

Iodine in drinking water and endemic goitre in mountainous and coastal zones of Albania

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Abstract This study was conducted in a mountainous area of eastern Albania (Mokra, district of Pogradec) and in a coastal area in southwestern Albania (Himara, district of Vlora). In the first area, water from 10 aqueducts and 26 local sources in 11 villages was analysed. In the second area, water from 15 aqueducts, 6 local sources and 11 home-dug wells in 13 villages was analysed. Levels of iodine, nickel, cobalt, calcium, nitrates and *E. coli* were determined in each sample. An epidemiological survey of endemic goitre was conducted in 889 people in the mountainous area and in 4119 people in the coastal area. The morbidity of endemic goitre was grouped into eight age groups and the severity of the disease was divided into three grades (I, II and III). The water of the mountainous area had 1.77 to 2.06 $\mu\text{g l}^{-1}$ iodine and the area was classified as a serious endemic area for goitre. Water in the coastal area had 7.37–8.48 $\mu\text{g l}^{-1}$ iodine and was classified as a light endemic area. The levels of nickel, cobalt and nitrates were within the standards for drinking water, but the water was generally contaminated with microbes and had relatively high levels of calcium and hardness. In the mountainous area, the population gets about 1.5 to 6.88 μg of iodine per person per day from iodized salt. The morbidity of endemic goitre in the mountainous area is 78.9% and in the coastal area is 14.5%. The epidemiological data were compared with data collected 20 years ago in the same areas. Grade I goitre has increased and grades II and III have decreased in both areas, in the last 20 years.

INTRODUCTION

Albania is located in the western part of the Balkan Peninsula and is bordered by Greece, Macedonia and Yugoslavia. More than 70% of the land is mountainous and the remainder in the western part of the country is primarily flat. The median altitude of the country is about 710 m and mountains in the northern, eastern and southeastern part of Albania reach heights of up to 2000 m a.s.l.

This study was conducted in the Mokra and Himara areas of Albania (Fig. 1) and is representative of the situation at the beginning of this decade. The Mokra area (Pogradec district) is situated in the eastern part of Albania, west of Ohrid Lake and at

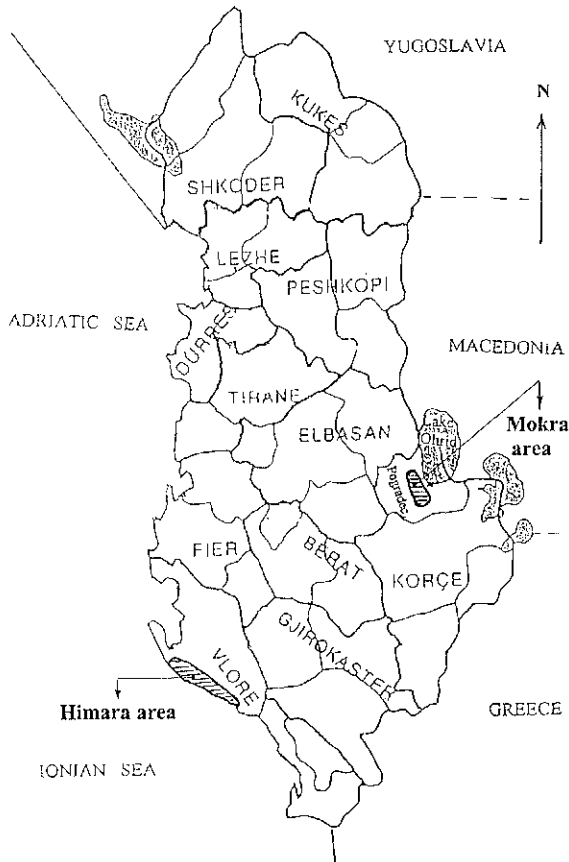


Fig. 1 Map of Albania showing the Mokra and Himara areas.

a height of 860–1126 m (Hoxha, 1976). The Himara area (Vlora district) is situated in the southwestern part of the country, by the Ionian coast.

There are many hypotheses about the etiology of endemic goitre, but the main factor is the lack of iodine in the environment (DeGroot & Stanburg, 1975; Hoxha, 1976; Oparin & Kyeryeva, 1970; VOZ, 1963; Werner & Ingbar, 1978). Secondary factors may include the organic and bacterial pollution of drinking water, high levels of hardness and calcium, lack of cobalt, lack of animal proteins and broad utilization of white cabbage, beans and chestnuts (Day & Powell, 1972; DeGroot & Stanburg, 1975; Hoxha, 1976; Lederer, 1986; Oparin & Kyeryeva, 1970; VOZ, 1963; Werner & Ingbar, 1978). Nickel reduces the fixation of iodine in the thyroid gland (Ickova & Elisyeyev, 1975).

Areas in which there is an deficiency or excess of a chemical element are considered to be abnormal geochemical areas (Gaboviç, 1971). Abnormal biogeochemical areas are those in which the flora and fauna are adversely impacted, and the diseases related to this condition are known as geochemical endemicities (Angjeli *et al.*, 1983; Gaboviç, 1971; Lederer, 1986; Zak, 1970). The iodine content of water is a reliable indicator of the iodine content of soil and of nutrients (Werner & Ingbar, 1978).

PREVIOUS INVESTIGATIONS

The most serious endemic goitre occurs in the mountainous areas where 40 to 85% of the population is affected by this disease (Hoxha, 1976). Light endemic areas are found in the coastal areas of Greece, Holland and Japan (Werner & Ingbar, 1978). In Italy, 10% of the population is affected (VOZ, 1963). According to Brock & Perinetti (Hoxha, 1976), in the areas where the water iodine content ranges from 0.5 to 1.78 $\mu\text{g I}^{-1}$, endemic goitre affects 55.6 to 84.7% of the population. When the iodine content ranges from 7.3 to 8.7 $\mu\text{g I}^{-1}$, 32.7 to 49.7% of the population is affected. Serious endemic goitre occurs in areas where the content of iodine in drinking water ranges from 1.0 to 2.0 $\mu\text{g I}^{-1}$ (Day & Powell, 1972; Hoxha, 1976; Hovorov, 1962). Endemic goitre is not detected when the iodine content ranges from 5.0 to 10.0 $\mu\text{g I}^{-1}$ (Lederer, 1986).

Over 20 years ago, 50.66% of the Albanian population was affected by endemic goitre. The most severely impacted area was in the eastern mountains. Data from Mokra & Himara for this period are presented in Tables 1 and 2.

METHODOLOGY

In the Mokra area, 10 aqueducts and 26 local sources of water in 11 villages were analysed. In the Himara area, water from 15 aqueducts, 6 local sources and 11 home-

Table 1 Goitre in the mountainous area of Mokra, district of Pogradec, over 20 years ago.

| Age (years) | Population examined | With goitre: | | Goitre grade I: | | Goitre grade II: | | Goitre grade III: | |
|-------------|---------------------|--------------|-------|-----------------|-------|------------------|-------|-------------------|-------|
| | | total | %* | total | %* | total | %* | total | %* |
| 0-6 | 971 | 457 | 47.06 | 231 | 23.80 | 209 | 21.52 | 17 | 1.75 |
| 7-14 | 1128 | 1037 | 91.90 | 342 | 30.32 | 563 | 49.91 | 132 | 11.70 |
| 15-20 | 542 | 471 | 86.90 | 94 | 17.34 | 249 | 45.94 | 128 | 23.61 |
| 21-25 | 561 | 413 | 73.60 | 47 | 8.37 | 255 | 45.45 | 111 | 19.78 |
| 26-30 | 586 | 423 | 72.18 | 34 | 5.80 | 274 | 46.73 | 115 | 19.62 |
| 31-40 | 804 | 318 | 64.43 | 26 | 3.23 | 359 | 44.65 | 133 | 16.54 |
| 41-50 | 453 | 260 | 57.39 | 19 | 4.20 | 190 | 41.94 | 51 | 11.26 |
| over 50 | 593 | 314 | 52.95 | 29 | 4.90 | 226 | 38.11 | 59 | 9.95 |
| Total | 5638 | 3893 | 69.05 | 822 | 14.58 | 2325 | 41.24 | 746 | 13.23 |

*Percentage of the population examined.

Table 2 Goitre in the coastal area of Himara, district of Vlora, over 20 years ago.

| Age (years) | Population examined | With goitre: | | Goitre grade I: | | Goitre grade II: | | Goitre grade III: | |
|-------------|---------------------|--------------|-------|-----------------|-------|------------------|------|-------------------|-------|
| | | total | %* | total | %* | total | %* | total | %* |
| 0-6 | 0 | 0 | 0.00 | 0 | 0.00 | 0 | 0.00 | 0 | 0.0 |
| 7-14 | 1541 | 299 | 19.40 | 163 | 10.58 | 135 | 8.76 | 1 | 0.065 |
| 15-20 | 513 | 66 | 12.86 | 28 | 5.46 | 36 | 7.01 | 2 | 0.39 |
| 21-25 | 143 | 12 | 8.39 | 3 | 2.10 | 9 | 6.29 | | |
| 26-30 | 207 | 15 | 7.24 | 3 | 1.45 | 12 | 5.79 | | |
| 31-40 | 282 | 19 | 6.74 | 5 | 1.77 | 13 | 4.61 | 1 | 0.35 |
| 41-50 | 251 | 19 | 7.57 | 2 | 0.79 | 17 | 6.77 | | |
| over 50 | 360 | 12 | 3.33 | 2 | 0.55 | 10 | 2.78 | | |
| Total | 3297 | 442 | 13.41 | 206 | 6.25 | 232 | 7.04 | 4 | 0.12 |

*Percentage of the population examined.

dug wells in 13 villages was analysed. Four water samples were taken from each source over one-year (one each season), and each sample was analysed for iodine, nickel, cobalt, calcium, nitrates and *E. coli*. Methods of determination and units for each index (Greenberg *et al.*, 1985) are presented in Table 3.

Table 3 Methods of analysis and units for each index.

| Index | Analytical method | Units |
|----------------|-----------------------------------|---------------------------|
| Iodine | Catalytic reduction method | mg l ⁻¹ |
| Nickel | Dimethylglyoxime method | ppm |
| Cobalt | Nitroso - R method | ppm |
| Calcium | EDTA titrimetric method | ppm |
| Nitrates | Cadmium reduction method | ppm (as NO ₃) |
| <i>E. coli</i> | Multiple-tube fermentation method | MPN |

A cross-sectional epidemiological survey of endemic goitre was conducted in a study population of 889 people in the mountainous area of Mokra and in 4119 people in the coastal area of Himara. The morbidity of endemic goitre was classified in to eight age groups: 0-6, 7-14, 15-20, 21-25, 26-30, 31-40, 41-50, and over 50 years old. The following classification system was used to characterize the various degrees of thyroid hyperplasia (Hoxha, 1976; Werner & Ingbar, 1978): Grade I: palpable, visible only with head raised; Grade II: easily visible with head in normal position; Grade III: visible at a distance. The epidemiological survey data were compared with data collected 20 years ago in the same areas.

The iodine intake per person was calculated using information from the mountainous area of Mokra on the quantities of (according to shop bills), and the concentration of iodine in, iodized salt (1:40 000) traded over a period of a year. Data on the quantity of daily iodine intake from food was obtained from previous studies (Marga, 1983). The results of the analysis for each index (excluding *E. coli*) were statistically evaluated for each season.

RESULTS

In the previous decade, the rural population consumed animal protein in smaller quantities. The population in Mokra consumes a greater quantity of beans, white cabbage, and to some extent, chestnuts. Some iron, nickel, cobalt and chromium mines are located in this area. In contrast, the population of Himara consumes fruit, fish and other food from the sea in greater quantities.

The results of the drinking water analysis for each index are presented in Table 4 for Mokra and in Table 5 for Himara. Table 6 shows the quantity of iodized salt traded over a period of a year in 10 villages of Mokra, the concentration of iodine in iodized salt (25 µg g⁻¹) received by two villages, and the quantities of iodine taken in by humans through this salt. The morbidity due to endemic goitre in Mokra and Himara during the period of this study is presented in Tables 7 and 8, respectively.

Table 4 Results of chemical analyses of water in the area of Mokra, district of Pogradec.

| Analytical parameters | Iodine ($\mu\text{g l}^{-1}$) | Nickel (ppm) | Cobalt (ppm) | Calcium (ppm) | Nitrates (ppm) | Bacterial analysis |
|-----------------------|---------------------------------|--------------|--------------|---------------|----------------|---|
| Spring | | | | | | |
| No. samples | 35 | 35 | 35 | 32 | 32 | Analysed: 31 Contaminated: 15 (48.4%) |
| Median value | 1.88 | 0 | 0 | 129.65 | 1.24 | |
| SD | 1.18 | 0 | 0 | 31.21 | 1.23 | |
| Min. value | 0.7 | 0 | 0 | 85 | 0.2 | |
| Max. value | 4.5 | 0 | 0 | 200.18 | 4.2 | |
| Summer | | | | | | |
| No. samples | 34 | 34 | 34 | 32 | 33 | Analysed: 31 Contaminated: 23 (74.2%) |
| Median value | 2.06 | 0 | 0 | 131.91 | 1.48 | |
| SD | 1.14 | 0 | 0 | 30.04 | 1.45 | |
| Min. value | 0.5 | 0 | 0 | 72.2 | 0.13 | |
| Max. value | 4.7 | 0 | 0 | 230.4 | 5.2 | |
| Autumn | | | | | | |
| No. samples | 34 | 34 | 34 | 30 | 31 | Analysed: 29 Contaminated: 22 (75.8%) |
| Median value | 1.89 | 0 | 0 | 138.34 | 1.38 | |
| SD | 1.19 | 0 | 0 | 28.63 | 1.25 | |
| Min. value | 0.7 | 0 | 0 | 78.1 | 0.1 | |
| Max. value | 4.7 | 0 | 0 | 182.3 | 3.6 | |
| Winter | | | | | | |
| No. samples | 33 | 33 | 33 | 23 | 32 | Not analysed |
| Median value | 1.77 | 0 | 0 | 118.92 | 1.6 | |
| SD | 1.1 | 0 | 0 | 26.87 | 1.41 | |
| Min. value | 0.5 | 0 | 0 | 74.1 | 0.3 | |
| Max. value | 4.7 | 0 | 0 | 166.1 | 4.9 | |
| Year | | | | | | |
| No. samples | 136 | 136 | 136 | 117 | 128 | Analysed: 36 Contaminated: 28 (77.8%) |
| Median value | 1.9 | 0 | 0 | 129.71 | 1.42 | |
| SD | 1.15 | 0 | 0 | 29.19 | 1.34 | |
| Min. value | 0.5 | 0 | 0 | 72.2 | 0.1 | |
| Max. value | 4.7 | 0 | 0 | 230.4 | 5.2 | |

DISCUSSION

The two study areas are geochemically distinct regions that differ with respect to the iodine content in drinking water and the severity of endemic goitre. Depending upon the season, the water of the Mokra area contains an average of 1.77 to 2.06 $\mu\text{g l}^{-1}$ of iodine, with an annual average iodine concentration of 1.9 $\mu\text{g l}^{-1}$. This is consistent with the levels in areas where grave endemic goitre exists (Day & Powell, 1972; Hoxha, 1976; Hvorov, 1962). Analysis of the water from five local natural sources revealed iodine levels from 3.7 to 4.7 $\mu\text{g l}^{-1}$. Iodine in the organic humic material from agricultural soil and turf contributes to the iodine found in the water of these five natural sources (Savina, 1970; Werner & Ingbar, 1978). This high iodine content provides an explanation for the coefficient of standard deviation values of 1.1 to 1.89 (Table 4). The average iodine content of the drinking waters of Mokra in 1978 was 1.0 $\mu\text{g l}^{-1}$ (Angjeli *et al.*, 1978), which was related to a low level of precipitation during that year. Among the secondary factors for this disease in the Mokra area, the most evident is the bacterial pollution of the drinking water (DeGroot & Stanburg, 1975; Hoxha, 1976; Werner & Ingbar, 1978), as shown by the finding that 77.8% of the sources were contaminated. The calcium content of the water in this area was 118.9–138.34 ppm (Table 4), while the hardness was 18.8–19.3°Gj (as season average). This could be as high as 33.6°Gj (Mato & Jajçari, 1980), so the water is

Table 5 Results of chemical analyses of water in the area of Himara, district of Vlora.

| Analytical parameters | Iodine ($\mu\text{g l}^{-1}$) | Nickel (ppm) | Cobalt (ppm) | Calcium (ppm) | Nitrates (ppm) | Bacterial analysis |
|-----------------------|---------------------------------|--------------|--------------|---------------|----------------|--------------------------|
| Spring | | | | | | |
| No. samples | 29 | 29 | 29 | 34 | 29 | |
| Median value | 7.59 | 0 | 0 | 115.08 | 5.76 | Analysed: 25 |
| SD | 2.08 | 0 | 0 | 25.88 | 4.28 | Contaminated: 16 (64%) |
| Min. value | 4 | 0 | 0 | 81.1 | 0.3 | |
| Max. value | 12.2 | 0 | 0 | 159.2 | 15 | |
| Summer | | | | | | |
| No. samples | 30 | 30 | 30 | 30 | 28 | Analysed: 30 |
| Median value | 7.48 | 0 | 0 | 115.41 | 5.3 | Contaminated: 18 (60%) |
| SD | 2.26 | 0 | 0 | 25.72 | 4.17 | |
| Min. value | 3.5 | 0 | 0 | 72.14 | 0.2 | |
| Max. value | 12.2 | 0 | 0 | 166.1 | 15 | |
| Autumn | | | | | | |
| No. samples | 30 | 30 | 28 | 25 | 31 | Analysed: 29 |
| Median value | 7.37 | 0 | 0 | 120.77 | 5.01 | Contaminated: 17 (58.6%) |
| SD | 2.04 | 0 | 0 | 28.77 | 3.95 | |
| Min. value | 5.5 | 0 | 0 | 89.1 | 0.11 | |
| Max. value | 12 | 0 | 0 | 210 | 15 | |
| Winter | | | | | | |
| No. samples | 23 | 23 | 24 | 25 | 24 | Analysed: 25 |
| Median value | 8.48 | 0 | 0 | 121.85 | 5 | Contaminated: 15 (60%) |
| SD | 2.76 | 0 | 0 | 31.8 | 2.39 | |
| Min. value | 4 | 0 | 0 | 80.2 | 0.5 | |
| Max. value | 13 | 0 | 0 | 190.3 | 10 | |
| Year | | | | | | |
| No. samples | 112 | 112 | 111 | 114 | 112 | Analysed: 32 |
| Median value | 7.72 | 0 | 0 | 118.28 | 5.27 | Contaminated: 28 (75%) |
| SD | 2.38 | 0 | 0 | 28.04 | 3.7 | |
| Min. value | 3.5 | 0 | 0 | 72.14 | 0.11 | |
| Max. value | 13 | 0 | 0 | 210 | 15 | |

Table 6 The quantity of iodine intake from iodized salt in the Mokra area.

| Villages | Population | Iodized salt traded during a year (100 kg) | Iodine received by iodized salt* ($\mu\text{g person}^{-1} \text{ day}^{-1}$) | Iodine conc. in iodized salt ($\mu\text{g g}^{-1}$) | Iodine intake from traded iodized salt ($\mu\text{g person}^{-1} \text{ day}^{-1}$) |
|-------------|------------|--|---|---|---|
| Dardhas | 1187 | 14.0 | 81 | | |
| Dunica | 977 | 4.5 | 31 | 1.2 | 1.51 |
| Podgozhan | 467 | 1.25 | 18 | | |
| Trebinje | 962 | 2.3 | 16 | 10.5 | 6.88 |
| Çezma Vogel | 643 | 0.9 | 10 | | |
| Çezma Madhe | 617 | 0.6 | 7 | | |
| Pleshisht | 765 | 0.8 | 7 | | |
| Kalivaç | 716 | 0.65 | 6 | | |
| Hondišt | 784 | 0.4 | 3.5 | | |
| Slabinje | 1126 | not traded | 0 | | |

*Based on an iodine concentration of 1:40 000 ($25 \mu\text{g g}^{-1}$).

designated as “hard” and “very hard” (Liptak, 1974). The high calcium and hardness levels aggravate the endemic goitre in those areas where there is a lack of iodine (Day & Powell, 1972). Nickel and cobalt were not detected in these waters while nitrates were present at very low levels, suggesting that these are not likely to be factors contributing to the endemic goitre. The low amount of animal protein in the diet and the high level of consumption of beans and white cabbage may be aggravating factors for endemic goitre in the Mokra area.

Table 7 Goitre in the mountainous area of Mokra, district of Pogradec.

| Age (years) | Population examined | With goitre: | | Goitre grade I: | | Goitre grade II: | | Goitre grade III: | |
|-------------|---------------------|--------------|-------|-----------------|-------|------------------|-------|-------------------|-------|
| | | total | %* | total | %* | total | %* | total | %* |
| 0-6 | 132 | 72 | 53.33 | 43 | 31.85 | 27 | 20 | 2 | 1.48 |
| 7-14 | 443 | 419 | 94.58 | 193 | 43.56 | 213 | 48.08 | 13 | 2.93 |
| 15-20 | 74 | 66 | 89.19 | 19 | 25.67 | 36 | 48.65 | 11 | 14.86 |
| 21-25 | 46 | 41 | 89.13 | 17 | 36.96 | 21 | 45.65 | 3 | 6.52 |
| 26-30 | 35 | 23 | 65.17 | 9 | 25.71 | 12 | 34.28 | 2 | 5.71 |
| 31-40 | 59 | 37 | 62.71 | 15 | 25.42 | 15 | 25.42 | 7 | 11.86 |
| 41-50 | 44 | 25 | 65.82 | 9 | 20.45 | 10 | 22.73 | 6 | 13.64 |
| over 50 | 53 | 19 | 35.85 | 6 | 11.32 | 8 | 15.09 | 5 | 9.43 |
| Total | 889 | 702 | 78.96 | 311 | 34.98 | 342 | 38.47 | 49 | 5.51 |

*Percentage of the population examined.

Table 8 Goitre in the coastal area of Himara, district of Vlora.

| Age (years) | Population examined | With goitre: | | Goitre grade I: | | Goitre grade II: | | Goitre grade III: | |
|-------------|---------------------|--------------|-------|-----------------|-------|------------------|------|-------------------|-------|
| | | total | %* | total | %* | total | %* | total | %* |
| 0-6 | 505 | 26 | 5.15 | 26 | 5.15 | 0 | 0 | 0 | 0 |
| 7-14 | 646 | 155 | 23.99 | 141 | 21.83 | 14 | 2.17 | 0 | 0 |
| 15-20 | 328 | 55 | 16.77 | 42 | 12.80 | 13 | 3.96 | 0 | 0 |
| 21-25 | 340 | 64 | 18.82 | 51 | 15.00 | 13 | 3.82 | 0 | 0 |
| 26-30 | 376 | 73 | 19.41 | 61 | 16.22 | 12 | 3.19 | 0 | 0 |
| 31-40 | 595 | 76 | 12.77 | 61 | 10.25 | 14 | 2.35 | 1 | 0.17 |
| 41-50 | 392 | 41 | 10.46 | 34 | 8.67 | 6 | 1.53 | 1 | 0.25 |
| over 50 | 937 | 106 | 11.31 | 80 | 8.54 | 24 | 2.56 | 2 | 0.21 |
| Total | 4119 | 596 | 14.47 | 496 | 12.04 | 96 | 2.33 | 4 | 0.097 |

*Percentage of the population examined.

The iodine level that the population of Mokra should have received through the iodized salt, if it contained $25 \mu\text{g g}^{-1}$, generally would have been $3.5\text{--}31.0 \mu\text{g}$ iodine per person per day (Table 6). Because of the fact that the iodized salt was not maintained in good condition (i.e. in a dry and dark place and in hermetically closed plastic bags), the actual iodine concentration in the traded iodized salt was 2.4 to 20.8 times lower (Table 6) than the normal concentration (i.e. $25 \mu\text{g g}^{-1}$). Therefore, the population actually receives only about $1.5\text{--}6.88 \mu\text{g}$ iodine per person per day through the iodized salt. According to theoretical calculations, the population of Mokra is considered to have received $40 \mu\text{g}$ iodine per person per day through the diet (Angjeli *et al.*, 1983; Marga, 1983). However, this level must be lower because in the endemic areas the iodine levels in the local food are lower (Hvorov, 1962; Lederer, 1986; Werner & Ingbar, 1978). Humans need $150\text{--}300 \mu\text{g}$ iodine per day and the quantity of $50 \mu\text{g}$ iodine day^{-1} is considered a critical minimal level. In areas where the population has an intake of only $20 \mu\text{g}$ iodine per day, about 85% of the population is affected with endemic goitre (Hvorov, 1962; Werner & Ingbar, 1978). In the mountainous areas the daily needs for iodine are much higher than in other areas (DeGroot & Stanburg, 1975). This analysis indicates that the population of Mokra suffers from serious endemic goitre.

The drinking water of the Himara area contains an average of 7.37 to $8.48 \mu\text{g l}^{-1}$ iodine, which is consistent with areas of light endemic goitre (Lederer, 1986; VOZ,

1963). Bacterial contamination, which was found in 75% of the water sources analysed (Table 5), is likely to have been a secondary factor contributing to the light endemic goitre. The relatively high levels of calcium in the Himara waters are not considered important. The iodine levels in food products in Himara must be sufficient because the population consumes a considerable amount of fish and other sea products. Other parameters, such as nickel, cobalt and nitrates, do not appear to be of public health concern. This area does not present conditions that favour endemic goitre.

In the mountainous area of Mokra, 78.96% of the population has endemic goitre. The population must receive from 90 to 95% of the total daily iodine intake (i.e. 135–225 $\mu\text{g day}^{-1}$) from food and from 5 to 10% (10–25 $\mu\text{g day}^{-1}$) from water (Memi *et al.*, 1972). However, people in Mokra receive less than 40 $\mu\text{g iodine day}^{-1}$ via food and about 4 $\mu\text{g iodine day}^{-1}$ from water. The iodine intake from iodized salt in the Mokra area is insignificant. The most affected age groups in this area are 7–14 year olds (94.58%), 15–20 year olds (89.2%) and 21–25 year olds (89.13%) (Table 7).

The prevalence of endemic goitre in the coastal area of Himara is 14.47% of the population. The most affected age groups in this area are 7–14 year olds (23.99%), 26–30 year olds (19.41%) and 21–25 year olds (18.82%) (Table 8).

In both areas the most affected age group is 7–14 year olds. This cannot be explained as “physiological goitre”, which is a functional insufficiency of the thyroid gland for which a compensatory reaction can occur (DeGroot & Stanburg, 1975; Hoxha, 1976; VOZ, 1963; Werner & Ingbar, 1978).

A comparison of the current endemic situation to that of over 20 years ago indicates that the morbidity associated with endemic goitre has increased 9.91% in the Mokra area and 1.06 % in the Himara area. Grade I goitre has increased by 20.4% and 5.79%, grade II has decreased by 2.77% and 4.71%, and grade III has decreased by 7.72% and 0.023% in these areas, respectively. We believe that the rise in endemic goitre in the Mokra area is primarily due to a failure to make the use of iodized salt obligatory, and secondarily due to the bacterial contamination of the drinking water, the high levels of hardness and a reduction in the consumption of animal protein by the rural population over the past ten years.

The 20.4% increase in grade I endemic goitre morbidity in the Mokra area indicates a need to implement efficient prophylactic measures. If the obligatory use of iodized salt “by law” (Hoxha, 1976) could be attained, endemic goitre in Mokra could be eliminated. If adequate corrective measures are not taken, the increase in grade I endemic goitre will be a prelude to an increase in the morbidity associated with grades II and III of this disease in the future.

CONCLUSIONS

- The Mokra area is a geochemical zone with very low iodine levels in the drinking water (1.77–2.06 $\mu\text{g l}^{-1}$), whereas the Himara area is considered normal with respect to iodine levels (7.37 to 8.48 $\mu\text{g l}^{-1}$).
- The iodine intake from iodized salt in the Mokra area is insignificant.
- Secondary factors that may contribute to endemic goitre in the Mokra area include bacterial contamination of drinking water, high levels of hardness, the reduction in

consumption of animal protein, and the high level of consumption of beans and white cabbage.

- Endemic goitre affects 78.96% of the population in the Mokra area, and 14.47% in the Himara area, which are 9.91% and 1.06% higher (respectively) than the levels in these areas 20 years ago.
- The rate of morbidity of grade I goitre in the Mokra and Himara areas has increased by 20.4% and 5.79%, respectively, compared to 20 years ago. The rate of morbidity of grades II and III goitre have decreased in these areas since that time.
- This situation justifies the obligatory use of iodized salt, as enforced through the “law”, in the areas where people are suffering from endemic goitre.

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