

## PECULIARITIES OF VEGETATIVE REGULATION OF HEART RATE IN WRESTLERS OF DIFFERENT AGE GROUPS

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**Abstract.** *Purpose:* the aim of the work was to study the characteristics of vegetative regulation of cardiac rhythm in athletes of high qualification of different age groups. *Material:* 26 wrestlers of Greco-Roman style of high qualification aged 19-34 years old were studied. Vegetative regulation was assessed by statistical analysis of heart rate variability using cardiac monitors «Polar RS800CX». *Results:* the results showed that the wrestlers of older age group has a greater level of tension of regulation of heart rhythm for compared with young athletes. This is confirmed by the reduced values of the mean square deviation RR- intervals and triangular index. According to the results of spectral analysis of cardio revealed activation of parasympathetic tone of the autonomic regulation of the heart rhythm of wrestlers in older age group, compared with young athletes. The increase of tension of regulation of heart rate in the wrestlers of older age group accompanied by a slowdown of aperiodic and periodic oscillations of cardio intervals. *Conclusions:* the high level of tension of regulation of heart rhythm in older wrestlers group (26-34) accompanied by the activation of neurohumoral centers and parasympathetic link of vegetative nervous system.

**Key words:** vegetative regulation of heart rate, wrestlers of high qualification, age groups, spectral analysis of cardio intervals.

### Introduction

One of key components of sportsman organism's functional state in conditions of intensive muscular functioning is system of heart rate's vegetative regulation [1,2,5,16]. There are many different approaches to determination of character of cardio intervals regulation system's response to certain loads [3,10,20,21]. However, in real conditions, providing control over sportsman's functional state is realized, the most widespread is still application of portable cardio monitors [9,12,13,11].

In modern Olympic sports especially important is age differentiation of elite sportsmen's training process, in order to ensure sport longevity [4,6,7,10]. This factor is conditioned by presence of still more quantity of sportsmen of 30 years and more age at stage of highest achievement [8,9].

In spite of urgent demand in working out of appropriate training programs for highly qualified sportsmen of different age, age peculiarities of their functional state have not been specified sufficiently yet.

### Purpose, tasks of the work, material and methods

*The purpose of the work is* to study vegetative regulation of heart rate of different age groups' highly qualified wrestlers.

#### *Material and methods:*

For determination of certain functional states of heart rate's vegetative regulation we examined 26 wrestlers of high qualification from national combined team of Ukraine (Greco-Roman wrestling) of 22- 34 years old age. They were divided in two groups: 22-25 years old and 26-34 years old. Besides, we examined 15 wrestlers from junior combined team of Ukraine (19-21 years old age).

Every of the tested sportsmen filled questionnaire before examination. The questionnaire included questions concerning sportsmen's agreement or disagreement to use results of stage by stage testing for scientific purpose. All sportsmen agreed to participate in researches in compliance with recommendations of ethic committees on problems of bio-medical researches [17].

Vegetative regulation was assessed by indicators of statistic analysis of heart rate's variability. For this purpose we used cardio-monitor «Polar RS800CX» [15]. We registered parameters of heart rate's vegetative regulation and results of spectral analysis of sportsmen. The received data were given in record with the help of statistic program «Kubios HRV» [18].

### Results of the researches

In table 1 we present mean values of heart rate's vegetative regulation of different age groups' wrestlers.

The carried out analysis witnesses about differences between wrestlers of older group and younger sportsmen (juniors and young sportsmen).

By indicators of mean duration of RR- intervals and heart beats rate wrestlers of older age group demonstrated higher level of functioning (frequency) of cardio vascular system (see table 1).

Besides, wrestlers of older group showed higher level of tension of heart rate's regulation, comparing with young sportsmen. It is proved by reduced values of mean square deviation of RR- intervals and triangular index (see table 1).

Table 1

*Mean values of heart rate's vegetative regulation of different age groups' wrestlers ( $X \pm S(X)$ ,  $n=41$ )*

Indicators	Вікові групи		
	Juniors (n=15)	Young wrestlers (n=14)	Older group (n=12)
Mean duration of RR-intervals, m.sec.	1114.96 $\pm$ 49.80	1080.11 $\pm$ 34.50	986.10 $\pm$ 33.01***
Mean square deviation of RR-intervals, m.sec.	125.21 $\pm$ 4.37	112.33 $\pm$ 3.71*	101.28 $\pm$ 2.99***
Heart beats rate, 1 minute	55.17 $\pm$ 2.30	56.71 $\pm$ 1.59	63.29 $\pm$ 3.52***
Triangular index, conv.un.,	19.81 $\pm$ 0.86	20.09 $\pm$ 1.18	13.92 $\pm$ 1.83***

Notes:

1.\*- $p < 0.05$ , comparing with group of juniors;

2.\*\*- $p < 0.05$ , comparing with young age group.

Thus, wrestlers of older age group demonstrated higher level of tension of heart rate's regulation, comparing with young sportsmen. It is reflected also in acceleration of heart beats rate.

In table 2 we give mean values of spectral characteristics of heart rate's variability of different age groups' wrestlers.

Analysis of table 2 witnesses: there is confident difference of spectral characteristics of heart rate's variability between age groups of wrestlers.

The lowest level of activation above low frequency spectrum was registered in wrestlers of young age group; the highest – in older age group (see table 2). This fact points at increasing of activation of neurohumoral centers of wrestlers' vegetative nervous system in conditions of wrestlers' age involution with adaptation to intensive muscular functioning [9]. However, increased, comparing with young group of sportsmen, values of super low frequency spectrum of heart rate's oscillations of juniors point at imperfectness of neurohumoral regulation's mechanism (see table 2).

Table 2

*Mean values of spectral characteristics of heart rate's variability of different age groups' wrestlers ( $X \pm S(X)$ ,  $n=41$ )*

Indicators	Вікові групи		
	Juniors (n=15)	Young wrestlers (n=14)	Older group (n=12)
Super low frequency spectrum (VLF), m.sec. <sup>2</sup>	9501.86 $\pm$ 382.01	7392.82 $\pm$ 254.19*	10105.20 $\pm$ 581.64**
Low frequency spectrum (LF), m.sec. <sup>2</sup>	3164.43 $\pm$ 359.55	2849.82 $\pm$ 266.26	2260.10 $\pm$ 310.51*
High frequency spectrum (HF), m.sec. <sup>2</sup>	2807.00 $\pm$ 231.49	2471.82 $\pm$ 197.38	13928.30 $\pm$ 2428.02***
LF/HF	1.48 $\pm$ 0.03	1.64 $\pm$ 0.01	1.94 $\pm$ 0.06*

Notes:

1.\*- $p < 0.05$ , comparing with group of juniors;

2.\*\*- $p < 0.05$ , comparing with young age group.

At the same time values of low frequency range of heart rate oscillations are the lowest in wrestlers of older age group, comparing with young sportsmen and juniors (see table 2). This fact points at optimal activation of parasympathetic link of vegetative nervous system of older age group's wrestlers.

Analogous result was received by indicators of high frequency spectrum of cardio-intervals (see table 2). Results witness about higher activation of parasympathetic tonus of heart rate's vegetative regulation of older group wrestlers, comparing with young group wrestlers and juniors.

However, vegetative balance (LF/HF) is in accordance with results of mean square deviation of cardio-intervals (see table 1). The received result witnesses about increasing of tension of heart rate's regulation with increasing of sportsmen's age (see table 1).

Thus, spectral analysis of cardio-intervals showed more perfect system of vegetative regulation of older group's wrestlers. However, age changes influence on activation of compensatory mechanisms of prevention from involution processes. In particular, it is illustrated by increasing of activation of neurohumoral centers and parasympathetic link of vegetative nervous system against the background of increasing of heart rate regulation's intensity.

Absolute values of indicators of scattergram of heart rate's variability of different age groups' wrestlers are given in table 3.

Table 3

Mean values of scattergram's indicators of heart rate's variability of different age groups' wrestlers ( $X \pm S(X)$ ,  $n=41$ )

Indicators	Вікові групи		
	Juniors (n=15)	Young wrestlers (n=14)	Older group (n=12)
SD1, m.sec.	67.71 $\pm$ 5.41	62.26 $\pm$ 7.79	47.68 $\pm$ 6.33***
SD2, m.sec.	160.37 $\pm$ 10.22	142.95 $\pm$ 15.16*	132.69 $\pm$ 18.99***

Notes:

- 1.\*- $p < 0.05$ , comparing with group of juniors;
- 2.\*\*- $p < 0.05$ , comparing with young age group.

Analysis of scattergram's results witnesses about presence of confident differences between wrestlers of different age groups by two indicators (see table 3).

Reduction of absolute values of SD1 indicators of older group's wrestlers, comparing with juniors and young wrestlers, shows slowing of a-periodic oscillations of cardio-intervals (see table 4). Less values of SD2 indicator of older group's wrestlers, comparing with juniors and younger wrestlers witness about slowing or periodic oscillations of cardio-intervals (see table 4) that in accordance with spectral characteristics of heart rate (see table 3).

Thus, increasing of cardio intervals regulation's intensity of older group's wrestlers is accompanied by slowing of a-periodic and periodic oscillations.

Table 4

Mean values of informational-entropy characteristics of heart rate's variability of different age groups' wrestlers ( $X \pm S(X)$ ,  $n=41$ )

Indicators	Вікові групи		
	Juniors (n=15)	Young wrestlers (n=14)	Older group (n=12)
Shannon Entropy, conv.un.	3.33 $\pm$ 0.09	3.21 $\pm$ 0.03	3.40 $\pm$ 0.06
Approximate entropy, conv.un.	1.01 $\pm$ 0.02	1.04 $\pm$ 0.02	1.01 $\pm$ 0.02
Sample entropy, conv.un.	1.45 $\pm$ 0.02	1.52 $\pm$ 0.09	1.32 $\pm$ 0.06**

Notes:

- 1.\*\*- $p < 0.05$ , comparing with young group.

In table 4 we present mean values of information-entropy characteristics of heart rate's variability of different age groups' wrestlers. Low values of sample entropy indicators of older group's wrestlers witness about more determined organization of heart rate's regulation system.

### Discussion

So we can say that wrestlers of older age group have more intensive regulation of heart rate, comparing with younger sportsmen. The received result is in accordance with commonly accepted idea of age involution of physiological functions. Just in connection with this V.M. Platonov puts question about increasing of periods of sportsmen's preparation for "sport longevity" [6,7]. Young sportsmen and juniors do not demonstrate such trend in indicators of heart rate's variability.

Simultaneously with increasing of heart rate regulation's intensity of older age group's wrestlers there appears activation of neurohumoral centers and parasympathetic link of vegetative nervous system. The received result proves the data of other authors [14,19] about increasing of neurohumoral mechanisms of heart rate's vegetative regulation in conditions of sportsmen's intensive muscular functioning.

Increasing of cardio-intervals regulation's intensity of older age group's wrestlers is accompanied by slowing of a-periodic and periodic oscillations and as a result heart rate's regulation system's organization seems to be more determined. Actually, age involution of older age group sportsmen's physiological functions is characterized by trend to rigidity of heart rate. However, this mechanism is rather complex and requires additional researches.

### Conclusions

1. Wrestlers of older age group demonstrated higher intensification of heart rate's regulation, comparing with younger sportsmen. It is proved by reduced values of mean square deviation of RR- intervals and triangular index.
2. By results of spectral analysis of cardio-intervals we found activation of parasympathetic tonus of heart rate's vegetative regulation of older group's wrestlers, comparing with young sportsmen. The received fact points at increasing of neurohumoral centers and parasympathetic link of vegetative nervous system against the background of increasing of heart rate regulation's intensity of wrestlers in conditions of age involution.
3. Increasing of heart rate regulation's intensity of older age group's wrestlers is accompanied by slowing of a-periodic and periodic oscillations of cardio-intervals.

### Conflict interests

The authors declare they have no conflict interests.

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