

## **FEATURES AND TIME DYNAMICS OF THE BODY MASS INDEX AND THE PONDERAL INDEX OF PROFESSIONAL BODYBUILDERS DURING THE 1980-2012 PERIOD**

*(Preliminary communication)*

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### **Abstract**

*In this article the author analyzes the values of two random variables (RV) – the body mass index (BMI) and the Ponderal index (PI) of the competitors which ranked on the first six places on the contests without categories Mr Olympia, Arnold Classic, and Night of the Champions and Ironman during the 1980-2012 periods. The goal of the study was to establish the features of the probability density functions (PDF) of these indices and their changes with the time. After analyzing the data we reached to the following conclusions: 1. the body composition of the bodybuilders which ranked among the top six in the professional tournaments without categories is characterized by a clustering around the mean values in the studied indices – the sample is very homogeneous; 2. the form of the estimated PDF is intrusive for a bigger probability than the Normal distribution suggests for an emergence of competitors with extreme values of BMI and PI; 3. We consider that we could look for the reason for the increase of the values of both RVs with the time in two directions: 1. Because of the features of the judging and the ranking in the bodybuilding, the preferences of the judges evolved towards tolerating more muscular competitors or 2. The muscle mass of all the professional bodybuilders increased with the time in the studied time period which lead to an increase of the muscularity of the studied sample of bodybuilders.*

**Keywords:** *statistical distributions, statistical probability, ranking in bodybuilding, bodybuilding assessment, anthropometric characteristics, body structure, Gaussian distribution, mean*

### **INTRODUCTION**

Bodybuilding is a scientific system for morpho-functional development and improvement of human body. The Bulgarian term for bodybuilding, *културуизъм*, comes from the French word *culturistique* which means culture of the body or culture of the body motion. During the last few decades the term *bodybuilding* became very widely used (Боянов, 1998; 1994; Chapman, 1994; Fair, 1999). Both terms, *culturistique* and *bodybuilding*, are now used interchangeably (Боянов, 1994; Панайотов, 2011). Bodybuilding is among the most popular sports nowadays. IFBB (International Federation of Bodybuilders) has increased the number of its members to 182 countries (among which is Bulgaria since 1990) since its foundation in 1946 and now is one of the world sports federations with most members.

The bodybuilding judges rank the contestants using a point system. Features like symmetry, muscularity and size are judged (Боянов, 1998, 1994; IFBB

RULES, 2009). In order the judging to be more honest and consistent with the body measures of the contestants, categories in the weight or height were introduced on many of the professional tournaments. On the most popular professional competitions, like Mr Olympia, Arnold Classic, Night of the Champions and Ironman, there are no categories whatsoever. This fact awakened our scientific curiosity (we already did some research on that topic (Панайотов, 2011) in revealing the characteristics of the anthropometric characteristics of the professional bodybuilders ranked on the top six places on the Mr Olympia, Arnold Classic, Night of the Champions and Ironman contests. For accomplishing that task we studied the data for the weight and the height of the contestant's which ranked on the top six places on abovementioned contests during the 1980-2012 periods – total 102 competitions and 612 rankings. The data is available on <http://www.bodybuilding.com/fun/bbcompres.htm>.

The goal of the study was to establish the characteristics of the probability density functions (PDF) of the anthropometric indices BMI and PI of the professional bodybuilders which ranked on the first six places on the contests without categories during the 1980-2012 period and the changes in these indices over time.

To achieve the goal we set the following tasks:

1. To accrue data of the weight and the height of the contestants which ranked on the first six places on the Mr Olympia, Arnold Classic, Night of the Champions and Ironman contests during the 1980-2012 period;
2. Based in the available data to calculate BMI and PI for each contestant;
3. To estimate the probability densities the BMI and the PI random variables;
4. To study the time fluctuations of the average annual values for both indices.

## RESULTS

The body mass index (Burke, 2005; Encyclopedia of human nutrition, 2005) (BMI) is widely used for assessment of the obesity rate in humans. It is calculated as the body mass in kilograms is divided by the second power of the height in meters. Values in the 18.5-24.9 interval are considered normal. The ponderal index (PI) has several varieties ([en.wikipedia.org/wiki/Ponderal\\_index](http://en.wikipedia.org/wiki/Ponderal_index)); here we calculated it as the body mass in kilograms divided by the third power of the height in meters. We decided to study exactly these two indices because we think they give a fast integral assessment of the body composition of anthropometrically similar groups as professional bodybuilders are. It was true that from their values we did not get information about the exact proportions and circumferences of the body, but when we took into account the fact that we studied bodybuilders which were ranked among the top six places on the most popular contests, we could be very confident that competitors with similar values of these indexes possessed similar body characteristics.

BMI has the peculiarity of being quite inaccurate in estimating the obesity rate for very tall or very short people. The reason for this is the difference in the speed of increase of the second and the third power of the linear dimensions of the human body (fig. 1). For that reason we considered PI as the more accurate measure of two of the obesity rate.

On table 1 we showed the descriptive statistics for the two random variables (RV) – BMI and PI. Apply-

ing the Central Limit Theorem (Обретенков, 1974; Панайотов, 2011; Freud, 1962; <http://www.bodybuilding.com/fun/bbcompres.html>) for the both RVs (taking into account the fact the without doubt the variances were finite) we estimated that with probability of 99.5% the mean value of BMI for bodybuilders ranked among the first six places of the studied contests was  $34.901 \pm 0,6\%$ , and the mean value PI for these bodybuilders was  $20,005 \pm 0,7\%$ . I.e. the comparatively big size of the sample allowed us to estimate the real values of these RVs very precisely.

The PDFs along with their best continuous fits (Mendenhall, Beaver, & Beaver, 1999; Papoulis, 1991; Ramachandran, & Tsokos, 2009), are shown on figures 2 and 3. The best fits were estimated using the Kolmogorov-Smirnov test. Judging from the graphs of the PDFs and the descriptive statistics (fig. 1) we saw that the forms of these PDFs are different from the normal and the values of the skewness and the kurtosis were higher than for the Gaussian distribution. These values were higher than the critical values of the scenes and the kurtosis for a sample with this size (Bouchaud, & Potters, 2009; Papoulis, 1991) either. PDFs with such forms are characterized with a big clustering around the mean and fat tails (Bouchaud, & Potters, 2009). At the same time their skewness was comparatively small – they were almost symmetrical. We had to emphasize on the fact that both PDFs were very similar with the Gaussian in the middle of the distribution. The differences became visible in the tails, precisely in the different speeds of convergence to zero. The PDFs which we estimated were characterized with a clustering around

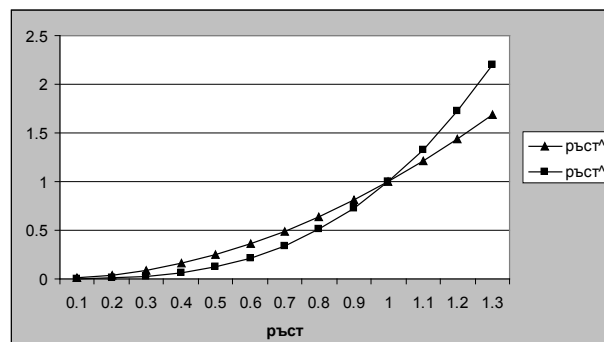


Fig. 1 Graph of the second and the third degree of the linear dimensions of the human body (the height)

Table 1.

RV	N	Mean	Standard deviation	Kurtosis	Skewness
BMI	612	34.901	2.967	0.698	0.066
PI	612	20.005	1.76	0.592	-0.244

the mean value and at the same time the probability of an emergence of a competitor with values of the RVs away from the mean, in the tails, was bigger than in the Normal PDF. Admittedly, we studied anthropometric indices and we could not expect competitors with values of the RVs several standard deviations away from the means to emerge. The advantage of estimating these PDFs was in the opportunity of evaluation of the probability of the emergence of competitors with extreme values of these RVs more often than the normal distribution suggested.

On figures 4 and 5 we showed the time dynamics of the annual mean values of the studied RVs. Positive trends on both graph were easily noticeable. Taking into account the fact that both RVs are obesity indices, we could interpret these trends for professional bodybuilders as an increase in the muscularity since 1980 to present days. We could conclude that in the studied period of time the body mass of the contestants which ranked among the top six in the professional tournaments with-

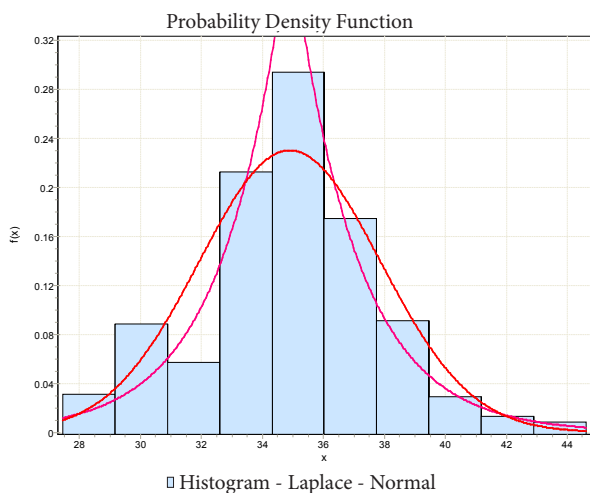


Fig. 2 Histogram, best fit of the PDF and approximation of the normal PDF for BMI values

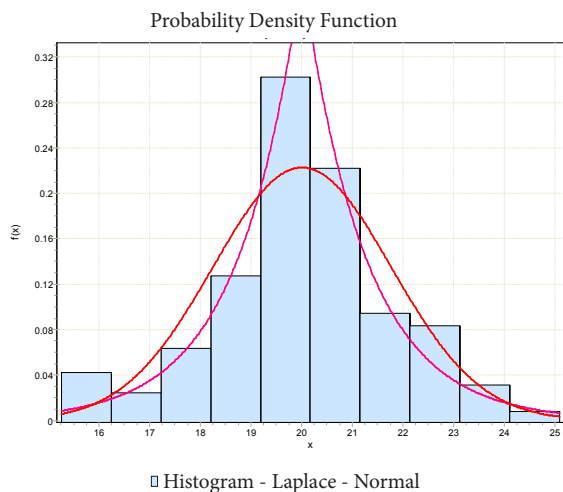


Fig. 3 Histogram, best fit of the PDF and approximation of the normal PDF for PI values

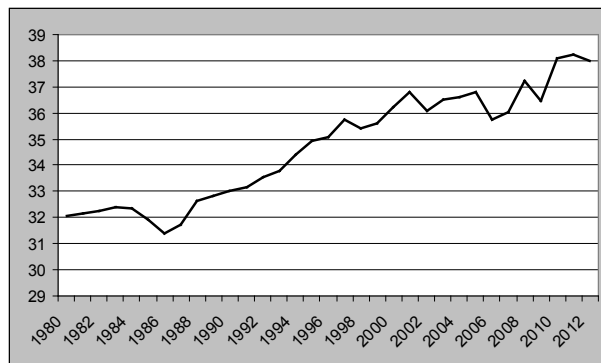


Fig. 4 Time dynamics of the annual mean values of BMI

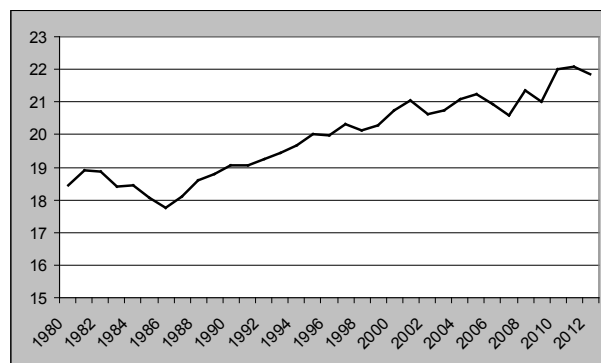


Fig. 5 Time dynamics of the annual mean values of PI

out categories increased with the passage of time, which, taking into account the features of the bodybuilding as a sport discipline, we considered as a sign of an increase of the muscle mass of the competitors.

**CONCLUSIONS**

1. The body composition of the bodybuilders which ranked among the top six in the professional tournaments without categories is characterized by a clustering around the mean values in the studied indices – the sample is very homogeneous;
2. The form of the estimated PDFs is intrusive for a bigger probability than the Normal distribution suggests for an emergence of competitors with extreme values of BMI and PI;
3. We consider that we could look for the reason for the increase of the values of both RVs with the time in two directions: 1. Because of the characteristics of the judging and the ranking processes in bodybuilding, the preferences of the judges evolved towards tolerating more muscular competitors or 2. The muscle mass of all the professional bodybuilders increased over the time in the studied period which lead to an increase of the muscularity of the studied sample of bodybuilders.

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