HAEMATOLOGICAL FINDINGS IN NON-WHITE SICK CHILDREN IN CAPETOWN

BY

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Previous investigations revealed the common occurrence of iron-deficiency anaemia in apparently healthy infants and pre-school children in the three main racial groups in Capetown (Lanzkowsky, 1959a, 1960, 1961). Treatment of these subjects with various oral iron preparations was followed by a significant rise in haemoglobin level (Lanzkowsky and McKenzie, 1959). Routine haemoglobin estimations of sick infants and children had revealed the frequent occurrence of low levels, and in view of the previous findings in healthy children it appeared important to determine haematological values in a series of these ill subjects.

Material

Haemoglobin estimations were done on 849 consecutive non-white infants and children attending the out-patient department of the Red Cross War Memorial Children's Hospital. Of these, 501 were Cape Coloureds and 348 were Africans.* Their ages ranged from 1 week to 6 years. As comparatively few white patients attend the hospital they were not included in this investigation.

Blood smears were examined and packed cell volumes (P.C.V.) and mean corpuscular haemoglobin concentration (M.C.H.C.) values determined in 100 of these patients, whose haemoglobin levels were found to be 0.5 g./100 ml. below the lowest figure accepted by Wintrobe (1956) as normal for each age-group.

The mean weekly family income was £4.12 in the case of Cape Coloured patients and £3.16 for African patients. These figures indicate that the Cape Coloured infants and children were from the "low-income" group and the Africans from the "medium-income" group in their respective sections of the community (Bronte-Stewart *et al.*, 1955; A. D. Moodie, 1959, personal communication).

In a sample of 332 of these out-patients 50.3% of Cape Coloured and 41.3% of African infants and children had been breast-fed for less than three months after birth. This is a much higher proportion than was found in healthy children in this community (Lanzkowsky, 1959a, 1960). In general all these patients had a poor dietary history.

The subjects for this study were taken seriatim from those attending the out-patient department for various ailments. Any patient who showed clinical signs of dehydration or who had a blood dyscrasia was excluded. They did not present primarily as cases of anaemia, and none had received iron other than that present in their usual diet. The majority of illnesses were acute and of not more than a few days' standing when the patient was brought to hospital. Table I details the diagnoses made in these infants and children.

*The Cape Coloured people are of mixed ethnic origin and the Africans consist of various tribes of indigenous groups of Southern Bantu. These people have a socio-economic status very much inferior to that of the white people.

Iron-deficiency anaemia in these cases was usually an incidental finding. Closer inquiry into the histories of these cases revealed four symptoms, present prior to the onset of the presenting illness, which could be attributed primarily to the presence of iron-deficiency anaemia. These were pallor, irritability, anorexia, and lassitude. Pallor of the mucosae was almost always present when the haemoglobin level was low. When the haemoglobin level was above 7 g./100 ml. the clinical assessment of anaemia on this criterion alone was often erroneous and could not be relied upon for the detection of anaemia. Anorexia, irritability, and decreased physical activity were found to be the commonest symptoms in those infants and children who were

TABLE I.—Presenting Conditions of 849 Cape Coloured and African Infants and Pre-school Children Investigated

Diagnosis	Cape Coloured	African	Total
No organic disease (behaviour disorders, crying at night, etc.)	37	30	67
Cardiovascular Disorders:			
Congenital heart disease	3	1	4
Rheumatic fever	1	0	1
Deficiency Diseases:			
Kwashiorkor	9	2	11
Marasmus	29	11	40
Rickets	7	16	23
Disorders of Eye, Ear, Nose, and Throat:			
Phlyctenular conjunctivitis	2	3	5
Otitis media	17	20	37
Tonsillitis	6	6	12
Gastro-Intestinal Disorders:			
Feeding problems	9	2	11
Gastroenteritis	159	127	286
Helminthiasis	15	6	21
Herpetic stomatitis	7	2	9
Infective hepatitis	1	0	1
Thrush	1	6	7
Infectious Diseases:			
Chicken-pox	2	3	5
Measles	5	7	12
Mumps	1	0	1
Whooping-cough	16	4	20
Neurological Disorders:			
Birth injury	1	0	1
Convulsions (febrile)	4	1	5
Mental deficiency	3	0	3
Respiratory Diseases:			
Bronchitis (with or without broncho-spasm)	45	28	73
Bronchopneumonia	2	2	4
Coryza	58	33	91
Pneumonia	13	8	21
Tuberculosis	7	5	12
Skin Diseases:			
Allergic	9	14	23
Infection	25	10	35
Parasitic	7	1	8
Totals	501	348	849

subsequently shown to have an iron-deficiency anaemia. In several patients, although the haemoglobin level was very low, there was no symptom which could be related to a deficit of iron.

Splenomegaly was occasionally found, but any associated systemic infection often causes splenomegaly in infants and children.

Methods.—Haemoglobin estimations were done on capillary blood by the oxyhaemoglobin method using a Klett-Summerson colorimeter previously calibrated against standard haemin and cyanmethaemoglobin solutions. P.C.V. determinations were made on venous blood by the standard Wintrobe (1929) procedure. Blood smears were stained by May-Grünwald-Giemsa method.

Results

The mean haemoglobin levels of sick Cape Coloured and African infants and pre-school children are shown in Table II. It reveals that the mean haemoglobin levels in the ill African infants and pre-school children in most age periods are higher than those groups in the Cape Coloured.

TABLE II.—Comparison of Mean Haemoglobin Levels in Sick Cape Coloured and African Infants and Pre-school Children

Age	Cape Coloured			African		
	No. of Cases	S.D.	Mean Hb (g./100 ml.)	Mean Hb (g./100 ml.)	S.D.	No. of Cases
<i>Infants under 1 year of age</i>						
1-1 month ..	17	3.06	14.44	14.25	—	2
1-2 months ..	28	2.44	11.42	11.35	3.93	13
2-3 months ..	28	1.23	9.88	10.57	0.95	17
3-4 months ..	45	1.22	9.99	10.37	1.40	31
4-5 months ..	35	1.43	10.19	10.54	1.45	30
5-6 months ..	33	1.51	9.97	10.38	1.02	12
6-7 months ..	33	1.61	10.27	9.94	1.04	16
7-8 months ..	36	1.75	10.05	9.97	1.47	27
8-9 months ..	25	1.55	9.79	9.96	1.63	16
9-10 months ..	27	2.11	9.43	9.74	1.27	11
10-11 months ..	22	2.13	9.47	9.34	2.03	24
11-12 months ..	28	1.67	9.14	9.82	1.88	14
<i>Children 1 to 6 years of age</i>						
1-year ..	49	1.98	8.81	9.47	1.83	46
2-years ..	29	1.58	9.37	9.42	2.09	25
3-years ..	11	1.44	9.99	11.01	1.44	21
4-years ..	15	1.23	10.71	10.82	1.00	18
5-years ..	20	1.96	10.66	11.00	0.84	12
6-years ..	20	1.31	10.73	11.39	1.24	13

TABLE III.—Comparison of Mean Haemoglobin Levels in Cape Coloured and African Infants and Pre-school Children in Apparent Health and in Illness

Age	Cape Coloured		African	
	Ill Hb (g./100 ml.)	Healthy Hb (g./100 ml.)	Ill Hb (g./100 ml.)	Healthy Hb (g./100 ml.)
<i>Infants under 1 year of age</i>				
First month ..	14.44	14.44	14.25	14.85
1-2 months ..	11.42	12.10	11.35	12.15
2-3 months ..	9.88	10.45	10.57	11.10
3-4 months ..	9.99	10.27	10.37	10.83
4-5 months ..	10.19	10.35	10.54	10.82
5-6 months ..	9.97	10.75	10.38	10.57
6-7 months ..	10.27	10.35	9.94	10.29
7-8 months ..	10.05	10.14	9.97	10.40
8-9 months ..	9.79	9.72	9.96	10.03
9-10 months ..	9.43	9.80	9.74	10.15
10-11 months ..	9.47	9.81	9.34	9.87
11-12 months ..	9.14	9.57	9.82	9.84
<i>Children 1 to 6 years of age</i>				
1-year ..	8.81	9.31	9.47	9.76
2-years ..	9.37	10.13	9.42	10.61
3-years ..	9.99	10.59	11.01	10.63
4-years ..	10.71	11.00	10.82	11.12
5-years ..	10.66	11.03	11.00	11.18
6-years ..	10.73	11.19	11.39	11.82

TABLE V.—Mean Haemoglobin, P.C.V., and M.C.H.C. Values in 100 Sick Cape Coloured and African Infants and Children

	Mean Value	Range	Standard Deviation
Hb (g./100 ml.) ..	8.35	2.3-10.9	1.76
P.C.V. (%) ..	31.35	8-45	6.56
M.C.H.C. (%) ..	26.30	17-31	2.79

TABLE IV.—Details of Red Blood Cell Morphology and Correlation with Haemoglobin Ranges in 100 Sick Cape Coloured and African Infants and Children

Hb Range (g./100 ml.)	No. of Cases	Normal R.B.C.s	Hypochromasia				Anisocytosis				Poikilocytosis			Polychromasia		Target Cells (Occasional)	Basophilic Stippling (Occasional)
			Sl.	+	++	+++	Sl.	+	++	+++	Sl.	+	++	Sl.	++		
2.0-2.9	1	—	—	—	—	1	—	1	—	—	—	1	—	1	—	—	—
3.0-3.9	1	—	—	—	—	1	—	2	—	1	—	2	—	2	—	1	—
4.0-4.9	5	—	—	1	3	1	—	2	—	1	—	1	—	2	—	—	—
5.0-5.9	2	—	—	—	1	1	—	1	—	—	—	2	—	1	—	—	—
6.0-6.9	6	1	—	1	2	1	—	2	—	1	—	2	—	2	—	1	—
7.0-7.9	24	—	4	6	9	3	—	6	9	4	1	1	2	3	—	3	—
8.0-8.9	17	—	6	5	4	—	—	9	2	—	1	—	1	2	—	1	2
9.0-9.9	36	12	16	3	3	—	—	7	2	—	—	3	1	—	—	—	1
10.0-10.9	6	3	1	2	—	—	—	1	—	—	—	—	—	—	—	—	—
11.0-11.9	2	1	1	—	—	—	—	—	—	—	—	—	—	—	—	1	—
Total	100	17	28	18	22	8	26	19	6	4	5	9	3	10	1	6	4
			76				55				17			11			

Sl. = slight.

Table III shows that the mean haemoglobin levels in the ill infants and pre-school children are lower than the values determined for apparently healthy infants and pre-school children (Lanzkowsky, 1959a, 1960, 1961).

Table IV shows the details of the 100 blood smears examined. The blood smears were assessed without knowledge of the exact haemoglobin value, and the Table shows the correlation between the iron-deficiency features of the smears and the corresponding haemoglobin levels. It will be seen that the lower the haemoglobin value the more likely was the smear to reveal the features of iron-deficiency anaemia.

The P.C.V. and M.C.H.C. values are shown in Table V. The low M.C.H.C. in each case confirmed the presence of iron-deficiency anaemia in every infant and child in this group.

Discussion

It was fairly clear in the early stages of this investigation that the mean haemoglobin levels of these non-white infants and children attending the out-patient department were much below the generally accepted normal levels for their age and below the mean haemoglobin levels for apparently healthy non-white infants and pre-school children.

A review of the literature failed to reveal any comparable investigation on infants and children in South Africa, and only a few surveys in other countries were found.

Guest *et al.* (1938) reported on 615 white infants and children, but in their analyses of haemoglobin levels they failed to distinguish between healthy and sick cases. For this reason, no conclusions relative to the present investigation can be drawn from their findings. Somerford (1938) found that 100 out of 179 debilitated children attending the out-patient department of the Royal Manchester Children's Hospital were anaemic. Her criteria for anaemia were a red-cell count of 4,000,000/c.mm. or less, and a haemoglobin level of under 70% on the Haldane scale. She made the surprising observation that children who were in better economic circumstances were more affected than those of poorer families.

Despite the fact that the mean haemoglobin levels of the infants and children in the present investigation were low and that the levels in some cases were very low, none of the 849 patients was brought to hospital primarily for symptoms which could be directly

attributed to the anaemia. On close questioning, most parents admitted that anorexia and decrease of physical activity had manifested, to a greater or less degree, before the onset of the illness which brought the children under observation. The mothers sought advice in most cases on account of infection. Of the 849 patients, 633 had infection. Histories of ascariasis were obtained in 21% of the Cape Coloured and 22% of the African patients.

The explanation of parental failure to seek medical attention for the anaemia almost certainly lies in the insidious nature of its onset and its slow progress. The absence of obvious signs and symptoms in these young children is attributable to the remarkable ability of the body to adjust itself to very low levels of haemoglobin. The physician often fails to recognize the condition, probably because his attention is focused on the presenting infection.

The symptoms of anaemia are usually recognized in retrospect by the parents after treatment has been instituted. Pallor, poor appetite, and decreased physical activity are often found in anaemic infants and children. Anorexia leads to the establishment of a vicious cycle in which the deficiency of iron is accentuated by a further reduction in dietary intake. Depraved appetite as seen in pica is less commonly reported, but it is of more significance than has been realized in the past (Lanzkowsky, 1959b).

In considering factors which may have contributed to the pathogenesis of the low haemoglobin levels which were found in infants and children in the present investigation, mention must be made of the influence of socio-economic status and the possible role of infection in these patients.

All the reports in the literature dealing with the question of the relationship between socio-economic status and haemoglobin level in healthy subjects conclude that low economic circumstances are associated with a lowered haemoglobin level (Fullerton, 1936; McCance *et al.*, 1938; Committee on Haemoglobin Surveys, 1945; Berry *et al.*, 1952). In the only report found on ill children, Somerford (1938) stated that the socio-economic status does not appear to influence the haemoglobin level. In the present series of ill infants and children the majority, who were Cape Coloured, came from the lowest-income group of their community. The correlation between socio-economic status and haemoglobin level was not investigated further.

Over the years many theories have been advanced on the pathogenesis of the anaemia associated with chronic infection. It appears most likely to be due to the result of impaired erythropoiesis and shortened survival of red blood corpuscles. Contributory influences may be: unusual affinity of reacting tissues for iron, direct blood loss into the inflamed area, and anorexia followed by inadequate intake of haemopoietic substances and impaired gastro-intestinal absorption of these substances during the illness (Wolman, 1957). In most instances infections of less than a month's duration are not accompanied by a significant anaemia (Wintrobe, 1956).

Lahey (1957) doubts whether infection *per se* in children causes anaemia but favours the view that it aggravates a pre-existing iron-deficiency state. Even if this limitation is accepted, repeated infections must have a cumulative effect which will sooner or later be significant. It is common knowledge that non-whites in Cape-town are often infected in infancy. Iron-deficiency

anaemia has been shown to occur in a high percentage of non-white infants and children. The facts revealed by the present work fit in very well with Lahey's concept. Furthermore, the custom, now apparently obsolete, of medical practitioners prescribing iron therapy routinely for the convalescent patients might well be revived to the advantage of such infants and children.

Summary

There have been no previous reports of investigations on haemoglobin levels in sick infants and pre-school children in South Africa and only very few publications of such studies in other countries.

Haemoglobin levels were determined on 849 non-white infants and children taken seriatim from those attending the out-patient department of the Red Cross War Memorial Children's Hospital. The mean haemoglobin values were found to be even lower than the mean values in apparently healthy infants and pre-school children in Capetown, among whom the occurrence of low haemoglobin levels has already been demonstrated. The mean levels in the Cape Coloureds were lower than in the Africans in almost all age groups. M.C.H.C. values determined in 100 cases in the series confirmed the presence of an iron-deficiency anaemia in every infant and child of this group.

The fact that none of the cases presented symptoms of anaemia despite the low haemoglobin levels emphasizes the insidious nature of onset and the slow progress of iron-deficiency anaemia in infants and children. After treatment parents appreciated that symptoms of anaemia had been present prior to treatment.

The roles of socio-economic status and infection in the aetiology and pathogenesis of iron-deficiency anaemia in these subjects are discussed.

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