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ANALYSIS OF DIFFERENCES BETWEEN SELECTED MORPHOLOGICAL AND MOTOR VARIABLES IN BOYS AND GIRLS PRACTICING CROSS-COUNTRY SKIING

INTRODUCTION

Competitive performance in cross-country skiing depends on the level of development of certain abilities, properties and characteristics in male and female competitors. Among these factors, the basic motor abilities and morphological characteristics play a crucial role, especially at a lower age. The development of motor abilities and morphological characteristics is especially important in male and female competitors during puberty [4]. Therefore, the knowledge of the said development in this age category is especially important for the coach, since only on the basis of this knowledge he or she can systematically and professionally direct and supervise the training process [5].

Researchers have established a hierarchical factor structure of the motor space. At the highest level, two basic mechanisms of movement have been defined. The first mechanism of the so-called energy regulation of movement is defined by the factor of intensity regulation and the factor of regulation of duration of excitation of the neuromuscular system. The second mechanism of the so-called information regulation of movement is defined by the factor of movement structuring and the factor of synergetic and tonic co-ordination of the neuromuscular system.

The morphological dimensions of the structure of human psychosomatic status are understood as the anthropometric dimensions of the body. The entire area of morphological dimensions can be divided into skeletal dimensions (longitudinal and width skeletal measures) and voluminosity dimensions (weight and subcutaneous fat tissue). Male and female cross-country skiers should feature a slightly above-average body height and relatively low body weight. They should have an emphasised circumference of the thorax and wide shoulders.

The aim of the study was to establish differences in the development of motor abilities and morphological characteristics between the sexes in this age category of test subjects.

METHODS

The subjects under study consisted of 20 boys and 20 girls (aged between 13 and 14). The following variables were examined: jumps over the Swedish bench (JSB), the Cooper test of 2400 m (CT), medicine ball throw (MBT), 20-m run from a standing start (20-R), standing triple jump (TJ), 60-m run (60-R), polygon backwards (PB), body height (BH), left upper arm circumference (LUAC), normal thorax circumference (NTC), body weight (BW) and abdominal skinfold (AS). The measurements of motor abilities and morphological characteristics were taken in April 2005. The basic motor tests were conducted in the gym and on the running track; the morphological measurements were performed in the laboratory. The collected data were processed with the SPSS statistical software package. Basic statistical characteristics of the variables were established. Statistical significance of the differences in motor and morphological variables between the sexes was established using the t-test for small independent samples.

RESULTS

Table 1. Coefficients of basic statistical characteristics and testing of the normality of distribution of motor and morphological variables

Variables	M	S.D.	MIN	MAX	SKEW	KUR	K-S Z	p(K-S Z)
MOTOR VARIABLES								
BOYS								
TJ	630.80	53.99	532.00	720.00	-0.01	-0.82	0.61	0.85
MBT	511.85	88.66	363.00	689.00	0.37	-0.07	0.62	0.83
20-R	3.58	0.19	3.30	3.96	0.48	-0.54	0.76	0.61
JSB	20.35	3.46	15.00	27.00	0.37	-0.51	0.45	0.98
CT	627.00	56.22	537.00	741.00	0.61	0.03	0.62	0.82
60-R	9.60	0.66	8.10	10.70	-0.45	0.46	0.67	0.75
PB	9.39	1.80	7.10	13.60	1.03	0.34	0.88	0.41
GIRLS								
TJ	579.62	37.86	500.00	630.00	-0.97	0.48	0.70	0.69
MBT	422.81	68.65	330.00	526.00	-0.00	-1.67	0.75	0.61
20-R	3.74	0.21	3.44	4.20	0.37	-0.13	0.45	0.98
JSB	19.12	4.30	13.00	28.00	0.99	0.61	0.79	0.55
CT	676.12	57.32	613.00	840.00	1.61	3.56	0.72	0.66
60-R	9.98	0.63	9.30	11.70	1.75	3.14	0.97	0.29
PB	10.07	1.54	7.80	12.80	0.36	-0.93	0.69	0.71
MORPHOLOGICAL VARIABLES								
GIRLS								
BH	159.37	6.93	148.70	173.40	0.32	-0.17	0.51	0.95
BW	48.67	7.62	37.00	65.40	0.27	0.04	0.58	0.87
LUAC	23.04	1.95	20.50	27.20	0.50	-0.58	0.56	0.91
NTC	71.08	3.35	66.60	77.00	0.23	-1.23	0.75	0.61
AS	11.03	2.56	7.60	16.40	0.40	-0.46	0.46	0.98
BOYS								
BH	161.53	10.32	138.00	182.30	-0.25	0.30	0.62	0.83
BW	48.90	9.38	33.40	70.80	0.56	0.15	0.47	0.97
LUAC	23.29	1.86	19.80	27.00	0.26	-0.41	0.60	0.85
NTC	77.74	5.84	70.20	91.30	0.85	0.47	0.78	0.57
AS	7.46	2.56	5.00	13.60	1.60	1.66	1.21	0.10

p(K-S)Z – two-tailed testing of the significance of the K-S Z value

M – mean MIN – minimum value

S.D. – standard deviation MAX – maximum value

SKEW – skewness K-S Z – K-S Z value

KUR – kurtosis

Table 2. Differences between boys and girls in the values of motor and morphological variables

VARIABLE	M	d(M)	T	p(t)	VARIABLE	M	d(M)	T	p(t)
TJ (b)	630.80				MBT (b)	511.85			
TJ (g)	579.62	51.18	3.20	0.00	MBT (g)	422.81	89.04	3.30	0.00
CT (b)	627.00				BH (b)	161.53			
CT (g)	676.12	-49.12	-2.58	0.01	BH (g)	159.37	2.16	0.71	0.48
20-R (b)	3.58				BW (b)	48.90			
20-R (g)	3.74	-0.16	-2.25	0.03	BW (g)	48.67	0.23	0.07	0.93
60-R (b)	9.60				LUAC (g)	23.29			
60-R (g)	9.98	-0.38	-1.77	0.08	LUAC (g)	23.04	0.25	0.38	0.70
PB (b)	9.39				NTC (b)	77.74			
PB (g)	10.07	-0.68	-1.20	0.23	NTC (g)	71.08	6.66	4.03	0.00
JSB (b)	20.35				AS (b)	7.46			
JSB (g)	19.12	1.23	0.94	0.35	AS (g)	11.03	-3.57	-4.10	0.00

M – arithmetic mean
d(M) – difference in arithmetic means between the variables of the two sexes
T – t-test values
p(t) – statistical significance of the t-test

DISCUSSION

Statistically significant differences between the sexes were established in the following variables of the motor space: TJ, CT, 20-R and MBT. The differences were thus found in the variables of a running character (the Cooper test, 20-m run), and in the two variables of speed strength and elastic strength. In three motor variables, i.e. co-ordination test and repetitive strength and speed tests (PB, JSB, 60-R) statistically significant differences between the sexes were not found.

The Cooper test is used for measuring, first of all, the level of development of endurance requiring above all highly developed aerobic abilities. The comparison between the sexes in cross-country skiing races showed higher average values of the parameters of development of aerobic abilities (VO_2max) in men than in women [2, 3]. However, it is obvious that in the case of this parameter significant differences between the sexes occur already in the lower age categories, which is also demonstrated by the Cooper test results.

In boys, contrary to girls, elastic, speed and explosive strength defined by the regulatory mechanism of the intensity of neuromuscular excitation were more pronounced in our case. The said mechanism is activated when movement at maximal speed or overcoming of a large force of external resistance is required.

In the morphological space, statistically significant differences between the sexes were established only in the variables of the thorax circumference and abdominal skinfold. On average, men have wider shoulders, and women have wider hips. These differences can already be noticed at the age of fourteen. The circumference of the thorax also points indirectly to the

ability of pulmonary ventilation, which is in positive correlation with aerobic processes. The lung capacity ensures the required air and oxygen flow, while at the same time it enables the elimination of waste substances harmful to the body during strain [1, 5].

No statistically significant differences were established in the body height and weight, and in the circumference of the upper arm. At first, the development of body height is faster in girls; however, boys soon catch up with them, and after the age of fourteen boys usually overtake girls. Girls overtake boys in the development of body weight between ten and eleven years of age, but boys soon catch up with girls, and after the age of fifteen boys also overtake them. The development of body weight is more continuous and steady in boys, while in girls it is more abrupt [4].

The study results clearly show that in training of male and female competitors of the same age, the different sexes must not be subjected to loads of equal intensity and magnitude. By taking into account the differences in the development of individual motor abilities and morphological characteristics between the sexes, it is necessary to form, in the process of training, homogenous groups, which are a prerequisite for a controlled determination of training loads suitable for individual male and female competitors.

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