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Processes of transformation of morphological dimensions among youth category soccer players caused by situational training

Key words: **soccer players; morphological characteristics; quantitative changes; situational training**
Ključne riječi: **nogometaši, morfološke karakteristike, kvantitativne promjene, situacioni trening.**

Original scientific paper

Abstract
The aim of this research was to determine quantitative changes of morphological dimensions among soccer players aged 12-15 (n=75), caused by programmed situational training. The program lasted six months, containing 72 training units based on situational training model and eight league games. The programme was developed on a modern vision of soccer training with younger categories which is promoted by the UEFA, and it is based on simplification and soccer problem solving through game (Michels, 2001). Training process is structured so that playing and exercise are combined, and in each stage situational working method was applied. The subject of the research included transformation processes of morphological characteristics among soccer players aged 12-15, with the aim of determining the effects of programmed training exercise on the dimensions covered by the research. Quantitative changes of morphological dimensions which occurred due to the effects of the six-month programme were analysed through canonical discriminative analysis under the model of differences. Acquired results show that a statistically significant change occurred within the period of two measurements. Greatest contribution to the discriminative function are provided by two variables for under-skin fat tissue measurement of the lower leg (AKNP), the upper leg (AKNB) and stomach (AKNT), transversal dimensionalities of the skeleton diameter of the knee (ADIKO), diameter of the foot joint (ADISZ) and one measure of the longitudinal dimensionality of the skeleton, the length of the foot (ADUS). It can be concluded that situational six-month training model positively affected the transformation of almost all morphological dimensions, especially of the variables manifested in the under-skin fat tissue.

Sažetak
Cilj ovog istraživanja bio je da se kod nogometaša uzrasta 12 -15 godina (n = 75) utvrde kvantitativne promjene morfoloških dimenzija, prouzrokovane programiranim situacionim treningom. Program je trajao šest mjeseci i sastojao se od 72 trenažne jedinice baziranih na situacionom modelu treninga i 8 ligaških utakmica. Sadržaj programa je koncipiran na modernoj viziji nogometnog treninga sa mlađim uzrasnim kategorijama koju propagira UEFA, a zasnovan je na pojednostavljenju i rješavanju nogometnih problema kroz igru (Michels 2001). Trenažni proces je struktuiran tako da se igra i vježbe kombinuju, a u svim fazama treninga primjenjivan je situacioni metod rada. Predmetom istraživanja obuhvaćeni su transformacioni procesi morfoloških karakteristika nogometaša uzrasta 12 -15 godina u cilju utvrđivanja efekata programiranog trenažnog rada na istraživane dimenzije. Kvantitativne promjene morfoloških dimenzija, nastale pod utjecajem programa u trajanju od šest mjeseci, analizirane su kanoničkom diskriminativnom analizom pod modelom razlika. Dobiveni rezultati pokazuju da je došlo do statistički značajnih razlika između dva mjerenja. Najveći doprinos diskriminativnoj funkciji imaju varijable za mjerenje potkožnog masnog tkiva potkoljenice (AKNP), nadkoljenice (AKNB) i trbuha (AKNT), transverzalne dimenzionalnosti skeleta dijametar koljena (ADIKO), dijametar skočnog zgloba (ADISZ) i jedna mjera longitudinalne dimenzionalnosti skeleta, dužina stopala (ADUS). Može se zaključiti da je situacioni model rada u trajanju od šest mjeseci pozitivno utjecao na transformaciju kod gotovo svih morfoloških dimenzija, a naročito na varijable koje manifestuju potkožno masno tkivo.

Introduction

Based on the conducted research on the morphological space, a certain number of factors which provided the information on the structure of the morphological dimensions have been identified as well as the hierarchy within the structure (Kurelić et al., 1975, Momirović et al., 1969). Information on the structure of the morphological characteristics in sports is very important in the view of their transformation and selection of the children for a certain sport. Morphological characteristics are affected by genetic factors (endogenous) and by factors of the environment (exogenous). The effect of the genetic factors is not equal for all morphological dimensions as it varies from .50 for under-skin fat tissue to .98 for longitudinal dimensionality of the skeleton. Greatest transformation under the effect of systematic operates is possible with under-skin fat tissue and volume, and it is practically insignificant when it comes to dimensionality of the skeleton (Malacko & Rađo, 2004). In the training process, the immediate aim is transformation of anthropological dimensions which form one organized, complex system. Changes in morphological structure which occurred under the effect of the properly programmed and dosed training process and biological growth and development, present a solid foundation for further proper development in other anthropological elements and, therefore, for success in the game of soccer (Gabrijelić, 1987, Jerković, 1984, Reilly et al., 2000, Strudwick et al., 2002). Understanding of the hierarchical structure of the factors on which the result in the contemporary game of soccer depends is the fundamental precondition for selection of soccer talents and for more efficient training planning and programming. Contemporary training of the youth categories in soccer is based on simplification of the problems and on playing, as it, with its aims and tasks, demands greater devotion of the professional staff to the processes of planning, programming and implementation of the preconception of the training features. The

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practised result- orientated selection and training of young soccer players in clubs inevitably lead to the decline of interest and loss of will among the children. In the process of selection, biologically superior children (bigger, stronger) have, in most cases, inexcusable advantage over children who have greater talent and much greater perspective (Čolakhodžić et al., 2008). It is a widely known fact that there is no firm relationship between the calendar (chronological) age and psychosomatic development, which is why the level of physical development (biological age) doesn't necessarily have to coincide with chronological age (Rađo et al., 2003, Bilić et al., 2003). Among younger categories, children want to play and to satisfy their basic need for movement and this is how the programme of work is organized. Through this research we wanted to prove that contemporary training process among younger age categories, in its scope and intensity as well as in its methodology of realization of training features, does effect the transformation of each morphological category among soccer players of pre-competitive age. The aim of this research is to determine the level of quantitative changes of morphological characteristics among soccer players aged 12-15 under the effect of programmed soccer training, that is, to determine if under the effect of programmed movement structures significant quantitative change of morphological dimensions occurs within this age group of soccer players.

Methods

Sample

The research was conducted on a sample of 75 examinees which have been selected from a population of soccer players aged 12-15. The selection criterion was that all examinees must be in good health, with no detected morphological, psychological and other aberrations, and that they have been undergoing the training process for at least three years. Only the results of those examinees who participated in the programme of 72 training units and eight league games and who took part in both initial and final measurement were taken into consideration and final evaluation.

Sample of variables

In choosing the variables, the results of the research already conducted have been used and measurements of the morphological characteristics were conducted in accordance with the instructions of the International Biological Programme (IBP). For the purpose of this research, variables which cover a hypothetical four-dimensional space of morphological characteristics have been used (12 variables).

Longitudinal dimensionality of the skeleton

1. Body height (AVIS),
2. Leg length (ADUN),
3. Foot length (ADUS),

Transversal dimensionality of the skeleton

1. Shoulder width (ASRA),
2. Diameter of foot joint (ADISZ),
3. Knee diameter (ADIKO),

Volume and body mass

1. Body mass (AMAS),
2. Mid span of the chest (AOGK),
3. Span of the upper leg (AOBU),

Under-skin fat tissue

1. Fat of the skin crinkle of the stomach (AKNT)
2. Fat of the skin crinkle of the upper leg (AKNB)
3. Fat of the skin crinkle of the lower leg (AKNP)

Data analysis methods

Main methods for data evaluation are determined by the characteristics and the size of the sample and by the problem of the research which is set forth. For inputs of the data evaluation and analysis of the results, suitable mathematical and statistical methods were used. Data evaluation was conducted in SPSS 12.0 for Windows program package. For all the variables, central and dispersion parameters of variables in initial and final measurement have been calculated (arithmetic centers, variance, minimum and maximum results and their spans, standard deviation). Canonical discriminative analysis was applied on a multi- variant level for determining global quantitative differences in two points of time (initial and final measurement). Statistically important discriminative variables on the $p < .01$ level which explain certain percentage of variability will be used for interpretation of the results.

Results and Discussion

In tables 1 and 2, central and dispersion parameters of the morphological space variables in both initial and final measurement are shown. As can be seen from tables 1 and 2, change in the value of central and dispersion parameters occurred with most variables. We can identify greatest change with the variables of body height (AVIS), leg length (ADUN), chest span (AOGK) and fat of the skin crinkle of the stomach (AKNT). We have increased dispersion in all variables, where the results in body height have range of 41.50 cm, while with the body mass variable the range between the lightest and the heaviest examinee is significant 45 kg in the initial measurement. Minimal result is 31.4 kg and maximum is 76.4. So, we are dealing with high dispersion of results which can be attributed to group heterogeneity (12-15 years) and to continual growth of the skeleton and of the mass in period between age 11-15 (Kurelić et al., 1975, Bilić et al., 2003). Main problem with such kind of research is to determine if significant change occurred due to certain training programme, and then to determine the cause and the essence of the changes. After applying the six-month programme, global quantitative changes of morphological characteristics of the given sample of examinees were analysed. Quantitative changes were analysed by canonical discriminative analysis in which orthogonal vectors in the space of manifested variables are isolated, being positioned so that they separate the groups of examinees in the variable space in the best way. Box's M-test (table 3) tested the correlation of the covariance matrixes between two subsamples, that is the initial and the final measurement of the examinee. It can be seen that the difference of the covariance matrixes is statistically significant on the $p< 0.01$ level (Sig. = ,00), which is the precondition for undergoing the following procedure of discriminative analysis. Criterion for discriminative force of the applied variables was Wilks's Lambda value of which is .30, which speaks of quite stressed discriminative force between the two measurements. Determining statistical importance of each discriminative variable was conducted on the basis of Bartlet's Chi- square test. The results of the canonical discriminative analysis with significance markers of the differences between two points in time in the space of morphological characteristics are displayed in table 4. One statistically important discriminative function on the $p< 0.01$ level (Sig. = ,00) was

acquired, which contains statistically important value (Canonical Correlation = .83), and which presents to us high correlation between the set of information based on which the discriminative analysis was conducted and the results in discriminative function. Based on the results in table 6 it is noticeable that greatest correlations with discriminative function, meaning with the variable which maximally differentiates the values of the results of morphological characteristics in initial and final measurement have variables for measuring skin crinkles of the lower leg (AKNP) and skin crinkles of the upper leg (AKNB), transversal dimensionality of the skeleton diameter of the knee (ADIKO) and foot joint diameter (ADISZ) and one measure of the longitudinal dimensionality of the skeleton, foot length (ADUS). Significant contribution to the function lies with the under-skin fat tissue of the stomach test (AKNT). Based on the correlations with discriminative function it can be seen that the least, insignificant correlation have variables leg length (ADUN) and variable AMAS for measuring body mass which can be explained with great influence of the genetic factor of longitudinal dimensionality of the skeleton and a relatively short period between the two measurements. High position of the variables for measuring under-skin fat tissue can be explained with heterogeneity of the sample (12 -15 years), development of the child which is most delicate and most intensive in this period and the still not fully formed muscle structure.

Table 1.
Central and dispersion parameters (initial measurement)

	valid n	mean	range	minimum	maximum	variance	std.dev.
AVISI	75	160,314	40,50	140,00	180,50	123,420	11,109
AMASI	75	48,677	45,00	31,40	76,40	116,913	10,816
ADIKOI	75	8,500	1,80	7,40	9,20	,164	,405
ADISZI	75	6,522	1,60	5,80	7,40	,159	,398
ADUSI	75	24,556	6,10	21,10	27,20	2,113	1,453
ADUNI	75	94,742	35,00	74,80	109,80	47,394	6,884
AOGKI	75	71,910	33,00	57,00	90,00	47,679	6,905
AOBUI	75	42,289	20,00	30,00	50,00	15,705	3,962
AŠRAI	75	27,54	12,80	22,80	35,60	6,792	2,606
AKNBI	75	1,344	1,76	,82	2,58	,167	,408
AKNPI	75	1,066	,78	,80	1,58	,029	,171
AKNTI	75	1,212	1,88	,72	2,60	,200	,447

Table 2.
Central and dispersion parameters (final measurement)

	valid n	mean	range	minimum	maximum	variance	std.dev.
AVISF	75	163,893	41,50	143,50	185,00	126,617	11,252
AMASF	75	49,766	43,80	32,60	76,40	119,207	10,918
ADIKOF	75	8,869	2,00	7,80	9,80	,220	,468
ADISZF	75	6,845	1,60	6,20	7,80	,174	,416
ADUSF	75	25,721	6,00	23,00	29,00	2,174	1,474
ADUNF	75	96,042	34,80	76,00	110,80	49,221	7,015
AOGKF	75	74,644	32,00	61,00	93,00	50,058	7,075
AOBUF	75	44,093	20,00	32,50	52,50	15,671	3,958
AŠRAF	75	28,849	13,10	23,50	36,60	7,046	2,654
AKNBF	75	,958	,70	,62	1,32	,032	,177
AKNPF	75	,822	,46	,64	1,10	,014	,119
AKNTF	75	,940	1,30	,50	1,80	,091	,301

Table 3.
Box's M test

Box's M		124,02
F	Approx.	1,45
	df1	78
	df2	69169,180
	Sig.	,00

Table 4.
Eigenvalues

Function	Eigen value	% of Variance	Cumulative%	Canonical Correlation
1	2,23	100,0	100,0	,83

Table 5.
Wilks's Lambda

Function	Wilks's Lambda	Chi- square	df	Sig.
1	,30	166,67	12	,00

Table 6.
Discriminative function structure matrix

	Function 1
AKNP	,557
AKNB	,413
ADIKO	-,284
ADUS	-,268
ADISZ	-,266
AKNT	,240
AŠRA	-,167
AOBU	-,153
AOGK	-,132
AVIS	-,108
ADUN	-,063
AMAS	-,034

Table 7.
Functions at Group Centroids

GRUPA	Function 1
1	1,485
2	-1,485

Conclusion

Quantitative changes of morphological dimensions which occurred due to the effects of the six-month programme based on situational training method were analysed on a sample of 75 young soccer players aged 12-15. Twelve variables in the space of morphological characteristics were measured on the tested sample, covering a hypothetical four-dimensional morphological characteristics structure model. The results were acquired by measuring the same variables before and after the programme, that is in two points in time. All of the provided values were analysed individually and within a set of variables of the space to which they belonged and which was the subject of the research, and according to basic descriptive data (central and dispersion parameters) it can be concluded that sharing of the results is found within the normal distribution with stressed dispersion in specific variables. The problem of this research was set in order to determine the scope of quantitative changes of morphological characteristics under the effect of programmed soccer movement structures. A quantitative change, that is changes of morphological characteristics, was analysed as a function of differences of arithmetic centre vectors of manifested and latent dimensions in two points in time. Based on the results of global quantitative changes determined with canonical discriminative analysis it has been established that significant change occurred between the two points in time. The results in the beginning and in the end of the programme point to the fact that six-month programme features statistically significantly contributed to changes within all variables of morphological space and all that on the $p < .01$ level of statistic relevance. It can be concluded that such a structured soccer training process based on situational model of playing positively effects transformation of almost all morphological characteristics.

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