Anaemia in the Poor-law Classes of Glasgow.

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PREFACE.

The investigation owes its initiation to Professor Noah Morris, whose constant helpful criticism and suggestions have been greatly appreciated. The writer is grateful to the Staff at the Biochemical Department, Stobhill Hospital for help and advice in the biochemical work. To Dr. R.A. Robb, Mathematical Department, Glasgow University, for his help in the Statistical work the writer is deeply indebted.

INTRODUCTION AND AIM OF INVESTIGATION.

Iron deficiency anaemia of the poorer classes has been investigated by various workers in different areas of Britain. Some have investigated the incidence in infants and young children, others in adults. The extensive researches of Mackay (23) (1928, 1931, and 1933b) have shown how prevalent this type of anaemia is in infants of the hospital class in London. Hutchison (15) (1938) found a similar condition occurred in the poorer infants of an industrial district of Glasgow. Somerford (34) (1938) in Manchester and Davidson and colleagues (3) (1933) in Aberdeen have shown that iron deficiency anaemia is prevalent in infants and young children of the poorer classes in their respective cities.

Iron deficiency anaemia, however, is not prevalent in poor children of school age. This is shown by the works of Davidson and colleagues (3) (1933), Osgood and Baker (27) (1935), and Somerford (34) (1938). Whitby and Britton (38) (1939) are of the opinion that the vast majority of anaemias, at this period, are symptomatic. At this age the vaso-motor system appears to be peculiarly sensitive so that anaemia is more apparent than real. They state, however, that the endocrine disturbances and the increased iron requirements associated with puberty, especially the onset of the menstrual function in girls, may contribute to an anaemic state. Perkins (31) (1934) found that the blood count at this age shows a considerable seasonal variation for no apparent pathological cause. He is, however, of the opinion that anaemias occurring at this period are mostly associated with definite morbid processes.

Price-Jones, Vaughan and Goddard [32] (1935), Davidson and colleagues [3] (1933) found on examining adult males of the middle and poorer classes, that iron deficiency anaemia was not prevalent. In contrast to this however, it has been shown by Davidson and colleagues [3] (1933), Fullerton [10] (1936) and Somerford [34] (1938) that iron deficiency anaemia is very prevalent in adult females of the poorer classes throughout reproductive life.

The investigations here recorded were undertaken to determine the incidence of iron deficiency anaemia in the poor law classes of Glasgow.

All people examined were themselves receiving, or were included in families who were receiving, maintenance allowances from the Public Assistance Department or the Unemployment Assistance Board.

Haemoglobin estimations were made on infants and children attending a Child Welfare Clinic, school children attending for examination at School Clinics and persons of all ages attending the Outdoor Medical Service Clinics. People living in Model Lodging Houses, male and female, were also included, so also were others of this poor law class who lived alone.

Altogether 1,059 persons of all ages, above six months, were examined in the investigation. They were not selected because anaemia was suspected, and the majority were apparently in good health. Those who were complaining were suffering from some minor ailment. None of them had received any iron additions to the diet.

A clinical history was obtained from all people examined. In the case of children the history was taken from the guardian. From women information was obtained regarding menstruation and pregnancies.

The method used for the estimation of the haemoglobin was the same in each individual case. The sample of blood was taken from the ball of the thumb which was pricked by a Hagedorn needle. The acid haematin method of Sahli was used for the estimation. The haemoglobinometer was calibrated so that a reading of 100 per cent was equivalent to 17·3 grams of haemoglobin per 100 c.cm. of blood, and the instrument was repeatedly checked for its accuracy.

The normal figures used for comparison are those of Mackay[25] (1933) for infants and young children, Davidson and colleagues[4] (1935) for children 2 - 5 years, and those summarized by Whitby and Britton[38] (1939) for all other ages.

Mackay[25] (1933a) and Elvehjem, Duckles and Mendenhall[7] (1937) have shown that the amount of haemoglobin, from birth to six months varies in all infants no matter to which class they belong. Because of this natural variation of the haemoglobin level of young infants, the lowest age examined in this investigation was six months.

RESULTS.

EFFECT OF AGE.

The data have been arranged in Table (1), a and b according to the ages and sexes of the subjects examined.

Table (1)a.

Male.

Age Group	Number Examined	Haemoglobin Range	Mean Haemoglobin	Normal
6mths. - 1 yr.	25	46 - 71%	59%	70%
1 yr. - 4 yrs.	78	42 - 79%	65%	70 - 74%
5 yrs.-14 yrs.	74	61 - 90%	76%	74 - 80%
15yrs.-45 yrs.	153	55 - 98%	82%	82 - 95%
46yrs.-65 yrs.	85	66 - 97%	80%	80 - 90%
Over 65 yrs.	70	54 - 94%	78%	76 - 80%

(1)b.

Female.

Age Group	Number Examined	Haemoglobin Range	Mean Haemoglobin	Normal
6mths. - 1 yr.	25	38 - 72%	59%	70%
1 yr.- 4 yrs.	79	27 - 82%	65%	70 - 74%
5 yrs.-14 yrs.	70	63 - 85%	77%	74 - 80%
15yrs.-45 yrs.	243	43 - 96%	74%	80%
46yrs.-65 yrs.	92	49 - 94%	78%	80%
Over 65 yrs.	65	51 - 95%	79%	76 - 80%

In these tables are included the haemoglobin range of each group, the mean value of the group and the normal as given from figures in the literature.

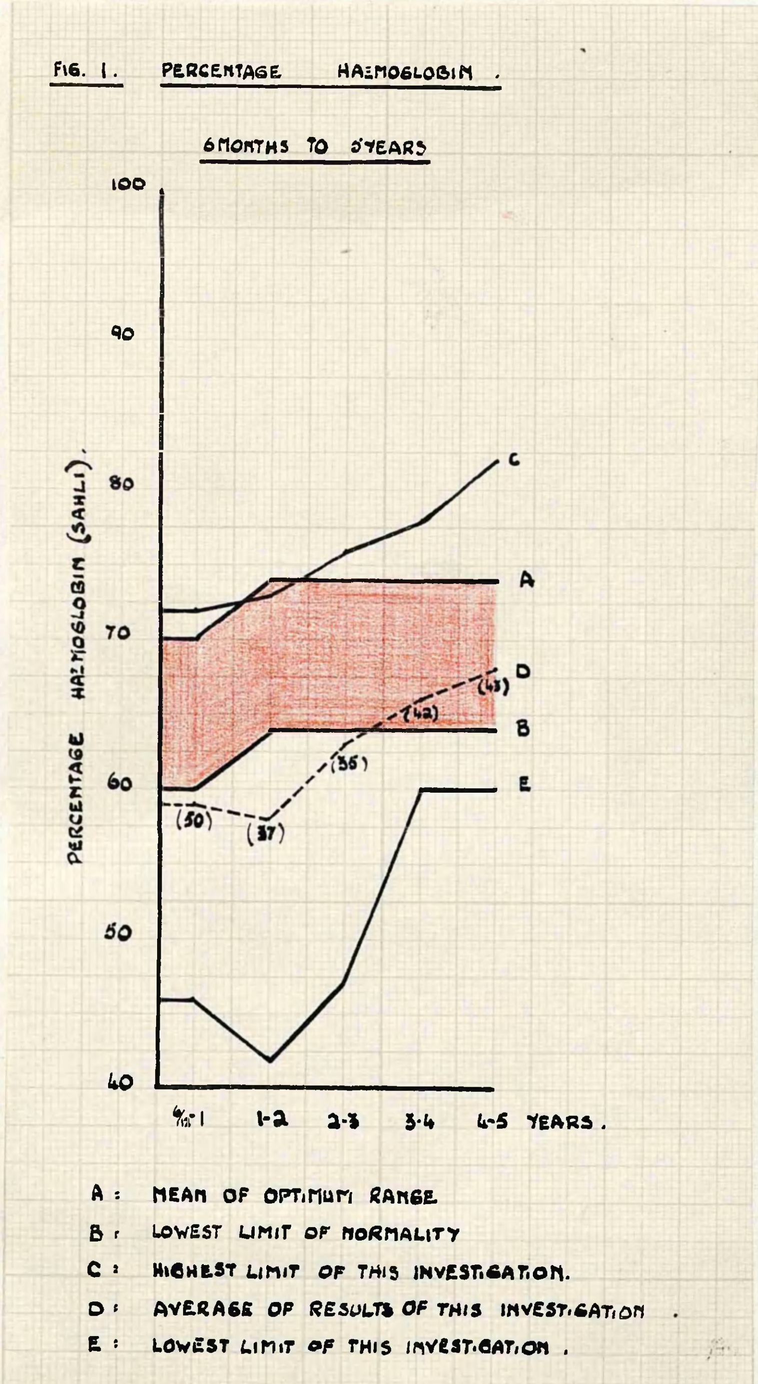
Examination of Age Groups.

In the first age group (6 mths. to 1 yr.) fifty infants were examined. The average haemoglobin figure was about 10 per cent below Mackay's normal for this age period. This result is similar to that of Fullerton[11] (1937) and also of Hutchison[15] (1938) who examined the haemoglobins of 300 infants of a similar class in another industrial district of Glasgow.

In the second age group (1 to 4 yrs.) the average haemoglobin figure had risen quite appreciably. The increase was not uniform however. It was lower, the average value being 58 per cent, during the second year of life than in between 6 months and 1 year. In children of 2 years however, it had again risen to 63 per cent, with a further slight increase in the average haemoglobin level in children of 3 and 4 years to 66 and 68 per cent respectively. There were no significant differences for sex within the first and second age groups.

Mackay[24] (1931) found that the average haemoglobin figure of babies of the hospital class is raised considerably by iron medication. The mean level attained was 70 per cent. This figure is thought to represent the optimum haemoglobin level in infancy, a variation of 10 per cent being regarded as within the limits of normality. In Fig(1) this optimum range and Davidson's corresponding standards adopted for the years 2 to 5 are indicated in the shaded area. A represents the mean of optimum range, B the lowest limit of normality and D the results of this inquiry of infants and children age six months to under five years. The figures at each point on curve D represents the number examined at each age period.

Fig (1).

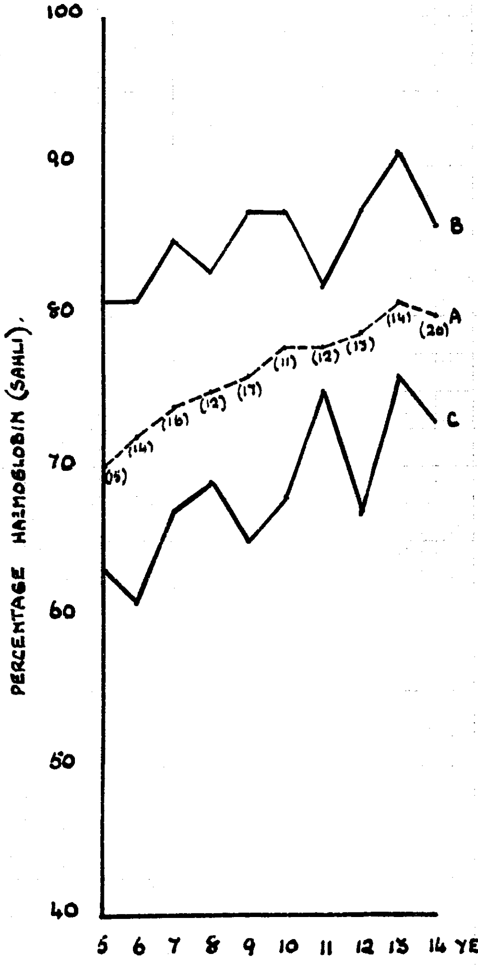


In relation to the lowest limit of normality, it is seen in Fig(1) that a child of this class, up to the age of 3 years is anaemic. After 4 years however, the level lies within the limits of normality, but just above its lower limit.

Fig (2).

FIG. 2. PERCENTAGE HAEMOGLOBIN.

5 TO 14 YEARS.



A: AVERAGE PERCENTAGE HAEMOGLOBIN AT EACH AGE PERIOD.

B: HIGHEST LIMIT, AT EACH AGE PERIOD, IN THIS INVESTIGATION.

C: LOWEST LIMIT, AT EACH AGE PERIOD, IN THIS INVESTIGATION.

In the <u>third age group</u> (5 to 14 yrs.) the average amount of haemoglobin was within normal limits. It was 76 per cent. There was again no significant differences for sex, but there was a tendency for the figure to rise slowly as age increased. At puberty the average haemoglobin had reached 80 per cent. The effects of age on the haemoglobin at this period is shown graphically in Fig(2). The figures at each point on curve D represents the number of children examined at each age.

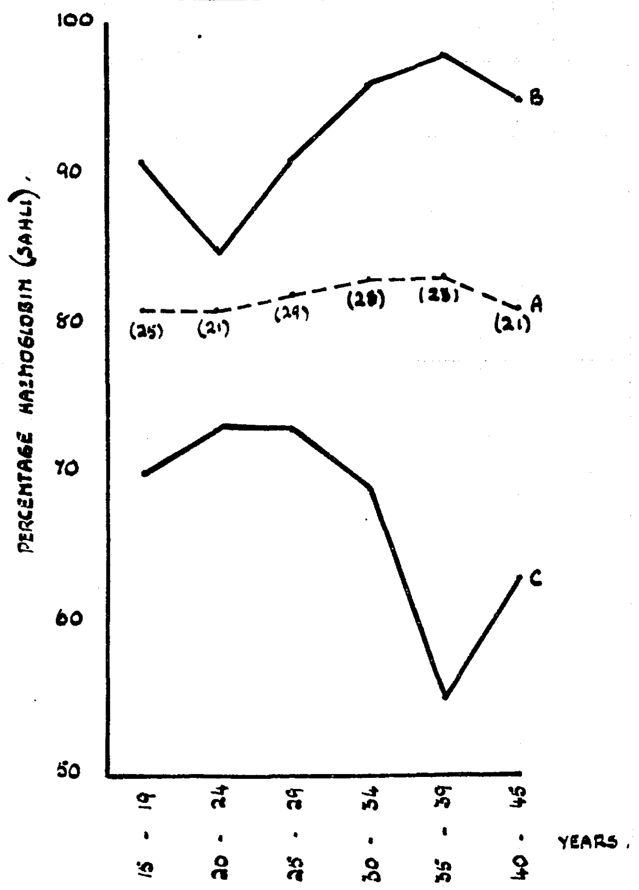
Somerford (34) (1938) examined the blood of 179 children who attended an out-patient department and whose ages varied from 2 months to 13 years, and stated that anaemia was much commoner in the first seven years of life than in the second seven. Davidson and colleagues (3) (1933) in an investigation on 750 children between the ages of 5 and 14 years, found that anaemia was conspicuous by its relative absence. Osgood and Baker (27) (1935) found on examining 112 boys and 103 girls, whose ages varied from 4 to 14 years, that the haemoglobin had a range from 10 to 14 grams per cent (58 to 82 per cent Sahli) with an average of 12 grams. The results obtained in the second and third age groups, in this investigation, are similar to the results found by these workers.

<u>Fourth age group</u> (15 to 45 yrs.) Three hundred and ninety six persons were examined in this group. Of these 153 were male and 243 female. Here there was a marked difference for the average haemoglobin levels for the two sexes.

Price-Jones, Vaughan and Goddard [32] (1935) found on examining 96 men of a middle class that the haemoglobin had a range from about 12·5 to 17 grams per cent (73 to 98 per cent).

Fig (3).

FIG. 3. PERCENTAGE HAEMOGLOBIN.
MALES.
15-45 YEARS



A : AVERAGE PERCENTAGE HAEMOGLOBIN AT EACH AGE PERIOD.

B : HIGHEST LIMIT, AT EACH AGE PERIOD, IN THIS INVESTIGATION.

C : LOWEST LIMIT, AT EACH AGE PERIOD, IN THIS INVESTIGATION.

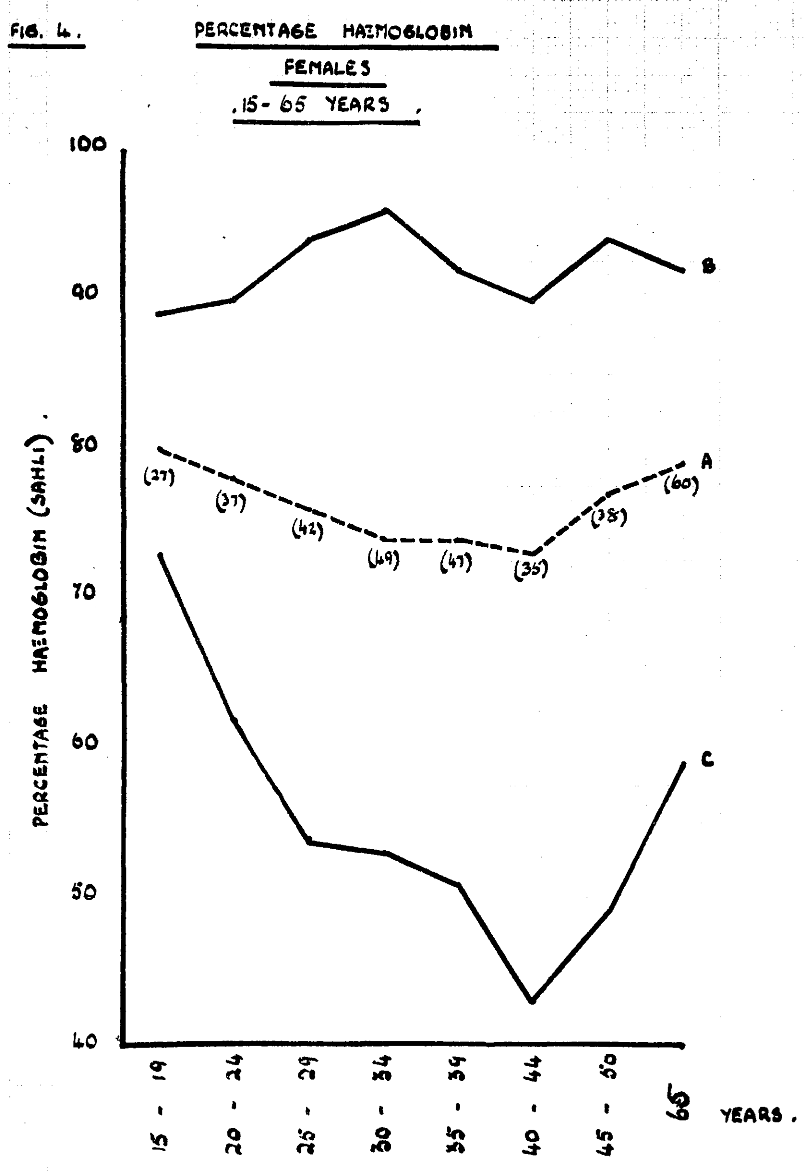
Only five of forty five males, of the poorer classes, examined by Davidson and colleagues [3] (1933) were found to be anaemic. In the present investigation similar results were found. The majority were within normal limits. Age appeared to have little effect at this period in males. The average haemoglobin at each age period was very similar. This is shown in graph form in Fig(3). The numbers at each point in curve A corresponds to the number examined at each age period.

In females however, a very different state was found. 59 per cent of the females of this group had a haemoglobin less than 80 per cent. The average for the whole group was 74 per cent.

Somerford [34] (1938) in examining the mothers in one hundred unemployed, poor and middle-class families, found that 45 per cent were suffering from anaemia. Of 455 adult females examined by Davidson and colleagues [3] (1933) mainly between the ages of 18 and 55 years, 213 (46·8 per cent) were anaemic. The majority of the women were of unemployed families. Fullerton [10] (1936) found that 52 per cent of 603 non pregnant women, mainly of the unemployed class, age 15 to 45 years were anaemic. It would seem that the average haemoglobin of women of this group, in this investigation is somewhat lower than that found by the above workers. It must be pointed out however, that the women examined by Somerford and Fullerton were not all of the unemployed class, while the ages of those examined by

Davidson and colleagues extended to 55 years, not 45 years as in this group.

Fig (4).



A: AVERAGE PERCENTAGE HAEMOGLOBIN, AT EACH AGE PERIOD, IN THIS INVESTIGATION.

B: HIGHEST LIMIT, AT EACH AGE PERIOD, IN THIS INVESTIGATION.

C: LOWEST LIMIT, AT EACH AGE PERIOD, IN THIS INVESTIGATION.

On examining this age group for women a little closer it was found that there was only a slight fall in the average haemoglobin figure, from that of normal, in the women of 15 to 20 years; but from that age there was a rapid fall in the average haemoglobin figure throughout reproductive life. In fact many of these women, especially between the ages of 30 and 44 years, are going about their everyday duties, apparently in good health, with no complaints, having a haemoglobin of 50 to 60 per cent.

In Fig(4) the effect of age on the incidence of anaemia in these women, is shown graphically. The figures at each point on curve A represents the number of women examined. On examining the graph, it is seen that the average haemoglobin figure falls from the age of 20 years to the menopause (45 yrs.). It then begins to rise and at the age of 65 years it has almost reached normality.

In the fifth age group (46 to 65 yrs.) the males, as seen in Table (1)a, had an average haemoglobin figure within normal limits.

The females of this group, as seen in Table (1)b, had a much better haemoglobin level than in the previous one. The figure was slightly below normal. Those below normal were mostly women whose ages ranged from 46 to 51 years. From that age however, the average figure improved. Davidson, Fullerton and Campbell [(4)] (1935) found in a series of investigations on women that there was quite a marked rise in the average haemoglobin level after the menopause.

In the sixth age group, that is in old age, there was practically no difference in the amount of haemoglobin for the two sexes. The averages of both, as shown in Table (1) a and b, were within normal limits.

Conclusion.

The results of this investigation indicate that anaemia, in this class of people, is relatively uncommon in children of school age, adult males, and women over the age of 50 years. It is prevalent however, in children under 4 years and very marked during the reproductive age in women.

ETIOLOGY.

The causative factors of this anaemia are here only considered in those groups where it was prevalent, viz. (1) Infants and young children and (2) Women between the ages of 20 and 44 years.

(1) Infants and Young Children.

Mackay [24] (1931) states that diverse views are held regarding the etiology of anaemia occurring in infants not obviously suffering from any other disease. It has been discussed under the name of "nutritional anaemia", "alimentary anaemia", "cow's milk anaemia" and simple anaemia of infancy. Mackay also states, quoting Baar and Stanskey (1923) that these anaemias show a similar blood picture, its most marked feature being the reduction in the haemoglobin percentage.

Duscussing the explanation of this anaemia we will consider:-

(a) Diet of child relative to iron intake.
(b) Predisposing factors in mothers.
(c) Birth weight and rate of growth.
(d) Infections.

(a) Diet of Child.

Tixier [36] (1911) although advocating iron treatment in anaemia of infancy and children, believed iron deficiency played a relatively small part in its production. Mackay [24] (1931) quotes Kleinshmidt as stating that iron therapy had no influence on the anaemia and attributed it to a toxic effect of milk, together with a congenital predisposition of unknown nature. Kleinschmidt recognised no anaemia in infants due to iron deficiency. Schwartz and Rosenthal (33) (1920) considered that iron deficiency could only partly account for this anaemia in infants. Josephs (18) (1934) found that there was a positive iron balance of about 6 milligrammes per month in bottle fed infants. Langstein and Edelstein (19) (1932) found a similar retention of iron in infants who were breast fed. Josephs concluded that an exclusive milk diet cannot cause anaemia, by its low iron content alone.

Hill (16) (1924) differed from these views and in his study of infantile anaemia concluded that when haemoglobin is insufficient it is due, most often, to lack of iron in the diet. Bunge (2) (1902) implies the possibility that infants fed over too long a period on milk will become anaemic after the iron store in the liver is used. Mackay, (24) (1931) after her thorough investigation on infants and young children, concluded that this anaemia of infancy is not due to any directly deleterious effect of cow's milk or of any of its constituents and believes that the etiological factor of primary importance is a deficiency of available iron.

It was found in the present series that of the fifty infants examined under one year, 16 were being breast fed, 7 had been breast fed and were changed to cow's milk or artificial milk foods and 27 had been fed on cow's milk or artificial foods since birth and were still being fed in this manner. Little difference was found in the haemoglobin level of infants fed in these three ways. All three averages were about 10 per cent below Mackay's normal.

Table (2).

	% Haemoglobin.		
Number Examined	Breast fed Infants.	Infants breast fed at beginning and changed to milk or artificial milk foods.	Infants fed with milk or artificial milk foods since birth.
1	63%	53%	38%
2	72%	61%	64%
3	57%	57%	61%
4	60%	65%	56%
5	67%	62%	54%
6	53%	59%	62%
7	64%	58%	50%
8	57%		57%
9	51%		67%
10	68%		57%
11	56%		63%
12	61%		58%
13	48%		71%
14	59%		54%
15	65%		52%
16	67%		60%
17			55%
18			61%
19			46%
20			65%
21			62%
22			56%
23			62%
24			63%
25			56%
26			59%
27			58%
Average	60%	59%	58%

In Table(2) the haemoglobin levels of the infants examined are tabulated in their respective columns according to how they were being fed. The average haemoglobin of each group is shown at the foot of the table. Most workers have found that the haemoglobin levels of breast fed infants are higher than those fed on cow's milk.

This table was examined statistically. Testing whether the averages obtained for the three groups differed significantly from each other, it was found by the analysis of variance that all three formed one homogeneous group. It must therefore be concluded that there is no significant difference in the three averages.

Table (3).

	% Haemoglobin.		
Number Examined	Breast fed since birth	Children fed with cow's milk or artificial milk foods.	Children fed with a mixed diet.
1	56%	62%	65%
2	65%	60%	58%
3	61%	58%	63%
4	53%	56%	62%
5	59%	61%	55%
6	55%	58%	56%
7	58%	66%	64%
8	56%	54%	60%
9	60%	56%	69%
10		55%	54%
11		60%	
12		65%	
13		62%	
14		60%	
15		53%	
16		57%	
17		58%	
18		27%	
Average	58%	57%	61%

Of the thirty seven children examined of one year old, 9 were still being breast fed, 18 were being fed with cow's milk or artificial infant foods and only 10 were being given small portions of the ordinary household meals. The haemoglobin levels of the 37 children are tabulated in their appropriate columns in Table(3). The average of each group is shown at the foot of the table. It is seen that the average haemoglobin of children receiving a more mixed diet is slightly higher than in the other two groups. This table however, was also examined statistically and it was found by the analysis of variance that all three groups form one homogeneous group. Thus there is no significant difference in the three averages.

It is known that infants are dependent on the store of iron in the liver at birth (Bunge [2] 1902) since infant feeding, whether human or cow's milk, does not provide the quantities of iron required for growth. Gladstone [12] (1932) found that the iron content in the liver increased till the age of two months and then diminished. At four months it had returned to birth level. He was of the opinion that haemolysis takes place until two or three months and then the stored iron is set free to form haemoglobin. This store is exhausted about the age of six months. If the infant after this age does not receive extras richer in iron than human or cow's milk, a deficiency of iron is likely to occur.

Few of the infants and children of one year in this series received any extras apart from a few who were occasionally given orange juice. It is seen that nine of the thirty seven children of one year were still being breast fed with no extras, and eighteen were still being given cow's milk or artificial infant foods.

This persistence of milk feeding in young children is very prevalent in this class. What extras they do get are mainly of a carbohydrate nature. Very few get a mixed diet containing an adequate amount of iron such as egg yolk, meat and green vegetables.

This prolongation of milk feeding is probably helped by the issue, from the clinics, of free milk to many of these children, especially to those who are underweight. Again, artificial infant foods can be purchased at the clinics at a reduced price by many of the mothers. They find it much cheaper and also easier to persist in feeding their infants and young children on milk diets rather than change to a mixed one.

Although the average haemoglobin figures of Tables (2) and (3) do not show a significant difference, nevertheless it would appear, from the results obtained when treating anaemic infants with iron, that inadequate feeding is a factor in the production of anaemia in this class of child. To illustrate this response to iron in anaemic infants, the results of three cases are here tabulated giving the initial haemoglobin of each and their subsequent haemoglobin estimates, taken every second week during treatment.

No.	Initial Haemoglobin	Weekly Haemoglobin Estimates.					
		2	4	6	8	10	12
1	54%	57%	60%	67%	69%	72%	
2	55%	60%	62%	69%	71%	74%	
3	53%	57%	65%	68%	70%	71%	

Each case was treated with iron and ammonium citrate. The initial dose was gr.¼ tid. this being added to the milk feeds. The dose was increased slowly until a maximum of gr.1½ tid. was being taken.

As seen in the above table, the anaemic state of the three children was quickly corrected by adding iron to the diet. In the course of about ten weeks the haemoglobin values were brought up to that of Mackay's optimum haemoglobin level in infancy.

It would thus appear that prolonged milk feeding and a slow commencement of a mixed diet are important etiological factors in the production of iron deficiency anaemia in this class of child.

(b) Predisposing factors in mothers.

Paxton (30) (1936) considered that infants born to anaemic mothers are unable to maintain a normal haemoglobin value during the first year of life. R.J. Gittins (Smallwood 1936) estimated the haemoglobin of two groups of women during pregnancy and after delivery, and the haemoglobin values of their infants were followed for the first six months of life. To one group of mothers grs.45 of iron and ammonium citrate were given daily for about three months before delivery. The other group of women received no iron. He found that infants born to the group of mothers receiving iron had a definitely higher haemoglobin value at each age period than those born to the mothers who had none.

Fullerton[11] (1937) examined the haemoglobin levels of 167 mothers and their infants age 9 to 16 months. His results differed from those of the above workers in revealing no significant correlation between maternal anaemia and anaemia in the offspring. Mackay[24] (1931) states, that although the theory that maternal deficiency of iron is a frequent cause of anaemia in infants is attractive, she has no evidence from her investigations to support it.

It may be that certain conditions of pregnancy, such as toxaemia or poverty, will restrict the iron in the mother's diet and so cause a deficiency of iron in her blood and hence a deficiency of the iron store in the foetal liver.

In this series eleven of the fifty mothers, of the children examined under one year, were in constant attendance at the clinic before the birth of the child. Of these, eight had a haemoglobin less than 74 per cent. Not one child of these eight anaemic mothers had a haemoglobin less than 10 per cent below Mackay's normal for this age period, after the age of six months. This was about the normal for all infants examined in this series. In Table(4) the haemoglobin of each of these eight mothers, before the birth of the child, is tabulated. So also is the haemoglobin of the child after a period of six months from birth.

Table (4).

No.	Haemoglobin of mother, before birth of child	Haemoglobin of child, at the age of seven months.
1	73%	68%
2	69%	64%
3	59%	63%
4	70%	65%
5	71%	60%
6	68%	64%
7	63%	62%
8	70%	67%

The table was examined statistically and it was assumed that the "normal" haemoglobin level for the mothers was 80 per cent, and the "normal" for the children 60 per cent, (this being Mackay's lowest limit of normality). The average haemoglobin for the mothers was 67·9 per cent, and this was found to be significantly lower than 80 per cent. The average haemoglobin for the children is 64·1 per cent and this was found to be significantly higher than 60 per cent.

From the small number examined no decision can be taken regarding the relation of the maternal and the infant's blood. It would appear however, since the percentage haemoglobin of these eight children is significantly above the normal range for infants of this series that the condition of the mother's blood had little influence on that of the childs. This was also held by Somerford [34] (1938) who, on examining the blood of 100 mothers and that of their youngest child, found that the most anaemic children were not the offsprings of anaemic mothers.

(c) <u>Birth weight and rate of growth.</u>

It is generally agreed that the smaller the infant at birth, the greater the likelihood that it will develop anaemia. This is borne out by the work of Mackay [24] (1931), Fullerton [11] (1937), and Hutchison [15] (1938). Low birth weight is stated to be the cause of the frequency of nutritional anaemia in premature infants and twins. (Parsons and Hawksley [28] 1933). The correlation between rate of growth and haemoglobin level has been stressed by Josephs [18] (1934) and Fullerton [11] (1937), this being greatest between 6 and 7½ months of age (Mackay [24] 1931).

Of the infants and children of one year examined in this series, three were premature births, two were twins, and seven had been underweight at birth. Of those twelve, ten at the examination had haemoglobin values of less than 10 per cent below Mackay's normal. Two of the prematures had the lowest haemoglobin levels of all infants and children examined. One who was fifteen months old had a haemoglobin value of 27 per cent, while the other who was nine months had one of 38 per cent.

In Table(5) the approximate weight at birth of each of the twelve children is tabulated. (This was got from the Child Welfare Clinic records). The age, weight and haemoglobin level of each child at the time of the examination are also tabulated in their appropriate columns.

Table (5).

	Age of child at examination in months.	Weight of child at birth Approx.	Weight of child at examination	Haemoglobin Estimates.
Premature Births.	9 mths.	5¼ lbs.	15 lbs. 9ozs.	38%
	13 mths.	6 lbs.	20 lbs. 2ozs.	53%
	15 mths.	5¼ lbs.	21 lbs. 7ozs.	27%
Twins.	10 mths.	6¼ lbs.	15 lbs.14ozs.	53%
	10 mths.	6¾ lbs.	17 lbs. 1oz.	65%
Under-weight at birth.	7 mths.	6¼ lbs.	13 lbs.13ozs.	56%
	10 mths.	5¾ lbs.	16 lbs.12ozs.	57%
	12 mths.	5¾ lbs.	19 lbs.11ozs.	63%
	13 mths.	6 lbs.	19 lbs.13ozs.	52%
	14 mths.	5¾ lbs.	19 lbs.15ozs.	54%
	16 mths.	5¾ lbs.	22 lbs.	53%
	18 mths.	6¼ lbs.	22 lbs. 3ozs.	56%

On examining the table, it is seen that many of the children had made satisfactory progress in weight since birth, but only two had haemoglobin values above the average haemoglobin level found in infants and young children in this investigation.

A statistical examination of the eleven children was also made (one extra child, whose haemoglobin was only 27 per cent, was excluded as being exceptional). The weight of each child at birth is known to be significantly underweight. The expected haemoglobin level in children of normal weight, in this class, has a lower limit of 60 per cent. This was accepted as a "normal". The average haemoglobin level of the eleven children is 54·54 per cent and by the theory of sampling for small numbers, this was found to be significantly lower than the assumed "normal" of 60 per cent.

From these results is seems very definite that birth weight plays a part in the anaemia of infants and young children. The smaller the infant at birth, the greater must be its rate of growth if it is to make satisfactory progress in weight and so the store of iron in the liver will be exhausted more quickly. Hence children of this class who have a low birth weight and whose diet is known to be deficient in its iron content, should be very apt to develop a severe iron deficiency anaemia.

(d) Infections.

Josephs[18] (1934) and Fullerton[11] (1937) are of the opinion that infections play a most important part in the etiology of iron deficiency anaemia of infants and young children. Hutchison [15] (1938) in examining 300 infants found that 55 per cent had a history of one or more infections. His work indicated that severe infections have an adverse influence in the utilization of iron for haemoglobin synthesis and that severe illnesses are frequently followed by anaemia. Mackay [23] (1928) found that anaemic infants had an increased susceptibility to infections.

Sixty per cent of the infants and 91 per cent of children from 1 to 4 years, in this investigation, had a history of one or more infections. The infections were mainly the exanthemata, respiratory and gastro-intestinal diseases. No difference was found in the average haemoglobin levels of children with a history of infection and those with no such history. It must be pointed out however, that there were very few children with no history of infection and so a proper comparison could not be made. Again, the histories were obtained from the mothers who were not all of average intelligence and so cannot be taken as reliable.

Most recent workers consider that infections,especially if they be severe,lower the haemoglobin level and so create an extra need for haemoglobin building. This causes a call for extra iron. The iron content in the diet of these children is often inadequate for growth alone and so it leads to an iron deficiency anaemia which may complicate the original infection.

This class of child rarely escapes disease owing to home circumstances and overcrowding. This is especially the case with the exanthemata. Thus if infection be an important etiological factor in iron deficiency anaemia, as is held by many workers, then the blood of these children should be definitely influenced.

Conclusion.

From the above observations I think it can be stated that inadequate feeding, low birth weight and infections all predispose to the incidence of iron deficiency anaemia in this class of child.

Whether inadequate feeding is due to economy or lack of proper teaching, mothers of this class do prolong the milk feeding period and are very slow in supplimenting this with a diet more rich in iron.

No doubt birth weight affects the haemoglobin of infants and children of all classes. Mothers of underweight infants of other classes however, can afford and are usually advised what type of diet their infants should be given, whereas mothers of this class cannot afford, or are slow in following advice regarding the diet the infant or child should have, so that the quantity of iron will be adequate for both growth and haemoglobin formation.

Similarly, infections affect all infants and children, but the incidence of infections is much greater in this class, due to home circumstances and overcrowding. Again, when these children are affected with disease their diet is not one, rich in iron, that would help them make good any loss.

It appears to me that the various clinics pay too much attention to increasing the child's weight and too little attention to the child's blood level. As the child grows, the store of iron in the liver is used and if this is not replenished by dietary iron then the store will soon become exhausted and the child become anaemic.

When the health of a child,of the poor classes, is being supervised at a clinic, a haemoglobin estimation should be periodically done to see if the level is being maintained as growth proceeds. If the level is found to be low or falling then increased dietary iron can be given. Expensive iron containing foods are not required. By adding a few grains of iron and ammonium citrate to the milk feeds, the normal blood level will soon be restored.

It has been found by Mackay, that by enriching the milk feeds with small amounts of iron that a low haemoglobin level will be restored and maintained within the limits of normality and that the child benifits greatly in general health.

The benificial effects of iron in anaemia of a young child is well demonstrated by one particular case. The child was one of the premature infants in this investigation, and when seen at the age of fifteen months, had a haemoglobin level of only 27 per cent. This child had been attending a clinic since birth and had been issued with free milk and various kinds of artificial milk foods during that time. The weight had improved but the child remained pale and was very susceptible to bronchitis and enteritis. From the commencement of iron therapy, given in the form of iron and ammonium citrate in the milk feeds, the haemoglobin level rapidly rose. At the end of thirteen weeks the level had risen to 74 per cent. The child's general appearance was much better and the appetite greatly improved.

(2) Women between the ages of 20 and 44 years.

The investigation has shown that anaemia is relatively uncommon in children from 5 to 14 years, adult males and women over the age of 50 years, but it is prevalent in women of 20 to 44 years. The conditions under which they all live are similar. Hence there must be some function of womanhood that is the deciding factor in the production of this anaemia.

The causative factors will be considered under:-

(a) Menorrhagia.

(b) Pregnancy and Childbirth.

(c) Infections.

(d) Diet in relation to iron intake.

(a) Menorrhagia.

Fowler and Barer [9] (1935) have shown how unreliable is the menstrual history. Many women considering themselves quite normal in this respect, have blood losses that vary considerably. Some lose moderate amounts while others have an excessive flow. They found on examining a group of women, who considered themselves to have normal menses that the amount of iron lost at each period varied from 3·5 to 450 mg..

It is evident from this work that menstrual loss varies greatly. If however, this be severe then the loss of iron will be considerable and if this is not compensated by a sufficient dietary iron then an anaemia will develop.

From the histories of the women examined in this series, twenty appeared to suffer from menorrhagia. Of these, seventeen had haemoglobins less than 80 per cent. Although it was difficult from the histories to determine whether the menorrhagia was heavy or slight it is of interest that 85 per cent of those complaining of excessive loss of blood during menstruation were anaemic.

(b) Pregnancy and Childbirth.

In considering the loss of iron in the mother from pregnancy and childbirth, we must consider the iron content of the uterus, placenta and foetus at term, the iron loss at parturition and loss due to lactation.

Fullerton[(10)] (1936) summarizing the results of various workers suggests that 550 mg. can be taken to represent roughly the iron supplied to the uterus and its contents during gestation. From the work of Galloway (1929) and Richter, Meyer and Bennet (1934) it may be concluded that approximately 170 mg. of iron is lost at parturition. Fullerton[(10)] (1936) quoting the figures of many investigators and averaging them, considers that 180 mg. constitutes the maternal iron loss during six months lactation.

Hence the total iron lost by the mother during pregnancy and the six months after delivery is approximately 900 mg. This loss occurs over a period of 460 days, so it represents a daily loss of about 2 mg. Thus in order to supply the demands of iron during pregnancy and lactation, a woman must achieve a positive balance of 2 mg. daily in addition to her ordinary needs. This can only be done if her dietary iron is sufficient.

Strauss[35] (1934), Witts[40] (1935) and Irving[17] (1935) are of the opinion that the anaemia which occurs so frequently during pregnancy is caused by an iron deficiency, due mainly to the supply of iron to the foetus. Massey, Watkins and Kilroe[20] (1932) differ from this however, and suggest that severe anaemia in pregnancy is really a pre-existing condition. Fullerton[10] (1936) investigating hypochromic anaemia in pregnancy and the puerperium states that where anaemia in pregnancy is marked, it has probably existed before pregnancy occurred and is exaggerated by physiological hydraemia. He is of the opinion however, that blood loss at parturition, though varying greatly in degree often produces a severe hypochromic anaemia.

In this series, any woman who was pregnant at the time of examination, or any who had had a child within a year previous to the examination were considered to be associated with pregnancy and childbirth. Eleven women were pregnant and forty had had a baby within the year preceding examination.

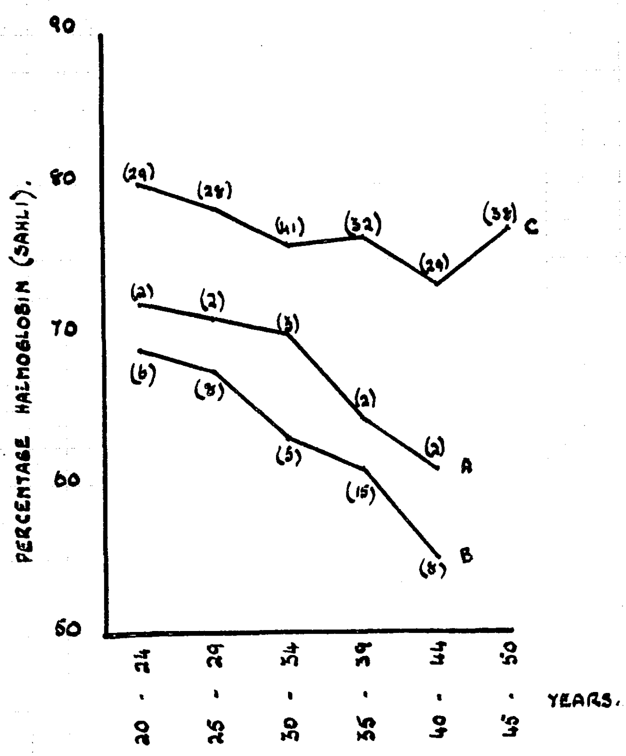
Of the eleven pregnant women, only one had a normal haemoglobin, six had haemoglobins between 70 and 80 per cent and in four the value was below 70 per cent. The average haemoglobin figure was 68 per cent. Of the forty associated with childbirth only two had normal values for haemoglobin, in eight the level was between 70 and 80 per cent and in thirty below 70 per cent. The average figure was 62 per cent.

In the investigation, it has been shown that the average percentage haemoglobin for this age period in women of this class is 74 per cent. Hence when these women become pregnant, the majority must have haemoglobins less than 80 per cent and so are anaemic when pregnancy occurs. It may be pointed out here, that during the investigation five who were attending either for treatment or as controls became pregnant. Not one of these five had a normal haemoglobin percentage before pregnancy occurred.

If we compare the average percentage haemoglobin figures of women affected by pregnancy and childbirth with the average percentage haemoglobin figure of all the women examined at this age period, it is seen that the former figures 68 and 62 per cent are considerably lower than the latter figure of 74 per cent. This indicates that although the majority of these women are anaemic when pregnancy occurs, the anaemic state is increased during gestation and still further affected by childbirth. The effects of pregnancy and childbirth on the haemoglobin level at each age period, as compared to the haemoglobin level, at each age period, found in women of 20 to 44 years in this investigation, who were not associated with pregnancy or childbirth, is shown in Fig (5).

Fig (5).

FIG. 5. PERCENTAGE HAEMOGLOBIN.



A : AVERAGE, AT EACH AGE PERIOD, OF WOMEN ASSOCIATED WITH PREGNANCY.

B : AVERAGE, AT EACH AGE PERIOD, OF WOMEN ASSOCIATED WITH CHILDBIRTH.

C : AVERAGE, AT EACH AGE PERIOD, OF OTHER WOMEN.

A is the curve formed by the haemoglobin levels of women affected by pregnancy, B the curve formed by those affected by childbirth, while C is the curve formed by the other women examined between the ages of 20 and 44 years. The small figures at each point of the curves represents the number examined at each age period.

(c) Infection.

Davidson and colleagues [3] (1933) state that since "infection" is a factor common in children over five years and adult males, where anaemia is not prevalent, as well as in females, of this age, where anaemia is prevalent, they are of the opinion that the role of "infection" in the production of the anaemia is only of subsidiary importance.

In this series, some of the women examined gave a history of having suffered from some "infection" such as bronchitis, cystitis, tonsillitis and gastritis. Only a few however, were suffering from any of these conditions at the time of examination and none gave a history of suffering from any chronic disease, such as syphilis or tuberculosis.

There was practically no difference in the average haemoglobin levels, when comparing those with a history of "infection" and those with no such history.

In Table(6) women examined at this age are distributed in three groups according to their haemoglobins being over 80 per cent, between 70 and 80 per cent and under 70 per cent. The number in each group associated with any of the above disabilities are also tabulated under the appropriate heading.

Table (6).

Group	Haemoglobin per cent.	Menorrhagia	Pregnancy and Childbirth	Infection	Free	Totals
1.	over 80%	3	3	8	60	74
2.	70 to 80%	6	14	5	24	49
3.	under 70%	11	34	7	35	87

On examining Table(6) it is seen that the proportion of suspected causative factors is lowest in group 1. and highest in group 3. The table was examined statistically. If the frequency of the diseases has no effect on the percentage haemoglobin stated, the 210 cases would be expected to be distributed at random except that they should add up to the totals of the tables. Table of expected frequencies (for distribution at random):-

Group	Haemoglobin per cent.	Menorrhagia	Pregnancy and Childbirth	Infection	Free	Totals
1.	over 80%	7·0	18·0	7·0	42·0	74
2.	70 to 80%	4·7	11·9	4·7	27·8	49
3.	under 70%	8·3	21·1	8·3	49·3	87
Totals		20	51	20	119	210

The differences between this table and the observed Table(6) are significant and can be traced in the main to the large number (34) under pregnancy and childbirth and slightly to the number under menorrhagia. The expected frequency under pregnancy and childbirth is only 21. The deviations in Table(6) are greater than can be attributed to random fluctuations.

Pregnancy and childbirth and in a lesser degree menorrhagia appear to be the factors most concerned in the production of the anaemia. Infection seems to be of little importance.

(d) Diet in relation to iron intake.

Davidson and colleagues [3] (1933) found on examining a large number of poor families that there is no correlation between the iron content of the diet and the haemoglobin content of the blood, in fact a very low iron intake was found in four families and still there was no anaemia. They found that the bulk of the diet in nearly all cases consisted of white bread, other wheat flour foods, potatoes, sugar, some meat and fish. The intake of fresh fruit, green vegetables and milk was low. These family diets were found to be poor in iron, in some cases the iron intake was between 5 and 6 mg. per person, per day. The average for all families was 11 mg. per person, per day and this was found to be quite sufficient to maintain a normal blood picture.

McLester [26] (1931) considers that an adult in ordinary life should ingest not less than 15 mg. of iron per day, this amount being present in every mixed dietary. Farrar and Goldhamer [8] (1935) estimate that 5 mg. per day are sufficient. Davidson and colleagues [3] (1933) state that although 15 mg. per day is suggested as a safe standard of the requirement of iron, it is obvious from their own results that a normal blood picture can be maintained at a much lower level.

In this investigation twelve large families were examined. The weekly diets and their costs were noted. It was found that the average cost per person, per day was 8¼d. The bulk of the diets consisted of white bread, potatoes and margarine. Cheap meat, eggs, fish, sugar, tea and milk were also used. Green vegetables and fruit, however, were rarely purchased.

This diet is very similar to that used by the families examined by Davidson and colleagues and it can be assumed that it too has a low iron content.

The father in each of these twelve families had a normal haemoglobin. The great majority of the children over three years had haemoglobin values within normal limits, but nine of the twelve mothers were anaemic. It would appear therefore, that the diet of this class of people contains sufficient iron to maintain a normal blood picture, provided there is no increase call for iron as occurs in the above mentioned conditions of womanhood.

Conclusion.

Pregnancy and childbirth and in a lesser degree menorrhagia appear to be the factors most concerned with the production of anaemia in these women. No doubt true histories of menorrhagia are difficult to obtain but the majority of the women complaining of such symptoms are anaemic. Whether the anaemia of pregnancy is a pre-existing condition or is caused by the loss of maternal iron to the foetus is still in doubt. It would appear however, that many of the women of this class are anaemic when pregnancy occurs and it may be that this anaemic state becomes greater with the supply of iron to the foetus.

That this anaemia is one of iron deficiency is clear from the dramatic effects which are produced by the treatment of these women with large doses of iron without any change in their diets. (These effects are well shown in the chapter dealing with iron medication). It appears that the dietary iron of this class is sufficient to maintain a normal haemoglobin level, so long as there is no extra call for iron as occurs in pregnancy, and after blood loss during menstruation and following pregnancy.

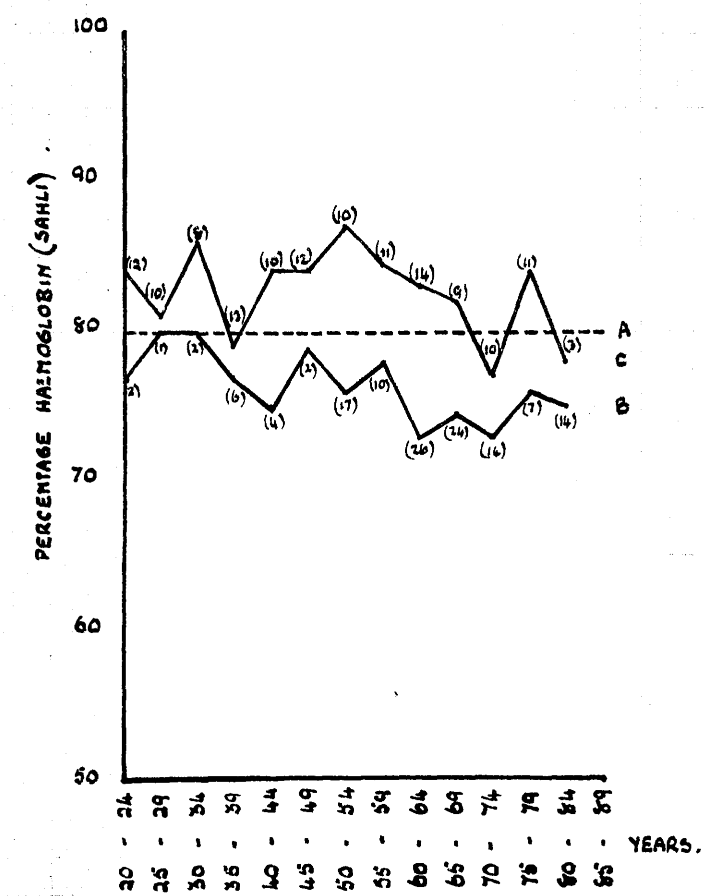
Although it cannot be said that the diet of these women is a factor causing the anaemia, it can be stated that it plays a large part in maintaining a low haemoglobin level by its low iron content.

THE EFFECT OF LIVING IN LODGING HOUSES.

On examining the haemoglobin of 113 males living in a lodging house, an average figure of 75 per cent was found. The haemoglobin ranged between 54 and 95 per cent.

Fig (6).

FIG. 6. PERCENTAGE HAEMOGLOBIN. MALES AND FEMALES LODGING-HOUSE INMATES



A: AVERAGE NORMAL (MALE AND FEMALE)

B: MALE AVERAGE, AT EACH AGE PERIOD, IN THIS INVESTIGATION.

C: FEMALE AVERAGE, AT EACH AGE PERIOD, IN THIS INVESTIGATION.

The haemoglobin values of 131 females, living in two lodging houses, gave an average figure of 82 per cent, the figures ranging between 49 and 98 per cent.

It is obvious that the mean level is much higher in females than in males. The figure for females is well within normal limits, but that of males is considerably below the normal figure of 80 per cent.

In Fig(6) this difference in the haemoglobin levels of males and females living in lodging houses, at each age period, is shown graphically. The figures at each point on the two curves represents the number examined at each age period. If 80 per cent be considered as the normal haemoglobin level, it is seen that the male curve does not rise above this whereas the female curve is mostly above this level.

Females.

One hundred and thirty one females, living in this manner, were examined. This number included 90 living in a Salvation Army model and 41 living in a privately controlled home. In the Salvation Army home the women had an average haemoglobin level of 85 per cent, while in the private home it was 78 per cent.

There was no significant difference in the cost of a bed per night in either of the two models, but there was a striking difference in the type and mode of feeding.

In the Salvation Army home, food was prepared and cooked in a modern kitchen by cooks. It was a mixed and varied diet composed of soups, vegetables, meat, eggs, fish, bread, tea, cocoa and various milk puddings. It was purchased by the women at a very reasonable sum, the average being about 1/- per day. The dining room was large, bright, clean and well ventilated. Meal times were regular.

In the privately controlled home however, cooking was done on a hot plate, by each individual, just when she chose to eat. The food mainly consisted of bread, potatoes, cheap meat, eggs, margarine, tea and milk. Soups, green vegetables, milk puddings and fish were rarely prepared. On enquiring it was found that the women usually had two or three meals per day. After cooking, the meals were taken in the same room as that in which the hot plate was installed. This was small, dull, dusty from the hot plate and warm owing to the ventilation being very poor. It was certainly a very unhealthy and not in any way an appetising dining room.

Sleeping accommodation was fairly good in both homes. In the Salvation Army home the majority of the women had an individual bedroom.

Women living in the homes were of the poor-law class. In the Army home they were of a better type than those in the private model. Their ages varied generally between 45 and 75 years but a few were younger. Owing to the strict supervision in the Salvation Army model few were addicted to drink, but in the private model many were so addicted, some being drinkers of wine of a cheap variety. This caused a decrease in the amount of money spent on food.

It was very difficult to get, from any of the women, a history of disease apart from bronchitis and gastric symptoms. 70 per cent had had families; 50 per cent had more than three children while many had larger families. The majority had lived for years in the models, some over twenty years.

The average haemoglobin level in the private model, although slightly below 80 per cent was fairly good. The average haemoglobin level in the Salvation Army model was especially good. It must be remembered that most of the women living in the models were over 45 years, and it has been shown in this investigation that the haemoglobin levels of women, after the menopause, rise quite considerably. Hence the average haemoglobin level of 78 per cent found in the private model is quite within normal limits for this age in women, although it is considerably below the average figure of 85 per cent as found in the Salvation Army model.

Women of both models were living more or less under the same conditions except in feeding arrangements. Income was the same, and little difference was found in sleeping accommodation. The women had similar types of families, and no doubt had suffered from the same diseases. Yet there was a difference of 7 per cent in the average haemoglobin levels of the two homes. It would appear that quality of diet, especially its iron content, was the important factor in causing this difference. In a lesser degree mode of cooking and regularity of meals may also have had some effect.

When we examine the diet of the Salvation Army home, it is seen to be varied and mixed, very similar to the diets of middle class families and certainly one richer in iron than the diets consumed by the families examined in this investigation, or the diet of the privately controlled home. Again, on examining the diet of the privately controlled home it is seen to be much the same as that of the twelve poor families already reported on. This diet was shown to be quite sufficient to maintain a normal haemoglobin level so long as there was no increased call for iron.

It would seem that the diet consumed by the women in the private model, contains sufficient iron to maintain a normal haemoglobin level, the great majority of the women being past the menopause and so having no increased call for iron. The diet of the Salvation Army model, being varied and more like the middle class diets contains sufficient iron, not only to maintain a normal haemoglobin level, but to raise this level considerably.

The haemoglobin values in the two homes were probably also affected by the differences in the cooking and dining arrangements. In the Salvation Army home food was prepared and well cooked, in a modern kitchen, by professional cooks. It was served in a dining room which was bright and clean and in a manner conducive to the appetite. In the private home however, food was prepared, cooked and eaten in the same room. The cooking utensils were dirty, the room was dark, warm and dismal in appearance, and the whole atmosphere was certainly against stimulating an appetite.

One striking feature in the Salvation Army model, was that four women between the ages of 32 and 41 years had had a child within ten months of the examination. All four had haemoglobin values above 85 per cent. This was in marked contrast to that found in women of this class, under the same conditions, but living in their own homes. The only explanation for this would appear to be that the diet in the Army home was well cooked and one sufficiently rich in iron, not only to maintain a very satisfactory haemoglobin level, but also to allow those mothers to make good progress in regaining their loss caused by pregnancy and parturition.

Males.

In the male model a different state of affairs was found. Preparation of food was by the hot plate method, each individual cooking and eating when he chose. The room containing the hot plate was also the dining room and this was dusty and badly ventilated. The majority of the men only cooked one meal per day and this was anything but a mixed one.

Diet mainly consisted of white bread, margarine, cheap meat, eggs, cheese and tea. Potatoes were prepared only by a few. Fish and green vegetables were not purchased. As already stated the majority of the men prepared one main meal in the day which was usually a fry. This was taken in the middle of the day. The other meals consisted of bread, cheese, margarine and tea.

The ages of the men varied from 35 to 70 years. Many of them had lived for years in the home. Although quite a proportion complained of disability such as bronchitis and gastric symptoms, few were receiving any medical treatment.

The majority were wine and beer drinkers, a considerable part of their income going in this way. This necessitated a very marked economy in diet.

Sleeping accommodation was very poor. Each floor consisted of about 50 cubicles, separated from each other by wooden partitions. The floor space of each cubicle was about 5 ft. by 7 ft. Only the outside cubicles had windows, the remainder being dark and badly ventilated.

The income of each man varied from about 15/- to £1 per week. The average was about 16/6d. per week. When it is considered that from this sum 5/6d. is paid each week for a bed, 2/- to 3/- for alcohol, 1/- to 2/- for tobacco, it only leaves about 6/- for food and clothing. This was well seen in the type of diet they consumed.

It was not possible, for purposes of comparison, to find a male home where cooking arrangements were similar to those of the Salvation Army home for women. In all male homes, where food is cooked for the men, the cost was too high for those living under the poor-law.

The average haemoglobin of the 113 males living in this model was 75 per cent. When comparing this with males of the same class, living in their own homes, it is seen that it is 5 to 6 per cent lower. Both types suffer more or less from the same disabilities, lead the same kinds of life, but their dietary arrangements are different. It would appear that this is the factor that plays the major part in lowering the haemoglobin level of men living in models.

Most workers consider that there is no correlation between the iron content of the diet of poor families and the haemoglobin content of the blood. This was also found in this investigation after the examination of twelve large families of the poor-law class. The father in each of these families had a normal haemoglobin. One must remember however, that the men of these families have their meals prepared for them, have three meals a day, and although their diet is not one of quality, it is varied and mixed to a certain extent, depending on the domestic abilities of their wives. Men living in models however, have no one to cook for them, the majority preparing only one meal in the day. This meal is usually composed of cheap meat, such as sausages, mince or bacon, three or four thick slices of white bread and tea. Sometimes eggs are prepared. It seemed on examining their diets that these men satisfy themselves by consuming large quantities of bread rather than preparing meals containing vegetables, fish or soup. The other daily meal or meals is usually composed of white bread, margarine and tea. Cheese, often toasted, is occasionally taken. This same type of feeding goes on for months and in many cases years.

It would appear that the whole mode of life, of men living in models, plays a part in the production of a low haemoglobin level. Irregular meals, poorly cooked meals, insufficient iron containing food stuffs, cooking and dining arrangements, and bad habits all seem to contribute to causing this low blood level. No doubt their incomes, small though they be, could be used to better advantage if their habits were improved upon.

Conclusion.

The incidence of iron deficiency anaemia in women living in model lodging houses is low, whereas in men, living under the same circumstances, it is high. The factors mostly concerned in maintaining this satisfactory haemoglobin level in women would appear to be type of diet, and in a lesser degree cooking and dining arrangements.

The factors causing a low haemoglobin level in men, would appear to be their mode of life and to long continuation of a diet rarely varied and poor in iron. It would seem that men left to the mercy of their own culinary incompetence are liable to eat peculiar diets, while their habits in using up part of their income, necessitate a marked economy in the amount and type of food consumed.

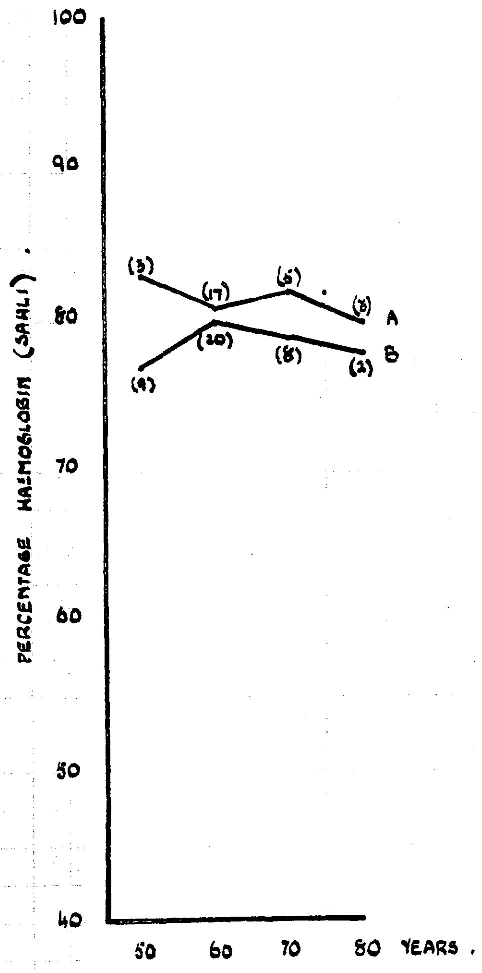
A point of some importance is that a model run under good supervision, where food is cooked and prepared for the inmates, and purchased by them at a reasonable cost is the ideal. It is certainly seen that women living in such a model can rapidly regain and maintain a haemoglobin level well within normal limits.

EFFECT OF LIVING ALONE.

In the investigation sixty seven people who lived alone were examined, to find if the conditions under which they live, have any influence on the blood level of this class.

Fig (7).

FIG. 7. PERCENTAGE HAEMOGLOBIN.
MALES AND FEMALES
LIVING ALONE



A: MALE AVERAGE, AT EACH AGE PERIOD, IN THIS INVESTIGATION.

B: FEMALE AVERAGE, AT EACH AGE PERIOD, IN THIS INVESTIGATION.

Twenty eight of them were male and thirty nine female. Most of them had been married. Their partners had died and their families, having married, had gone from the home. The great majority were over 55 years.

The males gave an average haemoglobin figure of 81 per cent, the figures ranging between 67 and 92 per cent. The average haemoglobin figure for the females was 79 per cent, the figures ranging from 68 to 91 per cent. In Fig(7) the curves formed by the male and female averages at each age period, are shown graphically. The small figures at each point on the curves represents the number examined at each age period.

It is obvious from the above results, that there is little difference in the amount of haemoglobin for both sex and age. The mean haemoglobin for both male and female is quite within normal limits.

It was found when visiting these people, that the majority both male and female, were of independent nature. They had no wish to live in the homes of any of their married sons or daughters. They appeared happy and took quite a pride in their homes, the great majority of which were clean and tidy. Many of them prepared their own meals. This in most instances was well cooked and appeared adequate. Most of the others had one or two of their daily meals in the home of one of their family.

Conclusion.

It would appear from the above observations, that living alone has no adverse influence on the haemoglobin level of this class.

THE EFFECT OF IRON MEDICATION.

The treatment of iron deficiency anaemia in women of this class was carried out with a view to finding the most suitable dose of iron required for an adequate response, without causing any adverse effects.

The iron salt used was iron and ammonium citrate. This had been prepared in accordance with the directions of the British Pharmocopoeia.

Hale White[14] (1927) gives as the dose of iron and ammonium citrate 5 to 10 gr. Witts[39] (1933) considers that the minimum effective dose is 60 gr. Davidson[5] (1933) recommends an average daily dose of 90 gr. Whitby and Britton[38] (1939) states that 60 gr. should be taken as the minimum daily dose, but that this should be gradually increased to a maximum of 120 gr. a day. The gradual increase from minimal to maximal doses has the advantage of reducing the incidence of digestive disturbances.

Fifty two anaemic women were chosen for iron medication. Haemoglobin estimations were carried out at weekly intervals for each patient.

The initial dose of iron administered to each patient was 15 gr. tid. This dose was increased weekly according to the response in the patient. Where this was good, the dose did not exceed 30 gr. tid. Where the response was poor the dose was gradually increased to a maximum of 60 gr. tid.

Table (7).

Patient.	Age.	Initial Haemoglobin per cent.	Weekly % Haemoglobin Estimates.																	
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	
1	32	73	75	78	82															
2	29	58	66	71	73	76	78	80	83											
3	29	68	68	71	72	75	79	82												
4	22	62	64	65	69	71	75	80	83											
5	25	70	73	79	84															
6	57	70	71	73	73	77	80													15-30 grs.tid.
7	33	72	78	84																
8	42	73	75	79	82															
9	38	70	73	73	75	76	76	79	81											
10	27	69	72	74	77	77	80	80	83											
11	33	70	75	76	79	79	81													
12	37	67	69	69	70	73	75	78	81											
13	31	70	68	70	72	77	81	86												
14	28	64	65	66	68	68	69	74	78	81										
15	34	54	59	61	68	73	80	87												
16	32	64	64	66	66	68	68	68	73	78	80	88								
17	45	68	70	70	71	72	73	73	73	75	77	79	80	84						15-40 grs.tid.
18	46	70	72	75	74	76	76	78	79	81	87									
19	47	68	67	68	70	74	75	75	75	79	81									
20	30	69	75	78	81	82														
21	56	54	57	61	68	70	73	77	82	85										
22	36	71	70	72	74	79	80	80	84											
23	42	71	73	74	76	78	80	84												
24	24	66	65	68	69	70	72	72	74	78	86	93								
25	45	66	64	64	68	66	68	71	73	76	79	80	87							15-50 grs.tid.
26	34	68	68	69	70	72	78	80	83											
27	38	62	64	64	68	66	66	68	70	72	74	76	79	80	84					
28	29	65	64	65	65	68	70	73	73	74	78	80	83							
29	26	54	55	56	60	61	63	65	73	74	77	80	80	81	90					
30	36	60	59	60	61	63	62	64	66	70	71	71	73	75	78	80	79	83		
31	27	43	44	47	49	54	59	63	71	72	75	80	83							
32	42	63	64	62	66	67	68	69	69	70	75	80	85							
33	26	65	64	64	66	68	70	72	72	74	73	75	76	79	80	84				
34	34	58	58	60	61	62	64	67	70	71	74	80	83	90						
35	40	66	68	68	67	68	69	70	72	76	77	80	83							
36	24	56	57	59	62	72	74	74	77	80	85									
37	26	51	51	53	55	56	61	66	71	73	73	78	78	79	80	85				
38	47	49	50	51	59	65	71	73	75	76	77	80	82	85						
39	31	50	52	53	55	59	61	64	68	68	74	79	83							15-60 grs.tid.
40	50	52	54	57	67	70	77	79	87											
41	39	61	60	62	62	63	64	68	71	75	76	81	88							
42	40	44	44	43	46	47	52	56	59	60	64	67	68	74	74	76	79	80	83	
43	33	64	65	66	66	65	67	70	72	75	77	79	80	82	85					
44	29	65	66	66	68	69	69	71	73	74	79	84								
45	40	67	67	69	70	72	73	75	73	74	75	77	80	84						
46	45	64	66	64	65	67	67	70	72	71	73	75	78	85						
47	43	53	56	61	63	65	68	67	73	78	82	91								
48	28	38	43	45	51	58	60	65	71	73	79	83								
49	43	59	60	63	64	66	66	70	70	73	73	74	75	76	78	80	80	85		
50	28	60	61	63	65	70	74	74	76	77	81	85								
51	40	61	64	64	69	70	74	78	78	79	80	80	86							
52	49	54	59	62	65	66	67	69	70	70	68	70	71	75	82	85				

In Table (7) each patient treated is arranged giving age, initial haemoglobin, and subsequent weekly haemoglobin estimates. In the margin the maximum dose of iron required for an adequate response in each patient is shown.

From Table (7) it is clear that the response to iron varies in each individual. Some respond to small doses, others require large doses continued over a varying period of weeks. Age does not appear to influence this response. Some of the younger patients differed in the amounts of iron required for an adequate response. This also occurred in older patients.

It was generally found however, that to get a continued satisfactory response in cases of severe anaemia the dose of iron had to be gradually increased to 60 gr. tid.

The duration of iron medication before a normal haemoglobin was given, also varied in each individual. Few gave a normal haemoglobin reading under six weeks, some required fifteen or sixteen weeks intensive treatment before a normal haemoglobin was found.

To maintain a good response and to get the patient's haemoglobin level to normal in a reasonable time the dose of iron had to be increased as the haemoglobin rise began to lag. If we divide the fifty two patients into four groups, according to the maximum dose of iron required, we find that in order to obtain an adequate haemoglobin response patients of the first group had to have the dose of iron increased to 30 gr. tid. Patients of the second group required the iron increased to 40 gr. tid., the third group to 50 gr. tid. and the fourth group to 60 gr. tid.

If we now examine the initial haemoglobins of the four groups, it is found that the average initial haemoglobin of

1st. group is 68•6 per cent.
2nd. group is 65•3 per cent.
3rd. group is 63•5 per cent.
4th. group is 56•6 per cent.

Thus it is seen, that the lower the initial haemoglobin level the greater must be the maximum dose of iron administered to obtain an adequate haemoglobin response in a reasonable time. A patient starting well, with say a weekly rise of 54 per cent to 59 per cent and then to 62 per cent may slow up considerably unless the dose of iron is increased so that progress can be maintained.

Owing to the fact that the initial haemoglobin values of the fifty two patients are different, and the response to iron therapy is greater the lower the initial haemoglobin, and also that the dose of iron given to each individual was not the same, one cannot calculate out a true average figure to show the average weekly haemoglobin rise for the fifty two patients.

This table was however examined statistically, and to illustrate this improvement in the haemoglobin rise three groups of patients were chosen whose initial haemoglobins were roughly as follows:-

Group 1. 43 - 44 per cent.

Group 2. 53 - 54 per cent.

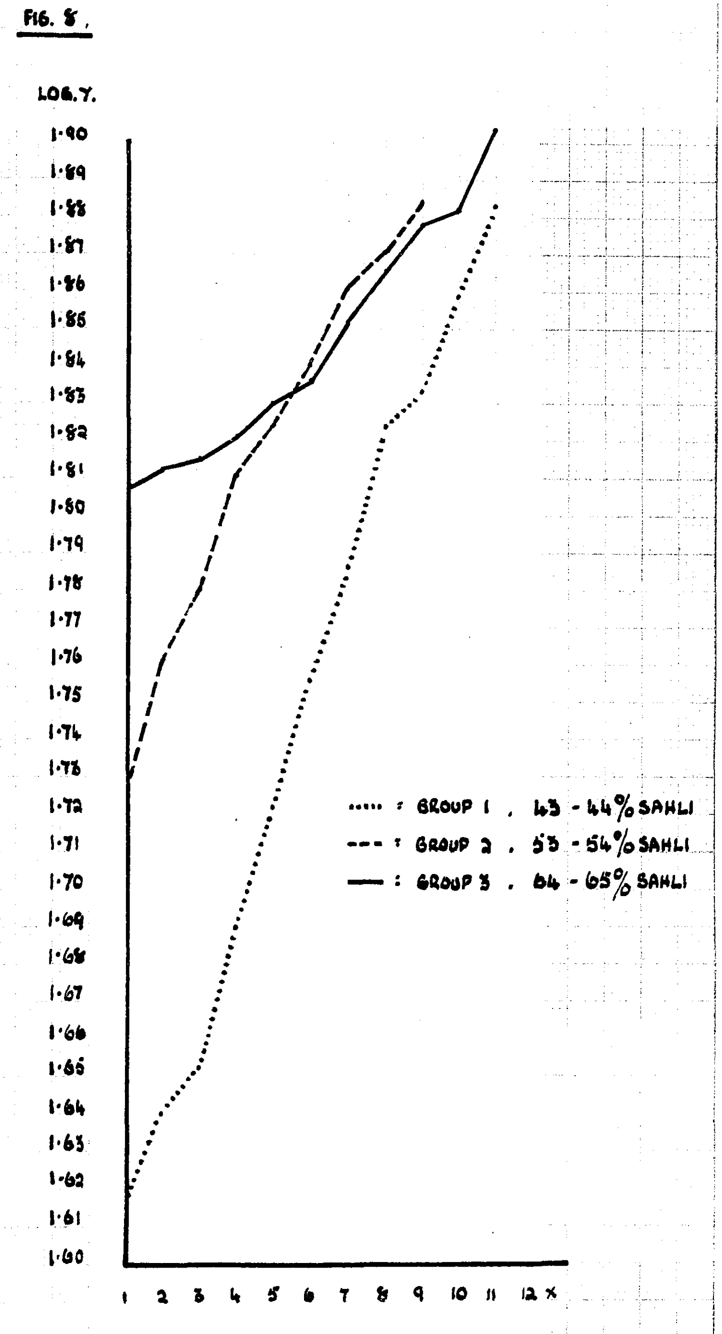
Group 3. 64 - 65 per cent.

As the data for all patients is not given for the same number of weeks, observations being stopped as soon as the patient's haemoglobin reached normal levels, individuals in any one group are statistically examined only for the number of weeks for which there were complete records for all individuals in each group.

The logarithm (y) of the percentage haemoglobins were taken and plotted against the time (x), the latter unit being one week. The three groups are shown in the one diagram (Fig.8). As a growth curve can be represented by the equation $y = ab^x$ that is $\log y = \log a + x \log b$, the plotting of log y against x should give a straight line. This is borne out by the three curves, each of which has a significant slope, that is a slope different from zero as given by a horizontal line. The relative rate of improvement in the percentage haemoglobin is shown by the slope of the line. This in turn is expressed through the value of log b in the equation $\log y = \log a + (\log b)x$. The coefficient log b has the following values:-

Group	log b
1	0·022
2	0·014
3	0.009

Fig (8).



It is seen that the slopes are different, Group 1 giving the biggest slope. This indicates that by increasing the dose of iron each week, according to the haemoglobin response, it was possible to maintain the same high relative rate of improvement as that initially produced by the smaller doses of iron.

At the first examination few of the patients complained of symptoms of anaemia. It would appear that this is due to the fact that many had become accustomed to living sub-normal lives and forgotten the joy of good health. They admitted this was so when, after treatment, their haemo-globin level had been restored to normal. On questioning them however, at the initial examination, many complained of excessive tiredness and lack of energy for their house-hold duties. After four or five weeks treatment it was surprising how many voluntarily stated that the tiredness had gone and that their housework was no longer a burden to them. Later when treatment was completed, none complained of tiredness and lack of energy, and the majority had a much improved general appearance and many a better appetite.

At the commencement of treatment, a few complained of symptoms caused by the taking of iron. Some had sickness and diarrhoea, others colic. By keeping the patient on the same dose as on the previous week and impressing on her that the symptoms would soon pass off, it was found that they quickly disappeared, and increased doses could again be administered.

Finding these women tolerated large doses of iron and ammonium citrate very well, an effort was made to shorten the duration of treatment by increasing the initial dose to 30 gr. tid. and increasing this dose by 10 gr. tid. at weekly intervals, until the maximum of 60 gr. tid. was reached. That is, after a period of three weeks the patient was taking a dose of 60 gr. tid.

Nine anaemic women were treated in this way. The results are tabulated in Table(8) giving patient's age, initial haemoglobin and weekly haemoglobin estimates.

Table (8).

Age	Initial Haemoglobin	Weekly Haemoglobin Estimates.								
		1	2	3	4	5	6	7	8	9
47	60%	61%	66%	70%	73%	76%	81%			
30	57%	59%	65%	73%	76%	77%	79%	83%		
34	60%	60%	64%	70%	74%	77%	78%	84%		
21	70%	71%	71%	73%	74%	79%	83%			
36	61%	67%	70%	73%	81%					
23	50%	52%	57%	65%	75%	78%	90%			
31	49%	51%	57%	61%	69%	70%	71%	76%	78%	82%
36	57%	61%	64%	65%	65%	67%	73%	79%	79%	81%
27	54%	56%	60%	62%	69%	74%	73%	77%	86%	

The average duration of treatment by this method was 7 weeks. When examined statistically the weekly haemoglobin rise by this method of treatment was found to be slightly greater than the weekly haemoglobin rise by the previous method.

In the course of treatment, four of the nine patients complained of gastric symptoms and diarrhoea. When such a complaint was made instead of reducing the dose of iron, a bismuth carbonate mixture was given along with the increased dose. This greatly relieved the symptoms, but in two of the cases it had to be continued for three weeks. Several of the others complained of frequent attacks of nausea and headache. The general findings were that although the haemoglobin level increased markedly by this method of iron administration the patients themselves, owing to the attacks of nausea, headache and gastric symptoms, did not show the same enthusiasm to continue treatment, nor did they appear to have the same benefit as those treated by the first method.

On examining Tables (7) and (8) it is seen that some cases, after treatment had been in progress for several weeks, showed a drop in the haemoglobin level, or it remained the same as that of the previous week. It was found that in many of those instances that the menstrual period had taken place between the two examinations, or was present at the time of the examination when the haemoglobin level dropped. This did not happen in every case, but it occurred so often when there was a fall in blood level that one was inclined to suspect that the fall was due to menstrual blood loss. There was an insufficient number examined however, to come to any definite decision.

A few women, after four or five weeks intensive iron treatment voluntarily stated that their menstrual period was the longest and heaviest for years.

Conclusion.

Since each individual was treated with doses of iron and ammonium citrate, without any alteration in the diet, it is evident from the above results, that this anaemia is due to iron deficiency.

I think it may be stated that this type of anaemia, in this class of women, responds to iron medication extremely well. An initial dose of 15 gr. tid. of iron and ammonium citrate appears to allow the patient to become tolerant to iron medication. This can be increased weekly according to haemoglobin response until if required a maximum of 60 gr. tid. is reached. Provided the initial dose is small and the increase gradual, there are few adverse symptoms.

THE EFFECT OF VITAMIN C.

Having observed during the investigation that pregnancy and childbirth are important factors in causing iron deficiency anaemia in women of the poor-law class, a series of experiments were conducted to ascertain the effects of doses of ascorbic acid on the haemoglobin level of women suffering from this disability.

Aron [1] (1939) found that fully grown guinea pigs deprived completely of ascorbic acid and fed on a scorbutogenic diet showed a distinct reduction in the haemoglobin content of the blood within twenty days. A supplement of iron did not prevent this decline in haemoglobin. By administering ascorbic acid in large amounts, either orally or subcutaneously this anaemia was cured. This cure however, was only successful in animals which had lost not more than one-third of their haemoglobin.

Parsons [29] (1938) after investigating the effects of vitamin C on the maturation of the red cell, states that his results seem to furnish conclusive evidence that vitamin C is essential for the normal maturation of the red cell.

The results reported thus far, of investigations made concerning the influence of vitamin C on blood are contradictory in several respects (Meyer and McCormack [22] 1928; Dunlop and Scarborough [6] 1935; Mettier [21] 1938; and Ungley [37] 1938). Aron [1] (1939) states that the fundamental problems are not as yet satisfactorily solved.

In this investigation, so that a comparison could be made of the effects of vitamin C with the effects of iron medication, some of the women examined were treated with iron and ammonium citrate, and others were given both vitamin C and iron and ammonium citrate. The subjects examined comprised forty women each of whom had had a child within six months, and each having a haemoglobin less than 70 per cent.

Ten were given doses of vitamin C, ten were treated with vitamin C and iron and ammonium citrate, and ten were given iron and ammonium citrate alone. The remaining ten acted as controls.

Before treatment commenced, the blood of each patient was examined for its haemoglobin and ascorbic acid content. During treatment a weekly haemoglobin estimate was done on each one until it came within normal limits or for a period of twelve weeks where the haemoglobin level did not reach normality. A final blood ascorbic acid estimate was done when the haemoglobin level became normal, or at the end of the period of twelve weeks in those whose haemoglobin level did not attain normality.

Throughout the investigation the women were kept on their usual home diet.

The vitamin C administered was prepared synthetically by Roche Products Ltd., and dispensed as "Redoxon" tablets. The dose given was 300 mg. daily by mouth. Iron medication commenced with an initial dose of 20 gr. tid. of iron and ammonium citrate. This was increased weekly by 10 gr. tid. until a maximum of 60 gr. tid. was being taken.

Sahli's haemoglobinometer was used for the haemoglobin estimations in the same way as in the investigation.

The blood ascorbic acid was estimated by the method of Farmer and Abt [41] (1935) and modified by Wilson [42] (1938).

The blood ascorbic acid in the normal individual, according to Greenberg, Rinehart and Phatak [13] (1936), ranges between 0·7 and 0·9 mg. per 100 c.cm. Those below 0·7 are probably suboptimal and below 0·5 mg. per 100 c.cm. must be considered low.

The results are tabulated in the following four tables. Table(9) comprises women treated with vitamin C alone, Table(10) those treated with vitamin C and iron and ammonium citrate, Table(11) those treated with iron and ammonium citrate alone, while Table(12) comprises the controls. In each table patient's age, initial haemoglobin and initial blood ascorbic acid are tabulated, so also are the weekly haemoglobin estimates and the final blood ascorbic acid estimate.

Table (9).

Women treated with vitamin C alone.

Patient.	Age.	Initial blood Vit C in mgs. ascorbic acid per litre.	Initial Haemoglobin per cent.	Weekly % Haemoglobin Estimates.												Final blood Vit C in mgs. ascorbic acid per litre.
				1	2	3	4	5	6	7	8	9	10	11	I2	
1	35	4•96	58	57	58	58	59	61	60	61	63	62	63	64	64	8•7
2	37	4•6	51	53	51	54	55	62	64	65	69	71	72	73	74	7•8
3	36	2•2	53	54	54	56	55	59	63	65	64	66	70	73	72	9•3
4	41	2•6	53	53	53	55	55	56	58	63	66	71	73	73	75	7•7
5	32	4•56	60	61	60	59	60	61	58	60	62	65	63	64	66	7•9
6	28	3•4	60	61	63	64	67	65	68	65	66	64	64	65	67	8•7
7	22	4•56	61	60	61	58	61	63	64	65	64	65	67	66	68	6•8
8	20	3•4	65	66	67	69	70	70	73	72	75	76	79	80	84	8•3
9	30	5•04	63	65	70	68	71	75	77	79	76	81	79	81	82	7•6
10	34	4•1	57	56	60	58	59	61	60	59	63	65	66	67	67	9•6

Table(10).

Women treated with vitamin C
and
iron and ammonium citrate.

Patient.	Age.	Initial blood Vit C in mgs. ascorbic acid per litre.	Initial Haemoglobin per cent.	Weekly % Haemoglobin Estimates.												Final blood Vit C in mgs. ascorbic acid per litre.
				1	2	3	4	5	6	7	8	9	10	11	12	
1	32	2·56	31	44	56	60	66	71	70	71	72	77	76	78	87	8·3
2	39	3·7	47	59	64	63	66	71	74	74	75	80	84			6·5
3	27	3·8	64	64	76	79	73	77	81	83						7·9
4	36	1·8	37	41	44	60	66	75	77	81						8·2
5	31	3·4	61	62	69	71	74	75	79	82						6·9
6	22	5·1	61	63	74	78	79	84								7·3
7	25	3·6	44	48	54	61	65	73	76	80	84					8·7
8	33	1·3	48	53	58	70	79	80	83							7·1
9	30	5·52	32	42	58	69	74	73	73	76	79	83				9·7
10	27	2·2	49	57	67	69	70	73	73	75	80					7·7

Table(11).

Women treated with iron and ammonium citrate alone.

Patient.	Age.	Initial blood Vit C in mgs.ascorbic acid per litre.	Initial Haemoglobin per cent	Weekly % Haemoglobin Estimates.												Final blood Vit C in mgs.ascorbic acid per Litre.
				1	2	3	4	5	6	7	8	9	10	11	12	
1	47	3·3	60	61	70	73	76	81	84							4·2
2	34	2·9	57	59	60	64	74	78	77	78	84					3·3
3	21	3·2	68	70	70	71	73	74	79	83						4·2
4	31	1·9	49	51	57	61	69	70	71	76	78	82				2·5
5	27	3·1	54	56	60	62	69	74	77	73	76	83				3·1
6	30	2·5	57	59	65	73	76	77	79	83						2·9
7	36	2·6	61	67	70	73	83									2·9
8	23	4·9	50	52	57	75	78	79	87							4·7
9	36	3·6	57	61	65	67	67	69	73	79	80	83				3·9
10	42	3·7	56	62	66	67	68	70	74	79	82					4·1

Table(12).

Controls.

Patient.	Age.	Initial blood Vit C in mgs. ascorbic acid per litre.	Initial Haemoglobin per cent.	Weekly % Haemoglobin Estimates.												Final blood Vit C in mgs. ascorbic acid per litre.
				1	2	3	4	5	6	7	8	9	10	11	12	
1	42	3·7	51	53	54	55	56	54	56	55	57	60	58	57	60	3·5
2	29	3·1	43	43	44	41	45	46	45	46	48	49	50	53	53	3·6
3	21	3·6	66	70	71	70	67	72	75	75	76	75	74	76	76	3·5
4	28	3·1	65	69	71	72	71	72	72	74	77	78	81			3·9
5	46	2·1	63	60	59	60	61	65	63	67	68	70	71	69	70	3·8
6	34	2·6	69	74	75	77	75	76	78	77	79	79	78	80		2·7
7	35	4·3	61	59	56	61	62	64	65	66	63	65	64	65	62	4·1
8	34	1·9	51	53	49	52	53	51	53	54	55	54	56	54	60	2·7
9	38	5·8	32	33	35	34	35	38	40	42	41	42	42	42	44	5·7
10	27	4·3	50	51	50	51	50	46	48	50	52	52	54	53	53	4·2

The four tables were examined statistically. In considering any of the tables it must be remembered that the initial haemoglobin percentage will probably affect the subsequent rate of growth of the haemoglobin percentage. Hence, in comparing Table(9) (Redoxon alone) with Table(12) (controls) patients were sub-divided into groups having approximately the same initial haemoglobin. Group 1. comprises patients in Table(9) whose initial haemoglobins were 51, 53 and 53 per cent and who were compared with patients in Table(12) whose initial haemoglobins were 51, 51 and 50 per cent. Group 2. comprises patients of Table(9) having initial haemoglobins of 60, 60, 61 and 63 per cent and who were compared with two patients in Table(12) whose initial haemoglobins were 61 and 63 per cent. Group 3. is composed of two patients of Table(9) having initial haemoglobins of 65 and 66 per cent and who were compared with patients in Table(12) whose initial haemoglobins were 65, 66 and 69 per cent.

In considering these various groups, a straight line was first fitted to the data, and coefficients of x gave the rate of increase of the percentage haemoglobin. These are tabulated thus:-

	% Rate of Increase		
Group.	Table(12) (controls)	Table(9) (Vit. C)	Remarks.
50-51%	0·48	2·06	Significant difference
60-63%	0.73	0·63	No Significant difference
65-69%	0·95	1·46	Significant difference

It is seen that there is a significant difference in the first group, no significant difference in the second group and a significant difference is present in the third group. On the whole it can be accepted that there is a slightly greater haemoglobin rise in patients treated with Redoxon alone than those patients receiving no treatment.

An interesting fact observed in this table may be pointed out here. It has been found during the investigation, that the lower the initial haemoglobin then the greater is the average weekly haemoglobin rise when adequate iron treatment is given. If we examine the above table we see that the reverse took place in patients of Table(12) (controls who received no treatment). Here patients who had an initial haemoglobin of about 50 per cent only had an average weekly haemoglobin rise of 0·48 per cent during the twelve weeks supervision, whereas patients who had initial haemoglobin values of about 60 and 65 per cent had average weekly rises of 0·73 and 0·95 per cent respectively.

In comparing Tables(10) (patients treated with combined iron and Redoxon) and (11) (patients treated with iron alone) with the controls Table(12), it was found that there was a marked significant difference in the haemoglobin response of patients receiving iron and Redoxon and iron alone, compared to the haemoglobin rise in the controls. The weekly haemoglobin rise in Tables(10) and (11) varied from 3·52 to 5·39 per cent, while the weekly rise in the controls only varied from 0·48 to 0·95 per cent.

Table(10) (patients treated with iron and Redoxon) was compared with Table(11) (patients treated with iron alone). This was done by the same method as that followed in the previous comparisons. A straight line was first fitted to the data and the coefficients of x gave the rate of increase of the percentage haemoglobin. These are tabulated thus:-

	% Rate of Increase.		
Group	Table(11) (Iron alone)	Table(10) (Iron & Vit C)	Remarks.
47-50%	5.39	4.69	No Significant difference
60-64%	4.50	3.52	No Significant difference

Thus there is no significant difference in the percentage haemoglobin rise in patients treated with iron and Redoxon and those treated with iron alone.

From the data, it would appear that vitamin C medication does not influence haemoglobin regeneration to any extent. It is seen that only a slight significant difference in the weekly haemoglobin rise existed in patients treated with Redoxon and those receiving no treatment, and that there was no significant difference in the weekly haemoglobin rise in patients treated with combined iron and Redoxon and those receiving iron alone.

On examining the tables, it is seen that women treated with vitamin C (Redoxon) with or without iron showed a normal blood ascorbic acid at the final estimate, while those having no vitamin C medication, showed little change in their blood ascorbic acid at the final examination from that found at the initial examination. It was still very low.

It would thus appear that women suffering from this type of anaemia, even when their vitamin C intake is good, or their blood ascorbic acid is within normal limits show a poor haemoglobin response unless the iron intake is adequate.

This haemoglobin response to iron medication, in patients whose blood ascorbic acid is within normal limits, is demonstrated in the following series. Patients 1, 5, 6 and 7 of Table(9) were treated with iron and ammonium citrate at the end of their twelve weeks medication with vitamin C (Redoxon). Each of the four patients as seen in Table(9) had a normal blood ascorbic acid at the commencement of iron therapy.

Table (13).

Patients.	Initial Haemoglobin.	Weekly Haemoglobin Estimates.				
		1	2	3	4	5
1.	64%	68%	73%	78%	81%	
5.	66%	73%	76%	78%	82%	
6.	67%	70%	73%	77%	81%	
7.	68%	72%	77%	79%	83%	

The initial dose of iron administered was 20 gr. tid. this was increased weekly, according to the haemoglobin response. It did not exceed 50 gr. tid. in any of the four patients. A weekly haemoglobin estimate was done until their haemoglobin levels exceeded 80 per cent.

In Table(13) the results are tabulated giving the initial haemoglobin and the weekly haemoglobin estimates until normality was reached.

The average weekly haemoglobin rise of the patients of Table(13) was 3·75 per cent. When comparing this rise with the average weekly haemoglobin rise of patients of Table(11), whose initial haemoglobins were in the 60 per cent group, it was found that there was little difference. Thus it would appear that the initial blood ascorbic acid has little influence on the haemoglobin response when iron treatment is given.

Conclusion.

It would appear that vitamin C medication, if given alone to women suffering from iron deficiency anaemia produces, if any, a very slow response in haemoglobin regeneration. If it be given along with iron medication, then the haemoglobin response is no better than that produced with iron alone.

SUMMARY.

One thousand and fifty nine persons comprising infants, young children, school children and adults of all ages were examined in the foregoing investigation of the incidence of anaemia in the poor-law classes of Glasgow. The results indicate that anaemia is prevalent in infants and children under four years and in women during the reproductive age. It is however relatively uncommon in children of school age, adult males and women over the age of fifty years.

That this anaemia is one of iron deficiency,is evident from the dramatic effects which are produced by the treatment of these women and young children with doses of iron without any change in their diets.

Evidence has been brought forward to show that inadequate feeding, low birth weight and infections all play a part in causing anaemia in infants and young children of this class. Repeated haemoglobin estimations on infants and children attending Child Welfare Clinics would distinguish, at an early stage,those suffering from anaemia. This would allow early advice and treatment to be commenced from which the child's general health would improve and its resistence to infections increase.

It would appear from the evidence that pregnancy and childbirth and in a lesser degree menorrhagia are the

factors mostly concerned with the production of anaemia in women of reproductive age. Infection seems to be of little importance.

The diet of this class of people appears to contain sufficient iron to maintain a normal haemoglobin level, so long as there is no extra call for iron as occurs in pregnancy, and after blood loss during menstruation and following pregnancy.

Sixty seven old people, who lived alone, were examined. The results indicate that the conditions under which they live have no adverse influence on the haemoglobin level.

The results of the examination of men and women living in lodging houses point to the conclusion that anaemia is more prevalent in males than in females. It would appear that mode of living and long continuation of a diet badly prepared, rarely varied and poor in iron are the important factors in causing this low haemoglobin level in men.

From the results of iron medication it may be stated that women of this class, suffering from this type of anaemia respond to iron extremely well. Provided the initial dose is small and the increase gradual, large doses of iron may be given with excellent results.

In view of the results of treatment with vitamin C, one is justified in concluding that the haemoglobin response in women suffering from iron deficiency anaemia, is no better when vitamin C is combined with iron, than that with iron alone.

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