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Selected Factors Influencing the Level of General Fitness in Elite Greco-Roman Wrestlers

by

Stanislaw Sterkowicz[1] Wlodzimierz Starosta[2]

The problem of level general fitness in wrestlers was investigated by many scientists, but in few papers factors influencing it were analyzed. The purpose of this study was to capture the kinetics of changes in general fitness as well as their age-dependent diversity, training experience, weight and the type body type as well as the sports level of the wrestlers. 61 elite Greco-Roman wrestling contestants (15 to 33 years of age and 2 to 20 years of training experience) were examined. The average body height equaled 173.14 cm, whereas body mass - 73.47 kg. ANOVA was used to analyze the differences in results of physical fitness (Starosta, 1985). The following factors were taken into account: A. age, B. training experience, C. body mass, D. body type, and E. sports level.

The age influenced the results of speed, strength and endurance tests. Training experience significantly affected the achievements in strength tests and strength endurance trials. Body mass affected local endurance of arm and trunk muscles. The pyknic body type was inversely related to aerobic endurance. The sports level clearly differentiated the results of strength endurance of arm and trunk muscles, whose function is extremely important in wrestling.

The monitoring of general fitness and the analysis of individual physical fitness profiles in comparison with those of the group revealed stronger and weaker aspects of the state of preparation of the wrestlers.

***Key words**: wrestling, physical fitness, motor abilities*

[1] - *Department of Combat Sports, Academy of Physical Education in Cracow*

[2] - *Academy of Physical Education in Poznan (Gorzow)*

Introduction

Great sports performance is a state of the competitor that undergoes changes, in its complex hierarchical structure. This is a qualitatively new condition during the competitor's preparation when all the factors that effect sports achievements are in optimal relations with each other and stay in harmony, which warrants maximum realization of the athlete's motor potential (Jelyazkov, 1998). An elite wrestler, first of all should display a high level of motor coordination, explosive strength, reaction speed, and relative strength. Speed-related endurance, the ability to relax (related to movement economy), strength as well as competition-related endurance, dynamic balance, and flexibility are of vital importance. However, a complementary role is played by static strength, speed of movements, static balance, and space orientation (Tumanian, 1998). The problem of the level of general in wrestlers was investigated by many scientists (Starosta, 1984; Starosta et al. 1985; Starosta, Glaz, Tracewski, 1985, 1990; Tumanian, 1998; Yoon, 2002), but very few papers dealt with the factors that influence it. Terbizan (1996) observed changes that occur in body build and motor efficiency of young wrestlers aged 15 - 17 years. However, Starczewska et al. (1999) described the diversity of sports level in the National Team competitors depending on their physical.

The purpose of this study is to describe the following aspects of Greco-Roman style wrestlers': 1) development kinetics general fitness, 2) diversity in the level of general fitness in relation to age, training experience, body mass, body type as well sports level.

Material and Methods

61 Greco-Roman wrestlers were examined at the training camp in the course of their preparatory period. 17 wrestlers of the Senior Polish National Team were tested in Gizycko, whereas 44 cadets, juniors - in Zakopane. The subjects from particular age groups represented different weight categories. The demographic information concerning them included their age and training experience (years), body height (cm) body mass (kg) at the time of the study, weight category, in which those subjects competed. The wrestlers were 15 to 33 years old, and their training experience was 2 to 20 years. The average body height in the group amounted to 173.14 cm, while body mass - 73.47 kg.

Measurements of the level of motor abilities were conducted according to the instruction concerning the battery of trials to evaluate general and special physical fitness applied in wrestling (Starosta, 1985).

The following general fitness tests were applied:

1. runs with forward rolls(s) - agility;
2. 20m run (s) - running speed;
3. vertical jump (cm) - explosive strength of lower extremities;
4. pull-ups (n) - dynamic strength, strength endurance of hands and arms;
5. push-ups (n) - local endurance arm and trunk muscles;
6. 1500m run (s) - endurance.

During statistical analysis of results, mean values and variability ranges were applied, by calculating the mean, median, and standard deviation. The statistical hypothesis concerning the differences between mean values were tested by means of ANOVA, whereas in case of uneven variances in sub-groups, those hypotheses were verified by the non-parametric test devised by Kruskal-Wallis.

When processing the results of physical fitness trial (1 - 6) as dependent variables, the following factors were taken into account in the statistical analysis:

a) Age (3 levels): younger (up to 17 years), intermediate (18 - 21 years) and older (above 21 years).
b) Training experience (3 levels): shorter (up to 6 years), average (7 - 9 years) and longer (above 9 years).
c) Weight category (3 levels): lighter (up to 65.80 kg), medium (65.81 to 81.12 kg) and heavier (above 81.12 kg).
d) Body build type (3 levels). The Rohrer index was calculated and the somatic body type classification quoted by Drozdowski was applied (1979). It isolated the following types: leptosomatic (L), athletic (A) and pycnic (P).
e) Sports level (3 levels).

First class (n = 34) national class (n = 20) international class (n = 7).

The factors: A, B, C were calculated, by the position of separate values in relation to the range including $\bar{x} \pm$ (0.5 S.D.):

Lighter weight category $\bar{x}$ <±(0.5 S.D.)> $\bar{x}$ younger age, shorter training experience.

Intermediate category $\bar{x}$ = ± (0.5 S.D.) = $\bar{x}$ age and average training experience.

Heavier weight category $\bar{x}$ >±(0.5 S.D.)< $\bar{x}$ older age, longer training experience.

In case of statistically significant inter-group differences ($p < 0.05$) repetitive comparison tests were conducted (Bonferroni's).

Results

The ANOVA indicates that the results achieved by the competitors during the run with forward rolls depend on their age and training experience. During

this physical fitness trial, the older competitors achieved better times, than individuals of younger and intermediate age. Statistically significant influence of training experience was revealed in the fact that the wrestlers with longer training experience had better times than those in the group with shorter training experience (tab. 1 and 2).

Table 1

Results of the run with forward rolls (s) in relation to the age of the competitors.

age	n	$\bar{x}$	Me	SD
younger	10	12.115	12.07	0.71
older	11	11.28	11.21	0.66
intermediate	40	11.92	11.96	0.47
Total	61	11.84	11.86	0.61
F = 7.70; W = 11.12; p < 0.01				

Table 2

Results of the run with forward rolls in relation to training experience.

Training experience	n	$\bar{x}$	Me	SD
longer	10	11.28	11.24	0.50
shorter	28	12.09	12.04	0.58
average	23	11.78	11.71	0.51
Total	61	11.84	11.86	0.61
F = 8.32; W = 12.83; p < 0.001				

Out of five factors (A-E), only age had a statistically significant impact on the result of the 20m running trial. The younger and older competitors formed a homogeneous group, whereas those from the intermediate age group achieved best results (tab. 3).

Table 3

Results of the 20m sprint (s) in relation to the age of contestants.

Age	n	$\bar{x}$	Me	SD
younger	10	2.75	2.78	0.12
older	11	2.69	2.64	0.13
intermediate	40	2.64	2.64	0.09
Total	61	2.67	2.65	0.11
F = 4.42; W = 6.20; p < 0.05				

The effect of age and training experience was also observed in the results of the vertical jump, where the groups of older wrestlers and the ones with the

longest training experience had significantly better results than the rest of the tested subjects (tab. 4 and 5).

Table 4

Results of the vertical jump (cm) in relation to the age of the contestants.

Age	n	$\bar{x}$	Me	SD
younger	10	50.90	49.5	5.17
older	11	59.77	61.0	8.86
intermediate	40	54.13	53.0	6.34
Total	61	54.61	53.0	7.11
F = 4.92; W = 7.70; p < 0.05				

Table 5

Results of the vertical jump (cm) in relation to training experience

Training experience	n	$\bar{x}$	Me	SD
longer	10	61.5	62.0	7.73
shorter	28	52.82	52.0	6.23
average	23	53.78	52.0	6.28
Total	61	54.61	53.0	7.11
F = 6.83; W = 10.08; p < 0.01				

A similar inter-group diversity, as in the case of explosive strength trial, was observed in the number of pull-ups, which depended significantly upon the age factor and sports experience. Additionally, a consistent influence of the sports level factor was revealed. The higher the sports level, the greater the number of pull-ups executed (tab. 6 - 8).

Table 6

Results of pull-ups in relation to the age of contestants.

Age	n	$\bar{x}$	Me	SD
younger	10	9.1	9.5	3.78
older	11	29.91	30.0	9.71
intermediate	40	14.73	13.0	7.75
Total	61	16.54	13.0	10.05
F = 22.52; W = 18.72. p < 0.001				

Table 7

Results of pull-ups in relation to training experience.

Trraining experience.	n	$\bar{x}$	Me	SD
longer	10	29.60	30.0	6.08
shorter	28	12.18	10.0	8.37
average	23	16.17	13.0	8.53
Total	61	16.54	13.0	10.05
F = 17.00; W = 21.08; p < 0.001				

Table 8

Results of pull-ups in relation to sports level

Sports-class	n	$\bar{x}$	Me	SD
I	34	11.41	10.0	3.81
MK	20	22.00	21.5	12.36
MM	7	25.86	30.0	9.86
Ogólem	61	16.54	13.0	10.05
F = 15.34; W = 14.60; p < 0.001				

The diversity of results in the push-ups was statistically significant in four out of the five considered factors. The influence of age, training experience, and sports level during this trial was similar to that observed in the pull-ups. Thanks to repeated comparisons, it was demonstrated that the groups of older competitors with longer training experience as well as those of international level achieved the best results. Furthermore, the number of pull-ups depended on body mass and it indicated the superiority of the intermediate category over the heavy one. The latter formed a homogeneous group with the lighter category (tab. 9 - 12).

Table 9

Results of push-ups in relation to age of contestants.

Age	n	$\bar{x}$	Me	SD
younger	10	17.30	16.5	5.68
older	11	37.91	38.0	15.80
intermediate	40	28.68	28.0	9.49
Total	61	28.48	27.0	11.93
F = 10.25; W = 16.14; p < 0.001				

Table 10

Results of push-ups in relation to training experience.

Training experience	n	$\bar{x}$	Me	SD
longer	10	40.80	38.5	13.07
shorter	28	24.11	22.5	9.46
average	23	28.43	31.0	10.72
Total	61	28.48	27.0	11.93
F = 9.19; W = 13.09; p < 0.01				

Table 11

Results of push-ups in relation to body mass of competitors.

Body weight	n	$\bar{x}$	Me	SD
heavier	16	22.75	22.0	11.16
lighter	22	28.77	27.5	10.72
medium	23	32.17	31.0	12.46
Total	61	28.48	27.0	11.93
F = 3.17; W = 5.47; p < 0.05				

Table 12

Results of push-ups in relation to sports level.

Sports-class	n	$\bar{x}$	Me	SD
I	34	25.12	25.0	9.19
MK	20	31.45	31.5	13.84
MM	7	36.29	38.0	13.67
Total	61	28.48	27.0	11.93
F = 3.79; W = 7.11; p < 0.05				

During the 1500m run, the group of younger competitors reached worse times than the competitors of intermediate and older age who formed a homogeneous group in this regard. At the same time a relationship was detected between the time to perform this trial and the somatic type. The subjects classified as pyknic had worse results than those, who were characterized by lower values of Rohrer's index, which indicated that they belonged to the leptosomatic as well as athletic type (tab. 13- 14).

Table 13

Results of the 1500m run in relation to age.

Age	n	$\bar{x}$	Me	SD
younger	10	361.69	352.84	37.90
older	11	326.44	325.43	26.28
intermediate	40	332.11	330.68	27.59
Total	61	335.94	331.69	31.02
F = 4.81; W = 7.15; p < 0.05				

Table 14

Results of the 1500m run in relation to body type.

Somatic type according to RI	n	$\bar{x}$	Me	SD
A	33	330.97	326.60	26.73
L	13	325.07	333.42	24.46
P	15	356.28	354.19	36.97
Total	61	335.94	331.69	31.02
F = 5.04; W = 6.41; p < 0.01				

Individual physical fitness profiles of international level competitors are illustrated in figures 1a and 1b in comparison with average values.

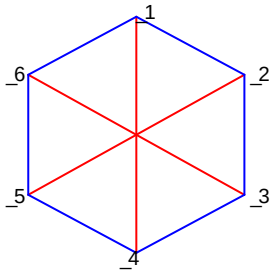

Fig. 1. *Key glyph to the interpretation of physical fitness profiles: _1. runs with forward rolls(s) - speed and technical skills;_2. 20m sprint (s) - running speed;_3. vertical jumps (cm) - explosive strength of lower extremities;_4. pull-ups (n) - dynamic strength, strength endurance of hands and arms;_5. push-ups (n) - local endurance arm and trunk muscles;_6. 1500m run (s) - aerobic endurance.*

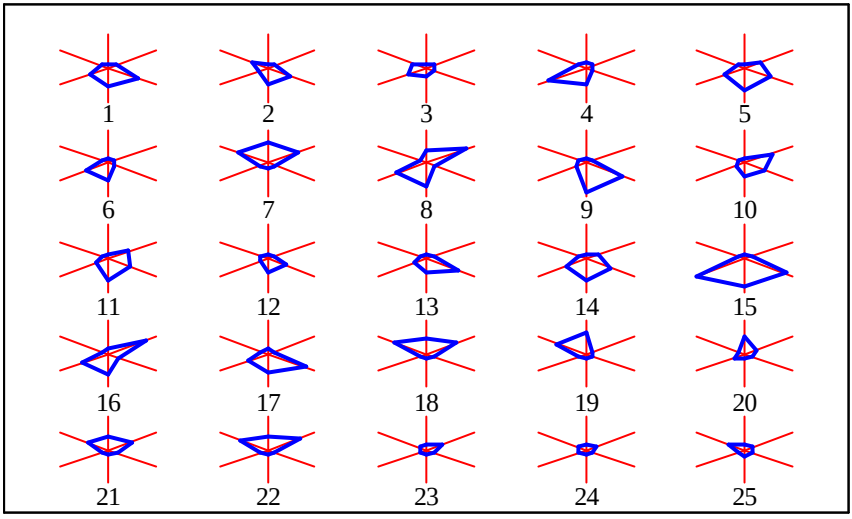

Fig. 1b. *Individual profiles of international (1 - 7) and national level competitors (8 - 25)*

Each radius includes the range from - 3 to +3 SD, so the mean values are situated in its centre. The three bottom radii show strength abilities, the upper radius in the left section indicates endurance abilities, whereas the remaining two depict the wrestlers speed abilities. The profile of competitor No. 15 stands out in the chart: he was the best not only as far as strength abilities were concerned, but also achieved very good times during the speed and endurance trials, which was characteristic of international level competitors (1 - 6). Yet, the profile of subject no. 18 (body mass close to 115 kg) was quite the opposite: he had a similar profile to that of the 125 kg category champion (No. 7).

Discussion

According to Yoon (2002), previous studies focussed on wrestler's static strength. In Tumanian's opinion (1998) this ability is of complementary significance. The rule changes of international competitions, which took place in 1970, forced athletes to fight more aggressively to obtain points. As a consequence, the attention of present-day research has been directed to dynamic rather than static strength (Yoon 2002).

During this study, which involved older and highly advanced contestants, it was shown that age was positively related to the level of strength abilities measured by the pull-up and push-up trials. Given the lack of data it was also important to determine if a significant relationship exists between the results of strength tests and sports experience. While investigating motor efficiency of

younger wrestlers, Terbizan (1996) found that both the values of static strength, absolute as well as dynamic indices were lower in 15 year olds than in 16-17 year olds. Excluding the influence of body mass, static strength did not diversify the age groups (Terbizan, 1996).

Song and Garvie (1980) observed that absolute strength was greater in the heavier weight category competitors, who took part in international competitions than in the lighter wrestlers. The above observations were confirmed on the sample of elite Polish contestants who, out of practical considerations, were arbitrarily divided into three weight categories. Song and Garvie (1980) pointed out that strength indices had an inverse dependence when related to body mass. It seems that relative evaluations should be applied because they yield especially precious information concerning the strength preparation of those athletes who compete in the same weight category.

When applying the popular Rohrer weight-height index and the Curtius classification (Drozdowski 1979) it was found that all somatic types were present among wrestlers (athletic - n = 33; pyknic - n = 15; leptosomatic - n = 13). Determining the relationship between strength and body type is aessential information for coachers when two opponents of different body height fight in the same weight category. Other authors paid attention to the great contribution of the mezo - and endomorphic component in wrestler's body type, wherein endomorphy and mezomorphy increased together with the competitor's body mass, while the contribution of ectomorphy decreased in heavier weight categories (Carter and Heneyman Heath 1990).

On the other hand, when considering the sports level factor strength was a feature that singled out the less efficient competitors from the more efficient ones, and the less experienced from the advanced ones. Definitely, the group of international level competitors achieved the best results during the pull-up and push-up trials. During a similar study conducted by Song and Garvie (1980), the greatest differences were registered in the test evaluating upper body strength. Interesting remarks were made by Starczewska et al. (1999). On the basis of results of the Wingate test for upper and lower extremities, they discovered that the more efficient competitors had a higher level of anaerobic power and capacity than the less efficient ones.

This research indicates the influence of age on the results of tests that contained speed and explosive strength (run with forward rolls, 20m sprint, vertical jump), where the best results were reached by older competitors. Training experience influenced the results of the 20m sprint and the vertical jump, which is regarded as an indirect index of maximal anaerobic power.

Direction-related differences observed between the average results of the 1500m run were connected with the age of competitors. The oldest ones covered this distance in the shortest time, while the youngest had the worst results. Moreover, a significant relationship of body type on the results of the 1500m run was observed. The higher the value of the Rohrer's index was, the worse the time of the distance run. A comprehensive review of literature made by Carter and Honeyman Heath (1990) indicates that a high value of mesomorphy relates positively to the majority of physical fitness tests, whereas strongly prominent endomorphism is negatively connected. Ectomorphy relates weakly or not at all with the level of physical fitness.

Conclusions

1. Age influenced the results of speed, strength and endurance tests.
2. Training experience significantly related to achievements in strength tests and strength endurance trials, while no relationship was registered with the endurance (1500m run) and speed (20m sprint) trials. The inter-group diversity of the running time with forward rolls may indicate that the competitors with greater experience were more efficient while executing forward rolls.
3. Body weight affected local endurance of arm and trunk muscles (number of push-ups).
4. The pyknic body type caused a decrease in the results achieved during the 1500m endurance run.
5. The sports level markedly diversified the level of strength endurance of arm and trunk muscles, whose function is extremely important in wrestling.
6. Monitoring the level of general fitness and analysing individual physical fitness profiles in comparison with those of the entire group revealed stronger and weaker aspects of the state of preparation of the wrestlers.

References

Drozdowski, Z. 1979. Antropologia sportowa. Sports Anthropology [in Polish]. PAN, Warsaw - Poznan.

Yoon, J. 2002. Physiological Profiles of Elite The Senior Wrestlers. Sports Med 32 (4), pp. 225 - 233.

Carter J. E. L. Honeyman Heath B. 1990. Somatotyping - Development and Applications. Cambridge Studies in Biological Anthropology. Cambridge University Press, pp. 234 - 236.

Cisar, C. J., Johnson, G. O., Fry A. C. 1987. Preseason Body Composition, Build, and Strength as Predictors of High School Wrestling Competition Success. J. Appl Sport Sci Res 1; pp. 66 - 70.

Song, T.M.K, Garvie G.T. 1980. Anthropometric, Flexibility, Strength, and Physiological Measures of Canadian Wrestlers and Comparison of Canadian and Japanese Olympic Wrestlers. Can J. Appl Sport Sci, 5; pp. 1 - 8.

Starosta, W. 1985. General and Special Physical Fitness of Advanced Wrestlers (Greco-Roman and free style) in the Light of Research Conducted between 1981 and 1984 [in Polish]. Institute of Sport - Polish Wrestling Association, Warsaw.

Starczewska-Czapowska, J. Faff, J. Borkowski, L. 1999. Comparison of Physical Fitness of the Successful and the Less Successful Elite Wrestlers. Biology of Sport, 16 (4), pp. 225 - 232.

Starosta, W. Glaz, A. Grabska, D. Pawlowa-Starosta T. Tracewski, J. 1985.Selected Motor Co-ordination Elements and Methods to improve them during Sports Schooling of Advanced Contestants, a report [in Polish]. Institute of Sport, Warsaw.

Starosta, W. Glaz, A. Tracewski, J. 1985. Variation Of Selected Agility (co-ordination) Indices in Young Wrestlers during Training. Biology of Sport, 1; pp. 75 - 86.

Starosta, W. Glaz, A. Tracewski, J. 1990. Auserwahlte Kennzahlen der Bewegungskoordination bei der Struktur korperlicher Leistungsfahigkeit der Ringkampfer im griechisch-romischen Stil. [in:] Bewegungskoordination im Sport (edited by W. Starosta). Internationale Gesellschaft fur Sportmotorik - Akademie fur Korperkultur in Poznan, Warsaw - Gorzów Wlkp. pp. 204 - 210.

Terbizan, D. J. Physiological Profile of Age-Group Wrestlers. Journal of Sports Medicine and Physical Fitness, 1996, 36 (3), pp. 178 - 185

Tumanian G. S. Sportivnaja borba: tieorya, mietodika, organizacja trienirovki. Vol.2, Sovietskij Sport, Moscow 1998 [in Russian].