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THYROID FUNCTION AND PHYSICAL ACTIVITY A PRELIMINARY COMMUNICATION

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Most previous studies of changes in the serum levels of thyroid hormones in response to stress and physical activity have been performed over a few hours (Refsun and Stromme, 1979; Brandt et al, 1976). However one recent report indicated that, in men, five days of physical exertion under adverse environmental conditions can suppress morning concentrations of serum thyroid stimulating hormone (TSH), tri-iodothyronine (T_3), and thyroxine (T_4), below those found normally (Aakvaag et al, 1978).

We have undertaken a preliminary investigation of four university students, two men, two women, to determine whether their morning and evening TSH, T_3 , and T_4 concentrations change from normal during a four day hill-walking exercise.

The four volunteers were aged 22 to 23 years old. Venous blood samples were drawn, without use of a tourniquet, with the subjects lying flat, at 08.00 hours and at 18.00 hours both during the control period and the field work. Morning samples were obtained within 30 minutes of waking, and, as in the evening, before eating. The evening samples were drawn within 15 minutes of the end of the walk during the field study.

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Fig. 1. Margaret Craig taking a sample of venous blood from Joanna Wardlaw at the camp on the side of Loch Long.

The blood was centrifuged immediately, the haematocrit measured, and the serum separated and stored at 0° C, until TSH, T_3 , and T_4 could be measured by radio-immunoassay.

The assays were performed by the Department of Clinical Chemistry, Royal Infirmary of Edinburgh, and the laboratory 95% reference ranges were 70-150 nmol/l for T_4 , 1.1-2.8 nmol/l for T_3 , and less than 5.7 mU/l for TSH. The coefficients of variance for the techniques were 8% for T_4 , 10% for T_3 , and 7% for TSH.

Samples were drawn over the two days prior to the

exercise, during which time the students attended university courses and did not participate in any sports. During the field study, environmental temperatures ranged from 18 to 22°C, and wind speeds up to 6 ms⁻¹. The subjects walked at an average speed of 8 km per hour for seven hours per day, from sea level to altitudes of around 1000 m, and slept in tents for eight hours per night.

We have calculated the mean 08.00 hour and 18.00 hour TSH, T₃, and T₄ values of each individual, both during the control period and the field exercise. Comparison of the figures shows a reduced mean morning TSH concentration in all four subjects during the exercise period (Table I). This reduction quantitatively was quite variable, as illustrated in Figure 2. In two cases, one male, one female, the difference was greater than the sum of the standard deviations of the means. In view of the small number of subjects, we have not performed a further statistical analysis. The evening values of TSH did not show a change, nor did the morning and evening T₃ and T₄ concentrations (Table I). The size of the diurnal variation in TSH was therefore reduced during the field study, and the serum T₃ and T₄ concentrations did not parallel the TSH levels in the morning. We cannot explain the large fall in TSH shown by subject number 4, who showed no evidence of thyroid dysfunction.

Fig. 2.

TABLE I
Mean TSH, T₃ and T₄ values $\pm$ standard deviations of 4 subjects, in the morning and evening during a 2 day control period and a 4 day field exercise

	Subject 1 Male		Subject 2 Male		Subject 3 Female		Subject 4 Female	
Time (hours)	08.00	18.00	08.00	18.00	08.00	18.00	08.00	18.00
TSH mU/l								
Control mean	2.60	1.65	1.60	1.40	2.80	1.85	6.05	2.75
$\pm$ S.D. (2 days)	0.10	0.05	0.10	0.10	0.10	0.15	0.45	0.75
Field study	1.55	1.70	1.45	1.10	2.52	1.775	2.80	2.23
$\pm$ S.D. (4 days)	0.20	0.21	0.27	0.07	0.50	0.40	0.29	0.75
T₃ nmol/l								
Control mean	1.60	1.65	1.95	1.90	1.10	1.55	1.70	2.05
$\pm$ S.D. (2 days)	0	0.5	0.1	0.1	0.1	0.4	0.2	0.2
Field study	1.30	1.50	1.40	1.50	1.30	1.40	1.60	1.20
$\pm$ S.D. (4 days)	0.3	0.3	0.3	0.2	0.2	0.3	0.4	0.2
T₄ nmol/l								
Control mean	91	118.5	108	124.5	72.5	76.5	116.5	133.5
$\pm$ S.D. (2 days)	3	4.5	0	8.5	4.5	7.5	1.5	2.5
Field study	88	103	95	114	89.5	82	121	115.5
$\pm$ S.D. (4 days)	10.5	12	12	10	10	9	16	8

Fig. 3. Left to right: K. Brown, Joanna Wardlaw, J. Adler and Margaret Craig during a brief stop before going on to the summit of The Cobbler.

The haematocrits of the four subjects did not alter significantly during the entire study, showing that the changes described were not due to haemodilution, a factor which can alter hormone concentrations in the blood (Terjung and Tipton, 1971).

These results are consistent with the belief that, in males and females, morning serum TSH concentrations are suppressed in response to a change in the environment, which includes increased physical activity. We did not demonstrate the reductions in morning serum T_3 and T_4 concentrations which were found by Aakvaag and co-workers in 1978 in response to prolonged physical exercise.

Acute exercise of one hour's duration causes the serum TSH concentration to rise (Galbo et al, 1977), but in our study neither morning nor evening TSH values increased during the four day field study, indicating that prolonged activity and acute exercise produce qualitatively different alterations in thyroid activity.

There is some evidence that the normal relationship between TSH, T_3 , and T_4 has altered during our field study since a suppressed morning TSH level was found with unchanged T_3 and T_4 concentrations. However,

point sampling of the hormones in the morning and evening is an unreliable method of assessing these relationships.

The subjects were not exposed to sleep deprivation or to a caloric deficiency, factors which have been shown to alter TSH, T_3 and T_4 levels (Aakvaag et al, 1978; Croxson et al, 1977). The causes of the changes we have described involve increased levels of physical activity while camping. Psychic stress can alter serum hormone concentrations but this is difficult to quantify or control.

There are many possible explanations for the changes we describe but our work does not provide any evidence which would help define the mechanisms involved. Further studies are planned to assess the role of the nervous and endocrine systems in causing the fall in the serum concentration of TSH which we observed during our field work.

Fig. 4. The view west from the summit of The Cobbler, showing Loch Long disappearing into the distance. J. Adler and Joanna Wardlaw are in the foreground.

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OBITUARY

Mr. John Jesse

With the death of John Jesse on July 6th, 1981, the USA have lost an outstanding coach, and the world a prolific writer of books on fitness and training for many sports. Before entering his 'teens, John started to train seriously, using a weight training programme many years before it became common amongst athletes. He obtained an athletic scholarship at the University of Southern California, and subsequently joined the State Police Force, where his expertise and tremendous enthusiasm helped to promote physical fitness in the Force. Later he devoted much of his time to writing articles and handbooks on training, which showed good insight into the physiological and biomechanical problems contributing to poor performance and liability to injury. For over thirty years he has promoted the need for fitness in educational establishments, developed techniques for advanced training, and was appointed head track and field coach to the United States Olympic Team in 1968. He joined many organisations dealing with sports medicine and training, such as the American College of Sports Medicine, the Australian Sports Medicine Federation, the New Zealand Sports Medicine Federation, the Canadian Association of Health, Physical Education and Recreation, and was one of the first overseas members of the British Association of Sport and Medicine, joining us in 1967. He contributed articles to our Journal, kept up an interesting correspondence, and paid his last visit to Europe two years ago, travelling specially from London to Loughborough for the purpose of making personal contact, and bringing his wife with him as a very welcome guest. He realised that he was an ill man, and has spent the past year and a half rushing to complete his life's work. I was very impressed with his enormous enthusiasm, and his insight into positive health as a way of preventing disease, as well as his everlasting interest in improving the standard of athletic fitness and performance.

Our sympathy is extended to his wife and son, who still live in Hermosa Beach, California.

H. E. Robson