

SOMATOTYPE CHANGES IN FEMALE APPRENTICES WITH HIGH PROTEIN NUTRITION

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Abstract: The paper presents a somatotype analysis of data from 40 female apprentices working in the processing of meat and milk products which therefore made possible enrichment of their diet with sizable amounts of additional high-quality proteins. The measurements were taken according to the Heath-Carter somatotype system, first at the beginning of their apprenticeship (mean age 15.3 years), and then 16 months later. A striking feature of the group was very low ectomorphic values, which during the observation period tended to become less extreme. Furthermore, there were remarkable differences according to whether the girls were participating in any voluntary noncompetitive sport activities or not. Non-participating girls were somewhat higher in endomorphy and mesomorphy, and significantly lower in ectomorphy, both at the beginning and end of the study period ($P < 0.01$). Individual somatotypes were far from stable: 60% of the subjects showed changes in at least one component by one whole unit or more. On the average there was in both subgroups a small decrease of the first two components and a marked unequivocal increase of ectomorphy, which was significantly greater in girls participating in some kind of sport.

Key words: Female apprentices, Somatotype, High protein nutrition.

Introduction

Somatotypology is a fascinating topic for study, not only by anthropologists, but also by researchers of many other related disciplines (ÉIBEN 1979), mainly because it permits to express and to study an individual's body form, i.e. the conformation of the entire body as opposed to the analysis of specific features (MALINA 1979). Both these authors — and many others — are stressing the complexity and interdisciplinary facet of physique, which results as the final state effected by a multitude of causal relationships interacting among themselves.

It would be far beyond the scope of the present paper to try and give a comprehensive review of all or most factors which are known to influence physique. The effect of nutrition on somatotype is obvious in its main dimensions, and has been known for a long time (see e.g. BROŽEK 1965). In more recent years, the interest has shifted towards the influence of work and/or sports exercise, especially in young and adolescent subjects (see e.g. MALINA 1979, PAŘIZKOVÁ and CARTER 1976). But data on the concurring effect of both factors seem to be somehow lacking, and therefore we gladly made use of the opportunity to study their possible interaction, offered by the possibility to analyze growing, young female subjects, who underwent a marked change in their nutritional habits (in the sense of an increased protein intake), and at the same time differed by their physical sports activities.

Repeated measurements taken on the same subjects permitted also to investigate the temporal variability of somatotypes, which is a typical characteristic if the developmental period (EIBEN 1979). In Czechoslovakia, there were several extensive data sets collected — to mention only ŠTĚPNIČKA (1976) and BLÁHA et al. (1982), but mostly of the cross-sectional type. Thus the longitudinal aspect of the present data may perhaps also be of a certain interest.

Material and Methods

The subjects of this study were 40 girls attending the Technical Apprentice School of the Milex Works in Nitra, Czechoslovakia. Their somatotype according to the standard Heath—Carter system was measured repeatedly, firstly at the start of their apprenticeship, a few weeks after the beginning of the new school year in September, and also at mid-term of their second schooling and training year, i.e. 16 months later. At the time of the first measurement the average age of the girls was 15.3 years.

The special feature of our sample consists in the fact that within the framework of their vocational training the girls were required to work regularly at the factory of the Milex Works at the processing of meat and dairy products, for 2—3 days per week, during the whole school year. Thus they had ample opportunity to obtain additional high-quality proteins for their food. Throughout our study it was repeatedly confirmed that they did indeed make full use of this opportunity, especially at the beginning of their apprenticeship.

Two groups of 20 subjects each were formed according to whether the girls were participating in some kind of voluntary extracurricular sport activity — of course only noncompetitively — like swimming, gymnastics, etc. (the so-called Sports Participation or SP group), or not (the so-called No-Sports or NS group). The three somatotype components according to the *Heath—Carter-method* were repeatedly ascertained by the same researcher (D. M.) and their individual changes calculated and processed by classical parametrical statistical methods.

Results and Discussion

Figure 1 presents the initial state, when the girls' mean age was 15.3 years. The average somatotype for the No-Sports group is 5.0—4.0—1.3 (indicated by the full circle), and for the Sports-Participating group 4.3—3.2—2.2 (indicated by the X). It can easily be seen that for both groups the first and second components are almost fully balanced, but that the third component has very low values. The between-group difference is statistically significant for endomorphy and ectomorphy, and for mesomorphy almost so. Highly informative is also the comparison with the dotted area corresponding to the "normal" or control values for females of this age group, as found by BLÁHA et al. (1982) at the Czechoslovak National Spartakiad 1980 at Prague.

The individual somatotype shifts for the 20 girls of the No-Sports group are depicted on Fig. 2. There is a quite marked intersubject diversity both as to the individual measurements and also the individual changes. Shifts of moderate size are frequent but not very homogeneous, although a certain

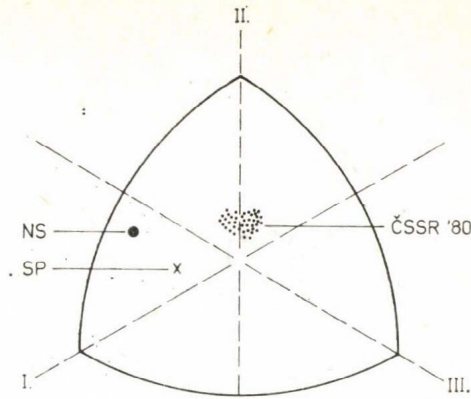


Fig. 1. Mean initial somatotypes of girl apprentices at 15,3 years of age. SP = Sports Participating group; NS = No Sports group; ČSSR '80 = control values for this age group

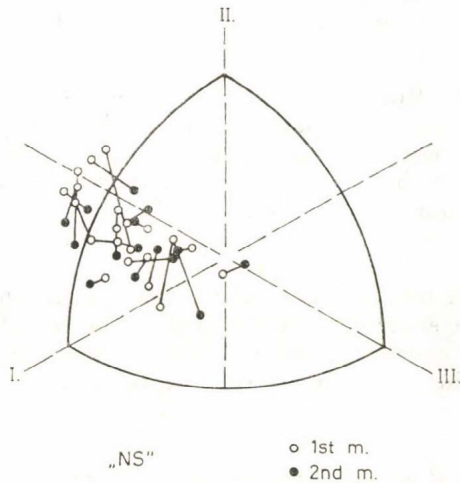


Fig. 2. Individual somatotype changes in 20 girls not participating in voluntary sports activities. Empty circles = first measurement; full black circles = second measurement

tendency for shifts to occur parallel with the ectomorphy axis seems to be present.

Figure 3 gives the analogous information for the girls participating in any voluntary sports activities in excess of the compulsory two lessons per week at the school. Also here we find a sizable intersubject dispersion, and the inconstancy of the individual somatotypes is even more marked. Nevertheless, also the tendency for shifts in the direction of the third component axis is at least equally obvious. Our observations so far go thus only to demonstrate that individual somatotypes in this sex, age and occupation group are highly unstable.

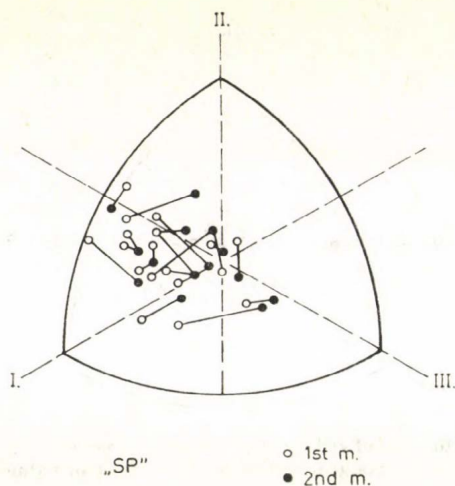


Fig. 3. Individual somatotype changes in 20 girls participating in some extracurricular sports activities. Empty circles = first measurement; full black circles = second measurement

The qualitative extent of this instability is presented on Fig. 4. Even if we assume that a score change by half a unit in either direction lies still within the limits of a methodologically and/or physiologically acceptable variability, the frequencies of even bigger and thus surely real changes are quite high. For the purposes of our present study we defined as "real", i.e. true shifts only such changes where the difference in any given component score attained at least one whole unit. With this proviso in mind we were able to define as stable, i.e. unchanged somatotypes only 9 cases in group NS and 7 cases in group SP, yielding together only 40 per cent of the sample examined. "True" changes equalling or exceeding one whole unit in one component only were found in 8 subjects in each groups, thus representing a further 40 per cent

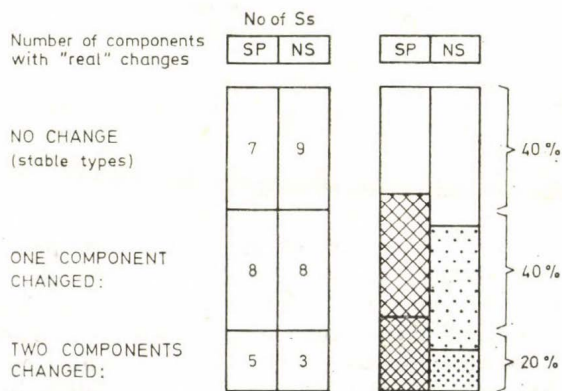


Fig. 4. Frequencies of subjects with stable and changing somatotypes, respectively, according to participation in sports activities (for details see text)

frequency. And in the remaining 20 per cent of cases "real" changes on two components simultaneously were observed: 5 and 3 girls, respectively. We are thus led to conclude that a change in somatotype was rather the rule than the exception, and that within a 16-months period almost two thirds (to be exact, 60%) of our female apprentices changed their somatotype by at least one unit on at least one component.

For further illustration of these dynamics we may perhaps add that if we had accepted as "true" changes also differences by half a unit, only a single girl (!) in each group would have remained in the category of "stable" types, while fully 95 per cent of the subjects showed a change in at least one component.

Which is the somatotype component which contributed most to the general instability? Figure 5 presents the extent and direction of the changes between the two measurements. Averages are indicated by the lengths of the strips, and twice the standard errors by inserted bars. The first component (endomorph) is the relatively least variable component: it decreased significantly (by 0.4 units only) in the Sports group, but only non-significantly so in the NS-group. As, however, the between-group contrast ($t = 1.41$) indicates no significant intergroup difference, we may mentally lump the two groups and speak of a generally observable (although small) decrease of the first component. The second component (mesomorph) shows also decreases in both groups, of which only the one is marked and significant viz. by 0.5 units in the NS-group), while the other one in the SP group is less. The contrast between the groups yields here a somewhat greater t-test value, i.e. $t = 1.78$, but is again not significant; thus also for the second component we may assume a common, generally decreasing tendency, to be present in our sample.

The most marked temporal instability is found in the third component, and that in the opposite sense. This increase in ectomorphy equals in the Sports

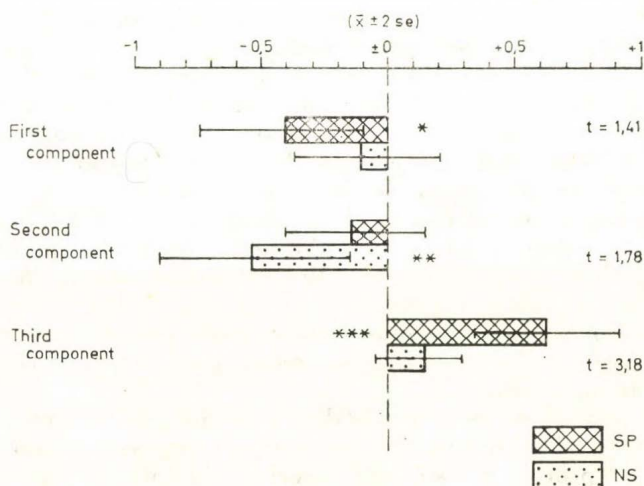


Fig. 5. Mean changes for single somatotype components. (Length of bar indicates arithmetical mean, and the inserted lines are \pm two standard errors. Asterisks show the significance level of the mean change for a given group by the paired-values t-test. At the right are the results of the between-group tests.)

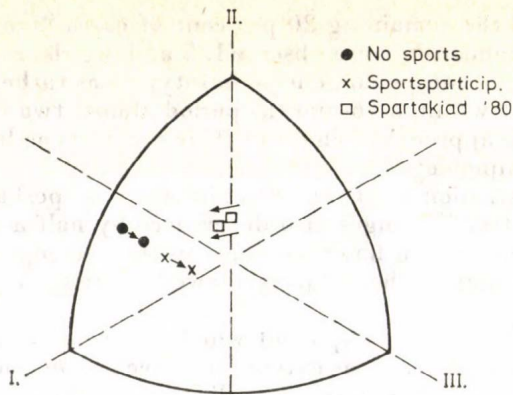


Fig. 6. Mean somatotype shifts during a 16-months period. The arrows indicate the direction of the changes. X = Sports Participation group; ● = No Sports group; □ = Czechoslovak National Spartakiad 1980

Participating group 0.62 units and is statistically highly significant, while in the No-Sports group it only just fails to reach a critical value. But in distinction versus the first two components, the between-group difference of the mean changes in ectomorphy is highly significant ($P < 0.01$). This finding implies that the general tendency for the third component to shift towards higher values is the most pronounced one of all the changes observed, and that this tendency affects the two groups with varying intensity, according to whether the subjects go in for voluntary sport activities (SP) or do not (NS). In both situations, ectomorphy increases at the expense of the first two components, which in the SP group means mainly endomorphy and in the NS group mainly mesomorphy.

Figure 6 presents a summary picture of the resulting somatotype shift trends. Here, the changes which took place during the observation period are quite clear, while it is equally obvious that the corresponding age differences in the female participants of the 1980 National Spartakiad are virtually negligible. The main aspect of change concerns a shift in the third component, almost parallel with its axis, and furthermore this trend is in the Sport group somewhat more pronounced than in the No-Sports group.

A common feature of both is that our subjects at the beginning and also at the end of the observation period exhibited an endomorphy average which was almost a whole unit higher than the national average. This of course is linked with the selection of their future vocation by the girls, i.e. to work in the milk and meat processing industry, certainly also by an increased protein intake, and possibly also through preferential tendencies for the professional environment in question.

The second component is only a little lower than the national average, and during 16 months of apprenticeship this average decreases moderately, in spite of the increased protein intake, and especially in spite of our subjects being apprentices who had for 2–3 days per week regularly to work in the workshops of the respective factories. We may of course this decrease perceive as a relative change only, induced by the massive increase of the third component, ectomorphy being the most conspicuous somatotype component in

our girl apprentices. Here, we observe, a marked mesopenia, even at the beginning of their professional training (i.e. at the first measurement), when the averages of both groups were well below the national average (by 0.8 units in the SP group and by 1.7 units in the NS group). Furthermore, there is an unequivocal parallelism for the dynamics of the two groups, tending towards "normalizing" the values of this component. This increase is somewhat less in girls who do not participate in sports activities, while the very substantial increase in the Sports group brings them (at the end of the observation period) quite near to the control average, thusly increasing the between-group difference in ectomorphy even further: this contrast yielded a t-value of $t = 5.12$. This being the principal difference between the two groups, we may take it to result from the differing degree of participation in voluntary sports.

Conclusions

Our main finding can be summed up in the statement that the somatotype of female apprentices, working in the meat and milk processing industry, is a characteristic which exhibits a very high degree of variability and shifting in time, even during a relatively short period of 16 months. Common features for all these subjects with a markedly increased protein intake is a slow normalization of the initially observed massive ectopenia, while the endomorphy values are but a little above the national control ones. This normalization of the ectopenia proceeds in girls who do practice any kind of (non competitive) sports at a significantly quicker pace than in girls who abstain from extra-curricular sports activities.

It is hoped that it shall be possible to continue the measurements and to extend the observations to cover the whole three years of apprenticeship, at the end of which the girls will be also somatically fully mature.

IPARI TANULÓLÁNYOK SZOMATOTÍPUS-VÁLTOZÁSAI FEHÉRJEDŰS TÁPLÁLKOZÁS MELLETT

Írta: MARCINKOVÁ, D.—ŠTUKOVSKÝ, R.

Összefoglalás

A szerzők dolgozatukban 40 ipari tanuló lány somatotípusának adatait közlik. A lányok hús- és tejfeldolgozó üzemekben dolgoztak, ahol lehetőségük nyílt arra, hogy táplálkozásukat nagy mennyiségű, magas értékű fehérjével egészítsék ki. A testméreteket a Heath—Carter somatotípus technika szerint vették fel, először a lányok iparitanuló tanulmányaik kezdetén (ekkor 15,3 év volt az átlagos életkoruk), majd 16 hónappal később. A csoport szembetűnő jellemvonása volt a nagyon alacsony ektomorfiáérték, amely a megfigyelés időszakában a kevésbé szélsőséges érték felé módosult. További figyelemre méltó különbségek voltak aszerint, hogy a lányok részt vettek-e valamely nem versenyszerű sporttevékenységben vagy nem. A sporttevékenységet folytató lányok valamelyest magasabb értékeket mutatnak az endo- és mezomorfiában, és szignifikánsan alacsonyabbak az ektomorfiában ($P < 0,01$, mindkét vizsgálat során). Az egyéni somatotípusok messze nem voltak állandóak. A vizsgáltak 60%-a mutatott legalább egy komponensben egy egységnyi vagy nagyobb változást. Általában mindkét alcsoportban csekély növekedés volt az első két komponensben, és egy feltűnő, nem egyértelmű növekedés az ektomorfiában, amely szignifikánsan nagyobb azoknál a lányoknál, akik valamely sporttevékenységet folytattak.

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