EVALUATION OF A PROGRAM TO OVERCOME VITAMIN A AND IRON DEFICIENCIES IN AREAS OF POVERTY IN MINAS GERAIS, BRAZIL[1]

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SUMMARY

Ramdon samples of children from both sexes from Belo Horizonte, the capital City, and from Turmalina, Jequitinhonha Valley, Minas Gerais, Brazil, were submitted to nutritional evaluation before and after the intervention "Program to Overcome Vitamin A and Iron Deficiencies in Areas of Poverty in Minas Gerais, Brazil".

After the first examination, all the children received, with an interval of 180 days, a single oral dose of vitamin A, oral iron sulfate during 50 days, and 200 mg of Mebendazol/day for three days. Thirty days after ending administration of the third dose of medicine, the children were subjected to a new evaluation. In Belo Horizonte, the first evaluation revealed a high prevalence of deficient and low values of vitamin A in preschool children (21.5%) and school children (21.7%). A small prevalence of

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low hematocrit values was also observed in both groups. Deficient and low values of hemoglobin were found as well in 21.5o/o of preschool children and in 17.5o/o of school children.

The second evaluation, practiced 30 days after the third dose of medicine, showed a small incidence of low vitamin A values (4.3o/o in preschool children and 2.9o/o in school children) and low hemoglobin values (6.5o/o in preschool children and 2.9o/o in school children). No deficient values of hemoglobin and vitamin A were observed. Concerning the hematocrit value, only one school child presented a low value at the second evaluation. On the other hand, in Jequitinhonha Valley, five cases of Bitot spot with conjunctival xerosis, two cases of corneal xerosis, and one case of keratomalacia were detected at the first examination. Thirty days after ending the third dose of medicine, only one corneal scar was observed. Only a small number of children with deficient and low levels of vitamin A and hemoglobin was found in the final evaluation (less than 8o/o), while this number was high at the first evaluation (above 38 and 12o/o, respectively).

These results show the efficiency of the intervention Program in relation to hypovitaminosis A and iron anemia prevention. The Program is now being implemented by the Brazilian Ministry of Health.

INTRODUCTION

Many studies have shown a high prevalence of iron and vitamin A nutritional deficiencies among the low socioeconomic classes in several regions of Brazil (1-17). These data are very important, since it is well known that iron nutritional deficiency increases infant and maternal mortality rates. When it affects the worker, it causes an important decrease in his productivity, resulting in a great economical loss for the country. Other important aspects to be considered in the prevalence of nutritional iron deficiency are the large incidence of verminosis (removal of organic iron), and the low level of basic sanitation and hygiene in the deficient population.

Vitamin A is involved in cellular metabolism. Its deficiency is related to growth, resistance to infections, immunological protection and skin protection. The visual organs are the first target of the disturbances caused by this nutritional deficiency. The main symptoms are: night blindness, ulceration of the cornea, and keratomalacia; the last two can cause total blindness which, obviously, is of great social impact.

In order to prevent vitamin A and iron deficiencies in areas of poverty is the State of Minas Gerais, Brazil, a governmental agency, the Instituto Nacional de Alimentação e Nutrição (INAN) of the Ministry of Health, implemented an intervention program in vulnerable regions. This "Program to Overcome Vitamin A and Iron Deficiencies in Areas of Poverty in Minas Gerais, Brazil" consists in the administration of iron sulfate, polyvalent vermifuge and massive doses of vitamin A, every six months, to children and to pregnant and nursing women from Jequitinhonha Valley and to preschool children from the periphery of Belo Horizonte.

The Jequitinhonha Valley is one of the poorest regions in Brazil. It has few natural resources and a limited food production activity. The access to the region is precarious, and the income distribution, unfair. Most of the population is undernourished. The socioeconomic problems are

almost the same in all the towns covered by the Program. The population of Belo Horizonte (Minas Gerais capital City) periphery is composed mainly of low socioeconomic undernourished people, living in slums. A low intake of vitamin A was found in both population groups by ENDEF-IBGE (Estudo Nacional de Despesa Familiar-Instituto Brasileiro de Geografia e Estatística) in 1974-1975.

The present survey began before implementation of the Program, took place during part of it, and was carried out for the purpose of evaluating the Program's efficiency. Results of the investigation are herein described.

MATERIAL AND METHODS

The Program to overcome vitamin A and iron deficiencies in areas of poverty in Minas Gerais, Brazil, was implemented in October 1983, and consists in the administration of:

- A single oral dose of 200,000 IU (gelatinous capsules, UNICEF) oleous solution of vitamin A to children from 1 to 14 years old, and to nursing women;
- a single oral dose of 100,000 IU oleous solution of vitamin A to children from 6 to 11 months of age;
- a single oral dose of 50,000 IU oleous solution of vitamin A to children from 0 to 5 months of age;
- 25 mg of oral iron sulfate per day during 30 days to children from 6 to 47 months of age;
- 200 mg of oral iron sulfate (1 tablet) per day during 50 days, to children from 4 to 14 years old and to pregnant women, and
- 200 mg of Mebendazol (100 mg twice a day, tablet or oral solution) during three days to children from 1 to 14 years old.

This Intervention Program was repeated with an interval of 180 days, and favoured 70,000 needy children aged four to 14 years from the periphery of Belo Horizonte, Minas Gerais capital city; 65,000 children from 0 to 14 years, 10,500 nursing women, and 8,000 pregnant women from Jequintinhonha Valley.

Several other entities participated, among them "Central de Medicamentos (CEME), Faculdade de Ciências Médicas de Minas Gerais, Universidade Federal de Minas Gerais (UFMG), Serviço Voluntário de Assistência Social (SERVAS), Movimento Brasileiro de Alfabetização (MOBRAL) e Programa de Desenvolvimento de Comunidades da Secretaria de Estado de Trabalho e Ação Social (PRODECOM)".

To evaluate the Program a random sample composed of a statistically significant number of children of both sexes from Turmalina (Jequitinhonha Valley) and periphery of Belo Horizonte, was used. All subjects were submitted to clinical and biochemical nutritional evaluation before and after the intervention.

1. Evaluation of the Program in Belo Horizonte

The study took place in the slums of Belo Horizonte, Minas Gerais. The random sample consisted of 130 preschool children and 120 school children from both sexes, of low socioeconomic strata.

All children were first subjected to a clinical evaluation, and afterwards, to a biochemical evaluation. The latter consisted in determinations of serum vitamin A (18), hematocrit and hemoglobin (19).

After this first evaluation, all children entered to form part of the Intervention Program (INAN, Brazil), repeated with an interval of 180 days.

Thirty days after receiving the third dose of medicine, the children underwent a new evaluation. Their number at the second evaluation was smaller than at the first one, due to several factors such as moving, admission to a hospital, refusal of having blood drawn, etc.

2. Evaluation of the Program in the Jequitinhonha Valley

The study took place in the urban and rural areas of Turmalina, a town from Jequitinhonha Valley chosen by casting lots. The random sample consisted of 261 preschool children and 406 school children from the rural area, and 226 preschool and 795 school children from the urban area of Turmalina.

All were first submitted to an eye examination in ambient daylight, and without use of lenses or tackles. Further, blood was drawn from a random subsample (107 children from the rural and 105 children from the urban area). They were then subjected to a biochemical evaluation which consisted of determinations for serum vitamin A (18), hematocrit and hemoglobin (19).

After this first evaluation, and as already stated, all children were submitted to the INAN's Intervention Program, repeated with an interval of 180 days.

Thirty days after the administration of the third dose of medicine, another subsample consisting of 109 children (4 to 14 years old) from the rural area, and 161 children from the urban area, underwent a new evaluation.

Finally, another subsample consisting of 42 children (4 to 14 years old) from the rural area, and 57 from the urban area, underwent the previous and final evaluation (longitudinal study).

3. Statistical Treatment

The Chi square (X^2) test was performed by comparing the frequency of the values of plasma vitamin A levels, hemoglobin and hematocrit between the different groups, before and after the Intervention Program.

RESULTS

1. Evaluation of the Program in Belo Horizonte

The clinical evaluation of the 130 preschool and 120 school children

belonging to the low socioeconomic strata in slums of Belo Horizonte showed no clinical signs of anemia or hypovitaminosis A.

Table 1 illustrates the first laboratory evaluation of the group (250 children). A high prevalence of deficient and low vitamin A values was observed both in preschool children (21.5°/o) and in school children (21.7°/o). Concerning the hematocrit, a small prevalence of deficient and low values was detected in preschool children (3.1°/o), and low values in school children (4.2°/o). Deficient and low values of hemoglobin were found in 21.5°/o of the preschool children and 17.5°/o of school children.

The determinations of plasma vitamin A, hemoglobin and hematocrit, in 92 preschool children and 69 school children who were subjected to the biannual treatment with Mebendazol, iron sulfate and vitamin A, are presented in Tables 2 and 3. As results reveal, 30 days after the end of the third dose, there were no children with deficient levels of vitamin A and only a small number with low vitamin A values (4.3°/o in preschool children and 2.9°/o in school children). The hematocrit values were also improved by treatments, since only a low value was detected in one child. Small percentages of children presented low values of hemoglobin (6.5°/o in the preschool group and 2.9°/o in school children). Deficient values of vitamin A and hemoglobin were not observed. The Chi-square (X^2) test showed significant differences ($p < 0.05$) of the vitamin A and hemoglobin values before and after the Intervention Program, both in preschool and in school children. No significant differences were detected in hematocrit values.

2. Evaluation of the Program in Jequitinhonha Valley

The results of the eye examination performed in children from both the rural and urban areas of Turmalina are presented in Table 4. Five cases of Bitot spot with conjunctival xerosis, two cases of corneal xerosis and one case of keratomalacia were observed in the first examination. Thirty days after the end of the third dose of medicine, only one corneal scar was detected (the child who presented keratomalacia in the first examination).

Table 5 depicts the results of plasma vitamin A, hemoglobin and hematocrit determinations in two random samples of children from rural and urban areas of Turmalina (before and after the Intervention Program). Children at the first evaluation were not the same as those of the final evaluation. As findings show, 30 days after the end of the third dose, there were only a small number of children with deficient and low levels of vitamin A, hematocrit and hemoglobin. The Chi-square test showed significant differences ($p < 0.05$) of the vitamin A, hematocrit and hemoglobin values before and after the Intervention Program both in the rural and urban areas.

The same results were found when the longitudinal study was performed. Table 6 shows the results of plasma vitamin A, hemoglobin and hematocrit determinations in 42 children from the rural area and 57 children from the urban area of Turmalina, before and after the Intervention Program. In this study no deficient values of vitamin A were observed at the final evaluation, and only one child presented a deficient

TABLE 1

DISTRIBUTION FREQUENCY OF DIFFERENT PLASMA LEVELS OF VITAMIN A, HEMATOCRIT AND HEMOGLOBIN IN 250 NEEDY CHILDREN, BELO HORIZONTE, MINAS GERAIS, BRAZIL

	Preschool (n = 130)		School (n = 120)	
	n	°/o	n	°/o
Vitamin A (plasma levels μg/dl)				
Deficient (<10)	5	3.8	3	2.5
Low (10 20)	23	17.7	23	19.2
Acceptable (>20)	102	78.5	94	78.3
Hematocrit (°/o)				
Deficient (<30.7)	1	0.8	0	—
Low (30.7 33.5)	3	2.3	5	4.2
Acceptable (>33.5)	126	96.9	115	95.8
Hemoglobin (g/dl)				
Deficient (<10.3)	9	6.9	7	5.8
Low (10.3 11.3)	19	14.6	14	11.7
Acceptable (>11.3)	102	78.5	99	82.5

TABLE 2

DISTRIBUTION FREQUENCY OF DIFFERENT PLASMA LEVELS OF VITAMIN A, HEMATOCRIT AND HEMOGLOBIN IN 92 PRESCHOOL CHILDREN, BELO HORIZONTE, MINAS GERAIS, BRAZIL, BEFORE AND 30 DAYS AFTER ADMINISTRATION OF THE THIRD BIANNUAL DOSE OF MEBENDAZOL (100 mg TWICE A DAY DURING THREE DAYS), IRON SULFATE (200 mg PER DAY DURING 50 DAYS) AND VITAMIN A (A SINGLE ORAL DOSE OF 200,000 IU)

	Preschool children (n = 92)			
	Before		After	
	n	°/o	n	°/o
Vitamin A (plasma levels μg/dl)				
Deficient (<10)	3	3.3	0	—
Low (10 20)	12	13.0	4	4.3
Acceptable (⩾20)	77	83.7	88	95.7
Hematocrit (°/o)				
Deficient (<30.7)	1	1.1	0	—
Low (30.7 33.5)	2	2.2	0	—
Acceptable (⩾33.5)	89	96.7	92	100.0
Hemoglobin (g/dl)				
Deficient (<10.3)	5	5.4	0	—
Low (10.3 11.3)	10	10.9	6	6.5
Acceptable (⩾11.3)	77	83.7	86	93.5

TABLE 3

DISTRIBUTION FREQUENCY OF DIFFERENT PLASMA LEVELS OF VITAMIN A, HEMATOCRIT, AND HEMOGLOBIN IN 69 SCHOOL CHILDREN, BELO HORIZONTE, MINAS GERAIS, BEFORE AND 30 DAYS AFTER ADMINISTRATION OF THE THIRD BIANNUAL DOSE OF MEBENDAZOL (100 mg TWICE A DAY DURING THREE DAYS), IRON SULFATE (200 mg PER DAY DURING 50 DAYS) AND VITAMIN A (A SINGLE ORAL DOSE OF 200,000 IU)

	School children (n = 69)			
	Before		After	
	n	o/o	n	o/o
Vitamin A (plasma levels μg/dl)				
Deficient (<10)	2	2.9	0	—
Low (10 20)	12	17.4	2	2.9
Acceptable (⩾20)	55	79.7	67	97.1
Hematocrit (o/o)				
Deficient (<30.7)	0	—	0	—
Low (30.7 33.5)	4	5.8	1	1.4
Acceptable (⩾33.5)	65	94.2	68	98.6
Hemoglobin (g/dl)				
Deficient (<10.3)	3	4.3	0	—
Low (10.3 11.3)	8	11.6	2	2.9
Acceptable (⩾11.3)	58	84.1	67	97.1

value of hemoglobin. The Chi-square test demonstrated significant differences ($p < 0.05$) of the vitamin A values before and after the Intervention Program both in the rural and urban areas. No significant differences were detected in hemoglobin and hematocrit values.

DISCUSSION

Vitamin A deficiency is one of the most important nutritional deficiencies in Brazil, and its consequences are severe. The combat against hypovitaminosis A may be carried out through several means: 1) fortification of highly consumed foods such as sugar; 2) regular distribution of pills containing high doses of vitamin A; 3) nutrition education; 4) introduction of vitamin A-rich foods in the school lunch. In Brazil, the INAN chose the second alternative.

There are controversies among the authors on the efficiency of oral doses of vitamin A against hypovitaminosis A. The results presented in this paper demonstrate the efficiency of an Intervention Program to

TABLE 4

PREVALENCE OF OCULAR LESIONS IN PRESCHOOL (0 TO 7 YEARS OLD) AND SCHOOL CHILDREN (7 TO 14 YEARS OLD)FROM THE URBAN AND RURAL AREAS OF TURMALINA, JEQUITINHONHA VALLEY, MINAS GERAIS, BRAZIL, BEFORE AND 30 DAYS AFTER ADMINISTRATION OF THE THIRD BIANNUAL DOSE OF MEBENDAZOL (100 mg TWICE A DAY DURING THREE DAYS), IRON SULFATE (200 mg PER DAY DURING 50 DAYS) AND VITAMIN A (A SINGLE ORAL DOSE OF 200,000 IU)

	Rural area				Urban area			
	Before		After		Before		After	
	Preschool	School	Preschool	School	Preschool	School	Preschool	School
	n = 261	n = 492	n = 326	n = 406	n = 442	n = 795	n = 226	n = 846
Bitot spot with conjunctival xerosis	1	3	0	0	0	1	0	0
Corneal xerosis	1	1	0	0	0	0	0	0
Keratomalacia	0	1	0	0	0	0	0	0
Corneal scars	0	0	0	1	0	0	0	0

TABLE 5

DISTRIBUTION FREQUENCY OF DIFFERENT PLASMA LEVELS OF VITAMIN A, HEMATOCRIT AND HEMOGLOBIN IN CHILDREN (4 TO 14 YEARS OLD) FROM RURAL AND URBAN AREAS OF TURMALINA, MINAS GERAIS, BRAZIL, BEFORE AND AFTER ADMINISTRATION OF THE THIRD BIANNUAL DOSE OF MEBENDAZOL (100 mg TWICE A DAY DURING THREE DAYS), IRON SULFATE (200 mg PER DAY DURING 50 DAYS) AND VITAMIN A (A SINGLE ORAL DOSE OF 200,000 IU). THE CHILDREN OF THE FIRST EVALUATION WERE NOT THE SAME OF THE FINAL EVALUATION

	Rural area				Urban area			
	Before n = 107		After n = 109		Before n = 105		After n = 161	
	n	o/o	n	o/o	n	o/o	n	o/o
Vitamin A (plasma levels μg/dl)								
Deficient (<10)	3	2.8	0	—	10	9.5	2	1.2
Low (10 20)	27	25.2	6	5.5	37	35.2	10	6.2
Acceptable (⩾20)	77	72.0	103	94.5	58	55.3	149	92.6
Hematocrit (o/o)								
Deficient (<30.7)	0	—	0	—	0	—	1	0.6
Low (30.7 33.5)	12	11.2	2	1.8	1	0.9	0	—
Acceptable (⩾33.5)	95	88.8	107	98.2	104	99.1	160	99.4
Hemoglobin (g/dl)								
Deficient (<10.3)	11	10.3	0	—	4	3.8	2	1.2
Low (10.3 11.3)	17	15.9	9	8.3	12	11.4	4	2.5
Acceptable (⩾11.3)	79	73.8	100	91.7	89	84.8	155	96.9

TABLE 6

DISTRIBUTION FREQUENCY OF DIFFERENT PLASMA LEVELS OF VITAMIN A, HEMATOCRIT AND HEMOGLOBIN IN CHILDREN (4 TO 14 YEARS OLD) FROM RURAL AND URBAN AREAS OF TURMALINA, MINAS GERAIS, BRAZIL, BEFORE AND AFTER ADMINISTRATION OF THE THIRD BIANNUAL DOSE OF MEBENDAZOL (100 mg TWICE A DAY DURING THREE DAYS), IRON SULFATE (200 mg PER DAY DURING 50 DAYS) AND VITAMIN A (A SINGLE ORAL DOSE OF 200,000 IU). THE CHILDREN IN BOTH EVALUATIONS WERE THE SAME (LONGITUDINAL STUDY)

	Rural area n = 42				Urban area n = 57			
	Before		After		Before		After	
	n	o/o	n	o/o	n	o/o	n	o/o
Vitamin A (plasma levels µg/dl)								
Deficient (<10)	3	7.1	0	—	4	7.0	0	—
Low (10 20)	11	26.2	1	2.4	18	31.6	4	7.0
Acceptable (⩾20)	28	66.7	41	97.6	35	61.4	53	93.0
Hematocrit (o/o)								
Deficient (<30.7)	0	—	0	—	0	—	0	—
Low (30.7 33.5)	2	4.8	1	2.4	1	1.8	0	—
Acceptable (⩾33.5)	40	95.2	41	97.6	56	98.2	57	100.0
Hemoglobin (g/dl)								
Deficient (<10.3)	2	4.7	0	—	2	3.5	1	1.8
Low (10.3 11.3)	6	14.3	2	4.8	5	8.8	2	3.5
Acceptable (⩾11.3)	34	81.0	40	95.2	50	87.7	54	94.7

overcome hypovitaminosis A in areas of poverty in Minas Gerais State, Brazil. These data are in accordance with studies of other authors (20-23) who show the efficiency of a biannual oral dose of 200,000 IU of only vitamin A to combat vitamin A deficiency. On the other hand, several studies indicate the inefficacy of massive doses of vitamin A in the treatment of this hypovitaminosis (24-26). If the results observed in the present study (efficiency of the intervention) are compared with our previous results (inefficacy of massive doses) in the city of Belo Horizonte (25,26), we notice that the fundamental difference consists in the presentation of vitamin A. In the experiments herein described, vitamin A was used in an oily solution, while hydrosoluble vitamin A chewing tablets were used in the former experiments (25,26). Therefore, it seems likely that the reason for the efficacy or inefficacy of the intervention depends on the presentation of vitamin A.

The distribution of vitamin A pills has several advantages: good acceptance; easiness of administration; very low cost (US$.007 per pill); high probability of reaching the vulnerable groups, and immediate effect.

On the other hand, in relation to nutritional anemia, the present results show the efficiency of the Intervention Program. The same advantages listed for distribution of vitamin A may be applied to ferrous sulfate.

The recommendation for administration of Mebendazol is supported in the literature. There is a direct correlation between intestinal parasitosis and anemia (27). In Brazil it is difficult to find undernourished people without parasitosis, a fact which leads to a certain confusion related to the physiopathology of both entities. In conditions of low income and lack of hygiene, the occurrence of parasites is the rule.

Based on our own findings and those of other groups in Brazil, the Brazilian Ministry of Health, through INAN, gathered the specialists on vitamin A. The following suggestions were made: 1) awareness of the Government and the population of the problem; 2) training people on the diagnosis and profilaxis of vitamin A deficiency; 3) distribution of vitamin A in high-risk regions in Brazil such as Northeast Brazil, Jequitinhonha Valley-MG, Ribeira Valley-SP, and periphery of big cities; and 4) inclusion of vitamin A-rich foods in all feeding or nutrition programs.

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RESUMEN

EVALUACION DE UN PROGRAMA PARA CORREGIR LAS DEFICIENCIAS DE VITAMINA A Y DE HIERRO EN AREAS DE POBREZA DE MINAS GERAIS, BRAZIL

Previo a, y después de la implantación de un "Programa de Intervención para Corregir las Deficiencias de Vitamina A y de Hierro en Areas de Pobreza de Minas Gerais, Brasil", se sometieron a evaluación nutricional muestras aleatorias de niños de ambos sexos en Belo Horizonte, la ciudad capital, y en Turmalina, así como en el Valle de Jequitinhonha, Minas Gerais.

Después del primer examen todos los niños recibieron, con intervalo de 180 días, una dosis oral única de vitamina A, sulfato de hierro oral durante 50 días, y 200 mg de Mebendazol/día por tres días. A los 30 días de haber finalizado la administración de la tercera dosis de medicina, los niños se sometieron a una nueva evaluación. En Belo Horizonte, la primera evaluación reveló una alta prevalencia de valores deficientes y bajos de vitamina A en niños preescolares (21.5o/o) y escolares (21.7o/o). Se constató también, en ambos grupos, una pequeña prevalencia de valores bajos de hematocrito. Se encontraron, asimismo, valores bajos de hemoglobina en 21.5o/o de preescolares, y en 17.5o/o de escolares.

La segunda evaluación, practicada 30 días después de administrar la tercera dosis de medicina, reveló una pequeña incidencia de valores bajos de vitamina A (4.3o/o en niños preescolares y 2.9o/o en escolares) y valores bajos de hemoglobina (6.5o/o en preescolares y 2.9o/o en escolares). No se observaron valores deficientes de hemoglobina ni de vitamina A. En cuanto a valores del hematocrito, sólo un niño de edad escolar acusó un valor bajo en la segunda evaluación. Por otra parte, al practicar el primer examen en el Valle de Jetiquinhonha, se encontraron cinco casos de mancha de Bitot y xerosis conjuntival, dos casos de xerosis de la córnea y uno de queratomalacia. Treinta días después de finalizar la tercera dosis de medicina, únicamente se detectó una cicatriz corneal. Sólo un pequeño número de niños acusó niveles deficientes y bajos de vitamina A y de hemoglobina al practicar la evaluación final (menos de 8o/o), mientras que cuando se hizo la primera evaluación el número era alto (por arriba de 38 y 12o/o, respectivamente).

Los resultados en cuestión demuestran la eficacia del Programa de Intervención en lo que respecta a la hipovitaminosis A y a la prevención de anemia ferropriva. El Programa está siendo aplicado por el Ministerio de Salud de Brasil.

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