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THE INFLUENCE OF SOME ANTHROPOMETRIC PARAMETERS ON THE MARATHON RESULTS OF THE WORLD ATHLETICS CHAMPIONSHIPS 2019 IN DOHA

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Abstract
The research was conducted on a sample of 55 successful female marathoners who participated in ten of the most popular marathon races. The sample of subjects includes ten of the best marathoners positioned in every race held at the 2019 World Athletics Championships in Doha, Qatar. The purpose of the research is to assess the impact of body height, weight and age of marathon runners on the final result in the race. The collected data is processed by the basic descriptive parameters. The entities have the average weight of 60.81 kg, with the average height of 171.65 cm, at the average age of 32.92, with the achieved average result of 137.86 hours into the race. In the intercorrelation matrix, only a significant correlation coefficient ($p<0.001$) is obtained for height and body weight. From the regression analysis the influence of the predictor variables (height, weight and age) on the criterion variable – sig.=0,60 (the result of the marathon) is not confirmed, which provides only 36% ($RO^2=.366$) of analysis in the common ground of variability. The remaining 64% of the analysis of the total variability of the criterion variable may be attributed to other anthropological characteristics, and mainly to functional characteristics of the anaerobic type.

Keywords*: Elite athletes, marathoners, anthropology, regression analysis.*

Introduction

The number of marathon races and runners has increased largely during the last decades (Knechtle et al., 2020). For instance, the number of finishers in the New York City Marathon doubled from the 1980s to the 2010s (Vitti A., Nikolaidis P. T., Villiger E., Onywera V., Knechtle B. 2020). This implied that many runners competed in a marathon race for their first time or had a small sport experience, and consequently, the need to aid such runners has been documented (Keogh A., Sheridan O. O., McCaffrey O., Dunne S., Lally A., Doherty C. (2020); Malchrowicz-Mośko E., León-Guereño P., Tapia-Serrano M. A., Sánchez-Miguel P. A., Waśkiewicz Z 2020). The globalization of sport (eg, mega-events such as the Olympics or FIFA world cups for the first time in South-America, Asia, Africa or Middle-East) alongside global warming and congested competition calendars increasingly expose athletes to hot conditions. While an air-conditioned stadium was used during the recent 2019 athletics World Championships (WC), this is evidently not possible for endurance road-race events. This study assessed how one or combinations of weather parameters (temperature, humidity, wind speed and solar load) affect peak performance during endurance running events and identified which events are most vulnerable to different weather conditions. The interplay of physiological determinants of endurance exercise performance may be particularly complex in long-distance running, since the anthropometric and body composition characteristics of athletes have an additional significance, due to the weight-bearing nature of running (Salinero, J. J., Soriano, M. L., Lara, B., Gallo-Salazar, C., Areces, F., Ruiz-Vicente, D., et al. (2017).Running is one of the sports practicing worldwide (Tschopp M, Brunner F. 2017), and the distance of a marathon (42.195 km) is one of the running races presenting the highest participation rates. (www.runningusa.org). To meet the challenging psychophysiological demands of a marathon race, one should have optimal levels of aerobic capacity, anaerobic threshold, and motivation. In addition, performance in marathon running depends on pacing, ie, the ability to appropriately expend energy to prevent premature fatigue prior to the completion of the event.(Skorski S, Abbiss CR. 2017).Training for long-distance running (LDR) aims to improve the “big three” performance-determining variables: maximum oxygen uptake (VO2max; the highest rate at which the body can take up and utilize oxygen during severe exercise), fractional utilization (the ability to sustain a high percentage of VO2max when running), and running economy (VO2 at a given submaximal running velocity).(Joyner MJ, Hunter SK, Lucia A, Jones AM. 2020) Together, these variables integrate the sustained ability to produce adenosine triphosphate (ATP) aerobically and convert muscular work to power/speed .(Jones AM, Kirby BS, Clark IE, Rice HM, Fulkerson E, Wylie LJ, Wilkerson DP, Vanhatalo A, Wilkins BW. 2021). Alongside physiological (Stellingwerff, 2012) and pacing strategies (Deaner et al., 2019), athletes could potentially improve marathon performances by incorporating particular biomechanical principles with regard to running form and technique (Pizzuto et al., 2019), and therefore try to prevent such dramatic changes in speed during competition.

The aim

The purpose of this article is to observe the correlations with the result obtained in marathon race through some anthropometrical variables, also the impact of these relationships and whether they are interdependent.

SAMPLE OF RESEARCH - In this research are included 3 anthropometric variables and a motor-specific variable of the 42,195 km. marathon. ANTHROPOMETRIC MEASUREMENTS - Body height (BH), Body mass (BM), Athlete age (AAG) MOTOR-SPECIFIC VARIABLE - Running 42,195 km (R42.195WCH)

Methods of processing results

The following statistical methods were used to process the results of this research: Am. - Arithmetic mean, St. Dev. - Standard deviation, St. Error. - Standard error of arithmetic mean, Max. - Maximum result, Min. - minimal results, Skew. - Distribution symmetry, Kurt. - Increase the distribution, r- the Pearson correlation coefficient, and testing the hypothesis of the validity of r. -g at the 0.05 levels of safety scales.

BASIC STATISTICAL PARAMETERS

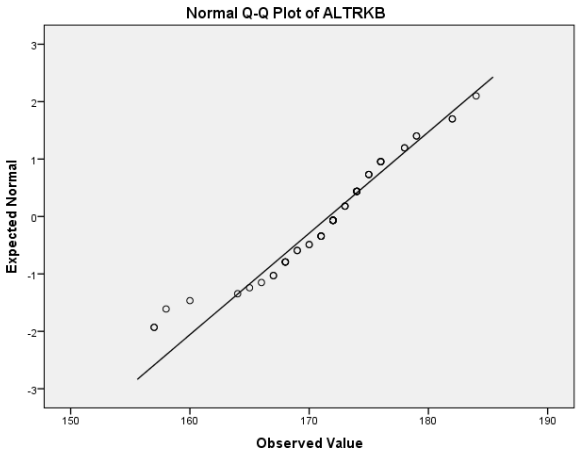
Basic statistical parameters of asymmetry and normal distribution of specific (42,195 km - marathon race) and anthropometric variables of Doha 2019 finalist athletes

In the following text, the basic statistical parameters of asymmetry and the normal distribution for each distance running and anthropometric variables applied in this paper will be presented and analyzed. Table 1 shows the basic statistical characteristics of the applied system of specific variables (runs) and anthropometric variables. The following are presented: Minimum values (min), maximum values (R. max), the arithmetic mean (Mean), standard deviation (STD. Dev), asymmetry parameters (SKEW and KURT), Coefficient of variation (CV)

Table 1. Basic statistical parameters of asymmetry and normal distribution of specific (42,195 km - marathon race) and anthropometric variables of Doha 2019 finalist athletes

Tab.1	N	Minimum	Maximum	Mean	Std. Deviation	Skewness	Kurtosis	CV
BH	55	157.00	184.00	171.6545	5.66411	-.623	1.070	3.29
BM	55	50.00	70.00	60.6182	4.78226	.084	-.252	7.88
AAG	55	25.00	44.00	32.9273	4.09089	.425	-.154	12.42
R42195KB	55	130.40	156.01	137.8616	5.58135	.925	1.062	4.04

Histogram 1. Histogram of the variable - Body height



The arithmetic mean of the measurement of the anthropometric variable Body Height (BH) (Table 1 and Histogram 1) is 171.65 cm. Minimum measurement results (157.00cm) and maximum (184.00cm) of the anthropometric variable Body height indicates that there is a significant difference between elite athletes in this anthropometric variable. The results show a slight tilt of the values of this variable indicating it has the highest values because the asymmetry test is negative. Athletes in age based on the values achieved in this anthropometric variable are presented as a homogeneous group and with a distribution that deviates from the normal one. Although there is a marked difference between the minimum and maximum result. Athletes based on the results achieved in this morphological variable are presented as a homogeneous group (CV=3.29%) where the values are clustered in the middle. (Skewness and Kurtosis) do not show a pronounced asymmetry, the distribution is mesocurtic. All the variables presented in table no. 1 are homogeneous.

CORRELATION RESULTS

The following text will present and analyze the purely linear correlation coefficients of specific, anthropometric and motor variables. Due to the better representation of the table and to observe more clearly the significant correlations of the different levels of connection, the coefficients in question are marked with an asterisk. Thus, the statistically significant coefficients of the variables with the highest degree of statistical inference ($p < 0.01$) are marked with two asterisks. Easier statistical inference criterion ($p < 0.05$) correlation coefficients are marked with an asterisk. The correlation matrix of the anthropometric and motor variables is presented in Table 2.

Table 2. Intercorrelation coefficients of anthropometric and motor - specific variables of the world athletics championships 2019 in Doha

Tabela 2	ALTRKB	APETKB	AMSHKB	V42195KB
BH	1	.730**	.006	-.100
BM	.730**	1	.140	.132
AAG	.006	.140	1	.240
R42195WCH	-.100	.132	.240	1

The first group in terms of height of correlation coefficients consists of anthropometric variables belonging to body height, (BM) correlation .730 ** p <0.01., Longitudinal dimension and that correlation coefficients are brought from the highest value of (BM) correlation .730 ** p <0.01.

REGRESSION ANALYSIS OF SPECIFIC, ANTHROPOMETRIC AND MOTOR VARIABLES OF THE WORLD CHAMPIONSHIPS AT 42.195 KM.

Through regression analysis in athletes (table 3) the value of the correlation between the group of independent predictive variables (anthropometric variables) and the dependent criterion variable (distance running 42.195km. (R42195WCH) in the World Athletics Championship, WCH 2019 was confirmed. Using the regression equation, for a given value of x the predicted value y can be found, but the size x can make better estimates between the minimum and maximum values in the data set. In fact, to find more accurate estimates the regression model (b1, b0) must be created each time a new data is found.

Table 3. Impact of anthropometric variables on the criterion variable distance running 42.195km (R42195WCH) in the World Athletics Championships WCH 2019.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.366[a]	.134	.083	5.99840

a. Predictors: (Constant), BH, BM, AAG

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	284.410	3	94.803	2.635	.060[b]
	Residual	1835.018	51	35.981		
	Total	2119.428	54			

a. Dependent Variable: R42195WCH

b. Predictors: (Constant), BH, , MB,AAG

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	170.498	28.597		5.962	.000
	BH	-.422	.213	-.381	-1.980	.053
	BM	.503	.255	.384	1.976	.054
	AAG	.289	.204	.189	1.421	.161

a. Dependent Variable: R42195WCH

Regression analysis represents the process of explaining the relationship between a dependent variable and an independent one (simple regression) or the relationship between a dependent variable and more than one independent variable (weighted regression) with a mathematical equation. If in regression analysis the relationship between the variables is linear, it is called linear

regression and the opposite is called nonlinear regression. In this chapter, only linear regression will be explained. Prediction of parameters in linear regression analysis is done using the smaller squares technique (Least Squares Method). Here, the goal is to find the distance distances of the points shown in the distribution diagram (scatter diagram) and their total minimization. Correlation of the whole system of independent anthropometric predictive variables Body height (BH), Body weight (BM) and calendar age (AAG) with the dependent criterion variable race walks distance 42.195 km. (R42.195WCH) has a multiple correlation coefficient with value R = 0.366 which explains the common variability between the system and the criterion variable, about 37% (R Square = 0.134). Distribution - F is the quotient distribution of the two variances, so it is always necessary to assign two degrees of freedom. The first degree of freedom is equal to the number of predictor variables (DF = n) while the second is performed so that the number of subjects reduced by the number of predictor variables minus 1 (DF = N - n - 1). We can emphasize that the F-test is not valid (2,635) and the multiple correlation is of such value that the reliability is valid, in the concrete case of this paper is significant (Sig = 0.060). In cases where the multiple (R) correlation between the predictor variables and the criterion variable is valid, it is necessary to look at which variables of the predictive variables have higher regression coefficients (Beta) and are valid table 3. From anthropometric variables during the execution of the dependent criterion running variable at 42,195 km. distance (R42195WCH) in the World Athletics Championship WCH 2019 has a significant impact Body height (BM), Sig = 0.053.Through regression analysis in athletes (Table 3) the value of the correlation between the group of independent predictive variables (anthropometric variables) and the dependent criterion variable (race walking distance 42.195km (R42195WCH) in the 2019 World Athletics Championships WCH. was confirmed. Using the regression equation, for a given value of x the predicted value y can be found, but the size x can make better estimates between the minimum and maximum values in the data system. In fact, to find more accurate estimates the regression model (b1, b0) must be created each time a new data is found.

Conclusion

We have tried to address the main forms and characteristics of the marathon race that belong to the group of measured-intensity endurance cyclic movements. The importance and form of marathon running are quite complex forms with which the athlete must face a rare sacrifice. As we elaborated above, we can conclude that learning technique and tactics is a process to which we must pay special attention, since long-distance running belongs to the endurance group and plays a dominant role in everyday life. This is a paper in which we have tried to chronologically analyze the technical, tactical and analysis stages and multi-year marathon planning. I believe that we have made a contribution of this segment, at least an innovation and maybe more. Prediction of parameters in linear regression analysis is done using the Least Squares Method. Here, the goal is to find the distances of the points presented in the scatter diagram and their total minimization. In table 1. We have presented the analysis of the basic statistical parameters, asymmetry and the normal distribution for each discipline of running and anthropometric variables applied in this paper according to the order. Tables 1 and 2 show the basic statistical characteristics of the applied system of specific variables (distance running) and anthropometric variables. The following are presented: Minimum values (min), maximum values (R. max), the arithmetic mean (Mean),

standard deviation (STD. Dev), asymmetry parameters (SKEW and KURT). The presentation of the distribution in Tables 1 and 2 is homogeneous. In Table 3, the height of the correlation coefficients consists of the anthropometric variables that belong to the body height, (BM) correlation .730 ** p <0.01., the longitudinal dimension and that the correlation coefficients are brought from the highest value of (BM) correlation .730 ** p <0.01. In Table 3, we can emphasize that the F-test is not valid (2.635) and the multiple correlation is of such value that the reliability is valid, in the concrete case of this paper is significant (Sig = 0.060). The success of marathon running should be sought in other anthropological factors, primarily in aerobic functional abilities. This is a scientific work that meets the criteria of research, which has the true structure of a genuine scientific research.

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