CHAPTER 26

IODIZED OIL IN THE PREVENTION OF ENDEMIC GOITER AND ASSOCIATED DEFECTS IN THE ANDEAN REGION OF ECUADOR

I. PROGRAM DESIGN, EFFECTS ON GOITER PREVALENCE, THYROID FUNCTION, AND IODINE EXCRETION[1]

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INTRODUCTION

In South American countries which made up the Inca Empire, the Quechua word coto is synonymous with goiter. In Quechua, coto means mound or protuberance, and the Indians used coto in reference to tumor in the neck (10, 11, 20, 22). Goiter was frequent among the Indians of the Andes at the time of arrival of the Spaniards (27). The recent discovery of a pre-Colombian figure with a prominent goiter testifies to the commonplace nature of the affliction (Figure 1).

The Spanish conquest of the Inca Empire caused a rapid disintegration of the economy. In 1543 Agustín de Zárate (37) had referred to the great number of llamas which existed in the Province of Quito, and Cieza de León, in 1547, stated that "the people are peaceful, and there is an abundance of bread and grains." (9) By 1596 Father Cobo was already worried about the state of poverty and degeneration of the Indians. Thus the socioeconomic patterns which the Europeans imposed upon this continent placed a great stress upon the normal biologic and cultural development of the American natives. In the eighteenth and nineteenth centuries, Jorge Juan and Antonio de Ulloa (26), Humboldt (25), Caldas (6), Boussingault (5), Orton (31), and Wolf (36) noted the extreme poverty which reigned among the Indians and half-breeds of the rural zones of the Andes. They remarked upon the great number of goitrous, deafmute, and defective persons in this region.

The Spanish and their direct descendents also had goiter on an important scale, and travelers of that time refer to this condition. The small sculptured pieces of the eighteenth century support this observation (Figure 2), especially since the Quitenian images of that time were almost entirely of a religious nature.

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2/ From the Radioisotopes Department, National Polytechnic Institute, and the Central University Medical School, Quito, Ecuador.

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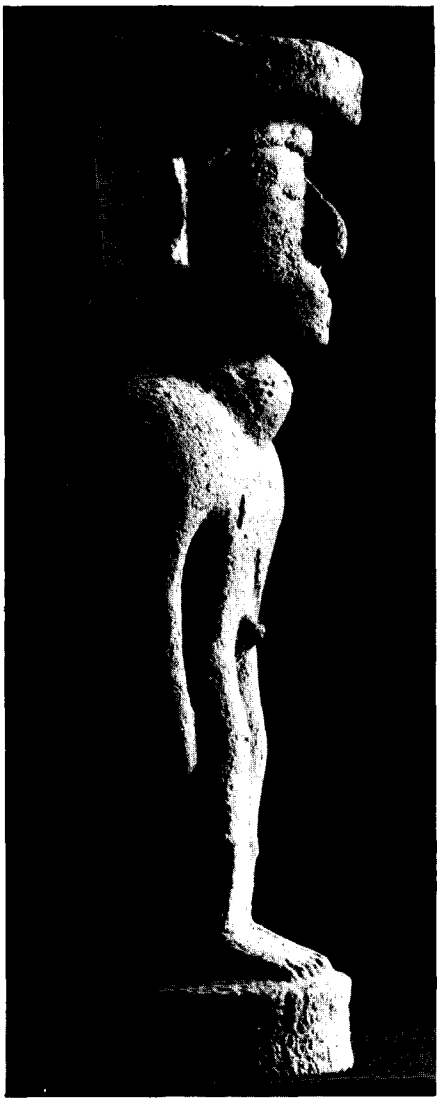

Figure 1. Pre-Colombian sculpture (50 cm high), showing the "Colorado" people who once resided in the Andean region of Ecuador, in the basin of the Guaillabamba River. From there they migrated to the coast. The age has been calculated at 800 years. Now in the Anthropologic Museum of Quito.

Figure 2. Small sculpture (15 cm high) from Quito in the last of the eighteenth century. Now in the Convent "El Carmen Alto," Quito.

In 1958 the Ecuadorean Institute of Nutrition conducted a survey (18) and found endemic goiter to be a grave problem in the Andean Region (Figure 3). It was observed that the prevalence of goiter varied between neighboring villages, that the size of goiter diminished in villages located at more than 3,200 meters above sea level, and that the mentally deficient persons, deaf-mutes, mutes, and deaf who were observed during the survey did not present the characteristics aspects of hypothyroidism. Studies of iodine metabolism indicated iodine deficiency as the principal causative factor (13, 16). The results were similar to the findings of Stanbury et al. (34) in endemic goiter in the Andean Region of Mendoza, Argentina.

Ecologic, ethnic, and socioeconomic studies in eight rural villages of the Ecuadorean Andean region in 1965 (19, 20) supported the following conclusions: (1) For endemic goiter to exist in a community, man must live under

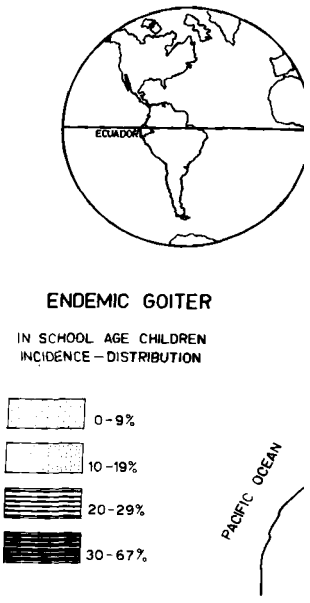

Figure 3. Geographic territorial divisions by the capital of the cour villages, including Toc of each one was made program.

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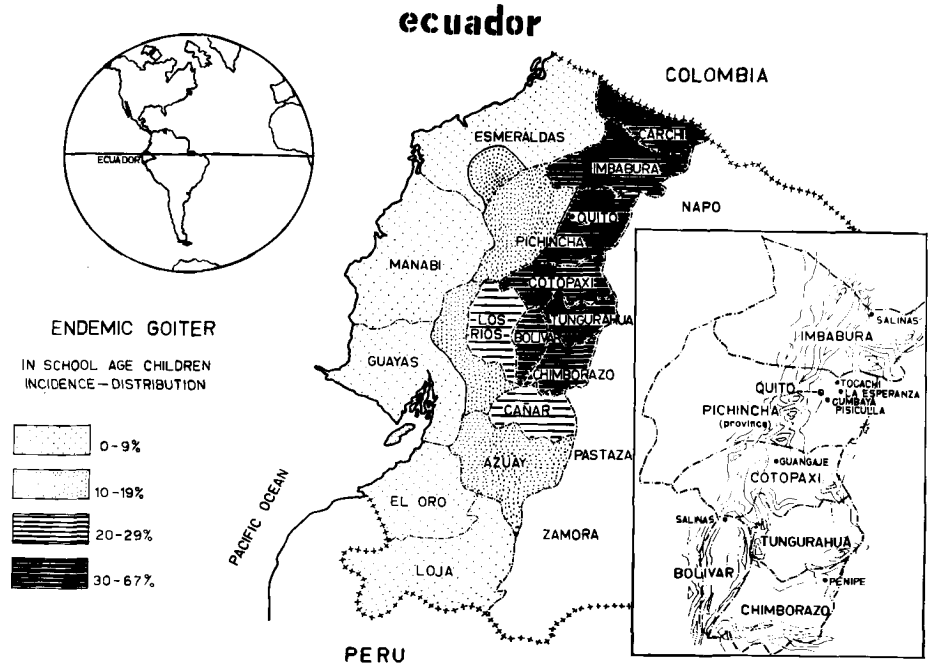

Figure 3. Geographic location of the Republic of Ecuador, and partial map of its territorial divisions by provinces. In the Province of Pichincha is included Quito, the capital of the country. In the frame is shown the location of the eight rural villages, including Tocachi and La Esperanza. Inventory of the total population of each one was made one year before the start of the iodized oil prophylactic program.

chronic iodine deficiency. (2) Severity of the endemic is related to the magnitude of iodine deficiency, but intercurrent socioeconomic and biologic factors in the community may modify the incidence of goiter. (3) These intercurrent factors are of themselves incapable of causing the endemic. (4) The prevalence of endemic cretinism, deafmutism, and motor abnormalities is highly correlated with the intensity of endemic goiter.

There are, unfortunately, many regions of the world where iodination of salt is not feasible at present. A number of years ago a program of goiter prevention by the injection of iodized oil was begun in New Guinea. Information available from those surveys (24, 28) indicated that prophylactic programs were effective in reducing the prevalence of goiter and that the procedure was practical and safe. The results obtained in New Guinea, however, failed to provide entirely satisfactory information regarding the effectiveness of this form of prophylaxis in reducing the incidence of goiter and gave practically no information regarding prevention of those disabilities which have been demonstrated to be in epidemiologic association with severe endemic goiter, such as endemic cretinism, endemic deafmutism, deafness, mutism, bone deformities, and endemic mental retardation.

Iodization of common salt has not been implemented in Ecuador. The socioeconomic conditions of the Andean people, basically composed of Indians

and half-breeds, have varied little since the Spanish colonial times or have changed at a very slow pace. Thus, everything has pointed to a virgin endemic of an ancient date, the primary causative factor of which has been a severe chronic deficiency of iodine. On the basis of these facts, we elected in March 1966 to carry out a program for prevention of endemic goiter and associated defects in two isolated villages of the Ecuadorean Andean region by means of the intramuscular administration of iodized oil.

MATERIALS AND METHODS

A socioeconomic inventory of the total population of eight rural villages in the Andean Provinces most affected by goiter (Figure 3) was made one year before administration of the iodized oil. The inventory was performed by one medical doctor and three medical students. Accompanying them was a representative of the Ecuadorean National Planning Board. He studied the economic status of each community by means of a survey on complete families taken as a random sample.

Two previously studied villages were chosen for the prophylactic program, Tocachi and La Esperanza (Figure 3). They were selected because of their remoteness and because in both of them endemic goiter is severe and cretinism is commonplace. They are situated about 70 kilometers north of Quito. They are six miles apart and are ethnically, socially, and medically entirely comparable. They are remote from any medical facility. The villagers have unusually limited social mobility and contact with the outside world. These villages share many characteristics with hundreds of others in the South American Andean region.

We elected to give iodine to the Tocachi population, since the population concentration was ideal. La Esperanza remained as the control village. The program was started in March 1966. The iodized oil was Ethiodol (37 per cent iodized poppy seed oil, each ml containing 475 mg of iodine, from E. Fougera, Inc., Hicksville, L.I., New York). Disposable plastic syringes were used to avoid problems of sterilization at high altitudes. The following dosage schedule was used:

Up to two years	0.2 ml of iodized oil
2 - 6 years	0.5 ml of iodized oil
6 - 12 years	1.0 ml of iodized oil
12 years old and up	2.0 ml of iodized oil

The oil was administered intramuscularly in the gluteal region in small children and in the deltoid region in adults. Drawback was practiced to ensure that oil was not injected intravenously. Merthiolate was used for skin sterilization.

The studies were done just before or at the same time as the iodized oil administration. A nutritional survey was conducted by sampling. Fifty families from Tocachi and 75 from La Esperanza were chosen.

Goiter prevalence was determined by five teams (each comprised of one medical doctor, two medical students, and one local leader). Four of the five teams were in charge of the four sections into which each village was divided.

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Precise data had been prepared on each section regarding house location, families in each house, names and ages of all members of a family, etc. The fifth team was stationed at the priest's house, where subjects previously chosen for special studies were examined. The attitude and cooperation of the people were excellent in both villages.

Evaluation of the thyroid size was in accordance with the classification of Pérez et al. 1961, and modified by us. This is:

Grade 0_a	-	not palpable;
Grade 0_b	-	palpable, but not visible with the head raised;
Grade I	-	easily palpable with head in normal position and visible with the head raised; Those glands presenting easily palpable nodules with head in normal position but not visible with head raised were included in this grade.
Grade II	-	easily visible with head in normal position;
Grade III	-	visible at a distance;
Grade IV	-	monstrous goiters.

For epidemiologic purposes, glands were considered abnormal when Grade I or larger. These glands were recorded as diffuse or nodular. A series of trials were needed for the responsible team leaders to come to agreement about grade and type (diffuse or nodular). The five teams administered the iodized oil to the Tocachi population at the same time as the epidemiologic survey. Ninety per cent (960) of the Tocachi villagers were injected. The other 10 per cent refused the injection. There were no cases of local reaction to the iodine, except for one of transitory erythema.

For evaluation of cretinism, the fundamental fact taken into account was the mental deficiency of the subject. The mental deficiency should be obvious in the opinion of the surveyer, and confirmed by the manner in which the subject lived in relation to the rest of the community. The subject would be considered by his family incapable of conducting the normal activities of the average inhabitants of the village (agricultural tasks, small crafts, etc.). This criterion was employed because many of the inhabitants of these communities were characterized by a certain degree of simplicity in comparison to residents of an urban area.

Examination of selected children included a PA x-ray of the left hand, as well as observation for gingival emergence of the deciduous and permanent teeth. Hand x-rays were taken using Kodak no-screen Ready Pack Medical x-ray films, at a tube-to-film distance of 91.5 cm (36 in) with a Bucky field-portable x-ray unit. Anthropometric measurements were also made in all these children.

Duplicate samples of water were taken, as well as samples of the crude sea-salt which is consumed in both villages. Samples of soil were also taken. Samples of first morning urine before breakfast were obtained. Half of these samples were sent to Boston Medical Laboratories (Boston, Massachusetts) in order to determine the stable iodine content. The other samples were examined in Quito. The samples of urine were used to determine iodine and creatinine according to the method of Bosnes and Taussky (4).

Blood samples were also taken for TI, PBI, T_4I, BEI, and BII determinations according to the methods of Benotti and Benotti (1, 3) and of Murphy (30). Resin uptake of ^{131}I-labeled triiodothyronine was according to Mitchell et al. (29).

Volunteers from both villages were brought to Quito. The ^{131}I thyroid uptake, conversion ratio, $PB^{131}I$ per cent per liter, salivary iodide clearance, saliva/plasma ratio, and saliva/PBI ratio tests were done after a dose of 50 microcuries of ^{131}I.

Shortly after the completion of the injection program a physician and a midwife were assigned fulltime to Tocachi and La Esperanza. Small dispensaries were established for administering to the general medical needs of the communities, but particularly to keep continuous close observation on the effects of the prophylactic program and on the progress and results of pregnancies as they might occur. All pregnancies in both villages have been followed and neuromotor development and physical growth of all of the children born in both villages have been studied since March 1966.

Epidemiological surveys on goiter prevalence and incidence were conducted at 6, 12, 20, and 25 months after the injection program. Thyroid functional studies and determinations of iodine and creatinine in urine were done at the same times.

After 25 months of iodinization in April 1968, exactly the same studies were made as in March 1966. These included nutritional surveys, x-ray studies, etc. Most of these were made on the same subjects. In April 1968 we also conducted intelligence performance tests, using the Goodenough Method modified in recent years by Harris (23), on school-age children.

RESULTS AND DISCUSSION

Both in Tocachi and La Esperanza the socioeconomic situation is precarious (Table 1).* This was noted by Luis León (27), who wrote, 28 years ago, that these villages "tend toward degeneration and extinction." At present the situation has changed but little. Both in Tocachi and La Esperanza there is a high percentage of infant mortality, a high incidence of illegitimacy, a low level of literacy, little exposure to culture outside the villages, and great poverty reflected by the small percentage of artisans and the low income. Chronic iodine deficiency is severe in both villages (Table 1). Prevalence of goiter and associated defects is high (Table 2).

* All tables appear at the end of this article.

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The mentally defective persons were divided into two types: Type I, with mental deficiency and severe impairment in hearing and speech; and Type II, with mental deficiency, impaired hearing and speech, short stature, and motor abnormalities including spastic paresis of the lower extremities. Both types are believed to be examples of endemic cretinism. The syndrome of cretinism in both villages is much like the endemic cretinism occurring in the Mulia Valley in western New Guinea (8). In Mulia iodine deficiency is equally severe and the incidence of cretinism is strikingly similar to that in Tocachi. In Tocachi, La Esperanza, and in Mulia, the clinical syndrome of cretinism is distinct from that associated with endemic goiter in the Belgian Congo, where hypothyroidism and dwarfing typically occur (12).

Numerous reports on the clinical features of cretinism in relation to endemic goiter have been reviewed by Choufoer (8) and need not be extensively reconsidered here. Studies on thyroid function and skeletal muscle structure in cretins from both Tocachi and La Esperanza (19, 35) have outlined two important facts. Thyroid function was similar in cretins and "normal" subjects in both villages, and there was no evident disorder in skeletal muscle structure. Thus there was no evidence of skeletal muscle involvement as in myxedema or in untreated congenital hypothyroidism, such as myotonia , increased muscle bulk, or delayed relaxation of stretch reflexes. We believe that intrauterine hypothyroidism leads to the neural abnormalities, and that these persist after birth despite the subsequent course of thyroid function. If the thyroid is able to compensate through any mechanism to prevent continued hypothyroidism, a deafmute, mentally defective individual of normal proportions may result. Otherwise the person may develop as a typical dwarfed cretin, who may be hypothyroid even in adult life.

Nutritional surveys done in March 1966 and in June 1968 outlined the following facts: caloric consumption was low, as were protein, fat, and vitamin A, especially of animal origin. The daily diet in these communities is fundamentally based upon barley, corn, and potatoes and other tubers. There has been no noteworthy improvement in diet during these two years (Table 3).

The height of adult subjects from Tocachi and those from La Esperanza was not significantly different (Table 4). Mean values for weight differed noticeably ($P < 0.04$ for males and < 0.03 for females). This is presumably attributable to a better caloric intake in La Esperanza.

A fall in the prevalence of goiter, both in the total population and in men and women, was regular and consistent for 20 months after Ethiodol administration. After the 20th month, also in the total population and in men and women, the decrease stopped and prevalence began to rise. The ratio of goiter in women and men increased while the prevalence of goiter in the total population decreased (Figure 4, Tables 5, 7, 9, 11, 14).

The prevalence of diffuse and nodular goiter, at the time of the survey conducted six months after iodization, presented the following picture (Figure 5): nodular goiter noticeably increased, while diffuse goiter decreased. In the following surveys, and up to the 20th month, nodularity steadily decreased. At the survey on the 25th month nodularity started a new increase. The nodular-diffuse goiter ratio increased, while the prevalence of goiter in the total population increased (20) (Tables 5, 7, 9, 11, 13).

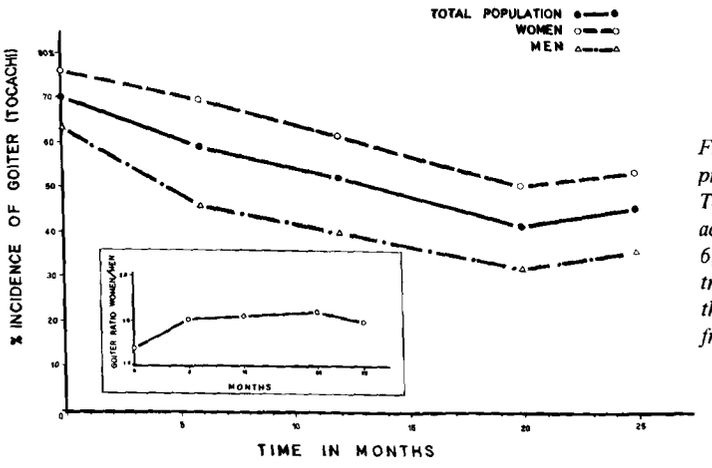

Figure 4. Total goiter prevalence, and prevalence in men and women from Tocachi, at the time of iodized oil administration and in the surveys at 6, 12, 20, and 25 months after administration. Female-male goiter ratio for the same periods is shown in the frame (Tables 5, 7, 9, 11, 13).

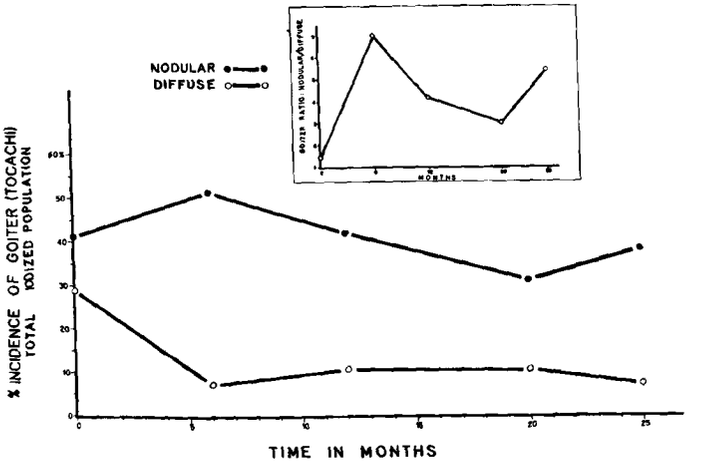

Figure 5. Prevalence of nodular and diffuse goiter for the total treated population from Tocachi at the time of iodized oil administration and in the surveys at 6, 12, 20, and 25 months after administration. Nodular/diffuse goiter ratio for the same periods is shown in the frame (Tables 5, 7, 9, 11, 13).

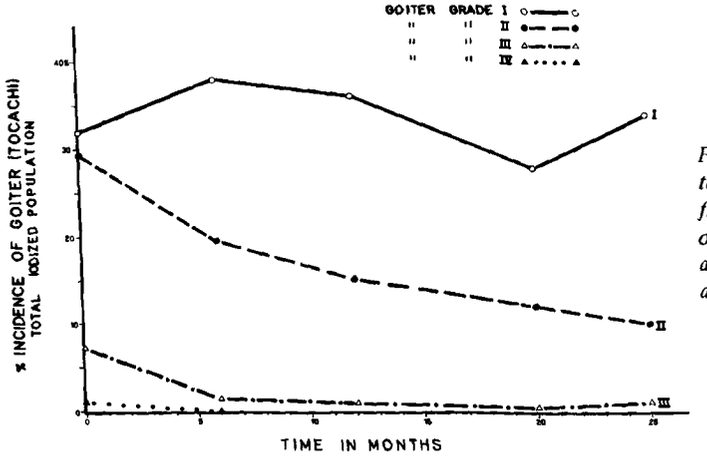

Figure 6. Goiter prevalence according to size for the total injected population from Tocachi at the time of iodized oil administration and in the surveys at 6, 12, 20, and 25 months after administration (Tables 5, 7, 9, 11, 13).

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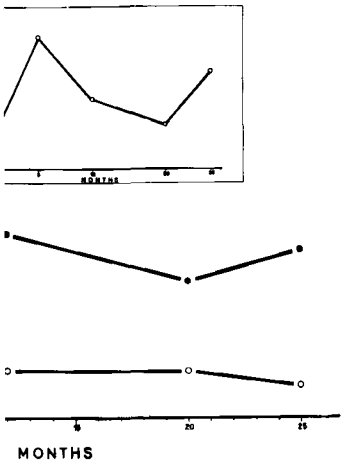


ure 6. Goiter prevalence according size for the total injected population m Tocachi at the time of iodized administration and in the surveys 6, 12, 20, and 25 months after ninistration (Tables 5, 7, 9, 11, 13).

As to goiter size, it was evident that administration of Ethiodol produced a distinct decrease of the incidence of Grade II goiters and larger, and this decrease continued into the survey at 25 months after iodization. Although the decrease in size of large goiters was achieved at the expense of an increase in the incidence of Grade I goiters, after the survey at 12 months Grade I goiters also tended to diminish. This trend persisted after 20 months. After the survey at 20 months, however, this type of goiter (but not those of larger size) tended to increase (Figure 6, Tables 5, 7, 9, 11, 13).

A linear study of the evolution of different grades and types of glands was made (Tables 15, 16, 17, 18, 19, 20, 21). There was a steady and progressive reduction of large goiters until the 20th month after iodization. Thus a Grade III goiter (Figure 7, Table 21), for instance, first became Grade II or I, and then these became Ob and Oa thyroids, as time passed, up to the 20th month. From the 20th month a considerable number of Grade I and II goiters became Ob thyroids, most of the Grade II goiters became Grade I, and the few Grade III goiters became Grade II. This has been the epidemiological picture which has been evident at the 25th month after iodization. As to linear evolution of nodular goiters (Figure 8, Table 20), we took as an example what happens to nodular goiter Grade II. More than half of the Grade II nodular goiters became nodular Grade I during the first six months. A good number of nodular Grade I progressively evolved and became Ob or Oa thyroids. At the same time nodular Grade II goiters became nodular Grade I. After the 20th month a significant number of nodular Grade II goiters became Nodular I, Oa thyroids became Ob, and some of these became Grade I. We must explain in this way the sharp increase of Grade I goiter prevalence 25 months after administration of Ethiodol, and also the beginning of an increase of goiter prevalence in the total population at that time. It seems unquestionable that the sharp increase of nodular goiter found six months after iodization is a result of involution of hyperplastic thyroid tissue resulting from the action of Ethiodol.

Regarding the effect of Ethiodol on goiter prevalence by age (Tables 6, 8, 10, 12, 14), the reduction diminished as age increased. The maximum reduction was seen during the first 18 years of life. There was minimal reduction after 40 years of age. Reduction at 25 months after iodization was 36 per cent for the total population. There was not a single instance of a palpable thyroid in children born in Tocachi to iodized mothers. Eighteen per cent of the children of La Esperanza up to 2 years of age, who were examined at the time of the April 1968 survey, presented palpable glands. As to the goiter prevalence in La Esperanza from March 1966 to April 1968, results indicate that there has been a significant increase (Tables 22, 23).

Six months after iodization, uptake of ^{131}I by the thyroid proved to be clearly depressed. A restoration toward normality was observed in successive control surveys, including the control conducted 25 months after injection (Table 24, Figure 9). The $PB^{131}I$ was low in a considerable number of cases in all control surveys (Table 25).

The deposit oil was not extractable with butanol. BEI has remained practically within normal limits 25 months after iodization (Table 26). Thus even during the first months the glands retained a normal capacity for transforming iodide into T_4 and T_3. PBI's were high until two years after iodization. This indicates that PBI determinations are not a valid index of thyroid function when iodized oil is used. Similar results have been reported by Carter, who studied the effects of oral Lipiodol on PBI concentrations (7).

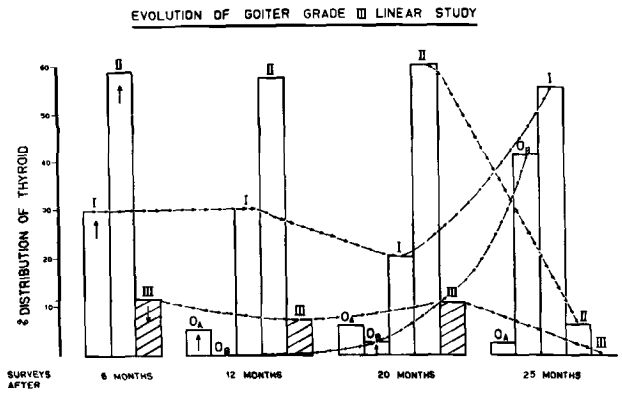


Figure 7. Goiter Grade III evolution, linear study. Surveys made in Tocachi at 6, 12, 20, and 25 months after iodized oil administration (Table 21). The number of subjects who presented Grade III goiter during the survey done just before injection was 70.

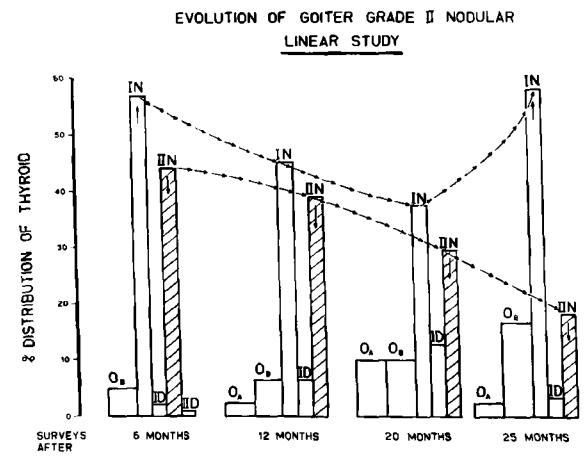
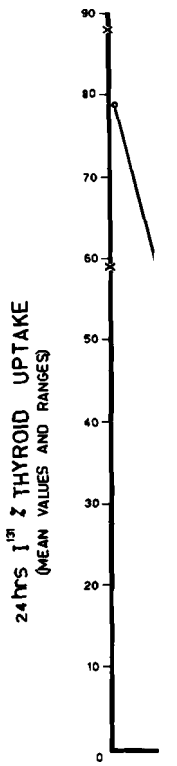


Figure 8. Evolution of Grade II nodular goiter, linear study. Surveys made in Tocachi at 6, 12, 20, and 25 months after iodized oil administration (Table 20). The number of subjects who presented Grade II nodular goiter during the survey done just before injection was 200.



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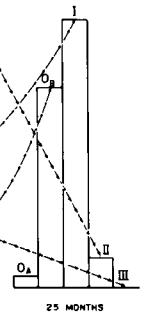

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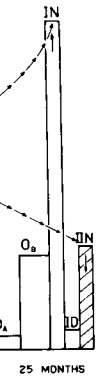

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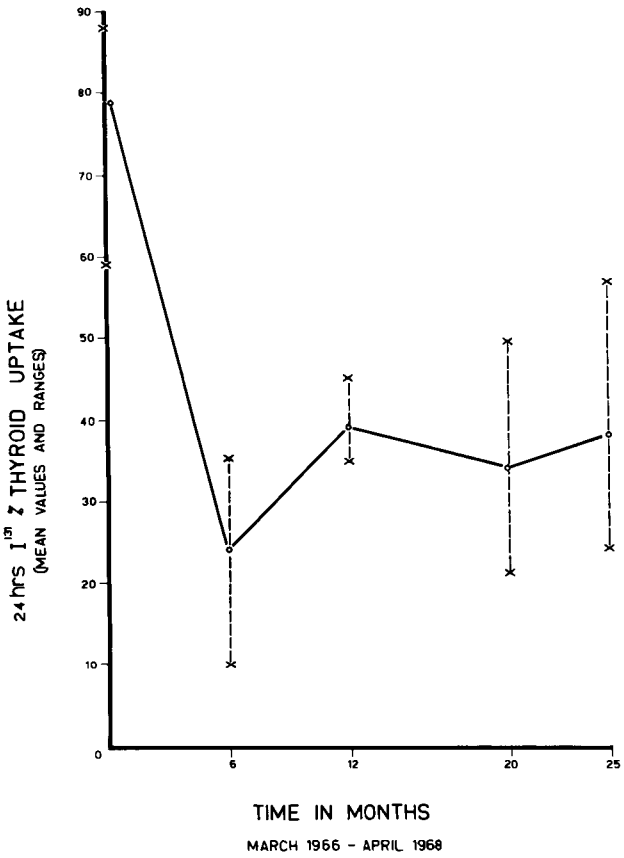

Figure 9. Mean values and ranges for the 24-hour ^{131}I o/o thyroid uptake, in Tocachi volunteers examined just before the injection of Ethiodol, and after 6, 12, 20, and 25 months.

Six months after iodization the Achilles reflex relaxation time was not statistically different between the inhabitants from Tocachi and those from La Esperanza (Tocachi: number of subjects = 195; mean value = 292 milliseconds; S.D. = 43. La Esperanza: number of subjects = 195; mean value = 293; S.D. = 32. t = 0.36). There were almost no subjects with values suggesting hypometabolism in either village.

The urinary excretion of iodine (UEI) (Table 27, Figure 10) followed an exponential pattern. The excretion pattern could be expressed by $UEI_t = UEI_i \cdot e^{-0.126 \cdot t}$. Since the subjects on whom we did UEI determinations were adults who had received 2 ml of Ethiodol (950 mg), elimination of those 950 mg would be virtually accomplished at the 40th month after injection. These results imply that an Ethiodol dose equal to half of that used would be eliminated in no more than thirty-five months.

Three subjects from Tocachi who refused injection in March 1966 were examined in April 1968. Their ^{131}I and ^{127}I tests and urinary iodine excretion were superimposable on those found in the same village before the prophilaxis program was started.

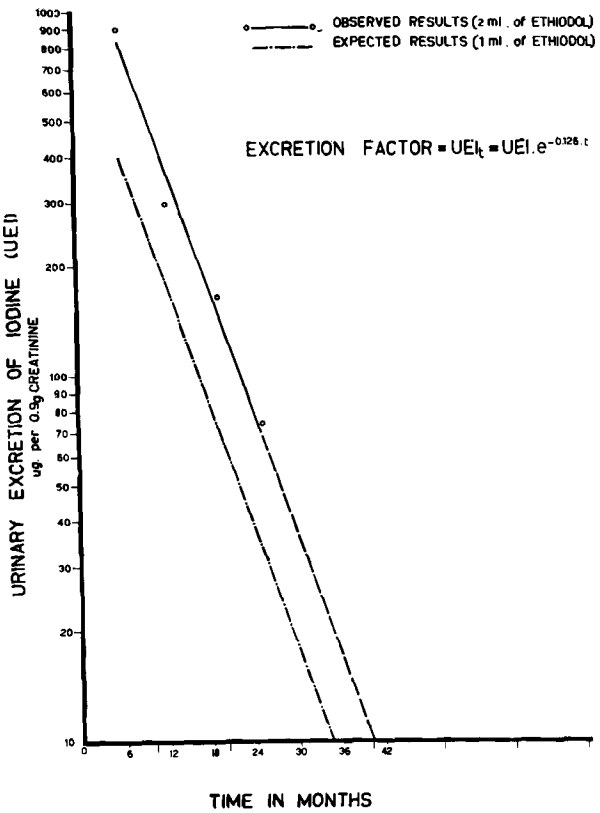

Figure 10. Evolution of urinary excretion of iodine (µg per 0.9 g creatinine). Mean values at 6, 12, 20, and 25 months after iodization. The UEI mean value in Tocachi was 10.4 µg daily before injection.

In the survey six months after administration of Ethiodol, there were a few subjects in Tocachi who presented a clinical picture suggesting hyperthyroidism. They were taken back to Quito for hospitalization and careful examination. The disease was confirmed in three women, all elderly and with large nodular goiters (Table 28). The laboratory tests useful for their diagnosis were the BMR, the BEI and T_3- ^{131}I resin uptake, since the other tests were exactly the same as for other iodized subjects who were not suspected of having hyperthyroidism. It is interesting to note that the suppression test with KSCN in these three patients performed according to the method of Sánchez-Martin (33) was the same as described by him for normal subjects, and also by Fierro-Benítez and Garcés (15) for subjects with endemic goiter without autonomous nodules.

Tapazol administration at a dose of 45 mg a day for two or three months was enough to change the picture in two (cases 1 and 2) of the three women. One of them was ready for an incidental gastrectomy three months from the beginning of treatment.

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The third woman presented hyperthyroidism one year after injection. Among laboratory tests done in March 1967, the results that were different from those of the other iodized subjects from Tocachi who had the same tests at the same time were the BEI, serum thyroxine, and resin uptake of ^{131}I-T_3. These were high. All these tests were within normal limits for other iodized subjects. In April 1968 this third woman continued to present clinical hyperthyroidism in spite of Tapazol administration at a dose of 75 mg per day (taken irregularly). Laboratory data were: ^{131}I thyroid uptake: 8 hr = 30 per cent; 24 hr = 38 per cent; 96 hr = 24 per cent; 24 hr conversion ratio = 56 per cent; 24 hr PB^{131}I per cent dose per liter = 0,24; BEI = 9.0 µg per cent; BII = 4 µg per cent. She was hospitalized by the end of April 1968 and became clinically euthyroid after six weeks of daily administration of 75 mg of Tapazol.

SUMMARY

Intramuscular injections of iodized oil (Ethiodol) have produced no local or general reactions of iodine intolerance. They may be administered by technical personnel under medical supervision.

Goiter in an isolated rural district of the Ecuadorean Andes has had a 36 per cent reduction two years after administration of iodized oil. Reduction has been small in the age group over 40 years.

Reduction of goiter incidence was regular and progressive until the period between the 20th and the 25th months after iodization, after which time prevalence of goiter began to increase. This was primarily an increase in the number of Grade I goiters. Larger goiters at the same period of time continued to decrease in size, and Grade I goiters did not increase in size. At the 25th month after the injection program there was a sharp reduction in the prevalence of large goiters.

The increased incidence of small nodular goiters, which was so noticeable at the 6th month survey, should be attributed to a better delineation of these nodules as a result of involution of previously hyperplastic thyroid tissue.

Administration of iodized oil to mothers before delivery has prevented the appearance of goiter in their children, at least for the first two years. Administration of iodized oil has produced a restoration of thyroid function to normal.

Urinary excretion of iodine following administration of iodized oil follows an exponential pattern. At doses used in the present program (2 ml of Ethiodol for adults), the urinary excretion of iodine would be over basal figures until 40 months after injection. If the dose would be reduced to 1 ml, the increased excretion would remain until 35 months after injection.

Among 960 subjects injected, three developed hyperthyroidism. They were women more than 45 years old with large nodular goiters. Laboratory tests useful for diagnosis were: BMR, BEI, T_4, and resin uptake of ^{131}I-labeled T_3. Tapazol was effective in curing the disease. One of the three hyperthyroid required hospitalization.

The present study indicates that the use of intramuscularly injected iodized oil is a useful means for combating endemic goiter and cretinism in rural areas where the endemic is severe. The method is cheap, long-acting, relatively free of side effects, and can be easily applied through modest local health services.

Using 1 ml of Ethiodol as a dose, results should be similar to those reported in this paper. Accordingly, we recommend that 1 ml of Ethiodol be used for adults in future programs, and proportionally smaller doses for children. The entire population of the goitrous area from 0 to 45 years of age of both sexes should be injected. There is no need to exclude persons with nodular goiter, but they may be given a smaller dose.

ACKNOWLEDGMENTS

Our gratitude is due Dr. John B. Stanbury, who made this program in Ecuador possible. We also wish to thank Dr. John Kevany, Dr. Andreis Querido, and Dr. Joseph Benotti for their help, cooperation, and training. The project has received generous help from Lederle Laboratories, the Teen Club of Chestnut Hill, Massachusetts, Caritas (Section of Ecuador), Life Laboratories (Ecuador), and the Andean Mission of Ecuador.

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Table 1. Ethnic and socioeconomic aspects of Tocachi and La Esperanza and data on iodine content of salt, water, soil, and urine.

	TOCACHI	LA ESPERANZA
Population	1,100	2,500
Altitude (meters above sea level)	2,952	2,883
% half-breeds	59.43	45.24
% Indians	38.80	50.08
% subjects born in the village	97.00	91.00
% infant mortality	43.00	29.00
% natural abortion	2.80	4.20
% unwed mothers	26.00	14.00
% illiterate subjects	31.00	34.00
% subjects who have visited the coast region	5.00	9.00
% artisans	5.00	5.00
Annual income per person (U.S. dollars)	90	85
Iodine content of salt, water, soil, and urine		
Iodine in salt (μg/g)	0.24	0.24
Iodine in water (μg/l)	1.00	0.85
Iodine in soil (μg/kg)	7.00	23.00
I^{127} urinary excretion (μg per 0.9 g creatinine)	10.4	17.7

Table 2. Prevalence

General goiter
Nodular goiter
Diffuse goiter
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TOCACHI	LA ESPERANZA
1,100	2,500
2,952	2,883
59.43	45.24
38.80	50.08
97.00	91.00
43.00	29.00
2.80	4.20
26.00	14.00
31.00	34.00
5.00	9.00
5.00	5.00
90	85
and urine	
0.24	0.24
1.00	0.85
7.00	23.00
10.4	17.7

Table 2. Prevalence of goiter and of neural and motor abnormalities, per cent of total population (March 1966).

	TOCACHI	LA ESPERANZA
General goiter	69.7	52.8
Nodular goiter	41.1	23.4
Diffuse goiter	28.6	29.3
ENDEMIC CRETINISM TYPE I: Mental deficiency and severe impairment in hearing and speech	7.4	5.5
ENDEMIC CRETINISM TYPE II: Mental deficiency and severe impairment in hearing and speech and short stature and motor abnormalities	0.8	0.5
DEAFMUTISM Severe impairment in hearing and speech	4.5	2.5
DEAFNESS Severe impairment in hearing	1.6	0.0
MUTISM Severe deficit in speech	0.4	0.4
MOTOR ABNORMALITIES	1.0	0.8
OTHER CONGENITAL MALFORMATIONS	0.4	1.2

Table 3. Average consumption of calories and nutritive elements per person per day. Tocachi and La Esperanza, March 1966 and June 1968. Children who were less than one year old were not taken into account (Ecuadorean National Institute of Nutrition).

	TOCACHI		LA ESPERANZA	
	March 1966	June 1968	March 1966	June 1968
Calories	1,577.64	1,604.49	1,699.58	1,860.00
Total protein (g)	38.66	39.15	39.03	48.31
Animal protein (g)	5.85	2.77	4.06	4.48
Vegetable protein (g)	32.81	36.38	34.97	43.83
Total fat (g)	22.32	25.17	26.30	24.16
Animal fat (g)	13.56	2.21	11.05	0.31
Vegetable fat (g)	8.76	22.96	15.25	23.85
Carbohydrate (g)	280.54	312.30	327.79	362.40
Calcium (g)	0.20	0.16	0.22	0.29
Iron (mg)	20.45	19.72	23.47	32.60
Total vitamin A (I.U.)	588.65	823.71	1,340.76	1,000.00
Animal vitamin A (I.U.)	114.81	40.79	75.82	152.00
Vegetable vitamin A (I.U.)	473.84	782.92	1,264.94	848.00
Thiamine (mg)	0.92	1.30	1.18	1.43
Niacin (mg)	17.86	27.68	25.09	29.32
Riboflavin (mg)	0.50	0.55	0.54	0.83
Vitamin C (mg)	56.32	119.94	93.81	108.61

Table 4. Height and weight of the subjects from 19 to 50 years old. Tocachi and La Esperanza, May 1966.

			Number	Mean value	Standard deviation	Probability
HEIGHT (cm)	MEN	Tocachi	113	152	8.3	0.7
		La Esperanza	80	156	6.7	
	WOMEN	Tocachi	206	142	6.7	0.6
		La Esperanza	220	145	6.4	
WEIGHT (kg)	MEN	Tocachi	113	53.4	6.8	0.04
		La Esperanza	80	57.0	7.0	
	WOMEN	Tocachi	213	45.6	7.0	0.03
		La Esperanza	217	50.0	6.6	

Table 5. Prevalence and distribution of goiter by type and size in the survey conducted just before injection. Total subjects surveyed: 960. Tocachi, March 1966.

		DIFFUSE GOITER						NODULAR GOITER			TOTAL	
		Oa	Ob	Oa+Ob	DI	DII	DIII	Total D	NI	NII	NIII	Total N	GOITER
MALE	No.	137	35	172	100	37	1	138	60	72	22	159	297
	%	29.2	7.4	36.6	21.3	7.8	0.2	29.4	12.7	15.3	4.6	33.9	63.3
FEMALE	No.	89	29	118	91	44	2	137	57	128	45	236	373
	%	18.1	5.9	24.0	18.5	8.9	0.4	27.9	11.6	26.0	9.1	50.3	75.9
M + F	No.	226	64	290	191	81	3	275	117	200	67	395	670

Table 5. Prevalence and distribution of goiter by type and size in the survey conducted just before injection. Total subjects surveyed: 960. Tocachi, March 1966.

					DIFFUSE GOITER				NODULAR GOITER					TOTAL
		Oa	Ob	Oa+Ob	DI	DII	DIII	Total D	NI	NII	NIII	NIV	Total N	GOITER
MALE	No.	137	35	172	100	37	1	138	60	72	22	5	159	297
	%	29.2	7.4	36.6	21.3	7.8	0.2	29.4	12.7	15.3	4.6	1.0	33.9	63.3
FEMALE	No.	89	29	118	91	44	2	137	57	128	45	6	236	373
	%	18.1	5.9	24.0	18.5	8.9	0.4	27.9	11.6	26.0	9.1	1.2	50.3	75.9
M + F	No.	226	64	290	191	81	3	275	117	200	67	11	395	670
	%	23.5	6.6	30.2	19.8	8.4	0.3	28.6	12.1	20.8	6.0	1.1	41.1	69.7

Table 6. Prevalence and distribution of goiter by age in the survey conducted just before injection. Total subjects surveyed: 960. Tocachi, March 1966.

AGE PERIOD YEARS	NUMBER					DIFFUSE GOITER				NODULAR GOITER					TOTAL
			Oa	Ob	Oa+Ob	DI	DII	DIII	Total D	NI	NII	NIII	NIV	Total N	GOITER
0-5	178	No.	98	18	116	45	15		60		2			2	54
		%	55.0	10.1	65.1	25.2	8.4		33.7		1.1			1.1	34.9
6-12	160	No.	37	12	49	68	30		98	5	8			13	111
		%	23.1	7.5	30.6	42.5	18.7		61.2	3.1	5.0			8.1	69.3
13-18	85	No.	11	8	19	23	7		30	9	27			36	66
		%	12.9	9.4	22.3	27.0	8.2		35.2	10.5	31.7			42.3	77.6
19-40	292	No.	54	12	66	40	13	3	56	60	82	24	4	170	226
		%	18.4	4.1	22.6	13.6	4.4	1.0	19.1	20.5	28.0	8.2	1.3	58.2	77.3
41-+	245	No.	26	14	40	15	16		31	43	81	43	7	174	205
		%	10.6	5.7	16.3	6.1	6.5		12.5	17.5	33.0	17.5	2.8	71.0	83.6

Table 7. Prevalence and distribution of goiter by type and size in the survey conducted six months after injection. Total subjects surveyed: 490. Tocachi, September 1966.

		DIFFUSE GOITER							NODULAR GOITER					TOTAL
		Oa	Ob	Oa+Ob	DI	DII	DIII	Total D	NI	NII	NIII	NIV	Total N	GOITER
MALE	No.	54	63	117	8	2		10	68	20	1		89	99
	%	25.0	29.1	54.1	3.7	0.9		4.6	31.4	9.2	0.4		41.2	45.8
FEMALE	No.	46	38	84	21	5		26	88	70	6		164	190
	%	16.7	13.8	30.6	7.6	1.8		9.4	32.1	25.5	2.1		59.8	69.3
M + F	No.	100	101	201	29	7		36	156	90	7		253	289
	%	20.4	20.6	41.0	5.9	1.4		7.3	31.8	18.3	1.4		51.6	58.9

Table 8. Prevalence and distribution of goiter by age in the survey conducted six months after injection. Total subjects surveyed: 490. Tocachi, September 1966.

AGE PERIOD YEARS	NUMBER		DIFFUSE GOITER							NODULAR GOITER					TOTAL
			Oa	Ob	Oa+Ob	DI	DII	DIII	Total D	NI	NII	NIII	NIV	Total N	GOITER
0-5	135	No.	79	37	116	6	1		7	11	1			12	19
		%	58.5	27.4	85.9	4.4	0.7		5.1	8.1	0.7			18.8	14.0
6-12	76	No.	6	27	33	13	2		15	22	6			28	43
		%	7.8	35.5	43.4	17.1	2.6		19.7	28.9	7.8			36.8	56.5
13-18	45	No.	2	14	16	4			4	18	7			25	29
		%	4.4	31.1	35.5	8.8			8.8	40.0	15.5			55.5	55.1
19-40	129	No.	8	18	26	6	4		10	66	26	1		93	103
		%	6.2	13.9	20.1	4.6	3.1		7.7	51.1	20.1	0.7		72.0	79.8
41-+	105	No.	5	5	10					39	50	6		95	95
		%	4.7	4.7	9.5					37.1	47.6	5.7		90.4	90.4

Table 9. Prevalence and distribution of goiter by type and size in the survey conducted 12 months after injection. Total subjects surveyed: 584. Tocachi, March 1967.

		DIFFUSE GOITER							NODULAR GOITER					TOTAL
		Oa	Ob	Oa+Ob	DI	DII	DIII	Total D	NI	NII	NIII	NIV	Total N	GOITER
MALE	No.	88	63	151	21	2		23	56	18	3		77	100
	%	35.0	25.0	60.1	8.3	0.7		9.1	22.3	7.1	1.1		30.6	39.8
FEMALE	No.	71	56	127	36	2		38	98	67	3		168	206
	%	21.3	16.8	38.1	10.8	0.6		11.4	29.4	20.1	0.9		50.4	61.8

6-12	76	No.	6	27	33	13	2		15	22	6			28	43
		%	7.8	35.5	43.4	17.1	2.6		19.7	28.9	7.8			36.8	56.5
13-18	45	No.	2	14	16	4			4	18	7			25	29
		%	4.4	31.1	35.5	8.8			8.8	40.0	15.5			55.5	55.1
19-40	129	No.	8	18	26	6	4		10	66	26	1		93	103
		%	6.2	13.9	20.1	4.6	3.1		7.7	51.1	20.1	0.7		72.0	79.8
41-+	105	No.	5	5	10					39	50	6		95	95
		%	4.7	4.7	9.5					37.1	47.6	5.7		90.4	90.4

Table 9. Prevalence and distribution of goiter by type and size in the survey conducted 12 months after injection. Total subjects surveyed: 584. Tocachi, March 1967.

		DIFFUSE GOITER							NODULAR GOITER					TOTAL
		Oa	Ob	Oa+Ob	DI	DII	DIII	Total D	NI	NII	NIII	NIV	Total N	GOITER
MALE	No.	88	63	151	21	2		23	56	18	3		77	100
	%	35.0	25.0	60.1	8.3	0.7		9.1	22.3	7.1	1.1		30.6	39.8
FEMALE	No.	71	56	127	36	2		38	98	67	3		168	206
	%	21.3	16.8	38.1	10.8	0.6		11.4	29.4	20.1	0.9		50.4	61.8
M + F	No.	159	119	278	57	4		61	154	85	6		245	306
	%	27.2	20.3	47.6	9.7	0.6		10.4	26.3	14.5	1.0		41.9	52.3

Table 10. Prevalence and distribution of goiter by age in the survey conducted 12 months after injection. Total subjects surveyed: 584. Tocachi, March 1967.

AGE PERIOD YEARS	NUMBER		DIFFUSE GOITER							NODULAR GOITER					TOTAL
			Oa	Ob	Oa+Ob	DI	DII	DIII	Total D	NI	NII	NIII	NIV	Total N	GOITER
0-5	127	No.	94	22	106	6			6	5				5	11
		%	74.0	17.3	91.3	4.7			4.7	3.9				3.9	8.6
6-12	115	No.	22	41	63	29			29	22	1			23	52
		%	19.1	35.6	54.7	25.2			25.2	19.1	0.8			20.0	45.2
13-18	58	No.	8	19	27	11	1		12	16	3			19	31
		%	13.7	32.7	46.5	18.9	1.7		20.6	27.5	5.1			32.7	53.4
19-40	141	No.	20	28	48	8	3		11	51	29	2		82	93
		%	14.1	19.8	34.0	5.6	2.1		7.8	36.1	20.5	1.4		58.1	65.9
41-+	143	No.	15	9	24	3			3	60	52	4		116	119
		%	10.4	6.2	16.7	2.0			2.0	41.9	36.3	2.7		81.1	83.2

Table 11. Prevalence and distribution of goiter by type and size in the survey conducted 20 months after injection. Total subjects surveyed: 560. Tocachi, November 1967.

		DIFFUSE GOITER							NODULAR GOITER					TOTAL
		Oa	Ob	Oa+Ob	DI	DII	DIII	Total D	NI	NII	NIII	NIV	Total N	GOITER
MALE	No.	118	51	169	15	1		16	45	16	2		63	79
	%	47.5	20.5	68.5	6.0	0.4		6.4	18.1	6.4	0.8		25.4	14.1
FEMALE	No.	99	50	149	37	5		42	59	46	6		111	153
	%	32.7	16.5	49.3	12.2	1.6		13.9	19.5	15.2	1.9		36.7	27.3
M + F	No.	217	101	318	52	6		58	104	62	8		174	232
	%	38.7	18.0	56.7	9.2	1.0		10.3	18.5	11.0	1.4		31.0	41.4

Table 12. Prevalence and distribution of goiter by age in the survey conducted 20 months after injection. Total subjects surveyed: 560. Tocachi, November 1967.

AGE PERIOD YEARS	NUMBER		DIFFUSE GOITER						NODULAR GOITER					TOTAL
			Oa	Ob	Oa+Ob	DI	DII	DIII	Total D	NI	NII	NIII	NIV	Total N	GOITER
0-5	156	No.	121	12	133	7			7	8	2			10	17
		%	77.5	7.6	85.2	4.4			4.4	5.1	1.2			6.4	10.8
6-12	95	No.	18	34	52	23	4		27	14	2			16	43
		%	18.9	35.7	54.7	24.2	4.2		28.4	14.7	2.1			16.8	45.2
13-18	43	No.	10	17	27	8			8	8				8	16
		%	23.2	39.5	62.7	18.6			18.6	18.6				18.6	37.2
19-40	134	No.	39	24	63	11	2		13	32	25	1		58	71
		%	29.1	17.9	47.0	8.2	1.4		9.7	23.8	18.6	0.7		43.2	52.9
41-+	138	No.	29	14	43	3			3	42	43	7		92	95
		%	21.0	10.1	31.1	2.1			2.1	30.4	31.1	5.0		66.6	68.8

Table 13. Prevalence and distribution of goiter by type and size in the survey conducted 25 months after injection. Total subjects surveyed: 758. Tocachi, April 1968.

		DIFFUSE GOITER							NODULAR GOITER					TOTAL
		Oa	Ob	Oa+Ob	DI	DII	DIII	Total D	NI	NII	NIII	NIV	Total N	GOITER
MALE	No.	129	100	229	14			14	94	18	2		114	128
	%	36.1	28.0	64.1	3.9			3.9	26.3	5.0	0.5		31.9	35.8
FEMALE	No.	96	90	186	39	1		40	111	58	6		175	215
	%	23.9	22.4	46.3	9.7	0.2		9.9	17.6	14.4	1.4		43.6	53.6

6-12	95	No.	18	34	52	23	4	27	14	2		16	43
		%	18.9	35.7	54.7	24.2	4.2	28.4	14.7	2.1		16.8	45.2
13-18	43	No.	10	17	27	8		8	8			8	16
		%	23.2	39.5	62.7	18.6		18.6	18.6			18.6	37.2
19-40	134	No.	39	24	63	11	2	13	32	25	1	58	71
		%	29.1	17.9	47.0	8.2	1.4	9.7	23.8	18.6	0.7	43.2	52.9
41-+	138	No.	29	14	43	3		3	42	43	7	92	95
		%	21.0	10.1	31.1	2.1		2.1	30.4	31.1	5.0	66.6	68.8

Table 13. Prevalence and distribution of goiter by type and size in the survey conducted 25 months after injection. Total subjects surveyed: 758. Tocachi, April 1968.

		DIFFUSE GOITER							NODULAR GOITER					TOTAL
		Oa	Ob	Oa+Ob	DI	DII	DIII	Total D	NI	NII	NIII	NIV	Total N	GOITER
MALE	No.	129	100	229	14			14	94	18	2		114	128
	%	36.1	28.0	64.1	3.9			3.9	26.3	5.0	0.5		31.9	35.8
FEMALE	No.	96	90	186	39	1		40	111	58	6		175	215
	%	23.9	22.4	46.3	9.7	0.2		9.9	17.6	14.4	1.4		43.6	53.6
M + F	No.	225	190	415	53	1		54	205	76	8		289	343
	%	29.7	25.1	54.8	7.0	0.1		7.1	27.1	10.0	1.0		38.2	45.3

Table 14. Prevalence and distribution of goiter by age in the survey conducted 25 months after injection. Total subjects surveyed: 758. Tocachi, April 1968.

AGE PERIOD YEARS	NUMBER		DIFFUSE GOITER						NODULAR GOITER					TOTAL
			Oa	Ob	Oa+Ob	DI	DII	DIII Total D	NI	NII	NIII	NIV	Total N	GOITER
0-5	166	No.	130	21	115	11		11	1	3			4	15
		%	78.3	12.6	90.9	6.6		6.6	0.6	1.8			2.4	9.0
6-12	139	No.	20	87	107	25	1	26	5	1			6	32
		%	14.3	62.5	76.9	17.9	0.7	18.7	3.5	0.7			4.3	23.1
13-18	64	No.	14	32	46	11		11	7				7	18
		%	21.8	50.0	71.8	17.1	17.1	17.1	10.9				10.9	28.2
19-40	192	No.	31	45	76	5		5	88	19	4		111	116
		%	16.1	23.4	39.5	2.6		2.6	45.8	9.8	2.0		57.8	60.5
41-+	197	No.	30	5	35	1		1	104	53	4		161	162
		%	15.2	2.5	17.7	0.5		0.5	52.7	26.9	2.0		81.7	82.3

Table 15. Evolution of thyroids of grade Oa, linear study. Number of subjects of this group surveyed in March 1966: 226.

		TOCACHI											
		SURVEY AFTER 6 MONTHS			SURVEY AFTER 12 MONTHS			SURVEY AFTER 20 MONTHS			SURVEY AFTER 25 MONTHS		
THYROID		MALE No. 59	FEMALE No. 40	M+F No. 99	MALE No. 71	FEMALE No. 42	M+F No. 113	MALE No. 59	FEMALE No. 34	M+F No. 93	MALE No. 88	FEMALE No. 54	M+F No. 142
Oa	No.	34	22	56	48	24	72	44	23	67	55	22	77
	%	57.6	55.0	56.5	67.6	57.1	63.7	74.5	67.6	72.0	62.5	40.7	54.2
Ob	No.	12	8	20	16	11	27	13	8	21	21	21	42
	%	20.3	20.0	22.2	22.5	26.1	23.8	22.0	23.5	22.5	23.8	38.8	29.5
IN	No.	8	5	13	5	3	8	2	2	4	9	3	12
	%	13.5	12.5	13.1	7.0	7.1	7.0	3.3	5.8	4.3	10.2	5.5	8.4
ID	No.	3	4	7	1	4	5	-	1	1	1	6	7
	%	5.0	10.0	7.0	1.4	9.5	4.4	-	2.9	1.0	1.1	11.1	4.9
IIN	No.	2	-	2	-	-	-				2	2	4
	%	3.3	-	2.0	-	-	-				2.2	3.7	2.8
IID	No.	-	1	1	1	-	1						
	%	-	2.5	1.0	1.4	-	0.8						

Table 16. Evolution of thyroids Ob, linear study. Number of subjects of this group surveyed in March 1966: 64.

		TOCACHI											
		SURVEY AFTER 6 MONTHS			SURVEY AFTER 12 MONTHS			SURVEY AFTER 20 MONTHS			SURVEY AFTER 25 MONTHS		
THYROID		MALE No. 59	FEMALE No. 40	M+F No. 99	MALE No. 71	FEMALE No. 42	M+F No. 113	MALE No. 59	FEMALE No. 34	M+F No. 93	MALE No. 88	FEMALE No. 54	M+F No. 142
Oa	No.	34	22	56	48	24	72	44	23	67	55	22	77
	%	57.6	55.0	56.5	67.6	57.1	63.7	74.5	67.6	72.0	62.5	40.7	54.2
Ob	No.	12	8	20	16	11	27	13	8	21	21	21	42
	%	20.3	20.0	22.2	22.5	26.1	23.8	22.0	23.5	22.5	23.8	38.8	29.5
IN	No.	8	5	13	5	3	8	2	2	4	9	3	12
	%	13.5	12.5	13.1	7.0	7.1	7.0	3.3	5.8	4.3	10.2	5.5	8.4
ID	No.	3	4	7	1	4	5	-	1	1	1	6	7
	%	5.0	10.0	7.0	1.4	9.5	4.4	-	2.9	1.0	1.1	11.1	4.9
IIN	No.	2	-	2	-	-	-				2	2	4
	%	3.3	-	2.0	-	-	-				2.2	3.7	2.8
IID	No.	-	1	1	1	-	1						
	%	-	2.5	1.0	1.4	-	0.8						

IIN	No.	2	-	2	-	-	-					
	%	3.3	-	2.0	-	-	-			2.2	3.7	2.8
IID	No.	-	1	1	1	-	1					
	%	-	2.5	1.0	1.4	-	0.8					

Table 16. Evolution of thyroids Ob, linear study. Number of subjects of this group surveyed in March 1966: 64.

		TOCACHI											
		SURVEY AFTER 6 MONTHS			SURVEY AFTER 12 MONTHS			SURVEY AFTER 20 MONTHS			SURVEY AFTER 25 MONTHS		
THYROID		MALE No. 17	FEMALE No. 13	M+F No. 30	MALE No. 20	FEMALE No. 16	M+F No. 36	MALE No. 20	FEMALE No. 14	M+F No. 34	MALE No. 27	FEMALE No. 18	M+F No. 45
Oa	No.	3	2	5	6	2	8	7	6	13	13	3	16
	%	17.6	15.3	16.6	30.0	12.5	22.2	35.0	42.8	38.2	48.1	16.6	35.5
Ob	No.	9	7	16	7	11	18	9	4	13	8	9	17
	%	52.9	53.8	53.6	35.0	68.7	50.0	45.0	28.5	38.2	29.6	50.0	37.7
IN	No.	5	1	6	4	3	7	3	3	6	4	2	6
	%	29.4	7.6	20.0	20.0	18.7	19.4	15.0	21.4	17.6	14.8	11.1	13.3
ID	No.	-	2	2	2	-	2	1	1	2	2	4	6
	%	-	15.3	6.6	10.0	-	5.5	5.0	7.1	5.8	7.4	22.2	13.3
IIN	No.				1	-	1						
	%				5.0		2.7						
IID	No.	-	1	1									
	%	-	7.6	3.3									

Table 17. Evolution of goiters diffuse I, linear study. Number of subjects of this group surveyed in March 1966: 191.

		TOCACHI											
		SURVEY AFTER 6 MONTHS			SURVEY AFTER 12 MONTHS			SURVEY AFTER 20 MONTHS			SURVEY AFTER 25 MONTHS		
THYROID		MALE No. 58	FEMALE No. 48	M+F No. 106	MALE No. 50	FEMALE No. 64	M+F No. 114	MALE No. 55	FEMALE No. 51	M+F No. 106	MALE No. 73	FEMALE No. 64	M+F No. 137
Oa	No.	7	8	15	10	13	23	20	16	36	14	14	28
	%	12.0	16.6	14.1	20.0	20.3	20.1	36.3	31.3	33.9	19.1	21.8	20.4
Ob	No.	27	14	41	21	19	40	16	17	33	42	26	68
	%	46.5	29.1	38.6	42.0	29.6	35.0	29.0	33.3	31.1	57.5	40.6	49.6
IN	No.	17	15	32	10	15	25	7	7	14	9	9	18
	%	29.3	31.2	30.1	20.0	23.4	21.9	12.7	13.7	13.2	12.3	14.0	13.1
ID	No.	5	6	11	8	16	24	10	10	20	8	13	21
	%	8.6	12.5	10.3	16.0	25.0	21.0	18.1	19.6	18.8	10.9	20.3	15.3
IIN	No.	2	3	5	1	-	1	2	1	3	-	1	1
	%	3.4	6.2	4.7	2.0	-	0.8	3.6	1.9	2.8	-	1.5	0.7
IID	No.	-	2	2	-	1	1				-	1	1
	%	-	4.1	1.8	-	1.5	0.8				-	1.5	0.7

Table 18. Evolution of goiters nodular I, linear study. Number of subjects of this group surveyed in March 1966: 117.

		TOCACHI											
		SURVEY AFTER 6 MONTHS			SURVEY AFTER 12 MONTHS			SURVEY AFTER 20 MONTHS			SURVEY AFTER 25 MONTHS		
THYROID		MALE No. 58	FEMALE No. 48	M+F No. 106	MALE No. 50	FEMALE No. 64	M+F No. 114	MALE No. 55	FEMALE No. 51	M+F No. 106	MALE No. 73	FEMALE No. 64	M+F No. 137
Oa	No.	7	8	15	10	13	23	20	16	36	14	14	28
	%	12.0	16.6	14.1	20.0	20.3	20.1	36.3	31.3	33.9	19.1	21.8	20.4
Ob	No.	27	14	41	21	19	40	16	17	33	42	26	68
	%	46.5	29.1	38.6	42.0	29.6	35.0	29.0	33.3	31.1	57.5	40.6	49.6
IN	No.	17	15	32	10	15	25	7	7	14	9	9	18
	%	29.3	31.2	30.1	20.0	23.4	21.9	12.7	13.7	13.2	12.3	14.0	13.1
ID	No.	5	6	11	8	16	24	10	10	20	8	13	21
	%	8.6	12.5	10.3	16.0	25.0	21.0	18.1	19.6	18.8	10.9	20.3	15.3
IIN	No.	2	3	5	1	-	1	2	1	3	-	1	1
	%	3.4	6.2	4.7	2.0	-	0.8	3.6	1.9	2.8	-	1.5	0.7
IID	No.	-	2	2	-	1	1				-	1	1
	%	-	4.1	1.8	-	1.5	0.8				-	1.5	0.7

IIN	No.	2	3	5	1	-	1	2	-	-	-	1	1
	%	3.4	6.2	4.7	2.0	-	0.8	3.6	1.9	2.8	-	1.5	0.7
IID	No.	-	2	2	-	1	1				-	1	1
	%	-	4.1	1.8	-	1.5	0.8				-	1.5	0.7

Table 18. Evolution of goiters nodular I, linear study. Number of subjects of this group surveyed in March 1966: 117.

		TOCACHI											
		SURVEY AFTER 6 MONTHS			SURVEY AFTER 12 MONTHS			SURVEY AFTER 20 MONTHS			SURVEY AFTER 25 MONTHS		
THYROID		MALE No. 22	FEMALE No. 34	M+F No. 56	MALE No. 35	FEMALE No. 35	M+F No. 70	MALE No. 33	FEMALE No. 28	M+F No. 61	MALE No. 41	FEMALE No. 35	M+F No. 76
Oa	No.		1	1	6	1	7	10	6	16	5	3	8
	%		2.9	1.7	17.1	2.8	10.0	30.3	21.4	26.2	12.1	8.5	10.5
Ob	No.	2	5	7	14	8	22	7	5	12	6	6	12
	%	9.0	14.7	12.5	40	22.8	31.4	21.2	17.8	19.6	14.6	17.1	15.7
IN	No.	14	16	30	14	18	32	15	8	23	27	20	47
	%	63.6	47.0	53.5	40.0	51.4	45.7	45.4	28.5	37.7	65.8	57.1	61.8
ID	No.	2	3	5	-	5	5	-	5	5	1	1	2
	%	9.0	8.8	8.9	-	14.2	7.1	-	17.8	8.1	2.4	2.8	2.6
IIN	No.	4	9	13	1	3	4	1	4	5	2	5	7
	%	18.0	26.4	23.2	2.8	8.5	5.7	3.0	14.2	8.1	4.8	14.2	9.2
IID													

Table 19. Evolution of goiters diffuse II, linear study. Number of subjects of this group surveyed in March 1966: 81.

		TOCACHI											
		SURVEY AFTER 6 MONTHS			SURVEY AFTER 12 MONTHS			SURVEY AFTER 20 MONTHS			SURVEY AFTER 25 MONTHS		
THYROID		MALE No. 19	FEMALE No. 24	M+F No. 43	MALE No. 27	FEMALE No. 30	M+F No. 57	MALE No. 23	FEMALE No. 27	M+F No. 50	MALE No. 30	FEMALE No. 32	M+F No. 62
Oa	No.	-	2	2	1	2	3	5	4	9	3	3	6
	%	-	8.3	4.6	3.7	6.6	5.2	21.7	14.8	18.0	10.0	9.3	9.6
Ob	No.	8	2	10	7	3	10	4	4	8	15	7	22
	%	42.1	8.3	23.2	25.9	10.0	17.5	17.3	14.8	16.0	50.0	21.8	35.4
IN	No.	6	11	17	10	10	20	7	3	10	-	-	-
	%	31.5	45.8	39.5	37.0	33.3	35.0	30.4	11.1	20.0	-	-	-
ID	No.	1	3	4	8	8	16	3	7	10	4	8	12
	%	5.4	12.5	9.3	29.6	26.6	28.0	13.0	25.9	20.0	13.3	25.0	19.3
IIN	No.	2	6	8	1	6	7	3	5	8	7	9	16
	%	10.8	25.0	18.6	3.7	20.0	12.2	13.0	18.5	16.0	23.3	28.1	25.8
IID	No.	2	-	2	-	1	1	1	4	5	1	5	6
	%	10.8	-	4.6	-	3.3	1.7	4.3	14.8	10.0	3.3	15.6	9.6

Table 20. Evolution of goiters nodular II, linear study. Number of subjects of this group surveyed in March 1966: 200.

	TOCACHI											
	SURVEY AFTER 6 MONTHS			SURVEY AFTER 12 MONTHS			SURVEY AFTER 20 MONTHS			SURVEY AFTER 25 MONTHS		
THYROID	MALE No. 19	FEMALE No. 24	M+F No. 43	MALE No. 27	FEMALE No. 30	M+F No. 57	MALE No. 23	FEMALE No. 27	M+F No. 50	MALE No. 30	FEMALE No. 32	M+F No. 62
Oa No.	-	2	2	1	2	3	5	4	9	3	3	6
%	-	8.3	4.6	3.7	6.6	5.2	21.7	14.8	18.0	10.0	9.3	9.6
Ob No.	8	2	10	7	3	10	4	4	8	15	7	22
%	42.1	8.3	23.2	25.9	10.0	17.5	17.3	14.8	16.0	50.0	21.8	35.4
IN No.	6	11	17	10	10	20	7	3	10	-	-	-
%	31.5	45.8	39.5	37.0	33.3	35.0	30.4	11.1	20.0	-	-	-
ID No.	1	3	4	8	8	16	3	7	10	4	8	12
%	5.4	12.5	9.3	29.6	26.6	28.0	13.0	25.9	20.0	13.3	25.0	19.3
IIN No.	2	6	8	1	6	7	3	5	8	7	9	16
%	10.8	25.0	18.6	3.7	20.0	12.2	13.0	18.5	16.0	23.3	28.1	25.8
IID No.	2	-	2	-	1	1	1	4	5	1	5	6
%	10.8	-	4.6	-	3.3	1.7	4.3	14.8	10.0	3.3	15.6	9.6

IIN	No.	2	6	8	1	6	7	5	8	7	3	10	
	%	10.8	25.0	18.6	3.7	20.0	12.2	13.0	18.5	16.0	23.3	28.1	25.8
IID	No.	2	-	2	-	1	1	1	4	5	1	5	6
	%	10.8	-	4.6	-	3.3	1.7	4.3	14.8	10.0	3.3	15.6	9.6

Table 20. Evolution of goiters nodular II, linear study. Number of subjects of this group surveyed in March 1966: 200.

		TOCACHI											
		SURVEY AFTER 6 MONTHS			SURVEY AFTER 12 MONTHS			SURVEY AFTER 20 MONTHS			SURVEY AFTER 25 MONTHS		
THYROID		MALE No. 24	FEMALE No. 73	M+F No. 97	MALE No. 34	FEMALE No. 91	M+F No. 126	MALE No. 27	FEMALE No. 78	M+F No. 105	MALE No. 48	FEMALE No. 101	M+F No. 149
Oa	No.	-	-	-	2	1	3	5	6	11	2	2	4
	%	-	-	-	5.8	1.0	2.3	18.5	7.6	10.4	4.1	1.9	2.6
Ob	No.	4	1	5	3	5	8	4	6	10	8	16	24
	%	16.6	1.3	5.1	8.8	5.4	6.3	14.8	7.6	10.4	16.6	15.8	16.1
IN	No.	12	34	46	17	39	56	12	28	40	29	58	87
	%	50.0	46.5	57.7	50.0	42.8	44.4	44.4	35.8	38.0	60.4	57.4	58.3
ID	No.	-	2	2	3	5	8	1	12	13	1	4	5
	%	-	2.6	2.0	8.8	5.4	6.3	3.7	15.3	12.3	2.0	3.9	3.3
IIN	No.	8	35	43	9	40	49	5	26	31	7	20	27
	%	33.3	47.9	44.3	26.4	43.9	38.8	18.5	33.3	29.5	14.5	19.8	18.1
IID	No.	-	1	1									
	%	-	1.3	1.0									

Table 21. Evolution of goiters nodular III, linear study. Numbér of subjects of this group surveyed in March 1966: 67.

		TOCACHI											
		SURVEY AFTER 6 MONTHS			SURVEY AFTER 12 MONTHS			SURVEY AFTER 20 MONTHS			SURVEY AFTER 25 MONTHS		
THYROID		MALE No. 6	FEMALE No. 27	M+F No. 33	MALE No. 10	FEMALE No. 27	M+F No. 37	MALE No. 6	FEMALE No. 27	M+F No. 33	MALE No. 12	FEMALE No. 34	M+F No. 46
Oa	No.				1	1	2	1	1	2	-	1	1
	%				10.0	3.7	5.4	16.6	3.7	6.0	-	2.9	2.1
Ob	No.												
	%												
IN	No.	2	8	10	2	7	9	-	6	6	8	9	17
	%	33.3	29.6	30.3	20.0	25.9	24.3	-	22.2	18.1	66.6	26.4	36.9
ID	No.				-	2	2	-	1	1			
	%				-	7.4	5.4	-	3.7	3.0			
IIN	No.	4	15	19	5	16	21	5	15	20	4	21	25
	%	66.6	55.4	57.5	50.0	59.2	56.7	83.3	55.5	60.6	33.3	61.7	54.3
IIIN	No.	-	4	4	2	1	3	-	4	4	-	3	3
	%	-	14.8	12.1	20.0	3.7	8.1	-	14.8	12.0	-	8.8	6.5

Table 22. Prevalence and distribution of goiter by type and size. La Esperanza, March 1966.

					DIFFUSE GOITER				NODULAR GOITER					TOTAL
		Oa	Ob	Oa+Ob	DI	DII	DIII	Total D	NI	NII	NIII	NIV	Total N	GOITER
MALE	No.	218	34	252	106	23	1	130	32	20	9		61	191
	%	50.3	7.8	58.1	24.4	5.3	0.2	30.0	7.3	4.6	2.0		14.0	44.0
FEMALE	No.	179	34	213	107	42	5	154	59	77	27	3	166	320
	%	33.5	6.3	39.9	20.0	7.8	0.9	28.8	11.0	14.4	5.0	0.5	31.1	60.0

IIN	No.	4	15	19	5	16	21	5	15	20	4	21	25
	%	66.6	55.4	57.5	50.0	59.2	56.7	83.3	55.5	60.6	33.3	61.7	54.3
IIIN	No.	-	4	4	2	1	3	-	4	4	-	3	3
	%	-	14.8	12.1	20.0	3.7	8.1	-	14.8	12.0	-	8.8	6.5

Table 22. Prevalence and distribution of goiter by type and size. La Esperanza, March 1966.

		DIFFUSE GOITER							NODULAR GOITER					TOTAL
		Oa	Ob	Oa+Ob	DI	DII	DIII	Total D	NI	NII	NIII	NIV	Total N	GOITER
MALE	No.	218	34	252	106	23	1	130	32	20	9		61	191
	%	50.3	7.8	58.1	24.4	5.3	0.2	30.0	7.3	4.6	2.0		14.0	44.0
FEMALE	No.	179	34	213	107	42	5	154	59	77	27	3	166	320
	%	33.5	6.3	39.9	20.0	7.8	0.9	28.8	11.0	14.4	5.0	0.5	31.1	60.0
M + F	No.	397	68	465	203	65	6	284	91	97	36	3	227	511
	%	41.0	7.0	48.1	22.0	6.7	0.6	29.3	9.4	10.0	3.7	0.3	23.4	52.8

Table 23. Prevalence and distribution of goiter by type and size. La Esperanza, April 1968.

		DIFFUSE GOITER							NODULAR GOITER					TOTAL
		Oa	Ob	Oa+Ob	DI	DII	DIII	Total D	NI	NII	NIII	NIV	Total N	GOITER
MALE	No.	116	162	278	98	15		113	143	44	9		196	309
	%	19.7	27.6	47.4	16.7	2.5		19.2	24.4	7.5	1.5		33.4	52.7
FEMALE	No.	77	122	199	107	31	2	140	137	141	25	1	304	444
	%	11.9	18.9	30.9	16.6	4.8	0.3	21.7	21.3	21.9	3.8	0.1	47.2	69.0
M + F	No.	193	284	477	205	46	2	253	280	185	34	1	500	753
	%	15.7	23.1	38.8	16.6	3.7	0.1	20.5	22.7	15.0	2.7	0.08	40.6	61.2

Table 24. Evolution of ^{131}I thyroid uptake in iodized subjects from Tocachi.

	2 hr. Mean value range	24 hr. Mean value range	96 hr. Mean value range
Before iodization No. 18	60 45-70	79 59-88	75 61-86
After 6 months No. 10	10 7-18	23 10-38	22 8-38
After 12 months No. 7	14 9-18	39 35-45	38 33-45
After 20 months No. 7	12 8-17	34 21-49	31 17-45
After 25 months No. 10	12 6-18	38 24-56	34 20-53
Non-iodized subjects (1 April 1968) No. 3	43 38-48	72 70-74	61 54-68

Table 25. Evolution of ^{131}I thyroid function in iodized subjects from Tocachi.

	Conversion ratio per cent, 24 hr. Mean value range	$PB^{131}I$ per cent 24 hr. Mean value range
Before iodization	86 55-92	0.29 0.10-0.34
After 6 months	6 2-15	0.019 0.008-0.04
After 12 months	14 8-21	0.04 0.02-0.07
After 20 months	31 15-51	0.21 0.06-0.42
After 25 months	36 11-57	0.14 0.02-0.24

Table 26. E

Before iodization No. 18
After 6 months No. 10
After 12 months No. 14
After 20 months No. 5
After 25 months No. 14

Table 27. Evolutic

Before iodization No. 27
After 6 months No. 10
After 12 months No. 35
After 20 months No. 13
After 25 months No. 43
Non-iodized subjects (April 1968) No. 18

ts from Tocachi.

96 hr. Mean value range
75 61-86
22 8-38
38 33-45
31 17-45
34 20-53
61 54-68

:ts from Tocachi.

^{131}I per cent 24 hr. n value range
0.29 0.10-0.34
0.019 0.008-0.04
0.04 0.02-0.07
0.21 0.06-0.42
0.14 0.02-0.24

Table 26. Evolution of ^{127}I blood tests in iodized subjects from Tocachi.

	TI µg% Mean value range	PBI µg% Mean value range	BEI µg% Mean value range	BII µg% Mean value range
Before iodization No. 18	2.84 1.2-5.6	2.76 1.2-5.0	2.08 0.8-5.0	0.60 0.4-0.8
After 6 months No. 10	20 9- 20	20 8- 20	4.40 2.0-7.0	10.00 6.0-15.4
After 12 months No. 14	11.16 8.0-15.2	11.14 7.8-14.4	5.85 4.6-6.8	5.62 2.2-10.2
After 20 months No. 5	9.13 7.3-10.8	8.01 7.1-9.5	5.50 4.1-6.5	2.20 0.9-3.2
After 25 months No. 14	7.72 2.0-12.2	7.15 1.5-11.0	5.69 1.4-7.4	1.57 0.4-4.5

Table 27. Evolution of urinary excretion of iodine in iodized subjects from Tocachi.

	UEI µg/100 ml.		CREATININE mg/100 ml.		UEI µg per 0.9 g creatinine	
	Mean value	Range	Mean value	Range	Mean value	Range
Before iodization No. 27	0.37	0.2-0.8	32.8	21-69	10.4	7.4-25.2
After 6 months No. 10	32.50	9.2-10.3	31.8	19-59	920.0	482-1,575
After 12 months No. 35	9.90	2.4-16.0	31.0	13-44	292.6	142-415
After 20 months No. 13	5.45	1.3-10.2	30.6	15-50	160.4	80-173
After 25 months No. 43	2.89	0.5-8.9	33.2	18-58	78.4	30-135
Non-iodized subjects (April 1968) No. 18	0.53	0.2-1.4	32.8	17-54	14.5	11.5-24.7

Table 28. Data obtained in the thyrotoxic women from Tocachi (after six months of administration of iodized oil).

	Patient No. 1	Patient No. 2	Patient No. 3
Age	45	67	60
Goiter March 1966	N-II	N-III	N-II
Goiter October 1966	N-I	N-III	N-I
BMR, per cent	+24	+53	+82
Cholesterol mg per 100 ml	212	190	178
^{131}I thyroid uptake			
8 hours	16	23	24
24 hours	22	32	33
96 hours	20	31	30
PB^{131}I per liter at 24 hours	0.02	0.008	0.09
KSCN Suppression test - per cent dose	1	4	0
BEI, µg per cent	7.8	12.0	8.0
BII, µg per cent	14.0	10.5	13.5
T_3-^{131}I resin uptake	40	50	52

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