

## ASSESSMENT OF RISK FOR IRON-DEFICIENCY STATES IN INFANTS AGED BETWEEN ONE AND THREE YEARS IN THE TOWN OF VARNA

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*Haemoglobin content of 1884 infants was estimated. Examinations were performed at the age of one and three years. This retrospective, 10-year long trial covered the children born between 1987 and 1996. Mean haemoglobin values demonstrated a tendency towards reduction since 1990 more outlined in boys than in girls. The relative share of the one-year old infants with haemoglobin levels over 120 g/l decreased while that one of the infants with haemoglobin levels below 110 g/l strongly increased. There was a considerable percentage of infants with haemoglobin content reduction between the first and third year of life. These results allow the assumption that there exists a risk for iron-deficiency states and anaemias in a significant part of the children aged between 1 and 3 years. This circumstance necessitates a complex preventive action.*

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**Key words:** iron deficiency, haemoglobin, spectrophotometry, infants, town of Varna

Examinations of children's haematologic parameters provides rich information and opportunities for objective assessment of population health (1,9). Iron-deficiency states represent one of the most common anomalies of the haematological status in early childhood. Despite the tendency towards the reduction of their incidence rate worldwide they are considered as a priority health topic even in the well-developed countries (12,14). The iron-deficiency states occur

in the so-called "practically healthy children". Their early detection is of utmost medical and social importance.

The purpose of the present investigation is to examine the haemoglobin concentration of infants aged between 1 and 3 years during a long-lasting period of time as well as to assess their risk for iron-deficiency states.

### MATERIAL AND METHODS

The haemoglobin content of a total of 1884 infants. Of them, they were 962 boys and 922 girls. The examinations were performed when the infants were turned one and three, respectively, as a

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component of prophylactic screening. The retrospective trial covered a 10-year period and included small children born between 1987 and 1996 from different regions of the town of Varna. The haemoglobin was estimated by using the cyanhaemoglobin spectrophotometric method with Drabkin's reagent. The assessment of the results was in conformity with the recommendations of WHO Consulting Commission concerning the usage of the haemoglobin value as a single screening parameter in the diagnosis of children's iron-deficiency states (1). According to them, the haemoglobin content should be over 120 g/l in the healthy early childhood population. Values between 120 g/l and 110 g/l should be considered as a parameter suggesting a latent iron deficiency while those below 110 g/l should indicate an iron-deficiency anaemia.

## RESULTS AND DISCUSSION

The results from this study showed that the mean haemoglobin values in one year-old infants remained close to the

physiological norm until 1990 (Fig. 1). In the subsequent years, however, there was a reliable haemoglobin content reduction. It was noteworthy that the average haemoglobin values were lower in boys than in girls as these differences were statistically significant ( $p < 0,05$ ) for 1991, 1992, and 1993.

With advancing age, the haemoglobin concentration increased and at the age of three years the mean haemoglobin levels became statistically reliably higher than those at the age of one year. Nevertheless the consecutive annual following-up the 3 year-old infants revealed a tendency towards a diminution of the mean haemoglobin values since 1991. However, the difference between the levels at the onset and the end of the period was statistically significant ( $p < 0,05$ ) only.

The individual evaluation of the haemoglobin content demonstrated that at the beginning of the period under observation (in 1988) the haemoglobin value was over 120 g/l in 57,14 per cent of the boys and in 51,13 per cent of the girls aged one year (Table 1). Since 1990, there was

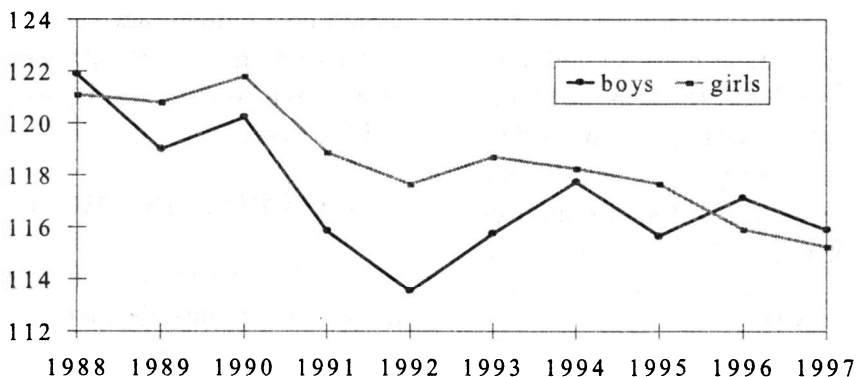


Fig. 1. Mean haemoglobin values of one-year old infants (in g/L)

a marked tendency towards a reduction of the relative share of these infants the differences between the onset and the end of the period being statistically reliably ( $p < 0,05$ ). In 1992, the haemoglobin content was particularly low in the boys and it was over 120 g/l in 20,18 per cent of them only. The relative part of infants with haemoglobin values below 110 g/l in the beginning of the period was low. Since 1990, however, this relative share sharply increased being more clearly outlined with the boys.

At the onset of the period of observation the haemoglobin content is already over 120 g/l in most children who are turned three (Table 2). This relative part, however, decreases until the end of the period. while, on the other hand, the number of the infants with haemoglobin content between 110 and 120 g/l increases. The latter is considered as low for this age. The percentage of 3 year-old infants with haemoglobin values below 110 g/l remains low during the whole period of observation.

**Table 1**

*One-year old infants' distribution according to haemoglobin concentration*

Year	Over 120 g/l		110-120 g/l		Below 110 g/l	
	boys (%)	girls (%)	boys (%)	girls (%)	boys (%)	girls (%)
1988	57,14	51,13	32,38	46,59	10,47	2,27
1989	46,42	50,00	40,47	41,66	13,09	8,33
1990	51,11	58,00	41,11	32,00	7,77	10,00
1991	36,69	39,56	39,44	46,15	23,85	14,28
1992	20,18	37,61	50,45	45,87	29,35	16,51
1993	29,35	39,44	48,62	50,45	22,00	10,09
1994	45,63	41,05	33,98	43,15	20,38	15,78
1995	31,37	39,09	45,09	40,90	23,52	20,00
1996	37,89	30,09	44,21	47,67	17,89	22,09
1997	33,92	30,23	32,14	38,00	33,92	28,00

**Table 2**

*Three-year old infants' distribution according to haemoglobin concentration*

Year	Over 120 g/l		110-120 g/l		Below 110 g/l	
	boys (%)	girls (%)	boys (%)	girls (%)	boys (%)	girls (%)
1990	68,57	78,40	28,57	21,59	2,85	0
1991	69,04	77,38	26,19	19,04	2,76	3,57
1992	70,00	70,00	20,00	26,00	10,00	4,00
1993	62,38	64,83	32,11	28,57	5,50	6,59
1994	56,88	62,38	35,77	24,77	7,33	12,84
1995	63,88	61,46	25,68	34,86	11,00	3,66
1996	57,28	58,94	39,80	36,84	2,91	4,21
1997	46,07	42,72	48,03	41,81	5,88	6,36

Haemoglobin elevation with age represents a physiological regularity of early infancy (4,7). It is of interest to determine the percentage of the infants which haemoglobin level has decreased during their 2-year growth period from the age of one till the age of three. Their relative share varies between 14,97 per cent and 31,0 per cent during the whole period of observation. This fact indicates that in some infants haemopoiesis does not compensate the rising requirements of the growing organism.

Our results allow the assumption that there exists a risk for iron-deficiency states and anaemia in a considerable part of the 1-3-year old infants. The etiopathogenetic role of irrational and inadequate nutrition for these states is crucial, indeed (2,4,5). Numerous authors relate the iron-deficiency states and anaemiae with poor economic status and insufficient nutrition (13,15). The period under observation coincides with the economic transition and the stagnation-induced lowering of the level of living standards of large social groups of the population. During the period from 1990 till 1996, reduced rates of real family consumption by more than 50 per cent have been established (3,6,11). There are data about unfavourable changes of the nutrition status of sucklings and infants aged up to 6 years manifested by chronic insufficient consumption of proteins, vitamins, mineral salts (iron salts including) for a long-lasting period (8,10).

Both primary and secondary prevention of iron-deficiency states and anaemiae represents an actual problem and thus it should be considered a priority of national public health policy. Mother's milk supply, especially during the first 6 months of life, along with timely and correct nutrition with vegetable, fruit, meat and other foods adapted to the corresponding age is an important prophylactic factor in this aspect. Iron-enriched foods have to be more widely applied in infants' nutrition schedules. Besides, as demonstrated by the present investigation, a timely prevention using iron-containing preparations is required to avoid the development of a pathological process in this health-risk population group.

## CONCLUSIONS

1. During the 10-year period of observation the mean haemoglobin values of 1-3-year old infants tend to decrease more outlined in boys.
2. The relative share of one-year old infants with haemoglobin levels over 120 g/l diminishes since 1990 while that one of the infants with haemoglobin levels below 110 g/l strongly enhances (by 2-3 times).
3. During the period of socio-economic transition there exists a risk for emerging iron-deficiency states and anaemiae in sucklings and infants requiring the performance of complex preventive measures.

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### Оценка на риска от желязодефицитни състояния при деца от 1 до 3 годишна възраст от Варна

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**Резюме:** Проучено е хемоглобиновото съдържание на 1884 деца. Хемоглобинът е изследван на 1- и 3-годишна възраст. Изследването е ретроспективно за 10 годишен период и обхваща деца, родени от 1987 до 1996 година. Средните стойности на хемоглобина показват тенденция за намаляване след 1990 г. по-силно изразено при момчетата. Относителният дял на децата на 1-годишна възраст с хемоглобин над 120 г/л намалява, а силно нараства процентът на децата с хемоглобин под 110 г/л. Значителен е процентът на децата, при които хемоглобинът намалява между 1- и 3-годишна възраст. Получените резултати дават основание да се приеме, че за значителна част от децата от 1- до 3-годишна възраст съществува риск от желязодефицитни състояния и анемия. Това налага необходимостта от прилагане на комплексни профилактични мерки.