during 1940-1 : [2]

Region	*Total number of cases*
Uttar Pradesh	100,000
Bihar	100,000
Punjab	30,000
Assam	30,000
Bengal	30,000
All other areas	negligible

TABLE I. HOSPITAL AND DISPENSARY RETURNS OF CASES TREATED FOR GOITRE (1947-9) *

Region	Year		
	1947	1948	1949
Ajmer-Merwara	—	3	3
Assam	27,403	24,183	33,999
Bihar	25,799	not available	not available
Bombay	571	696	926
Madhya Pradesh	165	616	not available
Madras	1,952	7,965	8,258
Orissa	31	215	not available
Punjab (India)	14,860	11,159	10,508
Uttar Pradesh	44,512	39,678	44,723
West Bengal	7,799	7,663	8,295
Total	123,092	92,178	106,712

*** Based on information kindly supplied by Dr. K. Mitra, Directorate-General of Health Services, New Delhi**

Considering the fact that only a small proportion of cases seeks hospital treatment, the vast majority being content to regard even large goitres as " natural " physiological phenomena, the actual number of persons affected with goitre in the general population must be several times the hospital figures. Results of recent goitre surveys conducted by the State public-health departments confirm this belief (see table II).

From the evidence available it seems safe to conclude that the incidence of endemic goitre in India has not changed appreciably during the past three decades. One wonders whether McCarrison's estimate that five million persons suffered from goitre in 1917 would be far from being valid today.

TABLE II. INCIDENCE OF ENDEMIC GOITRE IN INDIA ACCORDING TO RECENT SURVEYS *

Region	Incidence (%)	Number of persons surveyed	Year of survey	Source of information
Kashmir				
Karakoram	90	not stated	1945	*Indian med. Gaz.* **80**, 606
Uttar Pradesh				
Dehra Dun	32	554	1945	State public-health department
Bareilly	26	133	1947	*Indian med. Gaz.* **82**, 23
Bihar				
Purnia district	50	3 villages	1952	State public-health department
East Punjab				
Shiwalak Range	32	5,042	1952	State public-health department
Shiwalak Range	37	1,337	1952	State public-health department

* Much of the information contained in this table was kindly supplied by the Nutrition Officers of the States concerned.

Etiology of Himalayan Goitre

Although it is generally believed that the " immediate cause of simple goitre is failure of the thyroid gland to obtain a supply of iodine sufficient to maintain its normal structure and function ",[1] factors other than a simple environmental deficiency of iodine may be important in the etiology of endemic goitre. From their experience in India, both McCarrison and Stott were unwilling to accept iodine deficiency in soil and water as the most important cause of Himalayan goitre. The extensive clinical and experimental investigations of McCarrison suggested that infection with an organism of the coli-group might be the causative factor.[5] The field studies of Stott indicated that the drinking of hard water containing excessive amounts of calcium salts was responsible.[8] In his later work, McCarrison attributed a predominant part to faulty and unbalanced diets in the genesis of goitre.[6] In 1941, Wilson suggested that excessive intake of fluorine might be a factor in the etiology of goitre in the Punjab, where she found a close association between the incidence of endemic goitre and fluorosis.[9]

It is clear that the etiology of Himalayan goitre is complex. How each of the factors listed above acts as a goitrogenic agent remains obscure. While it is possible that bacterial pollution of water supplies and excessive intake of calcium play an important part, their effect on the iodine metabolism of the individual has not been adequately investigated. In fact, except for the early studies of McCarrison in Gilgit, no study directly aimed at investigating iodine metabolism and the functional state of the thyroid gland in Himalayan goitre has been made in recent years. The role of faulty

and unbalanced diets in the etiology of Himalayan goitre is difficult to assess, since much of the evidence presented by McCarrison is derived from studies on animals, and controlled dietary and nutritional surveys of populations in endemic areas are not available.

Prevention of Endemic Goitre

In spite of the complexity of the etiology of endemic goitre, it is not denied even by McCarrison and Stott that the easiest and cheapest means of preventing endemic goitre is by ensuring an adequate supply of iodine. It has been repeatedly shown during the past quarter of a century that the daily administration of iodine in small doses results in a marked reduction in the incidence of goitre and, in the long run, also eliminates the various grades of physical and mental deterioration associated with it. Of the methods of ensuring intake of adequate quantities of iodine daily, the iodization of salt used for domestic consumption is the most convenient and effective. Here we are confronted with our biggest problem : the problem of iodizing uniformly the coarse crystalline Indian salt.

Except for a small quantity of rock salt which is mined at Mandi in Himachal Pradesh, the bulk of salt produced in India is obtained by solar evaporation of brine.[3] About 75% of this is made up of sea salt, and the remainder is obtained from inland salt lakes. Efforts are being made by the Salt Expert Committee of the Government of India to improve the quality of Indian salt, but in the meantime some way must be found of iodizing the crude salt itself as uniformly as possible. This is important not only because urgent measures are required to combat endemic goitre, but also because it is difficult to persuade the people in the endemic areas, who have been used to crude salt for centuries, to change over suddenly to refined salt.

There are also other difficulties in the use of iodized salt for the prophylaxis of endemic goitre in India. It is well known that considerable losses of iodine from salt iodized with iodides can occur in damp climates and in strong sunlight. Under the conditions of salt storage and of climate obtaining in India, considerable loss of iodine from iodized salt would be expected to occur, although the actual extent of the loss under these conditions has not been investigated. Furthermore, the effect of various Indian methods of cooking on the stability of the iodine compound used in iodizing salt urgently requires attention.

The level of iodization of salt is important in this connexion. Different countries have adopted different levels, and the results in general have been uniformly good. The latest recommendation of the Medical Research Council of Great Britain (MRC) is that if all food salt, including table salt, is to be iodized, potassium iodide should be added in the proportion of 1 part

to 100,000 parts of salt.[7] It would ensure an intake of 76 μg of iodine per head per day on the assumption that the average daily consumption of salt per head is about 10 g. In India, salt is not usually taken separately from what is added to the food during cooking, and hence it is essential to iodize all salt used for domestic consumption. In order to prescribe the optimum level of iodization it is essential to know not only the intensity of local iodine deficiency, but also the salt intake of the affected population. There is some evidence to suggest that the salt intake of the Indian people is considerably higher than the figure of 10 g per head per day usually given for the British people and the USA. A diet survey recently conducted by workers in our laboratories revealed that the average daily salt intake per head in South India was about 18 g (Dr. K. Someswara Rao—personal communication, 1952). This is probably due to climatic factors. If the level of iodization of salt recommended by the MRC for the United Kingdom is adopted for India, each person in India would receive about 140μg of iodine per day. Allowing for losses of iodine due to storage, climatic conditions, and cooking processes, the actual intake of iodine per head per day would probably be well above the minimum daily requirement level, which ranges from 50μg to 100 μg.

In conclusion, it would seem appropriate to quote from an editorial in the *Indian Medical Gazette*, written nearly ten years ago on the subject of endemic goitre in India : " It would be a pity if, as a result of Sir Robert McCarrison's excellent researches which have had the stimulating effect of destroying complacency on the subject of aetiology of goitre, we were to allow ourselves to be distracted by vague generalities regarding improving environmental conditions and the standard of living from the well established fact that iodine given systematically will usually reduce the incidence of endemic goitre." [2]

ACKNOWLEDGEMENTS

The author wishes to thank Dr. K. Mitra, Directorate-General of Health Services, New Delhi, and the Nutrition Officers of the States of Punjab, Uttar Pradesh, and Bihar for information on the incidence of endemic goitre in recent years. Thanks are also due to Dr. V. N. Patwardhan, Director of the Nutrition Research Laboratories, for his helpful criticism and encouragement.

RÉSUMÉ

Le goitre existe dans plusieurs régions de l'Inde, accompagné de déficiences telles que la surdi-mutité et le crétinisme. La prophylaxie se heurte à des difficultés d'ordre technique. L'étiologie et la pathogénèse de la maladie doivent encore être élucidées.

Les versants sud de l'Hindou-Koush et de l'Himalaya, s'étendant sur 2.400 km environ, sont les régions d'endémie goitreuse peut-être les plus connues dans le monde. En

1917, le nombre des goitreux dans l'Inde était évalué à 5 millions (60 % des nourrissons étaient goitreux, dans certains villages himalayens). D'après le recensement de 1911, on a pu évaluer à 25.000 le nombre des sourds-muets, dans les régions qui étaient alors les Provinces Unies. Des enquêtes plus récentes — en particulier sur les cas hospitalisés — indiquent que l'incidence n'a guère varié dans l'Inde depuis une trentaine d'années.

Il semble que des facteurs autres que le manque d'iode dans le milieu ambiant peuvent intervenir dans l'étiologie du goitre. Les auteurs qui ont étudié le problème dans les régions himalayennes n'ont même pas attribué à cette carence le rôle principal. L'un a incriminé un micro-organisme du groupe du colibacille, et, plus tard, un déséquilibre alimentaire. D'autres chercheurs en ont vu la cause dans l'excès de calcium ou de fluor de l'eau. Il est certain que l'étiologie du goitre himalayen est complexe, mais aucune recherche systématique n'a encore été faite, qui permette d'assigner un rôle étiologique précis à l'un ou à l'autre des facteurs précédemment mentionnés.

Malgré la complexité du problème, les auteurs s'accordent à reconnaître que l'iode assurerait une prophylaxie efficace. Le problème technique qui se pose pour l'Inde est celui de l'iodisation uniforme du sel brut, en cristaux grossiers, consommé actuellement. La plus grande partie du sel utilisé dans l'Inde est produit par évaporation au soleil des saumures dont 75 % proviennent de la mer et 25 % des lacs salés. Il s'agit de trouver le moyen d'iodiser ce sel brut, car la population des régions d'endémicité, qui a consommé le sel sous cette forme pendant des siècles, n'accepterait pas facilement un sel raffiné. D'autre part, les conditions climatiques, l'humidité et la forte insolation sont préjudiciables à la stabilité de l'iode dans le sel.

L'addition d'iodure à raison d'une partie pour 100.000 parties de sel, recommandée en Grande-Bretagne, sur la base d'une consommation de 10 g de sel par jour et par personne, serait suffisante pour l'Inde, si l'on tient compte du fait que la population de l'Inde consomme environ 20 g de sel par jour et par habitant, mais que des pertes sensibles en iode se produisent, dues aux conditions climatiques et aux procédés de cuisson des aliments.

REFERENCES

1. Great Britain, Medical Research Council, Goitre Subcommittee (1944) *Lancet*, **1**, 107
2. *Indian med. Gaz.* 1941, **76**, 95
3. *Indian Trade & Indust.* 1950, **1**, 497
4. McCarrison, *R.* (1915) *Indian J. med. Res.* **2**, 778
5. McCarrison, R. (1917) *The thyroid gland*, London
6. McCarrison, R. & Madhava, K. B. (1932) *The life line of the thyroid gland*, Calcutta (*Indian Journal of Medical Research Memoir*, No. 23)
7. Murray, M. M., Ryle, J. A., Simpson, B. W. & Wilson, D. C. (1948) *Thyroid enlargement and other changes related to the mineral content of drinking water*, London (*Medical Research Council Memoir*, No. 18)
8. Stott, H., Bhatia, B. B., Lal, R. S. & Rai, K. C. (1931) *Indian J. med. Res.* **18**, 1059
9. Wilson, D. C. (1941) *Lancet*, **1**, 211