Reducing the risks of iodine deficiency disorders

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We all face a danger if our diet lacks iodine. Only a trace amount is required, as little as 150 μg is the recommended daily dose, but the consequences of insufficient iodine can be quite severe. The obvious manifestation is goitre — an enlargement of the thyroid gland in the neck — but lack of iodine will also lead to varying degrees of mental impairment, at worse severe mental and physical retardation (cretinism). Whereas the lack of iodine in our diet is a potential hazard, the likelihood of this occurring in the developed world is generally low. This is because we supplement our iodine intake with foods from outside our local environment. In particular, seafood, meat and dairy produce are quite enriched in iodine. However, under-development in many parts of the world, has left millions suffering from iodine deficiency: here, people live at subsistence levels and are very dependent on their immediate environment to provide food and water.

Traditionally, the main thrust of effort to reduce iodine deficiency disorders has been coordinated by the International Council for the Control of Iodine Deficiency Disorders (ICCIDD) with the iodisation of salt. This work has been very successful. In both of the high incidence IDD areas where our current project has collected data, the Atlas Mountains of Morocco and Xinjiang Province in China, IDD has been reduced over the years and large goitres are now rarely seen. Medical studies by the project have shown that in such areas the iodine status of the population has been raised, although evidence of historic iodine deficiency can still be seen. The areas that suffered more iodine deficiency have thyroid sizes larger than the areas that were historically free from such problems. However, salt iodisation is not applicable in every situation, particularly where populations would prefer to continue making salt freely from local sources. Other intervention techniques have been applied such as the iodisation of irrigation waters which had been done in one of the project's case study areas in Xinjiang. Our current project looks at why the environment is iodine deficient, and investigates whether we can realistically improve the iodine status of the soil and water.

The project has completed its data-gathering phase and is now considering all the new data available in order to produce publications and conference contributions concerned with the factors that control iodine's behaviour in the environment. The main aim of the project is to bring to the attention of the medical community the factors that control the iodine status of the environment, so that iodine supplementation programmes are better equipped to ensure effective measures to raise levels of iodine both in the population and their surroundings.

The project has to date achieved the following :

- A web site on environmental controls in iodine deficiency disorders has been created (www.bgs.ac.uk/dfid-kar-geoscience/idd).

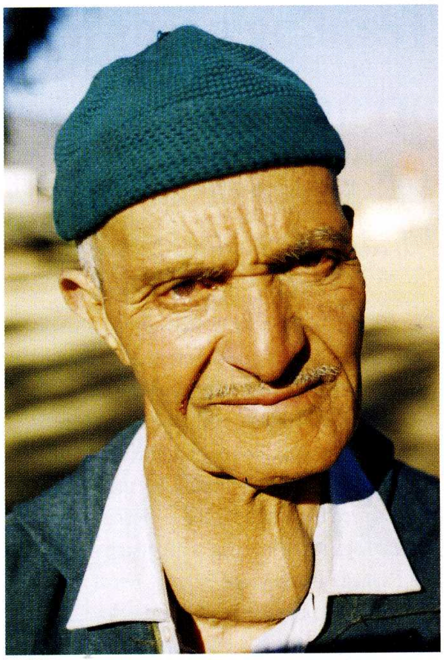
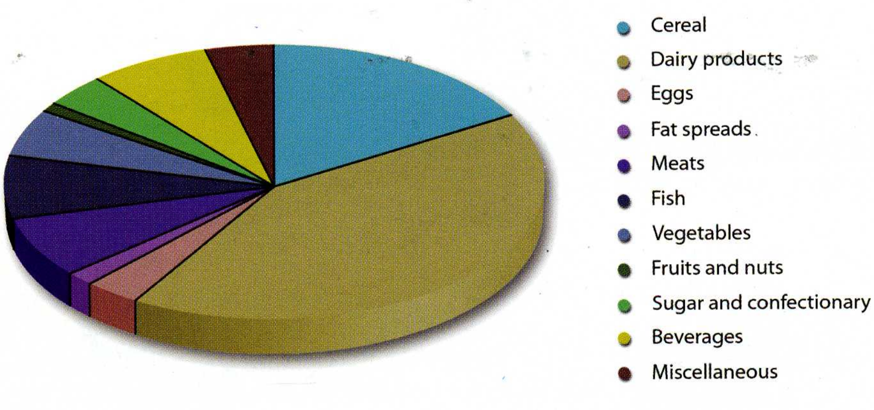


Photo © Alex Stewart

A resident of the Ounein Valley in the High Atlas Mountains, Morocco, with a goitre. Historically dietary deficiency of iodine reached more than 90% in some villages affecting more than 50% of households.

- An internet discussion group has been set up for medical workers and geochemists with an interest in the iodine status of the environment (http://groups.yahoo.com/group/iodine).
- Two technical reports have been written on the work carried out in Xinjiang Province, China and High Atlas Mts, Morocco. These contain new data on the iodine status of the local populations and the iodine levels found in soils, waters and crops.
- A database of iodine results for soils taken from published literature containing more than 2200 entries has been created, plus a similar database for iodine in foodstuffs and drinking water.
- A bibliographic database has been created containing in excess of 900 published references to work on iodine geochemistry and general articles on IDDs.



Graphic by Chris Wardle, BGS © NERC

Figure showing the contribution of food types to average daily intake of iodine(156 μg/day) for United Kingdom (15–18 year Group, 1997) from UK Food Standards Agency Revised Review of Iodine prepared for Expert Group on Vitamins and Minerals. Take everything out of the diet except cereal, eggs, vegetables and beverages to get a diet more typical of the underdeveloped world and the average iodine intake is reduced by two-thirds. In reality, far less food would be consumed in such places and this reduces the average intake to a small fraction of that consumed in the developed world.

Initial interpretation of available data suggests that, with the exception of coastal areas of the world, most of the land area is probably iodine deficient and unable to provide self-sufficient communities with adequate dietary iodine. Development, social and nutritional factors are therefore fundamental aspects of reducing the risks from IDDs. High prevalences of IDD are used to identify regions of the world where significant deficiencies of iodine in the environment occur.

Iodine is a very mobile element in the environment and migration through the atmosphere as a result of volatilisation from the soil-plant system is of far greater significance than has been previously reported. The iodine content of surface waters appears to be the best indicator of the iodine status of an environment and it is the mobile (e.g. water soluble iodine) that is off most importance in the food cycle. Groundwater can contribute a significant proportion of the daily iodine intake in areas that are otherwise iodine deficient.

Young glacial soils are often cited as a cause of iodine deficiency in the environment. However, soil iodine appears to equilibrate with the surroundings in tens of years rather than thousands, so 'young' glacial soils should have had time to adjust to the present surroundings. It is not the age of such soils that makes them iodine deficient, but rather their textural composition. The ability of a soil to retain iodine will depend on a complex interaction of soil characteristics, of which pH, organic content and textural composition appear to be important. Projects that add iodine to irrigation water need to maximise the soil's ability to retain the iodine, otherwise it will be rapidly lost from the environment. However, soils where iodine is too strongly retained will not yield iodine into the food cycle. Modifying agricultural practices, for example, the way soil is fertilised or drained, could induce small but important changes to the availability of iodine in the environment. In regions where iodine deficiency is critical, small changes to soil or water levels of iodine could significantly affect the iodine status of the local population.

An additional benefit of an improved knowledge of iodine's behaviour in the environment is that we are better able to understand what will happen to the extremely hazardous radio-isotope of iodine, I-131, which may accidentally be released from nuclear processes. This isotope will rapidly find its way to the thyroid gland and may lead to thyroid cancer.

A better knowledge of iodine's behaviour in the environment will help a multidisciplinary approach to reducing the risk of iodine deficiency. The medical community will have an additional tool to help rid the world of the most common cause of mental retardation and brain damage.

Photo © Alex Stewart
Children from the Xinjiang Province in China being weighed and measured as part of the project's study of the local population's iodine status.

Photo © Alex Stewart
Collecting a soil sample from a wheat field near Agadir, Morocco.

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