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HAEMOGLOBIN VALUES IN BUSINESS EXECUTIVES

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Many series have been published on the values of haemoglobin in healthy men; these usually place the mean value at about 14 to 15 g./100 ml. in agreement with the commonly used figure of 14·6 g./100 ml. = 100 per cent. (Miale 1962; Pryce, 1960; Britton, 1963). Variations in different industries and occupations have not however been studied in depth (Williams, 1966: lead workers; Kilpatrick, 1961; Kilpatrick and Hardisty, 1961: coal miners and other workers).

The data we present on 2,000 business executives is of interest in setting normal levels, because there is no other information on comparable higher income professional groups in Great Britain.

METHODS

The Institute of Directors Medical Centre was opened in June, 1964, and by the end of 1965 over 2,000 patients had been seen. 40 per cent. came as "individuals" at their own request, and 60 per cent. were sent by their firms for routine checks. The first 800 of the former and the first 1,200 of the latter with complete records were selected for analysis.

The examination consisted of a very detailed history, and a complete physical examination, and also included *x* rays of chest and abdomen, 12-lead electrocardiograph, spirogram, height and weight measurements, urine test, haemoglobin, erythrocyte sedimentation rate, serum cholesterol level, and any other investigations that were clinically indicated.

For the first few weeks the blood investigations were carried out by a different laboratory. This gave significantly different mean values ($t = 14{\cdot}7$; P less than 0·001), and these 134 men have therefore been excluded from further analysis.

Haemoglobin was estimated using a standard oxyhaemoglobin method (Dacie, 1956). Blood was collected in sequestrene bottles. 0·02 ml. was washed into 4 ml. of 0·04 per cent. ammoniated distilled water; the solution was read on an EEL colorimeter, standardized against a commercial standard (Haematrol). 100 per cent. corresponds with 14·6 g. Hb per 100 ml. blood.

RESULTS

The ages of the patients varied from 18 to 78 years (mean 46·96 ± 9·25). There was no significant variation in mean haemoglobin level with age Table I).

TABLE I

MEAN HAEMOGLOBIN LEVELS, BY AGE GROUP

Age Group (yrs)	No. of Cases	Mean (g./100 ml.)	S.E.
Under 35	42	14·67	±0·1502
35–39	118	14·65	±0·0895
40–44	258	14·68	±0·0606
45–49	353	14·64	±0·0541
50–54	326	14·61	±0·0539
55–59	323	14·71	±0·0542
60–64	262	14·56	±0·0602
65 and Over	44	14·63	±0·1467
Total "Normals"	1,826	14·64	±0·0228

Forty men were suffering from some condition known to affect the haemoglobin level, and these have been analysed separately. In the remaining 1,826 normal men the haemoglobin values were normally distributed (Fig. 1, opposite).

There was no evidence of any variation in the mean haemoglobin levels with the season of the year (Engelbreth-Holm and Videbaek, 1948), with the presence of mental stress, with a family history of ischaemic heart disease, or with radiographic evidence of cardiovascular abnormality.

Patients attending as "individuals" had a higher mean haemoglobin (14·714 g./100 ml. = 100·78 per cent.) than those sent by their firms (14·588 g./100 ml. = 99·92 per cent.); this difference is statistically significant ($t = 2{\cdot}56$, P less than 0·002).

There was an interesting increase in mean haemoglobin level with the number of cigarettes smoked (Table II, opposite).

A similar trend was shown with increased relative weight, higher alcohol consumption, and raised serum cholesterol levels (Fig. 2, opposite).

These differences are all statistically significant. Patients with an abnormal electrocardiogram had a higher haemoglobin (14·728 g./100 ml. = 100·88 per

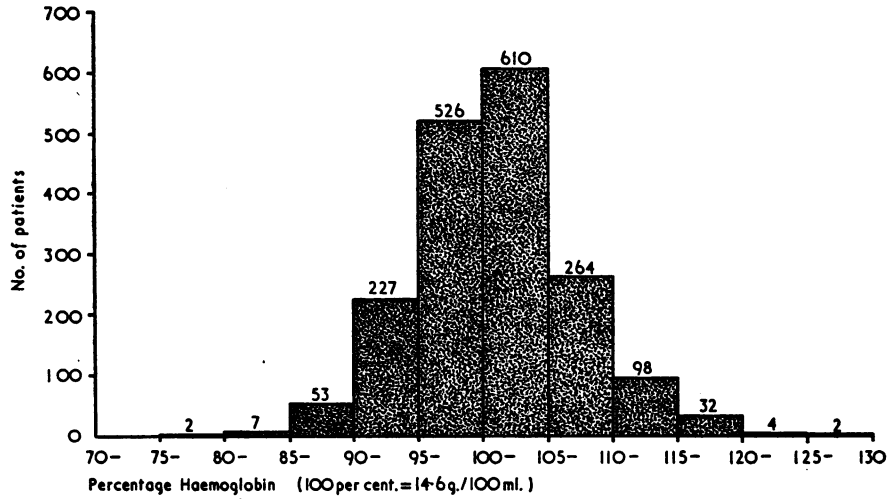

FIG. 1.—Distribution of haemoglobin values.

TABLE II
MEAN HAEMOGLOBIN LEVELS, BY SMOKING HABITS

Smoking Habits	No. of Cases	Mean Hb (g./100 ml.) = (per cent.)	Difference in Mean from Heavy Smokers (g./100 ml.) = (per cent.)	*t* for Difference	P
Non-smokers	398	14·558 = 99·71	0·288 = 1·97	4·35	< 0·0001
Pipe or Cigar Only	224	14·612 = 100·08	0·234 = 1·60	2·96	< 0·005
Given up Cigarettes	355	14·508 = 99·37	0·337 = 2·31	4·94	< 0·0001
1 to 9 a day	188	14·562 = 99·74	0·283 = 1·94	3·38	< 0·001
10 to 19 a day	185	14·613 = 100·09	0·232 = 1·59	2·75	< 0·001
20 or more a day (heavy)	476	14·845 = 101·68			

For any other pair of groups the biggest difference is 0·105 g./100 ml. = 0·72 per cent. $t = 1·19$ $P > 0·2$
For the whole lot variance ratio on 6 and 1819 d. f. $F = 5·68$ $P < 0·01$

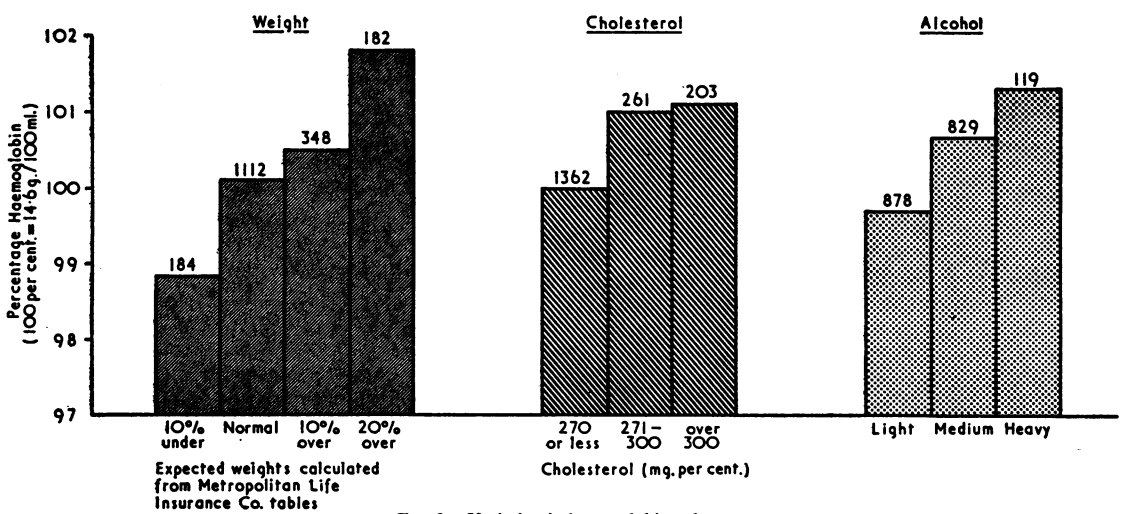

FIG. 2.—Variation in haemoglobin values.

cent.) than those with a normal electrocardiogram (14·609 g./100 ml. = 100·06 per cent.); the difference is statistically significant (t = 2·19; P less than 0·05).

The forty patients who were excluded because of disease had a mean haemoglobin of 13·298 g./100 ml. = 91·08 per cent. (range 10·22–16·35 g./100 ml. = 70–112 per cent.). The difference between them and the "normal" subjects is significant (t = 8·6; P less than 0·001).

Twenty patients were excluded because of peptic ulceration, five because of malignant neoplasms, and the rest for a wide variety of reasons. These patients were older than the "normals", as might have been expected (mean age 53·1 years, range 35 to 75 years; t = 4·1; P less than 0·001). The numbers are too small for further analysis. One patient with a haemoglobin of 23·2 g./100 ml. = 159 per cent., who was discovered early on in the series, is a member of the group that have been excluded as the estimations were done in another laboratory. He has subsequently been diagnosed as a case of polycythaemia rubra vera, and has improved considerably after a course of radioactive phosphorus.

Discussion

The outstanding feature of this socio-economic group is the complete absence of severe anaemia (haemoglobin less than 10·00 g.100 ml. = 68·5 per cent.) and low incidence of mild anaemia. This may be compared with experiences elsewhere. In Salford, 7·1 per cent. of men examined had a haemoglobin less than 12·4 g./100 ml. = 85 per cent. (J. L. Burn 1965). Forsyth and Logan (1964) estimate 56 cases of unrecognized anaemia in men in an average general practice of 2,250 (2·5 per cent.), taking as their limit for anaemia 11·8 g./100 ml. = 81 per cent. In our group the incidence was 0·9 per cent. under 12·4 g./100 ml. Hb, and 0·4 per cent. under 11·8 g./100 ml. Hb. The probable reasons for this absence of anaemia are the higher standard of nutrition and of medical care in this group. This may also account for the higher haemoglobin values found in the "individuals" who are probably, in general, financially better off than those sent by their firms. We found no significant variations in mean haemoglobin with age, in disagreement with the findings of Hawkins, Speck, and Leonard (1954). This too may be related to the absence of malnutrition in this group.

It has been shown that there is a considerable amount of carboxyhaemoglobin in the blood of heavy smokers (Desoille, Truffert, Lebbe, and Parent, 1962; Curphey, Hood, and Perkins, 1965). This may account for the higher mean haemoglobin found in this group; we suggest that they produce more haemoglobin to compensate for the amount bound to carbon monoxide.

It is important that this effect seems to apply only to the *heavy* smokers, who have a significantly higher mean level than all the other groups, whereas none of the differences between the other groups are significant, though they show interesting gradients (Table II). This suggests that, as far as significant carbon monoxide poisoning is concerned, only the heavy smokers are at risk. Smoking in these men correlates with alcohol consumption, with weight, and with serum cholesterol levels (Pincherle and Wright, in preparation), so the relationship between these factors and mean haemoglobin levels may be due merely to their common association with smoking, or may represent a true association.

Summary

The mean haemoglobin values in 2,000 executives are presented, and the factors affecting them discussed.

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