SECULAR TREND OF THE BODY BUILD CHARACTERISTICS OF BUDAPEST BASKETBALL PLAYER BOYS

Abstract of PhD Thesis

dr. univ. Anna Farkas

Doctoral School of Sport Sciences

University of Physical Education

Supervisor: Dr. Márta Bartusné Szmodis associate professor, PhD

Official reviewers: Dr. Csilla Suskovics associate professor, PhD

Dr. Zsombor Lacza senior research fellow, DSc

Budapest

2021

INTRODUCTION

In the area of human studies a significant part is about the stuctural and functional changes taking place in the subsequent generations of the populations, namely about the secular trend. The phenomenon is widely known in the literature of the anthropology and in human biology. The essence of it is the tendencious changes between the generations in the physique, in the structural and functional and also in psychological characteristics.

The cognition of those trends could help in the evaluation of the body development of the next generation, and also help with the PE teachers and coaches or other sport professionals about the age-dependent expectations and evaluations of the performance level.

In this investigation the results of the secular trend in anthropometric characteristics of Budapest basketball player boys were studied. Through that we intend to demonstrate the changes in the body parameters in different cohorts (chronologically different) of the same age groups of subsequent generations.

AIMS, HYPOTHESES

The aim was to demonstrate in an athletic group:

- to recognise the manifested tendency of changes of the secular trend in youth athletes;

- to demonstrate those changes in the subsequent decades;

- to follow up the measurable and numerical changes of the body parameters in different birth cohorts;

- to answer the question if there is any definite positive tendency of secular trend in the body parameters of young basketball player boys; and

- which variable, if any, show an opposite, negative trend of the changes, or have no changes at all.

Based on the above-mentioned aspects we have the questions, as follows:

- Could we verify the secular changes in the growth process of the athletic boys?
- In which variables could we prove the changes?
- Do those changes differ in scale of the reference values?
- How, if any, of the selection process effects the trends?
- What interrelationships could be observed among the physical characteristics of basketball player boys?

So our Hypotheses were:

1. Similar to the characteristic population (reference) tendencies positive secular growth changes in the athletic group could be detected.
2. It is supposed that the changes in the athletic groups are more pronounced, with a larger extent of changes by the time.
3. As the result of the previous sport selection the relationships between the variables can be supposed to differ from that of the reference sample.
4. It is supposed that opposite to the unfavourable tendency of the increased fat content of the population, no evidence for that trend could be found in the athletic boys.
5. It is supposed that the sport specific effects could modify the well-known secular trend characteristics.

Limitations

- some years of measurements has left out,
- only Budapest basketball palyer boys,
- number of subjects could not be increased,
- data collection did not follow exact decade periods,
- there was group and age number limits,
- no actual/same chonological control groups were available – but reference values,
- possible „distorting" effects of the sport selection on the physique,
- because of a fire in 2015 a part of basic data were destroyed.

SUBJECTS AND METHODS

In the study Budapest sport club basketball player boys were embraced ((N=1 443) measured between 1993 and 2018. The measurements were exclusively taken by the candidate. In case of multiple data collection (same person) only the last measurements were considered.

As having a few subjects only in the age extremes, only the 10 to 15 years-old groups were involved in the master sample to get statistically evaluable sample. So the master sample consisted of 1376 boys.

A master sample was devided - as the secular trend studies is followed at least decade -distance periods – birth cohorts were assigned in certain decade periods (Ist cohort – born between 1978-1987, $n_{1=}$746; IInd cohort – born between 1988-1997, $n_{2=}$ 392; IIIrd cohort – born between 1998-2008, n_3=238). Though the number of the subjects in the different cohorts are different it is satisfactory for the statistical evaluations of the characteristics of the physique of young boys.

Methods

Anthropometric methods

When taking measurements the suggestions of the International Biological Programme were followed. Subjects wear minimal underwear, and the measurements were taken on the right side of the body. Altogether 24 measurements were taken, listed below:

- Body height, Body weight, Width and depth measurements, Girths, Skinfolds

- Body mass index (BMI – kg/m^2)

- Body composition was characterized by body fat content, by the four fraction body composition and fat distribution – trunk/extremity ration and central/peripheral ratio

- Physique – *Growth type* - metric and plastic indices

- *Somatotype components of I, II, III*

Statistical methods

Basic data were recorded in Excel speadsheets programme, and Excel wa also used for constructing figures.

For data processing Statistica program was used (Statsoft Inc.), and for the comparison with the reference the https://www.graphpad.com/quickcalcs/ttest1/?format=SD program was used.

The yearly anthropometric data of the groups were characterised by means and SDs and minimum and maximum values. For the normality of the variables the Kolmogorov-Smirnoff test was used. For the normal distribution studied variables the parametric statistics were used.

The differences between the means and SDs of the cohorts were tested by Students *t*-test, or after *F*-test the ANOVA was used. The relationships were analyzed by Pearson's correlation-analysis.

In all statistical analyses the significance level was $p \leq 0{,}05$.

RESULTS

In the anthropometric studies the absolute values of body measurements and also the calculated indices could be compared, so complex characteristics can be described.

The changes of **body height** could be easily followed by the means of the same age groups in the birth cohorts. The values follow the tendency of the spontaneous growth, though the absolute values show larger than average scale of growth by age. The 15-year-old basketball boys values exceed that of the Hungarian adult reference values (ONV) in all cohorts, and in the IInd and IIIrd cohorts it was significant difference. It is the obvious result of the selection process favouring taller stature.

The data of the Ist cohort show a constantly increasing tendency, while in the other cohorts there was a non-constant, phasic but significant positive change. Some of the IIIrd cohort age groups, represent a non-significantly lower stature as e.g. in the 15-year-old group. It could be explained, as coaches told, the declining sportsmanship, and the unfavourably decreased number of applicants playing basketball.

The means of the **body weight** also follow the tendency of the spontaneous growth, though the values are more oscillating.

When comparing the **body height** of the reference values (ONV) and the present data most of the values exceeded the population reference significantly. In their case the combined effects of the secular growth trend and the selection prevail more strongly.

By the **skinfolds** the body fat content can be estimated, and also the body regional fat distribution can be characterized. The latter are reported also to follow an age-dependent changing tendency. In healthy and balanced growth and development the skinfolds ar eexpected to decrease in the second part of the male puberty, especially in athletic youth. In the IIIrd cohort, the minimal level or no decrease of the **biceps**, is the consequence of the disadvantageous civilizational effects, reported recently.

This phenomenon means the increased fat accumulation acting against the ordinary biological changes.

We found the same tendencies in **triceps skinfolds** with even higher absolute and stagnating values in the IIIrd cohort, that practically means an increase of the fat in this athletic sample.

The **subscapular skinfold** differed significantly also in the 14-year-old boys: Ist cohort vs IIIrd cohort, and the IInd and the IIIrd cohorts.

In case of healthy growth and development the probable regional decrease or loss of the previously accumulated fat is expected in boys, in all the trunk skinfolds, namely in **subscapular**, in **hip** (iliochristal) and **abdominal** ones. The expectation is met in the Ist and the IInd cohorts but in the IIIrd one, in the youngsters of the 2000, the values show an excess increase, especially in the ages of 14 and 15 years.

In the extremity fat accumulation the results of the basketball player boys of our sample also seem to refute the generally known and accepted tendencies. Though the mean values of the **thigh** and **medial calf skinfold** show a decreasing tendency even in the IIIrd cohort their extent is far from reaching the age-dependent characteristic reduction of 2 to 4 mm between 13 to 15 years of the earlier times (Ist, IInd cohorts).

The above-mentioned results are opposing to the older general, regular growth trend of „negative fat wave” occuring after the the 12 year of age peak value on the extremities in

boys, i.e. the decrease or more radically the drop of fat accumulation designated by the skindfold meaurements. Normally, this phenomenon is the result of the hormonally regulated maturation process, showing not a descending but an ascending tendency, – especially in the 14 year-old boys. In this group the expected fat decrease after sexual maturity is not existing, that draw our attention more urgently to the negative lifestyle characteristics of the athletic youth.

Body composition

The body fat content could be assessed using skinfold measurements and calculated by special equations.

By our result the children of the new millenium show relative fat accumulation opposite to the expected growth and development-dependent relative and absolute fat decrease in the second part of the male puberty The extreme SDs refer to the wide range of fat content even among the athletic youth.

The different methods of estimation show the same unfavourable tendencies, but the unfavourable changes in the IIIrd cohort.

In a few cases significant differences were found at the of 11 years, and the most at the 14 years, where the means of the IIIrd cohort had the highest values.

The triceps skinfold, the best predictor for the whole body fat showed strong correlation, irrespective of the estimation method.

The proportionally larger age increase of the **muscle content** in athletes in our sample is similar to that of the non-athletes, though in the IIIrd cohort values of the 14 and 15 year-old boys fail to reach the same level of increase.

Regional fat distribution

In the area of body composition the regional fat distribution can provide important information about the actual status and the changes, that could be adequatly or non-adequatly fit to the biological porcesses.

For demonstrate regional fat distribution the trunk/extremity skinfold ratio was used. Physiologically, the changes of the tendency is more influenced by the extremity fat loss. In

our study, the steeper slope of increase in the IIIrd cohort could not be explained by the periferal fat loss but it more the consequence of the trunk fat accumulation.

In the central/peripheral ratio the 13 and 14 year-old subjects of the IInd and IIIrd cohorts reflecting more on the trunk fat accumulation. The similar values in the 15 year-old groups are supposed to be the result of the multi-stage selection process.

We can see the age-dependent increase of the BMI values in the athletic groups, as well, with lower than the reference values. This is probably the result of, on one hand the lower than non-athletic children fat content and the somewhat lower body weight, and on the other hand the higher than average body height of the basketball boys. Only the values of 14 and 15 year-old boys of the IIIrd cohort approached or exceeded the reference levels, compared to the Ist and the IInd cohorts' values.

Physique

- *Somatotype*

Beyond the basic body dimensions and the body composition physique can be characterized by the **endomorphic, mesomorphic** and **ectomorphic** physiognomy. As seen in the literature review, there is an expected charcateristic age-dependent decrease of the endomorphic and increase in the ectomorphic components in complex pubertal process of the boys. Normally, the values of mesomorphy are stagnating in parallel with the larger increase of the ectomorphy, in the studied age period.

In contrast to the average tendencies the values of the endomorphy (designating relative fatness) were higher in the IIIrd cohort 11, 14 and 15 year-old boys, essentially displays the increasing tendency of the relative fatness.

The mesomorphy component shows different, more balanced values in all three cohorts. The relative muscularity values of the IIIrd cohort was mostly non-significantly slightly higher in the 12, 14 and 15 year-old groups compared to the IInd cohort. In accordance with the biological laws the more intense increase in muscularity would occure in later age period.

The third component, the **ectomorphy** of the somatotype describing the relative linearity shows an unified manner of increasing value for the whole sample, following the age-dependent tendency of characteristic change in the population, though the IIIrd cohort mean values are more diverse. The IIIrd cohort values refer to a less linear somatotype component. This result also draws our attention the results of the IInd cohort following the more favourable, charateristic marked age-dependent trend of increase in the ectomorphy in the 14 and 15 year-old basketball players.

- *Growth type*

Among the descriptors of the physique one of the two indices defines the body proportions and linearity of the body (**metric index**) and the developmental level of the musculo-skeletal system (**plastic index**). The metric index can be found in the negative value range, i. e. the more negative the metric index value the more linear body proportions we have. The average growth and developmental trend of changes the index shows a more linear physique toward the puberty and toward less linearity in postpubertal period.

It is worth noting as the value of the growth type **metric index** and the ectomorphy component of the somatotype are paralelly changing. Each characterise the body proportions and linearity of the body though using different estimating variables.

The **plastic index** values - describing the musculo-skeletal developmental level - beside the age-dependent increasing tendency of the variable, the effect of the secular trend changes also prevail, as the values of the consecutive cohorts are gradually increasing. There were no significant differences between the same age group values of the different cohorts.

In some of the studied parameters (body height, body weight, fat content, BMI) of the three cohorts **one-way ANOVA** was used for testing the the differences. In summary, our results revealed the most differences in the 11 and 14 year-old age groups. The body weight and BMI mean values of the 11 year-old boys were higher, while the relative muscle mass values were lower in the IInd and in the IIIrd cohorts compared to that of the Ist cohort. In the 14 year-old basketball players the above mentioned values of the IInd cohort showed a more favorable positive change compared to the Ist cohort, but unfavorable change in the IIIrd cohort, with an increasing value of the body weight and the fat content and decreasing muscle content, respectively. In the 12 year-old group of the IIIrd cohort

the body height and the body weight values differed with higher values, while in the 15 year-olds a positive difference in stature between the Ist and the IInd cohort and the increased body fat content between the Ist and the IIIrd cohort values differed significantly.

In the **correlation analysis** process a great number of significant relationships were found between the studied parameters. We found obvious strong correlations between the skinfolds. BMI was closely related to the girth measurements, especially with the thigh circumference, and with the flexed and stretched arm.

Within each cohort similar relationships were found, but we have to highlight the results of the IIIrd cohort. We found significant correlations between the BMI and the trunk skinfolds in each cohort but in the IIIrd one the BMI was more closely related to, than in the Ist and IInd cohorts with mediocre values. BMI showed also a stronger correlation with some further girth measurement values.

In the IIIrd cohort the BMI was closely positively related to the endomorphy component, and a negative relationship with the ectomorphy was found. With the Pařizková fat content mean values the IIIrd cohort were more closely related Than in the Ist or in the IInd cohorts. All those results indicate the disadvantageous changes of the body composition and the fat content parameters in the IIIrd cohort.

The triceps skinfold, that can be used by the suggestion of Rolland-Cachera method (1993) for assessing the whole body fat content alone, were the most closely related to the fat content in all birth cohorts.

CONCLUSIONS

By our results the conclusions are as below:

- The Hypothesis I is clearly proved that the sample of the young athletic boys follow a positive secular growth trend, with a clear increasing change of the body height and body weight in all three birth cohorts. The body weight differences incresed with a larger scale after 12 years of age between the age groups, with the largest changes in the IIIrd cohort.
- The Hypothesis II can also be accepted as beyond the changes of the reference values of the National Growth Study II, larger extent of changes

occured especially in the group of basketball player boys born between 1998-2008.

- It was supposed that we can find other, different connections in the athletic groups, as e.g. the result of the selection compared to the population reference values, but it could only be partly cartified. In the Ist and the IInd cohort basketball players the age-dependent or secular changes of the body parameters followed the same tendency as the reference values, with some different extent of changes, in a few cases. There is a novel phenomenon in the characteristic male tendency of change of the skinfolds and fat content. Contrary to the population trend of the 12 years peak of fat accumulation followed by a „negative fat wave", this decrease of the fat accumulation is missing in our IIIrd birth cohort sample. It can be explained by the changes of the modern lifestyle, elicite opposite effects on the adaptational level of regular training even in athletic youth, resulted in fat accumulation.
- Unfortunately we failed with supposing no extra fat accumulation in the athletic groups opposite to the normal population. The civilizational effects apply in athletes in the same way as in their nonathletic age peers. Nevertheless, the extent of the fat accumulation is far lower in athletes than in the youth with inactive lifestyle. For the sake of the long-term health of the society we have to take the warning sign of the fat content increase or even obesity seriously, among athletic children.
- Hopefully our present study play a warning and a gap filling role in the area of youth sport, and enrich our knowledge in sport science about the secular growth changes in athletes; we believe it is worth recognizing that in the basketball where the tall stature, the body size is proved to be an advantage in success, the knowledge about the secular trend changes beyond the inherited height, the more developed musculo-skeletal system, the favourable physique and body proportions should be mastered in the selection process. As the sport specific effects of regular physical training the adaptational signs as e.g. the stronger bones of the upper extremity – measured as elbow width – can be noticed. These favourable changes can be seen from 12 years on, compared to the reference values, as a proof to be able to reach high level of bone health with regular physical activity, only.

Based on all above results it can be indirectly stated that the regular physical activity, irrespective of the sport, could contribute to maintain the physical, mental and social health and development of the next generations' youth.

Beyond all that we can provide the knowledge for sport professionals: about the differences of growth and development of the consecutive generations, which may reflect on the necessity to modify the usual use of standard training methods; or to draw attention for the prevention of the higher risk of injuries, because of the growth and developmental changes shifted to earlier age.

In our present sample, from the point of the basketball sport selection, the results of the IInd cohort comprised the most favourable values, i.e. on one hand there was a wider choice from a larger subject number of selection among children; and on the other hand when considering the positive secular changes (higher stature, favourable body composition) compared to that of the Ist cohort, and especially in comparison with the IIIrd cohort's disadvantageous changes (skinfold ratios, changes of regional fat distribution, body fat increase). In the background of all these changes the civilizational effects can be supposed, the significantly changed customs, especially the excessive screen use, resulting negative consequences in athletic groups, as well.

Nevertheless, we have to remember that the actual performance level of an athlete, a ball game player could not be defined just as the summary of single partial abilities and capabilities, but contains the whole personality, the complexity of all traits playing role in achieving success in sport performance. And there could be many other influencing attributes not revealed or studied here.

The novelties of the study:

- The study of the impact of the secular trend in athletes.
- Documentation of the changes of body structure beyond the secular trend changes in young basketball players.
- Presentation of the time pattern of the secular trend changes.
- Demonstration of the age-dependent adaptational morphological changes in athletic boys.
- The new tendency - contrary to the usual biological developmental process - the lack of „negative fat wave", i. e. missing the decreasing tendency of body fat content in puberty, in the youngest cohort of athletic boys (IIIrd cohort).
- Contrary to expectations, unfavourable changes in body composition, namely in absolute skinfolds, in fat content and muscle content are demonstrated.
- The pattern of the regional fat distribution in the IIrd cohort shows a excessive fat accumulation on the trunk, drawing our attention to the long-term health risk even in the group of athletic boys.

OWN PUBLICATIONS

Dissertation related publications

Szabó A, Péronnet F, Frenkl R, Farkas A, Petrekanits M, Mészáros J, Szabó T. (1994) Blood Pressure and Heart Rate Reactivity to Mental Strain in Adolescent Judo Athletes. Physiology and Behaviour, 56: 219-224.

IF: 1.11

Szmodis M, Zsákai A, Bosnyák E, Protzner A, Trájer E, Farkas A, Szőts G, Tóth M. (2017) Reference data for ultrasound bone characteristics in Hungarian children aged 7–19 years. Annals of Human Biology, 44: 704-714.

IF: 1,531

Szmodis M, Szmodis I, Farkas A, Mészáros Z, Mészáros J, Kemper HCG. (2019): The Relationship between Body Fat Percentage and Some Anthropometric and Physical Fitness Characteristics in Pre- and Peripubertal Boys. International Journal of Environmental Research and Public Health 16: 1170.

IF: 2,849

Farkas A, Szmodis M. (2021) Secular Growth Trend Characteristics of the Body Structure in Hungarian Athlete Boys. Anthropologische Anzeiger DOI: 10.1127/anthranz/2021/1436.

IF: 0,877