Prevalence of goitre and urinary iodine status of primary-school children in Lesotho

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Objective To estimate the prevalence of goitre, urinary iodine status, coverage of supplementation of iodized oil capsules, and current use of iodized salt in children in Lesotho.

Methods Cross-sectional study of children from 50 primary schools in Lesotho. Thyroid glands of children aged 8–12 years were measured by palpation and graded according to the WHO, UNICEF, and the International Council for the Control of Iodine Deficiency's (ICCIDD) joint criteria. The use of iodized oil capsules was determined by a structured questionnaire and verified with the children's health booklets. Iodine content of household salt samples was analysed. Casual urine samples were analysed for urinary iodine.

Findings Median urinary iodine concentrations of 26.3 μg/l (range 22.3–47.9 μg/l) indicated moderate iodine deficiency. More children in the mountains than in the lowlands were severely iodine deficient (17.7% vs 1.9%). Adjusted prevalence of goitre (4.9%) increased with age, was higher in girls than boys, and ranged from 2.2% to 8.8% in the different districts; this indicated no public health problem. Overall, 94.4% of salt samples were iodized, and coverage of supplementation with iodized oil capsules was 55.1%.

Conclusion Mild-to-moderate iodine deficiency exists in Lesotho. Iodine deficiency was more severe in the mountains than the lowlands and is still a concern for public health. Use of iodized salt coupled with iodized oil supplementation effectively controls iodine deficiency disorders. Effective monitoring programmes would ensure the use of adequately iodized salt throughout Lesotho and serve to evaluate progress towards optimal iodine nutrition. Iodized oil capsule supplementation should continue in the mountains.

Keywords Goiter/epidemiology/prevention and control; Iodine/urine/deficiency/administration and dosage; Sodium chloride, Dietary/therapeutic use; Iodized oil/therapeutic use; Child; Age factors; Sex factors; Cross-sectional studies; Lesotho (*source: MeSH, NLM*).

Mots Clés Goitre/épidémiologie/prévention et contrôle; Iode/urine/déficit/administration et posologie; Chlorure sodium diététique/usage thérapeutique; Huile iodée/usage thérapeutique; Enfant; Facteur âge; Facteur sexuel; Etude section efficace; Lesotho (*source: MeSH, INSERM*).

Palabras clave Bocio/epidemiología/prevención y control; Iodo/orina; deficiencia/administración y dosificación; Cloruro de sodio dietético/uso terapéutico; Aceite yodado/uso terapéutico; Niño; Factores de edad; Factores sexuales; Estudios transversales; Lesotho (*fuente: DeCS, BIREME*).

Bulletin of the World Health Organization 2003;81:28-34.

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Introduction

Iodine deficiency has several important health consequences that together are called iodine deficiency disorders (IDD) (*1*). The effects begin before birth and have various manifestations throughout a person's life (*2*). The most outstanding abnormalities include detrimental effects on brain development, stillbirths, increased infant and child mortality, and growth abnormalities (*3, 4*). An estimated 1571 million people worldwide live in iodine-deficient environments and are at risk of IDD (*5*). It is further estimated that up until 1990 about 40 million children born each year were at some risk of mental impairment due to iodine deficiency in their mothers' diets. By 1997, that figure was closer to 28 million — still high, but showing a clear and rapid decrease since 1990. Programmes involving iodized salt are the most cost-effective way to supply iodine to large populations, but in cases of immediate need or where entry of iodized salt into remote, iodine-deficient areas is ineffective, supplementation with iodized oil capsules is the main alternative (*6*).

Lesotho is a country with a surface area of 30 335 km^2 and is completely landlocked by South Africa (*7*). The country is divided into four ecological zones and ten administrative districts. The prevalence of IDD in Lesotho was first recorded in a national survey of the nutritional and health status of children in Lesotho in 1960 (*8*). The survey reported a total goitre rate (TGR) of 41% and visible goitre rate (VGR) of 14% in schoolchildren aged 6–13 years; this indicated severe IDD. The national nutrition survey in 1988 showed a prevalence of goitre of 42% in women of childbearing age and 21% in schoolchildren aged 6–13 years; these rates indicated severe

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Ref. No. **01-1627**

and moderate IDD, respectively (*9*). Assessments of urinary iodine concentrations in the mountain and lowland regions of Lesotho showed median values of 35 μg/l and 55 μg/l, respectively; this indicated mild-to-moderate iodine deficiency.

The national micronutrient survey was conducted in 1993 as a second phase of the 1992 national nutrition survey (which had more emphasis on protein energy malnutrition than on micronutrients) (*7*). The micronutrient survey showed a TGR of 42.5% and VGR of 15.3% among primary-school children aged 6–16 years, which indicated severe IDD. A recent baseline cross-sectional study conducted in the Mohale Dam catchment area of the highlands of Lesotho indicated a prevalence of goitre of 17.5%, and a median urinary iodine concentration of 13 μg/l in children aged 10–14 years; this indicated mild-to-severe IDD (*10*). All of these studies show that Lesotho is one of the countries where IDD is a public health problem in need of correction.

After the 1993 national micronutrient survey, an IDD control programme was started. Iodized oil capsules were distributed as a short-term intervention. The first supplementation with iodized oil capsules (each containing 200 mg iodine) happened between February 1995 and May 1996 and the second between January 1997 and February 1998. Supplementation was provided at schools and clinics for all people aged 2–49 years, with priority given to primary-school children. Each person was supposed to receive capsules in both of the supplementation periods (1995–96 and 1997–98). The information was recorded in health booklets and duplicated in the clinics' and schools' record books. Some people may not have received supplementation, because it was not compulsory.

Awareness campaigns were initiated through local radio, newspapers, pamphlets and public gatherings, and legislation on universal iodization of salt was drafted in 1994 as the first long-term intervention. The legislation, which was promulgated in March 2000, states that food-grade salt, or other salt intended for human and animal consumption, imported to Lesotho must contain 40–60 ppm iodine. Lesotho receives its salt from South Africa, where legislation does not include iodization of salt for animal use, and it is possible that some non-iodized salt is exported to Lesotho.

Iodized oil supplementation, awareness campaigns and the introduction of the universal salt iodization were intended to control and prevent IDD in Lesotho. However, inadequate intake of iodine and other factors affecting iodine prophylaxis with iodized oil and iodized salt, mean that iodine deficiency might still be a public health problem in Lesotho.

We aimed to determine the current prevalence of IDD in Lesotho five years after the 1993 national micronutrient survey and after interventions to prevent IDD were introduced. We aimed also to add to the knowledge about Lesotho's status with respect to urinary iodine concentrations and goitre status, and, more importantly, to determine whether salt iodization and iodized oil supplementation are effective in controlling IDD in developing countries such as Lesotho.

Methods

All 10 administrative districts and the four ecological zones in Lesotho were included in the sample. The sampling frame therefore consisted of lists of primary schools categorized by ecological zones in each district. Stratified sampling was used to select five schools from all ecological zones in each district: for each district, two schools were selected from the mountains, one from the lowlands, one from the foothills and one from the Senqu river valley. As 75% of the country is mountainous, we selected two schools from the mountains so that we could have a larger sample size in this zone than the others. Altogether, therefore, 50 primary schools from the whole country were included in the sample.

We chose schoolchildren aged 8–12 years from each school as the study population, on the basis of the joint recommendation of the WHO, UNICEF and the International Council for the Control of Iodine Deficiency Disorders (ICCIDD) (*11*). Simple random selection was used to select 10 children from each school (50 schools × 10 children per school = 500 children) to give urine samples. Casual urine samples were obtained from children in the morning during school hours and were frozen until analysed for urinary iodine concentrations. Urinary iodine concentrations were measured at the National University of Lesotho (NUL) by alkaline ashing, iodide extraction from ash residue, and spectrophotometry of the Sandell–Kolthoff reaction (*12*). This method has a precision above 90% and sensitivity below 2 parts per billion in the NUL's laboratory.

The size of the thyroid was determined by two trained field workers (nurse and nutritionist) using a standardized procedure for palpation. The thyroid size was graded according to the joint criteria of WHO, UNICEF and ICCIDD (non-palpable goitre = grade 0, palpable but not visible goitre = grade 1 and palpable and visible goitre = grade 2) (*11*).

Information on the use of iodized oil capsules was obtained through a structured questionnaire and was verified using the children's health booklets. Children had been asked to bring their health booklet and a sample of salt used in their households. The iodine content of the salt samples was analysed using rapid test kits.

We used Statistical Analysis Software (SAS) (*13*) to analyse the results, which were summarized by frequencies and percentages for categorical data and by mean standard deviation, and the first, second and third quartiles for continuous data. To calculate the adjusted prevalence for the whole country, we adjusted specific rates according to the total number of children per district and per ecological zone. We used the Cochran–Mantel–Haenszel test to assess the statistical significance of the associations and the Kruskall–Wallis test to assess differences in medians.

The study was approved by the ethics committee of the University of the Free State, South Africa. Written permission to conduct this study was obtained from the Secretariat to the Ministry of Education and the head teachers and chiefs of the schools involved. Parents also signed consent forms written in both English and Sesotho.

Results

Urinary iodine concentration

Analysis of urine samples showed that the median urinary concentration at the national level was 26.3 μg/l (range, 22.3 μg/l in Thabatseka to 47.9 μg/l in Berea; $P<0.001$) (Table 1). The results indicated moderate iodine deficiency according to the joint criteria of WHO, UNICEF, and ICCIDD (*11*). No difference was seen between the median urinary iodine concentrations of girls (26.2 μg/l) and boys (26.4 μg/l).

Table 1. **Median urinary iodine concentrations at national and district levels where districts are recorded to present concentrations in ascending order**

Area	*n*	Median urinary iodine concentration (μg/l)[a]
Thabatseka	50	22.3
Maseru	50	24.2
Qacha's Nek	50	24.2
Buthabuthe	50	24.6
Leribe	50	25.2
Quthing	50	26.4
Mafeteng	50	26.4
Mokhotlong	50	27.3
Mohaleshoek	50	36.7
Berea	50	47.9
National	500	26.3

[a] Normal range = 100–199 μg/l.

The urinary iodine concentrations for all children were in the severe-(<20 μg/l)-to-mild (50–99 μg/l) ranges of iodine deficiency; none were in the range for adequate iodine intake (>100 μg/l) (Table 2). Urinary iodine concentrations for 56 (11.3%) of the children were in the severe range of iodine deficiency, 413 (82.6 %) in the moderate range (20–49 μg/l) and 36 (6.1%) in the mild range. No children had urinary iodine concentrations in the ranges for optimal iodine nutrition (100–199 μg/l), risk of iodine-induced hyperthyroidism (200–299 μg/l) or risk of adverse health consequences (>300 μg/l). In total, 469 (93.9%) of the children had urinary iodine concentrations <50 μg/l; this is another indicator used to assess IDD and monitor progress towards eliminating IDD as a public health problem. As indicated by the joint WHO, UNICEF, and ICCIDD criteria (*11*), the goal for IDD elimination as a public health problem is that the proportion of the samples <100 μg/l should be <50% and the proportion <50 μg/l should be <20%.

More children living in the mountains (17.7%) than in the lowlands (1.9%) were severely iodine deficient, and more children living in the lowlands (20.9%) than those living in the mountains (1.4%) had mild iodine deficiency. Iodine deficiency was therefore more severe in the mountains than it was in the lowlands ($P<0.001$).

Prevalence of goitre

Grade 0 and grade 1 thyroids were seen throughout the country (Table 3). Grade 2 (visible goitre) was not present in any of the children palpated. The adjusted prevalence of 4.9% (range 2.2% in Quthing, 8.8% in Thabatseka and Mohaleshoek; $P<0.001$) in the different districts indicated the absence of a public health problem according to the joint WHO, UNICEF and ICCIDD criteria (*11*).

Goitres were more prevalent in the mountains (6.3%) and foothills (6.0%) than in the lowlands and Senqu river valley (2.3%) ($P = 0.007$). The prevalence of goitre increased with age: it was 3% in children aged 8–9 years and 6.3% in children aged 12 years ($P<0.001$). The prevalence of goitre was higher in girls (5.4%) than in boys (4.5%), although significant differences were seen in only two districts.

Iodized oil capsule supplementation

Overall, 2789 (68.5%) of children received capsules during the first supplementation period (1995–96), 2756 (67.8%) during the second supplementation period (1997–98) and 2243 (55.1%) during both supplementation periods (1995–96 and 1997–98) (Table 4). Supplementation was never received by 769 (18.9%) of children.

Supplementation coverage was higher in the lowlands (71.2%) than in the mountains (41.3%). The largest proportion of children who never received iodized oil capsules was in the mountains (25.4%) and the smallest in the lowlands (10.9%) ($P<0.001$). Grade 1 goitres were identified in 112 (5%) of children who received capsules in both supplementation periods and 49 (6.4%) of those who never received capsules. This association, although not statistically significant, shows that thyroid size decreases as supplementation with iodized oil capsules increases.

Use of iodized salt

Overall, 212 (5.2%) of salt samples were not iodized (Table 5). The percentage of salt samples that was not iodized ranged from 1.8% in the lowlands to 7.6% in the mountains ($P=0.004$). Thyroid size decreased as salt iodization increased ($P = 0.001$): of the children who used non-iodized salt, 14.2% had grade 1 goitre and 5.2% had grade 0, but of those who used salt iodized at a concentration of 75 ppm iodine, only 2.8% had grade 1 goitre and 25.8 % had grade 0.

Table 2. **Distribution of iodine deficiency, by ecological zones**

Ecological zone	No. of children according to range of urine concentration (μg/l)					
	<20	20–49	50–99	100–199	200–299	>300
Mountains (*n* = 200)	35 (17.7)[a]	162 (80.9)	3 (1.4)	0	0	0
Lowlands (*n* = 110)	2 (1.9)	85 (77.2)	23 (20.9)	0	0	0
Foothills (*n* = 90	13 (14.2)	73 (81.6)	4 (4.2)	0	0	0
Sengu river valley (*n* = 100)	11 (10.8)	85 (85.0)	4 (4.2)	0	0	0
Adjusted total[b] (*n* = 500)	**56 (11.3)**	**413 (82.6)**	**31 (6.1)**	**0**	**0**	**0**

[a] Figures in parentheses are percentages.
[b] Adjusted according to total number of children per district and per ecological zone.

Table 3. **Adjusted prevalence of goitre at national and district level where the districts are recorded to present the number of children with no goitre in ascending order**

Area	*n*	% of children according to goitre grade		
		0	1	2
Thabatseka	50	91.2	8.8	0
Mohaleshoek	50	91.2	8.8	0
Buthabuthe	50	92.3	7.7	0
Mokhotlong	50	93.0	7.0	0
Qacha's Nek	50	94.8	5.2	0
Leribe	50	95.3	4.7	0
Berea	50	96.3	3.7	0
Maseru	50	97.3	2.7	0
Mafeteng	50	97.5	2.5	0
Quthing	50	97.8	2.2	0
Adjusted total[a]	**500**	**95.1**	**4.9**	**0**

[a] Adjusted according to total number of children per district and per ecological zone.

Discussion

Urinary iodine concentrations

Urinary iodine concentrations, which are the most reliable indicator of IDD, showed mild-to-moderate iodine deficiency in Lesotho according to the joint WHO, UNICEF, and ICCIDD criteria (*11*). All children had urinary iodine concentrations <100 μg/l and 93.9% had concentrations <50 μg/l: these values are much higher than the 50% and 20%, respectively, used as indicators to assess IDD and monitor progress towards eliminating IDD as a public health problem (*11*). These results indicate that iodine deficiency was still a public health problem in Lesotho, although it was less so than in the previous study (*10*).

Although the severity of IDD has decreased since the previous study, a large proportion of children in Lesotho are still at risk of developing IDD if no corrective action is taken. Studies have shown that a substantial number of schoolchildren with urinary iodine concentrations <50 μg/l are at significant risk of developing hypothyroidism and mental and physical retardation if iodine deficiencies are not corrected (*14*). Our results show that most children (93.9%) are at risk of these disorders and that immediate action is needed to ensure that adequately iodized salt is available in Lesotho.

Thyroid size

The prevalence of goitre in our study, which indicated the absence of a public health problem, cannot be compared directly with those in previous studies because of age differences. A dramatic decrease can be seen, however, when comparing the prevalence from previous studies in children aged 6–13 years (*8, 9*), 6–16 years (*7*) and 9–10 years (*10*). This decrease is attributed to the use of both iodized salt (*15, 16*) and iodized oil capsules (*17–20*).

Our results show that the prevalence of goitre increased with age — it was 3.0% for children aged 8 years and 6.4% for those aged 12 years. The prevalence of goitre also increased with age in both sexes up to 12–14 years in a study of children aged 5–15 years in the Mohale Dam catchment area of Lesotho (*10*). Similar results were obtained in Italy (Tiberina valley) (*16*); the authors suggested that mild-to-moderate iodine deficiencies in childhood cause subtle enlargements of the thyroid glands of juveniles, which may persist after iodine deficiencies are corrected. This may also be the reason for the higher prevalence of goitre in older children in our study.

The adjusted prevalence of goitre was higher in girls than in boys in our study. This confirms results from many studies, including previous studies in Lesotho (*7–10*). This difference may be because of differences in the metabolism of iodine during the growth of girls and boys (*17*).

Palpation method

Carefully controlled and blinded studies have shown a large inter- and intra-observer variation with the palpation method, especially in assessments of smaller enlargements of the thyroid (*11*). With this method, the frequency of misclassifications can be as high as 40% (*21*). Moreover, thyroid palpation is less reliable in children than in adults (*22*). Determination of thyroid size by ultrasonography is now standardized and, when available, it is the preferred method because it is an objective measure (*23*) and is more precise than palpation. Palpation has been used in all IDD surveys in Lesotho to estimate the prevalence of goitre because it has been stated to be useful in assessing goitre prevalence (*11*).

Table 4. **Iodized oil supplementation, by ecological zone**

Ecological zone	No. of children			
	Received iodized oil capsules			Never received iodized oil capsules
	1995–96 and 1997–98	1995–96 only	1997–98 only	
Mountains (*n* = 797)	742 (41.3)[a]	271 (15.1)	327 (18.2)	457 (25.4)
Lowlands (*n* = 788)	561 (71.2)	81 (10.3)	60 (7.6)	86 (10.9)
Foothills (*n* = 714)	505 (70.7)	19 (2.7)	102 (14.2)	88 (12.4)
Senqu river valley (*n* = 772)	426 (55.2)	151 (19.5)	53 (6.9)	142 (18.4)
Adjusted total[b] (*n* = 4071)	**2243 (55.1)**	**546 (13.4)**	**513 (12.6)**	**769 (18.9)**

[a] Figures in parentheses are percentages.
[b] Adjusted according to total number of children per district and per ecological zone.

Table 5. **Iodine content of salt, by ecological zone**

Ecological zone	No. of salt samples at various iodine concentrations (ppm)				
	0	25	50	75	100
Mountains (*n* = 1797)	137 (7.6)[a]	392 (21.8)	864 (48.1)	402 (22.4)	2 (0.1)
Lowlands (*n* = 788)	14 (1.8)	166 (21.1)	394 (50.0)	214 (27.1)	0
Foothills (*n* = 714)	39 (5.4)	149 (20.9)	351 (49.2)	175 (24.5)	0
Senqu river valley (*n* = 772)	28 (3.6)	161 (20.9)	388 (50.2)	195 (25.3)	0
Adjusted total[b] (*n* = 071)	**212 (5.2)**	**863 (21.2)**	**1 999 (49.1)**	**997 (24.5)**	**0**

[a] Figures in parentheses are percentages.
[b] Adjusted according to total number of children per district and per ecological zone.

We used palpation in our study because ultrasonography is cumbersome and costly to carry out in remote parts of low-income countries (*22*) and because, in the absence of ultrasonography, palpation is regarded as an acceptable and simple alternative (*21*). Trained and experienced observers were retrained on a standardized palpation method to minimize inter- and intra-observer variation during the study. Although great efforts were taken to eliminate such variations during the study, the reliability of this method is still of concern because the subjects were schoolchildren and the results showed only grade 0 and 1 goitres. A great concern is the fact that inter-observer variations in the diagnosis of grade 0 and 1 goitres could result in the overlap of mental and physical abnormalities between children with and without goitres living in the same environment (*24*). It could also result in severe endemic goitre from thyroid failure during the foetal or postnatal period — a critical time for brain development. The smaller thyroid sizes recorded confirmed that the palpation method used was inaccurate during our study.

Salt iodization

Thyroid size decreased and urinary iodine concentrations increased as salt iodization increased. This shows that iodized salt prophylaxis is effective in correcting iodine deficiency and in reducing goitre; this has also been reported in several international studies (*15, 16, 25, 26*). The availability of iodized salt in Lesotho was better than at the time of previous studies (*7, 10*). Lesotho imports all its salt from South Africa, and the increased use of iodized salt in the country was because of revisions to South African legislation in 1995 that introduced mandatory iodization at a higher iodine concentration (*27*). The increased use of iodized salt was also due to awareness campaigns started in 1994 and the introduction of the universal salt iodization legislation in Lesotho.

Iodine supplementation

Programmes to introduce iodized oil supplements have been shown to be effective in preventing endemic goitre in many countries. There was a duration between the last oil supplementation to the time of study (1999) of about two years (for children who received capsules in 1997) and about one year (for children who received capsules in 1998). International studies show that, at the time of the study, the iodine-containing capsules given to children in Lesotho during the supplementation programme might still have been having an effect in children who received capsules only in 1998 (*18, 19*). It is also possible that, because of the long time between supplementation and the present study, iodized oil supplementation did not significantly affect the urinary iodine concentrations (which reflect the current IDD situation) but did have an effect on thyroid size at the time of the study (*20*). Although not statistically significant, the results indicated that thyroid size decreased when iodized oil supplementation was present. It is possible that iodized oil supplementation — although inadequate because the coverage was less than the recommendation of 95% (*11*) — had an effect on the thyroid size in our study and that salt iodization contributed to a decrease in the prevalence of goitre and an increase in urinary iodine concentrations.

Discrepancies between urinary iodine concentrations and prevalence of goitre

Despite the low urinary iodine concentrations in our study, which indicated mild-to-moderate IDD, thyroid sizes were graded as only grade 0 and grade 1, and the prevalence of goitre indicated the absence of IDD. This discrepancy may be because urinary iodine concentrations reflect the current situation of iodine supply, while thyroid size indicates the long-term iodine status (1), or because of the inaccuracy of the palpation method, especially when thyroids are very small (*11*) — as was the case in our study. The prevalence of IDD determined by the two indicators does not necessarily need to be consistent.

The urinary iodine concentrations also indicated inadequate intake of iodine; this was unexpected because according to the analysis of the salt samples, 94.4% of children used iodized salt. This discrepancy is probably due to the rapid test method used to assess salt samples, which does not show their exact of iodine content.

Intracountry variation

According to the results of this and previous studies (*7–10*), mild-to-severe iodine deficiency persists in Lesotho — possibly due to the topography of the country. About 75% of Lesotho is mountainous, and all areas of the country are >1500 metres above sea level (*7*). The climate varies with the topography — the mountains have cool summers and cold winters, often accompanied by snow, while the lowlands have warmer summers and occasional rain. The topography of Lesotho means that iodine has leached from the soil (*14*), and this explains why mild-to-severe IDD persists across the whole country. This was confirmed in 1993, when analyses of soil and water samples collected in different parts of the country showed no iodine in any samples and when severe IDD was observed (*7*).

Although iodine deficiency is expected in the whole of Lesotho because of its topography, studies have shown that the prevalence of IDD varies within the country. Low urinary iodine concentrations and high prevalence of goitre were more common in the mountains than in the lowlands in our study; similar results were observed in previous studies (*7, 8*). The possible reason for differences in prevalence of goitre and iodine deficiency within the country is that some villages in the mountains are difficult to reach by road. Only limited access to iodized salt, limited campaigns on IDD awareness and limited supplementation with iodized oil could be achieved in villages in the mountains. Our study shows that children who never received capsules were most often from the mountains and that non-iodized salt was more common in the mountains than the lowlands.

Herbal medicines

Some people in Lesotho may have used herbal medicines to control IDD. This was not considered during our study and needs to be looked into in future studies.

Current situation in Lesotho

We took the results of urinary iodine concentrations, which showed the existence of mild-to-moderate iodine deficiency and a public health problem in need of correction, to represent the current situation of iodine deficiency in Lesotho. As all the children had iodine concentrations less than the cut-off point of 100 μg/l, it is clear that moderate iodine deficiency exists in this population at a level that could affect their mental health. Furthermore, the goal of virtual elimination of IDD as a public health problem by the year 2000, which was accepted by the United Nations Systems in 1990 (*1, 2*), has not been achieved in Lesotho.

Conclusion

Mild-to-moderate iodine deficiency exists in Lesotho. Iodine deficiency is more prevalent in girls than boys, increases with age, and is more severe in children from the mountains than the lowlands. This study shows that iodized salt, coupled with iodized oil supplementation, is effective in controlling IDD in less-remote parts of developing countries.

The iodine deficiency in the children is most likely a result of the poor iodine content in soil and water used for food production in Lesotho in combination with the limited dietary sources of iodine, such as sea-derived foods (*8*). One of the most significant and common sources of dietary iodine is iodized salt (*1*); the increase in consumption of adequately iodized salt brings hope that the iodine status in Lesotho will change. Since legislation in South Africa does not consider iodization of salt for animal use, it is possible that some noniodized salt is exported to Lesotho. An effective control programme, especially at points of entry to Lesotho and in traders' workshops, will be important in ensuring that iodized salt enters the country as stipulated in the Lesotho's legislation.

The micronutrient task force should work together with the Government of Lesotho to ensure proper monitoring and enforcement of the universal salt iodization legislation. In the meantime, awareness campaigns should continue to concentrate on policy-makers and remote areas of Lesotho, and iodized oil capsules should be distributed in the mountains. Periodic evaluation of the IDD control programme, which currently consists of salt iodization, is needed to ensure virtual elimination of IDD and sustainability of the programme. ■

Acknowledgements

We wish to thank the Food and Nutrition Coordinating Office for funding this study, Dr Tseki (NUL) for chemical analysis of the results, the micronutrient task force and all the field workers and the children who participated during the study.

Funding

Food and Nutrition Coordinating Office.

Conflicts of interest: none declared.

Résumé

Prévalence du goitre et iodurie chez des élèves du primaire au Lesotho

Objectif Estimer la prévalence du goitre, l'iodurie, la couverture de la supplémentation en capsules d'huile iodée, et la consommation actuelle de sel iodé chez les enfants du Lesotho.

Méthodes Une étude transversale portant sur les élèves de 50 écoles primaires du Lesotho a été réalisée. Chez ces enfants, âgés de 8 à 12 ans, la thyroïde a été mesurée par palpation et classée selon les critères communs de l'OMS, de l'UNICEF et du Conseil international pour la lutte contre les troubles dus à une carence en iode (ICCIDD). L'utilisation de capsules d'huile iodée a été déterminée au moyen d'un questionnaire structuré et vérifiée d'après les carnets de santé des enfants. La teneur en iode d'échantillons du sel utilisé dans le ménage a été mesurée. L'iodurie a été déterminée sur des échantillons d'urine recueillis simplement.

Résultats L'iodurie médiane, de 26,3 μg/l (intervalle : 22,3-47,9 μg/l), indiquait une carence modérée en iode. Les enfants des régions montagneuses étaient davantage sujets à une carence iodée sévère que ceux des plaines (17,7 % contre 1,9 %). La prévalence ajustée du goitre (4,9 %) augmentait avec l'âge, était plus élevée chez les filles que chez les garçons et se situait entre 2,2 % et 8,8 % selon les districts ; cette valeur n'était pas indicative d'un problème de santé publique. Globalement, 94,4 % des échantillons de sel contenaient de l'iode, et la couverture de la supplémentation par capsules d'huile iodée atteignait 55,1 %.

Conclusion Il existe au Lesotho une carence légère à modérée en iode. La carence en iode est plus grave dans les régions montagneuses que dans les plaines et demeure un problème de santé publique. La consommation de sel iodé, couplée avec une supplémentation sous forme de capsules d'huile iodée, permet de lutter efficacement contre les troubles dus à la carence en iode. Des programmes de surveillance efficaces assureraient la consommation de sel iodé dans l'ensemble du Lesotho et serviraient à évaluer les progrès réalisés en vue d'un apport d'iode optimal. La supplémentation sous forme de capsules d'huile iodée devra être poursuivie dans les régions montagneuses.

Resumen

Prevalencia de bocio y yodo urinario entre alumnos de escuelas primarias de Lesotho

Objetivo Estimar la prevalencia de bocio, las concentraciones urinarias de yodo, la cobertura de administración de suplementos de aceite yodado en cápsulas y el consumo actual de sal yodada entre los niños de Lesotho.

Métodos Se llevó a cabo un estudio transversal de niños de 50 escuelas primarias de Lesotho. Se sometió a exploración a los escolares de 8-12 años para palpar su tiroides y clasificarlo con arreglo a los criterios conjuntos de la OMS, el UNICEF y el Consejo Internacional para la Lucha contra los Trastornos por Carencia de Yodo (ICCIDD). El consumo de las cápsulas de aceite yodado se determinó mediante un cuestionario estructurado y se verificó con las libretas sanitarias de los niños. Se analizó el contenido de yodo de muestras de sal domésticas, y en algunos casos se obtuvieron muestras de orina para analizar el yodo urinario.

Resultados La concentración mediana de yodo urinario fue de 26,3 μg/l (intervalo: 22,3–47,9 μg/l), cifra indicativa de una carencia de yodo moderada. Los casos de carencia grave de yodo eran más frecuentes entre los niños que vivían en zonas montañosas que entre los niños de las tierras bajas (17,7% frente a 1,9%). La prevalencia ajustada de bocio (4,9%) aumentaba con la edad, era mayor en las muchachas que en los muchachos y variaba entre 2,2% y 8,8% según el distrito; ello indica que el trastorno considerado no representaba un problema de salud pública. En conjunto, el 94,4% de las muestras de sal estaban yodadas, y la cobertura de la administración de suplementos mediante cápsulas de aceite yodado era del 55,1%.

Conclusión Existe en Lesotho un problema entre leve y moderado de carencia de yodo. La carencia de yodo fue más grave en las zonas montañosas que en las tierras bajas, y representa todavía un problema preocupante para la salud pública. La utilización de sal yodada unida a la administración de suplementos de aceite yodado permite controlar eficazmente los trastornos por carencia de yodo. Si se aplicaran unos programas eficaces de seguimiento se podría asegurar que en todo Lesotho se usara sal adecuadamente yodada y se podrían evaluar los progresos hacia una situación de consumo óptimo de yodo. Es necesario proseguir en las zonas montañosas la administración de suplementos en forma de cápsulas de aceite yodado.

References

1. Hetzel BS. *The prevention and control of iodine deficiency disorders*. Amsterdam: Elsevier; 1993. p.1-16. Administrative Committee on Coordination/Subcommittee on Nutrition State-of-the-Art Series Nutrition Policy Discussion Paper no. 3.
2. World Health Organization. *Iodine deficiency: what it is and how to prevent it*. World Health Organization Regional Office for the Eastern Mediterranean, Alexandria. 1995. p.1-3.
3. Delange F. The disorders induced by iodine deficiency. *Thyroid* 1994;4:107-28.
4. Cobra C, Muhilal, Rusmil K, Rustama D, Djatnika, Suwardi SS, et al. Infant survival is improved by oral iodine supplementation. *Journal of Nutrition* 1997;127:574-8.
5. United Nations Children's Fund. *The state of the world's children: focus on nutrition.* New York: Oxford University Press; 1998. p.15-20.
6. Furnée CA, West CE, van der Haar F, Hautvast JGAJ. Efficacy of oral iodized oil is associated with anthropometric status in severely iodine deficient school children in rural Malawi. *British Journal of Nutrition* 2000;84:345-52.
7. Wolde Gebriel Z. *National Survey on Iodine, Vitamin A and Iron status of women and children in Lesotho*. Maseru: Ministry of Health; 1993. p.1-25.
8. Munoz JA, Anderson MM. *Report on a nutritional survey conducted in Basutoland from 1995-1960*. World Health Organization; 1960. WHO document, Brazzaville document AFR/Nutri/12.
9. Nyapisi M. *Iodine deficiency disorders in Lesotho*. Maseru: Ministry of Health; 1988. p. 2-34.
10. Jooste PL, Langenhoven ML, Kriek JA, Kunneke E, Nyaphisi M, Sharp B. Nutritional status of rural children in the Lesotho highlands. *East African Medical Journal* 1997;74:680-8.
11. *Assessment of iodine deficiency disorders and monitoring of their elimination. A guide for programme managers*. Geneva: 2001. WHO document WHO/NHD/01.1, 2001.
12. Aumont G, Tressol J. Improved routine method for the determination of iodine in urine and milk. *Analyst* 1986;111:841-3.
13. SAS Institute. *SAS procedures guide. Version 6.* Cary (NC): SAS Institute; 1990.
14. Dunn JT, Van Der Haar. *A practical guide to correction of iodine deficiency.* Technical Manual No.3. International Council for Control of Iodine Deficiency. Netherlands, WHO, UNICEF; 1990.
15. Jooste PL, Weight MJ, Lombard CJ. Short-term effectiveness of mandatory iodisation of table salt at an elevated iodine concentration on the iodine and goitre status of school children with goitre. *American Journal of Clinical Nutrition* 2000;71:75-80.
16. Aghini-Lombardi F, Antonangeli L, Pinchera A, Leoli F, Rago T, Bartolomei AM, et al. Effect of iodised salt on thyroid volume of children living in an area previously characterised by moderate iodine deficiency. *Journal of Clinical Endocrinology and Metabolism* 1997;82:1136-9.
17. *Global prevalence of iodine deficiency disorders*. MDIS working paper no. 1. Geneva: World Health Organization; 1993.
18. Benmiloud M, Chaouki ML, Gutekunst R, Teichert HM, Wood WG, Dunn JT. Oral iodised oil for correcting iodine deficiency: optimal dosing and outcome indicator selection. *Journal of Clinical Endocrinology and Metabolism* 1994;79:20-4.
19. Tonglet R, Bourdoux P, Minga T, Ermans AM. Efficacy of low oral doses of iodised oil in the control of iodine deficiency in Zaire. *New England Journal of Medicine* 1992;326:236-41.
20. Furnee CA. Prevention and control of iodine deficiency: a review of a study on the effectiveness of iodised oil in Malawi. *European Journal of Clinical Nutrition* 1997;51 Suppl 4:S9-10.
21. *Indicators for assessing iodine deficiency disorders and their control through salt iodisation*. Geneva: World Health Organization; 1994. p. 1-55.
22. Peterson S, Sanga A, Eklof H, Bunga B, Taube A, Gebre-Medhin M, et al. Classification of thyroid size by palpation and ultrasonography in field surveys. *Lancet* 2000;355:106-9.
23. Hetzel BS. Iodine deficiency disorders. In: Garrow S, James WPT, Ralph A, editors. *Human nutrition and dietetics*. 10th ed. Edinburgh: Churchill Livingstone; 2000. p. 621-40.
24. Tonglet R, Bourdoux P, Dramaix M, Hennart P, Ermans A-M. Interobserver variation in the assessment of thyroid enlargement; a pitfall in surveys of the prevalence of endemic goitre. *Food and Nutrition Bulletin* 1994;15:64-70.
25. *Joint WHO/UNICEF/ICCIDD consultation: review of findings from 7-country study in Africa on levels of salt iodization in relation to iodine deficiency disorders including iodine induced hyperthyroidism.* Geneva: World Health Organization; 1997. WHO document WHO/NUT/97.5.
26. I'Ons A, Jooste PL, Weight MJ, Huskisson, J. A field clinical trial of the short effects of iodised salt on iodine status of rural primary school children. *South African Journal of Clinical Nutrition* 2000;90:30-3.
27. Jooste PL, Benade AJ, Kavishe F, Sanders D. Does iodine deficiency exist in South Africa? *South African Medical Journal* 1995;85:1143-4.