Prevalence of iron deficiency in rural pre-school children in Northern Ireland

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SUMMARY. Screening for iron deficiency was offered to 485 pre-school children in one practice. A questionnaire asking for details of the child's birth, diet, medical history and social status was sent to all the families of these children. Three hundred and eleven children (64% of the total) had blood samples taken for haemoglobin concentration, mean corpuscular volume and serum ferritin levels. Fifty four of the children (17%) were iron deficient (serum ferritin less than 10 μg l^{-1} or mean corpuscular volume less than 75 fl), while 10 (3%) had iron deficiency anaemia (haemoglobin level less than 10.5 g dl^{-1}). The prevalence of iron deficiency and iron deficiency anaemia were not significantly associated with any social class. However, there was a higher prevalence among social class 3 children than children from other social classes, 29% of them having covert iron deficiency, while 6% were frankly anaemic. As there are no ethnic minorities in the practice, dietary inadequacy was likely to be the main cause of iron deficiency. After receiving iron supplements for up to three months, all the children who were iron deficient or anaemic and attended for follow up had normalized blood values. In view of the high prevalence of iron deficiency throughout the social classes, and its association with developmental delay and behavioural disorders, screening will be offered to all children when they attend for measles, mumps and rubella immunization, and those who do not attend will be followed up.

Introduction

IRON deficiency is a major health problem, particularly in childhood and adolescence, when maximum growth requirements outstrip dietary intake and body stores.[1-3] Throughout infancy iron fortified proprietary formula milks tend to prevent the development of iron deficiency, while breast milk, despite its lower content, contains iron which is more bioavailable. It should be remembered that in addition to iron deficiency anaemia there will be an equal or greater prevalence of iron deficiency that is not severe enough to cause anaemia.[4] Iron deficiency is significantly associated with retardation of physical and psychomotor parameters, while repletion of the body's iron stores rapidly reverses these developmental anomalies.[5-7] It is therefore important that this disorder be discovered and corrected.

It was decided to screen the children in one practice for iron deficiency in order to ascertain the prevalence of the condition with a view to planning a routine surveillance programme. The majority of families in the practice are in social classes 3, 4 and 5, where any delay in development in probably multifactorial. Iron deficiency is a contributing factor to developmental delay which is particularly amenable to correction. In view of the practice's high immunization rate (97%) and well attended baby clinic, it was felt that parents would be cooperative and interested in this project.

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Method

The study practice has 7087 patients served by four doctors from a modern purpose-built health centre and a smaller branch surgery. From the age–sex register 485 pre-school children over one year old were identified. A letter outlining the importance of discovering and treating iron deficiency in these children was sent to their families, and they were also informed of the availability of local anaesthetic cream prior to the child having the necessary venepuncture. An appointment date, subject to alteration was suggested. Accompanying the letter was a questionnaire asking about the child's birth, dietary and medical histories including immunization record, birth order, family history of disease and social status of the family.[8] Twice weekly anaemia clinics were held and those who did not attend initially received a further two requests to attend at any suitable surgery time.

The anaemia clinic was staffed by a doctor and a nurse. On presentation of the child with the parent — usually the mother — the questionnaire was examined and completed. Further education regarding iron deficiency was given and the planned follow-up schedule was described; at all times parents were given the opportunity to discuss any worries they might have regarding the child's health. Height, supine and standing, and weight in vest and pants were recorded on percentile charts. Venepuncture was then performed and in the majority of cases caused no discomfort, in fact several children slept through the procedure. Blood was obtained to measure haemoglobin concentration, mean corpuscular volume and serum ferritin levels. A haemoglobin concentration of less than 10.5 g dl^{-1} was considered to be anaemic; a mean corpuscular volume of less than 75 fl or serum ferritin level of less than 10 μg l^{-1} were considered iron deficient.

Approximately two weeks after this interview the parents were sent a letter outlining the results and thanking them for their cooperation. If the child was found to be iron deficient or anaemic a prescription for iron therapy was enclosed and an appointment was made with the dietician. Approximately 100–150 mg of elemental iron and vitamins incorporating vitamin C were prescribed on a daily basis for three months. Parents were then invited to attend the 'anaemia clinic' two weeks after the child had commenced iron therapy in order to confirm his or her haematological response. The children were examined and asked to return after three months of iron therapy so that their response in terms of repletion of iron stores could be documented.

The questionnaire data of the children screened were compared with those of the children for whom questionnaires were completed but who did not attend for blood test and examination. All the results were analysed using Pearson's chi-square test and where appropriate, Fisher's exact test.

Results

Over a four month period, 311 (64%) of the 485 pre-school children in the practice took part in the screening programme. Fifty four of the 311 children (17%) were found to be iron deficient and 10 (3%) had frank iron deficiency anaemia (Table 1). Two anaemic children had serum ferritin levels about 10μg l^{-1} and therefore 56 children in total had iron deficiency and/or anaemia. Neither iron deficiency nor anaemia was significantly associated with the childrens' sex, birth order, current weight or height, social class or whether they had been breast fed or

Table 1. Prevalence of iron deficiency and iron deficiency anaemia among pre-school children.

	Total no. of children	Number (%) of children: Iron deficient		Anaemic[a]	
All	311	54	*(17)*	10	*(3)*
Sex					
Male	174	29	*(17)*	6	*(3)*
Female	137	25	*(18)*	4	*(3)*
Age (years)					
1	75	15	*(20)*	4	*(5)*
2	86	18	*(21)*	4	*(5)*
3	105	15	*(14)*	0	
4	45	6	*(13)*	2	*(4)*
Breast fed					
Yes	65	12	*(18)*	4	*(6)*
No	246	42	*(17)*	6	*(2)*
Weaned					
Before 4 mths	88	17	*(19)*	5	*(6)*
After 4 mths	223	37	*(17)*	5	*(2)*
Current weight					
⩾ 10th centile	285	47	*(16)*	8	*(3)*
< 10th centile	26	7	*(27)*	2	*(8)*
Current height					
⩾ 10th centile	286	49	*(17)*	7	*(2)*
< 10th centile	25	5	*(20)*	3	*(12)*
Social class[b]					
1	20	2	*(10)*	0	
2	17	2	*(12)*	0	
3	83	24	*(29)*	5	*(6)*
4	99	15	*(15)*	2	*(2)*
5	92	11	*(12)*	3	*(3)*
Birth order					
1st–3rd	218	37	*(17)*	7	*(3)*
4th–6th	77	13	*(17)*	2	*(3)*
7th+	16	4	*(25)*	1	*(6)*

[a] Two anaemic children had serum ferritin levels above 10 $\mu g\ l^{-1}$. [b] Social class groupings for chi-square test: iron deficiency (1,2,3), (4), (5); anaemia (1,2,3), (4,5).

weaned before or after 4 months. However, children in social class 3 families had the highest prevalence rates, with 29% of children being iron deficient and 6% having frank iron deficiency anaemia. There was no disease process present to account for any case of iron deficiency or anaemia, nor was a particular age group significantly more susceptible to its development; there was a trend of decreasing prevalence with increasing age.

In the follow-up, 14 of the children had blood tests after two weeks on iron therapy; 32 children returned after taking iron supplements for approximately three months. All 32 children had normalized haemoglobin and serum ferritin levels after three months.

The children screened are representative of the practice as their questionnaire data did not differ from those who were not screened.

The mean corpuscular volume was not a sensitive indicator of iron deficiency as it was reduced in only 19 of the 56 children (34%) who were iron deficient and/or anaemic.

Discussion

This study involved a population based sample which was self-selected, thus introducing a possible selection bias. In this mainly rural practice, a predominance of middle and lower social classes would be expected and this was found to be the case. Notably, although the prevalence rates of iron deficiency and anaemia were highest in children from social class 3, there was no significant difference in prevalence rates between the different social classes. In contrast to other studies which have found that social status influences the prevalence of iron deficiency,[1,9] these findings emphasize the importance of screening all children routinely regardless of their social class.

It is probable that parents who brought their children for screening would be interested and better informed about health and diet; their children would be likely to be the healthier ones in the practice. This has serious implications because it indicates that the prevalence of iron deficiency in the whole pre-school community is probably even more than the 17% found here, while more than 3% of the children will have iron deficiency anaemia. Although not all children with iron deficiency will necessarily develop anaemia, several studies[4-7, 10-12] have reported developmental delays and behavioural abnormalities which were corrected on repletion of iron stores.

There are no ethnic minorities in the practice area and neither anaemia nor iron deficiency was associated with a disease process. Therefore the main cause of the deficiency must be inadequate dietary intake of iron during a period of sustained growth and high energy output. As only about 10% of dietary iron is absorbed it is important that there be a constant high content of iron in the diet. Education should cover the important fact that iron absorption from foods of animal origin generally surpasses iron absorption from foods of vegetable origin.[13]

The results of this study emphasize the need for a routine screening programme in order to uncover and treat iron deficiency and anaemia. Blood sampling is necessary in order to identify this disorder and the method used here involved painless venepuncture which is relatively inexpensive when the serious physical, psychological and educational consequences of iron deficiency are considered. Most parents were pleased to cooperate with the screening and grateful for the opportunity to discuss health education. The practice plans to offer screening to all children presenting for immunization in the second year of life. An education programme will start from the first presentation for initial immunization at three months (diphtheria, tetanus, polio and pertussis) where the practice uptake rate is 97%.

Every effort must be made to eliminate this covert disorder of childhood preferably through the introduction of routine paediatric surveillance for iron deficiency and anaemia.[14]

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