

# **Studies on the reduction of the thyroidal uptake rate in normal school children**

YARO RIBEIRO GANDRA  
Faculdade de Higiene e Saúde Pública  
Universidade de São Paulo  
São Paulo, S. P., Brasil

## **SUMMARY**

Administration of iodine ( $KIO_3$ ) to school children considered as normal reduces the radioiodine uptake in direct proportion to the doses administered. The daily or weekly system of iodine administration did not interfere substantially with the degree of reduction of the normal uptake. When the iodine administration was discontinued, in 4 weeks the return to the initial normal uptake levels was observed. Administration of iodine to communities is an effective means of reducing the uptake of radioactive iodine and can be applied as preventive method in public health.

---

After detonation of nuclear weapons there has been a precipitation of radioactive fission products of both long and short half life. These have been detected in plants and animals. Among the radioisotopes of short half life, iodine 131 is biologically one of the most important, since it is concentrated by the thyroid gland.

Successive examination of thyroids from animals have shown increasing accumulation of radioiodine in the days following atomic experiments (1, 2, 3). Furthermore, it has been found, although to a lesser degree, that man too has accumulated detectable quantities of radioiodine in the thyroid gland (1, 4, 5).

Evidently, the oral route is the main entrance of radioactive iodine, especially through milk consumption (4, 5, 2, 6). At least 70% of the radioactive iodine found in animals not living in confinement, came from pastures. On the other hand, since about 6% of the iodine 131 absorbed by the cow appears in the milk, this must be considered as one of the principal vehicles of dissemination (1, 7, 8). In many cases, the yearly average of 130  $\mu\mu$  C/1 considered to be the safe maximum according to the Medical Research Council (7) has been surpassed (8, 9). If a child or an adult consumes the same amount of milk, the specific activity of the iodine in the child will be greater than that in the adult. Thus, greater care in this regard is warranted as far as children are concerned.

Studies of the increased radioactivity at different distances from the test areas have shown that, at least up to the present, the radioactive precipitations do not constitute a real danger for the population. This may not be true if nuclear explosions occur under non-experimental conditions. The governments, through their public health agencies, must be prepared to face an eventuality of this type, and must implement programs to adequately protect the exposed population.

There are several studies on the experimental reduction of the  $I^{131}$  uptake rates of thyroid gland (10, 11, 12, 13). Most of the groups studied were, in general, different from ours, as they were goitrous and had generally high mean  $I^{131}$  uptake values.

The object of the experiments reported here was to study normal school children in terms of the reduction of radioiodine uptake, brought about by administration of stable iodine in various schedules and dosage patterns.

## MATERIAL AND METHODS

The samples studied consisted of 53 male school children between the ages of 7 and 9. They resided in the Educandario Dom Duarte, located 23 kilometers from the city of São Paulo, where the children have daily activities very similar to those prevailing in semi-urban areas of the State. They lived in "homes" where all received healthy food and identical treatment. Two groups were established: Group A with five sub-group received during eight weeks, daily except Sundays,

iodine in the form of potassium iodate capsules (Figure I). A sub-group I, Control, received placebo. Group B consisted of four experimental sub-groups, in which each subject received one capsule of potassium iodate every week during 8 weeks (Figure II).

All doses were administered by us personally and there was no change of diet during the experimental period.

The 24 hour radioiodine uptakes were measured every fifteen days. Before each new dose of  $I^{131}$  the residual radioactivity was measured and a correction calculated based on radioiodine decay.

After an interruption of the iodine treatment, we continued to measure the thyroidal uptake for an additional period of four weeks.

Sub-groups IV, V, VII and VIII, which received larger quantities of stable iodine, were under daily observation to detect any signs of intolerance or of thyrotoxicosis.

## RESULTS

The first serie of uptake tests was taken before the children received any iodine treatment. The averages of the sub-groups oscillated around 30%.

In Group A we were able to verify that starting from the initial values, considered normal, it was possible to achieve a continual decrease of the thyroidal uptake, at a proportional rate to the dose of administered iodine. After eight weeks of observation, during which time the daily iodine doses had been suspended, it was found that the average of uptake test tended to return to its previously normal values.

In Group B (Figure II) to which doses were administered weekly, practically the same reduction rate was achieved. A similar return towards normal was observed after suspending the weekly dose of iodate.

In order to determine whether or not the mean reduction in the uptake of each group varied significantly from one to the other, we carried out an analysis of variance on a fixed model in order to test the degree of equality of the average uptake rates in the different dosage groups.

We can see that in the children who received a single

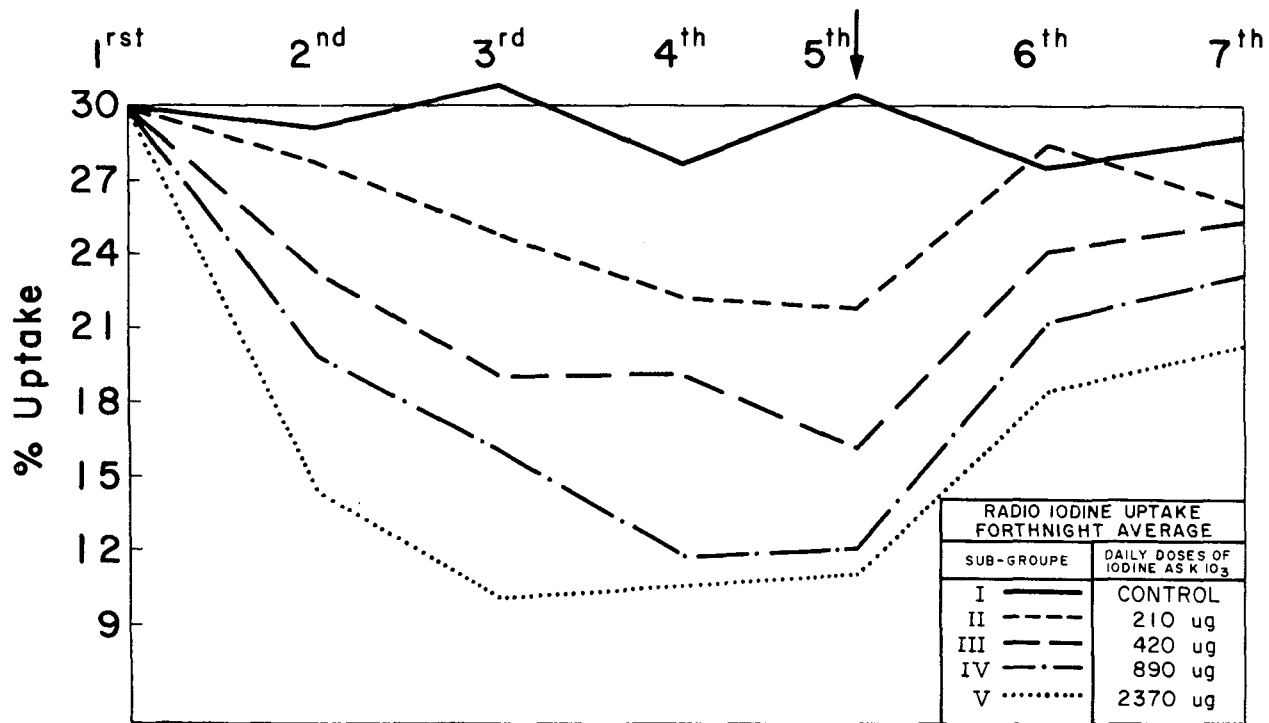


FIGURE I - REDUCTION ON THE THYROIDAL UPTAKE RATE OF  $I^{131}$  IN NORMAL SCHOOLCHILDREN UNDER DAILY DOSES OF IODINE ( $K IO_3$ )

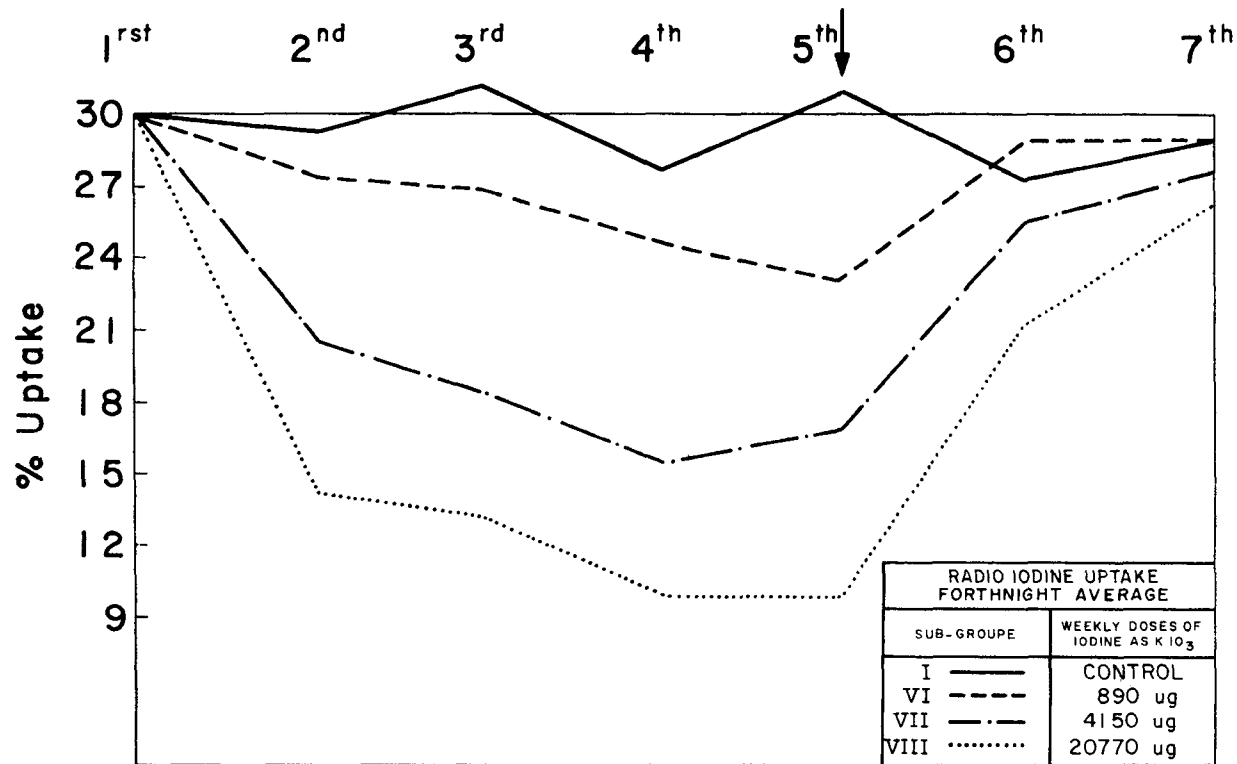


FIGURE II—REDUCTION ON THE THYROIDAL UPTAKE RATE OF I<sup>131</sup> IN NORMAL SCHOOLCHILDREN UNDER WEEKLY DOSES OF IODINE (K IO<sub>3</sub>)

weekly dose of iodine, the differences between the uptake averages of each group were, in all instances, statistically significant, excluding the fifth and sixth evaluation, when we had already suspended the administration of the iodine.

Among the school children who received daily doses of iodine, the differences of the average of the uptake rates among the groups were, in all instances, statistically significant.

## DISCUSSION

It is obvious that under certain circumstances of increased radioactivity of the environment caused by fallout of radio-nuclides, it would be necessary that Public Health Agencies make use of counter measures drawn up for the population protection. One of the most practical of these measures would be to reduce the quantity of radioactive iodine uptake by the thyroid gland. By increasing the pool of stable iodine, a dilution of radioactive iodine is brought about, with a consequent reduction of the Specific Activity.

From the viewpoint of the Public Health Agencies it would be interesting to know the behavior of individuals with a normal rate of iodine uptake. Working with normal school children we found that administration of doses of iodine progressively decreased the  $I^{131}$  uptake and that decrease was in relation to the quantity of iodine given. The highest index of reduction was attained after 30 to 60 days of treatment depending upon the doses and the interruption of the treatment permitted a rapid rise in the uptake of radioiodine in all groups.

It is interesting to note that the type of curves obtained when weekly doses of iodine were administered were similar to those in which daily doses were given. Comparing the sub-groups who received similar daily average doses, we found that there was an equivalence in the reduction of uptake rates in these sub-groups. This aspect might be relevant to the Public Health Agencies in devising a program for the distribution of doses to the population group to be protected.

## CONCLUSIONS

1. The administration of iodine ( $KIO_3$ ) to normal school children reduced the thyroidal uptake of radioiodine.

2. The reduction of radioiodine uptake was as high as the doses of stable iodine dispensed. Depending upon the amount of iodine, the initial uptake average of 30% was reduced to 10%.

3. Whether the iodine was administered weekly or daily practically did not interfere in the degree to which the normal uptake rate had been reduced.

4. Four weeks after the administration of iodine ( $KIO_3$ ) had been suspended, a return to the previous level of uptake was noticed.

5. The administering of iodine ( $KIO_3$ ) to the community is an efficacious means for reducing thyroidal uptake of radioactive iodine.

### ACKNOWLEDGMENTS

The help, guidance and supervision of Dr. John B. Stanbury is gratefully acknowledged.

The author is also very grateful to Dr. M. D. Hegsted for part of the financial support granted to us through the Harvard School of Public Health. We wish to acknowledge the cooperation of Dr. J. C. Mello Reis and the members of the School of Public Health of University of São Paulo.

### RESUMEN

#### Estudios sobre la velocidad de reducción de la captación tiroidea en escolares normales

Se hizo un estudio con 53 niños escolares, del sexo masculino, incluidos en las edades de 7 a 9 años, quienes fueron sometidos a dos tratamientos. Tratamiento A: cinco grupos de 5 a 7 niños cada uno recibieron por ocho semanas, diariamente, dosis de yodo: 0 (placebo), 210, 420, 890, 2.370  $\mu\text{g}$  de yodo ( $KIO_3$ ). Tratamiento B: cuatro grupos experimentales, de los cuales el primero, que recibió placebo, fue el mismo grupo testigo del tratamiento A. Los otros grupos consistían de 7 niños cada uno y recibieron por ocho semanas y semanalmente una cápsula de yodato de potasio, correspondiendo a 890, 4.150 y 20.770  $\mu\text{g}$  de yodo por dosis. Cada dos semanas el atrape de yodo de la tiroides fue medido 24 horas después de la administración de yodo radioactivo y después de haber medido la radioactividad residual, la baja fue calculada antes de administrar el suplemento de yodo estable. El promedio de atrape inicial de los diferentes grupos fue de alrededor de 30%. En los tratamientos A y B se notó que de los valores iniciales considerados como normales se obtenía una reducción continua del atrape proporcional a la dosis de yodo administrado. Los valores promedio más altos fueron de aproximadamente 10% del atrape.

Cuando la administración diaria de yodo fue descontinuada después de ocho semanas de estudio, se encontró que el valor promedio de atrape para ambas formas tendía a ser normal en cuatro semanas. Las curvas obtenidas con los dos tratamientos eran muy parecidas si se considera la dosis total recibida semanalmente. La variancia es analizada con un criterio estándar fijo. Las diferencias en promedio de atrape para cada grupo fueron estadísticamente significativas en todas las valuaciones, excepto para el quinto y sexto grupo de la forma B, cuando la administración de yodo ya había sido suspendida. En conclusión puede decirse que la administración de yodo ( $KIO_3$ ) a niños escolares considerados normales reduce el atrape de yodo radioactivo en proporción directa a la dosis administrada. El sistema de administración de yodo diaria o semanalmente no interfiere sustancialmente con el grado de reducción del atrape normal. Cuando la administración de yodo fue suspendida, se observó a las cuatro semanas el retorno al nivel normal de atrape. La administración de yodo a comunidades es un medio efectivo de reducir el atrape de yodo radioactivo y puede ser aplicada como método de prevención en salud pública.

#### BIBLIOGRAFIA

- (1) Comar, C. L., B. F. Trum, U. S. G. Kum III, R. H. Wasserman, M. M. Nold & J. C. Schooley.—Thyroid radioactivity after nuclear weapons tests. *Science*, 126: 16-18, 1957.
- (2) Robertson, H. A. & I. R. Falconer.—Accumulation of radioactive iodine in thyroid gland subsequent to nuclear weapon tests and the accident at Windscale. *Nature*, 184: (2) 1699-1702, 1959.
- (3) Van Middlesworth, L.—Iodine-131 in sheep before and after nuclear reactor accident. *Nature*, 181: (1) 256, 1958.
- (4) Burch, P. R. J.—Measurement at Leeds following the Windscale reactor accident. Iodine-131 in human thyroids and iodine-131 and caesium-137 in milk. *Nature*, 183: (1) 515-517, 1959.
- (5) Maycock, G. & J. Vennart.—Iodine-131 in human thyroids following the Windscale reactor accident. *Nature*, 182: (2) 1545-1547, 1958.
- (6) Spiers, F. W.—Increase in background gamma-radiation and its correlation with iodine-131 in milk. *Nature*, 183 (1) 517-519, 1959.
- (7) Medical Research Council. Radioactive fall-out and the testing of nuclear weapons. *Nature*, 192: (4802) 400-403, 1961.
- (8) Iodine-131 in milk Britain. *Nature*, 192: (4804) 707-708, 1961.
- (9) Iodine-131 in milk Britain. *Nature*, 192: (4802) 504, 1961b.
- (10) Maisterrana, J. A., E. Tovar, A. Cancino & O. Serrano, with the technical assistance of C. G. Muñoz & O. Rosales.—Nutrition and endemic goiter in Mexico. *J. Clin. Endocrinol.* (2) 24: 166-172, 1964.
- (11) Najjar, S. S. & C. W. Woodruff.—Some observations on goiter on Lebanon. *Amer. J. Clin. Nutrition*, 13: 46-54, 1963.
- (12) Ramalingaswami, H. A., T. A. V. Subramanian & M. G. Deo.—The etiology of Himalayan endemic goiter. *Lancet*, 1: 791-794, 1961.
- (13) Stanbury, J. B., G. L. Brownell, H. Perinetti, J. Itoiz & E. B. Castillo. "Endemic goiter. Adaptation of man to iodine deficiency." Cambridge, Massachusetts, Harvard University Press, 1954. Harvard University Monographs in Medicine and Public Health No. 12.