AN ASSESSMENT OF SPEED-STRENGTH ABILITIES IN YOUNG MEN

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INTRODUCTION

Muscle strength is one of the most important factors in sport performance and other human activities - in this case it concerns the physical preparation of military pilots, particularly in order to develop the +Gz toleration. Results obtained by Balldin (1984), Burton (1986) and Epperson et al (1985) suggest that a total body muscle strength training program is beneficial in increasing the anti-G straining maneuver (AGSM) tolerance. This is a special respiratory/muscular effort performed by fighter pilots to maintain consciousness during high-G maneuvering flight. Thus the physical training for cadet pilots, including strength exercises for the major muscle groups - arms, chest, abdomen and legs, is necessary for the best preparation to flight. The program should lead to an increase in maximum muscle strength and anaerobic power, also (Balldin,1984).

The study was designed to establish the parameters of speed-strength abilities of upper and lower extremities in young men, as the first step to design the specific strength training program for pilots. It allows us to find out the relationships between age, body mass, speed and muscle strength in order to improve the efficiency of weight training.

METHODS

One hundred young men (cadet-pilots) participated in the study. They were divided into two main groups: middle aviation school students and the Polish Air Force Academy students (table 1).

Table 1. The basic physical parameters of the subjects

Parameter	Students		Differences	
	Aviation School (n = 21)	PAF Academy (n = 79)	T-Student	p<
Age (years)	16.0 ± 1.1	20.9 ± 1.4	15.67	0.01
Body height (cm)	173.4 ± 5.3	178.0 ± 5.7	3.30	0.01
Body mass (kg)	63.8 ± 10.2	73.3 ± 7.3	4.79	0.01

In order to estimate the basic speed-strength parameters of upper and lower extremities both groups performed bench press and squats. The exercises were done on a computerized stand (locally made) under isokinetic (ω = 0.2 rad/s) and isotonic (M = 20 N×m) conditions (Saganiak et al., 1994). The main part of the stand is a hydraulic weight controlled by a special computer system, which allows a

high level of the resistance regulation throughout the full range of motion (not accommodating resistance - see Gabriel,1991). The subjects performed three trials with maximal effort to estimate the maximal speed (MS) and the maximal torque (MT) developed in the exercise. Descriptive statistics for each parameter as well as the t-test and Pearson's correlation matrix were used ($p<0.01$)

RESULTS

The mean values of MT developed in bench press and squats under isokinetic conditions by young cadets (751 ± 193 and 1482 ± 396 N×m, respectively) were significantly lower (table 2) then by older cadet-pilots (997 ± 231 and 1852 ± 433 N×m). There was no difference between groups concerning MS registered under isotonic conditions, both in bench press (1.44 ± 0.08 rad/s-young and 1.49 ± 0.12 rad/s-older) and squats (1.45 ± 0.19 and 1.51 ± 0.20 rad/s, respectively). Probably the differences in speed of movement performed under isotonic conditions reveal greater aging difference between the subjects (Poulin et al.,1992). In this research a significant correlation was found (table 3) between body mass and the maximal external torque developed under isokinetic conditions (stronger in the older group). Hortobagyi and Lachance (1987) showed similar findings concerning a strong correlation between the body mass of the subject and the results obtained in bench press and squats. There were no correlation between the maximal speed obtained in bench press and squats in both groups

Table 2. Average values (M - SD) of upper and lower extremities maximal speed and maximal torque in both groups of young student-pilots.

Parameter	Students		Differences	
	Aviation School (n = 21)	PAF Academy (n = 79)	T-Student	p<
BENCH PRESS				
Maximal speed (rad/s)	1.44 ± 0.08	1.49 ± 0.12	1.79	NS *
Maximal torque (N×m)	750.69 ± 192.75	997.21 ± 230.71	4.45	0.01
SQUATS				
Maximal speed (rad/s)	1.45 ± 0.19	1.51 ± 0.20	1.22	NS
Maximal torque (N×m)	1482.46 ± 396.27	182.55 ± 433.43	3.50	0.01

*NS - statistically not significant

Table 3. Correlation coefficients between body mass and speed-strength parameters in groups of middle aviation schools students (younger) and PAF Academy cadet-pilots (older).

Group	Maximal speed (rad/s)	Maximal torque (Nxm)
BENCH PRESS		
Younger	NS	0.69
Older	NS	0.75
SQUATS		
Younger	NS	0.64
Older	NS	0.85

CONCLUSIONS

The results of this study suggest that without special training, speed of movement remains constant in young men while muscle strength increases according to body mass changes. The maximal values of the speed of upper and lower extremities were achieved only in the age group 15-16 and they were independent of body height, body mass and the age of the investigated groups.

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