Evaluation of goiter using ultrasound criteria: A survey in a middle schoolchildren population of a mountain area in Central Italy

C. Marino¹, M. Martinelli², G. Monacelli¹, F. Stracci³, D. Stalteri⁴, V. Mastrandrea³, E. Puxeddu², and F. Santeusanio²

¹Centro Salute di Gubbio, U.S.L. no. 1 dell’Umbria, Gubbio; ²Dipartimento di Medicina Interna; ³Dipartimenti di Specialità Medico Chirurgiche e Sanità Pubblica, Università degli Studi di Perugia, Perugia; ⁴Direzione Generale U.S.L. no. 1 dell’Umbria, Città di Castello, Italy

ABSTRACT. Iodine deficiency is still an important health care problem in the world. In Italy, as in most European countries, it is responsible for the development of mild to moderate endemic goiter. In 1995 we conducted a goiter survey in the Gubbio township, an area of Umbria region in Italy, close to the Appenine mountain chain. This study demonstrated a high prevalence of goiter in the middle schoolchildren population, indicating the presence of moderate endemic goiter. Soon after, a goiter prevention campaign aimed at implementing the consumption of iodinated salt was started. In 2001, a second survey was conducted in the middle schoolchildren (age 11-14 yr old) of Gubbio and neighbour townships. Eight hundred thirteen subjects were studied. Data obtained in 240 age-matched children, studied in the same area in 1995, were used for comparison to monitor changes 5 yr after the beginning of iodine prophylaxis. Thyroid volume was measured by ultrasonography. Gland volume was expressed in ml. A large population living in a iodine-sufficient area, previously reported by others, was used as control. Urinary iodine excretion was measured randomly in 20% of the children. The overall prevalence of goiter decreased between 1995 and 2001 from 29 to 8%. Goiter odds ratio (OR), corrected for age, was 4.0 (95% CI 2.8-5.9) for 1995 compared to 2001 (p<0.000). Mean thyroid volume in the matched populations was 7.6±2.5 ml in 1995 and 5.7±2.1 ml in 2001. Median iodine urinary excretion increased from 72.6 to 93.5 µg/l, at the limit of statistical significance. Living in a rural area, no consumption of iodized salt and familiarity for goiter represented independent risk factors for goiter development. This study was the first conducted in Umbria region and confirmed that an implementation campaign for iodized salt consumption is a simple and useful instrument to prevent endemic goiter and related diseases. A new survey to evaluate goiter prevalence in the same area 10 yr after the beginning of iodine prophylaxis is already planned.


INTRODUCTION

Iodine deficiency and related disorders are still important health care problems in most countries of the world (1). An inappropriate low intake of iodine with the diet is responsible for the development of thyroid hypertrophy and other neuro-intellectual def-
goiters those thyroids whose volume exceeds the 97th percentile of the volumes of a age-matched population exposed to a normal iodine intake. Iodine deficiency is also indicated by a median urinary iodine excretion <100 µg/l.

Preliminary data of goiter prevalence in our area were obtained through two surveys conducted in 1995 on the schoolchildren populations of two different communities of Umbria Region, namely from the Foligno and Gubbio townships, that are located in a mountain area at the feet of Appenines in Central Italy. These previous studies demonstrated a high prevalence of goiter, as evaluated either by manual palpation in the Foligno community or by ultrasound examination in the Gubbio schools. Soon after the surveys, a goiter prevention campaign characterized by the implementation of iodized salt consumption in the population was started in the Gubbio area.

Here we present the data of a second survey in the middle schoolchildren population of Gubbio and neighbour townships, which was conducted in 2001 in order to 1) verify once again the prevalence of goiter 5 yr after the first study, 2) possibly compare the results between the matched populations examined in the two different periods, and 3) identify some variables associated with the development of goiter.

MATERIALS AND METHODS
Subjects
Eight hundred thirteen children, representing 99% of the middle school population (age 11-14 yr old) of the municipalities of Gubbio, Scheggia-Pascelup, Costacciaro, Sigillo and Fossato di Vico, were studied. The considered geographical area represents a vast sub-apenninic zone in the north-east of Umbria region, characterized by an altitude ranging between 500 and 800 m above sea level. The studied population was subdivided into urban and rural subgroups according to the residence, respectively in the main municipality, namely Gubbio, or in the smaller peripheral towns. Equivalent data obtained in 240 age-matched children studied in the same area in 1995, similar regarding height and weight, were used to perform some comparisons in order to monitor changes during time.

Parents of the children signed an informed consent in which they approved the child participation to the study, and the study was approved by the local Ethic Committee.

Thyroid volume and definition of goiter
Thyroid volumes were determined by ultrasonography. In detail, thyroid examination was performed using a portable real-time instrument (Esaote-Spazio, Ansaldo, Italy) equipped with a 7.5 MHz linear transducer. Gland volume was calculated according to the formula of the rotational ellipsoid model [width x length x thickness (all expressed in cm) x 0.52 for each lobe] and was expressed in ml (8). A single operator (C.M.), well trained in thyroid ultrasonography, performed all thyroid volume measurements in both the 1995 and the 2001 studies.

Published data (8) of mean thyroid volumes obtained in 2,693 children in the age of 6-14 yr, born and living in urban and iodine-sufficient areas, were used as control data. Goiter was defined in each age-group as a thyroid volume exceeding the upper limit of the 95% confidence interval (CI) of the age-matched control population. The limits were 7.9 ml at 11 yr, 8.1 ml at 12 yr and 9.3 ml at 13 and 14 yr.

Urinary iodine excretion
Morning casual urinary samples of 126 subjects were collected on the day of the examination and stored at –80 C for further determination of iodine excretion. Iodine concentration was measured on the samples using an autoanalyzer apparatus (Technicon, Rome, Italy), and the results were expressed as µg of iodine per liter of urine (9).

Other variables
Weight and height of each child were measured during the examination.
Date of birth, address, information on the family use of iodized salt (never, sometimes, always) and on the family recurrence of goiter in first and second degree relatives were collected through a specific questionnaire filled up by the parents at the time they signed the informed consent form.

Campaign for the use of iodized salt
An implementation campaign of iodized salt consumption was started in the Gubbio township in 1996 and continued thereafter. Managers of grocery stores were asked to expose the iodized salt packages in the shelves and to show posters with short messages inviting to the use of iodized salt at the shop entrances. Iodized salt was used in the preparations of meals for the schools. At regular time intervals, local TV channels broadcasted interviews with experts aimed at reminding to the population the problem of goiter and the benefits of iodine prophylaxis. This campaign is still ongoing.

Iodized salt purchase has been monitored through the sales data provided by the local salt wholesale dealers.

Statistical analysis
Goiter raw prevalence was calculated as the ratio of goiter number as well as total number of children and was reported with its CI (Wilson) at 95% (10).

Wilcoxon test was used to compare thyroid volumes in the 2 periods, and median of differences were calculated with the related 95% CI according to Newson’s method (11).

In order to evaluate relations between thyroid volumes and variables of interest, a robust regression model was used (12). Then we dichotomized thyroids into normal and pathologic glands according to the above criterion, and obtained goiter odds ratios (OR) for the different studied variables by adapting to the data a logistic regression model. For the inclusion of study variables in the models, we took into account both previous knowledge and results from univariate analyses. Due to limited available information, we did not consider interactions and non-linear functional forms for continuous variables (13). AIC criterion was used as a guide for model selection (14). The logistic model fit was evaluated by the Hosmer and Lemeshow test (15). Model-based goiter risk was calculated for selected variables.