

*Human and Animal Physiology*

## The Maximum Heart Rate as a Parameter of Sport-Age Functioning

Giorgi Zubitashvili

*Ilia State University, Tbilisi*

(Presented by Academy Member Nodar Kipshidze)

**ABSTRACT.** The maximum heart rate is the variable that is very important in determining the training quality as well as to avoiding unnecessary loading on the body. In spite of the known fact that heart rate depends on age, gender, sportive qualification, type of sport, load intensity and other environmental factors - it is still unknown exactly how much its value is affected by the factor of training. Aforementioned determined the research aim: to study the maximum heart rate value dependence on the age and training level on an example of different ages of judokas (8-20 year).

The maximum heart rate was measured by palpation during one minute. In order to achieve a maximum heart rate value in judokas developed fast durability test (fast throws) was used by the author, lasting for 100 seconds.

Quantitative heart rate data received after completing the test were depicted as minimum, average and maximum values ( $p < 0.05$ ).

The study compared the data of untrained persons and judokas (20-22 years of age). It was found that on the one hand training factor somewhat increases this index and the difference makes 7.1 beats per minute. On the other hand, it is proved that the maximum heart rate is affected by the age factor, and therefore this index from 8 to 20-years of age decreases annually on average by 1.2 beats (from 212 to 196).

The obtained results show that on the example of the heart rate the functional development for judokas extends well beyond the general biological characteristic regulations and makes standards specific for it. © 2012 Bull. Georg. Natl. Acad. Sci.

**Key words:** *functional system, the limit of detection, biological determination, training factor.*

The heart rate is one of the best indicators for determining the natural conditions of the body. In sports research practice it holds a special place in the evaluation of the training quality. Its precise definition is important not only because sportsman's body could get the maximum beneficial effect as a result of

exercise, but also in order to eliminate unnecessary loading of the heart.

Taking into account the aforesaid, the sportsman necessarily needs to know what maximum value of heart rate he has. It should be noted that in general there is no precisely determined, optimal heart rate,

and according to one author [1] it depends on age, gender, qualification, type of sport, load intensity and other environmental factors.

The data obtained on this issue [2] confirm that the maximum heart rate primarily depends on age: it is higher in children than in adults and decreases linearly with age. Maximum heart rate of children under the age of 10 is often more than 210 beats, while for a 20-year-old man this value makes 195 beats per minute. Longitudinal studies show that after the adulthood age heart rate decreases by 1 - 0.5 units every year.

There are contradicting opinions about interrelations between the training level and maximum heart rate: the data obtained by a number of researchers [3-7] prove that the training and exercise factors do not cause the maximum heart rate reduction, and along with the physical training its value remains unchanged or slightly decreases.

Different data are provided by other authors' [8] survey results, according to which the maximum heart rate value really changes with the factor of training and its maximum value may change from 3 - to 7% as a result of aerobic exercise or detraining.

Review of this information shows that it is still not really determined precisely whether the maximum

heart rate is affected by training factor. The aforesaid fact determined our goal.

The aim was to study maximum heart rate value dependence on the age and training level.

**Objectives:** 1. Registration of maximum heart rate in conditions of standard physical load on the example of judokas.

2. Review of maximum heart rate in different ages.

3. Determination of influence of training level factor on maximum heart rate. (Maximum heart rate value comparison between judokas and untrained persons).

### Material and Methods

The study was conducted on 8-20 year old judokas. At least 60 judokas were recruited in each age group.

The maximum heart rate was measured by palpation for a minute. In order to achieve a maximum heart rate value in judokas use was made of a fast durability test developed by the author, when a person under experiment without resistance from a partner performed throws at maximum speed for 100 seconds.

**Statistical Analysis.** Data were processed by the computer program SPSS 19. The ANOVA test was used in order to determine the dependence of the

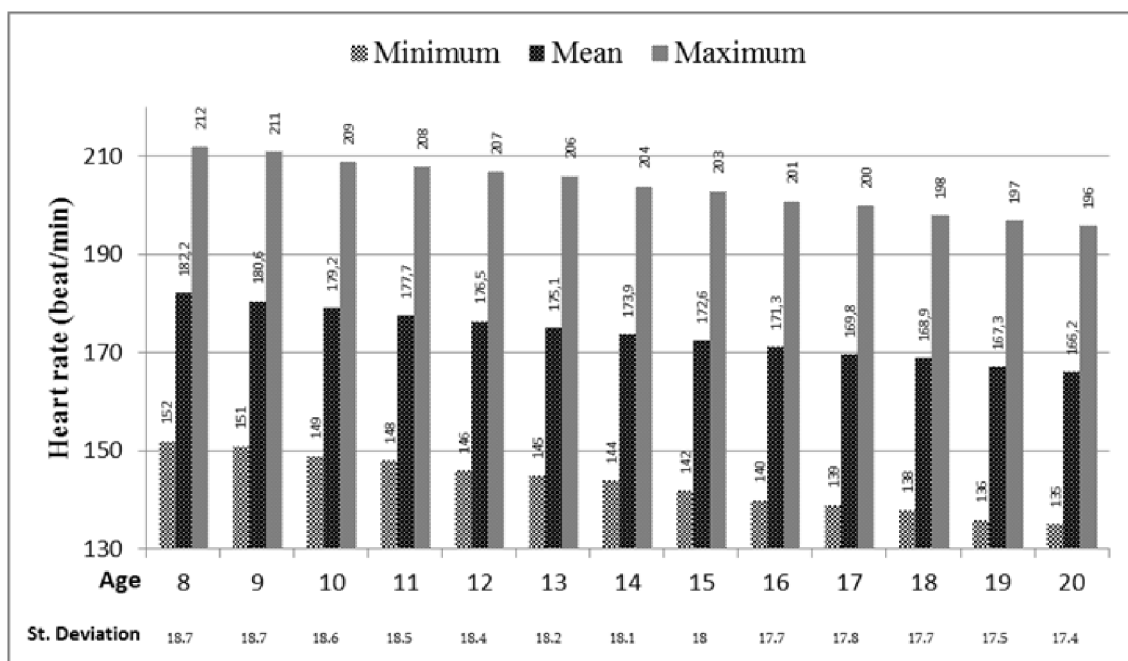


Fig. Descriptive data on the maximum heart rate of judokas.

maximum heart rate on age. Quantitative data are presented in the minimum, average and maximum values. Reliability level was  $p < 0.05$ .

## Results and Discussion

The obtained results are presented in the Figure.

The data, presented in the Figure show that the maximum heart rate varies significantly at different ages after loading completion. From 8 - to 20-years of age the heart rate minimum values decrease from 152 - to 135, and the maximum values from 212 - to 196. In this age range percentage assessment of the minimum and maximum value dispersion shows the opposite picture: at the age of 8 the lower value is fixed - 39.5% (152 and 212) than at the age of 20 - 45.2% (135 and 196).

The average values of maximum heart rate in standard loading conditions clearly show an example of the highest functional shifts for the younger children, as far as the obtained values are less for each of the next age. During one minute after loading completion the determined maximum heart rate average value reaches 182.2 at the age of 8. This mark decreases by 16 units (up to 166.2) and 9.6% by 20-year-old age. This issue may be explained by the following circumstances: at teen age the initial heart rate value (at rest) is still quite high, and training levels are low and therefore despite performing even fewer throws compared with older age (at 8 years of age on average 30.2 throws; at 20 years on average 45.1 throws), which was expressed in less volume of performed work - the body gets more loaded.

In order to solve the issue, set in the third objective of the research, maximum heart rates were compared between untrained persons and judokas. Our data (20 years - 196 beats per minute) were compared with the results of study of one of the researchers, [8] conducted on untrained persons of 22 years of age (188.9 beats per minute). The comparison showed that the training factor in judo at the older age causes maximum heart rate increase by 7.1 units (3.8%).

In order to determine whether the data obtained by us corresponded to the already existing information on this question - obtained in our study by the

continuous registration method results of maximum heart rate at the age of 20 (196 beats per minute) was compared to the data obtained in trained persons of the same age, [3], according to which the maximum heart rate amounts to the same value- 196 beat per minutes. On the one hand, this fact highlighted the tendency of maximum heart rate decrease together with the age increase (in our study 212 beats per minute were recorded in 8-year-old children), and on the other hand, in judokas of adult age (20 years) the specific result for maximum heart rate: 196 beats per minute.

The data obtained show that the maximum heart rate from 8 - to 20 years (during 13 years) reduces by 16 units (212-196), i.e. decreases in average by 1.2 units (16/13) each year. At the same time, according to the other author [2] the maximum heart rate from adult age decreases from 1 to 0.5 units each year. Based on the comparison of these data with the results of our study show that the maximum heart rate reduction occurs not only in adults, but in youths as well, and here the process is characterized by relatively higher intensity.

## Conclusions

The mean value of maximum heart rate from 8 to 20 years of age decreases by 16 units (182.2-166.2). This fact confirms that the value of this variable is especially affected by the age factor.

The maximum heart rate is also subjected to the influence of the training factor: its maximum value for the age of 20-22 years as a result of the judo training is in average by 7.1 units higher (196-188.9) compared with that of untrained persons.

The maximum heart rate from 8 - to 20-years of age decreases by 16 units (from 212 to 196). It means that it decreases in average by 1.2 units in each subsequent year. After 20 years of age it decreases with less intensity: from 1 - to 0.5 units per year.

The obtained results show that on the example of the heart rate the functional development for judokas extends well beyond the general biological characteristic regulations and makes standards specific for it.

ადამიანის და ცხოველთა ფიზიოლოგია

## გულისცემის მაქსიმალური სიხშირე, როგორც სპორტულ-ასაკობრივი ფუნქციონირების პარამეტრი

გ. ზუბიტაშვილი

ილიას სახელმწიფო უნივერსიტეტი, სპორტის ფაკულტეტი, თბილისი

(წარმოდგენილია აკადემიკოს ნ. ყიფშიძის მიერ)

სტატიაში შესწავლილია გულისცემის მაქსიმალური სიხშირის მარკერული სხვადასხვა ასაკის მაგალითზე. კვლევაში მოხდა უვარჯიშებელი და ძიუდოსეტი პირების მონაცემთა შედარება და დადგინდა, რომ წვრთნის ფაქტორი ამ მარკერულს რამდენადმე ზრდის. მეორე მხრივ დადასტურდა, რომ გულისცემის მაქსიმალურ სიხშირეზე მოქმედებს ასაკის ფაქტორიც და ამის გამო, ეს მარკერული 8-დან 20 წლამდე ყოველწლიურად საშუალოდ 1.2 ერთეულით მცირდება.

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Received June, 2012