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IRON DEFICIENCY ANAEMIA IN CAPE COLOURED AND AFRICAN CHILDREN IN CAPE TOWN*

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Routine haemoglobin estimations, carried out by one of us (P.L.) in the out-patient department of this hospital, showed that many Cape Coloured and African pre-schoolgoing children had low haemoglobin levels. Further haematological investigations (P.C.V., M.C.H.C., smear and bone-marrow, where indicated) showed that the low haemoglobin level was a manifestation of an iron-deficiency anaemia. Most of these children, however, on physical examination, had no evidence of anaemia. This observation led us to investigate the haemoglobin levels of apparently healthy children attending several crèches in the Cape Town area.

References to haemoglobin estimations on healthy children in South Africa are few.[1-5] None of the authors aimed at establishing a normal standard and, so far as we are aware, no standard of normality has been published for either European (White) or non-European (Coloured and African) children in this country. For the purpose of this investigation, therefore, Wintrobe's[6] standard of normal haemoglobin levels was accepted for comparison. Observations on a small number of White children from a high socio-economic group have shown haemoglobin levels almost identical to those of Wintrobe's normal standard.

MATERIAL

The children on whom haemoglobin estimations were carried out were all healthy Cape Coloured or African children between the ages of 1—7 years, attending local crèches. These probably represent a more privileged dietary group, since meals are provided at the crèches. Three municipal crèches for Coloured children, which were pooled, and one municipal crèche for African children were used in this investigation. In addition, 2 non-municipal crèches (Board of Aid and Windermere) for Coloured children were investigated.

The children at the 3 municipal crèches for Coloured children had been receiving 4 ml. (60 min.) Parrish's food (Syr. Ferr. Phos. Co.) daily for close on a year. At one non-municipal crèche (Windermere) iron tonics, which varied in nature and amount, had been given irregularly. The children at the remaining crèches had received no iron supplement to their diet.

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METHODS

All blood specimens were collected and haemoglobin estimations performed between the hours of 2 and 4 in the afternoon, and in the period September to December 1957.

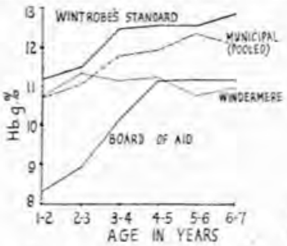
Blood for haemoglobin and a smear was taken from the heel prick of infants and the thumb of older children, using a triangular cutting needle. Free, unrestricted flow without necessity of external pressure of any kind was obtained in all cases.

Capillary blood, 0·02 ml., was pipetted into 8 c.c. of 0·04% ammonia in water and the haemoglobin level read by the oxyhaemoglobin method using a Klett-Summerson colorimeter previously calibrated for the purpose against standard haemin and cyanmethaemoglobin solutions. A child was deemed to be anaemic if the haemoglobin was ½ g. below the lowest level accepted as the standard of normal for that age group.

RESULTS

Peripheral smears showed that many were normal, while others showed all gradations of an iron-deficiency pattern. As could be expected, the haemoglobin level was a far better index of anaemia than was the morphology of the red blood corpuscles on the smear.

Comparison of the mean haemoglobin levels of the various groups with the standard adopted (Figs. 1 and 2, and Tables



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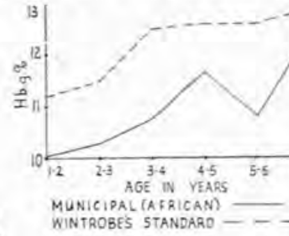

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Fig. 1. Mean haemoglobin levels for Cape Coloured children at various crèches.

Fig. 2. Mean haemoglobin levels at a municipal crèche for African children (Langa).

I–IV) shows that the Cape Coloured and African children investigated have lower haemoglobin levels than normal. From each group those who fulfilled the criteria, outlined above, for anaemia were given iron therapy. By chance different iron preparations were available and were used in different groups as follows.

TABLE I. MEAN HAEMOGLOBIN LEVELS. NON-MUNICIPAL CRÈCHE FOR CAPE COLOURED CHILDREN (BOARD OF AID)

Hb. g.%	*Age in years* 1-2	2-3	3-4	4-5	5-6	6-7	*Total*
5·5–6·5 ..	1	1	–	–	–	–	2
6·5–7·5 ..	–	1	1	–	–	–	2
7·5–8·5 ..	2	1	–	–	–	–	3
8·5–9·5 ..	2	3	1	–	–	–	6
9·5–10·5 ..	1	4	7	5	4	2	23
10·5–11·5 ..	–	2	6	8	2	3	21
11·5–12·5 ..	–	–	–	8	7	3	18
12·5–13·5 ..	–	–	–	1	1	–	2
Total cases ..	6	12	15	22	14	8	77
Average Hb. g.%	8·31	8·93	10·14	11·19	11·20	11·20	
St. deviation ..	±1·53	±1·48	±0·93	±0·87	±1·16	±0·83	
Wintrobe's standard g.%	11·2	11·5	12·5	12·6	12·6	12·9	

TABLE II. MEAN HAEMOGLOBIN LEVELS. NON-MUNICIPAL CRÈCHE FOR CAPE COLOURED CHILDREN (WINDERMERE)

Hb. g.%	*Age in years* 1-2	2-3	3-4	4-5	5-6	6-7	*Total*
8·5– 9·5 ..	–	–	2	–	1	–	3
9·5–10·5 ..	1	1	2	1	6	3	14
10·5–11·5 ..	2	4	8	7	5	1	27
11·5–12·5 ..	1	3	6	6	4	–	20
12·5–13·5 ..	–	–	–	–	1	2	3
13·5–14·5 ..	–	–	–	–	–	–	–
Total cases ..	4	8	18	14	17	6	67
Average Hb. g.%	10·78	11·35	11·19	11·28	10·80	11·00	
St. deviation ..	±0·92	±0·69	±0·91	±0·66	±1·00	±1·40	
Wintrobe's standard g.%	11·2	11·5	12·5	12·6	12·6	12·9	

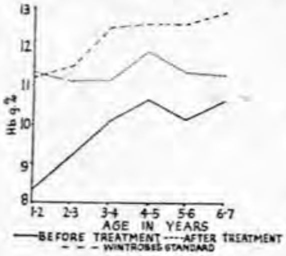
TABLE III. MEAN HAEMOGLOBIN LEVELS. MUNICIPAL CRÈCHES (POOLED) FOR CAPE COLOURED CHILDREN

Hb. g.%	*Age in years* 1-2	2-3	3-4	4-5	5-6	6-7	*Total*
8·5– 9·5 ..	1	1	–	–	–	–	2
9·5–10·5 ..	3	2	1	–	2	–	8
10·5–11·5 ..	4	3	3	6	3	3	22
11·5–12·5 ..	3	1	9	21	14	5	53
12·5–13·5 ..	–	1	1	7	14	1	24
13·5–14·5 ..	–	1	1	–	5	2	9
Total cases ..	11	9	15	34	38	11	118
Average Hb. g.%	10·72	11·06	11·80	11·97	12·40	12·13	
St. deviation ..	±0·85	±1·31	±0·98	±0·61	±0·96	±0·94	
Wintrobe's standard g.%	11·2	11·5	12·5	12·6	12·6	12·9	

TABLE IV. MEAN HAEMOGLOBIN LEVELS. MUNICIPAL CRÈCHE FOR AFRICAN CHILDREN (LANGA)

Hb. g.%	*Age in years* 1-2	2-3	3-4	4-5	5-6	6-7	*Total*
5·5– 6·5 ..	1	–	–	–	–	–	1
6·5– 7·5 ..	–	–	–	–	–	–	–
7·5– 8·5 ..	2	2	–	–	–	–	4
8·5– 9·5 ..	2	5	1	1	1	–	10
9·5–10·5 ..	3	2	8	1	1	–	15
10·5–11·5 ..	2	1	7	3	–	–	13
11·5–12·5 ..	4	6	6	3	2	1	22
12·5–13·5 ..	1	1	–	1	–	–	3
13·5–14·5 ..	–	–	–	1	–	–	1
Total cases ..	15	17	22	10	4	1	69
Average Hb. g.%	10·02	10·30	10·77	11·66	10·80	12·40	
St. deviation ..	±1·84	±1·67	±0·96	±1·28	±0·51	—	
Wintrobe's standard g.%	11·2	11·5	12·5	12·6	12·6	12·9	

The children at the non-municipal crèche (Board of Aid) were treated with 0·28 g. (4·5 gr.) of ferrous gluconate (Ferlucon) in 3 divided doses daily for 24 days. The results of treatment, reflected in Fig. 3 and the accompanying Table V, show a statistically significant rise in the haemo-



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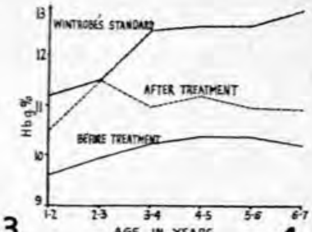

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Fig. 3. Non-municipal crèche for Cape Coloured children (Board of Aid). Treatment with 0·28 g. (4·5 gr.) of ferrous gluconate (Ferlucon) daily for 24 days.
Fig. 4. Non-municipal crèche for Cape Coloured children (Windermere). Treatment with 2 ml. (30 min.) colloidal iron (Colliron) daily for 18 days.

TABLE V. NON-MUNICIPAL CRÈCHE FOR CAPE COLOURED CHILDREN (BOARD OF AID)

Age in years	*Av. Hb. g.% before treatment*	*Av. Hb. g.% after treatment*	*No. of cases*	*Significance p*
1–2	8·32	11·32	6	$<0·001$
2–3	9·22	11·13	9	$<0·01$
3–4	10·10	11·14	14	$<0·002$
4–5	10·65	11·90	12	$<0·001$
5–6	10·15	11·37	4	} $<0·002$
6–7	10·62	11·30	5	
Total cases ..			50	

Treatment with 0·28 g. (4·5 gr.) ferrous gluconate (Ferlucon) daily for 24 days
All cases combined: $p < 0·001$ i.e. highly significant.

globin level of the various age groups, some of which were combined for statistical analysis because of paucity of numbers. The children at the non-municipal crèche (Windermere) were treated with 2 ml. (30 min.) of colloidal iron (Colliron) in 3 divided doses daily for 18 days. The results

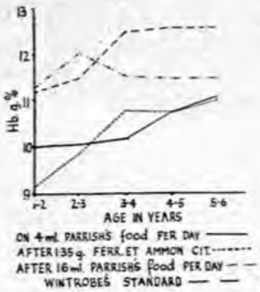
TABLE VI. NON-MUNICIPAL CRÈCHE FOR CAPE COLOURED CHILDREN (WINDERMERE)

Age in years	*Av. Hb. g.% before treatment*	*Av. Hb. g.% after treatment*	*No. of cases*	*Significance p*
1–2	9·60	10·50	1	
2–3	9·95	11·50	1	} $<0·01$
3–4	10·22	10·99	5	
4–5	10·37	11·17	5	$<0·05$
5–6	10·37	10·96	8	} $<0·02$
6–7	10·20	10·94	4	
Total cases ..			24	

Treatment with 2 ml. (30 min.) colloidal iron (Colliron) daily for 18 days.
All cases combined: $p < 0·001$ i.e. highly significant.

(Fig. 4 and Table VI) once again show a statistically significant rise in the haemoglobin level in various age groups.

It was decided to treat the Coloured children in the pooled municipal crèches, who had been receiving the customary 4 ml. (60 min.) of Parrish's food daily for close on a year, with an increased dose, and twice the maximum B.P.C. dose 16 ml. (240 min.) was given in divided doses daily for 24 days. Repeat haemoglobin estimations at this stage did not show any significant change. Subsequently, Ferr. et Ammon. Cit. 1·35 g. (22·5 gr.) daily was given for 24 days and the haemoglobin levels showed a statistically significant rise (Fig. 5 and Table VII). The children at the municipal crèche for Africans (Langa) were given Ferr. et Ammon. Cit. in the same dosage and again a statistically significant rise in



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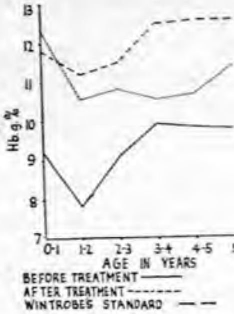

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Fig. 5. Municipal crèches (pooled) for Cape Coloured children. Treatment with 16 ml. (240 min.) Parrish's food per day for 24 days followed by 1·35 g. (22·5 gr.) Ferr. et Ammon, Cit. per day for 24 days.

Fig. 6. Municipal crèche for African children (Langa). Treatment with 1·35 g. (22·5 gr.) Ferr. et Ammon. Cit. daily for 24 days.

haemoglobin levels in the various age groups was demonstrated (Fig. 6 and Table VIII).

TABLE VII. MUNICIPAL CRÈCHES (POOLED) FOR CAPE COLOURED CHILDREN

Treatment with 16 ml. (240 min.) Parrish's food daily for 24 days, followed by 1·35 g. (22·5 gr.) Ferr. et Ammon. Cit. daily for 24 days.

Age in years	*Av. Hb. g.% on 4 ml. (60 min.) Parrish's food per day for 1 year*	*Av. Hb. g.% after 16 ml. (240 min.) Parrish's food per day for 24 days*	*No. of cases*	*Significance p*	*Av. Hb. g.% after 1·35 g. (22·5 gr.) Ferr. et Ammon. cit. daily for 24 days*	*No. of Cases*	*Significance p*
1–2	10·00	9·16	5		11·30	5	<0·01
2–3	10·08	9·90	4		12·03	4	<0·01
3–4	10·20	10·80	2	>0·05	11·55	2	
4–5	10·77	10·77	3		11·50	3	<0·02
5–6	11·10	11·03	8		11·51	7	
Total Cases ..			22			21	
All cases combined: $p<0{\cdot}05$ i.e. not significant.					All cases combined: $p<0{\cdot}001$ i.e. highly significant.		

13·8 g. of haemoglobin, found that the average haemoglobin in 132 Bantu school children on the rand was 97·48% and concluded that the average Bantu school child does not suffer from anaemia. Brock *et al.*,[3] in the Findings of the Cape Nutritional Survey, found 6·2% of Coloured school children and 3·1% of Bantu school children had a low level of haemoglobin. Le Riche[4] found that 2·5% of African children between 6 and 16 years on the Witwatersrand had a haemoglobin level below 12 g. and Kark and Le Riche,[5] using the 'Sicca' haemometer, found that the mean haemoglobin level of Bantu school children was 88·4% in boys and 87·75% in girls. In the present survey of pre-school-going children the incidence of anaemia was 64·9% for Coloured children and 66·7% for African children (Table IX).

TABLE IX. INCIDENCE OF ANAEMIA IN CAPE COLOURED AND AFRICAN CHILDREN

	Cape Coloured	*African*
Total Cases	262	69
No. Anaemic	170	46
Anaemic	64·9	66·7

TABLE VIII. MUNICIPAL CRÈCHE FOR AFRICAN CHILDREN (LANGA)

Age in years	*Av. Hb. g.% before treatment*	*Av. Hb. g.% after treatment*	*No. of cases*	*Significance p*
0–1	9·20	12·30	2	<0·001
1–2	7·83	10·58	4	
2–3	9·10	10·84	9	<0·001
3–4	9·94	10·59	7	
4–5	9·85	10·70	2	<0·01
5–6	9·80	11·40	1	
Total cases ..			25	

Treatment with 1·35 g. (22·5 gr.) Ferr. et Ammon. Cit. daily for 24 days. All cases combined: $p < 0{\cdot}001$ i.e. highly significant.

DISCUSSION

So far as we are aware no previous report has been published on the incidence of iron-deficiency anaemia in non-European children of the pre-school-going age in South Africa. The few references available deal with the incidence of iron deficiency anaemia in school-going children. Murray,[1] using the Tallqvist method, showed that the average haemoglobin in 543 poor-White children in a malarial area of the Northern Transvaal was 69·1%. Gear,[2] using a neoplasm haemometer in the scales of which 100% corresponds to

Several similar surveys in young children have been conducted elsewhere. Davidson *et al.*[7] showed that in the poorer classes of North East Scotland 41% of infants under 2 years and 32% of pre-school-going children were anaemic which they attributed to poor nutrition. Osgood and Baker,[8] in Portland, Oregon, found that in children between 4 and 13 years the haemoglobin ranged between 10 and 14 g. Colver[9] found that the average child under 3 years in South London was anaemic in relation to the 'iron standard', but that after 5 years the level lay in the limits of the 'iron standard'. MacKay[10, 11] established widespread existence of nutritional anaemia in breast-fed and bottle-fed infants in London.

From our results it would appear that iron deficiency is prevalent in pre-school-going Coloured and African children although it may not always be apparent. That this is not generally appreciated, is abundantly clear and we were, ourselves, surprised at the results. It is also evident that whereas most clinics, crèches and physicians prescribe vitamin preparations as a routine, iron therapy is far less widely prescribed although it is cheap and easily administered.

The importance of maintaining an optimal haemoglobin level has been stressed by MacKay[12] who showed that routine iron medication in infants raised the resistance to infection and greatly reduced the morbidity rate. This is an especially important consideration in a non-European community where such factors as undernutrition, overcrowding and poor living conditions tend to increase the morbidity rate.

The object of treatment must be to provide iron in an available form and in adequate amounts to prevent or correct the deficiency. All the preparations used in this survey, with the exception of Parrish's food, were effective in raising the haemoglobin levels to a greater or lesser extent. It is to be clearly understood that no attempt was made to raise the haemoglobin to levels comparable with those of Wintrobe. The object of treatment was merely to demonstrate the children's ability to respond to iron therapy. For various reasons treatment was carried on for only a short while and it is obvious that the treated groups, although showing a significant rise, had not reached acceptable 'normal' levels. No untoward effects necessitating cessation of therapy were observed in any of the cases.

There are several practical points which are important to physicians in prescribing iron medication for children such as those in this study. The cost, bulk, time of administration, the availability of adjuvant substances, or the presence of antagonists, are the main ones. The briefest of comments is therefore offered along these lines.

Iron medication must be given in frequent doses since only a small percentage of any dose can be absorbed and small doses reduce gastro-intestinal tract disturbances. Iron should be administered between meals. McCance *et al.*[13] have shown that phosphorus-containing phytates and phosphates combine with iron to form an insoluble unabsorbable salt. Medicinal iron should, therefore, be given when the upper gastro-intestinal tract is relatively free of those materials. Milk and milk products contain large amounts of phosphates, and contrary to common belief, are not good vehicles for iron medication. The phosphate content in Parrish's food, apart from the relatively low iron content of this preparation, may, in our opinion, contribute to the poor results achieved with it.

Diets containing vitamin C greatly increase iron absorption through the capacity of the vitamin C to maintain iron in the reduced state.[14] This has been demonstrated by observations on absorption of iron from foods tagged with radioactive iron.[15] Citrus fruit juices are ideal vehicles for giving iron to infants because they not only disguise the metallic taste of iron, but their ascorbic acid enhances its absorption.[16]

Where iron-deficiency anaemia is the reason for therapy or where prophylactic iron is indicated, iron should be administered and compound haematinic preparations should be avoided. These latter are expensive, wasteful, irrational and confuse further blood studies.

SUMMARY

Haemoglobin levels of healthy pre-school-going Coloured and African children attending local crèches were estimated. Of the 262 Cape Coloured and 69 African children examined 170 and 46, respectively, were deemed to be anaemic.

This study was not intended to compare the efficiency of one preparation of iron with another. It does, however, show that an inexpensive and simple salt, Ferr. et Ammon. Cit., in a dose of 1·35 g. (22·5 gr.) daily, was an efficient haematinic for these children. Ferrous gluconate and colloidal iron were also effective, whereas Parrish's food, even in massive doses, was ineffective.

A plea for more extensive prophylactic and therapeutic iron therapy is made.

We are indebted to Prof. F. J. Ford, Prof. J. G. Thomson, Dr. C. Merskey and Dr. J. D. L. Hansen for their helpful criticism and advice, also to Mr. J. N. Darroch for help with the statistical analysis. We would like to thank Dr. C. Robertson for her co-operation and permission to use the municipal crèches for these studies, the Board of Aid and Union of Jewish Women for permission to use their crèches, Evan's laboratory for their supply of Ferlucon and Colliron, Miss D. Barker, social worker, Red Cross War Memorial Children's Hospital, for arranging visits to the crèches, Mr. B. Todt for the photography and Miss D. Mendicoff for the illustrations and Mr. T. Norcott for technical assistance. We would also like to thank Dr. J. F. W. Mostert, Medical Superintendent, Red Cross War Memorial Children's Hospital, for permission to publish this work.

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