PHYSIQUE AND EFFORT SYNDROME.

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This paper describes an investigation into the significance of physique in effort syndrome.

The primary purpose of the investigation was to determine in what respects the body-build of effort syndrome patients as a group differed from the normal, and secondarily to determine the significance of physique in the development and form of the illness.

Numerous causative factors have been postulated to explain the pathogenesis of the condition since it was first described by Da Costa in 1877. It is possible to divide these into intrinsic (or constitutional) and extrinsic factors, the relative importance of which is found to vary considerably in different cases.

In some patients intrinsic factors are considered to be predominant, and it is customary to classify these under the term constitutional effort syndrome. These cases usually have a history of life-long effort intolerance or vegetative disequilibrium on exertion or excitement, and external factors seem to be relatively unimportant. The exact nature of the constitutional predisposition to effort syndrome is, however, not yet known.

It is possible to study constitution from many aspects, e.g. from the point of view of morphological, psychological, physiological, immunological characteristics. In this study the morphological aspect of human constitution is investigated, as physique lends itself more readily to exact measurement than other constitutional attributes.

Poor physical development had been noted in patients suffering from effort syndrome by Friedlander and Freyhof (1918), Swan (1921) and Wood (1941). The only work known to the writer in which measurements were used and evaluated statistically is that of Lewis (1941), who found that the mean Stromgren index of a group of effort syndrome patients did not differ significantly from that of a group of infantry soldiers.

In view of certain differences in skull and other measurements between the infantry group and data available on other normal groups of the British Isles, it was decided on Dr. A. J. Lewis's suggestion to extend the investigation, using a larger number of physical measurements on additional effort syndrome and normal control groups.

The Material.

The material consists of two groups of 100 soldiers who were successive admissions to the Effort Syndrome Unit of Mill Hill Emergency Hospital. The first group was measured in 1941 and the second in 1942. The lack of adequate anthropometric data on the population of the British Isles necessitated a corresponding anthropometric investigation on a group of 100 soldiers of comparable age and military status to the effort syndrome groups. The measurements of the control group showed little significant difference from the data available for the normal population (Cathcart *et al.*, 1935; Coon, 1939).

Technique.

The measurements were mainly taken by the technique described by Hrdlicka (1939); some measurements were taken by methods described by Martin (1928) and Wilder (1920). The following body-build indices were calculated:

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Stromgren's index = $-\cdot 04$ Stature $+ \cdot 127$ transverse chest diameter $+ \cdot 156$ sagittal chest diameter.

Brugsch's index = $\frac{\text{Chest circumference} \times 100}{\text{Stature}}$

(In this work chest circumference at inspiration was used.)

Morphological index = $\frac{\text{Symphysis height} \times 10^3 \times 100}{\text{Trunk length} \times \text{sagittal chest diameter} \times \text{transverse chest diameter.}}$

Rees and Eysenck index = $\frac{\text{Stature} \times 100}{6 \times \text{Transverse chest diameter.}}$

Differences in physique may be due to body size or to bodily proportion or physical type. Differences in size will be shown by the absolute measurements, and differences in physical type by body-build indices.

The distribution of physical types in the groups was determined objectively by means of the Stromgren index. The criteria laid down by Stromgren (1937) were found to be unsatisfactory, as they are based on the assumption that the majority of individuals can be divided into leptosomatic and pyknic types. Experience of the writer in anthropometric work on over 1,000 individuals refutes this—the majority of individuals were found to be of intermediate physique. The normal group was classified by inspection into physical types and the following distribution was found :

Leptosomes 23 per cent. Intermediate 53 per cent. Pyknic 24 per cent.

Using the criteria laid down by Stromgren there was little agreement in the distribution of physical types, but if the values of the 24th and 77th percentiles (corresponding to above distribution) of the Stromgren index were taken as the arbitrary lines of demarcation between the types, there was very close agreement between body type detected by inspection and objectively by using these values of Stromgren's index. Thus Stromgren index values of $-0{\cdot}133$ (24th percentile) and higher were taken as indicating pyknic habitus and values of $-0{\cdot}79$ (77th percentile) and lower, a leptosomatic habitus, the intermediate type being distributed between these values. Using these ranges of the Stromgren index we have the following distribution of objectively determined physical types in the control group :

Leptosomes 21 per cent. Intermediate 58 per cent. Pyknic 21 per cent.

Results.

Statistical comparison of absolute measurements and indices of body-build in the effort syndrome and control groups is shown in the Table. The significance of the difference of the means was determined by the critical ratio technique.

From the Table it will be seen that the first group of 100 effort syndrome patients were significantly greater in the following length measurements : stature, suprasternal height and trunk length, and significantly smaller in the following breadth measurements : biacromial diameter, transverse and sagittal chest diameters, indicating a more linear or leptosomatic habitus than the control group.

This conclusion is confirmed by the significant differences in Stromgren and morphological indices, which also point to a more leptosomatic habitus in the effort syndrome group.

The second group of effort syndrome patients had additional measurements taken. Sternal length, hip circumference and weight, showed no significant differences. Chest circumference and chest expansion were significantly smaller in the effort syndrome group. The Pignet and Stromgren indices indicate that the second effort syndrome group is also significantly more leptosomatic in bodily habitus than the control group. The second group did not differ significantly in stature, suprasternal or symphysis height, trunk length or skull measurements. It was significantly smaller in sagittal chest diameter (critical ratio = 2·9).

Taking the total group of 200 effort syndrome patients, we find that both the Stromgren and Rees-Eysenck indices indicate that the group is significantly more

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TABLE I.

Variate.	Effort syndrome. Mean.	Effort syndrome. Standard deviation.	Control group. Mean.	Control group. Standard deviation.	Critical ratio.
1st 100.					
Age	28·16	± 6·5833	29·27	± 6·066	1·387
Stature	172·84	± 6·6782	171·01	± 5·3264	2·287
Suprasternal height	141·908	± 5·435	139·47	± 4·678	3·437
Symphysis height	85·85	± 4·590	86·39	± 4·5522	0·835
Breadth of skull	15·125	± 0·511	15·275	± 0·52	0·71
Length of skull	19·505	± 0·6315	19·595	± 0·208	0·937
Cephalic index	77·585	± 3·146	77·905	± 3·2832	0·686
Biacromial diameter	37·58	± 1·9644	39·61	± 2·1095	7·048
Transverse chest diameter	27·14	± 1·7197	28·77	± 2·1206	5·992
Sagittal chest diameter	19·838	± 1·486	20·6	± 1·633	3·454
Bicristal diameter	28·63	± 1·663	29·08	± 1·5978	1·953
Trunk length	55·492	± 3·3116	53·41	± 2·058	2·774
Stromgren index	−0·8805	± 0·43116	−0·596	± 0·4516	4·566
Morphological index	299·1	± 45·70	285·85	± 44·18	2·084
2nd 100.					
Sternal length	21·62	± 1·4491	21·89	± 2·2374	0·263
Chest circumference (insp.)	91·74	± 4·2731	95·79	± 4·8730	6·0
„ „ (exp.)	85·39	± 3·9038	87·96	± 5·3016	3·254
Chest expansion	5·31	± 1·9236	7·95	± 2·7054	6·449
Hip circumference	80·53	± 3·406	79·93	± 6·644	0·740
Weight (kg.)	64·89	± 6·1098	65·6	± 6·8876	0·21
Pignet index	13·2	± 9·795	8·2	± 12·1105	3·01
Brugsch index (chest insp.)	53·62	± 2·1529	55·36	± 3·133	4·3

leptosomatic than the control group (Stromgren index, Mean = −0·806, S.D. = 0·583, C.R. = 4·1; Rees-Eysenck index, Mean = 104·67; S.D. = 7·58, C.R. = 3·36).

It is interesting to note that the Effort Syndrome Group was also significantly more leptosomatic than a group of 400 neurotic soldiers admitted to Mill Hill Emergency Hospital (Rees-Eysenck index, Mean = 102·04, S.D. = 6·974, C.R. = 2·67).

The distribution of physical types determined objectively by Stromgren's index in the total group was: leptosomes 50 per cent., intermediate 44 per cent., pyknic 6 per cent. Thus the percentage of leptosomes is significantly higher than in the control group (critical ratio = 4·49). The correlation of the total group to leptosomatic body-build as measured by the biserial co-efficient of correlation is statistically significant (0·264 ± ·6625).

If the control group can be taken as a satisfactory sample of the general adult population, we conclude that the effort syndrome patients have a greater affinity to the leptosomatic type of physique than the average. This suggests but does not prove that leptosomatic habitus may be a factor in the genesis of effort syndrome.

It is therefore of interest to compare the type of illness in effort syndrome patients of leptosomatic physique with those of pyknic physique.

The following striking differences emerge: 85 per cent. of leptosomes had effort intolerance and vegetative disequilibrium from an early age, compared with 7 per cent. in the pyknic group.

Long-standing timidity, anxiety and general neuroticism was found in 66 per cent. of the leptosomes and only 36 per cent. of the pyknics.

Leptosomes also showed a higher incidence of unsatisfactory factors in the family history. Chronic hypochondriasis occurred in greater frequency in the leptosome group (37 per cent., compared with 14 per cent. of the pyknic group).

The effort syndrome patients of pyknic habitus were characterized by a comparatively short duration of illness—in 85 per cent. the onset was less than two years before admission, compared with 9 per cent. in the leptosome group. In 20 per cent. of the pyknic group the illness was precipitated by marked environmental stress (e.g. severe enemy action), and in 40 per cent. was precipitated by a febrile illness.

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Thus it is striking that in the leptosomes constitutional factors predominate as evidenced by family history, long-standing symptoms of effort intolerance, vegetative disequilibrium, hypochondriasis and neuroticism. The pyknics on the other hand tend to have effort intolerance of recent origin, which was often brought on by extrinsic factors, e.g. traumatic experiences or febrile illness.

Discussion.

Many causative factors can operate in the pathogenesis of effort syndrome as in other psychosomatic disorders. Body-build and its associated physiological and psychological characteristics are possible constitutional factors in the causation of the syndrome. Our results show that there is a statistically demonstrable affinity between effort syndrome and the leptosomatic type of physique.

Results of workers in other fields suggest that the physiological attributes of the leptosomatic type of body-build may play a role in the aetiology of effort syndrome.

Pende (1928) and Wiersma (1933) maintain that leptosomes are predominantly sympatheticotonic; vegetative disequilibrium in the form of sympathetic hyperactivity is found in the majority of effort syndrome patients.

The work of Seltzer (1940) may have some bearing on effort intolerance. Seltzer found that leptosomes have a lower degree of mechanical efficiency as measured by oxygen intake experiments than those of pyknic physique.

The evidence thus suggests that the leptosomatic habitus and its physiological attributes can be contributory factors in the development of effort syndrome. Confirmatory evidence of constitutional predisposition in effort syndrome patients of leptosomatic body-build is given by the family history and long-standing symptoms of effort intolerance, vegetative disequilibrium, hypochondriasis and general neuroticism. In the small proportion of effort syndrome patients who have a pyknic habitus, there is little evidence of constitutional predisposition, and the syndrome usually is produced by exogenous factors.

Summary.

(1) An anthropometric investigation of 200 soldiers suffering from effort syndrome revealed that the group as a whole was significantly more leptosomatic in body-build than a comparable control group.

(2) The proportion of leptosomes was significantly greater and the proportion of pyknics significantly smaller than in the normal group.

(3) Comparison of the aetiological factors in the leptosomatic and pyknic effort syndrome groups showed striking differences, indicating marked constitutional predisposition in the leptosomatic group as shown by family history, long-standing symptoms of effort intolerance, vegetative disequilibrium, hypochondriasis and general neuroticism. The pyknic group on the other hand showed little evidence of constitutional predisposition; the illness was usually of comparatively short duration and mainly determined by exogenous factors.

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