# Exercise Lowers Thyroid Radioiodine Uptake: Concise Communication

Philip L. Hooper, Buck A. Rhodes, and Martin J. Conway

*Albuquerque Veteran's Administration Hospital, Lovelace Medical Center, and University of New Mexico, Albuquerque, New Mexico*

**The effect of exercise upon the uptake of radioiodine by the thyroid was examined in both rats and humans. Rats that exercised intermittently on a mechanical wheel for a period of 20 days had significantly lower uptake values ($p < 0.0001$) than sedentary controls. Human volunteers that ran at least ten miles/week had a lower mean 24-hr uptake value ($8.0 \pm 2.8\%$) than nonexercising subjects ($14.3 \pm 5.1\%$, $p < 0.01$). Other thyroid function studies (thyroxine, triiodothyronine, triiodothyronine resin uptake, thyroid-stimulating hormone) did not differ significantly between the exercising and nonexercising groups. These studies suggest that exercise significantly alters thyroid iodine economy.**

**J Nucl Med 21: 835–837, 1980**

In previous investigations one of us (B.A.R.) observed a significant alteration of thyroidal iodine handling in the exercising rat (*1*). To explore further the possible role of exercise in altering thyroidal iodine metabolism, we examined the effect of endurance exercise upon the uptake of radioiodine by the thyroid in both rat and human.

## MATERIALS AND METHODS

Fourteen male Wistar rats received a specially prepared iodine-deficient diet. Iodine was added to the drinking water so that each rat received on an average 7.5 $\mu$g of iodine per day. Water consumption was monitored. Eight of the rats were housed in cages equipped with mechanical activity drums (exercise group), while six (nonexercise group) were housed in regular cages. In the exercise group, exercise was documented by recording the number of turns of the activity drums per week. Weight of exercising rats did not differ from nonexercising rats. Twenty days after initiating the study, each rat was given intramuscularly 0.5 $\mu$Ci of carrier-free I-123 in 2 cc of normal saline solution. The I-123 activity of the thyroid gland was measured at 1.5, 12, and 38 hr after the injection. To determine uptake values, the rats were anesthetized with 50% $CO_2$–50% $O_2$, and the radioactivity measured with an in vivo rat thyroid counter (*2*). The percent uptake of the gland was calculated by comparing the rat's thyroid activity with the activity of the I-123 injection solution.

Ten subjects (seven males, three females, ages 25–38) who gave a history of running at least 10 miles per week were selected for study (exercise group). In addition, ten subjects (seven males, three females, ages 24–37) who described their life habits as sedentary were studied (nonexercise group). The two groups did not differ in body weight, and no subject gave a history of thyroid disease or other major illness. No subject was taking drugs known to alter thyroidal uptake, or had received iodinated x-ray contrast media within the previous year.

Serum was collected before the administration of radioactive iodine for determination of total thyroxine ($T_4$) and total triiodothyronine ($T_3$), triiodothyronine resin uptake ($T_3U$) and thyroid-stimulating hormone (TSH). A free thyroxine index (FTI) was determined from the formula: $T_4 \times T_3U/100$. All subjects included in the study had normal $T_4$, $T_3$, $T_3U$, FTI, and TSH values. For

Received Feb. 25, 1980; revision accepted April 21, 1980.

For reprints contact: Philip L. Hooper, MD, Ambulatory Care, Albuquerque Veteran's Administration Hospital, 2100 Ridgecrest Dr. S.E., Albuquerque, NM 87108.

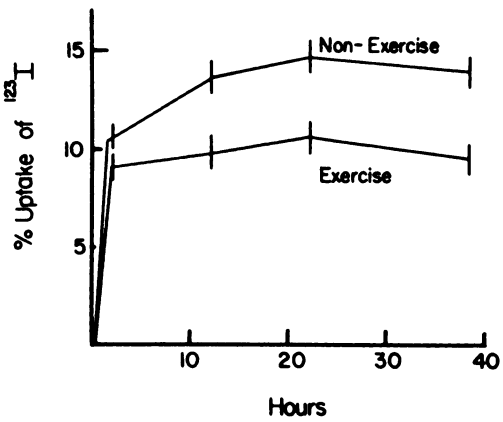


FIG. 1. Thyroidal radioiodine uptake in exercising and nonexercising rats.

an indirect estimate of dietary iodine, subjects collected 24-hr urine samples.

Each subject was given 100 $\mu$Ci of I-123 orally in liquid form. The only radionuclide impurity at the time of calibration was I-125 (<1.4%). Extrathyroidal radioactivity was estimated by counting over the thigh. Thyroidal I-123 uptake values were measured with a single-channel analyzer according to the recommendations of the International Atomic Energy Agency (*3*). Statistical analysis was performed by Student's t-test.

## RESULTS

The results of the rat data are shown in Fig. 1. The exercise group had a lower uptake of I-123 than the nonexercise group. The difference was significant at 1.5 hr and remained significant throughout the 38 hr in which measurements were made ($p < 0.0001$). A record of water intake suggested that the exercising rats drank slightly more water per day than nonexercising rats, and thus received 8.0 $\mu$g of iodine per day compared with 7.0 $\mu$g in the nonexercising group. However, this difference in iodine ingestion was not statistically significant.

The results of the human data are summarized in Table 1. Significantly lower 24-hr uptakes of I-123 were found in the exercise group (8.0% ± 2.8%) than in the nonexercise group (14.3% ± 5.1%, $p < 0.01$). The two groups did not differ in $T_4$, $T_3$, $T_3U$, FTI, TSH, urinary iodine, or 2-hr uptake.

**TABLE 1. THYROID FUNCTION STUDIES IN EXERCISING AND NONEXERCISING HUMAN SUBJECTS**

| Number of subjects | Nonexercise 10 | Exercise 10 |
|---|---|---|
| $T_4$ ($\mu$g/dl) | 7.9 ± 0.8 | 7.7 ± 1.6 |
| $T_3$ (ng/dl) | 127 ± 19 | 128 ± 17 |
| $T_3U$ (%) | 42.8 ± 2.3 | 40.6 ± 3.1 |
| FTI | 3.4 ± 0.4 | 3.1 ± 0.5 |
| TSH (milliIU/ml) | 3.1 ± 0.7 | 3.1 ± 0.6 |
| 24-hr urinary iodine ($\mu$g) | 380 ± 156 | 440 ± 190 |
| 2-hr uptake (%) | 4.0 ± 3.7 | 3.5 ± 1.9 |
| 24-hr uptake | 14.3 ± 5.1 | 8.0 ± 2.8 ($p < 0.01$) |

## DISCUSSION

The results of the present study demonstrate that endurance training in both rat and human subjects is associated with a lower uptake of radioiodine by the thyroid. The study complements the observation of Rhodes (*1*), that exercising rats have diminished thyroid iodine content. In that study, 5 wk of treadmill running were associated with a 50% reduction in thyroidal iodine stores.

An extensive review of the literature revealed only one other study that examined the effect of endurance exercise upon thyroid iodine uptake. In that study, Wilson (*4*) exercised 17 healthy adult men for 3 wk. Although he reported the change as not significant, twenty-four hour uptake values appeared to fall from 30% before the conditioning period to 24% after it. Two weeks after cessation of the training, the uptake values rose to 28%. The apparent substantial fall in uptake values that Wilson observed further prompted us to pursue our study.

It is unlikely that the difference in uptake values can be explained merely by a difference in iodine ingestion. Neither the iodine ingested by the rats nor the urinary iodine excretion in the humans differed appreciably between the two groups. However, it is possible that exercise might lower uptake values through a reduced secretion of TSH. While some investigators have reported a rise in TSH after prolonged strenuous exercise (*5*), Sowers and coworkers (*6*) have demonstrated a prolonged depression of serum TSH after human volunteers exercised for 15 min on a treadmill (a level of exercise similar to that engaged in by our human subjects). Since serum TSH is a major determinant of thyroidal iodine uptake (*7*), a prolonged reduction in TSH during the day should reduce thyroidal uptake. It is of interest that glucocorticoids, (which are known to rise after exercise (*6*), both suppress baseline TSH (*8*) and reduce thyroidal radioiodine uptake (*9*). Our data do not allow us to address the role of TSH in inducing lower uptakes. The TSH assay used in this study is insensitive at very low values, unlike Sowers' highly sensitive double-antibody method. Furthermore, it is unlikely that static TSH levels that are in a physiologic range would predict biologic response in a dynamic system. Finally, other factors such as altered adrenergic activity or thyroidal blood flow may play a role in lowering uptake values.

The effect of endurance exercise upon thyroid function has been studied in both animal and human models. Although endurance training is not associated with altered serum concentration of $T_4$ or $T_3$, several studies have found an exercise-induced increased turnover of both $T_4$ and $T_3$ (*10, 11*). In spite of impressive studies of iodine metabolism and exercise, a major discrepancy remains: How can exercise cause both decreased iodine uptake and increased thyroid turnover, while serum hormone levels remain unaltered?

REFERENCES

1. RHODES BA: Effect of exercise on the thyroid gland. *Nature* 216:917-918, 1967 (Letter to the Editor)
2. BUDDEMEYER EU: An efficient technique for the reproducible in vivo assay of thyroidal radioiodine in small animals. *Int J Appl Radiat Isot* 19:33-38, 1968
3. Calibration and standardization of thyroid radioiodine uptake measurements. Recommendations drawn up at Consultants' Meeting convened by International Atomic Energy Agency. *ACTA Radiol* 58:233-240, 1962
4. WILSON O: Field study of the effect of cold exposure and increased muscle activity upon metabolic rate and thyroid function in man. *Fed Proc* 25:1357-1362, 1966
5. REFSUM HE, STROMME S: Serum throxine, triiodothyronine and thyroid stimulating hormone after prolonged heavy exercise. *Scand J Clin Lab Invest* 39:455-459, 1979
6. SOWERS JR, RAJ RP, HERSHMANN RP, et al: The effect of stressful diagnostic studies and surgery on anterior pituitary hormone release in man. *ACTA Endocrinol* (*Kbh*) 86:25-32, 1977
7. ROSENBERG IN, BASTOMSKY CH: The thyroid. *Ann Rev Physiol* 27:71-106, 1965
8. NICOLOFF JT, FISHER DA, APPLEMAN MD: The role of glucocorticoids in the regulation of thyroid function in man. *J Clin Invest* 49:1922-1929, 1970
9. REISS RS, RIGGS DS, THORN GW, et al: *Proceedings of the First Clinical ACTH Conference*. Philadelphia, The Blakiston Co., 1950, p 193
10. IRVINE CHG: Effect of exercise on thyroxine degradation in athletes and non-athletes. *J Clin Endocrinol* 28:942-948, 1968
11. TERJUNG RL, WINDER WW: Exercise and thyroid function. *Med Sci Sports* 7:20-26, 1975