PRIMARY SCHOOL CHILD DEVELOPMENT – ISSUES OF SOCIOECONOMIC STATUS

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Abstract:

The aim of our four-year longitudinal survey was to compare the somatic and motor development of 7-year-old girls growing up in families that need continuous municipal financial support, respectively to the ones not needing it. Eight consecutive data collections were carried out in three geographic and economic regions of Hungary from 2003 to 2007. The study group (receiving financial support because of low socioeconomic status during the whole observation period) contained 152 girls and the comparison one (no financial support) consisted of 343 female peers. To receive regular financial support because of low socioeconomic status (SES) a family has to meet one of the five criteria prescribed by the law and used in the official statistics for the status of families. Between-observations differences were tested by repeated measures ANOVA (8 data collection sessions by 7 variables). In the case of a significant F-test the Tukey's *post-hoc* tests were used. Between-groups differences were analysed by independent *t*-tests. Age dependence was also studied by linear regression analysis that might serve for extrapolation in the phase of linear growth before the observed youngest age, but not for those older than the oldest observed age. In the case of a significant correlation the differences between the standardized curves (Betas) were analysed by *t*-tests using the standard errors of the coefficients. The level of effective random error was set at 5% in all significance tests. Body height and body weight arithmetic means were consistently and significantly greater in the comparison group. The weight means were proportionate to the taller stature. Consequently, the means of BMI and weight-related body fat content were statistically the same. The children of the low SES performed worse in speed, explosive strength (power) and speed endurance estimated by three motor tests. Other conditions being equal to the observed differences were attributable to the poor economic conditions affecting the study group already before and during the observation period. Nevertheless, it was not an absolute but a long-lasting relative sort of malnutrition (inadequate intake of protein, vitamin, etc.) that most likely affected the children from the low socioeconomic status group.

Key words: *longitudinal study, body dimensions, body mass index, fat percentage, motor performance*

Introduction

The socioeconomic status (SES) of families is one of the environmental factors that, through diverse and not always known mediation (e.g. nutrition, health care, personal hygiene, etc.), may influence child growth and maturation. A good few human biologists (Eiben & Mascie-Taylor, 2003; Malina, Bouchard, & Bar-Or, 2005; Simiya, Nakahara, & Shohoji, 2001) think that dietary anomalies are closely linked to SES of the family. Since SES criteria vary considerably with studies and countries, comparisons are difficult (Malina et al., 2005). Criteria relevant to one geographic area or cultural group or country are not necessarily relevant to others. In the developed western countries the commonly used indicators of SES include annual family income, *per capita* income and education of the head of the household. However, in several countries (Hungary is one of them) the first two mentioned indicators are sociologically sensitive data, too delicate to be asked about.

Because of the profound and rather abrupt changes in financial incomes and life standards of the Hungarian families they have become markedly polarized since the nineties of the last century. Unemployment and poverty have become widespread, so many families are now in need of social welfare benefits. According to the plenary session of the Hungarian Parliament, in 2006 about 250 thousand schoolchildren were starving while the Opposition's estimate was 350 thousand.

Even if one sets the real prevalence of starvation somewhere in between the two estimates, it would mean that every fifth or sixth child suffers from poor economic status of her/his family. It is no wonder that public data about the real or estimated prevalence are unavailable. However, malnutrition cannot be specified in Europe at the turn of the millennium merely as a smaller than biologically necessary calorie intake (starvation). Protein/amino-acid intake or vitamin and mineral supply when biologically inappropriate (either in quality, quantity or composition) are as important factors in nutrition as the lack of the necessary calories (specific nutrient deficiencies and protein-energy malnutrition). The symptoms developed because of long-lasting relative malnutrition may naturally differ (Bielicki, 1986; Simondon, Simon, & Simondon, F., 1997).

The aim of our four-year longitudinal survey was to compare the somatic and motor development of 7-year-old girls growing up in families that need continuous municipal financial support, respectively to the ones not needing it.

Methods

Subjects

In designing the schedule and data collections we observed the respective prescriptions of the Helsinki Declaration (WMA, 1996) for non-invasive studies. The eight anthropometric and motor data collections were carried out from 2003 to 2007 in 16 schools of three different geographic and economic regions of Hungary, namely, in the towns of Nyíregyháza (East Hungary), Szigetszentmiklós (the central part of the country) and Győr (North-West Hungary).

The total sample consisted of 495 non-athletic volunteer girls. Their age ranged between 6.51 and 7.50 years at the beginning of the study in September 2003. The regular physical activity of these children was only curricular physical education: 4-5 classes (of 45 minutes each) during a 10-day cycle of school education. Both the children and their parents were informed about the purpose as well as about the technical details of the study and a written consent of one of the parents for each child was collected. By the concordant official information given by the municipal governments and school secretaries 152 of the 495 children needed financial welfare-benefit. The basic criteria are set by Hungarian law (namely: unemployment benefit, regular municipal financial support) and/or child-welfare subsidy (single parent family, chronic child disease or more than three children in the family). These children have school meals free of charge also. Any of these financial aid criteria results in grouping the child into the stratum of low socio-economic status needing financial support. The only criterion of membership in the subject groups was whether or not their family needed continuous financial support during the whole observation period. Because of the limited subject number in the study group other factors of multiple social disadvantages could not be analysed in this comparison. Accordingly, there were 343 girls in the comparison group. These children were estimated by us to belong to some layer of the Hungarian middle socioeconomic stratum.

Experimental protocol

The differences between mean body height, body weight, body mass index (BMI), relative body fat content (estimated as by Parízková, 1961), the mean scores in 30m dash, 400m run, and standing long jump as well as the patterns of change with age were analysed in this comparison. The motor tests were performed on an open track-and-field arena within the same week as the anthropometric data collection.

Statistical analysis

Between-observations differences were tested by repeated measures ANOVA (8 observations by 7 variables). In the case of a significant F-test the Tukey's *post-hoc* tests were used. Between-groups differences were analysed by *t*-tests for independent samples. Age dependence was also studied by linear regression analysis that might serve for extrapolation in the phase of linear growth before the observed youngest age, but not for those older than the oldest observed age. In the case of a significant correlation the differences between the standardized curves (Betas) were analysed by *t*-tests using the standard errors of the coefficients. The level of effective random error was set at 5% in all significance tests.

Results

Statistics for the anthropometric characteristics and the linear regression analysis are summarized in the tables. Table 1 contains the respective arithmetic means and standard deviations of stature. The study group children were significantly and consistently shorter than their comparison group peers. Their delay was approximately 6 months in the body's longitudinal growth. Body height increments were significant from observation to observation in both samples (F-tests: study group = 5050.0, comparison group = 10002.0). The correlations of body height with age were .73, and .80 for the study and comparison group, respectively. A medium common variance (53% for the study group and 64% for the comparison group) was found in both samples. The curves of body height increase with age did not differ significantly (Table 2), but the intercepts did, that is, the two growth lines ran parallel. Signs of any catch-up growth could not be observed in the study group.

Table 1. Descriptive and comparative statistics for body height

Group	Study group			Comparison group	
Age	Mean	SD	*t*-test	Mean	SD
7.22	122.70	5.49	9.70	127.26*	4.51
7.75	125.66	5.58	9.98	130.52*	4.73
8.31	128.44	5.83	9.98	133.51*	4.93
8.81	130.98	6.01	9.75	136.14*	5.17
9.26	133.67	6.26	9.74	139.05*	5.40
9.80	136.98	6.46	9.31	142.44*	5.83
10.36	140.56	6.68	9.24	146.13*	5.97
10.88	143.35	6.89	9.81	149.46*	6.18
F, df/p	5050.0	7;144/.00		10002.0	7;335/.00

Legend: SD = standard deviation, * = a difference significant at 5% between the study and comparison groups, F = F-test for differences between ages, df = degrees of freedom, p = level of significance of F-test.

Descriptive and comparative statistics for body weight are summarized in Table 3. The study group girls were significantly lighter in all the eight observations. Mean differences ranged between 2.7 and 3.9kg. Body weight increments were proportionately larger than those in the 6-monthly increments of body height. Between-observations weight gains were consistently significant in both groups (F-tests: study group = 4135.0, comparison group =2187.0). The correlations of body weight with age were .52 (study group), and .57 (comparison group), respectively, but common variances were markedly lower (study group = 27%, comparison group = 32%) than for stature. The slopes of age-related body weight increase were not significantly statistically different in the two groups (Table 2).

Table 2. Coefficients and comparisons of linear regression equations on age

Variable	r	F_{reg}	$a_{y.x}$	$b_{y.x}$	Beta	SE_{Beta}	$t_{\beta study-comparison}$
BH_{study}	.73	1482	81.53±.34	5.66	.742	.002	.66
$BH_{comparison}$	.80	4850.	83.87±.21	5.98	.799	.001	
BW_{study}	.52	496	-6.42±.10	4.09	.530	.003	1.02
$BW_{comparison}$	.57	1193	-6.08±.07	4.41	.557	.002	
BMI_{study}	.29	123	9.51±.17	.83	.304	.010	4.06*
$BMI_{comparison}$	.28	221	10.49±.12	.78	.274	.006	
$F\%_{study}$	.38	205	3.84±.12	1.91	.380	.053	1.26
$F\%_{comparison}$	.34	344	6.21±.08	1.73	.334	.003	
$30m_{study}$	-.56	402	8.72±.42	-.24	-.859	.064	4.12*
$30m_{comparison}$	-.50	673	8.52±.27	-.23	-.504	.042	
SLJ_{study}	.56	486	45.03±.18	9.62	.542	.001	7.36*
$SLJ_{comparison}$	.58	1281	35.66±.11	11.33	.572	.001	
$400m_{study}$	-.35	126	167.46±.29	-4.85	-.352	.002	11.13*
$400m_{comparison}$	-.41	397	176.75±.16	-6.32	-.409	.001	

Legend: study = study group; comparison = comparison group; BH = body height (cm); BW = body weight (kg); BMI = body mass index ($kg \cdot m^{-2}$); F% = weight-related body fat percentage; 30m = 30m dash (s); SLJ = standing long jump (cm); 400m = 400m run (s); subscripts denote abbreviated low and middle socioeconomic status; r = linear correlation coefficient; F_{reg} = F-test of linear regression; $a_{y.x}$ = intercept; $b_{y.x}$ = non-standardized regression coefficient; Beta = standardized regression coefficient; SE_{beta} = standard error of the standardized regression coefficient; * = significant difference at p<.05.

Table 3. Descriptive and comparative statistics for body weight

Group	Study group			Comparison group	
Age	Mean	SD	*t*-test	Mean	SD
7.22	23.14	4.94	5.34	25.90*	5.47
7.75	25.04	5.55	5.23	28.09*	6.19
8.31	27.44	6.31	4.76	30.57*	6.95
8.81	29.71	7.26	4.39	32.93*	7.66
9.26	31.43	8.00	5.36	35.03*	8.32
9.80	33.46	8.54	4.33	37.20*	9.02
10.36	36.09	9.54	3.98	39.81*	9.64
10.88	38.07	9.92	4.00	41.94*	9.98
F, df/p	4135.0	7;144/.00		2187.0	7;335/.00

Legend: SD = standard deviation, * = a difference significant at 5% between the study and comparison groups, F = F-test for the differences between ages, df = degrees of freedom, p = level of significance of F-test.

BMI (Table 4) and body fat percentage (Table 5) indicate nutritional status by biologically different trains of thought. The patterns of group differences of these nutrition status indicators were similar but not the same. The BMI means were significantly different in the first two observations, and the relative fat differences were significant in the 3rd observation as well. The age-related increase in BMI of the study group was significant across the first 4 observations, but later only one-year differences were significant (F-test: 243.5). BMI increase in the comparison group was consistent (F-test:

558.7), only the final two observations were the exceptions. Individual BMI increase with age was very heterogeneous in both groups. BMI correlation coefficients with age were .29 in the study group and .34 in the comparison group. Common variances were approximately 8% only. The curves of age-related increase in BMI were statistically different ($t_{\text{bstudy group–bcomparison group}}$ = 4.06), a slightly faster BMI increase was found in the study group girls.

The differences between the successive relative fat means (Table 5) were consistently significant in the comparison group. The same was similar in the study group but the difference between the 7th and 8th observations was an exception. Between-group differences were only significant for the first three occasions. The correlation between age and relative body fat was significant, but the common variances were very moderate (14% in the study group and 12% in the comparison group). In spite of moderate between-group differences the curves of age-related body fat percentage did not differ statistically. The standard deviations were large for both nutrition indicators.

Between-group differences in performance are shown in Figures 1, 2 and 3. Scores in the 30m dash (Figure 1) indicate the speed of the individual. The mean running speed of the study group girls was consistently and significantly slower than the mean running speed of the comparison group. Mean differences ranged between .09 (8th observation) and .14 seconds (2nd observation). The increase in speed was consistent in the comparison group (F-test: 408.1) and less so in the study group girls (F-test: 186.3) where the differences between the 4th and 5th, as well as between the 5th and 6th observations were not significant. The age-related increases in speed were statistically significant, but the correlation coefficients (-.56 study group and -.50 comparison group) indicated only moderate relationships. Common variances were 31% and 25%, respectively. In spite of very similar statistics and patterns of means the slopes of increase were statistically different. A slightly faster speed development was observed in the comparison group girls ($t_{\text{bstudy group–bcomparison group}}$ = 4.12).

The scores in the standing long jump (Figure 2) indicate the level of explosive strength and leg-trunk-arm co-ordination (Szabó, 1977). Jumping performance was significantly poorer in the study group girls. Only the first data collection represented an exception with a statistically same jumping mean of the two groups compared. Significant mean differences ranged between 5cm and 9cm. The differences between the successive means were consistently significant in the comparison group children (F-test: 488.3), but only one-year increments were significant in the study group girls (F-test: 155.5). The relationship between age and jumping performance was mediocre in both groups ($r_{\text{study group}}$ = .56, $r_{\text{comparison group}}$ = .58), and common variances were below 35%. The speed of increase in jumping performance was significantly ($t_{\text{bstudy group–bcomparison group}}$ = 7.30) higher in the comparison group girls.

The patterns of change and group differences in the 400m run are shown in Figure 3. Mean running performance was generally better in the comparison group. Only the group means of the first observation in the 400m run were statistically the same. Significant mean differences only ranged between 4 seconds and 6 seconds. The age-related increases were significant in both

Table 4. Descriptive and comparative statistics for body mass index

Group	Study group			Comparison group	
Age	Mean	SD	*t*-test	Mean	SD
7.22	15.32	2.34	2.36	15.91*	2.66
7.75	15.74	2.84	2.38	16.38*	2.89
8.31	16.50	2.80	1.83	17.04	3.13
8.81	17.15	3.06	1.62	17.66	3.31
9.26	17.43	3.30	1.69	17.99	3.44
9.80	17.69	3.43	1.50	18.20	3.54
10.36	18.08	3.68	1.22	18.51	3.61
10.88	18.30	3.60	.96	18.63	3.51
F, df/p	243.5	7;144/.00		558.7	7;335/.00

Legend: SD = standard deviation, * = a difference significant at 5% between the study and comparison groups, F = F-test for the differences between ages, df = degrees of freedom, p = level of significance of F-test.

Table 5. Descriptive and comparative statistics for body fat content relative to body weight

Group	Study group			Comparison group	
Age	Mean	SD	*t*-test	Mean	SD
7.22	17.43	4.76	2.03	18.47*	5.47
7.75	18.50	5.06	2.14	19.65*	5,73
8.31	19.74	5.20	1.97	20.82*	5.81
8.81	21.05	5.40	.99	21.60	5.84
9.26	21.67	5.84	1.69	22.65	6.01
9.80	22.87	5.93	.94	23.42	6.05
10.36	23.75	6.12	.76	24.20	6.07
10.88	24.24	6.16	.76	24.69	6.06
F, df/p	325.5	7;144/.00		650.1	7;335/.00

Legend: SD = standard deviation, * = a difference significant at 5% between the study and comparison groups, F = F-test for the differences between ages, df = degrees of freedom, p = level of significance of F-test.

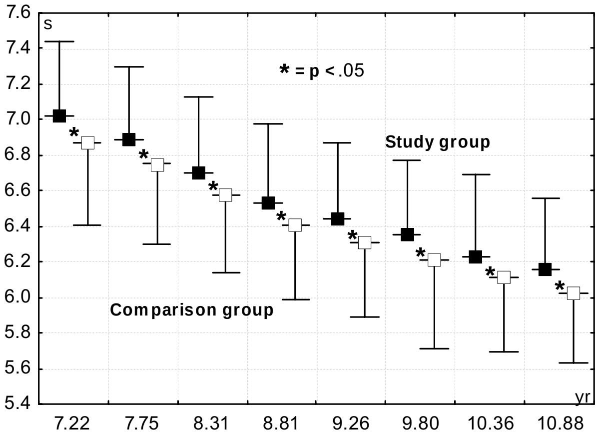

Figure 1. Group differences in 30m dash times (s).

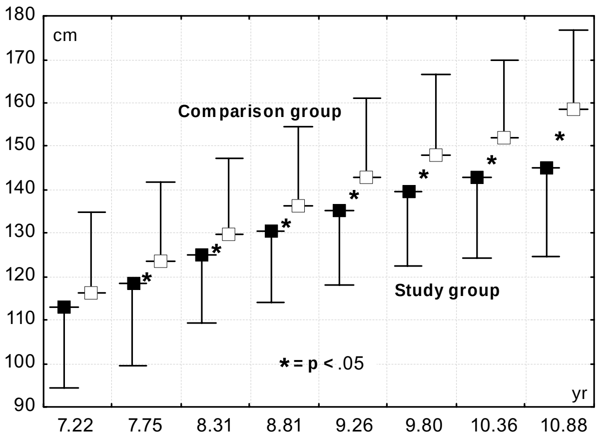

Figure 2. Group differences in standing long jump (cm).

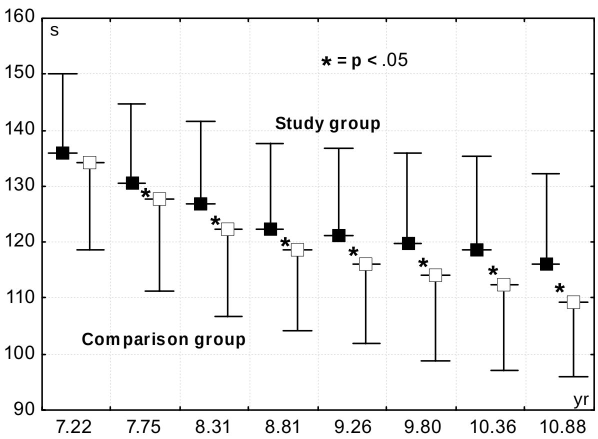

Figure 3. Group differences in 400m run times (s).

groups (F-tests: study group = 77.6, comparison group = 249.9), but only the one-year increments in performance were significant. The correlation coefficients between age and running time were -.35 in the study group and -.41 in the comparison group girls. Since common variances were below 20%, these relationships can be evaluated as very moderate. Variation coefficients exceeded 15% of the respective means. The age-related increase in running performance was significantly faster in the group of comparison group girls ($t_{\text{bstudy group} - \text{bcomparison group}} = 7.30$).

Discussion

There were consistent significant differences in favour of the comparison group between the successive means of body height and body weight as well as of the performance scores. Although body size and performance differences between the study group and comparison group girls were significant both statistically and in the sense of human biology, we were happy not to find the three widely accepted signs of chronic malnutrition (lack of adequate nutrition) suggested by de Onis and Blossoner (1997), namely, more than two standard deviations below international reference data median for

weight-for-age,
height-for-age, or
weight-for-length.

Because of their high prevalence, however, forms of chronic mild-to-moderate relative malnutrition (specific nutrient deficiency and protein-energy malnutrition) are also important (Benefice, Fouere, & Malina, 1999). These forms of malnutrition are very often associated with smaller body size, reduced muscle mass, reduced level of physical performance, and reduced level of habitual physical activity (Benefice & Malina, 1996).

On the basis of the observed mean body height differences our conclusions are as follows.

Body height means of the study group girls agreed with the reference values published by Eiben and associates in 1992, but were significantly lower than the more recent Hungarian reference values (Tóth & Eiben, 2004). This means that their growth delay expressed in the rate of the Hungarian secular changes in growth is of more than 15 years. The successive means in the comparison group children were higher than the 1992 references, but they were close to the recent ones. Mean body weights and consequently BMIes of our subjects were larger than the respective reference data of 15 years ago (in respect of the study group) or the recent ones (in respect of the comparison group). This result may be an issue of the smaller sample size. The prevalence of overweight or obesity – using either BMI cut-off values (Cole, Bellizzi, Flegal, & Dietz, 2000) or body fat percentage (Lohman, 1992) – grew from 8.5 to 20.4% in the study group subjects and from 17.2 to 21.9% in the comparison group children. The latter does not differ markedly from the observations of Prókai et al. (2005). Taking into account the very young age of our subjects the increments in mean body fat percentage starting from the 4th observation should be qualified as too large and dangerous (Guo, Chumlea, Roche, &

Siervogel, 1997; Goran, 1997). We note that body weights, BMIes and fat percentages exceeding the biologically necessary ones are but partly attributable to nutritional anomalies. A good number of reports on cross-sectional data collected in various geographic regions during the past 20 years confirm a lower level of habitual physical activity and poorer physical performance in children and adolescents (Tomkinson, Olds, & Gulbin, 2003). We share the opinion that a markedly reduced level of habitual physical activity is one of the most important components in this respect. Sághi and associates (2000) and also Othman et al. (2002) reported alarming data about a continuous decrease of habitual physical activity in Hungarian children during the past 15–20 years.

There are only two larger Hungarian samples we could compare the observed motor performances to. The mean performances of our subjects in the three motor tests lagged very much behind the 30-year-old observations0 of Szabó (1977), irrespective of socioeconomic status. When compared to the observations of Vajda and associates (2005), even the significantly better physical performances of our comparison group girls were poorer than average, not to mention a desirable level. Since physical performance was poor in both groups, it would be an error to attribute it exclusively to malnutrition. Such a low level of physical performance capacity is mainly a consequence of general hypoactivity.

The observed significant differences between the two groups in body size have led us to the inference that the anomalies of nutrition that we supposed had arisen from the low socioeconomic status must have existed already before school age. Although our data only referred to school-age girls, the linearity of the relationship supports this assumption. By the calculated speeds of dimensional increase or development we could state that during the study initial differences at best failed to change (body height, body mass, BMI, relative body fat) or the lagging behind of the study group even increased (motor performances). Considering their very moderate performance and slow increase with age, any effects of inheritance (Watanabe, Mutoh, & Yamamoto, 2000) can be ruled out from among the possible explanations. We inferred therefore that the background of the poor performance was a joint consequence of mild malnutrition (inadequate protein intake, vitamin and mineral supply) and habitual hypoactivity.

Although our kinanthropometric data only refer to three economic and geographic regions of the country, available estimates (Bodzsár, 2000) favour the assumption that a growing number of Hungarian children suffer from relative malnutrition. Thus what we observed does not apply to just a small section of society, it is a menacing social problem. One is unable to predict or estimate its further consequences. After a South-American investigation of poor children Post and associates (1992) concluded: malnutrition would result in a significant retardation of growth and development, and even when nutrition gets normalized, children are unable to compensate for the consequences of relatively long-lasting malnutrition. In our study group children's relative malnutrition exists and may have existed for years before the first observation. Although these inferences may seem speculative, they are not since 1) the lagging behind had already existed at the beginning of the study, and 2) the observed rates of growth coincide with the reports that deal with the consequences of mild malnutrition.

Because of the sample size and regional limitations of our study the somatic and motor development patterns of our comparison group failed to represent truly the valid and normal developmental trends and processes. Considering the newly developed social differences along with the economic changes we have to stress the importance of collecting all the available knowledge concerning the details of low socioeconomic status, both in the interest of public health and for the promotion of physical education at school.

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RAZVOJ DJECE RANE OSNOVNOŠKOLSKE DOBI – PROBLEMI SOCIO-EKONOMSKOG STATUSA

Sažetak

Uvod

Velika većina biologa smatra da su prehrambene anomalije vrlo usko vezane uz socio-ekonomski status (SES) obitelji. Budući da kriteriji SES-a znatno variraju u raznim dosadašnjim istraživanjima, a isto tako variraju i u različitim državama, vrlo ih je teško uspoređivati. Zbog velike i poprilično nagle promjene u ekonomskim primanjima i životnim standardima, mađarske su se obitelji dosta polarizirale od devedesetih godina prošlog stoljeća. Nezaposlenost i siromaštvo se proširilo te su mnoge obitelji osuđene na primanje socijalne pomoći.

Cilj našeg četverogodišnjeg longitudinalnog istraživanja bio je usporediti somatski i motorički razvoj djevojčica od 7. do 11. godine koje žive u obiteljima koje primaju gradsku financijsku pomoć i onih iz obitelji koje tu pomoć ne trebaju.

Metode

Osam antropometrijskih i motoričkih mjerenja provedeno je u razdoblju od 2003 do 2007 godine u 16 škola iz tri različite geografske i ekonomske regije Mađarske. Ukupan broj ispitanika bio je 495 djevojčica, koje se ne bave sportom, a dragovoljno su se prijavile za istraživanje. Na početku istraživanja, u rujnu 2003. godine, njihova kronološka dob bila je u rasponu od 6,51 do 7,50 godina. Redovitom tjelesnom aktivnošću ispitanice su se bavile samo u okviru nastave tjelesne i zdravstvene kulture: 4-5 nastavnih sati u trajanju od 45 minuta unutar dvotjednog nastavnog ciklusa od 10 dana. Prema službenim informacijama dobivenim od lokalne samouprave i školskih tajnika, 152 djevojčice (eksperimentalna grupa) od ukupno 495 koristilo je socijalnu pomoć tijekom cijelog ciklusa promatranja. U skladu s time, imali smo grupu od 343 djevojčice (kontrolna grupa) koje nisu primale socijalnu pomoć. Za tu je djecu procijenjeno da pripadaju dijelu mađarske srednje socio-ekonomske klase.

U sklopu ove usporedbe analizirane su razlike između prosječne tjelesne visine i tjelesne težine, indeksa tjelesne mase, postotka tjelesne masti (procijenjene prema metodi Parízkove, 1961), sprinta na 30 m, trčanja na 400 m, skoka u dalj s mjesta, kao i trendovi promjena rezultata kroz godine. Razlike među promatranjima su testirane metodom ANOVA (7 varijabli u 8 mjerenja). U slučaju pozitivnog F-testa koristio se Tukeyjev post-hoc test. Razlike između grupa testirane su t-testom za nezavisne uzorke. Ovisnost promjena o starosti ispitanika testirala se putem linearne regresijske analize. U slučaju značajne korelacije, razlike između standardiziranih regresijskih koeficijenata (β) bile su analizirane t-testom korištenjem standardne pogreške koeficijenata. Razina slučajne pogreške postavljena je na 5% za sve testove značajnosti.

Rezultati

Djevojčice u eksperimentalnoj grupi bile su značajno niže i to kroz cijeli period istraživanja, u svih osam mjerenja, u odnosu na ispitanice iz usporedne skupine. Njihovo kašnjenje u dosizanju visine svojih vršnjakinja iz druge grupe bilo je otprilike 6 mjeseci. Povećanje visine bilo je značajno između svakog mjerenja u obje skupine ispitanica (F-test: eksperimentalna grupa = 5050,0, kontrolna grupa = 10 002,0). Korelacija visine s kronološkom dobi bila je 0,73 za eksperimentalnu grupu, odnosno 0,80 za kontrolnu grupu. Koeficijenti povećanja visine u ovisnosti na kronološku dob nisu se značajno razlikovali, ali su postojale razlike u pojedinim segmentima, odnosno regresijski pravci bili su paralelni. Djevojčice iz eksperimentalne skupine bile su značajno lakše u svih osam mjerenja. Srednje vrijednosti razlika kretale su u rasponu od 2,7 do 3,9 kg. Povećanja u masi tijela bila su proporcionalno veća nego 6 mjesečna povećanja visine. Povećanje tjelesne težine između svakog mjerenja bilo je statistički značajno za obje skupine (F-test: eksperimentalna grupa = 4135,0, kontrolna grupa = 2187,0). Korelacija tjelesne težine s kronološkom dobi bila je 0,52 za eksperimentalnu grupu, odnosno 0,57 za kontrolnu grupu. Koeficijenti povećanja tjelesne težine u odnosu na kronološku dob bili su identični za obje skupine.

Prosječne vrijednosti indeksa tjelesne mase bile su statistički značajno različite u prva dva mjerenja, dok su razlike u postotku masnog tkiva bile statistički značajne u prva tri mjerenja. Povećanje ITM-a u odnosu na kronološku dob kod eksperimentalne grupe bilo je značajno kroz prva 4 mjerenja, ali nakon toga su se statistički značajnima pokazale samo promjene koje bi se dogodile kroz godinu dana (F-test. 243,5). Povećanje ITM kod kontrolne skupine bilo je stalno (F-test: 558,7), a smo su posljednja 2 mjerenja bila iznimke. Individualno povećanje ITM u odnosu na kronološku dob bilo je vrlo heterogeno u obje grupe. Korelacijski koeficijenti ITM i kronološke dobi bili su 0,29 u eksperimentalnoj grupi, odnosno 0,34 u kontrolnoj grupi. Razlike između aritmetičkih sredina potkožnog masnog tkiva bile su značajne u kontrolnoj grupi kroz sva mjerenja. Slična je situacija bila i u eksperimentalnoj grupi, osim što nisu zabilježene statistički značajne razlike između 7. i 8. mjerenja. Razlike između grupa bile su statistički značajne samo u prva 3 mjerenja. Korelacija između kronološke dobi i postotka potkožnog masnog tkiva bila je značajna, ali zajedničke varijance bile su umjerene (14% u eksperimentalnoj grupi i 12% u kontrolnoj grupi). Unatoč umjerenim razlikama između grupa, koeficijenti postotka masnog tkiva u odnosu na kronološku dob nisu se statistički značajno razlikovali.

Test sprint 30 metara korišten je za procjenu brzine. Prosječne vrijednosti sprinta na 30 m u eksperimentalnoj grupi bile su značajno slabije u svim

mjerenjima. Razlike u aritmetičkim sredinama kretale su se u rasponu od 0,09 (8. mjerenje) do 0,14 (2. mjerenje). Brzina se povećavala dosljedno u svim mjerenjima u kontrolnoj grupi (F-test: 408,1) i manje dosljedno u eksperimentalnoj grupi (F-test: 186,3), gdje razlike između 4. i 5., odnosno 5. i 6. mjerenja nisu bile značajne. Povećanje brzine u odnosu na kronološku dob bilo je statistički značajno, ali korelacijski koeficijenti (-0,56 u eksperimentalnoj grupi i -0,50 u kontrolnoj grupi) ukazali su na samo umjerenu povezanost. Usprkos vrlo sličnim statističkim pokazateljima i trendovima promjena aritmetičkih sredina, koeficijenti povećanja bili su statistički značajno različiti. Nešto brži napredak u razvoju brzinskih sposobnosti primijećen je u kontrolnoj grupi ($t_{beksperimentalnagrupa\text{-}bkontrolnagrupa}$ = 4,12).

Testom skok u dalj s mjesta procjenjivala se razina eksplozivne snage i koordinacije noge-tijelo-ruke. Slabiji rezultati zabilježeni su u eksperimentalnoj grupi. Samo rezultati prvog mjerenja bili su iznimka te se dobivene aritmetičke sredine rezultata nisu statistički značajno razlikovale. Značajna razlika između aritmetičkih sredina kretala se u rasponu od 5 do 9 cm. Razlike između aritmetičkih sredina zabilježenih kroz mjerenja bile su konzistentno značajne u kontrolnoj grupi (F-test: 488,3), ali u eksperimentalnoj grupi su samo jednogodišnje razlike bile značajne (F-test: 155,5). Korelacija između kronološke dobi i rezultata u skoku u dalj s mjesta bila je osrednja u obje skupine ispitanica ($r_{eksp.\ grupa}$ = 0,56, $r_{kontrolna\ grupa}$ = 0,58). Rezultati u skoku u dalj s mjesta su se statistički značajno brže povećavali u kontrolnoj grupi ispitanica ($t_{beksper.\ grupa\text{-}bkontrolan\ grupa}$ = 7,30).

Aritmetičke sredine rezultata trčanja na 400 metara bile su generalno bolje u kontrolnoj grupi. Samo rezultati zabilježeni u prvom mjerenju nisu bili statistički značajno različiti. Statistički značajne razlike između aritmetičkih sredina kretale su se u rasponu od 4 do 6 sekundi. Rezultati su se u odnosu prema kronološkoj dobi statistički značajno poboljšavali u obje skupine (F-test: eksperimentalna grupa = 77,6, kontrolna grupa = 249,9), ali samo u periodu od jedne godine. Korelacijski koeficijenti između kronološke dobi i brzine trčanja na 400 metara bili su -0,35 u eksperimentalnoj grupi, odnosno -0,41 u kontrolnoj grupi. Povećanje brzine trčanja povezano s kronološkom dobi bilo je statistički značajno veće u kontrolnoj grupi ($t_{beksper.\ grupa\text{-}bkontrolna\ grupa}$ = 7,30).

Rasprava

Prosječne vrijednosti rezultata ispitanica eksperimentalne skupine bile su slične dobivenim rezultatima u istraživanju Eibena i suradnika (1992), ali su bile statistički značajno niže od onih zabilježenih u istraživanju nedavno provedenim u Mađarskoj (Tóth & Eiben, 2004). To znači da naše ispitanice zaostaju više od 15 godina za mađarskim prosjekom sekularnih promjena rasta. Prosječne vrijednosti u kontrolnoj grupi bile su više nego što su zabilježene u istraživanju iz 1992, ali su bile vrlo slične vrijednostima zabilježenima u kasnijem istraživanju iz 2004.

Zapažene značajne razlike između dviju grupa u volumenu tijela dovele su nas do zaključka da su anomalije koje su se dogodile zbog loše prehrane, koje su prema našem vjerovanju rezultat lošeg socio-ekonomskog statusa, morale postojati već prije školske dobi. Prema dobivenim rezultatima o brzini promjena pojedinih dimenzija, odnosno razvoja pojedinih antropoloških karakteristika, možemo zaključiti da se tijekom ovog istraživanja inicijalne razlike nisu mijenjale (visina, težina, ITM, postotak masnog tkiva) ili se zaostajanje u rezultatima u eksperimentalnoj skupini čak i povećalo (motoričke sposobnosti). Zbog toga smo zaključili da je pozadina loših rezultata zajednička posljedica slabe i nepravilne prehrane (neadekvatan unos proteina te loša vitaminska i mineralna suplementacija) i uobičajena hipoaktivnost.

Iako se naše istraživanje odnosi na samo 3 ekonomske i zemljopisne regije naše zemlje, dostupne procjene idu u prilog pretpostavkama da rastući broj mađarske djece pati od relativno loše prehrane. Budući da se dobiveni zaključci ne odnose samo na mali broj stanovnika, navedeni problem je vrlo opasan. Teško je predvidjeti ili procijeniti daljnje posljedice ovog problema.