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Original article

## THE ROLE AND IMPORTANCE OF ANTHROPOMETRIC AND PHYSIOLOGICAL INDICATORS OF BASKETBALL REFEREES

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### Abstract

*Aim.* The basketball referee is the person who judges all phases of the game, taking decisions in fractions of a second. For this we need to analyze him in depth meaning also his antropometric and physiological indices.

*Methods.* I have verified a number of anthropometric indices such as size, weight and span, a number of physiological indices: respiratory frequency, cardiac frequency, vital capacity.

*Results.* All correlations that can be extracted from existing tests have been objectively observed.

*Conclusions.* Also, the tests that are required at this date, without a centralized and well-prepared training basis, are not relevant and can not be correlated with the subjects' anthropometric or physiological parameters.

Keywords: anthropometric, physiological, basketball, referees

### Introduction

The referee is „the person who is in charge of conducting a sports competition.” (DEXI, 2007, p.117)

“Each referee knows that basketball is a fast and exciting game with coaches and spectators, who, especially at the end of the game, can not control themselves. It is up to a good referee to prepare for such situations and to control such emotions” (Priebst, 2007, p.11)

He often applies training close to the level at which top athletes apply, the best-rated teams, with all the specialists they need.

The theoretical basis of this approach is provided by some research that states „linear increase in oxygen consumption and heart rate depending on the intensity of the submaximal effort, allows predicting by extrapolation the maximum oxygen consumption that subject might have, without the need to subject it to maximal effort.” (Weineck, 1997, p.89-95)

”Physical training includes a whole system of measures ensuring a functional capacity high body by the high level of development of motor skills base and the specific optimal values of the indices morpho-functional full possession of exercises used and perfect health.” (Negrea, Mușat, 2016, p. 585-589)

### Methods

The subjects of the research are 55 basketball referees, referees from the National Championship (Men's National Basketball League and Women's National Basketball League). I have verified a number of anthropometric indices such as

size, weight and span, a number of physiological indices: respiratory frequency, cardiac frequency, vital capacity.

„Achieving high-performance in major competitions, highlighted a number of aspects that characterize the current basketball game practiced by the best teams in the world” (Predescu, Ghițescu, 2001, p 7-9)

Below we will present the data from our substantive records on a number of 55 subjects. The data are anthropometric and physiological indices that are recorded at the beginning of each season, both on the basis of the measurements and on the basis of a medical certificate from the specialist.

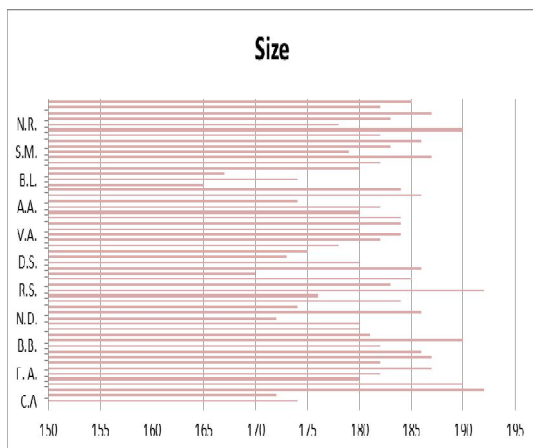
Table no. 1 Data of the index size

Size	
Mean	181,2545455
Standard Error	0,806630011
Median	182
Mode	182
Standard Deviation	5,982128266
Sample Variance	35,78585859
Kurtosis	0,250344071
Skewness	-0,607428955
Range	27
Minimum	165
Maximum	192
Sum	9969
Count	55
Largest(1)	192
Smallest(1)	165
Confidence Level(95.0%)	1,617195791
CV	0,033004018

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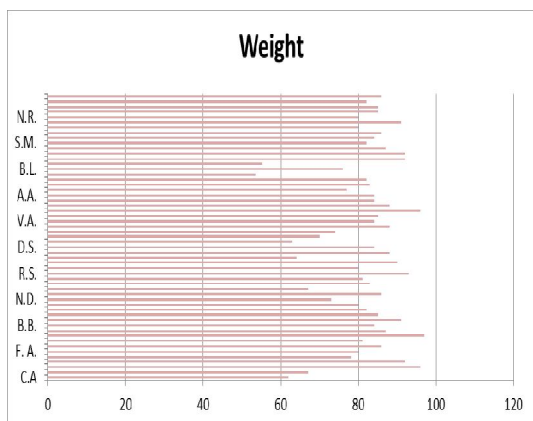


1. Chart Size

Following the chart with the size index representations, we observe a high homogeneity of the subjects. And the statistical coefficient analysis table shows a coefficient of variability of 2%, so the average is representative, the median being 182cm, with a maximum of 192cm, and a minimum of 170cm.

Table no. 2 Data of the index weight

Weight	
Mean	81,66363636
Standard Error	1,298280042
Median	84
Mode	84
Standard Deviation	9,628302486
Sample Variance	92,70420875
Kurtosis	1,265723582
Skewness	-1,122993554
Range	43,5
Minimum	53,5
Maximum	97
Sum	4491,5
Count	55
Largest(1)	97
Smallest(1)	53,5
Confidence Level(95.0%)	2,60289475
CV	0,117901956

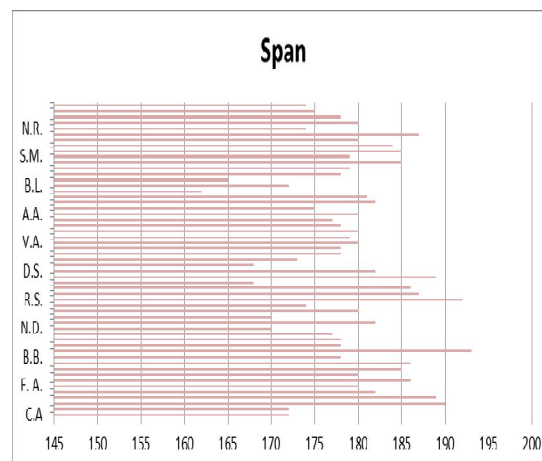


## 2. Chart Weight

As a result of calculating the coefficient of variability, 10% for the weight index, we have a high homogeneity of the subjects of the proposed sample, but not as high as it is for the index height. The minimum of this index is 63kg and the maximum of 99kg.

Tableno.3 Data of the index span

Span	
Mean	179,1272727
Standard Error	0,886887094
Median	179
Mode	180
Standard Deviation	6,577330725
Sample Variance	43,26127946
Kurtosis	0,127249329
Skewness	-0,217408291
Range	31
Minimum	162
Maximum	193
Sum	9852
Count	55
Largest(1)	193
Smallest(1)	162
Confidence Level(95.0%)	1,778101554
CV	0,036718757



3. Chart Span

Based on the graph for the span data of the subjects, a coefficient of variability of 3% can be observed, which means that the homogeneity is high and the average of the subjects is representative.

Following the correlation of anthropometric data we have the following results:

Table no.4 Data of indices' correlations

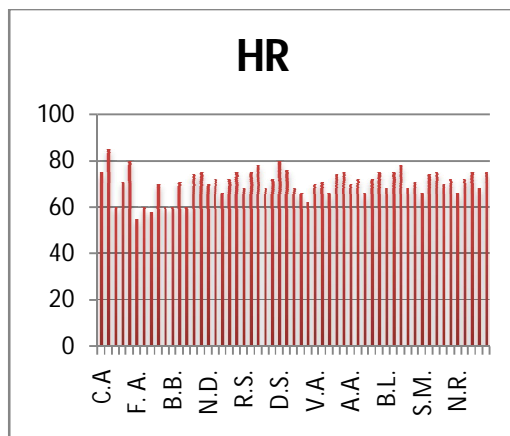
Indices	Correlation index	Comments
Size-Weight	0,891425	A directly proportional and very strong correlation.(89%)
Weight-Span	0,810864	A directly proportional and very strong correlation.(81%)
Span -Size	0,922754	A directly proportional and very strong correlation.(92%)

As we can well see, the data of the anthropometric indices currently used for the evaluation of the basketball referees are correlated with each other, and we can say that they are very important for the level of training and performance of the referees.

Next, we will present the statistical data and the resulting graphical data for the physiological indices of the sample of subjects for preliminary testing.

Table no.5 Data of HR index

HR	
Mean	70,87272727
Standard Error	0,806144144
Median	71
Mode	75
Standard Deviation	5,978524981
Sample Variance	35,74276094
Kurtosis	2,495843936
Skewness	0,316563976
Range	37
Minimum	55
Maximum	92
Sum	3898
Count	55
Largest(1)	92
Smallest(1)	55
Confidence Level(95.0%)	1,616221687
CV	0,084355791

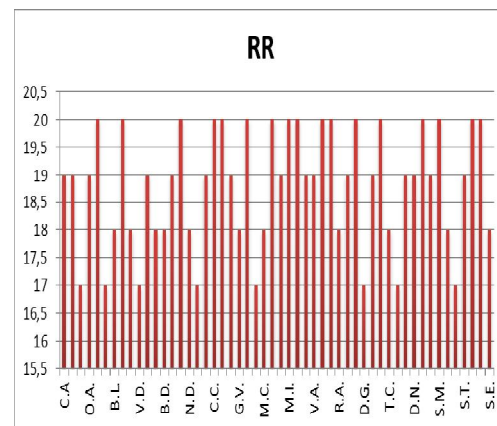


4. ChartHR

Having a 7% coefficient of variability for the physiological index, the heart rate HR, we can conclude that the homogeneity in this echelon is high, the mean being representative.

Table no.6 Data of RR index

RR	
Mean	18,8
Standard Error	0,145412452
Median	19
Mode	20
Standard Deviation	1,078407605
Sample Variance	1,162962963
Kurtosis	-1,087962659
Skewness	-0,41188265
Range	3
Minimum	17
Maximum	20
Sum	1034
Count	55
Largest(1)	20
Smallest(1)	17
Confidence Level(95.0%)	0,291534411
CV	0,057362107



5. Chart RR

As it can be noticed from the table above, we have a coefficient of variation of 5%, for respiratory rate, RR which means a high degree of homogeneity and a relevant average of the sample.

Table no. 7 Data of VC index

VC	
Mean	4528,727273
Standard Error	20,04297495
Median	4475
Mode	4450
Standard Deviation	148,6426805
Sample Variance	22094,64646
Kurtosis	-0,863611777
Skewness	0,381902046
Range	500
Minimum	4300
Maximum	4800
Sum	249080
Count	55
Largest(1)	4800
Smallest(1)	4300
Confidence Level(95.0%)	40,18374508
CV	0,032822175

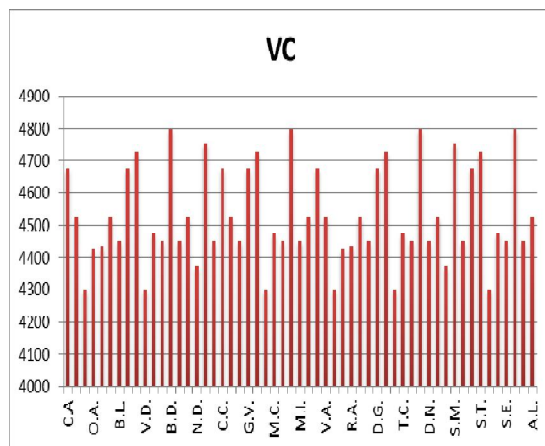


Chart 6VC

The coefficient of variability of the vital capacity, VC, index is 3%, which means a relevant mean of the sample and a high homogeneity.

We will further present the correlations between the physiological indices of the sample:

Table no.8 Correlation of the physiological indices of the sample

Indices	Correlation	Comments
FC-FR	0,025969	A directly proportional and very strong correlation.(2%)
FR-CV	-0,17475	An inversely proportional and not very strong correlation.(17%)
FC-CV	0,34964	A directly proportional and stronger correlation than FC-FR.(34%)

Table no.9 Correlation of anthropometric indices with physiological indices

Indices	Correlation	Comments
Size-FC	-0,01598	An inversely proportional and not very strong correlation (5%)
Size-FR	-0,09684	An inversely proportional and not very strong correlation (9%)
Size-CV	0,210398	A proportional and stronger correlation (21%)
Weight-FC	0,004616	A directly proportional but not strong correlation. (0,4%)

Weight -FR	0	There is no correlation between these indices.
Weight- CV	0,156771	A directly proportional but not strong correlation (15%)
Span- FC	0.066299	A directly proportional but not strong correlation.(6%)
Span-FR	-0.10479	An inversely proportional correlation.(10%)
Span- CV	0.14189	A directly proportional and not strong correlation.(14%)

### Discussions

I would like to say that the work of a referee to become the best is similar to the work of a top player. He must also have an important amount of talent, and by talent here we mean having a “sense of game”, which is indispensable for a referee who wants to reach the highest levels.

“The modern basketball game is running at high speed, at a sustained pace, which implies great physical effort”. (Negrea, 2016)

„On the background of a specific and partial endurance effort that runs close to the aerobic-anaerobic threshold, the basketball referee performs short and medium speed efforts.” (Martinescu, 2014)

We have to notice that, over the years, the changes to the regulation have led to an increase in the importance and responsibility of referees during the games. We must not forget that the referee is that judge in the field who has the power and responsibility to make decisions.

“The considerable increase in the role of the specific training of the referees involved in the development of the number of the international sports competitions and, implicitly, of the national ones, specialized the training co-entrant and methodology according to the needs of the competitions.” (Predescu, Ghițescu, 2001, p.128).

“In order to obtain good performance by a referee, the ability to solve the specific problems that arise during the competition must be developed by creating similar situations in the training.” (Arnauld, 2004, p. 34)

Observing all this new challenges and trends in basketball we can say that this topic is not enough researched in our country, although at the present time the bases of a very rigorous training system for basketball referees in Europe are laid.



### Conclusions

In conclusion, after analyzing the preliminary data, we note that between the indices that are currently demanded, namely the anthropometric, size, weight, span and physiological indices, FC, FR, CV, for which we need medical certificates from specialized doctors, inconclusive data result on the level and objective evaluation of basketball referees. Also, the tests that are required at this date, without a centralized and well-prepared training basis, are not relevant and cannot be correlated with the subjects' anthropometric or physiological parameters.

All correlations that can be extracted from existing tests have been objectively observed. Thus, we can underline the fact that at this time the tests applied to the basketball referees are very little relevant with the level of umpire age, the development of the training and the performance of the referees for higher level results.

„When a referee realizes that he is responsible for seeing all players on the court, refuses to be intimidated by players, coaches and supporters and leads the game with the full flexibility of his judgement, and implements knowledge with skill and courage, only then can he be considered worthy by the name of the referee.” (FRB., 1995)

### Acknowledgements

For all of our participants from my study I want to say thank you.

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