SOMATIC AND MOTOR DEVELOPMENT OF CYPRIOT ELEMENTARY SCOOLBOYS

Abstract of the PhD thesis

Polydoros Pampakas

Doctoral School of Sport Sciences
Semmelweis University

Supervisor: † Dr. János Mészáros professor, PhD
Dr. Erika Koltai research fellow, PhD

Consultant: Dr. Ferenc Ihász associate professor, PhD

Official reviewers:
Dr. Csaba Sós associate professor, PhD
Dr. Miklós Bánhidi college professor, PhD

Head of the Final Examination Committee:
Dr. Csaba Istvánfi professor emeritus, CSc

Members of Final Examination Committee:
Dr. József Pucsok professor, DSc
Dr. Anikó Barabás associate professor, CSc
Dr. Tamás Szabó director general, CSc

Budapest, 2013

1. Introduction

Health is a human condition with physical, social and psychological dimensions, each characterized on a continuum with positive and negative poles. Positive health pertains to the capacity to enjoy life and to withstand challenges. Negative health pertains to morbidity, and in the extreme, with premature mortality (Bouchard and Shephard, 1994; Paffenbarger et al., 2001). Naturally, the role of behavioral and environmental factors cannot be neglected in this respect. By the statistics of Mokdad and associates (2004) poor diet and physical inactivity are the major behaviors associated with greater health risks.

The lifestyle of most people in industrially developed countries is significantly influenced by mass media. Paradoxically, the mass media, and particularly television, can play an important role in the management of low level of habitual physical activity and obesity. A number of studies have confirmed that obesity is directly related to the number of hours spent watching television and other screens. The inactive behavior of television viewing is often combined with the frequent, very attractive commercials advertising food and drink (Bar-Or, 1998; James, 2002; Parízková and Hills, 2005). Unfortunately, the power of advertising is such that first of all young people and children are captive audiences and readily associate with the unfavorable practices that are presented, most commonly of highly processed and energy-dense foods.

2. The aim of the study, questions, hypothesizes

2.1. The aim and questions

The aim of the longitudinal study was to analyze and evaluate the pattern of somatic (morphological and selected functional, physiological) growth and development in Limassol elementary school boys. Although the statistical and biological relationship between the speed of somatic development and physical performance may have special importance in some questions, we intend to draw above all public health-related conclusions.

We wish to realize the fulfillment of the main goal along the answers and conclusions for the following questions:

1. Is the change of basic body dimensions and calculated anthropometric indices proportionate with the increase in stature between the years of 6 to 10?

2. What distorting effects can be observed in the growth patterns if the subjects are overweight or definitely obese?

3. Is there a statistically significant human biological relationship between the age-related changes of somatic (body composition) and functional characteristics?

2.2 Hypothesizes

Before the summary of possible assumptions some important facts should keep in view. (a) Although the somatic development of Cypriot boys was analyzed in a nation-wide cross-sectional representative sample (Photiou, 2008), longitudinal reference is not available. (b) Because the speed and pattern of somatic and functional growth and development are biologically determined (the more or less expressed inter-race differences cannot be excluded) the observed sample dependent characteristics arise from the environment. (c) Cyprus can be evaluated as a technologically developed country, consequently, the general trends and all effects of life-style (UN Population Division, 2003; Lissau et al., 2004; Mamen and Martinsen, 2010) are necessarily effective in our society too. According to the great number of respective scientific publications instead of zero hypothesizes we prefer the research hypothesizes.

Premise 1: The basic assumption in respect of our first question is, that exclusively the biologically determined regulation of growth and development never results in non-physiological disproportion (Mészáros Zs. et al., 2008). The possible list of opposite statements is rich. The great number of modifying and very often distorting effects could be mentioned in this relationship (Boreham et al., 2001; Tomkinson et al., 2003). Both the national (Photiou, 2008; Pampakas et al., 2010) and the earlier quoted international results suggest the significant biological effects of body fat content relative to mass. We suppose this indicator will remarkably modify the biologically determined pattern of growth and somatic development. The observed proportion of overweight and obese children will be high in our sample; consequently the overall health prediction of our children will be negative.

Premise 2: The judgment of biological relationships between various indicators is a difficult task, especially in early childhood. The characteristic fast growth and development in these age groups very often overlap the negative (or sometimes already non-physiological) consequences of the unfavorable body composition (Salmon et al., 2005; Cole et al., 2007; Hume et al., 2008). We cannot forget, nevertheless, the risk factors are active; consequently the developed status is dangerous. We cannot neglect the biological relationships between the depot fat (or the low level of muscle mass) and the observed physical and physiological indicators but the correlations will be weak or moderate in the given pairs of variables.

Premise 3: The increased stiffness of the aorta and large artery entail an increase in pulse pressure through the compliance and reducing impact of pulse wave reflection. The elevated pulse pressure shows to trigger endothelial dysfunction. We assumed that the long-term obesity greatly affects the quality of the circulatory system and observed the signs of this in the early childhood. Fat groups selected averages (ASI) increases confirms this process.

3. Subjects

A total (n=158) of elementary school children took part in the longitudinal data collection between 2007 and 2010 (each year in the same period). According to the prescription of the Declaration of Helsinki the subjects were volunteer boys exclusively. All of them were definitely Greek origin. Beyond the kind cooperation of the pupils and the school-staff members, the written consents of one of their parents were also collected before the investigation. The following settlements were involved to the investigation: Limasol and the different little settlements around of Limasol. The children were healthy at the time of investigation. All of them took part in the curricular physical education classes (2 × 45 minutes in a week). Although the level of habitual physical activity can definitely influence the body composition taking into account the low rate of extracurricular physical activity of these boys was not taken into consideration grouping criteria.

To complete the aims detailed anthropometric and psychological measurements were carried out.

4. Methods

4.1. Anthropometric methods

Anthropometric measurements for the estimation of physique and body build can be evaluated as relatively new methods. Some of their significant advantages (comparing to somatoscopic techniques) are the clear objectivity (a well practiced investigator can record the body dimensions reproducibly), and their speed using computer programs during data evaluation.

4.2. The estimation of Conrad growth type

Conrad (52) has suggested the characterization of two developmental directions. The various physique patterns were described by two indices based on different body dimensions. Beyond the constitutional characteristics Conrad has analyzed also the bone-muscle development of the physique based on metric- and plastic index.

4.3. The estimation of relative body fat content

The calipermetric estimation of relative body fat content, developed by Pařízková (51), meets both conditions mentioned. This procedure requires the measurement of 5 skinfold thicknesses: over biceps and triceps, subscapular, suprailiac and medial calf.

As one of the estimates of fatness or obesity the Body Mass Index (BMI) was also calculated.

$$\text{Body Mass Index} = \text{body mass (kg)} \times \text{height (m)}^{-2}$$

4.4. Measurement of status of circulatory system

The general status indicators of the peripheral circulatory system (pulse, systolic and diastolic pressure) were before and after the treatment recorded with the Cardio Vision device (is it the MS-2000 IMDP, Las Vegas, NV, USA) in a lying position, on both upper arms and ankles one after another.

4.5. Estimation of endurance ability based on 800 meter run.

For the assessment of cardio respiratory endurance and the estimation of relative aerobic power 800 meter run was used.

5. Results

In order to successful presentation of results we selected based on %fat of them (normal, overweight, obese I., obese II.). The normal weight grouping were shorter than the overweight ($p=0.17$). The obese II children were significantly taller than the normal weight ($p<0.001$), the overweight ($p=0.001$) and obese I ($p=0.028$) groups. The %fat increased in all groups significantly ($F=52.11$, $df = 2$, $p< 0.001$) within the study period and %fat was significantly ($F=266.11$, $df = 3$, $p< 0.001$) different between groups. The normal and overweight groups increased %muscle in all sessions, however for obese I and obese II groups, the improvements were only between sessions one and two. Post hoc comparisons between groups indicate that the obese II grouping had significantly less %muscle than the normal ($p<0.001$), overweight ($p<0.001$), and obese I ($p=0.010$) groups. No other group's comparisons for either body mass or %muscle were significantly different. The obese II group was significantly slower than the normal ($p = 0.004$) and overweight ($p = 0.007$) groups. No other group differences were significant. The results of a factorial analysis with repeated measures resulted in no interaction for systolic blood pressure, heart rate, or arterial stiffness index. A significant interaction was evident in diastolic pressure and pulse pressure however. Diastolic pressure was significantly ($p<0.001$) higher in both obese groups as compared to the normal and overweight group. Among the other cardiovascular parameters, only main effects for arterial stiffness index were significant. For all groups, the arterial stiffness index increased significantly ($F=4.43$, $df =2$, $p =0.01$) over the study period. Post hoc comparisons indicate that the index was significantly lower in the first measure as compared to the second ($t=2.23$, $df =145$, $p=0.027$) and the third measure ($t=3.40$, $df=151$, $p=0.001$). Comparing between groups results, the arterial stiffness index was significantly ($F=3.95$, $df=3$, $p=0.01$) with post hoc testing indicated only that the normal weight group had significantly ($p = 0.03$) lower values than the obese II group and no other significant between groupings

6. Conclusions and new results

1. The increases in body mass were significant for all groups which are expected with increases in stature over the study period. The components of body composition (fat% and %muscle) did differ between the groups across the study period. The %muscle increase was significant for the obese groups but only between the first two years, while the other groups (normal and overweight) continued to increase over the entire study three year study period. Cessation of gaining muscle might be an artifact for this study population however considering that the obese children were also taller and heavier than the other groups at the first measure, continued natural growth might be slowed by hormonal feedback loops. Over the ages (6-10 years) in boys, we do not expect early sexual maturation which would add testosterone as the growth determinant. With adequate (and possibly excess) nutrition in the obese groups, the development of fat deposits might be a natural reaction to reduction in human growth hormone (HGH) (and thus insulin-like growth factors) levels in the last year. Since this study did not monitor these anabolic hormones, this explanation of the lack of muscular development in the third measure for obese groups is just speculative. Of course, if the normal and overweight groups engaged in physical training which develops skeletal muscle, then the gains over the obese groups are expected. In these young children, physical training however is not expected to provide significant gains over control (a group that does not engage in this activity). Therefore lower %muscle in the obese children might be due to their physical inactivity, a behavior that has been linked to skeletal muscle atrophy. In our opinion the significantly taller mean stature of overweight and obese boys between 7 to 11 years of age needs a detailed explanation. The taller height of over-feed individuals is a relatively new phenomenon in the literature of human biology.
2. The performance in the 800 meter run improved in all groups over the study period. While this "weight-bearing" activity might be influenced by higher body mass, the increase in the performance suggests that the gains in stature had a beneficial effect on running. It's likely that the stride length of the children increased as their stature improved. This longer stride would result in a faster velocity and therefore improve the time to complete this endurance event. Therefore if improvements in fitness capacity are of concern in obese children, the data suggest that a similar gain with growth is expected in all groups. For this endurance event, the lack of muscular development did

not seem to influence the performances. Other fitness measures, such as a push up or pull up might have resulted in differences in the development of fitness over the study period since this task are dependent upon muscular development.

3. The increase in systolic and diastolic pressure over the study period should be explained. The differences between systolic pressure in the obese and non-obese (normal and overweight) might be due to differences in stroke volume at rest. The amount of blood ejected into the systemic arteries is mostly due to heart size. The obese groups were taller and heavier with might suggest larger heart size using the law of proportions. However no differences were evident in heart rate between the groups which were to validate this statement. Therefore, the higher systolic pressure might be viewed as a potential sign of early stage hypertension. The higher diastolic pressure in the obese groups confirms that these children might be showing indices of hypertension, a condition associated with obesity. If cardiovascular disease is linked to obesity, even in children, the arteries might be susceptible to "stiffness" evaluated in this study. For this comparison, the obese groups as well as the overweight children showed higher arterial stiffness indexes (ASI). This measure has been linked to peripheral vascular disease in adults, a form of cardiovascular disease which causes reduced circulation in the limbs. More information is needed to determine if higher ASI in children suggest this condition.

Publications of Mr. Polydoros Pampakas

1. Mészáros Zsófia, Mészáros János, Uvacsek Martina, **Polydoros Pampakas**, Osváth Péter, Völgyi Eszter, Frenkl Róbert (2007): A szomatikus és motorikus fejlődés különbségei 7-11 éves fiúknál – a szocio-ökonómiai status hatásai. *Sportorvosi Szemle,* **48:** 3. 114-119.

2. Mészáros Zsófia, Vajda Ildikó, Mészáros János, **Polydoros Pampakas**, Sziva Ágnes, Osváth Péter, Zsidegh Miklós (2007): Korai gyermekfejlődés: a szocio-ökonómiai státus hatásai. *Magyar Sporttudományi Szemle,* **8:** 4. 8-13.

3. Zsidegh Petra, Mészáros Zsófia, Faludi Judit, **Pampakas Polydoros**, Völgyi Eszter, Zsidegh Miklós (2007): Prepubertás korú fiúk testi és fizikai teljesítmény-fejlődésének megítélése egy integrált paraméter alapján. *Magyar Sporttudományi Szemle,* **8:** 4 17-24.

4. **Pampakas Polydoros**, Mészáros Zsófia, Photiou Andreas, Sziva Ágnes, Zsidegh Petra, Mészáros János (2008): Az emelt szintű testnevelés hatása 7-11 éves fiúk szomatikus és motorikus jellemzőire. *Magyar Sporttudományi Szemle,* **9:** 1. 3-8.

5. Mészáros, Zs., Mészáros, J., Völgyi, E., Sziva, Á., **Pampakas, P.**, Prókai, A., Szmodis, M. (2008): Body mass and body fat in Hungarian schoolboys: differences between 1980-2005. *J Physiol Anthropol,* **27:** 5. 241-245.

6. **Pampakas, P.**, Mészáros, Zs., Király, T., B. Szmodis, M., Szakály, Zs., Zsidegh, M., Mészáros, J. (2008): Longitudinal differences and trends in body fat and running endurance in Hungarian Primary schoolboys. *Anthropol Anz,* **66:** 3. 317-326.

7. Prókai A., Kiss K., Mavroudes M., **Pampakas P.**, Zsidegh M., Mészáros Zs., (2008): Depózsír-független teljesítmény-különbségek nem sportoló fiúknál. *Magyar Sporttudományi Szemle,* **9:** 3. 20-22.

8. Zsófia Mészáros, János Mészáros, B. Márta Szmodis, **Polydoros Pampakas**, Péter Osváth, Eszter Völgyi (2008): Primary school child development – issues of socioeconomic status. *Kinesiology*, **40:** 2. 153-161.

9. Vajda Ildió, Batta Klára, Hegedűs Ferenc, Vajda Tamás, **Pampakas Polydoros**, Bartusné Szmodis Márta (2010): A testi fejlettség, a relatív testzsírtartalom és a Cooper-próbával jellemzett állóképesség nemzedékenkénti különbségei általános iskolás fiúknál. *Magyar Sporttudományi Szemle*, **11:** 1. 20-24.

10. **Pampakas P**, Mészáros Zs, Vajda I, Vajda T, Zsidegh M, Mészáros J (2010) Prepubertáskorú fiúk testzsírtartalmának és futóteljesítményének változása: Ciprusi-magyar összehasonlítás. MAGYAR SPORTTUDOMÁNYI SZEMLE 11:(42) pp. 17-22. (2010)

11. Mészáros Zsófia, **Pampakas Polydoros**, Zsidegh Miklós, Rikk János, Szmodis Márta, Ihász Ference (2011): Különböző távú futások és a testtömegre vonatkoztatott oxigénfelvétel kapcsolata 9 éves fiúknál. Magyar Sporttudományi Szemle, **12:** 11-15.