

THE WEIGHT OF PROJECTILE AND THROW DISTANCE

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INTRODUCTION: The throw distance depends on initial speed, elevation angle, weight of projectile and its aerodynamic properties. In terms of biomechanics, the initial speed is dependant on the weight of projectile, force capacity of the subject and the throwing technique. When addressing motion equation of oblique throw inclusive of air resistance and projectile weight we get an equation expressing maximal throwing distance X_m (Packel & Yuen, 2004; De Mestre, 1990):

$$X_m = \frac{v_0^2 \sin 2\alpha}{g} \left(1 - 2\sqrt{2} \frac{kv_0^3}{3mg^2} \right)$$

The aim of the study is to analyze the influence of projectile weight on throw distance under stabilized aerodynamic parameters.

METHODS: A group of men (n=85, BH \pm 0.08 m, BW 76.52 ± 10.37 kg) and women (n=70, BH 1.69 ± 0.07 , BW 58.81 ± 6.04 kg) performed a set of throws under the condition of reaching maximal distance with projectiles of varying weight (tennis balls with varying filling, weight: 60, 120, 170, 185, 220, 286, 345 g). The ascertained final score corresponded with the highest distance from two trials (coefficient reliability $r_{tt} = 0.82-0.95$). By means of 2D kinematics, analyses (SIMI) the initial speed of throw and elevation angle was evaluated (not the subject matter of this study). STATISTICA 6 (one-way analysis of variance, correlation analysis, tests of normality data distribution) was used.

RESULTS AND DISCUSSION: The relation between projectile weight and throw distance is illustrated in Table 1. There is an obvious non-linear relation between two quantities, whereby increasing projectile weight causes increase in throw distance and in the event of crossing a certain weight threshold, it begins to shorten. Statistical analysis confirms significant differences between partial throw lengths and approximately defines the limits for optimal weight. The trend of dependency among men and women was alike, whereas the shape of curve differs slightly. Key factors influencing the ascertained tendency include force of air resistance for low weight and muscle force capacity of the individual in case of higher weight.

Table 1 Relation between projectile weight and throw distance

		Ball weight (g):							
		60	120	170	185	220	286	345	
Distance (m)	Men	Mean	39.29	46.88	48.14	48.11	47.42	43.93	41.30
		S.D.	6.88	7.58	8.11	8.58	8.85	8.66	8.09
	Women	Mean	24.13	28.05	27.77	27.43	26.87	25.83	24.00
		S.D.	4.89	5.98	5.76	6.00	5.34	5.81	5.20

CONCLUSION: In both groups, the research validates the existence of optimal weight fields of thrown projectile in relationship to throw distance. In terms of effective utilisation of force capacity of an individual and further throwing practice, it is necessary to set optimal weight limits for projectile per individual.

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