SOMATIC GROWTH IN MAPUTO SCHOOL POPULATION: TRENDS AND BIO-SOCIAL MEANINGS

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Keywords: somatic growth, africa, socio economic status

A cross sectional study with a sample of 2271 Mozambican school aged subjects (1098 boys, and 1173 girls; age 6 to 17) has been carried out in 1999. The study aimed (1) to contrast the somatic growth of this population with WHO norms, (2) to study the influence of socio-economic status, and (3) to verify the influence of dramatic changes in economic conditions in their growth status, comparing times of war and time of peace in an African country. Information available concerns height, weight, skinfolds (triceps and subscapular), and body mass index (BMI). Subjects were divided in three groups according to their socio-economic status: low, average, high. Analysis included descriptive statistics and Ancova (covariate=age). In order to compare times of war and time of peace a study done in 1992 at the some schools were used as baseline information (i.e. war time).
Results shows a clear demarcation of percentiles 10, 50 and 90 of height by age and weight by age with those of the WHO, particularly after age 11 in boys and 12 in girls. Maputo students are always shorter and weight less the norms proposed by WHO. In boys, BMI is also somewhat lower than WHO norms, but in girls mean values approach percentile 50. Privilege boys are significant taller, heavier and fatter than those from middle and low class. Girls follow similar profile exept for body fat since middle class girls shown the some values as those from high class. Height, weight, BMI, fat mass, and lean body mass were always higher in 1999 sample comparing with values from 1992 study.
In conclusion: (1) there is a substantial difference in height and weight values of Maputo students regarding WHO norms; (2) it is evident a clear advantage of being of higher socio-economic status; (3) socio-economic, hygienic and sanitary factors are the responsible agents for the greater values of 1999 sample; (4) differences concerning stature of students with higher socio-economic status and the WHO norms are almost irrelevant. This last aspect reveals the importance of socio-economic status in the assessment and evaluation of the growth process, implying its importance in facilitating the expression of the genotypes available in the population.

A MULTI-DISCIPLINARY STUDY ASSESSING THE PERFORMANCE OF JUNIOR (UNDER-16) RUGBY UNION PLAYERS OVER A WEEK LONG NATIONAL CHAMPIONSHIP

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Keywords: injury, performance, rugby

Increasing popularity of Rugby Union among adolescents resulted in the Australian Rugby Union investigating factors to describe best practice within talented youth. A multi-disciplinary research project was conducted during the week of the national championships in 2002.
Players representing the full-back, hooker, lock, half-back, and 5/8 from 12 teams across Australia provided anthropometric, nutrition and psychosocial profiles, as well as pre and post game measures of body mass, lactate, repeated sprint speeds and ratings of leg soreness. Players were further divided into Division One, in which players were mainly from well-populated and traditional rugby union states and Division Two, in which the players were from smaller states and representative squads. Severity ratings of injuries in the two years before the championships and during the championship week were also collected. Following tests for normality, the between-Divisions comparisons were assessed using Fisher's exact tests and independent sample T tests.
No differences were reported in the majority of variables including anthropometry, psychosocial measures, relative carbohydrate intake, body weight changes before and after games, and injury severity during the week. When compared with Division Two players, Division One players demonstrated greater changes in lactate during the game (3.0 mM vs 0.9 mM, $P = 0.01$), and ratings of leg soreness following the game ($P = 0.048$). Eighty-two percent of Division One and 43% of Division Two players reported injuries incurring two or more weeks of lost games in the two years prior to the tournament ($P= 0.055$). Division One players rated higher than Division Two players on a psychosocial measure of freedom from worry ($P= 0.054$).
Results indicate that markers of playing intensity may best discriminate between the divisions and provide benchmarks for aspiring youth who have a goal of long-term excellence in the sport of rugby union.

ADAPTATIVE EFFECTS OF DIFFERENT STRENGTH TRAINING PROGRAMS (STRENGTH AND/OR PLYOMETRIC TRAINING): COMPARATIVE STUDY OF JUNIOR FEMALE VOLLEYBALL PLAYERS

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Keywords: strength, plyometric, female junior volleyball

Introduction

Muscular strength in most sports is a determinant factor for performance. This is especially evident in volleyball. This sport has gradually come to demand players, who are taller, stronger

and more agile in order to satisfy greater physical demands during a game. Moras (2000) considers strength an important motor capacity for the performance of volleyball players. The American Volleyball Coaches Association (1997) states that strength training (ST) is obligatory in order to optimise a volleyball player's performance.
Vargas (1982) mentions that the majority of volleyball movements occur on the basis of greater strength velocity.exercises Examples of this are: quick start, change of direction, sudden stops, jumps, along with rapid movements of upper body and limbs whenever a player does blocking, serving and striking. Blume (1989) also agrees on the importance of explosive strength and states that rapid attack and defense movements suggest a solid development when force is involved. Therefore, strength in its multiple aspects: rapid, explosive and reactive strength is extremely important in the volleyball (Carvalho, 1998).
Authors such as Weineck (1986) and Saraiva (2000) say that obtaining high levels of sport performance becomes more and more difficult when there is inadequate training and development of strength in children and adolescents. Saraiva (2000) also talks about the importance of strength training in female teams due to their natural physical "fragility" in comparison to the opposite sex. Thus, we believe that working with junior athletes, in particular females, in order be familiar with the effect of a strength training initialising before any type of sport activity.
In relation to the quality and orientation of ST among young athletes a balanced and multilateral strength training program is recommended so that there is greater fitness, better sports performance and a higher prevention of injuries. On the one hand, much literature focuses on the importance of plyometric training in Volleyball because of high levels of rapid strength in stretch-shortening cycle (SSC).
Pyometric is a method which combines strength and speed; it is a capacity of the most rapid speed possible (Cossenza, 1995). Plyometric refers to many types of jumps, such as: hopping on one or both feet, vertical, horizontal and combined jumps, jumping on and over objects, jumping from high to low levels without bounce.
The main aims of the present study were not only to verify the adaptative effects of different strength training programs (strength and/or plyometric training) but also to confirm which of the two is more adequate in improving different types of strength and speed.

Methodology
The sample involved 17 female volleyball players at a junior level with the same competitive abilities. The sample was divided into two distinct experimental groups: one training program corresponded to common strength and plyometric exercises (mixed training) for lower limbs (CMGC team, n=10); the other program corresponded to plyometric exercises for the lower and upper limbs (AASM team, n=8). The training lasted ten weeks.
Assessment took place before and after each training program and involved the following parameters: anthropometric measurements, maximum isometric strength (knee extension 90º) dynamic strength (pull-over and leg press) power, explosive and reactive strength (SJ, CMJ, CMJ-bl, CMJ-stk, DJ 40cm and PMM-15") and speed (zig-zag and Japanese).

Table 1 – Evalution tests of maximum isometric and dynamic strength, of explosive and reactive strength and of speed

Tests	Capacities
Knee extension 90º	Maximum isometric strength
Pullover	Dynamic strength of the upper limbs
Leg press	Dynamic strength of the lower limbs
Squat Jump (SJ)	Explosive strength of the lower limbs
Counter-movement Jump (CMJ)	Explosive and long reactive strength of the lower limbs
Counter-movement Jump "balance" (CMJ-bl)	Explosive and long reactive strength ("an upward" arm push)
Counter-movement Jump "strike" (CMJ-stk)	Explosive and long reactive strength (volleyball strike)
Drop Jump (DJ 40)	Short reactive strength of lower limbs
PMM (15")	Resistance of short reactive strength and elasticity index
Zig-zag test	Speed and agility
Japanese test	Speed and agility

Training Programs
The program of resistance training was applied only to the CMGC. The load was: 2 series of 12 to 15 repetitions, with an interval of 120" between series. The load was always increased when athletes could do more than 15 repetitions easily. The exercises were: bench press; lat pull-down; leg press; knee flexion; pull-over; knee extension; bicep curls; rowing; calf raises; abdominals; back extension.
The plyometrics training program for both teams involved, load: 2 series of 15 repetitions and 30" interval between exercises and 1'30" between series. Exercises: (i) going up and down a step as quickly as possible; (ii) side to side jumps over a bench; (iii) double leg speed hop; (iv) knee tuck jump; (v) depth jump; (vi) jump from a box/step followed by vertical bounce; (vii) one legged hop; (viii) squat jump.
This plyometric training program was done by AASM. A warm up of 15' which included multiple types of jump like: skips, ricochets, hops, bounds, leaps and lunges. Exercises: (all exercises were performed in pairs and with medicines balls) (i) chest pass; (ii) throwing over head throw; (ii) one handed pass (alternating); (iii) chest pass with leg extension; (iv) scoop toss; (v) sit-up throw; (vi) throwing with legs a part and back to back lateral throw.

Statistical procedures
For all the variables we calculated the mean and deviation pattern. In each group and in two study periods, we carried out the T-test for repeated measures. The analysis of change within each type of strength training program was done in the following mode: (i) regression analysis of the values compared with the initial values; (ii) one-factor analysis of variance to test the differences in the performance of the groups considered; (iii) multiple comparison procedure *a posteriore* carried out with the Scheffé test when the F-value was significant. The level of significance was maintained at 0.05. The analysis of the data was done through the use of the statistical program Statview 2.0.

Results and discussion
Isometric and dynamic strength
One can see from Table 2, in relation to the knee extension test and the pullover and leg press, that the groups registered improvement. But it was only in the pullover that significant statistical differences occurred in both groups.

Table 2 – Maximum isometric and dynamic strength in each group [mean (x), standard deviation (Sd), absolute (Abs) and percent (%) gains, t and p values, during both moments of assessment.

Measure	Group	n	Pre Test		Post Test		Gains			
			X	Sd	X	Sd	Abs.	%	t	p
Pullover	CMGC	9	48.13	3.72	51.25	5.18	3,12	6,09	-2,38	0,0492*
(1RM)	AASM	8	43.75	5.83	48.75	7.44	5,00	10,26	-5,29	0,0011*
Leg Press	CMGC	9	135.00	13.69	140.00	13.23	10,00	7,14	-2,12	0,0667
(1RM)	AASM	8	141.25	31.82	145,00	36.25	3,75	2,59		
Knee	CMGC	9	28.42	16.46	32.39	10.74	3,97	12,26		
Extesion	AASM	8	30.57	4.96	40.56	13.39	9,99	24,63	-2,66	0,0324*

** Significant statistical differences (p ≤ 0,05)*

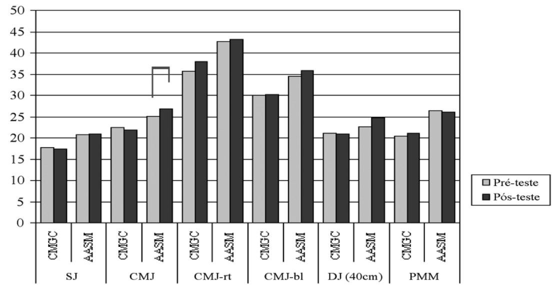
The AASM team showed significant statistical gains in relation to the maximum strength. However, neither one of the training programs showed relevant changes within the group.

Explosive and reactive strength
Table 3 and Figure 1 show results of the vertical jump tests which assessed explosive and reactive strength (long and short) of the upper limbs. The results confirmed that the AASM group had gains in the following tests SJ, CMJ, CMJ-bl, CMJ-rt and DJ40 but with a decrease in the PMM. However, there were significant statistical changes in CMJ. The CMGC team had gains in the CMJ-bl, CMJ-rt and PMM, and less in the SJ, CMJ e DJ40 all with no statistical significance. This results are abnormal and difficult to explain.

Table 3 – Explosive and reactive strength in each groups [mean (x), standart deviation (Sd), absolute (Abs) and percent (%) gains, t and p values, at both moments of assessment].

Measures	Group	n	Pre test		Post test		Gains			
			X	Sd	X	Sd	Abs.	%	t	p
SJ	CMGC	9	17.65	2.21	17.29	2.19	-0,36	-2,08		
	AASM	8	20.83	4.40	20.90	4.51	0,07	0,33		
CMJ	CMGC	9	22.36	3.14	21.91	2.88	-0,45	-2,05		
	AASM	8	25.09	5.24	26.86	5.00	1,77	6,59	-4,62	0,0024*
CMJ-bl	CMGC	9	30.03	2.97	30.20	3.81	0,17	0,56		
	AASM	8	34.54	7.53	35.88	8.10	1,34	3,73		
CMJ-stk	CMGC	9	35.75	3.09	37.91	4.34	2,16	5,69		
	AASM	8	42.68	9.09	43.29	8.30	0,61	1,41		
DJ	CMGC	9	21.07	2.73	21.02	3.16	-0,05	-0,24		
(40 cm)	AASM	8	22.73	2.93	24.77	2.52	2,04	8,24	-2,19	0,0645
PMM	CMGC	9	20.41	2.96	21.20	2.75	0,79	3,73		
	AASM	8	26.46	5.97	26.03	5.37	-0,43	-1,65		

** Significant statistical differences (p ≤ 0,05)*



** Significant statistical differences (p ≤ 0,05)*

Figure 1 – Comparison of the mean values (cm) of explosive and reactiva strength for the lower limbs (SJ, CMJ, CMJ-bl, CMJ-stk, DJ40 and PMM), in each group (CMGC vs *AASM team) during both moment of assessment.*

When comparing both groups, the CMGC team had lower results in all the tests before beginning the training programs. The analysis of variance (ANOVA), the regression of the final values from the initial ones showed significant differences between the CMGC and the AASM in the CMJ test, which indicates that the program that AASM underwent was more demanding in order to obtain better gains.

Speed
The study which took place was registered in two tests: Zig-zag and Japanese tests.
When analysing Table 4, one can verify that the AASM team managed to conclude both tests in less time, contrary to what happened to the CMGC team. There are differences which have relevant statistical differences in the Japanese test, these differences do not relate to improved performance but to bad results obtained by the CMGC.

Table 4 –Speed in each groups [mean (x), standart deviation (Sd), absolute (Abs) and percent (%) gains, t and p values, at both moments of assessment].

Measure	Groups	n	Pre test		Post test		Gains			
			X	± Sd	X	± Sd	Abs.	%	t	p
Zig-Zag	CMGC	9	6.63	2.24	7.18	0.39	0,55	7,66		
	AASM	8	6.74	0.46	6.60	0.49	-0,14	-2,12	1,91	0,0974
Japanese	CMGC	9	8.49	0.17	8.63	0.25	0,14	1,62	-2,6	0,0289*
	AASM	8	8.18	0.49	8.07	0.51	-0,11	-1,36		

** Significant statistical differences (p £ 0,05)*

Conclusions
This analysis permitted us to come to the following conclusion: Both training programs had gains in maximum isometric and dynamic strength but the plyometric training group predominated, because it had significant statistical gains in two tests and the mixed training group only had gains in the pullover. In relation to explosive and reactive strength, only the plyometric training program had gains of a statistical importance and it was also here that greater gains occurred in speed displacement. Although, the plyometric program showed greater gains, the range of improvement was not satisfactory in order to differentiate the two groups. Therefore one can not conclude the accuracy of either training programs.

References
American Volleyball Coaches Association (1997). Coaching Volleyball. In Kinda S. Asher. Chicago. Masters Press,
Blume, G. (1989): Voleibol. Édiciones Martinez Roco, S.A. Barcelona
Carvalho, C. (1998): O desenvolvimento da força nas crianças e jovens a sua treinabilidade. Treino desportivo. Edição do CEFD. Ano I, 3ª série, pp 29-36.
Cossenza C. (1995): Musculação. Sprint. Rio de Janeiro.
Moras, G. (2000): La preparación integral en el Voleibol – 1000 Ejercícios y Juegos. Volume I. Colección Deporte – 2ª Edição. Editorial Paidotribo. Barcelona
Saraiva, L. (2000): Efeitos múltiplos e multilaterais de um plano de treino de força geral no desenvolvimento das diferentes expressões de força - um estudo em voleibolistas juvenis do sexo feminino. Dissertação de Mestrado. FCDEF - UP.
Vargas, R. (1982): La preparación Física en Volleyball. Editorial Augusto E. Pila Teleña. Madrid.
Weineck, J. (1989): Manual de treinamento esportivo. 2ª edição. Editora Manole Ltda. Brasil.

COMPLEX TRAINING VS. ANALYTICAL TRAINING: EFFECTS ON GENERAL ENDURANCE OF YOUTH BASKETBALL PLAYERS

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Keywords: complex training, general endurance, basketball

Introduction
Teaching Basketball is a slow process that requires a strong investment from coaches and players.
Methodological orientations for young athletes sport preparation suggest the importance of aerobic exercise (Bompa, 2000; Basketball Canadá, 1987; Janeira, 2001).
Traditionally, continuous race is the most used method to endurance development, habitually accomplished in an analytical context.
Recently, some authors have been criticizing this training process (away from game context) and they have been promoting a different training type designated by Complex Training, accomplished from tactical exercises and game structures with multiple repercussions in the different components of the athletes' physical fitness (Chirosa Rios et al., 1998; Janeira, 2001; Vaquera, 2001). Complex Training is highly motivator for athletes (requesting exercises always accomplished with ball) and also contains a strong idea of time economy (Lozano, 2001; Janeira, 2001).
In spite of arguments promoting Complex Training, is still unknown its effectiveness in young Basketball players preparation. The aim of this study was the following: (i) to evaluate the effect of the Complex Training and the Analytical Training in general endurance of youth Basketball players.

Methods
The sample comprises 10 athletes all from the same male team (age=11,80±0,87 years), random splited in 2 groups (GExp1, GExp2). All players were submitted to the same specific type of training in Basketball. The training programs were applied in the end of the regular training sessions, during 8 weeks with a tri-weekly regularity. The GExp1 carried through 20 minutes of continuous race; the GExp2 fulfilled a circuit training program that included 4 techcnical-tactical exercises applied at 4 differentiated moments (each exercise was applied during 2 weeks, with the following load dynamics: 3 series of 4 minutes each with 1 minute interval between series). The player's general endurance was evaluated in a pre post-test model using as criteria method the distance covered in the Cooper Test (Kirkendall et al., 1987).
Statistical analysis included Mann-Whitney U test for inter-groups comparisons and Wilcoxon test for intra-groups comparisons.

Results and discussion
Table 1 presents differences from pre to pos test in the two groups studied.

Table 1. Results of mean comparison between pre and pos test in Gexp1 and Gexp2.

	Pre – test	Pos - test	T	p
GExp1	2233,8±180,65	2360,41±183,31	-3,579	0.023 (*)
GExp2	1928.76±279.37	2034.02±291.66	-6,401	0,003 (*)

Main results revealed significant differences between pre and post-test in the two groups studied (GExp1: +126,61±79,11 meters, p=0,023; GExp2: +105,26±36,99 meters, p=0,003). However it is clear a similarity between pre and pos test. (Table 2.) In fact, relative profits between pre and pos test were the following: GExp1=5,73% and GExp2= 5,48%.
Table 2 presents the absolute and average profits between pre and pos test in the two groups studied.

Table 2. Average profits (absolute and relative) between pre to pos test in Gexp1 and GExp2.

	Absolute profits	% profits
GExp1	126.61±79.11	5.73±3.49 (*)
GExp2	105.26±36.77	5.48±1.99 (*)

Values are average ± standard deviation
(*) Statistical differences between pre and pos test.

The largest profits identified in GExp1 relatively to GExp2 can be probably attributed to the obvious similarities between continuous race training and the evaluation test used. However, Complex Training differs just 0,25%. From our point of view this value is irrelevant and expresses the idea of quality in technical, tactical and physical conditioning training designed to implement the aerobic capacity of the youths Basketball players. In other words, the Complex Training proposed, based upon exercises usually used in Basketball practices and tactical structures designed from team's game model, were able enough to develop athletes' aerobic capacity levels, at least to similar values reached through continuous race training.
These results confirm "youth training process should be drawn in a very strong approach to Basketball from a economic training perspective" (Janeira, 2001; pp. 31). The author also refers that the advantages of this training method are multiple with

main relevance on: (i) the mobilization of the more used muscular groups, and (ii) the simultaneous development of technique, tactics and physical conditioning in similar conditions to the competition. On the other hand, this training method seems to be highly profitable facing the limited available time for the youth athletes' training process and it is also attractive and motivator.
In fact, with the Complex Training it seems possible to promote a multiple sport preparation with high-level athletes' effort and with a strong time economy.
Training programs supplied in GExp2 provided a significant increase in the distance from the first to the second evaluation moment. This increment of the aerobic capacity express by the high distance travelled in the second evaluation was obtained by a work volume of about twenty minutes, distributed in four series, with one minute interval between them. This fact allowed a continuous effort, mobilizing the more requested muscular groups in Basketball and an execution intensity that allowed us to identify each athlete's breathing frequency. This methodological training organization allows us to establish that the more close the situations proposed are from the game reality, faster and better will be the motor transfer and the promotion of Complex Training as an effective training process.
In conclusion, the Complex Training showed a similar power to the Analytical Training in the modification of the general endurance of youth Basketball players.

References
Basketball Canada (1987). Level 1 Technical. Canada: National Coaching Association of Canada.
Bompa, T. O. (2000). Total Training for Young Champions
Chirosa Ríos, L. J.; Chirosa Ríos, I.; Puche, P. P. (1998). [On-line]: www.efdeportes.com/efd11a/bnm.htm
Janeira, M. A. (2001). Treino Desportivo-Especial (4): 30-32.
Kirkendall, D. R.; Gruber, J. J.; Johnson, R. E. (1987). Measurement and Evaluation for Physical Educators.
Lozano, D. O. (2001). [On-line]: www.efdeportes.com/efd41/infl.htm
Vaquera, A. (2001). Clinic,(55): 29-32.

PHYSIOLOGICAL AND ANTHROPOMETRIC DIFFERENCES BETWEEN AGE GROUPS OF YOUNG BRAZILIAN SOCCER PLAYERS DURING THE SEASON

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Keywords: soccer, exercise, physiology, anthropometry

Success in soccer is dependent upon a variety of factors. These include the physiological and anthropometic characteristics of the players, their level of skill and their psychological profile. The aim of this study was to examine the differences in physiological and anthropometric characteristics between age groups, obtained in three separated stages during the season (March, June and November), in young male soccer players.
The subjects were 70 males brazilian soccer players between the ages of 14 and 18 years.The players group was divided into age group: U15 (n= 20), U17 (n= 36) and U19 (n= 14). All players competed in the 2002 season. The first and second test session was conducted at the beginning and final of preparation period to the season (in March and June) and the third test session at the final of competitive period (November). The battery of tests included measurements of body mass (kg), heigth (cm), sum of 2 skinfolds (triceps and subscapula) (mm), Yo-Yo Intermittent recovery test (m) to assess the ability to recover after intense exercise (Bangsbo, 1996), a 30-m sprint (s), a Quebec 10s test to assess anaerobic power (W/kg) and capacity (J/kg) (Simoneau, Lortie, Boulay, Bouchard, 1983). The assessment conditions were similar (surface, hour, temperature) in all tests. For data analysis we used the procedures to descripitive statistics (mean, standard deviation), the one-way ANOVA for testing the mean differences between the age group. A criterion alpha level of $p<0.05$ was used and Duncan post hoc comparisons were used to distinguish between the groups.
The U17 athletes and U19 had significantly greater mean body mass, in the first test session, and Yo-Yo intermittent recovery test, in all test sessions, and a significantly lower time 30-m sprint, in the first and second test sessions, than U15. The U19 athletes had significantly greater mean Yo-Yo intermittente recovery test, in all test sessions, and a significantly lower time 30-m sprint, in the first and second test sessions, than U17. The results of this study suggest that the main differences between age groups during the season is in the ability to recover after intense exercise and speed.

SOMATOTYPE AND PHYSICAL PERFORMANCE IN YOUNG FEMALE VOLLEYBALL PLAYERS

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Keywords: somatotype, physical performance, young female, volleyball

The purpose of this study was to evaluate the magnitude and relevance of the relationship between somatotype and physical performance of young female volleyball players.
Subjects for this study were 179 young female volleyball players aged 15.28±1.38 (12.00 to 17.90) years old. Somatotype was assessed with the Heath-Carter method for determination of Endomorphy, Mesomorphy and Ectomorphy. Physical performance was evaluated with the following tests: 18 m Run, Shutle Run (48 m) Static jump (SEM), Counter Movement Jump (SCM). These tests were done according to Bosco protocol. Statistical analysis included not only basic stats, but also canonical correlation (Rc) which uses Chi2 as test statistic for the significance of Rc, and Stuart-Love canonical redundancy index (SLri) as a mesure of multivariate variance-covariance extrated by somatotype of physical performance domain. All analysis were done in Systat 10.
Somatotype and physical performance variables showed high reliability estimates ($R>0.80$). Voleiball players were classified as mesomorphic-endomorph (4.68 - 3.84 - 2.32).
Only one canonical correlation was found significant and was low value, $Rc=0.40$, $\chi^2(12)=33.304$, $p=0.001$; common vari-

ance-covariance was Rc^2=17.4%. Canonical loadings in each domain (somatotype and physical performance) showed a high value for endomorphy (0.95) and negative values for physical fitness (18 m run =- 0.68; SEM = -0.96; SCM = -0.81). Conclusions: (1) somatotype as a whole explains little generalized variance-covariance of the physical performance of young female volleyball players; (2) endomorphy is highly responsible for this characteristics because it was negatively related to performance in running speed and explosive strength. These aspects call for a more in depth approach of the relationship between some somatic variables (not shape variables) and the motor domain of young volleyball players.

PHYSICAL STRUCTURE AND AEROBIC/ANAEROBIC FITNESS OF ADOLESCENT HOCKEY PLAYERS AND LINE-SKATE RUNNERS WITH A SPECIAL REGARD ON SPECIALIZATION AND ELITISM

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Keywords: physical structure, aerobic/anaerobic fitness , sport selection

The present study summarizes the morphological and physiological information of line-skaters and hockey players taking into account their level of competition. This information would be relevant to support decision making on sport specialization and sport selection during adolescent years.
The sample is composed of 20 line-skaters of the Portuguese national team and 51 male hockey players (41 local athletes, 10 participants in the 2002 European Championship). Data collection comprised anthropometric information needed to determine body size, fat body mass (Boileau et al., 1985), androgyny (Tanner et al., 1951) and somatotype (Carter & Heath, 1990), while fitness were assessed as aerobic capacity (PACER) and anaerobic peak power (Wingate test).
Comparisons between sports showed that line-skaters and hockey players have similar body size. However, the formers are more androgynous ($p<.05$). Hockey players tend to be slightly fatter and attain better performance in aerobic test and poorer results in anaerobic parameters.
Comparisons of hockey players by competitive level show that athletes selected for national team are heavier ($p<.01$), leaner ($p<.01$) and more androgynous ($p<.01$). Data regarding physiological profile showed that top players are fitter in both aerobic ($p<.01$) and anaerobic fitness ($p<.01$). After controlling for differences in body size, youth elite hockey players and line-skaters seem to have similar anaerobic profile than older team sport players reported by Kalinski et al. (2002).

References
Carter J, Heath B (1990). Somatotyping - development and applications.
Kalinski MI, Norkowski H, Kerner M, Tkaczuk WG (2002). Eur J Sp Sc. Vol. 2 (3)
Tanner JM, Lond MB, Penna MD (1951). The Lancet. 1: 574-579

MODELING STABILITY OF SOMATOTYPE. A STUDY IN BOYS AND GIRLS FROM THE AUTONOMOUS REGION OF MADEIRA (PORTUGAL)

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Keywords: modeling, stability, somatotype

This study aims at the search of somatotype stability and predictors of interindividual changes (sports participation and skeletal maturation).
A sample of 99 boys and girls from the Autonomous Region of Madeira (Portugal) were followed longitudinally for three years (mean ages of 11.73; 12.70; 13.73). Somatotype was rated according to the Heath-Carter methodology. Sports index was evaluated with the Baecke et al. (1982) questionnaire. Skeletal age was assessed using the Tanner-Whitehouse Mark II system. Stability of somatotype and predictors of change were modeled with a quasi-simplex covariance structure within the Mplus (Muthén and Muthén, 2001) software framework.
Reliability estimates for somatic measurements (R>0.87), response to questionnaires (R>0.73) and skeletal rating (% Agreement >81.3%) were all excellent, giving credit to the quality of the data available.
Somatotype, as a whole, is highly stable β_{21}= 0.84; β_{32}= 0.96) with very low residual variances (D21= 0.20; D32=0.20). Tracking is also very high, $r_{1,2}$=0.93; $r_{2,3}$=0.94; $r_{1,3}$=0.88. No significant influences were found for sports participation nor for differences in biological maturation.
In conclusion several points deserve attention: (1) the very high stability of somatotype over a 3 year period during puberty; (2) somatotype as a whole tracks well from 11.73 to 13.73 years, with a high predictability; (3) sports index does not influence somatotype plasticity during this period probably due to the fact sports ratings are stable over this period (Sp1=2.68; Sp2=2.90; Sp3=2.77); (4) although differences were found in skeletal age at each period (p1=9.60-15.70; p2=9.87-15.83; p3=10.96-17.35), mean ages are almost equal (p1=12.58; p2=12.90; p3=14.14); (5) we think that a greater sample and a panel study with more measurement periods would probably change these results and would show the plasticity of physique over the entire puberty within the limits of genotypic influences.

PHYSIQUE AND BODY COMPOSITION PARAMETERS OF PREADOLESCENTS

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Keywords: physique, body composition, preadolescents

Introduction

By our knowledge it is evidence that there are sex characteristic differences between adults, between females and males. But what is the case in earlier ages? Those differences would become obvious by the adolescence and after, but they are not so marked during the preadolescent age period. The most marked differences in the two sexes are occurred in body dimensions, such as body height and weight, in the skeletal system, as the characteristics of bone mass and density, and in body composition. The increasing tendency of gaining body fat in females starts at an early stage of puberty, caused by the sex specific hormone level increase. The male-specific changes, in this respect, will cause marked increase in muscle mass all through the puberty period, and lead to absolute and relative body fat decrease.

All those sex-specific differences can be summarised by the well-known phenomenon of sexual dimorphism, that is more characteristic in adulthood, but also have some signals before the so obvious changes in the maturation process. Some differences in lean body mass and fat mass in young boys and girls was reported Faulkner et al. (1993) and Nelson et al. (1997). Those findings pointed out the differences in body composition parameters even before puberty, with very similar, mostly no significant differences in the height and weight mean values. The essence of those non-significant differences seems to turn from quantitative to qualitative changes, that leads also to the difference in measurable and so different gender characteristics. So when speaking about gender differences we have to be more precise in monitoring bodily parameters, because it seems that some detectable differences exist in spite of the very similar body dimensions. Moreover, not to consider only the statistics to prove changes but even yet the slight differences should be taken into account.

Methods

The sample embraced altogether 517 Hungarian elementary schoolchildren, 244 girls and 273 boys, respectively. Their chronological age was 9 years. All body measurements were taken by the guidelines of IBP (Weiner and Lourie 1969), namely: body height, weight, shoulder width, chest width, chest depth, bi-iliochristal diameter, bicondylar width of the humerus and the femur, chest circumference, upper arm circumference – relaxed and contracted, forearm circumference, hand circumference, thigh, calf and wrist circumference, and the skinfold thicknesses, namely: biceps, triceps, supscapular, supra-iliac, abdominal, thigh and medial calf skinfolds were taken. Basic body measurements, such as body height and weight were taken, and BMI was calculated, though we know that BMI has its validity mostly in large samples, and in limited extent in children (Lohman 1992). Conrad's growth type indices (1963) were used to characterise the body proportions and the musculo-skeletal development of the body. Metric index refers to body proportions using chest width, chest depth and body height parameters, assessed by sex-specific equations. Plastic index characterises the musculo-skeletal developmental level by the absolute value of the shoulder width, forearm circumference and hand circumference measurements. The metric and plastic indices indicate an individual point in a specific co-ordinate system, with different scaling for the genders, following an age dependent tendency through childhood and adolescent period. Somatotype components were used to describe endomorphy (relative fatness), mesomorphy (relative robustness) and ectomorphy (relative linearity) of the youngsters following the suggestions of Carter and Heath (1990).

Body composition parameters were assessed by Drinkwater and Ross body fractionation technique (1980) estimating body fat, bone, muscle and residual absolute and percentage values. In this study the body-weight-relative means are demonstrated. Body fat content also was assessed by Parizková's method (1961) in percent of the body weight.

Means and standard deviations were calculated and also minimum and maximum values are demonstrated in the tables (Table 1 and 2). Linear correlation coefficients were calculated showing age-dependent interrelations between the studied variables in 9-year-old boys and girls (See Table 5 and 6).

Results

The means, standard deviations and minimum and maximum values of the studied parameters are demonstrated in Table 1 and 2, for the girls and for the boys, respectively.

In body height and weight no significant differences were found in the means of the girls and boys. The BMI means also were the same, to statistically. We can see something very interesting in the trend of changing the BMI with age. Both in Hungarian and international reports exists a trend that boys' BMI mean values exceeded that of the girls in the early childhood, than in preadolescent period girls had higher means, and only in later adolescent years, by 16 or 17 years boys had again larger BMI (Lohman 1992, Eiben et al 1998). This phenomenon might be explained – in spite of the generally larger body size of the boys - by the earlier maturation of the girls, the proportionally larger body mass, due to the more expressed increase in body fat content (See Table 4).

Somewhat higher mean values for the boys can be seen in plastic index, so their musculo-skeletal developmental level were higher than that of the girls. After the adolescent period it is obvious that the males are more developed in that respect. On the other hand, girls are significantly more linear, characterising them by the metric index.

By the Carter and Heath (1990) somatotype components both girls and boys belonged to the central area somatotype, though girls had somewhat higher endomorphy, slightly lower mesomorphy and practically the same ectomorphy component mean values. Bodzsár (2001) reported on the consequently more marked endomorphy in girls compared to boys. She also stated, that gender differences in the characteristics of the physique became more expressed with age. The rate of the three components suggests the higher adulthood muscularity of the males and higher relative fatness of the females.

The body fat content was consequently higher for the girls, irrespectively the method assessed by. This difference, if not even reached the level of significance, focuses on the future trend of changes in the two sexes.

There was a standard difference between the two fat estimation method of Parizková (1961) and Drinkwater and Ross (1980) technique. By our experiences the Drinkwater and Ross method slightly overestimates the fat content, and it is not so sensitive for the changes. By increasing the fat content there is an increasing tendencybetween the difference of the two method's assessment. By our opinion Parizková's method gives more real results and also follow the changes of the body composition easily. But we also use the Drinkwater and Ross technique, to characterise the other body components.

Table 1: Means, standard deviations, minimum and maximum values of girls (n=244)

Parameter	Mean	SD	Minimum	maximum
chronological age	9,13	0,25	8,51	9,50
body height	136,87	6,72	120,90	160,30
body weight	31,29	6,92	20,00	55,50
BMI	16,58	2,72	9,14	26,36
Metric index	-1,81	0,30	- 2,38	-0,56
Plastic index	63,61	3,81	56,00	76,00
Endomorphy (I)	3,99	1,79	0.88	8,88
Mesomorphy (II)	3,90	0,91	2,04	6,79
Ectomorphy (III)	3,45	1,47	0,10	7,37
Fat % (Parizková)	19,38	5,32	7,40	31,40
Fat % (Drinkwater & Ross)	17,55	3,07	7,78	28,95
Bone %	19,19	1,27	16,40	24,69
Muscle %	40,19	2,03	29,75	45,34
Residual %	23,06	1,54	19,10	26,98

Table 2: Means, standard deviations, minimum and maximum values of boys (n=273)

Parameter	Mean	SD	Minimum	maximum
chronological age	9,12	0,27	8,51	9,50
body height	137,58	6,65	118,10	155,10
body weight	32,04	7,29	18,00	61,90
BMI	16,78	2,69	12,27	28,29
Metric index	-1,52	0,29	- 2,17	-0,48
Plastic index	64,83	3,89	54,20	76,30
Endomorphy (I)	3,48	1,87	0,53	9,50
Mesomorphy (II)	4,31	0,95	2,12	8,50
Ectomorphy (III)	3,32	1,34	0,00	6,31
Fat % (Parizková)	17,69	6,08	4,00	32,80
Fat % (Drinkwater & Ross)	15,64	3,98	7,88	27,24
Bone %	20,29	1,19	16,88	24,12
Muscle %	40,69	2,31	34,28	45,90
Residual %	23,36	1,65	18,72	27,79

Table 3: Comparative data of basic anthropometric variables – boys and girls

		Girls	Boys
This study	Body height	136,87 (6,72)	137,57 (6,64)
	Body weight	31,29 (6,92)	32,03 (7,29)
	Plastic index	63,61 (3,81)	64,83 (3,89)
Eiben et al (1998) Budapest data	Body height	133,5 (6,6)	134,4 (5,7)
	Body weight	28,8 (5,8)	29,6 (5,3)
Eiben et al. (1991)	Body height	132,44 (6,11)	133,15 (6,28)
	Body weight	28,20 (5,54)	28,60 (5,76)
Mészáros and Mohácsi (1983)	Body height	132,84	133,62
	Body weight	28,93	29,61
	Plastic index	62,68	64,07

The relative residual mass was the same in the two genders, but the bone percentage value was somewhat higher for the boys, that could be a signal for the consequently higher adolescent and adulthood average bone mass, both in absolute and in relative meaning.

In Table 3 we can see the mean values of the different nationwide studies (Mészáros and Mohácsi 1983, Eiben et al. 1991, Eiben et al. 1998), how body measurements and characteristics had been changed in the last decades. It can be clearly seen that recent data exceeded that of the previous studies of the eighties and the nineties, proving the secular growth changes in the subsequent generations. It is also interesting that the Budapest data. There was a standard difference between the two fat estimation method of Parizková (1961) and Drinkwater and Ross (1980) technique. By our experiences the Drinkwater and Ross method slightly overestimates the fat content, and it is not so sensitive for the changes. By increasing the fat content there is an increasing tendency both height and weight mean values exceeded that of the nationwide results. The phenomenon that children living in (large) cities have larger body size compared to children living in the country, in little settlements or villages could be seen and was proved in Hungary in different age groups (Eiben et al 1998, Farkas et al 1989/90). The background of it could be explained by the relatively more frequent external impulses, larger amount of information stimulating the growing and developing organism.

Table 4: Comparative data on the BMI reference values

	Girls	Boys
Lohman (1992)	16,3	16,2
Eiben et al (1998) Nationwide	16,0 (2,3)	16,0 (2,3)
Budapest data	16,0 (2,2)	16,2 (2,0)

Considering the results of the linear correlations there were some differences between the genders. First of all, the chronological age proved to be independent in girls, but it was slightly related to height, metric index and to the ectomorphy somatotype component. Among the closest relationships we have to mention both in boys and girls between the body weight and BMI and the plastic index. Both connections seem evidence since BMI contain the major factor of body weight. On the other hand, the plastic index could be in close connection with the body weight, because both are related to body size, as well. BMI has a negative connection with the ectomorphy component, so those children being more ectomorph, would have lower BMI value.

Table 5. Results of linear correlation in girls (n=244)

	BH	BW	BMI	MIX	PLX	I	II	III	F%	FD%	B%	M%	R%
BH	xx												
BW	,67	xx											
BMI	,30	,90	xx										Girls
MIX	--	,57	,74	xx									
PLX	,70	,90	,76	,54	xx								
I	,20	,72	,83	,63	,55	xx							
II	--	,59	,79	,75	,56	,64	xx						
III	--	-,72	-,92	-,75	-,59	-,81	-,87	xx					
F%	,31	,77	,82	,58	,59	,97	,60	-,78	xx				
FD%	,25	,62	,68	,42	,41	,91	,41	-,64	,93	xx			
B%	-,23	-,36	-,34	-,20	-,18	-,53	--	,24	-,53	-,60	xx		
M%	--	-,44	-,52	-,39	-,31	-,75	-,36	,51	-,75	-,86	,30	xx	
R%	-,26	-,62	-,64	-,33	-,44	-,76	-,58	,67	-,79	-,77	,21	,51	xx

Where: BH- body height, BW – body weight, BMI – body mass index, MIX and PLX – metric and plastic indices of Conrad's growth type, I,II, III – Heath and Carter somatotype components, F% - body fat content, estimated by Parizková's method, FD% - body fat content estimated by Drinkwater and Ross technique, B% - M% - R% - bone, muscle and residual percentage values of body fractionation method.

Table 6. Results of linear correlation in boys (n=273)

	CA	BH	BW	BMI	MIX	PLX	I	II	III	F%	FD%	B%	M%	R%
CA	xx													
BH	,25	xx												
BW	--	,73	xx											
BMI	--	,41	,92	xx										Boys
MIX	,21	-,30	,24	,49	xx									
PLX	--	,73	,88	,77	,20	xx								
I	--	,36	,78	,86	,43	,66	xx							
II	--	--	,63	,82	,60	,60	,71	xx						
III	,14	--	-,69	-,89	-,67	-,59	-,81	-,88	xx					
F%	--	,44	,80	,84	,33	,70	,97	,65	-,77	xx				
FD%	--	,41	,74	,77	,26	,58	,92	,53	,69	,96	xx			
B%	--	-,28	-,40	-,36	-,20	-,29	-,46	--	,28	-,46	-53	xx		
M%	--	-,30	-,60	-,64	-,30	-,49	-,81	-,43	,58	-,85	-,90	,31	xx	
R%	--	-,36	-,67	-,70	--	-,51	-,76	-,65	-,64	-,79	-,77	,13	,55	xx

Abbreviation: CA - chronological age, others see above in Table 5.

The connection between the first (endomorphy) component, the relative fat content and the body fat, assessed by either the Parizková's (1961) or the Drinkwater and Ross (1980) technique would be closely related in both sexes. All those children having higher muscularity or robustness, characterised by the mesomorphy component would be less ectomorphic, and "vica versa". The other close and reversed relationship, that seemed evidence, occurred between the body fat and the muscle content, estimated by the Drinkwater and Ross (1980) method.

Discussion

In our present report we described the basic anthropometric characteristics of the 9-year-old preadolescent children. That age period is the last phase of the growth process, when the representatives of the two genders are yet similar in their body measurements and the characteristics of the physique, though some kind of differences we could find even at that early age period. At that time the two genders do not differ significantly in most of the bodily parameters, but show some kind of "signals" of the future sex-dependent dimorphism (Nelson et al. 1997, Faulkner et al. 1993). Most of those non-significant trend of differences are in close connection with the body composition parameters, such as body fat content, irrespective of the method of assessment. On the other hand we have to add, that the fat content estimated by Parizková's method (1961) had closer relations with the studied parameters. In this respect, it seems to us that using this assessment we could gain more real variable. The somatotype components also contained some possible directions of changes, such as the more characteristic endomorphy in girls. Bodzsár (2001) found a constantly higher endomorphy existing in girls and she also stated that gender differences would become more obvious by the adolescent period and later. The trend of changes in somatotype components have gender characteristics, as girls are becoming more endomorphic and less ectomorphic during puberty.

All above mentioned findings showed, that no real differences can be seen in basic body dimensions at the studied age, but from than on, a gradually accelerating effect of growth, development and maturation would lead to the characteristic gender differences i.e.: an increasing tendency of BMI in girls up to 16 to 17 years of age. After that age boys would exceed that of the girl/female mean values. We know as evidence, that body fat content increase would be more expressed in girls, due to the hormonal changes, and the same reason would lead to muscle content increase in boys, later. So the difference could be seen more in the body composition parameters.

By observing the differences in the studied variables in the consecutive decades we can also state that secular trend changes are even existing in basic body dimensions. By the interrelationships in the studied variables we found very similar connections in the two genders that also strengthened our experience: the similarity in the developmental phase of the 9-year-old children. But at the same time we have to remember that there are some detectable sex differences before the onset of puberty, even at the age of 9 years or so, when there are not yet measurable differences in body dimensions (Kelly et al 1992, Forbes 1987, Nelson et al. 1997, Faulkner et al. 1993). The higher fat content in females starts accumulate in the early years and would become sex characteristic evidence by the puberty and later. In this respect we also have to take into consideration that genders have different activity level that also contribute to the gradual changes and the more expressed differences between boys and girls, or later, females and males.

References

Bodzsár ÉB (2001) Humanbiologia Budapestiensis, Suppl 28 (in Hungarian)

Carter JEL, Heath BH (1990) Somatotyping. Development and application. Cambridge University Press, Cambridge

Conrad K (1963). Der konstitutionstypus Springer Verlag, Berlin.

Drinkwater DT, Ross WD (1980). Kinanthropometry II. 178-189 University Park Press Baltimore

Eiben OG et al (1991) Humanbiologia Budapestiensis, 21

Eiben OG et al (1998) Humanbiologia Budapestiensis Suppl 24 (in Hungarian)

Faulkner RA et al (1993). Calcifion Tissue Inter 53:7-12

Farkas A et al (1989/90) Anthropológiai Közlemények, 32: 197-200.

Forbes G (1987). Human body composition Growth aging, nutrition and activity, Springer Verlag New York

Kelly J et al (1992). J Ped Child Health 28:158-161

Lohman TG (1992) Advances in body composition assessment. Monograph No3Human Kinetics Publ.

Mészáros J, Mohácsi J(1983). The level of maturation and the prediction of adult hight determined by the developmental process of urban youth. Candidate Thesis. Hungarian Academy of Science, Budapest (in Hungarian)

Nelson D et al (1997). Bone 20:73-79

Parizková J (1961). Metabolism 10:794-807
Weiner JES Lourie JA (Eds)(1969) Human biology. A Guide to Field Methods IBP Handbook No 9, Blackwell Oxford

BODY FAT CONTENT AND AEROBIC POWER IN 10-YEAR-OLD BOYS

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Introduction
The hypothesis that the higher level of cardiorespiratory fitness provides protection against obesity and also the hazards of obesity does not mean that aerobic power of fat and obese children and adolescents is consistently lower than that of the lean ones, however, the lower physical performance - assessed by various running, jumping and throwing test scores - of fat and obese children seems to be obvious, and can be attributed to the joint consequences of high body fat content and sedentary life style (Bouchard 2000, Frenkl et al. 1988, Othman et al. 2002). Regular physical activity is an important factor in the regulation of body composition. Although training-associated changes in fatness are reasonably well-documented in children and youths, information about the effects of regular training on adipose tissue cellularity and metabolism in children is lacking. Relative changes in VO_2max per unit body mass associated with training are remarkable, generally a little trainability of maximal aerobic power is characteristic in children under age 10 (Malina and Bouchard 1991). Since Othman and associates (2000) published significantly greater peak aerobic power in 9-10-year-old athletic boys than in non-athletes, it is not certain whether these results are the consequences of a low adaptive potential of young children to aerobic training or to the inadequacies of the training program. The selection effect cannot be excluded as well in this respect. The results of Prud'homme and co-workers (1984) suggest that trainability of maximal oxygen consumption also depends on individual genotype, that is, adaptive responses to training are determined in part by genes. Nevertheless, research data confirm the common observation that overfat children perform poorly on exercise tasks, particularly in weight-bearing activities. Watson (1988) described an average 46 yd decrement in distance covered in a 12 min walk/run test for each 1% increase in body fat content in a group of adolescent boys. Body fat content over a definite level (25%) may also have a significant influence on the results of laboratory exercise tests especially in non-athletic children.
The aim of the study was to compare the selected measured and calculated spiroergometric characteristics evaluated as a function of relative body fat content.

Methods
A total of 97 volunteer, healthy but non-athletic boys, living in the capital were tested in the spring of 2002. Their calendar age ranged between 9.51 and 10.50 years. The boys and their parents were informed about the aims and every technical details (risks) of the investigation and the written consents were also collected. Three subgroups were formed by their weight-related body fat content (F%) estimated by the suggestions of Parízková (1961).
— Subgroup 1: F% < 24.9; n = 35; normal fat group,
— Subgroup 2: F% is between 25.0-29.9; n = 41; fat group,
— Subgroup 3: F% > 30.0; n = 21; obese group.
The members of Subgroup 1 and 2 took part in the curricular PE classes only, the obese children because of their high body fat content were edged on adapted physical education.
Body build was characterised by the metric index (Conrad 1963). This indicator is the ratio of chest depth and width (corrected by the stature) and describes the constitution between the picnomorphic and leptomorphic extremes. The more positive the metric index, the more picnomorphic the physique is. Stages of genital development were described by the Tanner scores (Tanner 1962). In taking the anthropometric dimensions the IBP (International Biological Program) suggestions (Weiner and Lourie 1969) were observed. Aerobic power and ventilatory parameters were measured during graded exhaustive treadmill exercise, by using a Jaeger m-DATASPIR analyser. Before the spiroergometric data collection, the children took part in a medical examination including all fields that are officially required for general sport medical licence. Beyond the directly measured data the aerobic power and minute ventilation were related to body mass and lean body mass, and the oxygen pulse was also calculated. Following individual warm up test exercise started at 4 km x h-1 belt speed and zero inclination. Belt speed was increased in every 3 minutes by 2 km x h-1. Physical performance was expressed in Watts. Differences between the subgroup means were analysed by F-test, following one way ANOVA.

Results
Means, standard deviations and the summary results of one way ANOVA are summarised in Table 1. The upper third of the table contains the anthropometric variables, the middle one refers to the measured physiological performances and the bottom section indicates the relative (calculated) physiological variables. Differences between the subgroup means of anthropometric variables were significant consistently at 5% level of random error, nevertheless, the grater means of body mass and lean body mass in subgroup 2 and 3 can be attributed to the sampling. Thus the obese children were markedly taller than the fat and non-fat boys of this comparison, and more and more picnomorphic (round shaped) morphological constitution refer to the greater and greater relative body fat content means. The results of all the three possible comparisons were significant in case of metric index. The greater than 0.2 metric index unit difference can be evaluated as extremely high and means anthropologically various physique.
The obese boys had significantly greater peak minute ventilation and absolute oxygen consumption than the normal fat children, however, both the absolute and relative standard deviations (SD x 0.01mean-1) around the VO_2 mean of obese boys was also greater (10.53% vs. 13.24%). The statistically same mean physical performances (watts) and the significantly different body mass means indicate the remarkably shorter exercising time, consequently the lower peak running intensity of the obese children. The relative measures of peak aerobic power (VO_2/kg, VO_2/LBM), minute ventilation (VE/kg, VE/LBM) and physical performance (Watt/kg) were the greatest consistently

in the group of normal fat boys, and the lowest in the obese children. An almost linearly decreasing trend with increasing body fat content can be determined by all the means of relative indicators of aerobic power and physical performance.

Table 1. Descriptive and comparative statistics for anthropometric and spiroergometric variables

Subgroup	F% < 24.9		F% = 25.0-29.9		F% > 30.0		
Variable	Mean	SD	Mean	SD	Mean	SD	P
BH	141.79	6.81	142.84	6.49	149.06	7.25	<5%
BM	35.99	4.68	42.28	6.01	55.94	7.70	<5%
F%	21.43	2.66	27.37	1.12	31.21	0.88	<5%
MIX	-1.20	0.18	-0.97	0.23	-0.78	0.24	<5%
LBM	28.28	3.67	30.71	4.37	38.48	5.30	<5%
HR	201.34	7.51	196.56	8.88	202.69	9.86	NS
V_E	66.04	11.44	62.75	9.90	74.11	12.37	<5%
VO_2	1780.07	187.40	1761.81	198.29	2091.60	276.90	<5%
Watt	92.31	21.51	84.56	18.55	110.13	20.62	NS
VO_2/kg	49.46	5.21	41.67	4.69	37.79	4.95	<5%
VO_2/LBM	62.94	6.63	57.37	6.46	54.36	7.20	<5%
O_2P	8.84	0.93	8.96	1.01	10.32	1.37	NS
V_E/kg	1.83	0.32	1.48	0.23	1.32	0.22	<5%
V_E/LBM	2.34	0.40	2.04	0.32	1.93	0.32	<5%
Watt/kg	2.56	0.60	3.09	0.68	1.97	0.37	<5%

Abbreviations: SD = standard deviation, BH = height (cm), BM = body mass (kg), F% = relative body fat content, MIX = metric index (cm), LBM = lean body mass (kg), HR = heart rate (beat x min-1), VE = minute ventilation (l x min-1), VO_2 = absolute aerobic power (l x min-1), VO_2/kg = aerobic power relative to body mass (ml x kg-1 x min-1), VO_2/LBM = aerobic power relative to lean body mass (ml x kg-1 x min-1), O_2P = oxygen pulse (ml x beat-1), VE/kg = minute ventilation relative to body mass (l x kg-1), VE/LBM = minute ventilation relative to lean body mass (l x kg-1), P<5% = difference between the means is significant at 5% level of random error, NS = non-significant.

Among the relative performance variables only the means of oxygen pulse (one of the useful estimates of cardiac performance during exercise) did not differ significantly. These oxygen pulse averages were not significantly lower than the those of the regularly training soccer players of the same age (Mészáros et al. 1991) The standard deviations indicating the intra-group variability were marked in all the three subgroups and all the relative measurements. The body fat content had not significant effect on standard deviations.

Discussion

In respect of the real anthropometric differences it is suggested to point out the early observations of Johnston and Malina (1966). That is, the early maturing children are more or less taller and they have significantly more subcutaneous fat between 7 and 17 years. Such effects of the various maturity levels cannot be excluded naturally (since neither X-ray pictures nor hormone levels were analysed in our investigation), but the reversed order of ideas can be true either. Namely not every 10-year-old obese boy is biologically advanced. Nevertheless no consistent or remarkable differences were observed between the stages of genital development. Since the stature means of fat, obese and non-fat individuals are not different in young adulthood the effects of inheritance can also be neglected in all certainty. Whereas the more positive mean metric indices of the fat and obese children and adolescents are returning results without race or ethnic differences (Mészáros et al. 2001, Mohácsi et al. 2003, Othman et al. 2002) it is difficult to separate between the methodological consequences of thick skinfolds around the chest and the inherited characteristics (genetically picnic body build) of the physique. The observed mean difference between the metric indices of normal fat and obese children was extremely high (0.42 unit) in proportions greater than the difference between the body fat content means. Since the structure of used chest calliper reduces markedly the distorting effects of skinfolds in taking the chest diameters, consequently the possibility of real constitutional differences is greater. Moreover this question also needs further investigation.

Since our subjects were young and healthy (but basically hypoactive) their absolute cardiorespiratory characteristics did not differ significantly. Both the 1.8 l x min-1 oxygen uptake in the normal fat children and 2.1 litre of the obese boys as exercise physiological performances can be evaluated as medium or good. That is the other side of this problem for what physical workload and what exercise intensity can they perform on the medium or good exercise physiological basis.

Studies of fat and moderately obese children have failed to indicate any evidence of human biological or physiological impairment during exercise (Maffeis et al. 1994, Rowland 1991). The peak oxygen uptake and minute ventilation expressed as absolute values (l x min-1) are the same even greater in obese children compared to non-obese ones. Nevertheless, the peak physical performance and the oxygen economy are generally smaller in obese children.

This evidence supports the conclusion that endurance performance and relative aerobic power, relative minute ventilation are more or less depressed in fat and obese children because of the inert load created by their gained body fat rather than because of a lower cardiopulmonary performance.

According to the observation of Rowland (1996) in such young children the positive effects of regular physical activity or the negative consequences of hypoactivity can prove rather in the physical and less in the exercise physiological characteristics. Consequently we cannot be satisfied with the observed absolute or relative physical performances either of the investigated normal fat or the obese children. Since the members of all the three subgroups need marked development in running performance, the greater physical workout would be important from this therapeutic standpoint.

References

Bouchard C. (2000). Physical Activity and Obesity. Human Kinetics, Champaign, Illinois.

Conrad K. (1963). Der Konstitutionstypus. Springer Verlag, Berlin.

Frenkl R. Mészáros J. Mohácsi J. Bukta M. (1988). Young athletes; biological, physiological, and educational perspectives. Human Kinetics Publishers, Inc., Champaign, Illinois, 93-97.

Johnston FE. Malina RM. (1966). Human Biology, 38: 1-21.

Maffeis C. Schena F. Zaffanello M. Zoccante L. Schutz Y. Pinelli L. (1984). Acta Paediatr., 83: 113-116.

Malina RM. Bouchard C. (1991). Growth, maturation, and physical activity. Human Kinetics Books, Champaign, Ill. 385-388.

Mészáros J. Petrekanits M. Mohácsi J. Farkas A. Frenkl R. (1991).Papers of the Scientific Session in Szeged (Hungary). Szeged-Ulm, 181-187.

Mészáros J. Othman M. Szabó T. (2001). The exchange and development of sport culture in east and west. NTNU-AIESEP, Taipei, 102-103.

Mohácsi J. Lee CP. Zsidegh M. Tatár A. Mészáros J. (2002). Collegium Anthropologicum. 26: 142.
Othman M. Sziva Á. Mészáros J. Mohácsi J. (2000). Kalokagathia, 75th Anniversary, Special Issue, 152-157.
Othman M. Lee CP. Soliman YA. Mészáros J. Mohácsi J. (2002): XXVII FIMS World Congress of Sports Medicine, Abstracts, Budapest, 2002. 101.
Parizková J. (1961). Metabolism, 10: 794-807.
Prud'homme D. Bouchard C. Leblanc C. Landry F. Fontaine E. (1984). Med.Science in Sports and Exercise, 16: 489-493.
Rowland T. (1991). Amer. Journal Dis. Child., 145: 764-768.
Rowland T. (1996). Developmental exercise physiology. Human Kinetics, Champaign, Illinois.
Tanner JM. (1962). Growth at Adolescence (2nd edition). Blackwell Scientific, Oxford.
Watson AWS. (1988). Ir. Journal Med. Sci., 157: 383-384.
Weiner JES. Lourie JA. (Eds.)(1969). Human Biology. A Guide to Field Methods. IBP Handbook, No. 9. Blackwell Scientific Publishers, Oxford.