HAEMOGLOBIN LEVELS AMONG AN INDUSTRIAL POPULATION

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THIS survey consists of haemoglobin levels found among a ten per cent random sample of an industrial population.

The population surveyed was that of a general practice centred on a surgery two miles north of the centre of the city of Birmingham. The practice was entirely National Health Service. Ninety per cent of the practice lived within half a mile of the surgery. Most of the housing in the area was built in the period 1880–1910 and consists of small, terraced houses. The age-sex structure of the practice was similar to that of the city as a whole. Seventy per cent of the adult male population of the city is engaged in productive industry in a wide variety of engineering processes, and 47.5 per cent of the population of the Aston Ward consists of foremen and skilled workers (Birmingham 1963).

An age-sex register had been made up for the Medical Research Council epilepsy survey and had been used for the College of General Practitioners diabetes survey. The sample examined consisted of all those patients born in each tenth year, from 1880 onwards, who were on the National Health Service list of the practice on 16 October 1964. Of the 325 patients, only two refused to allow a sample to be taken.

Blood samples were taken from a prick in the pulp of the third or fourth fingers, excepting the four-year-olds, where the lobe of the ear was used. Haemoglobin estimations were made with an EEL photoelectric colourimeter using oxyhaemoglobin and a neutral grey standard. Packed cell volumes were determined by a Hawksley microhaematocrit centrifuge. A centrifuge was not in use at the start of the survey and PCV values are not estimated in all cases. In table II, where this is thought to have introduced bias, as in the women aged 44, the PCV levels have been excluded from the tables. In any patient who had been treated for anaemia during the previous two years, the haemoglobin level before treatment was the value

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taken. The arbitrary definition of anaemia is that used by Davidson in 1943, that is an haemoglobin level below 12.5 gm/100 ml. for men and below 12.0 gm/100 ml for women. For the four and 14-year-old groups and in pregnancy the author has defined anaemia as an MCHC below 31 per cent.

TABLE I
ANALYSIS OF RANDOM SAMPLE

Year of Birth	*Age*	*Total on list*	*Died*	*Gone away*	*Refused*	*Total available*	*Total done*	*Percentage done of those available*	*Non pregnant*		*Pregnant*		*Total anaemic*	*Percentage anaemic of those done*
									Normal	*Anaemic*	*Normal*	*Anaemic*		
Females														
1880	84	7	0	0	0	7	7	*100*	5	2	0	0	2	*29*
1890	74	10	0	0	0	10	10	*100*	8	2	0	0	2	*20*
1900	64	19	0	0	0	19	19	*100*	16	3	0	0	3	*16*
1910	54	26	1	1	0	24	24	*100*	19	5	0	0	5	*21*
1920	44	22	0	0	1	22	21	*96*	16	5	0	0	5	*24*
1925	39	19	0	1	0	18	18	*100*	11	6	1	0	6	*33*
1930	34	20	0	4	0	16	16	*100*	10	3	2	1	4	*25*
1940	24	26	0	2	0	24	24	*100*	15	5	3	1	6	*25*
1950	14	25	0	0	0	25	25	*100*	24	1	0	0	1	*4*
1960	4	29	0	0	0	29	29	*100*	28	1	0	0	1	*3·5*
Totals		203	1	8	1	194	193	*99·5*	152	33	6	2	35	
Males														
1880+	74	7	0	0	0	7	7	*100*	6	1			1	*14*
1890	84													
1900	64	13	0	2	0	11	11	*100*	11	0				
1910	54	17	0	1	1	16	15	*94*	14	1			1	*7*
1920	44	28	0	2	0	26	26	*100*	25	1			1	*4*
1930	34	16	0	1	0	15	15	*100*	14	1			1	*7*
1940	24	19	0	3	0	16	16	*100*	16	0				
1950	14	23	0	3	0	20	20	*100*	19	1			1	*5*
1960	4	21	0	1	0	20	20	*100*	20	0				
Totals		144	0	13	1	131	130	*99·3*	125	5			5	
GRAND TOTAL		347	1	21	2	325	323	*99·5*						

Among the four-year-olds the MCHC is seen to be similar to that of the 24-year-old men. Since men of this age are not likely to be anaemic, it is assumed that the low haemoglobin at this age is due to natural biological variation. The levels are at variance

with normal values given by some authorities (Birmingham 1964, Nelson 1954), but are higher than those found in the 1943 Medical Research Council survey (M.R.C. 1945, p. 31), and much higher than those found in Aberdeen in 1942 and 1945 (M.R.C., p. 39, Davidson 1942). This is presumably due to an improved state of nutrition in the present sample.

TABLE II

MEANS AND STANDARD DEVIATIONS

Females—non-pregnant						
Age	*Hb gm per cent*		*PCV per cent*		*MCHC per cent*	
84	11·99	(*2·12*)	38·21	(*4·60*)	31·38	(*3·26*)
74	12·84	(*0·76*)	40·56	(*1·48*)	31·79	(*1·45*)
64	12·70	(*1·70*)	39·40	(*2·50*)	32·23	(*1·79*)
54	12·56	(*0·81*)	38·95	(*1·98*)	32·35	(*1·64*)
44	12·23	(*1·47*)	*	(*)	*	(*2·06*)
39	12·03	(*1·22*)	38·18	(*2·69*)	31·49	(*2·16*)
34	12·31	(*1·37*)	39·69	(*3·72*)	31·01	(*2·00*)
24	12·24	(*0·94*)	39·55	(*1·98*)	30·95	(*1·77*)
14	12·47	(*1·24*)	37·59	(*3·72*)	33·18	(*2·38*)
4	12·21	(*1·09*)	36·78	(*2·57*)	33·20	(*1·85*)
Males						
74 & 84	13·59	(*0·87*)	42·58	(*3·10*)	31·91	(*1·36*)
64	14·34	(*0·93*)	44·18	(*2·46*)	32·45	(*1·16*)
54	14·12	(*1·26*)	43·57	(*2·17*)	32·41	(*2·11*)
44	14·41	(*1·13*)	44·30	(*2·65*)	32·52	(*1·17*)
34	14·32	(*1·25*)	42·95	(*2·70*)	33·30	(*1·56*)
24	14·62	(*0·83*)	43·65	(*3·46*)	33·53	(*2·32*)
14	12·90	(*1·14*)	39·44	(*2·22*)	32·74	(*1·99*)
4	12·50	(*0·63*)	37·52	(*2·26*)	33·33	(*1·43*)

Among adolescents the figures for the present survey are slightly lower than those of the Aberdeen survey of 1935 and the Medical Research Council survey of 1943, and considerably below those found by Berry in 1952 (Berry 1952). It has been stated that adult haemoglobin levels are reached at puberty, (*Brit. med. J.* 1965a). This may be true for girls and women, but it is not true for men and boys. A rise in male haemoglobin levels, above the levels for women, has been shown to begin between 11 and 12 years of age, and to be well marked by the age of 14 (Walsh 1957, Osgood 1935). There is some evidence that there is a delay in achieving puberty and a lower standard of nutrition, among the children of large families. There are also considerable differences in height and weight among children in different parts of the country, and between different social classes, which are due to differing standards of

nutrition (Scott 1961, Lambert 1964, p. 20). All these factors may need to be considered in assessing the results of various surveys. It is known that adolescents may be relatively poorly nourished and the author's figures appear to support this.

Among women of childbearing years there is a close similarity between the figures from Aston and Wensleydale (Kilpatrick 1961). About 25 per cent of the population in each age group are anaemic, and the mean levels are similar to those of the Medical Research Council survey of 1943, the only significant difference being a lower mean haemoglobin level among women aged 15 to 24 in the Wensleydale survey. The survey in Belfast in 1962 shows a lower level of anaemia (Elwood 1964). If allowance is made for differences in collecting the statistics, then 15 to 20 per cent of the population in this age group may be anaemic. Fry's figures from Beckenham show a level of 26 per cent for this age group (Fry 1966). Berry's figures from varied groups of women in 1952 show a markedly higher mean haemoglobin level, but whether this is due to social or other factors is difficult to assess.

Among postmenopausal women, the only significant difference between women in the various surveys is the higher levels found in the Rhondda Valley in 1958. The reason for this is not known.

Among men, those aged 24 have significantly higher mean haemoglobin levels in the Aston survey, and also those aged 55 to 64 in the Rhondda Valley (Kilpatrick and Hardisty 1961). There is no obvious reason for this since the levels in other age groups are similar. Again Berry's figures are higher than those of other surveys.

The figures for men and women in the older age groups are similar to those found by French (1958) and Semmence (1959), who

TABLE III

PERCENTAGE ANAEMIC MEN AND WOMEN OVER 60 IN THE SURVEY COMPARED WITH THOSE OF FRENCH (1958) AND SEMMENCE (1959)

Authority	*Men*		*Women*	
	Over 60	*Over 70*	*Over 60*	*Over 70*
French	*12·2*	*22·0*	*14·8*	*18·0*
Semmence ..	*5.0*	–	*13·0*	–
Aston	*5·5*	*14·0*	*19·0*	*23·0*

show the following percentages of anaemia among their patients, although the various statistics have not been collected in precisely the same way.

The fact that haemoglobin levels in the four-year-olds in the

present survey are higher than those found in 1943, while the levels of the 14-year-olds are lower, is hard to explain in terms of war-time diet and present day affluence. It is also difficult to see why there should be significant differences between the male populations studied, among whom anaemia is uncommon.

There is a close similarity between the results of the present survey and those of the Medical Research Council survey of 1943. This suggests that there is little change between the nutritional value of the diet eaten during the war and that eaten now. This is in agreement with Lambert's appraisal of nutrition in Britain in 1950 to 1960 "an apparent rise in the standard of living of certain groups has been accompanied by a fall in the adequacy of their diet" (Lambert 1964, p. 22).

Haemoglobin levels in Scotland and the North appear to be lower than those in London and the South (Butler 1963). The only foodstuff whose intake follows a similar pattern seems to be green vegetables (Ministry of Agriculture 1961). It may well be that this plays a part in regional differences in the incidence of anaemia, not only by its iron content but also by the adjuvant effect of ascorbic acid. This may also explain any regional differences in folic acid absorption and megaloblastic anaemia of pregnancy that may exist (Wrigley 1962, *Brit. med. J.* 1965b).

The fact that the level of anaemia should be as high as 25 per cent among women of child-bearing age in such different and widely separated areas as Wensleydale, Beckenham, Belfast and Aston suggests that iron deficiency is widespread and unsuspected. It presents a challenge to preventive and general medical services that is largely unrecognized.

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