RESEARCH OF HANDS' STRENGTH AND ENDURANCE INDICATIONS OF ARM SPORT ATHLETES HAVING DIFFERENT LEVELS OF SKILLS

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Annotation. *Purpose*: comparative study of indicators of hands' strength and endurance at athletes of arm sport of different skill levels. *Material*: the study involved 50 athletes. Athletes were divided into two groups: 1 - 15 athletes with high skill levels (age $25,25 \pm 0,62$ years) and 2 - 35 athletes and fans of mass categories (age $22,21 \pm 0,35$ years). *Results*: it is shown that the results of carpal dynamometry right and left hands were significantly higher in group 1 (respectively: $60,50 \pm 0,91$ kg and $53,75 \pm 0,83$ kg against $52,35 \pm 0,51$ kg and $48\ 53 \pm 0,46$ kg). Strength endurance was significantly higher in group 2 (respectively: $32,97 \pm 0,61$ sec $33,09 \pm 0,62$ sec against $23,78 \pm 0,85$ sec and $24,66 \pm 0,78$ sec). Found that carpal dynamometry has a maximum contribution to the system (in group 1 for the right hand - 18.17, for the left - 23.50, in group 2 - 7.44 and 7.10). Correlation coefficients dynamometry in group 1 were significantly higher. Strength endurance had almost no connection with the study of reliable performance. *Conclusions*: it is proved that the level of carpal dynamometry is an important informative and adequate criterion. This indicator is characterized by a maximum contribution backbone.
Key words: arm sport, carpal, dynamometry, power, endurance, correlation.

Introduction

Importance of studying of physical characteristics, first of all, power ones and connections between them in different kinds of sports, in opinion of Walter Herzog, is conditioned their mutual influence on each other and demand in ensuring of high quality management, which, finally, determines effectiveness of training [1]. Owing to growing popularity of arm wrestling, there increases significance of its complex scientific investigation; with it main direction should be studying of contribution of certain morphological factors in ensuring of efficiency [2]. Significance of such characteristics as amplitude of movements in arms' joints, fine coordination of hand's muscles, anthropometric specificities of upper limbs for optimization of sportsmen's training has already been proved [2-4]. Application of bio-mechanical approaches proved possibility of increasing of sportsmen's successfulness depending on development of different muscles' groups, values of mass centers and angles between main levers, considering level of sportsmanship [4-6]. Successfulness, in opinion of Linda F. Spenst, Alan D. Martin & Donald T. Drinkwater, is determined by specific gravity of sportsmen's muscular mass [7]. Combination of sufficient muscular development and optimal amplitude of joints ensure maximal effectiveness of sportsmen's training [8].

Thus, selection of criteria, which would permit sufficiently quickly and precisely evaluate sportsmen's functional state is an urgent scientific task, with it such indicators shall be adequate to peculiarities of a kind of sport. The available data permit to accept for such research testing of power endurance as modified test by Rosenblatt, which was used for evaluation of adaptation in extreme conditions, considering maximal adequacy and informative content [9].

Purpose, tasks of the work, manerial and methods

The purpose of the present work is comparative analysis of strength and power endurance indicators of arm wrestlers of different qualification. As *material* we used results of testing of 52 persons, who were divided in two groups: 1 – sportsmen of highest level of fitness (HLF) – 15 persons of 25.25 ± 0.62 years old with qualification from candidate master of sports to honored master of sport; 2 - sportsmen of mass grades (SMG); 35 persons of age 22.21 ± 0.35 years old.

Application of such anthropometric and functional *methods* and hand dynamometry (HD), determination of power endurance (PE) by time of enduring load, which equals to 75% from hand dynamometry, determination of body mass and length as main indicators of physical condition. On the base of the received data we calculated a number of commonly accepted indices of physical condition. Statistical analysis of these data was carried out with the help of licensed electronic tables Excel with determination of parametrical and non-parametrical methods [10].

Results of the research

The received results, which are presented in table 1, permit to affirm that there are certain differences in physical fitness and condition of the tested. For example, results of HD, both of right and left hands, were confidently better in group HLF that again proves our earlier conclusions about significance of this parameter in this kind of sports [2]. At the same time indicators of PE, on the contrary, were better in SMG group, also for right and left hands. Such contradiction between strength and power endurance, in our opinion, reflects peculiarities of Arm-wrestling in physiological and bio-chemical aspects and coincides with opinion of Mikel Izquierdo, Javier Ibáñez, Keijo Häkkinen e.a. [11] that peculiarities of a kind of sport pre-condition orientation on development of maximal strength or power endurance.

Table 11

Indicators of physical condition and physical fitness of sportsmen of different qualification

Indicators	HLF (n=15)	SMG (n=35)
Right hand dynamometry, kg	60.50±0.91*	52.35±0.51
Power endurance of right hand, kg	23.78±0.85*	32.97±0.61
Left hand dynamometry, kg	53.75±0.83*	48.53±0.46
Power endurance of left hand, kg	24.66±0.78*	33.09±0.62
Mass of body, kg	80.72±1.04	78.70±0.50
Length of body, kg	175.56±0.66*	179.94±0.45
Ketle's index, kg.p. m^2	25.99±0.52*	24.31±0.26
Power index of right hand ,%	75.47±0.84*	67.07±0.60
Power index of left hand ,%	67.45±0.86*	62.10±0.54

* - differences are confident at (p<0.05)

Arm-wrestling duel, which does not last more than 10-20 seconds, conditions short-term and explosive character of load permit to consider it an anaerobic work of maximal power. In this case PE is not indicator, ensuring successfulness in duel, that pre-determines in sufficient attention to its development in HLF group and, as a result, its weakening in group of experienced sportsmen. In our opinion, the determined differences reflect peculiarities of training of qualified sportsmen and beginners. If for beginners the main accent is made on general physical training, including PE, then for qualified sportsmen the training is more specialized and is oriented on improvement of not only physical but also physiological, psychological, tactic and other qualities, ensuring success. This statement coincides with opinion of Gareth Gilbert & Adrian Lees about changes of strength characteristics of highly qualified athletes under influence of differently oriented exercises [12].

In group SMG length of body is significantly higher, while by body mass the tested had no confident differences. Interesting, in our opinion, data were received with comparison of anthropometric indices. Ketle's index 2 in SMG group was at normal level and in HLF group it was a little higher than norm and significantly differed from SMG group. In our opinion it proves bigger specific weight of more experienced sportsmen. One more argument, which proves validity of this assumption, are results of comparison of power index, which illustrate strength of hand in relation to mass. In HLF group it was it was confidently higher both by left and right hands, with it in both groups it exceeded 50% that permits to speak about level higher than middle and again proves assumption about high significance of HD in arm-sport.

Research of interactions between physical condition's indicators not only gives information about state of organism but permits to specify the most important criteria, which determine successfulness of sportsmen. For example Jongsang Son, Sungj Hwang & Youngho Kim offered to use calculation of correlation coefficients for evaluation of optimality of muscular movements as indicator of training's effectiveness [13]. Researches of Lawrence E. McClements proved rather high correlation between peculiarities of physical condition and strength, with it rising of these indicators in the process of training was used as criterion of its effectiveness [14].

We have calculated indicators of non parametric correlation by Pirson, built correlation matrixes for both groups and conducted their comparative analysis/ We have stated that the most substantial indicator for both groups was HD that is proved by results of determination of the so-called indicators of system-formation (ISF), which reflects contribution of certain criteria in formation of system. In group HLF ISF HD of right hand was 18.17, of left hand - 23.50, in group SMG accordingly 7.44 and 7.10. In our opinion the obtained results one more prove that strength of hand muscles is the main criterion, which determines successfulness in arm sport. Indirect confirmation of this statement is the fact that PE in both tested groups had no significant and confident correlations, i.e. its contribution in formation of system is minimal.

Correlation coefficients of HD with other anthropometric indicators and calculated indices are given in table 2.

Table 2

Correlation coefficients of arm-wrestlers

Pair of indicators	HLF(n=15)	SMG(n=35)
HD r- BM (body mass)	0.79±0.17	0.08±0.17*
HD r – BL (body length)	0.81±0.16	0.21±0.17*
HD r - BMI	0.66±0.21	-0.07±0.17*
HD l- BM	0.72±0.19	0.17±0.17*
HD l - BL	0.78±0.17	0.22±0.17*
HD l – BMI	0.57±0.23	0.02±0.17**
PE r – PE l	0.83±0.15	0.73±0.12
HD r – PE r	0.97±0.07	0.88±0.08

* - differences are confident at (p<0.05), ** - trend to confidence of differences (p<0.1)

Also confident exceeding of correlations in HLF group by most of studied combinations is interesting; with it in this group level of connections permits to speak about strong dependence, while in SMG group it is often weak and

insignificant. In our opinion it must be regarded as reflection of high level of sportsmanship, as one more prove of significance of hand strength's determination for evaluation of arm-wrestlers' fitness. At the same time two dependences, determined for PE, in spite of expressed character, did not differ significantly in tested groups that again confirm insignificance of this criterion in arm-wrestling.

Conclusions:

Thus, the fulfilled comparative research of indicators of strength and power endurance of different qualification's arm-wrestlers proved that level of hand dynamometry is an important informative and adequate criterion, which determines fitness in this kind of sports, which is characterized by maximal system formation contribution. At the same time determination of power endurance is not of great importance that is conditioned by character of sportsmen's training, peculiarities of this kind of sports, i.e. short term explosive work of anaerobic character.

The prospects of further researches shall be oriented on studying of strength of fingers that will permit to choose optimal tactic techniques of duel depending on morphological functional features of sportsmen.

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