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# The Role of Motor and Nutritional Individuality in Childhood Obesity

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**A B S T R A C T**

*Nutritional and motor individuality vary significantly among human subjects, and their mutal relationship is decisive for a desirable energy balance and turnover with regard to body composition, physical fitness level and health. Early establishment of optimal individualities, with regard to genetic, epigenetic and other factors which influence the organism early in life is desirable for a positive life-long health prognosis and life expectancy. Approaches for the evaluation of both nutritional and motor individualities have been elaborated as an important starting point for their positive development and eventual modification. This should aim to achieve not only prevention of diseases, but also to improve health prevention and achieving the status of »positive health«.*

***Key words:*** *motor development, nutrition, adiposity, growth*

## Introduction

Changes of the status of health today have been characterized mainly by a significant reduction of infectious diseases, but a marked increase of non-communicable illnesses, especially cardiovascular and metabolic ones. As the genofond could not have been changed so quickly as the increase of associated health problems, the role of the environment has been considered as one of the most important variables. The impact of lifestyle changes – especially nutrition and physical activity have been considered as essential factors contributing to negative changes of body composition –increased adiposity and reduction of physical fitness level. Adequate and/or optimal levels of both of these factors are a prerequisite of good health.

Moreover, based on a specific genetic background during a lifetime starting with the fetal period, the mutually related effects of various factors acting in a synchronic and/or asynchronic manner, have not contributed in the same way to the development of any particular individuality, which can vary in the sensitivity and reaction to the environment. Many interventions aiming at the improvement of health and its functional status have therefore not been homogenously efficient and/or lasting. Until recently, the role of particular individualities has mostly not been taken into account. As a starting point, more exact and detailed procedures for their definition and evaluation can improve this situation.

## Nutritional Individuality

In her study, Widdowson[1,2] described and defined »nutritional individuality«: observing that the amount of energy consumed by subjects with the same weight was found to be markedly different, and vice versa that subjects with the same energy intake could have very different weights. Factors such as individual preferencies in food choice, total amount of ingested food, the type of digestion, absorption, metabolization, utilization of nutrients *etc*. have been considered as an explanation. Genetic factors also contribute to nutritional individuality[3,4]. Tarasuk and Beaton[5,6] found that variation in energy intake is due to particular nutritional individuality. As a result different body weight, BMI, body composition, functional capacity and health status under comparable nutritional situation can be also considered.

These individual differences can be shown during very early periods of growth, beginning at birth. Pediatricians claim that newborns and infants behave often quite differently with regard to breast feeding (*e.g.* either consume mother´s milk calmly as offered, or interrupt drinking it early, or even refuse it, *etc.*). This difference can be accentuated later during subsequent months and years of life: there are children in which no problems with regard their consumption of food appear, and others who regularly express difficulties – *i.e.* accept only a part of the adequate amount of recommended food; are »choosy«

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eaters; must be persuaded to eat; must be offered a compensation for eating as required (to get some reward), or refuse to eat at all, *etc*. The latter might be reflected both immediately, and/or later in growth and development of BMI, body composition, morbidity and other parameters. In this respect, there are still unsufficient results of long-term human studies.

The reverse situation can be shown with regard to overeating. Some children eat much more than corresponds to their needs. Gluttony, craving for sweets and other items can manifest already during a very early age. Quite often such nutritional behavior can persist until later years, and have further undesirable consequences. In spite of obvious health risks. the reasons and mechanisms of such nutritional behavior have not yet been elucidated in detail. Individualized food behavior can also be influenced by lifestyle and social factors, and appears during growth[7].

## Motor Individuality

Similarly, »motor individuality« can be revealed, especially the total amount of spontaneous physical activity and subsequent total energy output varies significantly[8]. Physiological individuality contribute markedly to motor development and behavior[9].

Genetic factors are considered first of all, *e.g*. one-week follow-ups showed greater similarity in total amount of spontaneous physical activity in homozygotic than in dizygotic twins, or in unrelated subjects[10]. The character of motor activity, structure of movements, and their disposition along time can also be different. Particular individuals can be recognized according to the character of his/her gait, gesticulation, body posture and its changes, and performance of particular motor tasks. Twin studies contributed significantly to the elucidation of genetic participation with regard to physical activity and leisure, and their effect on health[11–14]. The structure of movement and performance in certain sport disciplines (running, jumping, *etc*.) again resemble most in monozygotic twins[15]. Development of physical fitness, motor skill, neuromuscular performance and coordination, anaerobic power *etc*. were considered as influenced genetically also in other studies[16–21]. Physical activity and participation in exercise can be genetically influenced[22–28]. Motor abilities (also called »acrobatics«) were included among the most important which are genetically predisposed, similarly as musical and mathematic aptitudes.

Motor individuality and functional capacity are still and first of all perceived as important with regard to sport performance and competition. However, these factors are essential for every one (may be more than a certain body size, provided in normal range); *e.g.* a subject with a higher level of functional capacity uses a smaller part of it in everyday activities and during emergencies. Increased capacity also means a lower wear-and-tear of the organism[29]. More fit individuals were, therefore, shown to be less prone to the development of contemporary »diseases of civilization« such as hypertension, heart disease, colon cancer, diabetes, *etc*.

Differences in motor individuality are also apparent since the earliest periods of life. A newborn is either quiet – »a sweet child« (whose mother can get enough sleep), or move vigorously, crying often (and this can equally be considered as a kind of exercise for an infant), and is difficult to appease. The latter is surely dependent also on psychological and other factors. The progress of motor development – *e.g*. the age of the start of independent sitting and walking can vary in individual children by months. Early adaptations in the family, model of parents and the regime of physical activity since early life also are significant influences. Even such factors as metabolic consequences may be decisive. However, the reasons as well as later consequences of all these factors have not been longitudinally followed and analyzed yet.

Studies of preschool children show as well obvious primary inter-individual differences in the level of spontaneous physical activity and motor performance in various tasks (*i.e*. running, jumping, skill tests, *etc.*)[8]. Children (aged 4.7 years on the average) who were spontaneously more active tended to have better results in the modified step test, were less fat along with slightly higher energy intake, and had a significantly higher level of HDL. Differences in sponaneous level of physical activity appear later during childhood and adolescence, and significantly influence participation in organized physical education, exercise and sports[8].

## Mutual Relationships between Nutritional and Motor Individuality

Energy balance between energy intake and output from the relationships of the above mentioned individualities and their impact on growth, weight, body mass index (BMI), body composition and health, have very rarely been followed in simultaneous long term studies. In addition to resulting health status and impacting morbidity, and energy turnover also has an essential role: its high level (*i.e.* both high intake and high expenditure of energy) – usual during growth and development, is desirable also later in life. Increased levels of physical activity allowing a higher food intake reduces the risk of deficiencies of vitamins and minerals during younger age periods, and is associated with reduced body fat. This applies as well to adult and advanced age when increased BMI and adiposity are usual. Reduction of these characteristics of aging can be achieved in subjects who adhere to a higher level of physical activity and exercise.

Under conditions of high energy turnover, a proper balance between energy intake and output was more easily achieved, and resulted among adolescent athletes in a desirable level of BMI, body adiposity, lean body mass development, high level of physical performance and skill[30,31]. Under reverse conditions with a low level of energy output and intake (usual also at an advanced age), proper balance can be achieved with difficulty, or not at all. This is manifested especially by the increasing prevalence of

obesity during growth, usual in sedentary subjects who do not have excessively increased energy intake or more often have inadequate composition of the diet. Delayed effects have not been followed in studies of humans.

Some results were obtained in experimental models using laboratory animals, in which delayed consequences later in life could be followed up. The conclusions could be hardly transferred to human species. However, some factors influencing the organism in early life can be considered as well[8].

## The Effect of Different Food Intake on Nutritional Individuality Development

Differences in dietary intake were observed in all age categories including the period of growth and development. The energy intake per unit of weight during growth could vary markedly, in spite of similar overall development. This was mainly followed up in an experimental model with laboratory animals which enabled longitudinal follow-ups continuously during longer periods of life[8]. With regard to early life, results of studies concerning the effect of malnutrition of the pregnant mother, reduced birth weight and later health status of the individual were related to increased prevalence of obesity and hypertension[32]. Not only overweight and obesity, but also diabetes have been appearing in this respect more recently, especially in India. Predisposition to obesity can be considered as the effect of »thrifty genes« which is attributed to adaptational processes which developed during historical periods of food scarcity enabling survival under unfavourable nutritional conditions, but contributing to undesirable results under conditions of adequate and/or abundant food availability[33–35]. These genes predispose individuals significantly for a particular type of nutritional individuality.

Recommended dietary allowances (RDA) elaborated by the World Health Organization (WHO)[36,37], and other nutritional institutions in various countries of the world, as related to desirable human growth, were defined. Up to now most of the studies have concerned the effect of extreme nutritional situations – either malnutrition or starvation, and/or overnutrition along with unbalanced composition of the diet, resulting in overweight and obesity. This has surely been caused by the urgency of nutritional problems with regard to health. In extreme situations the results could be different according to the individual conditions: *e.g.* under comparable conditions of starvation such as in concentration camps, some subjects survived, others did not[38].

On the other hand, with similar nutrition one member of the same family becomes overweight and/or obese, and the others do not. The latter can happen also under conditions of the same lifestyle including physical activity; such a situation, especially in children causes problems with treatment and prevention in a particular family, which cannot be homogenous. Therefore, influencing the development of a desirable nutritional and motor individuality is needed. Numerous studies were conducted, especially during school age[39]. However, very few studies follow up the energy intake simultaneously with energy output during sufficiently long periods of life. As a result, the role of the effect of the interrelationships between energy intake and output and resulting energy balance have been still poorly elucidated.

## The Effect of Physical Activity and Exercise in Different Individuals

The effect of the adaptation to different regimes of physical activity and exercise was mostly studied in school children, obviously due to greater availability of subjects. As mentioned above, motor individuality can vary markedly since early childood, as can be revealed by the comparison of coefficient of variations (CV) on motor performance tasks starting with preschool age (Table 1)[8].

**TABLE 1**
MORPHOLOGICAL AND MOTOR PERFORMANCE CHANGES DURING PRESCHOOL AGE

| Age – years | | 3–4 | | | 4–5 | | | 5–6 | | | 6–7 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | X | SD | CV | X | SD | CV | X | SD | CV | X | SD | CV |
| BMI (kg/m²) | boys | 15.38 | 1.2 | 7.2 | 17.59 | 1.3 | 7.3 | 18.37 | 0.9 | 4.9 | 18.54 | 1.3 | 7.0 |
| | girls | 15.76 | 0.9 | 5.7 | 17.02 | 0.8 | 4.7 | 17.42 | 1.2 | 6.8 | 18.2 | 1.4 | 7.6 |
| Sum of 5 | boys | 29.2 | 8.7 | 29.8 | 26.6 | 4.4 | 16.5 | 26.6 | 7.0 | 26.3 | 20.9 | 3.7 | 17.7 |
| Skinfolds (mm) | girls | 31.8 | 9.0 | 22.1 | 30.3 | 6.7 | 22.1 | 25.7 | 6.7 | 26.0 | 29.1 | 9.6 | 33.0 |
| Cardiac Efficiency | boys | 3.12 | 1.18 | 7.8 | 2.95 | 1.19 | 40.2 | 3.45 | 0.92 | 26.6 | 3.68 | 0.82 | 22.3 |
| index (CEI 1) | girls | 2.85 | 0.72 | 25.1 | 2.56 | 0.64 | 25.1 | 3.06 | 0.97 | 31.7 | 3.18 | 0.74 | 23.2 |
| 20 m dash | boys | 6.8 | 0.8 | 11.7 | 6.0 | 0.8 | 15.3 | 5.1 | 0.2 | 3.9 | 4.9 | 0.2 | 4.1 |
| (s) | girls | 7.4 | 0.8 | 10.8 | 6.2 | 0.7 | 11.3 | 5.1 | 0.2 | 3.9 | 5.1 | 0.3 | 5.9 |
| Broad Jump | boys | 60.7 | 15.4 | 16.9 | 75.5 | 12.8 | 16.9 | 95.5 | 14.4 | 15.0 | 103.5 | 18.7 | 18.6 |
| (cm) | girls | 59.1 | 18.6 | 31.4 | 71.6 | 15.7 | 21.9 | 90.9 | 17.7 | 19.5 | 96.2 | 16.5 | 17.1 |
| Ball Throw | boys | 419 | 142 | 33.9 | 562 | 199 | 35.4 | 813 | 209 | 35.7 | 1028 | 404 | 39.3 |
| r. hand (cm) | girls | 326 | 101 | 30.1 | 438 | 131 | 29.9 | 601 | 126 | 20.9 | 695 | 135 | 19.4 |

The influence of physical education classes, taken together with one parent or other caretaker, showed first of all a signficant effect of increased level of motor activity, as well as differences in the effects of it. The effect of various regimes of physical activity and the participation in mentioned special classes of physical education for preschoolers revealed significant differences between active and sedentary subjects, e.g better results of motor tasks, trend for lower adiposity, higher levels of HDL *etc*., in the active ones[8].

An eight-year longitudinal study of boys (10.8–17.8 years)[3], showed significant effects of regular, systematic, supervised training in light athletics and basketball (*e.g.* more than eight hours per week over eight years). Reduced adiposity; greater development of lean body mass; higher level of the aerobic power – characterized by higher values of maximal oxygen uptake per kg of total and lean body mass, and higher level of motor performance were observed in trained boys. Similar results were found in trained and untrained subjects followed up in the framework of IBP (Table 2), and also in other young athletes (Table 3). Particular initial individuality resulting both from genetic and previous environmental factors has an essential effect on the decision to start and also to endure in a regime of exercise which achieves significant positive functional and morphological results. However, the effect was again quite varied.

The evaluation of a physical activity regime using only questionnaires and not the direct measurements of physical activity often does not sufficiently define its character, and therefore some studies do not confirm its effect. This applies both to normal, and also to obese children. In this respect it is necessary to emphasize that only a certain intensity, character, frequency, regularity, and continuous ongoing – uninterrupted regime has to be assured so as to achieve significant positive outcomes. The results of most of these studies also concern only some parameters – either morphological, or functional, and/or biochemical *etc*. ones, but not more of them simultaneously in the same group. Only some of these parameters might be influenced, and all this again depends on the initial characterization of particular individual subjects. This implies that a special pedagogic problem is the necessity of an individual tailoring of exercise which depends on the initial individuality, which ensures whether the subject is interested to participate and endure in such an activity regime during necessary period of growth. An ongoing regime during the whole life span is desirable with regard to health, and optimal body composition and functonal capacity.

**TABLE 3**
BODY MASS INDEX, BODY COMPOSITION AND INTAKE OF FOOD IN ADOLESCENT HOCKEYISTS

| | X | SD | CV |
|---|---|---|---|
| Age years | 15.4 | 0.5 | 3.2 |
| Height (cm) | 170.3 | 8.5 | 4.9 |
| Weight (kg) | 53.9 | 8.4 | 15.6 |
| BMI | 20.2 | 1.3 | 6.4 |
| Fat % | 8.8 | 3.6 | 40.9 |
| Intake of energy MJ | 16.6 | 3.1 | 18.6 |
| »protein« (g) | 128.2 | 20.2 | 15.7 |
| »fat« | 163.3 | 40.7 | 24.9 |
| »carbohydrates« | 510.8 | 103.7 | 20.3 |

Delayed effects of early adaptations to exercise concerning lipid metabolism, cardiac microstructure development and sensitivity to noxi were revealed. These effects were shown in an experimental model with laboratory animals adapted either to increased and/or reduced physical work load at the beginning of life. This concerned also the consequences of exercise of the pregnant mother, manifested in adult offspring[8]. However, in humans there are no data on delayed effect of physical activity and exercise at early age during later periods of life.

## The Importance of Early Establishment of a Positive Individuality

Early adaptations can contribute in a desirable way to inherited faculties and contribute to the positive development of both nutritional and motor individualities. Families with a proper nutritional and physical activity regime – when parents are active, usually have also active offspring with a higher level of functional capacity. When an adequate regime of the child is in the family intro-

**TABLE 2**
THE COMPARISON OF BODY COMPOSITION AND AEROBIC POWER IN CONTROL, INACTIVE AND EXERCISED BOYS IN DIFFERENT AGE CATEGORIES (IBP DATA)[31]

| Age | | Control inactive | | | Exercised | | |
|---|---|---|---|---|---|---|---|
| | | X | SD | CV | X | SD | CV |
| 12 years | Fat % | 18.5 | 5.1 | 27.5 | 14.9 | 3.8 | 25.5 |
| | $VO_2$max mL/kg/min | 44.5 | 7.8 | 17.6 | 45.5 | 7.6 | 16.7 |
| 15 years | Fat % | 13.3 | 4.2 | 31.5 | 12.1 | 3.6 | 29.7 |
| | $VO_2$ max mL/kg/min | 43.2 | 7.7 | 17.8 | 53.0 | 5.5 | 10.3 |
| 18 years | Fat % | 12.9 | 4.4 | 34.1 | 9.9 | 2.7 | 27.2 |
| | $VO_2$ max mL/ kg/min | 45.3 | 9.5 | 20.9 | 55.4 | 4.6 | 8.3 |

duced since birth, it can continue, due to this adaptation also during preschool and school age, as well as later in life. This can promote also later in life the involvement in exercise on an optimal level, and preserve desirable fitness and health much more easily. Genetic and epigenetic factors along with a favorable early environment predispose therefore for a desirable spontaneous interest in exercise, as well as stimulate an adequate and/or above-standard development of cardiorespiratory efifciency and motor skills. Early adaptation and development of an optimal individuality results also in lower strain during activity, lower fatigue and thus greater enjoyment of a desirable physical activity regime up to later periods of life. This is also the best guarantee of prevention of obesity[39].

As mentioned above, simultaneous studies in both dietary intake and physical activity regime have been rare up to the present, especially during early childhood. Studies in preschoolers showed positive effects of higher physical actitivy regime. This was accompanied by reduced adiposity, higher level of functional capacity, higher level of HDL and of motor skill[8]. In adolescent athletes, such a status can be achieved using higher physical activity regimes which allows as well a higher dietary intake[38,39].

Reduced adiposity, enhanced development of lean body mass and high aerobic power and skill was thus revealed in subjects with relatively high intake of food. With increased exercise it is not necessary to follow reduced and controlled food intake, which is more difficult to define and arrange without a dysbalance in energy and deficiencies of certain essential nutritional items (minerals, vitamins *etc*.). Recommendation for an adequate physical activity regime can guarantee desirable somatic development and nutritional status, and also to prevent obesity[39].

## The Role of Nutritional and Motor Individuality in Obesity Developement and Treatement

Genetic predispositions for the development of obesity were revealed in many studies[41]. More recently, epigenetic factors were also considered and followed up. However, studies during longer periods of life in humans are rarely possible. As mentioned above, even siblings in the same family with comparable environmental conditions do not achieve the same level of adiposity, even when the same monitored diet and physical activity regime are used, supporting the importance of the role of individual characteristics.

Global epidemy of obesity concerning the child population, can at present achieve even morbid dimensions. However, »hidden obesity« – defined by increased adiposity along with not markedly increased BMI due to reduced muscle and physical fitness development, has been appearing more often. This situation is especially related to particular individualities – both nutritional and motor ones, and the latter has a decisive role in this type of obesity.

The treatment of obesity in children is a special problem as it does not agree with natural tendencies of growth and development. Change in the relationship between adipose and lean tissues along with continuing growth and maturation of the organism has to be achieved, along with reduction of fat and increase of lean body mass. Increased exercise is a most natural approach, and a desirable result is significantly related to the optimal relationship of nutrition and motor individualities, as well as to the degree and duration of increased adiposity and their consequences[39].

As observed in numerous studies, individually differentiated results of such treatment have been shown. Some subjects react faster and on a higher level, and the

**TABLE 5**
CHANGES OF BODY WEIGHT, HORMONAL AND BIOCHEMICAL PARAMETERS BEFORE AND AFTER REDUCTION THERAPY IN OBESE ADOLESCENTS[42]

| | Before | | | After | | |
|---|---|---|---|---|---|---|
| | x | SD | CV | x | SD | CV |
| Body weight (kg) | 77.4 | 12.0 | 15.5 | 68.2 | 11.2 | 16.4 |
| Insulin mU/L | 15.4 | 5.6 | 36.3 | 13.0 | 7.4 | 56.9 |
| Cortisol mmol/L | 746.0 | 456.0 | 61.1 | 539.0 | 357 | 66.2 |
| Thyroxin-T4 nmol/L | 108.0 | 33.0 | 30.5 | 94.0 | 29.0 | 30.8 |
| Triacylglycerols nmol/L | 1.35 | 0.81 | 54.0 | 0.81 | 0.61 | 75.0 |

**TABLE 4**
BODY WEIGHT, LEAN BODY MASS (LBM %), OXYGEN UPTAKE DURING THE SAME PHYSICAL LOAD (VELOERGOMETER) AND VITAL CAPACITY IN OBESE BOYS AND GIRLS BEFORE AND AFTER REDUCTION THERAPY (DIET, EXERCISE, BEHAVIORAL AND PSYCHOLOGICAL INTERVENTION IN SEVEN WEEKS SUMMER CAMP)[39]

| | BOYS | | | | | | GIRLS | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | before | | | after | | | before | | | after | | |
| | x | SD | CV | x | SD | CV | X | SD | CV | X | SD | CV |
| Weight (kg) | 65.7 | 14.0 | 3.9 | 58.5 | 12.3 | 21.0 | 70.3 | 12.9 | 17.5 | 63.1 | 10.1 | 16.0 |
| LBM % | 68.6 | 3.9 | 5.7 | 74.8 | 4.8 | 6.4 | 68.1 | 3.9 | 5.9 | 72.9 | 4.4 | 6.0 |
| Oxygen uptake mL $O_2$ /kg/min | 11.6 | 0.9 | 7.7 | 9.7 | 1.76 | 18.1 | 10.2 | 0.88 | 6.2 | 9.7 | 0,88 | 9.0 |
| Vital capacity mL | 2942 | 462 | 15.7 | 3073 | 506 | 16.4 | 2640 | 545 | 20.7 | 2838 | 595 | 20.6 |

results can be longer-lasting than in other cases. To explain such differences is again difficult, and many factors including initial individuality have to be considered. The results of the follow-up of obese children before and after a seven week summer camp with reducing regime (*i.e.* monitored diet, regular exercise of a different character, behavioral and psychological intervention) found on the average of cca 10 percent improvement in the individual characteristics (body composition, percent of the adipose tissue, aerobic power, results of skill tests, *etc*. However, the range of changes was quite large – from 4–16 % of changes on the initial measurements, and were also characterized by the coefficients of variation (Tables 4,5)[39,42]. Moreover, positive results of exercise lasted longer. Eventually normalization was achieved in some participants, but in others a positive effect was short-lasting and a return to the initial and/or worse status occurred. Even after returning home, different environment and other conditions in different subjects have to be considered. These results and their duration after reduction treatment ~~is~~ are obviously due to the initial individuality.

## Approaches to the Definition of Nutritional and Motor Individuality

As follows from the given examples, the role of motor and nutritional individualities, and especially of their mutual relationship is essential. Of course there exist many other individual features and characteristics of human subjects such as endocrinological, biochemical, psychological, intellectual and others. However, nutritional and motor individuality (which are also closely related to the mentioned ones) are decisive as indispensable conditions of optimal health status especially with regard to body composition, functional capacity and fitness. Their definition and assessment are desirable, and should be taken into account when evaluationg the health status, and especially its prognosis of a particular subject. Follow-up-of dietary intake, *i.e.* individual items intake and its energy, food choice and habits, preferences and aversions, as well as of motor habits – direct measurements of physical activity level, testing cardiorespiratory efficiency, aerobic power, endurance, skills, eventually structure of movement *etc*. in mutual relationships, could contribute to a better definition of necessary life condition changes.

At present, health care is first of all aimed at the treatment of existing illnesses, however, disease prevention and especially health promotion should include aforementioned aspects when trying to define and arrange proper regimes of nutrition, physical activity, exercise and sport participation. Their evaluation can therefore be a desirable starting point in the treatment and prevention of mentioned diseases. This has been recognized more frequently during last decades as a more efficient approach to the reduction of costs for health care for the increasing number of »diseases of civilization«. In this respect, prevention of the development of unfavorable nutritional and motor individualities since early childhood can be a significant contribution. Health recommendations should consider particular individualities[43].

Moreover, an above-average somatic, functional development – *i.e.* »positive health« should be the final aim. Factors contributing to the desirable development of stable optimal individualtities concerning both nutrition and physical activity have also not been defined yet in detail, similarly as for many other human characteristics. With regard to changing life conditions – inadequate nutrition and reduced physical activity more efficient approaches and procedures for this purpose should be emphasized and promoted. There have been some previous empirical experiences with regard to that, which under the conditions of present life are not sufficient. Frequent contradictory results of interventions – both concerning nutrition and physical activity – which do not respect the initial individual characteristics can be thus better explained and prevented, and better results could be achieved in the future.

## REFERENCES

1. WIDOWSON E, Proc Nutr Soc, 21 (1962) 121. — 2. WIDDOWSON E, J Coll Gen Pract, 6 (1963), Suppl. 2, 10. — 3. CHILDS B, World Rev Nutr Diet, 63 (1990) 14. — 4. ECKHARD RB, J Nutr, 131 (2001) 336S. — 5. TARASUK V, BEATON GH, Am J Clin Nutr, 54 (1991) 464. — 6. TARASUK V, EATON G, Appetite 18 (1992) 43. — 7. BECKERT-ZIEGISCHMID C, Soz Preventivmed, 50 (2005) 206. — 8. PAŘÍZKOVÁ J, Nutrition, physical activity, and health in early life. 2nd Ed. (CRC Press, Taylor and Francis Group, Boca Raton – London – New York, 2010). — 9. KOLPAKOV VV, BESPALOVA T.V, LARKINA N, LEBEDEVA KA, TOMILOVA EA, BELOVA TF, Fiziol Cheloveka, 5 (2009) 88. — 10. LEDOVSKAYA NM, Experiences in the assessment of physical activity in twins. In: SLONIM AD, SMIRNOV KM (Eds), Physical activity in man and hypokinesia. (Institute of Physiology, Novosibirsk, 1972) (in Russian). — 11. DUNCAN GE, GOLDBERG J, NOONAN C, MOUDON AV, HURVITZ P, BUCHWALD D, PloS One, 16 (2008) 2019. — 12. WALLER K, KUJALA UM, KAPRIO J, KOSKERVUO M, RANTANEN T, Med Sci Sports Exerc, 42 (2010) 658. — 13. LESKINEN T, SIPILÄ S, ALEN M, CHENG S, PIETILÄINEN KH, USENIUS JP, SUOMINEN H, KOVANEN V, KAINULAINEN H, KAPRIO J, KUJALA UM, Int J Obes, 33 (2009) 1211. — 14. AALTONEN S, ORTEGA-ALONSO A, KUJALA UM, KAPRIO J, Twin Res Hum Genet, 13 (2010) 475. — 15. SKLAD M, Wychowanie fiziczne a Sport, 3 (1972) 1638 (in Polish). — 16. MAES HH, BEUNEN GP, VLIETINCK RF, NEALE MC, THOMIS M, VANDEN EYNDE B, LYSENS R, SIMONS J, DEROM C, DEROM R, Med Sci Sorts Exerc, 28 (1996) 1479. — 17. WILLIAMS M, GROSS JB, Acta Genet Med Gemellol (Roma), 29 (1980) 127. — 18. GASKILL SE, RICE T, BOUCHARD C, GAGNON J, RAO C, SKINNER JS, WILMORE JH, LEON AS, Med Sci Sports Exerc, 33 (2001) 1832. — 19. MISSITZI J, GELADAS N, KLISSOURAS V, Med Sci Sports Exerc, 6 (2004), 233. — 20. MARIDAKI MJ, Sport Med Phys Fitness, 6 (2006) 540. — 21. PEETERS MW, THOMAS MA, MAES HH, LLOOS RJ, CLAESSENS AL, VIETINCK R, BEUNEN GP, Behav Genet 35 (2005) 551. — 22. SIMONEN RL, PERUSSE L, RANKINEN T, RICE T, RAO DC, BOUCHARD C, Med Sci Sports Exerc, 34 (2002) 1137. — 23. MITCHELL BD, RAINWATER DL, HSUEH WC, KENNEDY AJ, STERN MP, MACCLUER JW, Ann Epidemiol, 13 (2003) 128. — 24. ERIKSSON M, RASMUSSEN F, TYNELIUS P, Behav Genet, 36 (2006) 238. — 25. SEABRA AF, MENDONÇA DM, GÖRIG HH, THOMAS MA, MAIA JA, Eur J Epidemiol, 23 (2008) 205. — 26. WOOD AC, RIJSDIJK F, SAUDINO KJ, ASHERSON P, KUNTSI J, Behav Genet 38 (2008) 266. — 27. HOPKINS N, STRATTON G, MAIA J, TINKEN TM, GRAVES LE, CABLE TN, GREE DJ, J Pediatr 157 (2010) 943. — 28. STUBBE H, BOOMSMA DI, VINK JM, CORNES BK, MARTIN NG, SKYTTHE A, KYVIK

KO, ROSE RJ, KUJALA UM, KAPRIO J, HARRIS JR, PEDERSEN NL, HUNKIN J, SPECTOR JD, DE GEUS EJ, PloS One, 1 (2006) 22. — 29. ÅSTRAND PO, RODAHL K, Textbook of work physiology. 2nd ed (McGraw-Hill, New York 1977). — 30. PAŘÍZKOVÁ J, HELLER J. Relationship of dietary intake to work output and physical performance in Czechoslovak adolescents adapted to various work loads. In: SHEPHARD RJ, PAŘÍZKOVÁ J, (Eds) Human growth, physical fitness and Nutrition (Medicine and Sport Science, Basel, 1991). — 31. SELIGER V, Survey of the physical fitness of the inhabitants of Czechoslovakia. In: WAINER JS, (Ed) Human Adaptability (Taylor and Francis, London, 1977). — 32. BARKER DJP, Br Med J, 3012 (1990) 1111. — 33. WELLS JC, Int J Obes (Lond), 33 (2009) 1331. — 34. WELLS JC, Am J Hum Biol, 23 (2011) 65. — 35. PRENTICE A, Physiol Behav, 86 (2005) 640. — 36. WORLD HEALTH ORGANIZATION, Energy and Protein Requirements, Report of a point FAO/WHO/UNU Expert Consultation, Rome 1981, Technical Report Series No.724 (WHO, Geneva, 1985). — 37. ONIS M, BLOSSNER, M (Eds) WHO Global Database on Child Growth and Malnutrition (WHO, Geneve, 1997). — 38. PAŘÍZKOVÁ J, Body fat and physical fitness. Body composition and lipid metabolism in different regimes of physical activity (Martinus Nijhoff BV/Medical Division, The Hague, 1977). — 39. PAŘÍZKOVÁ J, HILLS AP, Childhood obesity: Prevention and treatment. 2nd ed. (CRC Press, Boca Raton-London-New York-Washington, 2005). — 40. SLOVER PJ, GARZA C, J Nutr 132 (2002) Suppl 8, 2476S. — 41. HAINEROVÁ I, Genetic factor in etiology and pathogenesis of obesity. In: PAŘÍZKOVÁ J, LISÁ L (Eds) Obesity in childhood and adolescnce. Therapy and prevention (Galen, Praha, 2007) (in Czech). — 42. ŠONKA J, KOSTIUK P, HILGERTOVÁ J, Acta Univ Carolinae, 39 (1993) 33.

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## ULOGA MOTORIČKIH I PREHRAMBENIH KARAKTERISTIKA KOD PRETILE DJECE

## S A Ž E T A K

Prehrambene i motoričke posebnosti značajno se razlikuju od čovjeka do čovjeka. Njihov odnos ključan je za održavanje balansa energije i promet u odnosu na tjelesnu kompoziciju, nivo fizičke spreme i zdravlja. Rano uspostavljanje optimalnih posebnosti, u odnosu na genetičke, epigenetičke i druge faktore koji utječu na organizam u ranim godinama poželjno je za dugi životni vijek i zdravlje. Pristup za vrednovanje prehrambenih i motoričkih karakteristika elaboriranо je kao važno polazište za pozitivan razvoj i eventualne promjene. To bi trebalo pomoći ne samo u prevenciji bolesti, nego i u poboljšanju prevencije i postizanja statusa »pozitivnog zdravlja«.