Thyroid abnormalities related to iodine excess from water purification units
Laura Kettel Khan, Ruowei Li, David Gootnick, and the Peace Corps Thyroid Investigation Group*

In January, 1998, the Peace Corps contacted the US Centers for Disease Control and Prevention about an increase in goitre since 1995 among Peace Corps Volunteers in Niger, West Africa. A survey of 96 Volunteers was carried out to assess thyroid status and function and practices related to iodine intake.

33 Peace Corps Volunteers had thyroid dysfunction (29 thyrotropin concentrations >4·2 mU/L, four had concentrations of <0·4 mU/L; normal range, 0·4–4·2 mU/L). All Peace Corps Volunteers in Niger used water purification systems containing iodine-based antimicrobial filters. Most Peace Corps Volunteers (81%) used two-stage filters consisting of two ceramic filters with an iodine-resin second stage to inactivate bacteria and viruses. Others (17%) used three-stage filters consisting of a single-filter cartridge incorporating a prefilter, an iodine-resin second stage, and a carbon-based third stage to remove residual iodine. The other Volunteers (2%) used no water-purification systems.

The two-stage iodine-resin ceramic filters were initially distributed in December, 1994, to a limited number of Peace Corps Volunteers who needed replacement filters. The number of two-stage filters in use increased gradually until late 1995, when all new Peace Corps Volunteers received two-stage filters. The distribution of two-stage filters is temporally related to the incidence curve of thyroid abnormalities among volunteers.

Drinking water samples contained a mean concentration of 10 mg/L iodine. Because of the arid environment, most Peace Corps Volunteers reported consuming at least 5–9 L of water daily, which led to an intake of at least 50 mg iodide per day through the drinking water—at least 330 times the recommended dietary allowance of 0·15 mg iodine. The adjusted odds ratio for thyroid dysfunction (abnormal thyrotropin) adjusted for age, sex, and other potential confounding factors, was 3·9 (95% CI 1·1–14·3) (p=0·04) for two-stage water filters, with a positive relation with duration of exposure (adjusted odds ratios 4·6 and 10·9 at 6 and 12 months, respectively).

Goitre and thyroid dysfunction have been previously reported from excess iodine, whether from dietary, pharmaceutical, or water-purification tablets. These disorders have been reversed by decreases in exposure.

We have been unable to identify any change in iodine consumption, diet, or environmental exposure (eg, chemical, pharmaceutical, or agroindustrial agents) that might be linked to the development of goitre or thyroid dysfunction other than iodine excess from the water purification system. The four-fold risk of thyroid dysfunction provides strong evidence for the water filter as the primary causal factor for the thyroid abnormalities. Because of this strong association, by August, 1998, all iodine-based filters in Niger had been replaced by boiling or microfiltration and chlorine purification. Peace Corps Volunteers in Niger will be monitored clinically and biochemically over the next 12 months.

Our findings have far-reaching public-health importance for many workers and travellers in areas without reliable sources of drinking water. The Centers for Disease Control and Prevention and the WHO Collaborative Center for Drinking Water Safety and Treatment promote the use of NSF International Standards and certified products around the world. Iodine-based water purification units are currently exempt from regulation. Beyond the implications for water purification, these findings will inform the development of tolerable upper limits for iodine exposure, and follow-up will provide additional data on the natural history of recovery from chronic exposure to high concentrations of iodine.

*Peace Corps Thyroid Investigation Group

Mark Mani, A Russell Gerber, Gail A Bozell, Office of Medical Services, Peace Corps, Washington, DC; James Creighton, Gladys George, Walter Katrice, Africa Region, Peace Corps, Washington, DC; David DeLozier, US Department of Energy; Dayton T Miller, National Center for Environmental Health, Atlanta, Georgia, Division of Environmental Health Laboratory Sciences, Atlanta, Georgia; Centers for Disease Control and Prevention, Barbara A Bowman, National Center for Chronic Disease Prevention and Health Promotion, Division of Nutrition and Physical Activity, Centers for Disease Control and Prevention, Atlanta, Georgia.


National Center for Chronic Disease Prevention and Health Promotion, Division of Nutrition and Physical Activity, Centers for Disease Control and Prevention, 4770 Buford Highway NE, Atlanta, GA 30341, USA (L Kettel Khan), and Office of Medical Services, Peace Corps, Washington, DC