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Effects of Biomotor Structures on Performance of Competitive Gymnastics Elements in Elementary School Male Sixth-Graders

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A B S T R A C T

In order to identify the biomotor systems that determine performance of competitive gymnastics elements in elementary school male sixth-graders, factor structures of morphological characteristics and basic motor abilities were determined first, followed by relations of the morphological-motor system factors obtained with a set of criterion variables evaluating specific motor skills in competitive gymnastics in 110 male children aged 12 years ± 3 months. Factor analysis of 17 morphological measures produced three morphological factors: factor of mesoectoendomorphy (general morphological factor) and factor of pronounced endomorphy, i.e. excessive adipose tissue, along with low skeleton longitudinality. Factor analysis of 16 motor variables yielded four motor factors: factor of general motoricity; factor integrating leg flexibility and arm explosiveness; factor juxtaposing body flexibility and repetitive leg strength; and factor predominantly defining leg movement frequency. Three significant canonical correlations, i.e. linear combinations, explained the association between the set of six latent variables of the morphological and basic motor system, and five variables assessing the knowledge in competitive gymnastics. The first canonical linear combination was based on the favorable and predominant impact of the general motor factor (a system integrating leg explosiveness, whole body coordination, relative arm and trunk strength, and arm movement frequency), along with unfavorable effect of morphological factors on the gymnastics elements performance, squat vault and handstand in particular. The relation of the second pair of canonical factors pointed to the effects of leg flexibility and arm explosiveness on the cartwheel and backward pullover mount performance, whereas the relation of the third pair of canonical factors showed a favorable impact of the general morphological factor and leg movement frequency regulator on the forward shoulderkip from increase, cartwheel and handstand performance.

Key words: *elementary school male students, morphological-motor status, competitive gymnastics, canonical relations*

Introduction

According to kinesiologic definition, competitive gymnastics is a sport of esthetically shaped acyclic structures that are evaluated according to the predetermined convention of movement, defined by the FIG Code of Points (FIG, 2006)[1].

Anthropometric studies in gymnasts have shown them to predominantly differ from the standard population of male children in shoulder width, which is greater in the former, and in the amount of subcutaneous adipose tissue, which is lower in the former. The (atypical) growth results recorded in gymnasts should probably be ascribed to intensive training as well as their specific selection. In their three-year longitudinal study, Baxter-Jones et al. (1995)[2] investigated growth and development of gymnasts, swimmers, football players and tennis players. ANCOVA results showed body height according to chronological and biological age to be statistically significantly greater in swimmers (161.6±0.6 cm) as compared with gymnasts (150.7±0.8 cm) and football players (158.7±0.6 cm); in swimmers, body weight was statistically significantly greater (51.3±0.6 kg) than in other groups of subjects. As all study groups had started sports training before puberty, the authors considered the early maturation recorded in swimmers and late maturation in gym-

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nasts to have probably resulted from specific selection for a particular sport.

Weimann et al. (1998)[3] investigated the impact of high-intensity training on biological age in male and female gymnasts. A mean 1.7-year delay in the bone mass growth was recorded in female gymnasts as compared with age-matched control subjects, whereas the bone and chronological age was identical to that recorded in control subjects. In female gymnasts, there was no puberty-related, statistically significant increase in estrogen concentration, considered by the authors to be consequential to the small amount of subcutaneous adipose tissue. The lower level of subcutaneous adipose tissue was related to high-intensity training and inadequate calorie intake. These effects of prepuberty were not recorded in male gymnasts, a finding attributed by the authors to different training methods used in male and female gymnasts.

Daly et al. (1998)[4] studied the effect of training in gymnasts aged 10.5±0.9 years on testosterone, growth hormone and cortisol concentrations, and on dietary habits during ten months. Study results showed no differences in the concentrations of testosterone, cortisol and growth hormone between gymnasts and control group at any time point. The growth hormone to cortisol ratio was statistically significantly lower in gymnasts than in control group during the period of physical preparation ($p<0.05$), whereas no differences were found in the testosterone to cortisol ratio. Diet showed no correlation with any hormone concentration, and no between-group differences were found in the body height to body weight ratio. Based on the results obtained, the authors conclude that gymnastics training probably was not intensive enough to modify adrenaline function, or the subjects achieved appropriate training adjustment. The reduction of anabolic and catabolic balance as represented by the growth hormone to cortisol ratio suggested the catabolic state, probably as the result of excessive strain, inadequate recovery and/or inadequate calorie intake relative to the consumption, growth and maturation.

Weimann (2002)[5] estimated sex hormone levels, leptin concentration, body composition, diet and dietary habits in national team male and female gymnasts in order to determine sex-related differences. The percentage of adipose tissue was reduced in comparison with control age-matched population of both sexes, to a greater extent in female gymnasts. Total energy intake and food intake were reduced in both sexes, yet less pronounced in male gymnasts. In contrast to their male counterparts, in female gymnasts the high-intensity training occurs during the highly sensitive stage of pubertal maturation. Thus, female gymnasts show low estrogen level, hypoleptinemia, adipose tissue decrease, reduced energy intake and retarded menarche, whereas in male gymnasts pubertal development is almost intact.

Gurd and Klentrou (2003)[6] investigated the effect of intensive training on the growth and biological development in gymnasts. Study results showed energy consumption to be statistically significantly greater and the percentage of adipose tissue lower in gymnasts than in control group, however, without a statistically significant between-group difference in the body non-adipose mass. These findings suggested that body composition must have been »missed« in gymnasts in spite of their greater energy consumption through intensive training, and no effects on their growth and development could be identified.

Faria and Faria (1989)[7] investigated correlation of anthropometric characteristics and motor abilities with gymnastics performance in 65 American junior gymnasts. Results obtained in contestants winning the first ten places were compared with the results recorded in those ranking 11 to 34 at all-round championship. Study results showed the former group, elite gymnasts to have statistically significantly less adipose tissue than the latter, with the mean strength to body size ratio of 148.2 ± 21.1% and 138.8 ± 16.8%, respectively. In comparison with other gymnast classes, elite gymnasts were characterized by shorter stature, lower amount of subcutaneous adipose tissue and greater amount of muscle mass. According to motor abilities, elite gymnasts showed superior relative and absolute strength, and greater flexibility in the pelvic region, shoulders and back, as compared with the groups of lower performance.

Čaklec and Hraski (1990)[8] investigated correlation between 15 tests assessing specific motor abilities and results achieved at gymnastics contest in a sample of subjects attending Pioneer School of Competitive Gymnastics. Significant correlation of the test battery was recorded with overall all-round result and scores achieved in particular contest disciplines, except for floor exercises. The tests basically measuring function efficiency of the mechanisms for movement structuring showed contributed most to the formation of regression factors upon particular criterion variables, followed by the tests assessing efficiency of the mechanism regulating excitation intensity and duration.

Sullivan et al. (1994)[9] determined anthropometric characteristics in adolescents showing high performance in horse vault and assessed the impact of anthropometric characteristics and motor abilities on predicting vault performance. Study sample included 87 gymnasts aged 13–18. The jump intensity ranged from 1.98 to 4.72. The subjects were classified as ectomorphic mesomorphs with average somatotype. ANOVA showed the values of body height, motor abilities and performance to rise statistically significantly with age, while the somatotype and skinfold score remained unchanged. Regression analysis identified arm strength as the best predictor of good vault performance. Correlation analysis revealed the arm strength to highly correlate with vault intensity, age, body weight, long jump, speed run, triceps circumference, body height, lower leg circumference and bar hang performance. Vault performance was best predicted by hand grasp, which highly correlated with body height, simple measurements of lower extremity speed, upper body strength and endurance. The authors believe that the results obtained in the study may prove useful in the selection and training of young vault athletes.

The aim of the present study was to determine relations of morphological characteristics and motor abilities with the level of acquiring competitive gym motor structures in elementary school male sixth-graders. Latent structure of predictor (morphological and motor) systems was determined first, followed by assessment of relations between these structures, i.e. latent morphological and motor variables, with the level of acquiring motor skills in competitive gymnastics.

Subjects and Methods

Subject sample

The study sample included 110 clinically healthy male sixth-graders from three elementary schools (Bijaći from Kaštel Novi, Kman-Kocunar from Split, and Knez Mislav from Kaštel Sućurac), chronological age 12 years (±3 months), having attended physical education and health culture classes on a regular basis and included in extracurricular activities other than competitive gymnastics.

Variable sample

The sample of variables used to assess morphological characteristics consisted of 17 standard anthropometric measures taken according to the International Biological Program recommendations[10,11]: body height, leg length, arm length, shoulder width, knee diameter, elbow diameter, wrist diameter, pelvis width, body weight, triceps circumference, forearm circumference, upper leg circumference, lower leg circumference, triceps skinfold, subscapular skinfold, abdomen skinfold, and lower leg skinfold.

Basic motor abilities were assessed by use of 16 standard motor measuring instruments considered to cover the following latent movement dimensions: coordination (bar agility, polygon backwards, sidesteps); flexibility (shoulder dislocation, side split, forward bow); movement frequency (hand tapping, foot tapping, foot tapping against wall); and various strength factors (explosive strength: standing long jump, supine med-ball throw, high start sprint 20 m; static strength: bent arm hang; and repetitive strength: trunk lifting, modified test of semi-crouches in 30 s, modified bar hangs).

The scores allocated by six educated judges for performance of the gymnastics motor structures of cartwheel, handstand, forward shoulderkip from increase, squat vault and backward pullover mount, as part of the official curriculum of physical education in elementary school sixth grade, were used as criterion variables. The education of judges was based on the FIG Code of Points (FIG, 2006)[1].

Statistical analysis

Latent variables of the morphological and basic motor systems were obtained by factor analysis using the model of main components. The number of significant factors was determined by use of Kaiser-Guttman criterion, according to which a component showing variance exceeding 1.00 is considered significant.

Correlation between the set of predictor variables (factors of anthropometric and basic motor systems) and set of criterion variables (assessing specific motor skills in competitive gym) was determined by canonical correlation analysis using classic Hotelling procedure. The significance of canonical correlation coefficients was tested by Bartlet's χ^2-test at a level of $p<0.01$.

Results and Discussion

Table 1 shows results of descriptive and factor analysis of the morphological variables measured in the study sample of male sixth-graders. Factor analysis of the morphological system yielded two significant factors, which taken together explained 77.76% of the system variance.

The first factor of the morphological system analyzed (F1) defined 58.41% of total predictor space, and showed a statistically significant correlation with all variables hypothetically measuring body voluminosity, transverse skeleton dimensionality, longitudinal skeleton dimensionality, and to a lesser extent with the variables hypothetcally measuring subcutaneous adipose tissue. This factor could therefore be interpreted as a factor of mesoectoendomorphy and/or factor responsible for general morphological development.

Second factor of the morphological system analyzed (F2) was bipolar and described 19.35% of total system va-

TABLE 1
BASIC DESCRIPTIVE PARAMETERS OF VARIABLES (AX, SD) AND STRUCTURE OF LATENT VARIABLES OF MORPHOLOGICAL SPACE (F)

Variable	AX	SD	F1	F2
Body height (cm)	159.39	8.92	0.73	–0.37
Leg length (cm)	93.54	6.56	0.62	–0.61
Arm length (cm)	69.22	4.72	0.71	–0.59
Shoulder width (cm)	34.45	2.44	0.69	–0.53
Knee diameter (cm)	9.47	0.63	0.84	–0.06
Elbow diameter (cm)	6.29	0.54	0.86	–0.21
Wrist diameter (cm)	5.12	0.45	0.72	–0.48
Pelvis width (cm)	22.40	1.90	0.72	–0.22
Body weight (kg)	50.25	11.51	0.98	0.04
Triceps circumference (cm)	23.96	3.41	0.90	0.27
Forearm circumference (cm)	22.46	2.23	0.93	0.00
Upper leg circumference (cm)	46.84	5.41	0.80	0.32
Lower leg circumference (cm)	33.01	3.63	0.86	0.07
Triceps skinfold (mm)	7.83	3.69	0.64	0.60
Subscapular skinfold (mm)	8.00	4.38	0.64	0.67
Abdomen skinfold (mm)	8.58	5.43	0.67	0.65
Lower leg skinfold (mm)	5.16	2.57	0.51	0.60
Lambda			9.93	3.24
Variance %			58.41	19.35

Lambda – characteristic values, Variance % – percentage of variance explained by a particular factor riance. It was predominantly defined by adipose tissue measures at positive pole and average projections of the measures of longitudinal skeleton dimensionality at negative pole; accordingly, these boys had pronounced adipose tissue and short stature (small body length). Thus, it could be interpreted as a factor responsible for adipose tissue excess, i.e. endomorphy.

Results of descriptive and factor analysis of the motor variables applied are presented in Table 2. Factor analysis of the motor system (method of main components) yielded four significant factors, which taken together explained 63.88% of the system variance.

The first factor of the motor system analyzed (F1) explained 35.31% of total system variance and showed a statistically highly significant correlation with the variables hypothetically assessing various motor abilities: explosive strength of lower extremities, basic strength of upper extremities, body coordination and movement frequency of upper extremities. This factor primarily integrated whole body coordination with explosive strength of lower extremities, relative basic strength of upper extremities (overcoming resistance, i.e. own body weight) and movement frequency of upper extremities. Thus, it could be interpreted as a factor of general motor efficiency of the subject sample. The percentage explained by this factor in the total percentage of system variance, i.e. significant reduction in variance % from the first to the second factor (from 35.31% to 12.13%) could be explained accordingly.

Second factor of the motor system analyzed (F2) explained 12.00% of total system variance and integrated leg flexibility and arm explosiveness.

Third factor of the motor system analyzed (F3), which explained more than 9.00% of the predictor space variability, juxtaposed body flexibility accompanied by upper extremity explosiveness at negative pole and repetitive strength of lower extremities accompanied by upper extremity flexibility at positive pole.

Fourth factor of the motor system analyzed (F4), which explained over 7.00% of total system variance, showed a statistically significant correlation with the variables measuring movement frequency, predominantly with the variable of foot tapping against wall. This factor was primarily responsible for coordination of lower extremity movement frequency and could therefore be termed regulator of lower extremity movement frequency.

Table 3 presents results of canonical correlation analysis of latent morphological and motor variables with the variables assessing specific motor skills in competitive gymnastics in the study sample of elementary school male sixth-graders. The results of canonical correlation analysis indicated the inter-relationship of latent morphological and motor characteristics and criterion variables of performing competitive gymnastics elements to be defined by medium high coefficients of correlation, while isolating three linear combinations, i.e. three pairs of canonical factors.

TABLE 2
BASIC DESCRIPTIVE PARAMETERS OF VARIABLES (AX, SD) AND STRUCTURE OF LATENT VARIABLES OF BASIC MOTOR SPACE (F)

Variable	AX	SD	F1	F2	F3	F4
Bar agility# (s)	5.04	1.65	–0.67	–0.40	0.00	–0.09
Polygon backward# (s)	14.08	3.76	–0.80	–0.15	–0.14	0.09
Sidesteps#	10.27	1.19	–0.76	–0.04	0.00	0.08
Shoulder dislocation# (cm)	83.09	14.32	–0.13	0.27	–0.44	0.46
Side split (cm)	151.70	16.19	0.14	–0.77	0.17	–0.14
Forward bow (cm)	55.60	11.57	0.33	0.20	–0.65	–0.03
Hand tapping (f)	29.52	3.05	0.59	–0.01	–0.15	0.46
Foot tapping (f)	18.84	1.83	0.49	–0.33	0.36	0.38
Foot tapping against wall (f)	20.17	2.43	0.45	–0.38	0.04	0.60
Standing long jump (cm)	171.42	21.69	0.82	–0.21	–0.22	–0.06
Supine med-ball throw (dm)	120.08	12.84	0.19	–0.69	–0.44	–0.25
High start sprint 20 m# (s)	4.03	0.42	–0.84	–0.17	0.05	0.20
Bent arm hang (s)	27.27	19.46	0.68	0.17	0.00	–0.18
Sit-ups (f)	39.47	7.55	0.58	–0.37	–0.20	–0.09
Semi-crouch in 30 s (f)	33.18	5.45	0.52	0.10	0.60	–0.04
Modified bar hangs (f)	11.33	7.30	0.75	0.27	0.03	–0.14
Lambda			5.65	1.94	1.48	1.15
Variance %			35.31	12.13	9.25	7.19

#variable with opposite metric orientation
Lambda – characteristic values, Variance % – percentage of variance explained by a particular factor

TABLE 3
CANONICAL RELATIONS BETWEEN THE SET OF LATENT MORPHOLOGICAL-MOTOR VARIABLES AND SET OF SITUATION-MOTOR VARIABLES

Morphological-motor factors	CAN1	CAN2	CAN3
MesoEctoEndomorphy	0.65	0.07	–0.60
Endomorphy	0.47	0.04	0.07
Integration of strength, coordination and speed	–0.86	0.28	–0.32
Leg flexibility + arm explosiveness	–0.09	0.60	0.76
Body flexibility (–)/Leg strength (+)	–0.21	–0.45	0.26
Regulation of leg movement frequency	0.03	0.35	–0.40
Competitive gym elements	CAN1	CAN2	CAN3
Cartwheel	–0.38	0.78	–0.43
Handstand	–0.53	0.41	–0.38
Squat vault	–0.95	–0.15	0.07
Backward pullover mount	–0.44	0.65	0.21
Forward shoulderkip from increase	–0.18	0.01	–0.41
CanR	0.55	0.41	0.39
$CanR^2$	0.31	0.17	0.15
p	0.00	0.00	0.01

CAN – structure of canonical variables, CanR – coefficient of canonical correlation, $CanR^2$ – coefficient of canonical determination, *p* – level of significance

The first pair of canonical factors showed a significant correlation ($p<0.001$) with quite a high canonical coefficient of correlation of 0.55. According to the coefficient of canonical determination ($CanR^2$), this correlation explained 31% of variability of the set of variables analyzed.

First canonical factor of the predictor set of variables was predominantly defined by the very high projection of the general motor factor, which integrated the explosive strength of lower extremities, basic strength of upper extremities and trunk, ability of coordination and movement frequency of upper extremities into a unique motor structure upon which the students' motor efficiency was based. All this was accompanied by unfavorable (below-average) values of morphological factors, the first one in particular, defined as mesoectoendomorphy.

The structure of the canonical factor of the criterion set of variables was characterized by very high favorable projection of the criterion variable of squat vault and moderate projection of the variables of handstand, backward pullover mount and cartwheel.

Considering gym element performance, an appropriate motor system predominated by the abilities of whole body coordination, lower extremity explosiveness and relative strength of upper extremities and shoulder girdle was formed, which to the greatest extent determined performance of all elements of competitive gymnastics, squat vault in particular, followed by handstand, backward pullover mount and cartwheel. Formation of a morphological system appropriate for gym element performance would only occur after long-term competitive gym training. Considering that adipose voluminosity is a limiting factor on performing all gym elements, as demonstrated by the studies conducted by Dzhafarov and Vasil'chik (1987)[12], and Claessens and Lefevre (1998)[13], its unfavorable impact on the criterion variable performance was logical and acceptable.

The role of the general motor factor in performing gym elements is interpreted through hypothetic complexity of performing these elements, i.e. requiring a great number and high level of development of motor abilities, coordination, explosive strength and speed in particular. Thus, squat vault performance consists of a number of stages-routines: running start, take-off, flight and reaching the apparatus with hands, taking off from the apparatus with hands and landing, all integrated into a unique motor structure.

Second pair of canonical dimensions explained 17% of the common variability ($CanR^2=0.17$). Relation in this pair of canonical factors revealed the impact of lower extremity flexibility and upper extremity explosiveness on cartwheel and backward pullover mount performance. Thus, besides the effect of general motoricity factor, the performance of cartwheel, backward pullover mount and handstand was additionally influenced by leg flexibility (in terms of proper regulation of lower extremity muscle tone) and arm explosiveness. The complexity of appropriate cartwheel performance implies dynamic and rhythmic body weight transfer from the legs to the arms, to the astride stand, with extension of all body joints and standing astride in the vertical stage of performance, dynamic and rhythmic pushing from the floor with the arms (arm explosiveness), leg and whole body movement to the final position. On performing backward pullover mount, above-average basic relative strength of upper extremities is probably an additional requirement in order to keep the body in the hang or semi-hang position as close as possible to the bar as the center of rotation.

Third pair of canonical dimensions explaining 15% of the common variability ($CanR^2=0.15$) showed bipolarity and distinguished two groups of subjects: boys with above-average development of the general morphological factor and factor responsible for coordinated frequency of lower extremity movements but below-average leg flexibility and arm explosiveness; therefore, these study subjects achieved above-average results on performing forward shoulderkip from increase, cartwheel and handstand in comparison with the subjects with opposite characteristics, i.e. with below-average development of the general morphological factor and below-average function of the lower extremity movement frequency regulator but with above-average leg flexibility and arm explosiveness, thus showing poor results on performing forward shoulderkip from increase, cartwheel and handstand. Therefore, relation in the third pair of canonical factors revealed a favorable impact of the general morphological factor and lower extremity movement frequency regulator, and an unfavorable effect of leg flexibility and arm explosiveness on the performance of forward shoulderkip from increase, cartwheel and handstand. Relations in the third pair of canonical factors showed the general morphological development (total body mass) and ability of coordinated frequency of lower extremity movements to be crucial in the performance of cartwheel and forward shoulderkip from increase in particular. Obviously, total body mass that is predominantly saturated by muscle tissue (through the first morphological factor), followed by the ability of coordination, leg explosiveness (through the first motor factor) and speed of leg movements (through the fourth motor factor), was limiting performance of cartwheel and forward shoulderkip from increase in particular, in this group of subjects. Thus, these morphological-motor characteristics are integrated into the kinetic chain of performance of these competitive gymnastics elements.

Conclusion

Factor analysis of the morphological system showed the morphological structure, i.e. mesoectoendomorphic morphological structure, to predominate in elementary school male sixth-graders. This morphological structure explained more than 58% of the common variability and was the major feature of the study sample.

The second most relevant morphological feature was pronounced endomorphy with below-average longitudinality of skeleton dimensionality, recorded in 19% of the study subjects.

Factor analysis of the motor system yielded a motor structure that predominantly determined motor efficiency of the study subjects, thus also their performance of the elements of competitive gymnastics. This motor structure integrated whole body coordination, lower extremity explosiveness, basic relative strength of upper extremities and movement frequency of upper extremities, and as such it manifested high motor efficiency. This general motor factor was the basis of motor efficiency in more than 35% of the study subjects. Other motor factors isolated explained a considerably smaller yet significant proportion of the sample variability.

The isolated and characterized motor system (first motor factor) predominantly determined the quality of gymnastics element performance, squat vault, handstand, backward pullover mount and cartwheel in particular (Table 3). This demonstrated the striking complexity of motor skills in competitive gymnastics, where success depends on almost all relevant basic motor abilities: coordination, explosive strength, basic strength (of arms in particular) and speed (of arms), and their inter-relations.

However, integration of the optimal motor system into the optimal morphological system will only ensue in the next steps of selection in male competitive gymnastics.

The relations of motor abilities and morphological characteristics with performance of gymnastics elements in elementary school male sixth-graders were similar to those found in the promising young male gymnasts[2–7,9,12–14].

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UTJECAJ BIOMOTORIČKIH STRUKTURA NA IZVEDBU ELEMENATA SPORTSKE GIMNASTIKE UČENIKA ŠESTOG RAZREDA OSNOVNE ŠKOLE

S A Ž E T A K

U cilju identifikacije biomotoričkih sklopova koji određuju izvedbu gimnastičkih elemenata kod učenika 6. razreda osnovne škole najprije su utvrđene faktorske strukture kako morfoloških karakteristika, tako i bazičnih motoričkih sposobnosti učenika kronološke dobi 12 godina ± 3 mjeseca (n=110), a zatim su utvrđene relacije dobivenih faktora morfološko-motoričkog prostora sa skupom kriterijskih varijabla koje procjenjuju specifična motorička znanja iz športske gimnastike. Faktorskom analizom 17 morfoloških mjera dobivena su dva morfološka faktora: faktor MezoEktoEndomorfije (opći morfološki faktor) i faktor izrazite endomorfije, tj. prekomjerne količine masnog tkiva, a uz malu longitudinalnost skeleta, dok su faktorskom analizom 16 motoričkih varijabla dobivena četiri motorička faktora: prvi je opći faktor motorike, drugi integrira fleksibilnost nogu i eksplozivnost ruku, treći suprotstavlja fleksibilnost tijela i repetitivnu snagu nogu, a četvrti definira uglavnom frekvenciju pokreta nogu. Tri značajne kanoničke korelacije, tj. linearne kombinacije, objasnile su povezanost između skupa od šest latentnih varijabla morfološkog i bazično motoričkog prostora i pet varijabla za procjenu znanja iz športske gimnastike. U osnovi prve kanoničke linearne kombinacije je pozitivan i dominantan utjecaj općeg motoričkog faktora (sklop koji integrira eksplozivnost nogu, koordinaciju cijelog tijela, relativnu snagu ruku i trupa i frekvenciju pokreta ruku), uz negativan utjecaj morfoloških faktora na kvalitetu izvedbe gimnastičkih elemenata, poglavito zgrčke i stoja na rukama. U relaciji drugog para kanoničkih faktora je utjecaj fleksibilnosti nogu i eksplozivnosti ruku na realizaciju premeta strance i uzmaha jednonožnog, a u relaciji trećeg para kanoničkih faktora je pozitivan utjecaj općeg morfološkog faktora i regulatora frekvencije pokreta nogu na izvedbu sklopke, premeta strance i stoja na rukama.