

**RELATIONSHIP BETWEEN BIOLOGICAL MATURATION,
BODY COMPOSITION AND PSYCHOLOGICAL FUNCTIONS –
LONGITUDINAL STUDY**

Ph.D. Thesis

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INTRODUCTION

Adolescence is regarded as a unique phase of human development. Among adolescent girls menarche is an important landmark in the process of growth and maturation (Minimol, 2003). The onset of puberty has been viewed as a marker for entry into adolescence, and thus has received a great attention in research. The hormonal changes of puberty are related to the personal and social effects of physical changes and most importantly the time of changes. Being an early or late maturer (one year earlier or later than average) affects adolescents' satisfaction with their appearance and their body image (Atkinson et al., 2000). Early onset of puberty in girls has been regarded as a stressful event and therefore it is relating to deficits in their functioning. Earlier maturer girls experience more depression and anxiety (Brooks-Gunn & Rubble, 1983), have lower self-esteem (Simmons & Blyth, 1988), and are generally less satisfied with their weight and appearance. They tend to be embarrassed by the fact that their bodies are more womanly in shape than those of their female classmates that emphasize a lean look. They are also more likely to have both emotional and behavioral problems.

The sex difference in fat distribution develops during adolescence. Comparing the two genders in femoral and abdominal depots, adolescent males have more fat deposition in the trunk or abdominal region, while females accumulating their fat on their buttock and femoral areas (Malina & Bouchard, 1991). Increasing evidence suggests a close association between early sexual maturation (SM) and obesity in girls and female adults. Earlier maturing girls are more likely to be obese than non-early maturers, and are at greater risk of developing overweight in adolescence and also in adulthood (Adair & Gordon-Larsen, 2001; Biro et al., 2001; Wang, 2002; Beunen et al., 1994). Those who mature early also tend to have more of their subcutaneous fat on

the trunk than others at the same age (Beunen et al., 1994; vanLenthe et al., 1996).

AIM OF THE STUDY

The purpose of this dissertation was to analyze and determine relation between biological maturation, body composition and psychological functions in girls with various sexual maturation (early matures, average and late matures). Further to analyze the differences in biological and psychological attributes among the three groups of girls.

SUBJECTS AND METHODS

Subjects

Sample selection was randomly stratified and sample (N=207 at the end of 10th measurement) consists of Hungarian girls exclusively. Anthropologically all of them were Europid origin. A three years longitudinal data collection was completed initially from 5th grade (10-11-year old) from 10 elementary schools 10 times every 4th month during the observation. To answer the questions described earlier, we formed 3 groups by the mean of menarche in our sample. The classification of cases was based on tertiles of the age of menarche

G1; Early-maturers (first 33% of the sample),

G2; On-time maturers (middle 33% of the sample),

G3; Late-maturers (last 33% of the sample).

Methods

Participants were weighed with light clothes and without shoes. Height was determined using an anthropometer device to the nearest 0.1 cm. Weight was determined within 0.1 kg for each subject using an electronic scale.

Body mass related body fat was estimated by the caliper metric method of Pařízková (1961). This procedure requires the measurement of 5 skinfold thicknesses: over biceps and triceps, subscapular, suprailiac and medial calf.

Growth type was estimated by the method of Conrad (1963). Metric index relates the chest width to the chest depth and is corrected by the actually measured stature, therefore describes the roundness of the chest. Plastic index is the arithmetic sum of three body dimensions that are characteristic for bone-muscle development.

Self-administered questionnaires were used to describe state and trait anxiety (Spielberger, 1973) and self-efficacy towards physical activity (Schwarzer, 1993).

Differences among the groups were analyzed by one-way ANOVA or Kruskal-Wallis ANOVA depending on respective distributions and measurement scales. Changing during the three years was tested by repeated measures of ANOVA or Friedman ANOVA according to the distributions and measurement scales. Relations between anthropometric variables and psychological variables by groups were analyzed by Kendall- τ correlation.

RESULTS

The most important results of the research were that the growth type of children has changed according to the biological development of the muscles and skeletal system, but the differences in anthropometric characteristics among early-, on-time, and late maturer girls were mostly significant. Early maturer girls were significantly heavier, they had higher value in BMI, in body mass related body fat percentage, and in plastic index, and had lower value in metric index than on-time and late maturer girls.

We did not find significant difference in psychological variables among early-, on-time and late developer girls except in

state anxiety score between on-time and late maturers at the 2nd measurement, nevertheless there were no correlation between the biological and psychological variables, except between body height and state anxiety and between PLX and state anxiety at the 1st measurement and between body mass related body fat percentage and state anxiety at the last measurement.

The relation between state- and trait anxiety was significant for the whole sample at each measurement time, but between state anxiety and self-efficacy toward physical exercise statistical correlations showed up in early maturers at the 3rd and in late maturers at the 4th measurement, but correlations were inverse.

CONCLUSION

Our main finding was that, as body height differences were equalized among the different maturation groups, differences in body weight, BMI, body mass related body fat percentage, in metric and plastic indexes still existed. Therefore those girls, who experience the onset earlier than the average, are in danger for obesity in adulthood also. Our study is not able to clarify whether the observed differences were because of the earlier onset, or the first bleeding is the influence of the already experienced fat accumulation. Further research, starting at earlier age, is needed to reliably answer this biological question.

Because we did not find consequent relations between the biological and psychological attributes as others report, further research is also needed to clarify if this result can be due to the change of psychological judgment on the biological maturation or it is just a sample specific outcome.

PUBLICATIONS OF ESZTER VÖLGYI

Publications related to the topic in international journals

1. **Völgyi, E.**, Tylavsky, FA., Lyytikäinen, A., Suominen, H., Alén, M. and Cheng, S. (2008). Assessing body composition with DXA and bioimpedance. Effects of obesity, physical activity and age. *Obesity (Silver Spring)*16:3. 700-705. **IF: 3.491**
2. Mészáros, Z., Mészáros J., Szmodish, B.M., Pampakas, P., Osváth, P. and **Völgyi, E.** Primary school child development – Issues of socio-economic status. *Kinesiology* (In Press.)

Publications not related to the topic in international journals

1. Leibinger, É., Hamar, P., **Völgyi, E.** and Dancs, H. (2007). Hungarian PE teacher's opinions about current issues of PE learning and teaching methods. *Kinesiology Slovenica*, 13:1. 14-20.

Publications in Hungarian journals

1. **Völgyi, E.**, Ember, A., Kalabiska, I., Csende, Zs. Antropometriai és pszichikus változók hosszmetzeti vizsgálata nyugat-magyarországi lányoknál. *Magyar Sporttudományi Szemle* (In Press.)
2. **Völgyi, E.**, Kyprianou P., Mészáros, Zs. és Sipos, K. (2007). Ciprusi fiúk antropometriai tulajdonságainak és ACSI-28 teszteredményeinek összehasonlítása In. Mónus A. (Szerk.) *V. Országos Sporttudományi Kongresszus. Válogatott tanulmányok*. Budapest, 100-106.
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7. Mészáros, Zs., Mészáros, J., Uvacsek, M., Pampakas, P., Osváth, P., **Völgyi, E.** és Frenkl, R. (2007). A szomatikus és motorikus fejlődés különbségei 7-11 éves fiúknál – a szocio-ökonómiai státusz hatásai. *Sportorvosi Szemle*, 48:3. 114-119.
8. Mészáros, J., Zsidegh, M., Mészáros, Zs., Tatár, A., **Völgyi, E.**, Prókai, A., Vajda, I., és Mohácsi, J. (2005). Testzsírtartalom és szomatikus fejlődés. In. Mónus A. (Szerk.). *IV. Országos Sporttudományi Kongresszus II. kötet*, Budapest, 46-51.
9. Prókai, A., **Völgyi, E.**, Mészáros, Zs., Tatár, A., Zsidegh, M., Uvacsek, M., Vajda, I., és Mészáros, J. (2005). Relatív testzsírtartalom és motorikus teljesítmény. In. Mónus A. (Szerk.). *IV. Országos Sporttudományi Kongresszus II. kötet*, Budapest, 238-243.
10. Tatár A., Zsidegh M., Prókai A., Vajda I., **Völgyi E.**, és Mészáros J. (2005). Sportoló és nem sportoló fiúk testi felépítése és fizikai teljesítménye. In. Mónus A. (Szerk.). *IV. Országos Sporttudományi Kongresszus I. kötet*, Budapest, 233-238.
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motorikus teljesítmény - nemzetközi összehasonlítás. In. Mónus A. (Szerk.). *IV. Országos Sporttudományi Kongresszus I. kötet*, Budapest, 245-248.

Quotable abstract presentations

1. **Völgyi E**, Csende Z, Mészáros J. Body composition and psychological factors in Hungarian girls (3-year follow up). 13th Annual Congress of the European College of Sport Science, Portugal, 2008.
2. **Völgyi, E.**, Faludi, J., Zsidegh, M., Sipos, K. and Csende, Z. (2007). Body composition and psychological functions in Hungarian girls (2.5-year follow up). In. Jürimäe T & Jürimäe J (Eds.) *Acta kinesiologiae universitatis tartuensis*. Vol. 12. Supplement. p.203. (**Highly Recommended Poster**)
3. **Völgyi, E.**, Tylavsky, FA., Suominen, H., Cheng, SM., Lyytikäinen, A., Alén, M., Kujala, UM., Kröger, H. and Cheng S. (2007). Regular physical activity has only temporary effect on bone gain in pubertal girls: A 6.5 year follow-up study. 2007 Abstracts, 29th Annual Meeting of the American Society for Bone and Mineral Research. *Journal of Bone and Mineral Research*. Vol. 22. Suppl. 1. p.S136. **IF: 6.635 (Plenary Poster, Young Investigator Travel Grant)**
4. **Völgyi, E.**, Lyytikäinen, A., Suominen, H., Alén, M., Häkkinen, K. and Cheng, S.(2006). Comparison of DXA and two bioimpedance methods in assessing whole body fat mass in men and women with different body mass index and physical activity. *The 8th Scandinavian Congress of Medicine and Science in Sports Programme and abstracts*, Finland, 103.
5. **Völgyi, E.**, Kyprianou, P., Mészáros, Z., and Sipos K. (2005). Comparison between anthropometric properties

- and coping strategies in Cypriot school-boys. 4th *European Sports Medicine Congress Abstracts*, Cyprus, 95. (**Young Investigator Award**)
6. **Völgyi, E.**, Mészáros, Zs., Prókai, A., Zsidegh, M., Csende, Zs., & Mészáros, J. (2005). Body composition and motor fitness differences: Hungarian-Hungarian comparison. *23rd PWP Meeting Program and abstracts*, Switzerland, 20.
 7. **Völgyi, E.**, and Kalla, L. (2004). Running performance in lean and obese boys. *The 16th International Conference on Sports Sciences for Students*. Semmelweis University, Budapest, Faculty of PE and Sports Sciences, 17. **2nd place**.
 8. Ma, HQ., **Völgyi, E.**, Suominen, H., Wang, Q., Rahkila, P., Cheng, SM., Lyytikäinen, A., Alén, M. and Cheng, S. (2007). Tibial bone mineral density and geometric properties in females of three generations. 2007 Abstracts, 29th Annual Meeting of the American Society for Bone and Mineral Research. *Journal of Bone and Mineral Research*. Vol. 22. Suppl. 1. p.S495. **IF: 6.635**
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11. Faludi, J., Zsidegh, M., Prókai, A., **Völgyi, E.**, Uvacsek, M. and Mészáros, J. (2007). Relationship between classification labels of overweight or obesity and motor performance in boys aged 11-13. In. Jürimäe T & Jürimäe J (Eds.) *Acta kinesiologiae universitatis tartuensis*. Vol. 12. Supplement. p.80.
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