Original Article

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THE FREQUENCY OF ANAEMIA IN INFANTS IN GOSPIĆ AND THE EFFECT OF NUTRITION ON ITS FREQUENCY

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Objective - The study was undertaken to establish the frequency of iron deficiency anaemia in infants in Gospić and the effect of nutrition on its frequency.
Subjects and methods - The study comprised 347 infants, who were patients at the paediatric clinic of Gospić Health Centre over a two year period. The subjects of the study were 282 infants who met the criteria set, and who underwent screening for iron deficiency anaemia at the age of six months of life. On the basis of their history taken regarding how they had been fed, the effect of nutrition on the frequency of anaemia was established, whereby the infants were divided into two groups: group 1 (breast-fed infants) and group 2 (non-breast-fed infants).
Results - In this period, from 01.06.2000 to 01.06.2002, 347 babies were born who also became patients of the paediatrics clinic of the Gospić Health Centre. Of these, 282 infants met the criteria to take part in the study, whilst 65 infants were not included because they did not meet the criteria. Of the total of 282 infants included in the study, the criteria for diagnosis of iron-deficiency anaemic, on the basis of the screening method, were met by 68, or 24.1%. Of the total of 68 infants diagnosed with anaemia, 27 or 39.7% were in group 1, whilst 41 or 60.3% were in group 2 of the infants studied (χ^2=8.83; df=1; p=0.003).
Conclusion - The results indicate that iron deficiency anaemia is a frequent illness in infants after six months of life, but iron preparations should be given exclusively to infants with diagnosed iron deficiency anaemia on the basis of screening. Infants who are breast-fed have less anaemia.

Key words: Infants ▪ Iron deficiency anaemia ▪ Screening

Introduction

Iron deficiency anaemia occurs due to the lack of iron in the organism. It belongs to the group of deficiency anaemias and is the most frequent anaemia in infancy (1). The incidence of this illness depends on the level of development of the country (2). It is lowest in Scandinavian countries, at about 5%, and iron is only used in anaemic infants (3), whilst in undeveloped countries in Africa it is more than 80% and according to the WHO recommendations iron is given as a prophylactic to all infants (4).

Infants are an especially at-risk group for the development of anaemia due to their intensive growth and development, which increases the volume of blood three times, and due to their nutrition, which is basically low in iron (5). It is believed that infants who are born prematurely and with low birth weight are most at-risk, followed by infants whose mothers were anaemic during pregnancy and infants who are not fed adequately. The need for iron is relatively high in infancy, at 7 to 10 mg/day, and is almost identical as for school children (6).

There are contrasting views on the issue of nutrition or breast-feeding and its effect on the frequency of anaemia. A large group of authors believe that breast-fed children are less anaemic in comparison with infants fed with other types of milk (7, 8). However, some studies indicate that infants who are fed naturally are more frequently anaemic (9, 10).

Mother's milk does not contain the optimal quantity of iron, but it does contain the enzyme lactoferrin and vitamin C, which facilitate the absorption of iron from human milk. That is to say, according to the European Society of Paediatric Gastroenterology, Hepatology and Nutrition (ESPGHAN), absorption of iron from mother's milk is between 15 and 20%, that is, the bioavailability of iron from mother's milk is greater than from any other foodstuff, including meat (11). Therefore it is to be expected that infants who are breast-fed are less anaemic. If an infant is not fed on mother's milk, it is believed that it is better to feed it on artificial preparations enriched with iron than on cow's milk, which apart from being more poorly absorbed also causes micro-haemorrhaging in the intestinal wall.

There has been no research into the frequency of anaemia in infants on the level of the Republic of Croatia, although the Act on Health Care Measures of 2006 prescribed the compulsory screening of infants for anaemia (12). This research was undertaken in Gospić, in central Croatia, which does not differ in social and economic terms from the rest of the country, therefore it is not expected that the data obtained differ from the Croatian average.

The aim of the study was to establish the frequency of iron-deficiency anaemia in infants in Gospić and the effect of nutrition on its frequency.

Subjects and methods

The Study Area

The city of Gospić is the main administrative centre of the Lika-Senj County, the largest county in Croatia in terms of area, spreading over 5350.50 km^2. It is located in the hilly, mountainous region of central Croatia.

Subjects

The study comprised 347 infants who were patients at the paediatrics clinic of the Gospić Health Centre, born during a two-year period, from 01.06.2000 to 01.06.2002. To be included in the study the subjects had to meet the following criteria: the parents of the infant lived in the area of Gospić; the infant underwent regular check-ups and treatment at the paediatrics clinic of Gospić Health Centre; during a visit to the paediatrics cli-

nic screening for iron deficiency anaemia was undertaken in infants aged 6 to 7 months, by establishing the red blood count from capillary blood, in line with the Child Health Care Act of the RC - OG 126/06 (12); the screening for anaemia was undertaken using the following parameters: haemoglobin, hematocrits, MCV (mean corpuscular volume), MCH (mean corpuscular haemoglobin), MCHC (mean corpuscular haemoglobin concentration) and by surveying the mother or from data from the health file, the method of feeding the infant in the first six months of life was analysed.

Methods

The study was undertaken as a cross-sectional study. On the basis of a survey, filled in by the mothers, data were collected relating to the type of nutrition of the infant. The replies to the following questions were used:

1. Has your infant been fed on mother's milk?
2. How long did you feed your infant exclusively with your milk?
3. How did you introduce other forms of milk nutrition?
4. Did your infant undergo a red blood count test as screening for anaemia on a visit to the paediatrics clinic at the age of 6-7 months?

It was possible to answer the first question with YES or NO. If the answer was YES, in their answers to the second question the mothers stated the duration of exclusive breast-feeding in months. The third question related to a more detailed explanation of the introduction of supplementary feeding and the age of the infant when it was introduced. It was possible to answer the last question with YES or NO. The infants for whom the answer was YES, alongside the existence of laboratory parameters in their medical documentation, met the criteria to be subjects of this study.

Two groups were formed of infants who met these criteria: group 1 consisted of those infants who were exclusively breast-fed for 4 or more months (hereinafter: group 1). Group 2 consisted of infants who also met these criteria but were not breast-fed (hereinafter: group 2).

From the patients' medical documents at the paediatrics clinic of Gospić Health Centre, the existing laboratory findings were analysed of red blood count, taken from capillary blood, as part of the regular screening for iron deficiency anaemia. The following parameters were analysed: haemoglobin values expressed in grams per litre, hematocrits as a percentage, and the constant erythrocytes: MCV expressed in femtolitres (fl), MCH expressed in picograms (pg) and MCHC expressed in grams per litre (g/l).

The frequency of iron deficiency anaemia in infants was established on the basis of the WHO parameters: haemoglobins lower than 110 g/l, hematocrits lower than 0.33, two of the following parameters: MCV lower than 72 fl, MCH lower than 27 pg or MCHC lower than 350 g/l. If the laboratory parameters taken from capillary blood met these criteria, we deemed that the infant had iron deficiency anaemia.

Statistical analysis

The results are presented in absolute and relative numbers, and the difference between the groups was tested using the χ^2 test. The difference between the groups was seen as significant if $p<0.05$.

Results

In this period, from 01.06.2000 to 01.06.2002, 347 babies were born who also became patients of the paediatrics clinic of the Gospić Health Centre. Of these, 282 infants met the criteria to take part in the study, whilst 65 in-

Table 1 Distribution of infants in relation to the presence of anaemia and feeding method

Feeding method	Infant		Total (n; %)
	With anaemia (n; %)	Without anaemia (n; %)	
Group 1	27 (39.7)	131 (61.2)	158 (56.0)
Group 2	41 (60.3)	83 (38.8)	124 (44.0)
Total:	68 (100.0)	214 (100.0)	282 (100.0)

fants were not included for several reasons: four families moved away from Gospić, 17 infants did not undergo regular check-ups at the paediatrics clinic, for 36 infants we did not obtain data on nutrition or due to illness the infants did not attend the clinic regularly, so that screening for iron deficiency anaemia was not undertaken in 8 infants.

Of the total of 282 infants included in the study, the criteria for a diagnosis of iron-deficiency anaemic, on the basis of the screening method, were met by 68, or 24.1%. Of the total of 68 infants who were diagnosed with anaemia, 27 of them, or 39.7%, were in group 1, whilst 41 or 60.3% were in group 2 of the infants studied (χ^2=8.83; df=1; p=0.003) (Table 1).

Discussion

Although statutory screening of infants for iron deficiency anaemia at 6 months of age was prescribed by law in 2006, there has been no state epidemiological study of the frequency of this illness in the Republic of Croatia. The results of research show the frequency of anaemia in infants in the city of Gospić as 24.1%. Does this result justify the use of screening for anaemia and targeted therapy using iron preparations for anaemic infants, or would prophylactic use of iron for all infants be justified? Comparing the results obtained for the frequency of iron deficiency anaemia in African countries, the poorest countries in the world, where, according to data from the World Health Organization the frequency of iron deficiency anaemia in infants is above 80%, the frequency of anaemia found in Gospić is significantly lower.

In these undeveloped countries there is no need nor possibility for screening for anaemia, and it is certainly justified to give all infants prophylactic iron preparations (4). In contrast to this, developed countries in Europe, such as Denmark and Sweden, report on a significantly lower frequency of anaemia of about 5% (2). Hercberg et al. (3) deem that it is impossible to achieve a lower rate than this, and iron is not given as a prophylactic, but it is introduced into therapy only in anaemic infants. In view of the fact that according to data from the WHO the frequency of anaemia in transition countries is from 20 to 50%, and screening for anaemia is recommended, as well as therapy with iron only for anaemic infants, the frequency of iron deficiency anaemia of 24.1% places the Republic of Croatia, where Gospić is located, in this group of countries.

For a specific illness to meet the criteria for screening it has to be sufficiently frequent in a population, the screening method must be simple, quick, accessible and cheap, and treatment must be possible and justified. Does iron deficiency anaemia meet these criteria? With a frequency of 24.1% it is certainly a frequent illness, it may be simply diagnosed by taking capillary blood without venopuncture, and it is treated simply and cheaply with iron preparations in the form of an oral suspension (13). In contrast, the consequences of long-term and untreated iron deficiency anaemia, such as psychomotor development delay and a tendency to

infection, are significant in terms of infant morbidity. The value of iron preparations is certainly without doubt in children with proven anaemia, but it should not be overlooked that Domellof (14) emphasizes the harm caused by the unnecessary burden on the infant metabolism caused by iron salts.

An examination of the literature shows a high degree of variance between the data on the basis of which the diagnosis of iron deficiency anaemia is set, which prevents a comparison of studies, due to: use of different parameters for setting the diagnosis, different threshold values of the same parameters, and the different ages of the infants, or children, who undergo the tests. In this study, parameters of red blood count were analysed which are available to everyone in Croatia, and their low values were significantly indicative for introduction of therapy with iron preparations on the level of primary health care, as well as control of those results after therapy.

Regarding the influence of nutrition, authors have differing viewpoints. In the study by Obradović et al., (9) a higher frequency of anaemia was found in breast-fed babies, and this was also confirmed by Godel (10). However, the studies by Grgurić and Zakanj (5, 7) encourage breast-feeding, or feeding with mother's milk, due to the lower frequency of anaemia in infants in comparison with those fed with other milk preparations, and especially with cow's milk, which also causes micro-haemorrhaging in the intestinal wall. In this study, a statistically significant difference was shown between the frequency of iron deficiency anaemia in terms of nutrition, where breast-fed infants were less often anaemic.

Of the total of 68 anaemic infants, 27 (39.7%) were breast fed, showing the importance of lactoferrins and vitamin C from the mother's milk, which increase the bioavailability of iron, regardless of the relatively small quantity of iron in the milk and the infant's great need. We must not overlook the effect of a mother's anaemia on the frequency of anaemia in her children, in view of the fact that during their child-bearing years, women and pregnant women are a high risk group for the occurrence of this illness. Therefore, an anaemic mother gives her child less reserves of iron than a mother who is not anaemic.

The frequency of iron deficiency anaemia assessed by analysis of haemoglobins, hematocrits, and the erythrocyte constants MCV, MCH and MCHC from capillary blood, is most often sufficient for a diagnosis of iron deficiency anaemia. Moreover, children are spared painful venopuncture. A more precise diagnosis of anaemia, with an assessment of latent and manifest iron deficiency anaemia or loss of iron reserves in the organism, is established from venous blood, by expensive methods, which we did not undertake. On the basis of these parameters, the diagnosis of iron deficiency anaemia in the subjects was probably of acceptable reliability, and lower values of these parameters were sufficiently indicative to introduce iron therapy. We took microcytic anaemia as equivalent to iron deficiency anaemia, taking into consideration the fact that the frequency of thalassemia minor(the second most frequent microcytic anaemia) in Croatia is 0.8%, whilst it is slightly higher in neighbouring countries, such as Slovenia (1.2%) and Macedonia (2.9%) (15).

Conclusion

Iron deficiency anaemia is a frequent illness in infants after they reach 6 months of age in the Gospić area, which indicates the validity of the legal provisions on systematic screening for this illness. Iron must be given to infants with diagnosed iron deficiency anaemia, whilst prophylactic use of iron is justified in countries with a low standard of

living, where it is not possible to undertake screening. The promotion of natural feeding, alongside its other advantages, also leads to a reduction in the frequency of iron deficiency anaemia. Infants who are not able to be fed with mother's milk, should be introduced to a diet of manufactured milk preparations enriched with iron (11).

Conflict of interests: The author declare that she do not has any conflict of interests. The study was not sponsored by any external institution.

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