

## Estimation of post exercise thyroid hormones in trained students of physical education college underwent submaximal exercise

\*Maha A. Hamdi, \*\*Hammodi Essam Noaman, \*\*\*Mossa M. Marbut

\*Student at département of physiology, College of Medicine, University of Tikrit, Tikrit, Iraq

\*\* College of physical education, University of Tikrit, Tikrit, Iraq

\*\*\* Department of physiology, College of Medicine, University of Tikrit, Tikrit, Iraq

Received 2/5/2011 Accepted 6/6/2011

### Abstract

Thyroid hormones stimulate oxygen consumption by most of cells in the body. Help in regulation of lipid & carbohydrate metabolism. The second function is to secrete calcitonin, a hormone that regulate calcium levels. The aim of this study is to investigate the effect of submaximal exercise on post exercise levels of serum T3, T4, & TSH in young healthy students. Thirty student subjects were participate in this study from physical education college, university of Tikrit. The study was done from Jan. to the end of February 2011. Their age were between 20 -22 ( $20.53 \pm 1.73$  years). A total 5 minutes warm up was given for each subject, then 9 minutes of exercise was applied to the students with a gradually increasing intensity every 3 minutes ( starting from 50, 100, 150 watts) up to 75% of their maximal heart rate. Blood samples were taken before & 5 minutes after exercise. T3, T4 & TSH were measured before & after exercise. Heart rate was measured at resting state before starting exercise & 1, 2, 3 minutes after the end of exercise (recovery heart rate). There is no significant difference between pre & post exercise value of T3. Also, there is slight decrease in serum T3 level after exercise. Also, there is no significant difference between pre exercise value of T4 comparing with post exercise value. However, there is a highly significant difference between preexercise value of TSH, comparing with post exercise value. In previous study, the rate of increase of TSH is going linear with increase in intensity of exercise. The present study is partially agree with previous findings of continuous TSH increase until 15 minutes after the end of exercise with unchanged or slightly decrease T3 level. A possible cause for the increase of TSH levels may be due to pituitary secretion & may serve to fulfill the exercise induced increase in peripheral need for thyroid hormones.

### تقدير هرمونات الغدة الدرقية في طلبة كلية التربية الرياضية بعد ممارسة التمرينات الرياضية

مها ارشد حمدي حمودي عصام نعمان موسى محمود مربوط

#### المستخلص

هرمونات الغدة الدرقية تحفز استهلاك الأوكسجين من قبل معظم الخلايا في الجسم. تساعد في تنظيم التمثيل الغذائي للكربوهيدرات والدهون. والوظيفة الثانية هي إفراز هرمون الكالسيتونين، وهو الهرمون الذي ينظم مستويات الكالسيوم. الهدف من هذه الدراسة إلى هو دراسة تأثير التمرين الرياضي على مستويات هرمونات الغدة الدرقية في مصل الدم (T4، T3)، لدى الطلاب الشباب الأصحاء. شارك في هذه الدراسة 30 طالب من كلية التربية الرياضية في جامعة تكريت. تمت الدراسة من كانون الاول إلى نهاية شباط 2011. وكانت أعمارهم تتراوح بين 20 - سنة 22 ( $20.53 \pm 1.73$  سنة). كان التمرين يشمل على 5 دقائق الإحماء و تم تطبيق 9 دقيقة من التمارين للطلاب مع زيادة كثافة تدريجيا كل 3 دقائق (ابتداء من 50، 100، 150 واط) تصل إلى 75

% من معدل ضربات القلب القصوى. تم أخذ عينات الدم قبل وبعد التمرين بخمس دقائق. تم قياس T3، T4 و هرمون المحفز للغدة الدرقية قبل وبعد ممارسة التمرين الرياضي. تم قياس معدل ضربات القلب في حالة الراحة قبل بدء ممارسة التمرين ثم بعد 1، 2، 3 دقائق بعد انتهاء التمرين (معدل ضربات القلب بعد انتهاء التمرين). لا يوجد فرق معنوي كبير بين قيمة T3 قبل وبعد ممارسة التمارين. هناك انخفاض طفيف في مستوى مصطلح T3 بعد التمرين. وليس هناك فرق كبير بين قيمة الثايروكسين بين قبل وبعد التمرين T4. ومع ذلك، هناك فرق كبير جدا في هرمون المحفز للغدة الثايرويد TSH بين قيمة قبل التمرين *preexercise* مقارنة مع قيمة نفس الهرمون بعد الرياضة. في دراسة سابقة، فإن معدل الزيادة في TSH يتناسب مع الزيادة في كثافة التدريبات. هذه الدراسة هو توافق جزئيا مع النتائج السابقة من زيادة TSH المستمر حتى 15 دقيقة بعد نهاية التمرين مع أو بدون تغيير انخفاض طفيفا مستوى T3. قد يكون السبب المحتمل لزيادة مستويات الهرمون يكون راجعا إلى إفراز الغدة النخامية ويمكن أن تستخدم لتحقيق ممارسة يسببها زيادة هامشية في حاجة لهرمونات الغدة الدرقية.

## **Introduction**

The thyroid gland is one of the largest endocrine glands of the body. The gland has two functions. The first is to secrete thyroid hormones, which maintain the level of metabolism in the tissues. Thyroid hormones stimulate oxygen consumption by most of cells in the body. Help in regulation of lipid & carbohydrate metabolism. The second function is to secrete calcitonin, a hormone that regulate calcium levels (1). It is well known fact that exercise affects activity of many glands & the production of their hormones (2). One of these glands affected by exercise is the thyroid gland. Thyroid gland secretes two separated amino acid-iodine bound thyroid hormones known as 3-5-3' triiodothyronine (T3) & 3-5-3'-5' tetraiodothyronine (T4 thyroxine), both of which are also found in the free form (fT4, fT3). Thyroid hormones are important for the regulation general metabolism, growth & tissue differentiation as well as gene expression, (2,3,4). It is also known that thyroid hormones acts in fatty acid oxidation & thermoregulation (1,5). Some studies were done on animals show that thyroid hormones regulate the transcription of several genes expressed in skeletal muscle, such as the gene coding for type I myosin heavy chain (MHC), actin & the sarcoplasmic reticulum (SR) (6,7). The aim of this study is to investigate the effect of submaximal exercise on

levels of post exercise serum T3, T4, & TSH in young healthy students.

## **Subjects & methods**

Thirty student subjects were participate in this study from physical education College, University of Tikrit. The study was done from beginning of January to the end of February 2011. Their age were between 20 -22 (20.53 ± 1.73 years). All subjects were informed about the aim & procedure of the study methods. All subjects were volunteers & randomly chosen from all students. All of them had a medical examination & completed healthy history. A total 5 minutes warm up was given for each subject, then 9 minutes of exercise was applied to the students with a gradually increasing intensity every 3 minutes ( starting from 50, 100, 150 watts) up to 75% of their maximal heart rate. Blood samples were taken before & 5 minutes after exercise. The T3, T4 & TSH were measured before & after exercise. Heart rate was measured at resting state before starting exercise & 1, 2, 3 minutes after the end of exercise (recovery heart rate). All data were presented as a mean & standard deviation (SD). Student T test was used to compare the differences between values. The accepted level of significance for differences was equal to or less than 0.05 for all tests (P value < 0.05, 0.01).

**Results**

Thirty students were participate in this study. Table 1 shows the characteristic of subjects. Their ages were between 20 -22 ( $20.53 \pm 1.73$ ), the mean body weights was  $67.37 \pm 7.7$  kg & the mean of BMI is  $22.16 \pm 2.31$ . There is no significant difference between pre & post exercise value of T3. Also, there was slight decrease in serum T3 level after exercise. Also, there was no significant difference between pre exercise value of T4 ( $1.296 \pm 0.076$ ) comparing with post exercise value ( $1.261 \pm 0.012$  ng/ml ), (Table 2) However, there was a highly

significant difference between preexercise value of TSH ( $1.5633 \pm 0.792$ ), comparing with post exercise value ( $2.567 \pm 0.91$  n IU/ml),  $p < 0.01$ , (Table 2, fig. 1). Table 3 show the resting heart rate & recovery heart rate at 1, 2, & 3 minutes after the cessation of exercise & also resting & post exercise blood pressure (figure 2, 3). The present findings showed that the recovery heart rate after 3 minutes after cessation of exercise was above 100 beat/ min ( $110 \pm 16$  b/min). This indicated that some subjects who participate in this study were not fit & not well trained.

**Table(1):- The mean & standard deviation (SD) of some parameters of subjects**

Parameters	Mean & S.D
Age (years)	$20.53 \pm 1.73$
Body weight (Kg)	$67.37 \pm 7.7$
Height (cm)	$174.27 \pm 5.5$
BMI kg/m <sup>2</sup>	$22.16 \pm 2.31$

**Table (2):- The mean & standard deviation (SD) of T3, T4, & TSH before & after exercise**

Hormone	Before exercise	After exercise	P value
T3 ng/ml	$1.493 \pm 0.51$	$1.383 \pm 0.38$	NS
T4 ng/ml	$1.296 \pm 0.076$	$1.261 \pm 0.012$	NS
TSH nIU/ml	$1.563 \pm 0.792$	$2.567 \pm 0.91$	< 0.01

**Table(3):- Show the mean & SD of heart rate & blood pressure at resting, Recovery heart rate at 1, 2 & 3 minutes after cessation of exercise**

Parameters	Resting value	1 minute	2 minute	3 minute
Heart rate(b/min)	$72.0 \pm 6.5$	$155.1 \pm 7.7$	$129.6 \pm 14.3$	$110 \pm 16$
Systolic Bp mmHg	$124 \pm 5$	$155.1 \pm 7.8$	$167.6 \pm 16$	$144 \pm 14.5$
Diastolic Bp	$77.7 \pm 4.3$	$60 \pm 2.6$	$60 \pm 1.8$	$61.6 \pm 4.6$

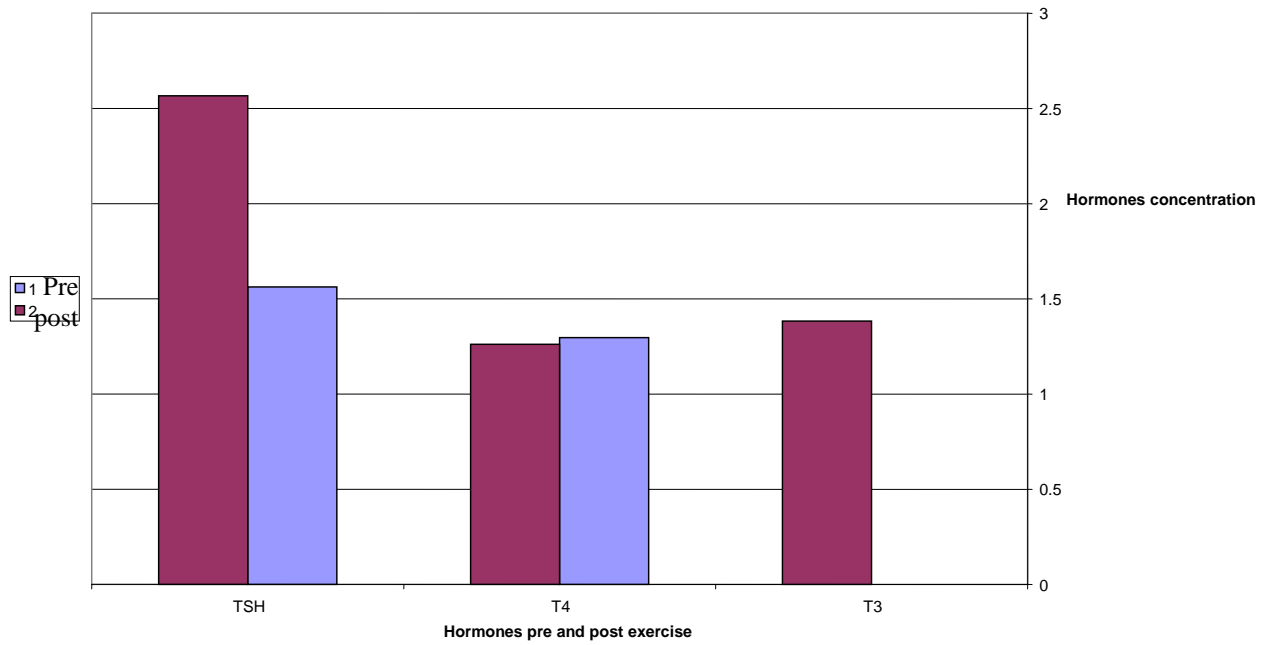


Fig.(1):- show the concentration of T3, T4 & TSH pre & post exercise

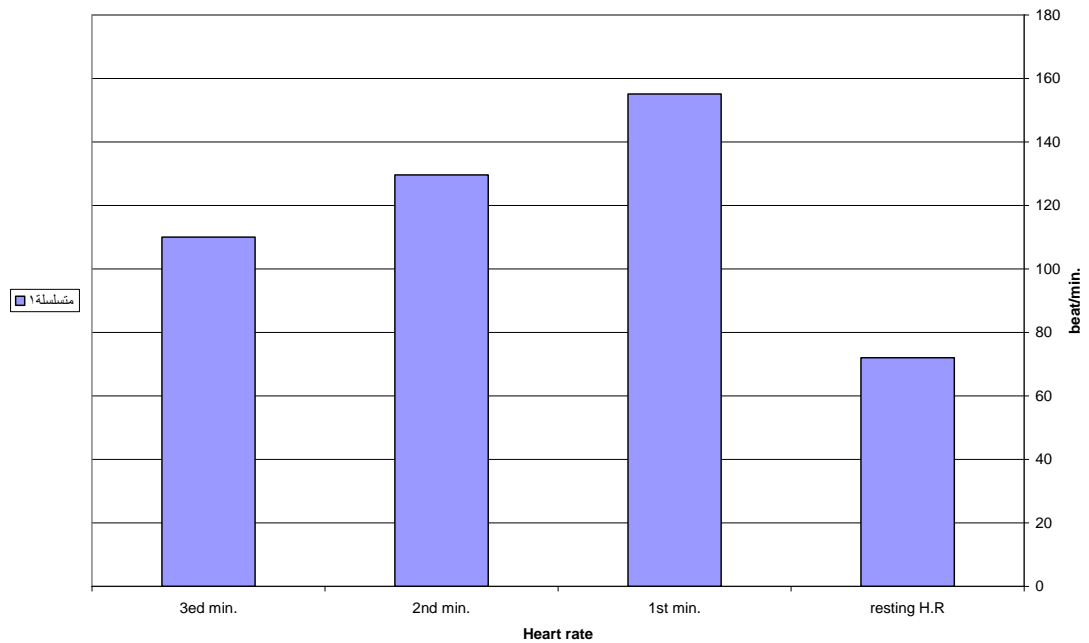
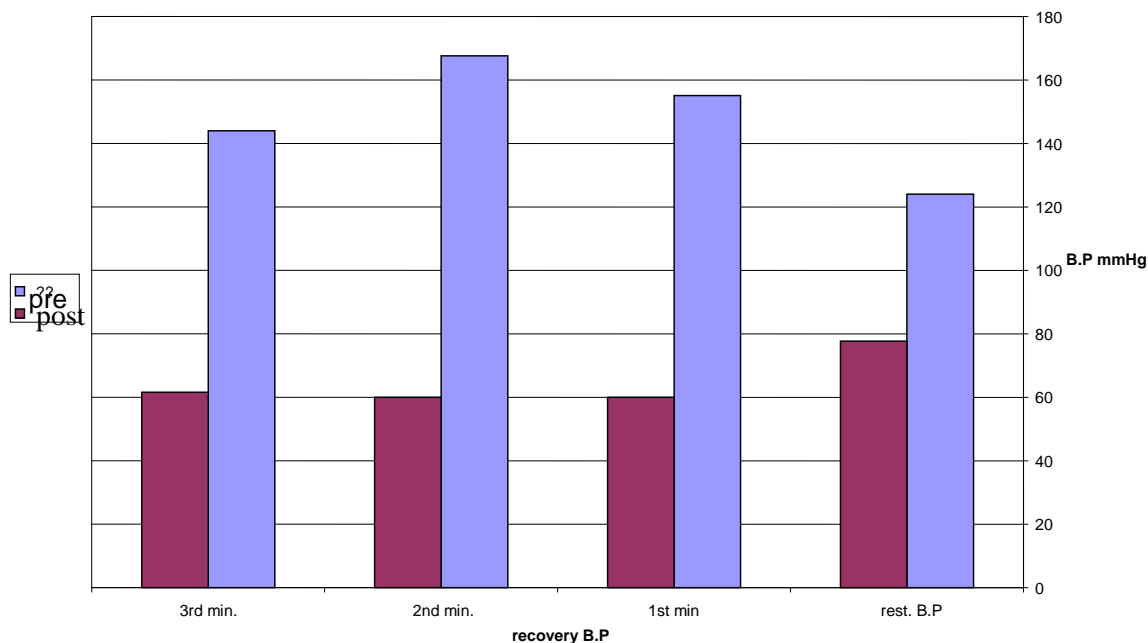


Fig. (2):- Show the resting & recovery heart at 1,2 & 3<sup>rd</sup> minute post exercise



**Fig. (3):- Show the systolic & diastolic blood pressure at resting & at post exercise at 1, 2, 3 minutes**

### Discussion

The present study performed & estimated thyroid hormones before & after three minutes at the end of exercise at recovery period. The present study find that there is no significant differences between resting level & 3 minutes after cessation of exercise in regard to T3 & T4 levels. This finding could explain by either, there is no acute effect of exercise on thyroid function or there is peripheral metabolism of thyroid hormones during exercise. Compelling evidence suggests that, if exercise related energy expenditure exceeds calories consumed, a low T3 syndrome may be induced (4, 8). Peripheral metabolism of thyroid hormones can be changed significantly by a number of physiological conditions, which alter the deiodination pathway & lead to change in the circulating level of thyroid hormones (9,10). The decrease in serum T3 (table 2), may be consistent with a decreased activity of hepatic 5'-deiodinase activity, since

this enzyme is responsible for the production of T3 & the clearance of rT3. These alterations in thyroid hormones could be prevented solely by increasing dietary caloric consumption without any alteration in the quantity or intensity of exercise (4, 8). In the present study, all subjects are inform to be overnight fasting. Also, in the present study there was a significant difference in regard TSH between resting level ( $1.5633 \pm 0.792$ ) & 3 minute after cessation of exercise ( $2.567 \pm 0.91$  nIU/ml). In a previous study, the rate of increase of TSH is going linear with increase in intensity of exercise (3). The present study is partially agree with previous findings of continuous TSH increase until 15 minutes after the end of exercise with unchanged or slightly decrease T3 level (11). A possible cause for the increase of TSH levels may be due to pituitary secretion & may serve to fulfill the exercise induced increase in peripheral need for thyroid hormones (12). The present study conclude that

the rise in cell metabolism during exercise may lead to change in thyroid hormone concentration & a rise in TSH level after exercise. Thyroid function may depend on a certain degree on the exercise intensity, which in the present study was constant (75% of maximal heart rate), & perhaps to other factors such as specific features of subjects. Pakarinen et al studied the effects of one week of very intense strength training on the thyroid hormones of male lifters showed a significant decrease in TSH, T3 & T4, with unchanged fT4 & thyroid binding globulin (13). Also, in another study, untrained subjects experienced a decrease in rT3 & cortisol & increase in T3 after exercise. However, trained subjects had an increase in cortisol & rT3 & a decrease in T3 with exercise, but concentration of T4 was unchanged in both groups (trained & untrained subjects), (9,14). The present results regarding thyroid hormones seen following exercise might be mediated by elevated cortisol levels after exercise, previous works found that there is an increase in cortisol level 30 min after the end of exercise (3, 15). However, additional research is required to establish this connection.

## References

- 1-Barrett, K.E; Barman, S.M; Boitano, S; Brooks, H.L. Ganong's Review of medical physiology. 23rd edition. McGraw hill. Lange. 2010. 301-9.
- 2-Lamb, DR. Physiology of exercise. Responses & adaptations. 2nd edition. Macmillan publishing company. NY. 1984.351-2.
- 3-Ciloglu, F., Peker, I., Pehlivan, A., Karacabey, K., Lihan, N. Exercise intensity & effects on thyroid hormones. Neuroendocrinology Letters. 2005; 26: 830-4.
- 4- Baylor LS., Hackney AC. Resting thyroid & leptin hormones changes in women following intense, prolonged exercise training. Eur. J. Appl. Physiol. 2003; 88:480-4.
- 5-Gullu, S., Altuntas, F., Kamal, N. Effects of TSH suppressive therapy on cardiac morphology & function: beneficial effects the addition of B-blockade on diastolic dysfunction. Eur. J. Endocrinology. 2004;150: 655-61.
- 6-Caiozzo, VJ., Menzel, D., Baldwin KM. Single fiber analysis of type IIA myosin heavy chain distribution in hyper & hypothyroid soleus. Am. J. physiol. 1993; 265:842-59.
- 7-Farnburg BL. Calcium transport by skeletal muscle sarcoplasmic reticulum in hypothyroid rat. J. Clin. Invest. 1968; 47:2499-2506.
- 8-Lucia A, Hoyos, J, Perez, M., Chicharro, JL. Thyroid hormones may influence the slow component of VO<sub>2</sub> in professional cyclists. Japanese Journal of physiology. 2001; 52:239-242.
- 9-Deligiannis A, Karamouzis M, Kallaras C. Plasma TSH, T3, T4 & cortisol responses to swimming at Varsity water temperatures. Br. J. Sports Med. 1993; 27:247-50.
- 10-Muscat, GE, Griggs, R., Downes, M., Emery, J. Characterization of the thyroid hormone response element in the skeletal alpha actin gene: negative regulation of T3 receptor binding. Nucleic acids Res. 1994; 22: 583-91.
- 11-Simsch, C., Lormes, W, Petersen, KG., Hackney AC. Training intensity influences leptin & thyroid hormones in highly trained rowers. Int. J. Sports Medicine. 2002;23: 422-7.
- 12-Huang WS., Yu, M., Cheng CY., Chin, HM. Effect of treadmill exercise on circulating thyroid hormones measurements. Med. Princ Pract 2004; 13: 15-9.
- 13-Pakarinen, A., Halkinen, K., Alen, M. Serum thyroid hormones, thyrotropin & thyroxine binding globulins in elite athletes during very intense strength training in of one

week. J. Sports Med. Physiol. Fitness. 1991; 31: 142-6.

**14-**Rosolowska-Huszcz D. the effect of exercise training intensity on thyroid activity at rest. J. Physiol. Pharmacol. 1998; 49:457-66.

**15-** McCarthy DA., Grant M., Marbut MM., Watling M., Wade AJ. Brief exercise induces an immediate & delayed leucocytosis. Br. J. Sport Med. 1991; 25(4): 191-95