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Short Communication

Raised thyroid stimulating hormone associated with kelp intake in British vegan men

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To explore the hypothesis that the iodine intake of vegans might be inadequate, thyroid stimulating hormone concentrations were measured in plasma samples from 101 British men, of whom 48 were vegans and 53 were omnivores. The geometric mean thyroid stimulating hormone concentration, adjusted for age and body mass index, was 47% higher in the vegans than in the omnivores ($P=0.001$). Five vegans but none of the omnivores had a thyroid stimulating hormone concentration above the reference upper limit of 5 mU/l ($P=0.022$). High concentrations of thyroid stimulating hormone are usually indicative of marginal iodine status, but can also result from excessive iodine intake. The three vegans with the highest values of thyroid stimulating hormone reported regular use of kelp tablets or kelp powder. None of the other vegans, and none of the omnivores, reported taking kelp. After exclusion of the three vegans who took kelp, the remaining vegans had an adjusted geometric mean thyroid stimulating hormone concentration 29% higher than that of the omnivores ($P=0.012$). It was concluded that use of kelp can be associated with raised thyroid stimulating hormone, and that the iodine status of vegans who do not use kelp requires further investigation.

Key words: iodine, kelp, thyroid stimulating hormone, vegans.

Introduction

Most foods are poor sources of iodine because most soils contain little iodine. Seafood is the only consistently rich source of iodine, but milk is now the most important individual source of iodine in the average British diet (Wenlock *et al.*, 1982). The high average iodine content of British milk is largely due to the supplementation of cattle feed with iodine, with some additional iodine coming from the use of iodophors as disinfectants during milking (Wenlock *et al.*, 1982). Meat is also an appreciable source of iodine in British diets (Wenlock *et al.*, 1982). Vegans do not consume fish, dairy produce or meat, so they are likely to have a low dietary intake

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of iodine unless they regularly eat food containing seaweed or food supplemented with iodine. It is possible that they may also consume more goitrogens than average, from foods such as brassicas (Passmore & Eastwood, 1986).

The lower reference nutrient intake for iodine for men in Britain is 70 μg/d (Report of the Panel on Dietary Reference Values of the Committee on Medical Aspects of Food Policy, 1991). The mean daily iodine intakes in the Dietary and Nutritional Survey of British Adults were 243 and 176 μg in men and women respectively (Gregory *et al.*, 1990). For comparison, a study of six Swedish vegans reported mean daily iodine intakes of 82 and 58 μg in men and women respectively (Abdulla *et al.*, 1981), although it should be noted that their diet was largely raw food and was not typical of that of British vegans, and that the diet was collected in an area where the occurrence of endemic goitre was high before iodine fortification of table salt was introduced; serum concentrations of thyroid stimulating hormone, thyroxine and triiodothyronine in these subjects were within the reference range. A recent case report (Labib *et al.*, 1989) has described hypothyroidism in a 4-year-old British boy who was put on a restrictive diet which excluded milk, dairy products and fish, and which included large amounts of soya milk, which has previously been associated with goitre in infants (Shepard *et al.*, 1960).

In view of these reports, we felt that it would be of interest to look at a proxy measure of the iodine status of British vegan men by measuring their plasma concentration of thyroid stimulating hormone, a first-line test for the evaluation of thyroid function. Clinical signs of hypothyroidism are often absent in adults with iodine deficiency, but biochemistry characteristically shows high concentrations of thyroid stimulating hormone, low thyroxine, and normal triiodothyronine (Hetzel *et al.*, 1990). Our hypothesis was that the vegans might have higher concentrations of thyroid stimulating hormone than the omnivores because of a lower dietary intake of iodine.

Methods

The subjects were a subset of participants in a nationwide prospective study of health in vegetarians and omnivores (Thorogood *et al.*, 1990). The subjects were recruited between 1980 and 1984 and at recruitment each completed a questionnaire which asked about health and aspects of diet including the use of nutritional supplements. Blood samples were collected between April 1984 and January 1986, and plasma stored at −20°C until analysis in 1990. All subjects were sent a 4-d dietary diary in 1985 or 1986, after the collection of blood samples. This diary included a question on current use of nutritional supplements. Adequate plasma samples were available from 48 male vegans who, at recruitment, were non-smokers, were not using long-term medication, had no history of cardiovascular disease, and had a plasma testosterone concentration in the normal male range (Key *et al.*, 1990). The comparison group were 53 omnivores of similar age who met the same criteria. Completed dietary diaries were subsequently returned by 42 of the vegans and 26 of the omnivores.

The plasma thyroid stimulating hormone concentration was measured by a two site immunoradiometric assay (Immuno Diagnostic Systems Limited). Assays were done with tubes identified by code numbers only and in random order. Between-batch coefficients of variation for three quality control sera were 4.0, 3.2 and 6.2% at mean thyroid stimulating hormone concentrations of 1.5, 4.6 and 23.2 mU/l respectively. Thyroid stimulating hormone concentrations were logarithmically transformed to produce an approximately normal distribution for comparisons of means, and the mean values presented below are geometric means. Means were compared and adjustments made for age and for body mass index as linear variables using analysis of covariance and the SPSS statistical package. Two-sided significance tests were used.

Results

The vegans and omnivores were similar in

age (means 41.9 and 39.5 years respectively) and body mass index (means 22.4 and 23.0 kg/m^2 respectively). Geometric mean thyroid stimulating hormone concentrations were 2.4 (95% CI 2.0–2.8) and 1.7 (1.5–2.0) mU/l in the vegans and omnivores respectively ($P=0.004$). This difference increased slightly after adjusting for age and body mass index (means 2.5 and 1.7 mU/l respectively, $P=0.001$). Five of the 48 vegans but none of the 53 omnivores had a thyroid stimulating hormone concentration above 5 mU/l, the upper level of normal in our laboratory ($P=0.022$, Fisher's exact test). Thyroxine was measured in the samples from the five vegans with thyroid stimulating hormone concentrations greater than 5 mU/l. The plasma concentrations of thyroid stimulating hormone (mU/l) and thyroxine (nmol/l) in these five vegans were 5.3, 87; 8.3, 94; 11.3, 106; 13.4, 106; 26.4, 60. The reference range for thyroxine in our laboratory is 70–140 nmol/l.

Records of use of nutritional supplements were available for all the vegans at recruitment (before the collection of blood) and for all but six of the vegans at the time they were sent the dietary diary (shortly after the collection of blood). Three vegans reported in the dietary diary that they usually took kelp (tablets or powder); one of these also reported use of kelp tablets at recruitment. These three subjects had the highest plasma concentrations of thyroid stimulating hormone (11.3, 13.4 and 26.4 mU/l). The other two vegans with thyroid stimulating hormone concentrations above 5 mU/l (5.3 and 8.3 mU/l) did not report any use of kelp at recruitment or at the time of completing their dietary diary. Records of use of nutritional supplements were available for all omnivores at recruitment and for 26 omnivores at the time they were sent the dietary diary; none of these records mentioned the use of kelp.

After exclusion of the three vegans who reported taking kelp, the geometric mean thyroid stimulating hormone concentrations adjusted for age and for body mass index were 2.2 (95% CI 1.9–2.5) and 1.7 (1.5–1.9) mU/l in the vegans and omnivores respectively ($P=0.012$).

Discussion

The results reported are for a large sample of healthy British vegan men and should therefore be reliable. The plasma samples had been stored for up to 6 years before assay, but there was no evidence of deterioration in the samples in comparison with thyroid stimulating hormone measurements on fresh samples in our laboratory. Furthermore, the collection of blood samples from the vegans commenced a few months before that from the omnivores, so that relatively low thyroid stimulating hormone concentrations might have been expected in the vegans if the samples had deteriorated during storage.

We thought initially that the higher geometric mean concentration of thyroid stimulating hormone in the vegans than in the omnivores might be due to a lower dietary intake of iodine, possibly compounded by a higher dietary intake of goitrogens. However, the observation that the three highest concentrations of thyroid stimulating hormone occurred in the plasma samples from the three vegans who took kelp strongly suggests that the kelp caused the increase in thyroid stimulating hormone. The subject with the highest plasma concentration of thyroid stimulating hormone (26.4 mU/l) had a plasma thyroxine concentration below the reference range, suggesting that taking kelp might cause hypothyroidism.

It has long been known that a very high plasma concentration of iodide can inhibit the release of thyroxine and tri-iodothyronine from the thyroid and that this is associated with increased secretion of thyroid stimulating hormone (Wolff & Chaikoff, 1948). Seaweed is very rich in iodine, and excessive intake of iodine from seaweed used as a staple food can result in endemic goitre (Lamberg, 1991). It has also been suggested that the high iodine content of kelp tablets can cause hyperthyroidism in susceptible individuals (de Smet *et al.*, 1990).

After exclusion of the three vegans who reported taking kelp, the adjusted geometric mean concentration of thyroid stimulating hormone was still significantly higher

in the vegans than in the omnivores, an observation which is consistent with our original hypothesis. It is conceivable that our sample of vegans included subjects with slightly raised concentrations of thyroid stimulating hormone because of a low intake of iodine, as well as subjects with markedly raised concentrations of the same hormone because of excessive intake of iodine.

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