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Can toenail iodine concentration be used as a biomarker of iodine status?

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Although adequate iodine status in pregnancy is vital for the development of the fetal brain, assessing iodine status of an individual is problematic with the methods in common usage. While the concentration of iodine in spot-urine samples is frequently used for assessment of population iodine status, it is not a suitable method for individual iodine-status assessment because of the variability in both fluid and dietary iodine intake from day-to-day[1]. Toenail concentration of other trace minerals, for example selenium, have been used successfully to estimate status of individuals, including pregnant women[2]. Toenail iodine concentration has been shown to reflect dietary intake in adults in the USA[3] but no such studies have been done in pregnant women. Toenails clipped during early pregnancy would have been laid down prior to pregnancy, hence toenail iodine concentration should reflect pre-pregnancy iodine status. As such, it may be a good indicator of the availability of thyroidal iodine stores in early pregnancy which is the most crucial time for fetal brain development.

This study used samples and data from a randomised controlled trial of selenium in 230 UK pregnant women[4] (selenium supplementation had no effect on thyroid function or iodine status). Women were asked to clip their toenails after allowing four weeks of growth from the 12-week recruitment point i.e. at 16 weeks gestation. Toenail iodine concentration was measured by neutron activation analysis at the TU Delft Reactor Institute. Accuracy of the method was checked with a certified reference material TraceCERT^{TM}, (iodine content 1001 mg/kg, range 981–1021 mg/kg) and our measured value was within range at 994·9 mg/kg (SD 19·6, n = 12). We explored the relationship between toenail iodine concentration, urinary iodine-to-creatinine ratio and maternal thyroid function at 12, 20 and 35 weeks. The relationship between dietary intake of iodine-rich foods and toenail iodine concentration was also evaluated. Variables were log-transformed to enable parametric testing.

Toenail clippings were available from 218 women. The median mass of toenail clippings was 83·5 mg (IQR 65·8, 116·6). The median iodine concentration in the toenails was 0·06 mg/kg (IQR 0·04, 0·10) with a range of 0·001 to 1·08 mg/kg. There was no significant correlation between toenail iodine concentration and urinary iodine-to-creatinine ratio at 12 ($p = 0·80$), 20 ($p = 0·37$) or 35 weeks ($p = 0·54$). There was also no significant correlation between toenail iodine concentration and serum thyroid stimulating hormone (TSH) at 12 ($p = 0·42$), 20 ($p = 0·48$) or 35 weeks ($p = 0·71$), nor with free thyroxine (fT4) at the same time points ($p = 0·99$, $p = 0·81$, and $p = 0·22$, respectively). There was no significant difference in toenail iodine concentration by consumption of milk (<140, 140–280 or >280 ml daily, $p = 0·81$), seafood (fewer or more than two portions per week, $p = 0·56$) or dairy products (fewer or more than one portion per day, $p = 0·35$).

There was no association between toenail iodine concentration and maternal thyroid function measured in any trimester of pregnancy, nor with urinary iodine-to-creatinine ratio. Furthermore, the intake of iodine-rich foods was not related to toenail iodine concentration, suggesting that the latter is not a sensitive marker of iodine intake. The results from this cohort of mildly-to-moderately deficient pregnant women suggest that toenail iodine concentration is not a useful biomarker of iodine status in pregnancy.

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