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„Z"-SCORES OF ANTHROPOMETRIC AND MOTOR PARAMETERS OF GIRLS IN AEROBIC GYMNASTICS

„Z"-HODNOTY SOMATICKÝCH A MOTORICKÝCH UKAZOVATEĽOV DIEVČAT V ŠPORTOVOM AEROBIKU

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Abstract

This study presents the evaluation of chosen anthropometric and motor parameters in group of female junior competitors throughout the course of 2-year preparation of aerobic gymnastics by means of Z-scores. The observed group consisted of 12 girls (average age at the beginning of observance 14.08 ± 1.19 years). Evaluation of anthropometric (body height, body weight, body mass index, percentage of body fat, acting body weight) and motor parameters (sit-ups in 30 seconds and 60 seconds, pull-ups to bar, modified push-ups, standing long jump, backwards tandem walking, shuttle run 4×10 m, Jacík's test) was carried out in standard conditions in nine girls at 3-month intervals. It has been confirmed that female probands with higher Z-score of motor parameters together with lower Z-score of anthropometric parameters achieved higher sport performance during the 2-year observance at competitions, with an exception of one such proband.

Slovak abstract

V príspevku je prezentované hodnotenie vybraných somatických a motorických ukazovateľov v súbore juniorských pretekárok v priebehu dvojročnej prípravy športového aerobiku prostredníctvom Z-hodnôt. Hodnotený súbor tvorilo 12 dievčat (priemerný vek na začiatku sledovania 14,08 + 1,19 roka). Hodnotenie somatických (telesná výška, telesná hmotnosť, tzv. body mass index, percento tuku, aktívna telesná hmotnosť) a motorických ukazovateľov (ľah–sed 30s a 60s, výdrž v zhybe podhmatom, modifikované kľuky, skok do diaľky z miesta, chôdza vzad v tandeme, člnkový beh 4×10m, Jacíkov test) sa realizovalo v štandardných podmienkach v deviatich 3-mesačných časových intervaloch. Potvrdilo sa, že probandky s vyšším Z-skóre motorických ukazovateľov a súčasne s nižším Z-skóre somatických ukazovateľov dosahovali vyššiu športovú výkonnosť v dvojročnom sledovaní na súťažiach s výnimkou jednej probandky.

INTRODUCTION

Aerobic gymnastics belongs to the disciplines performed with maximum intensity, with duration of competition set-up 1 minute 30 seconds (tolerance ± 5 seconds). Realization of sports performance in aerobic gymnastics engages to a great degree neuromuscular, cardiovascular and respiratory system with predominantly lactic energy coverage (Kyselovičová, 2007). By its motor structure and exercise forms, this sports discipline contemporary belongs to coordination demanding technical aesthetic disciplines. Development of sport performance here, as in other sports, is limited by the level of specific fitness and coordination abilities in mutual harmony with rational technique of each separate move and exercise forms of various difficulties, since every sport performance is presented with competition set-up, making of which falls under the specific rules of International Gymnastics Federation (Mineva, 2006).

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Current research was focused on complex evaluation of level of anthropometric and motor parameters by means of calculated Z-scores throughout the period of two 1-year sport preparation cycles of female aerobic gymnastic competitors. These findings could be regarded as preliminary research, a part of VEGA 1/0882/14 grant project, which could serve as a basis for further exploration.

METHODOLOGY

The chosen group consisted of 12 girls – competitors of junior category. Their average age at the beginning of observation was 14.08 years, ± 1.19 years, the lowest calendar age was 13 and the highest 17 years. Probands undertook sport preparation five times a week for a duration of 120 minutes.

All anthropometric measurements (body height, body weight, body mass index [BMI], percentage of body fat, acting body weight percentage and kg) were conducted by standard methodology and conforming to compliant methodology of multiple authors (Riegerová & Ulbrichová, 1993, Riegerová, 1994, 2002). The BMI was calculated from body weight and body height values, which is considered as the most commonly featured indicator for measurement of relative amount of body fat. It was calculated as body weight (kg) and body height (m^2) ratio, as published by Riegerová and Ulbrichová (1993) and Riegerová (1994). The thickness of skinfold was measured by Harpenden brand calipers. *Percentage of body fat* was calculated according to the methodology by Drinkwater & Ross (1980). Furthermore, the *ABW in percentage* (100 − % of fat) and in *kilograms* (percentage of fat × body weight/100) was calculated out of the percentage of probands' body fat.

Level of motor performance was assessed by 8-entry motor test battery (sit-ups in 30s and 60s, pull-ups to bar, modified push-ups, standing long jump, backwards tandem walking, shuttle run 4 × 10 m, Jacík's test). Its basis (five tests) consisted of Eurofit tests (Moravec *et al.*, 2002), supplemented by three tests, which respect specific requirements of aerobic gymnastics (Jacík, 1985, Mineva, 2006). The used battery is included in general motor performance control system of junior representation in aerobic gymnastics, which has been extended by dynamic balance test.

The Z-score of chosen parameters has been calculated for every proband (Reisenauer, 1970) using the equation:

$(x_i – x) / decisive\ deviation$

x_i – proband's measured individual value

„Ladder of successfulness" of probands has been made on the basis of determined level of motor performance expressed by the Z-score. Complex evaluation of two 1-year sport preparation cycles forms an average performance of probands characterised by null Z-score on axis. All positive Z-scores displayed above the null value are considered as above-average performance within the observed group of girls. On the other hand, all negative values, which are displayed under the null value are to be considered below average within the investigated group of girls.

RESULTS

The group of girls was divided into three categories on the basis of motor parameters Z-scores. The first category consisted of five probands (F.N., M.Z., P.M., M.D. and K.N., respectively Tab. 1 and achieved above-average level of motor parameters that were displayed in the positive section of Z-scores axis. Three probands were close to the average mark (V.M.; O.M. and L.S., respectively Tab. 1) out of which two were on the positive side and one on the negative side of the axis. The last category consisted of four girls (K.L., G.V., Š.K. and F.M, respectively Tab. 1) whose motor performance was below average within the observed group and was expressed by negative Z-score.

Anthropometric parameters were evaluated by the same principle as level of motor parameters by means of Z-scores. Average value, the same as with evaluation of motor performance, was expressed by null value on the axis (Fig. 1). All the positive values displayed above the axis null value were, contrary to motor performance evaluation, considered as a negative phenomenon and on the other hand, negative values displayed below the null value of the axis were to be regarded as a positive phenomenon (Fig. 1). The group of girls, the same as with evaluation of motor parameters, was divided into three groups. First group consisted of probands (F.N., M.D., K.L. and V.M., respectively; Tab. 2) who achieved above-average level of anthropometric dispositions within the observed group of girls and it was expressed by negative Z-score (Tab. 2, Fig. 1). Two probands were close to the average mark (O.M. and Š.K., respectively Tab. 2), both on the negative side of the axis. The most represent category is six-member group of probands (P.M., K.N., M.Z., L.S., F.M. and G.V., respectively Tab. 2), whose level of anthropometric parameters was below average within the observed group of girls, which corresponded with their positive Z-scores (Tab.2, Fig. 1).

Complex evaluation of motor and anthropometric parameters of probands by means of Z-scores allowed dividing the probands into three groups. The first group consisted of

Table 1. The Z-score of performances in motor tests of probands after 2-year sport preparation in aerobics gymnastics

Ordinal number of proband on the basis of her Z-score	1	2	3	4	5	6	7	8	9	10	11	12
Name of proband	F.N.	M.Z.	P.M.	M.D.	K.N.	V.M.	O.M.	L.S.	K.L.	G.V.	Š.K.	F.M.
Z-Score	4.28	3.86	3.24	2.84	1.73	0.81	0.53	−0.11	−2.05	−4.50	−4.93	−5.70

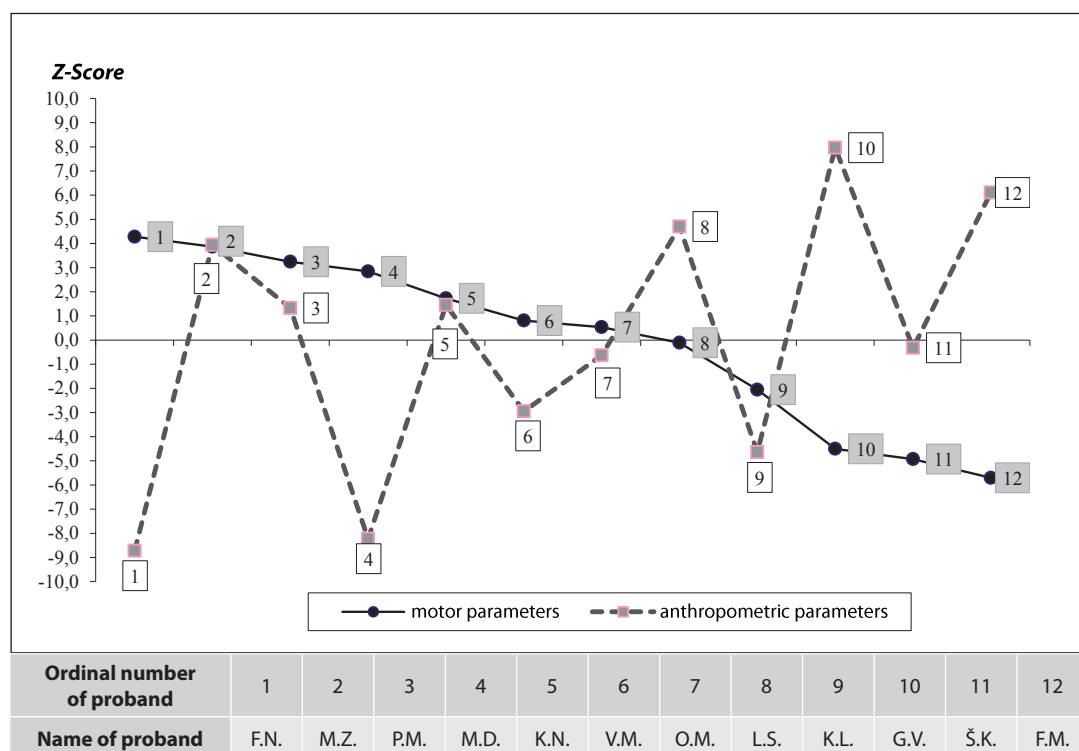| Ordinal number of proband	1	2	3	4	5	6	7	8	9	10	11	12
Name of proband	F.N.	M.Z.	P.M.	M.D.	K.N.	V.M.	O.M.	L.S.	K.L.	G.V.	Š.K.	F.M.

Figure 1. The Z-scores of chosen anthropometric and motor parameters of probands after 2-year sport preparation in aerobic gymnastics

the probands (F.N., M.D., V.M. and O.M., respectively; Fig. 1) whose above-average motor performance within the observed group of girls was supported by above-average anthropometric disposition. The second group consisted of the probands (M.Z., P.M. and K.N., respectively; Fig. 1) whose anthropometric disposition were lagging behind the above-average motor performance and the last one consisted of the probands (G.V., F.M., Š.K. and L.S., respectively; Fig. 1) whose below-average level of motor performance was in accordance with below-average level of anthropometric parameters, alternatively was at the average mark.

Complex Z-score evaluation of anthropometric parameters, motor parameters and sport performance in the group of girls has revealed their coherence with all the probands (Tab. 1–3, Fig. 1), most significantly with two probands (F.N. and F.M., respectively; Tab. 3, Fig. 1) those were on the extreme side of performance. It was identified that one proband (L.S., Tab. 3, Fig. 2) had incoherence between Z-scores' results of observed parameters and her sport performance. These observations are in conformity with the statement made by Hatiar *et al.* (1998) and confirm the fact that every talent needs to be looked at in a complex manner and the limiting factors of performance and their correlation analyzed profoundly. According to Feč (2000), talent in aerobic gymnastics is individual, whose inherent predispositions mainly in anthropometric, physiologic, motor, psychic and social areas allow for continued growth of sport performance.

CONCLUSION

Ideal polarised ratio of motor performance Z-scores and, on the other hand, Z-scores of anthropometric parameters was identified in one proband (F.N., Tab. 3, Fig. 2) whose Z-score of both observed parameters was in conformity with her sport performance. Conformity between the Z-score results of observed parameters and performance at competitions was also identified with proband F.M. (Tab. 3, Fig. 2); these results, however, belonged to the weakest compared to the group's performance. Sport performance is a result of multifactorial influences, each of which has its merit, that has been confirmed by results from our previous studies; there was confirmed important relationship between anthropometric and motor parameters (Palovicova, 2004; Tibenská & Kyselovičová, 2007, Tibenská *et al.*, 2009, Lenková, 2010). Human organism has the ability to compensate certain deficiencies in some factors, the image of which also is a discrepancy between the values of Z-scores of observed parameters and performance at competitions of proband L.S. (Tab. 3, Fig. 2), whose case, as can be assumed on the basis of long-time coach practice in testing her anthropometric and motor parameters, was the case of insufficient motivation to achieve maximum performance. Leading with this discrepancy, there comes realisation that in individual sports, too little attention is being paid to mental predispositions of sportsmen to achieve maximum and stable sport performances.

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Table 2. The Z-scores of chosen anthropometric parameters of probands after 2-year sport preparation in aerobic gymnastics

Ordinal number of proband on the basis of her Z-score	1	2	3	4	5	6	7	8	9	10	11	12
Name of proband	F.N	M.D.	K.L.	V.M.	O.M.	Š.K.	P.M.	K.N.	M.Z.	L.S.	F.M.	G.V.
Z-Score	−8.72	−8.23	−4.64	−2.95	−0.63	−0.32	1.33	1.45	3.94	4.70	6.11	7.96

Table 3. Competition positioning of probands at competitions in aerobic gymnastics in years 2003–2005 (x – average value; y. – years)

Ordinal number of proband out of complex evaluation (Fig. 1)	Name of proband	Points score	Position at competitions
		y. 2003 – 2005 [x]	y. 2003 – 2005/position[x]
1	F.N.	17.71	2
2	M.Z.	16.72	3
3	P.M.	16.44	4
4	M.D.	15.35	7
5	K.N.	16.12	6
6	V.M.	16.14	5
7	O.M.	14.63	8
8	L.S.	17.84	1
9	K.L.	13.55	9
10	G.V.	13.39	10
11	Š.K.	12.14	11
12	F.M.	8.73	12

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