IODINE DEFICIENCY: THE CONSEQUENCES AND ITS CORRECTION

C. Popovici, S. Haritonov, O. Deseatnicov, R. Sturza
Technical University of Moldova

1. IODINE DEFICIENCY DISORDERS PROBLEM STATEMENT

Iodine deficiency is the single most common cause of preventable mental retardation and brain damage in the world. It also decreases child survival, causes goiters, and impairs growth and development [1]. The mean Intelligence Quotient (IQ) of the deficient community is decreased by about 13.5 IQ points [2]. Iodine deficiency (ID) in pregnant women causes miscarriages, stillbirths, and other complications. Children with Iodine Deficiency Disorders (IDD) can grow up stunted, apathetic, mentally retarded, and incapable of normal movements, speech, or hearing [3].The World Health Organization (WHO) has estimated that over 2.2 billion persons worldwide reside in regions of environmental ID and are at risk of IDDs [4]. This may be a soft figure, but it suggests the importance of the problem for public health. Of those at risk, possibly half have clinically detectable thyroid abnormalities; of this group, probably one-fifth have health-significant impairments, and an unknown number have reduced intellectual function. Recognition of the baleful effects of iodine deficiency on the development of the nervous system has led to the recognition of ID as the most common cause of preventable mental retardation in the world.

Iodine deficiency was once considered a minor problem [5], causing goiter, an unsightly but seemingly benign cosmetic blemish. However, it is now known that the effects on the developing brain are much more deadly, and constitute a threat to the social and economic development of many countries [6].

The above pyramid (Figure 1) illustrates the fact that the visible effects of IDD (cretinism) account for only as much as 10% of the ramifications. At least 90% of IDD consequences remain hidden [7].

2. EXTENT AND DISTRIBUTION OF IODINE DEFICIENCY

Iodine is sparsely distributed in the earth's surface. As a result, IDDs have been exceedingly common in most populations [8, 9, 10]. These disorders were highly prevalent in every region of the world (Table1). It was established that 6% - deficient, 91% - sufficient, 3% - excess and 0% - unknown in Americas and 65% , 35% acordingly in West and In the past, IDDs were frequent in much of Western Europe, and a severe problem in most Latin American countries, throughout most of Africa, in the Middle East, in the Himalayan region and southward on the subcontinent, in China, and in Southeast Asia. Iodine deficiency is a current problem among the countries of the former Soviet Union.

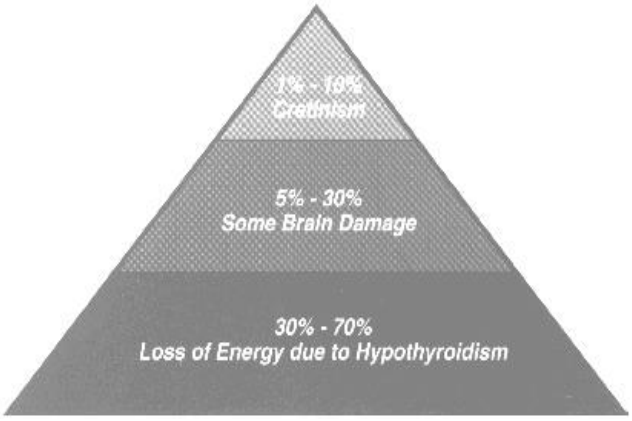

Figure 1. Iodine Deficiency Disorders (IDD) problem pyramid.

The populations of Republic Moldova consume average 40-60 μg I/a day. Household iodized salt use 33% of population. The hilly areas of Moldova are Central Europe likely to be low in iodine placing human populations at risk. Approximate 85% of populations of Moldova live in iodine deficient regions [11]. Ministry of Health of Moldova with support of UNICEF studied nutritional statute of adults and children in Moldova in period from 1994 to 1997. There was established insufficiency of iodine because of prevail vegetable products in the diet. Some vegetables contain goitrogenous substances that interfere with iodine absorption [12]. Thus, 37% of the children in Moldova suffer from goiter (table2).

Prevalence of IDD is different in every region of Moldova. It was established that 26.9% of children in the south, in the north 39.1% of children, in the centre 41.6% and in the west 33.9% have goiter (fig. 2) [13].

Table 1. Summary of the world's iodine nutrition*

	Afr (SS)	Amer	As/Pac	E. Eur/CA	China/FE	Mid E/N Afr	SE Asia	W/C Eur	Total	
Population (millions)	633	835	662	287	1,309	514	1,269	580	6,089	
Number of Countries	44	25	14	15	3	19	7	32	159	
Iodine Nutrition										
By population (millions)										
Deficient	262	49	467	284	25	304	1267	376	3034	
Sufficient	311	757	68	3	1284	210	2	204	2839	
Excess	54	29	127	0	0	0	0	0	210	
Unknown	6	0	0	0	0	0	0	0	6	
By population, distribution (%)										
Deficient	41	6	71	99	2	59	99	65	50	
Sufficient	49	91	10	1	98	41	1	35	47	
Excess	9	3	19	0	0	0	0		3	
Unknown	1	0	0	0	0	0	0		0	
By number of countries										%
Deficient	25	6	9	14	2	9	6	13	84	53
Sufficient	18	18	4	1	1	10	1	19	72	45
Excess	1	1	1	0	0	0	0	0	3	2

Afr (SS) = Sub-Saharan Africa; Amer = Americas; As/Pac = Asia/Pacific; E. Eur/Ca = East Europe and Central Asia; China/FE = China and Far East Mid E/N Afr = Middle East and North Africa; SE Asia = Southeast Asia; W/C Eur = West and Central Europe; *Adapted from ICCIDD, 2002; www.iccidd.org

Table 2. Ponder of children from 8 to 10 years old which present goiter in accordance with diverse individuals[1]

		Number of the examined children	Goiter, %
Total		3313	36.7
Zone	Rural	2233	37.3
	Urban	1080	35.4
Sex	F	1626	37.3
	M	1685	36.1
Region	North	814	39.1
	Centre	1297	41.6
	South	701	26.9
	West	501	33.9

[1] Adapted from [6].

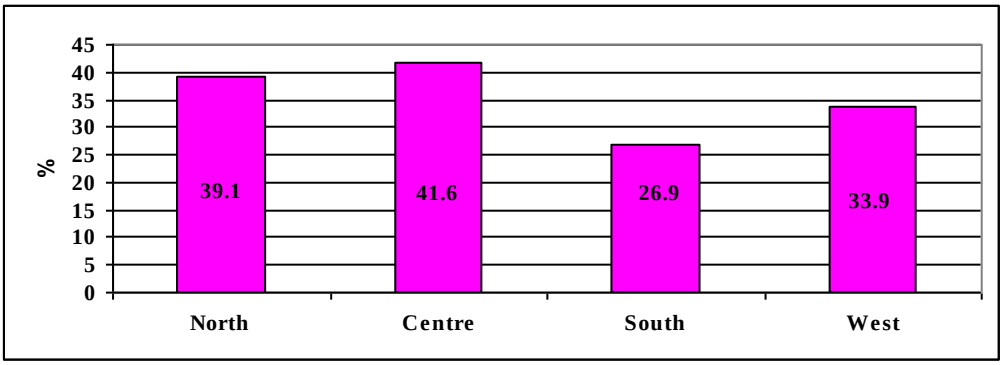

Figure 2. Ponder of the institutionalized children with goiter in different regions of Republic Moldova.

3. ECONOMIC COSTS OF IODINE DEFICIENCY

Any attempt to assess the costs of ID would be subject to tenuous assumptions and large-scale errors. Costs would be region-dependent: for example, the costs of a case of cretinism in the rural highland Andes or Central Africa are not comparable to the costs in an industrial region. The costs of lost productivity, premature death, fetal losses, and reduced energy would require—at best—guesswork. The costs of surgical procedures for goiter in Germany have been calculated, and they have been huge [14].It has been said that only

a few years ago, half of the surgical procedures done in the major hospital in western Austria were performed to address goiter. Thyroidectomies were the mainstay of some of the busiest and most important clinics in the United States.

Calculating costs without comparing benefits would be a relatively pointless enterprise. When efforts have been made to do so, the ratio of benefits to costs has been enormous [15, 16, 17]. Prevention is thus a highly advantageous undertaking.

4. PREVENTION AND CORRECTION of IODINE DEFICIENCY

Iodized salt. The goal in the prevention of IDDs is universal salt iodization (USI). Programs must take into account possible losses between point of manufacture or import and the consumer's table. Losses may vary among the forms of iodine used (iodide vs. iodate), heat, purity, humidity, packaging, shelf time, and losses in cooking. Programs should also be designed around salt consumption patterns in order to make the maximum effort to ensure an intake of iodine within the desired range. A mean consumption of 15 grams or more daily has been observed in some communities; in others as little as 2 grams have been consumed. Salt may be iodized in several ways, including dry mixing, drip, or spray techniques. Generally the iodine is sprayed or drip-fed on the salt as it flows down a mixing-screw conveyer; if the salt is finely ground, the iodine may be added dry.

Iodinated Bread. Three programs—in the Netherlands, Russia, and Tasmania—have used bread as a vehicle for the distribution of iodine. Both the Dutch and the Australian programs were dropped for logistical reasons, because of an attendant rise in iodine-induced thyrotoxicosis, or because iodine became available from other sources. The Russian program is too recent to judge, but it appears promising in communities where bread is centrally prepared and iodized salt is unavailable.

Iodinated Water. Water has been successfully used as a vehicle for the prevention of IDDs. A silastic cylinder containing iodine has been used in bore holes in several African countries to achieve some success in raising community iodine intake, but the many associated difficulties have prevented its widespread use [18].In selected rural regions of Thailand and Indonesia, iodine is added intermittently to cisterns that store water for drinking and cooking[19].Iodine has been introduced into city water supplies in Sicily with a bypass through an iodine-containing canister. Reduction in IDDs was reported, but the method fell into disuse because of mechanical, legal, and monitoring problems.

An ambitious program to introduce iodine into irrigation water in the desert areas of western China [20]has been hugely successful in increasing yields in sheep farming and in reducing infant death rates [21, 22].

Iodinated Oil. Iodinated poppy seed oil has been widely and successfully used in the prevention of IDDs since its introduction in the late 1950s in New Guinea [23].Other unsaturated oils have also been used. Needs may be met for a year or more by a single dose, depending on its size and route of administration. These mixtures have been used both intramuscularly and orally in different doses varying from 2 ml to several ml. Most programs have used either 1 or 2 ml in older children and adults, but success has been achieved with smaller doses [24, 25]. Side effects have been virtually nonexistent, except for occasional instances of induced thyrotoxicosis. The technique is more expensive than USI. A major expense will be determined by the costs of the team, which is often posted to remote regions. Iodinated oil has been accepted well by target groups. It is currently reserved for communities where it is unlikely that USI will be introduced within the foreseeable future (and such areas are disappearing) and areas where the need is urgent and USI is unlikely to reach the target population immediately.

Irrigation water has been successfully iodinated in western China [26]. The water is derived from glacial streams, and never reaches the sea. All farms and households in the region subsisted on this water. Potassium iodide in 5 percent solution was slowly dripped into the water from tanks at a rate that provided approximately 10 to 80 µg iodide per liter for several weeks each season. There followed a sharp rise in iodine excretions among the population and a sustained rise in iodide in the soil. Improvements were noted in survival and weight gain among domestic animals, and growth of children also improved.

5. CONCLUSIONS

1. Iodine deficiency and IDDs have largely but not entirely disappeared from North America and Western Europe, but some areas of Germany, Italy, and Belgium continue to have suboptimal levels of iodine that require correction. ID is still present in much of the African continent, the Middle East, and large parts of Asia. It is also found in the Republic Moldova.

2. The use of iodized salt, iodinated oil, iodinated water and iodinated bread are all reserved for special circumstances until IDDs are eliminated as a health problem. Of the alternative methods, iodinated oil has proved to be the most successful, but it requires a skilled team, availability of disposable syringes and needles, and carries an attendant risk of infection.

3. Although much progress has been made in the past decade in the control of iodine deficiency in many countries around the world, the problem of the disorders deriving from iodine deficiency continues to exist.

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