CONSTITUTION AND CORONARY HEART DISEASE*

By O. Elliot

SYNOPSIS

Constitution has been a *leitmotiv* of human disease throughout the growth of medicine from Hippocrates' *Habitus apoplecticus* to present study of host factors in illness.

These correlational studies were limited due to the use of static body types. This difficulty was overcome when Sheldon introduced somatotype procedure which is based on the concepts of component dominance and variation in physique.

Various methods are used to streamline somatotyping which is difficult, time consuming, and expensive. Multiple regression formulae derived by computers from physical measurements are the most successful means of predicting somatotypes.

Many associations are found among somatotypes and afflictions of man, particularly in coronary heart disease where the highest risks are among endomorphic mesomorphs. These findings are limited to western groups. Their applicability to coronary patients elsewhere has not yet been examined.

INTRODUCTION

To some scientists the analysis of physical constitution invokes the image, or rather spectre of phrenology**. Since phrenology and the study of constitution developed at about the same time, they invariably became associated in many people's minds.

On the other hand, medical practitioners have always been aware that certain types of people were more apt than others to be severely afflicted by particular illnesses. Facies and habitus are two aspects of patients invariably brought up over and over again during case presentations, particularly of genetic syndromes, and play an important role in medical illustrations such as those of Netter. This discussion concerns the latter of the two topics, habitus, as expressed in the body build of man.

As Sir William Osler pointed out, a great physician is known by his ability to diagnose the patient as well as the disease or, ". . . to learn not only what kind of disease the patient has but what kind of patient the disease has" (Sheldon, 1940).

Human constitutional study dates back to the time of Hippocrates and has undergone many modifications (Sheldon, Stevens and Tucker, 1940). The best known methods are those of Kretschmer and Sheldon. Kretschmer devised three types: the pyknic or compact build, the asthenic (without strength), and the athletic. Generalized sketches of his body types are shown in Figs. 1-3. Most of Kretschmer's work was with mental patients. In his study of the psychoses he referred to his pyknic patients as "circulars", more prone to manic depression, and found that most schizophrenics were of asthenic (leptosomic)† body build, with a smaller number fitting into the athletic category (Kretschmer, 1951). Other clinical associations, particularly arteriosclerosis, have been made with his body types (Table I). Kretschmer has had considerable influence on medical thought, particularly in Central Europe, and has passed away only recently (1964).

TABLE I

CLINICAL ASSOCIATIONS OF KRETSCHMER'S BODY BUILDS

Condition	Reference‡
Arteriosclerosis	37 (Review)
Serum lipids	27
Tuberculosis	39
Arthritis	56
Gastrointestinal disease	56
Epilepsy	39-40
Mental disease (schizophrenia and manic depression)	39-40
Hyperthyroidism	39-40
Leukemia	1

‡ Listed by Reference Number to conserve space.

† Sometimes the leptosome is considered as a stronger variation of the asthenic body build.

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** Phrenology has been defined as use of the shape of the skull to predict aspects of mind and character or, more simply, study of bumps on the head.

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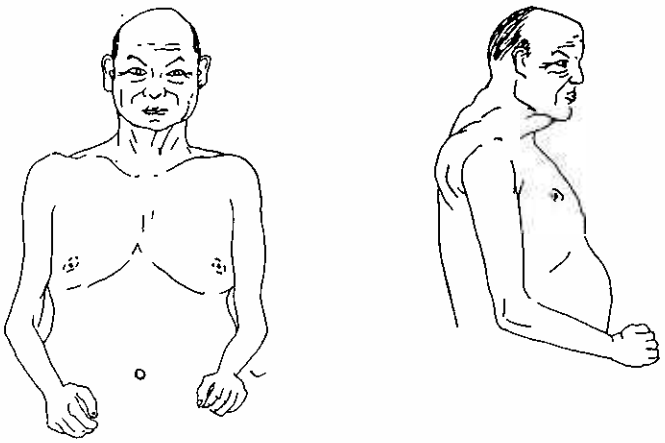

Fig. 1. The Pyknic Body Type.

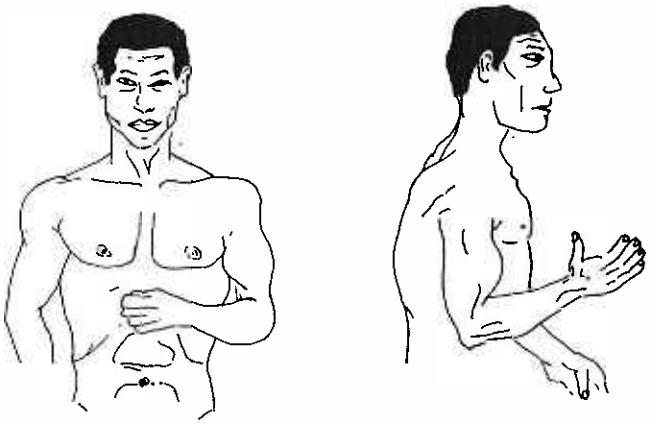

Fig. 2. The Athletic Body Type.

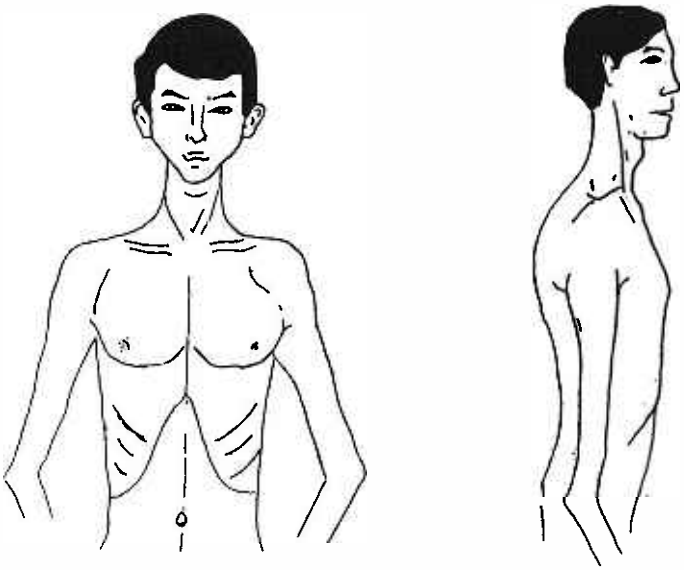

Fig. 3. The Asthenic Body Type.

TABLE II

CLINICAL ASSOCIATIONS OF MALE SOMATOTYPES

Condition	Reference
Coronary heart disease	9, 13-15, 20-23, 38, 48, 55-56, 59-61
Hypertension	13, 55-56
Serum lipids (especially cholesterol)	20, 31, 63
Diabetes	11, 42, 55
Tuberculosis	13, 55, 57
Gastrointestinal disorders	58
Peptic ulcer:	
Duodenal	11, 13, 55, 57
Gastric	56-57
Gall bladder disease	56-57
Arthritis:	
Rheumatoid	11, 56
Osteoarthritis	55-56
Paralytic complications of poliomyelitis	57
Meniere's disease and otosclerosis	11
Toxic diffuse goiter	11
Hyperthyroidism	57
Hypothyroidism	24
17-Ketosteroids	65
Hypopituitarism and hypogonadism	57
Schizophrenia	11, 47, 57
Reactions to drugs*	51
Specific gravity	17
Cancer:	
All forms	57
Lung cancer	55

*Based on the somatotype procedures of Hooton (1959).

TABLE III

FUNCTIONAL ASSOCIATIONS OF MALE SOMATOTYPES

Condition	Reference
Suicide	47
Smoking	8, 54, 55*
Delinquency and crime	25, 26, 28, 33, 47, 53, 58, 64
Choice of career and faculty of study	46-47, 64
Performance in work	6, 10, 64
Athletic performance	47
Intelligence	47
Duration of stay in hospital	47

*Seltzer adapted his own method of studying the "masculine component".

SOMATOTYPES

Several persons have worked in recent years on methods of somatotyping the human body. Even though some of them, particularly Hooton (1959), made valuable contributions, I will restrict this discussion to the investigations of Sheldon (a student of Kretschmer) and his colleagues, as most pertinent to research on coronary heart disease. Sheldon, Stevens and Tucker (1940) presented a threefold view of somatotypes as characterized by: endomorphy, mesomorphy and ectomorphy. Impressionistic drawings of his three types are found in Figs. 4-6. Sheldon found only these three extremes although he expected more.

The three extremes appear related to the three primary germ layers. Sheldon (1940) did autopsy work and found three types of physiques. The first had enormous intestines, liver and other digestive viscera. The gut was long and heavy and there was a conspicuous laying on of fat. The heart and kidneys were of moderate size. In the second type he found very large hearts, arteries and muscles. The third type had small, short intestines contrasted with large skin and surface areas.

As summarized by Sheldon *et al* (1940) the functional elements of the digestive system are derived from endoderm. On the other hand, bone, muscles, connective tissue, heart and blood vessels are drived from the mesoderm, the second embryonic layer. Still further, the skin, hair, nails, sense organs, nervous system (including brain) are derivatives from the embryonic ectoderm. Sheldon's classification is based on the relative preponderance of these parts to other parts. An individual is therefore not classified as a mesomorph but as a dominant mesomorph or endomorphic mesomorph. This is in itself a considerable departure from the older typologies, including even that of Kretschmer.

Sheldon experimented with Viola's and Kretschmer's procedures, with measurements and contours. He ended up using photographs, perhaps partly influenced by the standardized photographic records of Sargeant on Harvard undergraduates. According to Sheldon there are not three types of poeple but a continuous distribution of people and physiques.

> "Physique is a continuum, and any system of rating must have as its purpose the location of the individual on the 3-dimensional spectrum of physique."

He tried to avoid typology with his idea of varying components in which each person is scored as to his three components on a seven point scale. According to this scheme an individual could be a 346 (3 in endomorphy, 4 in mesomorphy and 6 in ectomorphy), a 712 or a 631. The components are always expressed in this order: endomorphy, mesomorphy, ectomorphy. Using this seven point scale for three components, 343 numerical possibilities existed, however Sheldon found only 76 somatotype combinations in 4,000 young college men. The use of half steps has helped to make the seven-point scale less discrete and more continuous, consequently adding a vast number of possible combinations.

Certain problems may appear to exist in somatotyping and constitutional research in general. One concern is the replicability of results from observer to observer. Enough studies have been completed (Tanner, 1954; Brouwer, 1957; Hunt and Barton, 1959; Damon, 1960; Sheldon, Stevens and Tucker, 1940), with correlations of 0·9 or higher between independent ratings, to remove this as a bone of contention. Another question refers to the permanence of the somatotype throughout life. In spite of one conflicting report (Hunt and Barton, 1959) most evidence indicates that the physique of a person does not change with time (Damon, 1965). A man can become a lean or fat 444 but cannot change from a 444 to a 443. Recent studies on ageing and fat cells indicate that the size and not the number of fat cells vary with time (Newsweek, 1970, Oct. 19:48-49), tending to support the concept of the basic invariability of the somatotype.

Typology in constitutional medicine is subject to the same sort of critical evaluation as typology in other biological fields. The taxonomy of the vertebrates has been plagued by problems resulting from over-reliance on types, particularly those established on the basis of one fossil specimen or biological observation. Types generated from a paucity of evidence have been elevated to the level of Plato's *eidos*, ideal form (Mayr, 1957), on both the drawing board of evolutionary textbook illustration and the lecture platform. Many of these cobwebs of thought will require as much effort to sweep away as was expended by Vesalius (1514-1594) in his attempts to bring actual observations into the field of anatomy. In devising a somatotype technique with three continuous scales and an insistence on the pattern, or *Gestalt*, of relative dominance of these three components within one man, Sheldon has done a great deal in bringing the field of human constitutional study down from the realm of Platonic *eidos* to the practical world of usable methods in clinical medicine.

Sheldon has given us, in somatotyping, the best approximation yet, for the human body, to Le Gros Clark's (1955) Total Morphological Pattern.

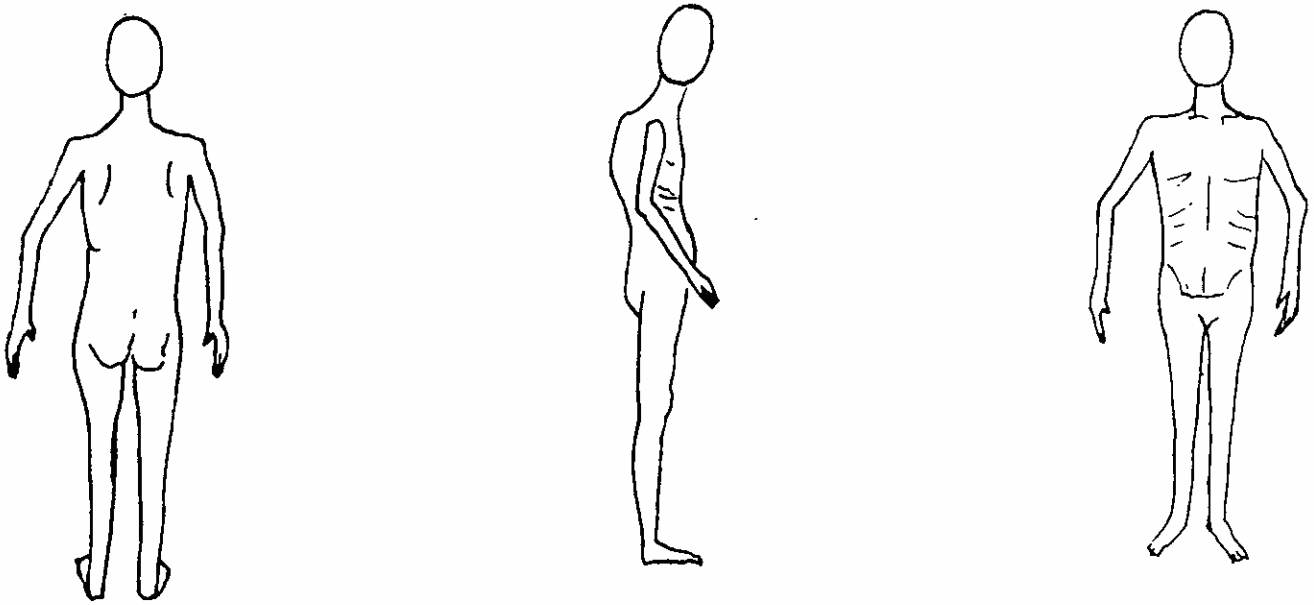

Fig. 4. Ectomorphy.

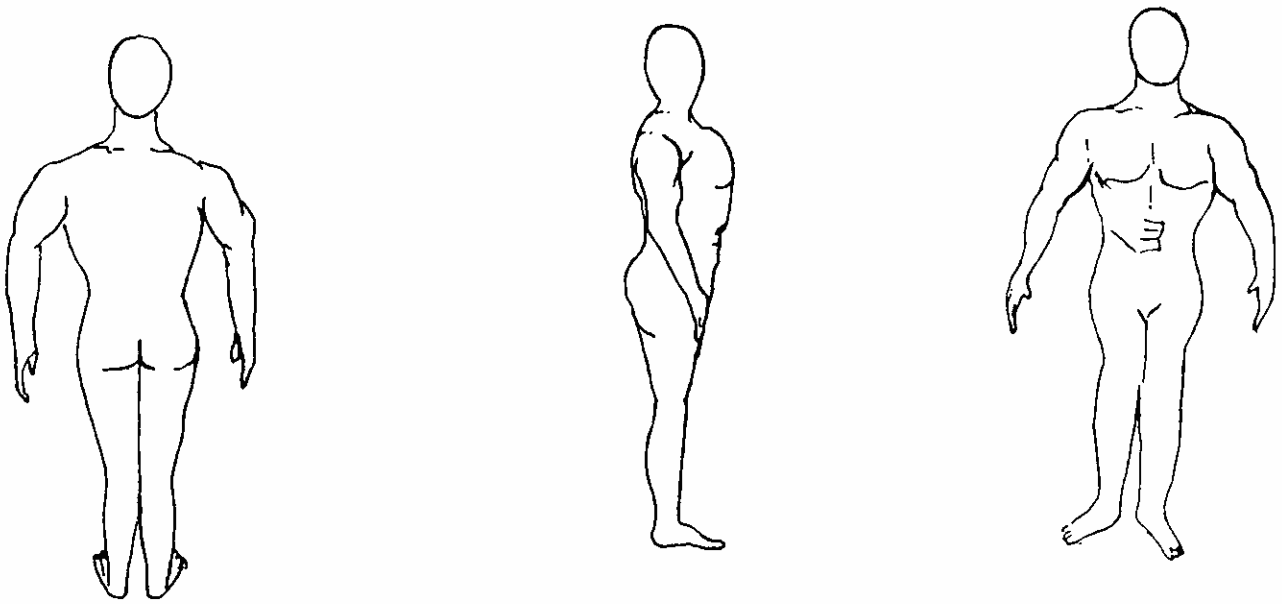

Fig. 5. Mesomorphy.

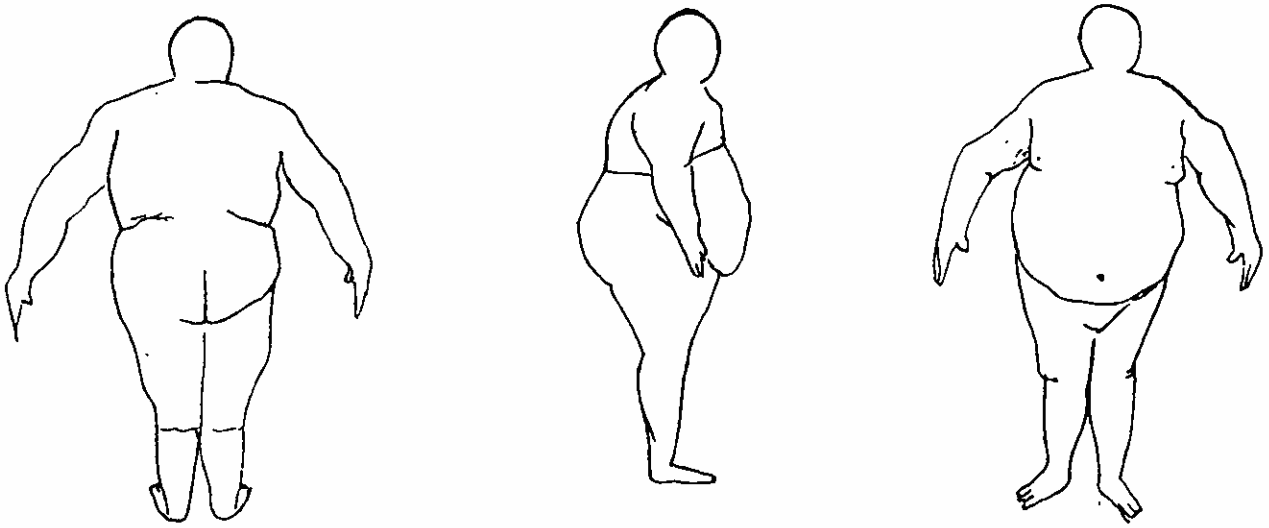

Fig. 6. Endomorphy.

SOMATOTYPE PREDICTION FROM ANTHROPOMETRY

Both Sheldon (1940) and Hooton (1959) considered the possibility of predicting somatotype from physical measurements. If one conducts a flowchart study of the human factors involved in somatotyping it is obvious that the difficulties boil down to personal and equipment problems. The long training period necessary to master the technique of somatotyping is one drawback while convincing subjects to pose in nude or near nude states is another. The expensive and rather cumbersome equipment makes it rather difficult to take photographs in field situations, meaning any situation where the apparatus has to be packed and transported away after use.

Early attempts to predict somatotype from individual measurements (Dupertuis, 1950) and from factor analysis of several measurements were not successful, as reviewed in Damon, Bleibtreu, Elliot and Giles (1962). A step-wise computer analysis employing anthropometric variables in multiple regression was tried on several samples. Fairly good predictive formulae were obtained using samples of American white and negro soldiers (Damon, Bleibtreu, Elliot and Giles, 1962), war veterans, and Italian-American factory workers (Damon, 1965). A separate study of Chinese on Taiwan yielded even better results (Chen, Damon and Elliot, 1963).

These studies provided predictive equations for somatotypes that are now being given preliminary trials in research on various medical conditions.

The following discussion will deal strictly with results obtained by means of the Sheldonian or "classical" somatotype methods.

SOMATOTYPES AND DISEASE

Several associations and correlations have been made between somatotypes and pathological conditions, as well as physiological and behavioural traits. Some of these are presented in Tables II and III. Whether a person agrees with these associations or not, the findings are certainly worthy of serious consideration and further investigation. It is important to mention here that this presentation is restricted to men though a few studies have found association of somatotype with pre-eclamptic toxemia (Myles, 1964), endometrial cancer and carcinoma of the breast and uterus (Seltzer and Mayer, 1966), and CHD (Gertler, White *et al*, 1954) in women.

CORONARY HEART DISEASE (CHD)

Criteria for the definition of coronary heart disease are reviewed in Robb-Smith (1967) and Kannel *et al* (1961). Suffice it to say that considerable variation exists in the literature as to what combinations of symptoms and findings are used to identify the condition. Autopsies are not always possible to make definitive diagnosis.

Various factors have been singled out as increasing the risk of developing CHD. These include: obesity, age, blood pressure, serum lipids, amount and type of food, exercise, smoking, air and sound pollution and genetic propensity. Stress has often been implicated not only in the etiology of the disease (Damon *et al*, 1967) but in causing headaches to the investigators attempting to define and study it. Animal studies (Ratcliffe, 1963; Ratcliffe and Cronin, 1958; Lindsay and Chaikoff, 1963) in particular have emphasized the stresses of increased population density.

One of the major interests in CHD studies is the singling out of two groups of men: (*1*) those least likely to show the disease and (*2*) coronary prone individuals. Such attempts have yielded complicated, and in one instance, humorous profiles. The late Gordon Myers made a thumbnail sketch of the cardiovascular superman, the man least likely to have CHD (cited in Groom, 1961). I quote his statement here:

> "An effeminate municipal worker or embalmer,
>
> Completely lacking in physical and mental alertness and without drive, ambition or competitive spirit who has never attempted to meet a deadline of any kind,
>
> A man with poor appetite, subsisting on fruit and vegetables laced with corn and whale oils,
>
> Detesting tobacco,
>
> Spurning ownership of radio, TV, or motor car,
>
> With full head of hair and
>
> Scrawny and unathletic in appearance,
>
> Yet constantly straining his puny muscles by exercise,
>
> Low in income, B.P., blood sugar, uric acid, and cholesterol,
>
> Who has been taking nicotinic acid, pyridoxine, and long term anticoagulant therapy
>
> Ever since his prophylactic castration."

The consistency of results in the various studies of CHD and somatotypes has been surprising. The mesomorphic somatotype has been the form most commonly implicated as prone to high risk. Only Paul *et al* (1963) found somewhat varying results in which they singled out endomorphy as the most predisposing constitutional factor in CHD, how-

ever, as Damon *et al* (1969) point out, the former workers employed methods of analysis and definition somewhat different from other studies.

Since there is, with the above exception, general agreement, I have selected for discussion a few investigations as representative of the trend of findings on somatotypes and CHD. Spain, Bradess and Huss completed autopsies on 38 men under 46 years of age who died suddenly from CHD. Most of these were dominant mesomorphs. The study also involved 73 men of the same age group who died from violent deaths. Half of these apparently normal men had anatomically significant coronary atherosclerosis and were likewise mainly dominant mesomorphs. A later study by Spain *et al* (1955) supported this association between mesomorphy and CHD necropsies. Large scale surveys in New York City and longitudinal studies in various communities such as Framingham, Massachusetts and Albany, New York have pinpointed the high risk body types even more precisely. Spain *et al* (1963) investigated 5,000 Jewish men in New York City and found that endomorphic mesomorphs faced a CHD risk three times that of ectomorphs despite the presence or absence of hypertension. The endomorphic mesomorphic constitution was likewise singled out as most prone to CHD on the basis of 97 male coronary patients from the Framingham project (Gertler, White *et al*, 1954). These researchers plotted the distribution of their CHD and control cases according to the two-dimensional method of Sheldon (1940). The CHD group clustered in the "northwest" or endomorphic mesomorph corner whereas the controls showed a more equitable distribution. Ectomorphs were again confirmed as least prone to coronary disease. A more recent study (Damon *et al*, 1967) applied the equations that we had developed earlier (Damon, Bleibtreu, Elliot and Giles, 1962; Chen, Damon and Elliot, 1963) to predict somatotypes from physical measurements. The results supported the association between mesomorphy and endomorphy with CHD. Preliminary findings were also reported (Damon *et al*, 1969) on the attempt to bypass somatotype photographs by predicting CHD from anthropometric variables alone.

GENERAL DISCUSSION

Constitutional research offers a possible approach to the study of the "host factor" in CHD and other clinical investigation.

Mesomorphic men appear to be relatively prone to CHD. This does not, however, implicate the mesomorphic build, in itself, as more hazardous to life than the other somatotypes. Sheldon (1940) has pointed out that all the great classes of constitution have their share of medical problems as well as biological advantages. CHD is obviously not caused by mesomorphy. Kretschmer made the following statement on constitution as a causative factor in pathological conditions:

> "The genesis of a particular change depends not so much on the constitutional type as does the prognosis, that is, the course of the disease and its outcome" (quoted in Hoehne, 1964).

It is possible that particular somatotypes, such as mesomorphic ones, may be predisposed toward certain ways of life which in turn augment the person's susceptibility to CHD. Mesomorphy is the fertile field, as it were, in which CHD grows and develops.

Variations in body build occur throughout the world, often on an ethnic basis. Human biologists are familiar with the fact that there are significant body build variations between Orientals and Occidentals (Chen, Damon and Elliot, 1963). An obvious difference is that Oriental people tend to have relatively long trunks in contrast to Africans, Indians and northern Europeans who have relatively long limbs. Previously supposed lack of CHD among Asiatics has been complicated by the findings of gross lesions in 65% of series of autopsies on Japanese (Groom, 1961). Coronary disease was described in 867 persons from a total of 3,054 cardiac cases in Indians (Malhotra and Pathania, 1958), who by the way, are Caucasians.

If we think in terms of stress as a predisposing factor for CHD then it may be possible that cultural patterns could select one type of man in Western society and another in the Eastern world to fill the CHD slot. This consideration would be of help if a differing somatotype constellation is found to consistently occur among eastern coronary patients. Malhotra and Pathania (1958) did not classify their CHD cases in terms of somatotypes, yet they found only 6.7% thin and 29% obese persons in their series. Only further investigation on CHD can tell if similar somatotypes are found to inhabit the same epidemiological niche in Indian as in Western society.

Before closing this discussion on constitution and CHD there is one final matter that should be considered. This relates to the constancy of the somatotype. Somatotypes apparently do not vary during life, indeed Sheldon (1940) believes they may be identified at birth. If somatotypes are constant, if they have a genetic basis (Stern, 1960), and if mesomorphy is associated with CHD, we may ask why CHD is increasing at an ever rapid rate particularly in the Western countries.

Robb-Smith (1967) offers evidence to qualify the latter generalization. He states that there is no modern epidemic of coronary disease. He finds no proof that there is an increase in CHD or a corresponding decrease in myocardial degeneration. The increased prevalence of heart disease is associated with the increased expectation of life which is in part due to control of many infectious diseases. Robb-Smith goes on to quote Greenwood (1948) as saying: "Even trained statisticians sometimes confuse names with things. More than one rate of mortality has risen (or fallen) on paper."

Robb-Smith (1967) states that many of our findings relate to the interpretation of the Registrar-General's classification, to changing assignments and rules. Only in recent years has there been any semblance of inter-national comparability. We need to know the detailed practice of various statistical centres to attempt comparisons among various regions of the world.

In seeking to unearth the basis of CHD we have discovered many artifacts rather than the Venus de Milo we hope for. Some of these artifacts consist of fuzzy definitions and terminology and others have generated spontaneously from statistical and sampling errors. Science is unfortunately not always able to classify results under the headings: facts, probabilities, possibilities and lies, as Thomas Jefferson once hoped newspapers might do with their news (Groom, 1961) but it should benefit us to remember that the latter two categories occur as frequently as the former two.

The applicability of constitution to medical practice will rest on the decision of the clinicians to whom this paper is dedicated. Hopefully, the study of physique, and somatotypes in particular, may prove of some value to the study of coronary heart disease and perhaps more useful to science than the topic of phrenology with which it was formerly associated.

ACKNOWLEDGEMENTS

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