

## CORRELATION BETWEEN ANTHROPOMETRIC CHARACTERISTICS AND COMPETITIVE RESULTS OF ELITE JUNIOR JAVELIN THROWERS

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The purpose of this study was to find the anthropometric characteristics of elite junior javelin throwers on a sample of eleven finalists of the European Athletic Junior Championship (MEPA, 1998). The chosen subjects were measured with a set of nine anthropometric variables, according to the methodology prescribed by the International Biologic Programme. The results show that no common constitutional type of a junior javelin thrower exists, but that the anthropometric characteristics are very individually defined. Correlational analysis shows that no statistically significant ( $P < 0.05$ ) correlations exist between the individual anthropometric characteristics of the throwers with their competitive result. Successful javelin throwing is therefore a synthesis of anthropometric characteristics and motor abilities, as well as an optimal technique.

**KEY WORDS:** javelin, elite athletes, juniors, anthropometry, optimisation

**INTRODUCTION:** Javelin throwing belongs to the group of cyclic-acyclic track and field disciplines, for which linear and translatory type of movement is characteristic. The result in javelin throwing is defined mainly by proper technique, specific motor abilities, aerodynamic factors and anthropometric characteristics of the athlete (Rynes, 1977; Moriss & Bartlett, 1996). The latter are especially important from the viewpoint of the biomechanical characteristics of javelin-throw technique. As do all the track and field throws, javelin also demands a very specific somatotype of the athlete. Some studies (Terauds, 1975; Rynes, 1977; Lohman et al., 1978; Milanovic, 1980) show that javelin throwers belong to the mesomorphic somatotype, according to Sheldon's typology. Its characteristics are increased body mass and height, muscularity and pronounced transversal measures, such as shoulder width, as well as joint diameters, especially elbow and knee.

From the viewpoint of kinematic and dynamic technique characteristics, maximal launch velocity, optimal launch angle and launch height represent the three most important factors that define the end result in javelin (Komi & Mero, 1985; Whiting et al., 1991; Hinz, 1991; Best et al., 1993; Mero et al., 1994; Moriss et al., 1997). The realisation of launch velocity is therefore the consequence of an efficient transfer of approach velocity of the athlete with the musculo-tendon chain of leg action, hip and shoulder girdle and the action of the elbow and wrist joints. It represents a harmonious inter-muscular co-ordination and action of the stretch reflexes (Komi, 1995). The second parameter, which defines the javelin's flight and through it the end result, is the launch angle. Its optimal value is between  $33^\circ$  and  $36^\circ$  (Best et al., 1993; Mero et al., 1994; Bottchner & Kuhl, 1998). The third parameter is the launch height, mostly defined by the body height of the athlete. The optimal launch height is supposed to be 105% of the body height of the athlete (Bottchner & Kuhl, 1998). Any deviation from this optimal launch height results in a shorter flight parabola of the javelin and with it a poorer result.

In comparison with the other track and field throwing disciplines (shot-put, anvil, discus), javelin throwing does allow a "wider" span of anthropometric characteristics of the athlete. Elite javelin throwers are of two types - "heavy" and "light". Several studies exist, dealing with the anthropometric characteristics of elite throwers. The main purpose of our study was to find the anthropometric characteristics of junior elite throwers and their correlation with the throwing results. The anthropometric characteristics are without doubt an extremely important factor, which should be taken into consideration in the selection process of young talented throwers.

**METHODS:** The subject sample included eleven javelin throwers (average age  $18.6 \pm 0.7$  years, average height  $1.86 \pm 0.05$  m, average mass  $90.78 \pm 9.70$  kg, average result in javelin  $70.37 \pm 5.4$  m), finalists of the European Athletic Junior Championship in Ljubljana in 1998. The young athletes were measured with a battery of nine anthropometric measures, according to the

procedure of the International Biologic Programme-IBP (Standard battery of anthropometric measures for assessing somatotype). The measurements were taken by a professionally trained medical team, immediately prior to the competition. The permission for anthropometric measuring was given by the technical delegate of the International Amateur Athletic Federation (IAAF). The data was analysed with the computer programme SPEX 1.2. The basic descriptive statistical parameters were computed, as well as Pearson product-moment coefficients to test for correlation with the competitive results.

**RESULTS AND DISCUSSION:** The results presented in Table 1 show the basic anthropometric characteristics of elite junior javelin throwers. The average body height (BH) is 1.86 m, the highest athlete measured 1.93 m, the shortest 1.78 m. Mero et al. (1994) found similar values for a sample of eleven male finalists of the Barcelona 1992 Olympic Games. The average height of the throwers was 1.88 m. The differences in body mass (BM) are larger. The average body mass of junior throwers is 90.1 kg. In comparison with the Mero study (1994) we find that the athletes in our sample are lighter on the average by about 6 kg. On the basis of these results we can also see that our sample of eleven junior javelin throwers is very heterogeneous in body height and body mass. A.M., who was the lightest of them all (71 kg), became European Champion and the bronze medal went to the athlete F.C., who has the largest body mass in the subject sample (100.2 kg).

**Table 1 Anthropometric characteristics of elite junior javelin throwers and their correlation with the competitive results**

c	Name		RE	BM	BH	RH	SW	PW	KD	TC	SC	BMI
1	M.A.		78,42	71,0	1,82	230,0	38,2	27,3	9,1	54,2	37,2	21,45
2	A.J.	FIN	77,60	87,7	1,90	246,0	42,7	27,6	10,0	59,3	40,7	24,56
3	F.C.	D	75,86	100,2	1,78	231,0	42,8	30,0	10,2	65,9	43,8	31,70
4	G.S.	SLO	73,06	89,1	1,92	250,0	41,8	29,1	10,8	58,5	40,2	24,47
5	J.V.	FIN	71,40	102,0	1,82	241,0	43,6	37,2	10,0	64,7	44,4	30,81
6	B.A.	D	70,22	101,1	1,87	246,0	43,2	29,5	10,5	65,0	43,2	28,96
7	W.T.	DEN	68,52	95,4	1,87	237,0	42,8	27,8	10,7	66,2	42,8	27,65
8	P.D.	GB	67,36	89,9	1,88	240,0	43,2	29,4	10,3	63,0	41,7	25,46
9	C.K.	LIT	64,32	94,9	1,93	252,0	45,7	30,2	10,7	61,8	41,8	25,54
10	P.F.	I	63,96	89,8	1,90	250,0	46,2	32,4	9,7	58,4	38,6	24,87
11	A.A.	LAT	63,34	77,5	1,80	237,0	39,4	28,6	10,2	55,7	39,5	23,91
			70,37	90,78	1,86		42,69	29,92	10,20	61,15	41,26	26,31
		S.D.	5,43	9,70	0,05	7,61	2,34	2,81	0,50	4,19	2,26	3,12
		R		0,11	0,27	0,41	0,44	0,23	0,37	0,04	0,01	0,05

**Legend:**

RE – competitive result in javelin (m)  
 BM – body mass (kg)  
 BH – body height (m)  
 RH – reach height (m)  
 SW – shoulder width (cm)  
 PW – pelvic width (cm)  
 KD – knee diameter (cm)

TC – thigh circumference (cm)  
 SC – shank circumference (cm)  
 BMI – body mass index  
 MEAN – arithmetic mean  
 S.D. – standard deviation  
 R – correlation between anthropometric variable and javelin result

There is no optimal model of body height and mass, these two parameters are very individually defined and correlated with numerous other factors, which generate throwing efficiency in their mutual interaction. Other authors (Milanovic, 1980; Komi & Mero, 1985; Mero et al., 1994) also

found that competitive results in javelin are very independent of the anthropometric type of the athlete. Currently the two top javelin throwers in the world, the bearer of the gold medal from Sydney J. Zelezny (CS) and the bearer of the silver medal S. Backley (GB) belong to very different somatotypes. While S. Backley is 1.96 m tall and weighs 95 kg, J. Zelezny's height is 1.86 m and he weighs only 80 kg.

Besides the body mass and height, their ratio is also important (Ross & Martin, 1987). This ratio manifests itself in the Body Mass Index ( $BMI = BM / BH^2$ ). The range of BMI for young throwers is from 21.45 to 31.70, with a mean of 26.31. The javelin-throwing finalists at the Olympic Games in Los Angeles in 1984 had a mean BMI of 26.63. At the games in Barcelona in 1992, the average BMI amounted to 26.86 (Mero et al., 1994). Elite senior javelin throwers are therefore somewhat heavier and higher than their junior counterparts. These results lead us to conclude that the anthropometric model, from the viewpoint of body mass and body height, of young javelin throwers is very similar to that of elite throwers, pointing to a narrow selection, since the sample represents eleven finalists of the European Junior Athletic Championship. Achieving top results at the junior level is obviously generated by similar factors as in the elite senior competition.

The importance of transversal measures, as predictors of success in javelin throwing, has been established also by other authors (Milanovic, 1980; Gregor & Pink, 1985). One of the most important is shoulder width, which amounts to  $42.69 \pm 2.3$  cm for throwers. Shoulders are that body segment, which is the key generator of launch efficiency in the muscular chain action in javelin throwing. Konstandinov (1979) stresses in his study that shoulder width is an important selection criterion of potential young throwers. Bi-crystal width of the pelvis is  $29.92 \pm 2.8$  cm. The width of the knee joint, which defines the morphologic structure of the lower extremities, is  $10.20 \pm 0.50$  cm. The width of the knee is an important factor from the bio-mechanical point of view, larger knee width namely means a more economic distribution of the pressure generated by the reaction of the surface in the launch action. The standard deviations show us that the subjects are very homogeneous. We can therefore conclude that a mesomorphic somatotype of young throwers is one of the most important selection factors.

Circumferences of the lower extremities (circumference of the thigh, circumference of the shank) represent muscular mass on the active segments of the body, which produce force in the approach phase and in the last three strides of the launch action. The average circumference of the thigh is  $61.15 \pm 4.1$  cm and shank  $41.26 \pm 2.26$  cm. A study by Milanovic (1980) showed that the thigh and shank circumferences are statistically significant positive predictors of the competitive result in javelin throwing.

The second goal of the current study, besides analysing anthropometric characteristics of young javelin throwers, was to find if statistically significant correlations exist between the individual anthropometric characteristics and the competitive result in javelin throwing. The Pearson correlation coefficients (Table 1) show that no significant correlations exist at the 5% error level between the anthropometric variables and the criterion. This fact is rather surprising, but the results prove that successfulness in this discipline is markedly individually defined and dependent on an optimal inter-relation of anthropometric characteristics, basic and specific motor abilities, as well as the level of technique quality of the athletes. The variables reach height and shoulder width have the highest correlations with the competitive result, but they are not statistically significant. Even if the athletes, who competed in the finals of the European Junior Athletic Championship, represent a rather selected sample, their anthropometric characteristics are very heterogeneous. The competitive result in javelin throwing is obviously a synthesis of many inter-dependent factors and morphology is just one of them.

**CONCLUSION:** Studying morphologic characteristics of young javelin throwers is important, both from the viewpoint of selection as well as the training process. Javelin throwing is a specific track and field discipline, which does demand a certain anthropometric profile of the athletes, but this profile has a rather wide span of anthropometric characteristics. Top results in this category are achieved both by tall athletes with a relatively low body mass, as well as those with great body mass and of lesser body height. Correlation analysis did not give statistically

significant associations between the anthropometric characteristics of young elite javelin throwers and their competitive results. It is obvious that in this period we still cannot speak of an ideal constitutional model of a javelin thrower. The competitive result is the resultant of morphologic characteristics, basic and specific motor abilities, as well as a bio-mechanically optimal execution of the throwing technique.

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