

PHYSIQUE OF COAL-MINERS

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Abstract: The authors intended to answer the question whether the predisposition of physique has any role in development of silicosis. They carried out a detailed anthropometric investigation on 150 coal-miners suffering from silicosis and on their 97 healthy counterparts who formed the control group. The persons investigated worked 15-25 years under the surface.

To estimate the somatotype of the coal-miners, the Heath-Carter somatotyping method was used. The mean somatotype of coal-miners suffering from silicosis is 3.78-6.07-1.16, and that of healthy coal-miners is 5.46-6.44-0.93, respectively. The mesomorphy component dominates in both groups. It is connected with the heavy physical work done permanently under the surface, but, on the other hand, these coal-miners were chosen from among the strong, corpulent shifts of the population. The value of endomorphy component in the coal-miners suffering from silicosis is significantly lower than in their counterparts. The total body fat of the former group is 21.9%, significantly lower than that of the healthy group (27.1%) which is qualified as obese. The ectomorphy component shows a very low value in both groups, the body build of coal-miners is very little linear.

It is conspicuous that in both groups the overwhelming majority of the subjects is endo-mesomorph, and both groups are very homogeneous in physique. This phenomenon rarely appears in such an extent in other professional groups. It seems to be that in coal-miners the physique has no primary role in development of silicosis.

Key words: Physique, Somatotype, Coal-miners, Silicosis.

Introduction

In the literature of constitutional biology it is well-known that a certain type of physique predispose to several different diseases. The term „type” needs to be, at the same time further clarified. On the other hand, it is also known that the same illness can appear in patients with different types of physique.

Before going into details we must draw attention to the fact that the type of physique, as all types, is an abstraction and individuals can only very rarely embody it. As Kretschmer (1921) stated, we all are alloys of physiques.

By *physique* we mean the morphological constitution of an individual which is formed by the manifestation of genetic endowment and the result of adaptation to environmental effects (Eiben 1972).

In the 1940s when clinical constitution researches described the above-mentioned statements it was already known that genetic and environmental factors have an effect on the physique. The question had risen whether it is the fundamental type of physique which predisposes to a certain disease or only a difference of the constitution which appears only in a particular part of the body. Some inherited diseases belong to this group which are based on a local difference taking place only in one of the germ layers or in one of the organ systems. The idea that the predisposition of the physique can be found in all diseases and moreover that each individual has his/her own susceptibility to certain diseases, was generally accepted. So the constitutional diagnostics were not concentrated on typing, but rather on the detailed recognition of constitutional predisposition.

The above-mentioned fact that the same illness appears in different types of physique raised the question: What is the incidence frequency of the different types of physique in

certain diseases? According to clinical constitutional biology a disease is predisposed by one of the extreme types of physique, for instance the pyknic. The disease, however, can be found in quite a great number of people among those of mixed type of physique and in a small number also among people with the opposite type of physique which in this case is leptosomic. Experiments verify that in the width development of the body a characteristic variational sequence can be followed in each group of the different diseases.

From constitutional viewpoints, the causes of the diseases are environmental factors, and local or general predisposition of the physique.

A Selected Overview of Literature on the Subject

It is a significant observation that although the pyknic constitution does not predispose to pulmonary tuberculosis, environmental factors can also stimulate the development of the disease in these people. Beneke (1881) noted that he often found miners with strong physiques suffering from pulmonary tuberculosis due to the inhalation of dust. Clinical diagnoses of these people usually show cirrhotic peribronchial bronchiectasia whereas mostly phthisis and dystrophy appears among miners with weak constitutions.

It is not possible to exclude that the constitutional differences in the structure and tissue of the lung have some role in predisposition to these diseases (Orsós 1928, 1933).

Only very little data are available concerning the clinical parameters and even less about the physique of miners suffering from inhalation of dust.

It is well-known that the permeation of silicosis all over the world demonstrates that the individuals of each race and groups of peoples are susceptible to this damage, namely, the longer and the more intensive they inhale the dust in great concentration, the more susceptible they are.

Ickert (1931) investigated the harmful effects of dust-inhalation among copper miners in Mansfeld. In leptosome miners he found serious silicosis combined with pulmonary tuberculosis while the miners with pyknic and athletic constitution showed only a very slight susceptibility. In the same mining district Geisler (1937) did not find any correlation between copper miners' physiques and silicosis.

Beckmann (1951), based on his vast investigation, published that people of pyknic constitution are especially suitable as miners, because in their case the silicosis develops much more slowly than in those having athletic or asthenic constitutions. Leptosoms were found to be relatively suitable from the viewpoint of susceptibility to silicosis because they were found to be in between the pyknic and athletic and asthenic constitutions. (In his publication Beckmann drew attention to the difficulties of typing, to the differences derived from the age and to the necessity of further physiological and psychological investigations.)

In spite of these, Cochrane (1951) found that in people with asthenic constitutions, tuberculosis breaks out with great probability after a few years of mining. Lassere (1941) investigating Austrian coal miners also stated that people with asthenic constitutions are especially unsuitable as miners.

Ceelen (1951) raised the question whether the different behaviour toward silicosis can be explained by the stronger resistance of pyknics or by the congenital disposition of asthenics. It should also be taken into consideration that hypoplasia of the heart and blood vessels, which appears almost always in asthenic people, causes the insufficient blood supply to the lungs and can be connected with the disposition to infections, especially to silicosis.

On the basis of the investigations of Krüger and Schlomka (1954) the question arose whether it would be worth investigating the dependence of silicosis on the physique with the help of the methods of constitutional biology, because people belonging to the pyknic constitutional type show a greater susceptibility to the 2nd and 3rd phase of silicosis than the leptosoms (incidence frequency is 2-3 times greater).

Cochrane (1951) studying miners, drew attention to the importance of constitutional indices. Although in an index which is the ratio of height and one of the width measurements he did not gain significant differences between the groups of miners being in various stages of lung diseases caused by dust-inhalation, he emphasized the prognostic importance of constitutional indices. It is well-known that in athletes, especially those having a great stamina for example long-distance-runners, the chest depth is apparently large (Eiben 1972).

There are remarkable data available on the appearance of silicosis from studies carried out in families and twins. In certain mining families silicosis did not appear through generations, on the other hand, in other families its serious form appeared fairly soon (Lochtkemper 1935, 1951, Worth-Schiller 1954). This observation suggests the hereditary disposition.

Rasche and co-workers (1982) recite epidemiological observations carried out on coal-miners,

which with help of comparable dust pollution unanimously proved that there are individual differences in appearance and development of different pulmonary diseases (pneumoconiosis) caused by dust-inhalation. Several miners show radiologically observable lung deformations after the inhalation of a relatively small amount of dust. For the special protection of these susceptible miners the knowledge of the individual factors, characteristic of those partly predisposed to pneumoconiosis, is needed. In the course of their investigations they found no significant differences in laboratory-parameters (apart from differences in HLA type). So they could not decide whether the difference they had found were the causes or the results of the development of pneumoconiosis. They did not published any data on physique.

The occupation usually has an early effect on physique, especially in young people (Buday 1943). Among the coal-miners in Mecsek hills we often met corpulent variations, similar to the „brachy” type of Viola (1933). This type of physique can be characterized by domination of the trunk, which is the centre of the vegetative life. The extremities, especially the lower limbs are short. Since the productivity of the body is proportional to the volume of the trunk, if all the other conditions are standard, people with this type of physique are able to perform strenuous activity, but they are slow. Their most important advantage is that they don't tire easily. Their musculature is not fatigable, in this respect it is similar to the smooth muscle. They are suitable for slow tonic contraction and as a consequence of this they will be hypertrophic.

Data on the somatotype of miners could not be found in the literature.

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The aim of our study was to clarify whether the constitutional predisposition has any role in the development of silicosis in the coal-miners in Mecsek hills.

Material and Methods

A detailed anthropometric programme was carried out on 150 coal-miners (mean age: 47 year; from 27 to 63 years of age) suffering from silicosis and on a normal healthy group of 97 coal-miners (mean age: also 47 year; from 35 to 55 years of age). The members of both groups worked for 15–25 years under the surface.

The anthropometric technique of Martin (Martin–Saller 1957) was used, taking into consideration the recommendation of the International Biological Programme (Tanner et al. 1969).

The physique was estimated according to the Heath–Carter anthropometric somatotyping method (Carter 1975).

Results

The values of height in the two groups are almost the same. The ill coal-miners are 169.3 cm tall and their healthy counterparts are 168.3 cm. Regarding the weight no significant difference can be found between them. The body weight of the coal-miners suffering from silicosis and that of the healthy coal-miners are 77.1 kg and 80.9 kg, respectively. The latter value is 5 per cent more. The epicondylar widths of the humerus and femur show that the developmental level of the skeleton is similar in both groups although the coal-miners suffering from silicosis seem to be in a minimal degree leaner. The extremities of the latter group are relatively more muscled while in the healthy coal-miners the higher values of subcutaneous fat are obvious (Table 1).

Apart from the latter measurements the two groups of the investigated coal-miners do not differ significantly in their body measurements from each other and also the values of standard deviation show that on the basis of their body build the coal-miners form a fairly homogeneous group.

The mean of the somatotypes in silicotic coal-miners is 3.78–6.07–1.16, while in healthy coal-miners: 5.46–6.44–0.93. Compared these values with Student's test, the differences in every component are significant, in endomorphy $t=12.2616$, $P < 0.001$, in mesomorphy and in ectomorphy $t=2.2904$, and $t=2.2986$, resp., and in both cases $P < 0.05$.

The *mesomorphic* component is dominant in both groups and this can be brought into

Table 1. Body measurements and other characteristics of physique of Mecsek coal-miners

Body measurements	Coal-miners suffering from silicosis N=150		Coal-miners, healthy (control group) N=97	
	\bar{x}	s	\bar{x}	s
Stature (cm)	169.31	5.89	168.55	6.67
Weight (kg)	77.06	12.57	80.90	12.80
Bicondylar humerus (mm)	73.06	4.19	74.19	4.02
Bicondylar femur (mm)	97.90	5.16	100.54	5.09
Upper arm circumference, relaxed (cm)	30.58	2.56	31.26	2.87
Upper arm circumference, contracted (cm)	32.01	2.65	32.55	2.96
Middle arm muscle circumference (cm)	28.06		27.69	
Middle arm area (cm ²)	74.98		78.45	
Middle arm muscle area (cm ²)	63.09		61.42	
Calf circumference (cm)	36.67	2.80	36.93	2.69
Calf muscle circumference (cm)	34.33		33.46	
Calf area (cm ²)	107.67		109.14	
Calf muscle area (cm ²)	94.30		89.47	
Subcutan fat (skinfold thicknesses)				
over triceps (mm)	8.06	2.54	11.40	4.57
subscapular (mm)	13.21	4.55	19.78	6.15
supra-iliac (mm)	15.61	5.45	25.76	8.93
medial calf (mm)	7.46	2.76	11.07	4.83
Fat mass (kg)	17.18		22.39	
Fat%	21.89		27.10	
Lean body mass (kg)	59.88		58.52	
Density	1.049		1.038	
Endomorphy	3.78	1.12	5.46	1.40
Mesomorphy	6.07	1.16	6.44	1.35
Ectomorphy	1.16	0.79	0.93	0.73
SDI	3.49		3.58	

connection with the hard physical work that they had done under the surface for a long period of time. It should also be taken into account that these men were chosen from the strong, well-muscled strata of the population because of their suitability for mining. The domination of mesomorphy is certainly a selectional factor. The *endomorph* component shows a significantly lower value in silicotic coal-miners. Their total body fat is only 21.9%. The subcutaneous fat of healthy miners is 1.5 times greater than that of their silicotic counterparts. The total body fat of healthy coal-miners is 27.1% so therefore they are qualified as obese. The lean body mass and density of coal-miners suffering from silicosis are greater than those of their healthy counterparts. The *ectomorph* component shows a low value in both groups; the body build of the coal-miners is only slightly linear (Fig. 1).

It is obvious that both groups are mostly endomorphic-mesomorph and also very homogeneous in their somatotype. Their SDI values hardly differ from each other (3.49 and 3.58, resp.). This phenomenon in such a degree can rarely be seen in groups of other occupations.

Somatotype of the coal-miners suffered from silicosis was investigated also in connection with their career in mines, as well as connection with severity of their illness.

Taken as a function of length of time what the coal-miners worked underneath the

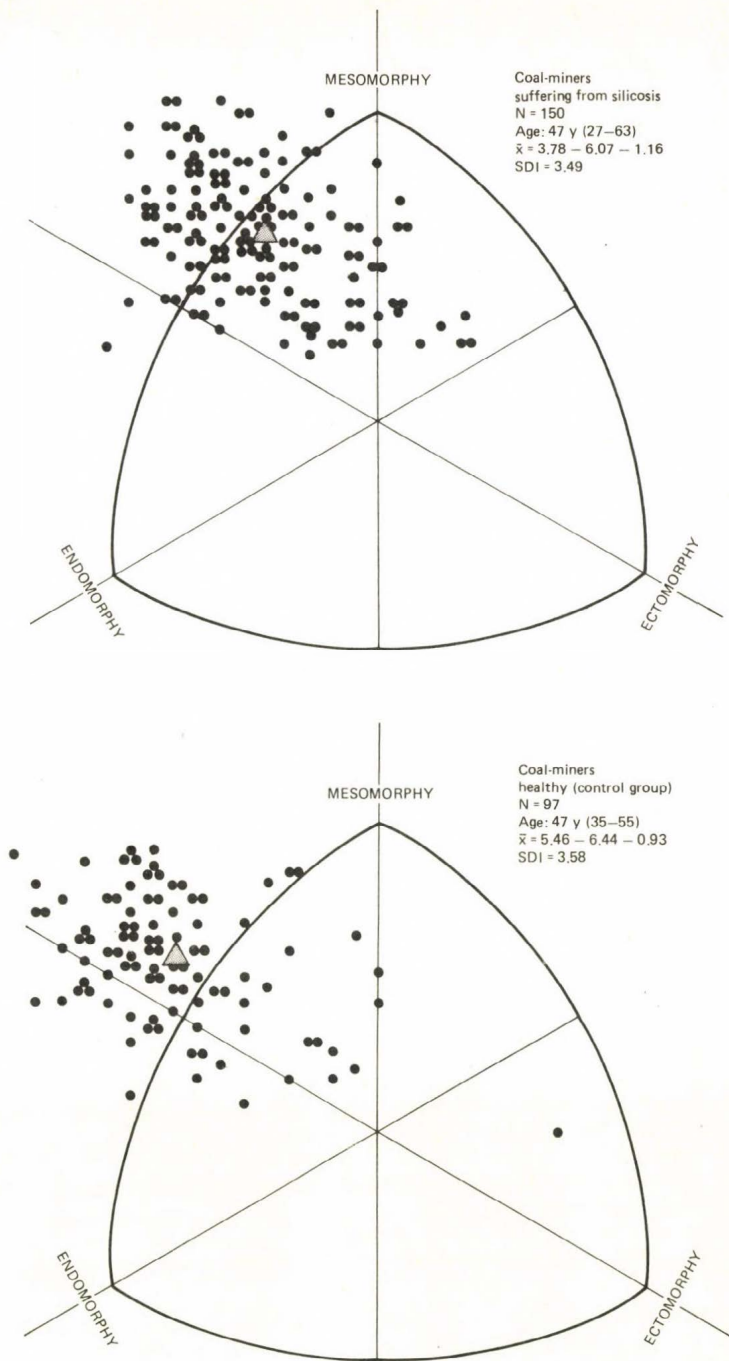


Fig. 1: Somatotypes of two groups of coal-miners

surface, there is no significant differences in their somatotype. The subgroups of coal-miners worked 5–10, 11–15, . . . 36–40 years underneath the surface, have 5.4–6.5 units in their first component, 3.0–4.2 units in their second one and 0.8–1.7 units in their third one.

In respect to the illness, the coal-miners suffered from silicosis were reduced into two groups: (1) with mild form of silicosis in which case small shadows and/or emphysema appeared on their lung (N=140), and (2) with serious form of silicosis with extended hilus-lesions (N=10). Mean somatotypes of these groups were (1) 3.90–5.95–0.90 and (2) 3.70–6.06–1.20, resp. The differences between the somatotype components of the two groups are not significant.

From our initial examinations we may not draw final conclusions. Actually it seems so that physique has *no primary role* in the development of silicosis. We assume that the above presented characteristics of the physique are also in connection with the hard physical work of the miners, which is required in the mines of the Mecsek hills, because the area's geological structure renders mechanization impossible.

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