



## PHYSICAL FITNESS AND THE LEVEL OF LEARNING BY PILOT CADETS IN THE INITIAL PERIOD OF STUDYING IN THE POLISH AIR FORCE ACADEMY (PAFA) IN DĘBLIN

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**Introduction:** The aim of the study is to analyze physical fitness taking into account the learning outcomes of pilot cadets of the Polish Air Force Academy.

**Methods:** Two groups of PAFA cadets were examined: from the second year of studies (Group I) and from the first year (Group II). The following exercise stress tests were used for the assessment of physical fitness: pull-ups, 100 m, 1000 m and 50m swim. Analysis of the average scores obtained during the semester examination session was performed in particular score ranges of physical fitness.

**Results:** The obtained results show that in both examined groups, the most physically fit candidates learn at a level higher than the average score of the whole cohort population.

**Conclusions:** The conducted studies may provide the basis for establishing a new minimum threshold of 60 points per possible 100 points, necessary for PAFA candidates during the recruitment process.

**Keywords:** physical fitness, learning, pilot cadets

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## INTRODUCTION

Functioning in many professions, especially those related to the performance of very precise operative actions associated with aircraft piloting, requires very good health, fitness and physical performance, and predisposition to learn fast and master professional knowledge, as well as general knowledge in the field of many sciences. Such requirements are imposed, among others, on candidates for military aviation, where, in addition to technical knowledge, required is efficiency of operation both in standard conditions and in extreme stressful situations generated by the physical environment of the flight [9]. Moreover, inefficient performance of tasks in aviation professions creates health risks for both flight crew and other persons, as the aircraft travels in space and may cause collision with other aircrafts or objects on the ground [6]. Therefore, in order to prevent such negative events, a mandatory commission health assessment for aviation candidates was introduced at the beginning of the previous century. This health assessment is carried out by a multidisciplinary team of clinical medicine physicians, aeromedicine specialists and psychologists with knowledge of the conditions and the specificity of performance of the tasks during education at the airline university.

Due to the fact that aviation develops very rapidly and new aircraft designs, which allow for performance of very dynamic flights with altitude and velocity changes, are being created, both the psychophysical requirements and the knowledge necessary to operate a very complex technique are growing. This situation requires a precise assessment of the predisposition for aviation professions, taking into account both the aviation technology currently used and the technology that will have to be used after finishing education at the aviation academy. Therefore, there are many reasons why the subject of physical fitness of young people and their intellect is a subject of interest of scientists from many fields of scientific life, including physicians, psychologists and specialists in the field of physical culture. This topic is the subject of research, discussion and observation [2]. Especially since the National Health Programme, in its long-term periodic activities, put nutrition and physical activity in the first place from among the eighteen strategic objectives, and in the later decades these objectives were kept up to date [4,5,11]. The group of experts preparing the National Health Programme was guided by the analysis of scientific facts. These facts show that the lack of

physical activity is closely related to acquisition of knowledge, learning and appropriate nutrition.

Above all, the profession of a jet-powered aircraft pilot must be performed by people who are characterized by high physical fitness as well as good physical and mental health. The main reason for this view and the requirements of high psychophysical fitness is the assumption that future professional tasks in aviation will often be performed under extreme physical and social conditions. In addition, professional activity at a high level should be maintained for about 20 years of service in combat aviation. Therefore, no selection can be carried out for the profession of pilot without identifying the right predisposers of professional success in the aviation service.

Among researchers interested in the issues of selection for aviation, the opinion prevails that intellectual performance should correlate with physical fitness of pilots [1,8,10]. The most recent psychomotor fitness tests [3,8,9] authorize for this statement.

Due to the existing diversity of views on this topic, an attempt was made to analyze the physical fitness outcomes during recruitment as compared to the outcomes obtained by cadets during the first semester session in particular subjects.

The aim of the study was to check whether the candidates admitted to the Polish Air Force Academy with the highest number of physical fitness points will also have a high average grade from the examination session.

## MATERIAL AND METHODS

The results of the recruitment of PAFA pilot cadets from years 2015 and 2016 were analyzed. 53 candidates from recruitment in 2015 (Group I) and 74 candidates from recruitment in 2016 (Group II) were examined (see Tab. 2). During the PAFA entrance examination, all persons underwent the analytical physical fitness test consisting of such elements as: pull-ups, 100m dash, 1000m run. The tests were carried out in sports clothes, and 50 m freestyle swim in a swimsuit. Time was measured with an accuracy of 0.1 second.

The tests were carried out according to the standards of physical fitness presented in Tab. 1. The indicator of the effectiveness of learning was the positive grade at the physical fitness test in the range of 30-100 points. In the analyses conducted, the average score of the exams of the first semester in 2015 (group I) was compared with the outcomes of physical fitness tests from the stage

of recruitment to the aviation academy. Identical treatment was taken with Group II examined in 2016. The obtained results are presented in the Tab.s below.

### Method of testing

100 m dash - position- low start, start at sound signal.

1000 m run - position- standing position, start at sound signal.

Pull-ups - position - upper grip pull-ups, to the command "exercise" - start the exercise in such a way that after each pulling up the arms are straight in elbow joints.

50 m swim - position - from the start post - start of swimming at sound signal.

### Statistical analysis

The results of the performed tests were subjected to statistical analysis by calculating the arithmetic means (M), standard deviation ( $\pm$  SD) and the range of fluctuations (MIN and MAX) for individual physical fitness tests and examination grades.

Tab. 1. Criteria for men's eligibility for physical fitness in 2015 and 2016.

Points of qualification	Men			
	Pull-ups (number of repetitions)	100 m (sec.)	1000 m (min.)	50 m swim (sec.)
0	<5	>14.0	>3.46	
5	5	14.0	3.46	Passage
6			3.45	110
7	6	13.8	3.44	105
8			3.43	11
9	7		3.42	95
10		13.7	3.41	90
11	8		3.40	85
12			3.39	80
13	9	13.6	3.38	75
14			3.37	70
15	10		3.36	65
16		13.5	3.35	60
17	11		3.34	57
18			3.32	54
19	12	13.4	3.30	52
20			3.28	50
21	13		3.26	48
22		13.3	3.24	46
23	14		3.22	44
24			3.21	42
25	15	13.2	3.20	40

## RESULTS

Comparison of somatic parameters shows that the examined persons do not differ significantly in body structure from each other (Tab. 2). The analysis of physical fitness outcomes and average semester final grades showed, in all respondents in group I, the physical fitness average expressed in points at the level of 85.37 and the average end of semester final grade of 4.14 (Tab. 3). It was observed that the examined persons, who received 100 points for physical fitness, obtained the highest average semester final grade of 4.15 (Tab. 4, Fig. 1). The research shows that cadets in group I obtained less physical fitness points and a lower average semester final grade.

Tab. 2. Age and somatic data in groups I and II.

Parameter	Group I (N-53)	Group II (N-74)
Age /in years/	20 $\pm$ 2.20	20.1 $\pm$ 2.00
Body height /cm/	179.0 $\pm$ 5.74	180.0 $\pm$ 4.00
Body weight /kg/	73.6 $\pm$ 7.60	76.4 $\pm$ 6.30
BMI /	23.0 $\pm$ 1.71	23.6 $\pm$ 1.90

Legend: mean,  $\pm$ -standard deviation.

Tab. 3. Physical fitness and learning outcomes in a semester of the examined pilot cadets in group I (N-53).

Test	Mean	Min.	Max.	SD
Pull-ups /amount/	13.15	1	21	3.44
100m dash /s/	13.36	12.0	14.8	0.58
1000m run /min/	3.18	2.58	3.46	0.14
50m swim /s/	40.44	25.9	64.20	7.18
Average points of physical fitness	<b>85.37</b>	<b>33</b>	<b>100</b>	<b>16.36</b>
Average grade in learning in semester I	4.14	3.59	4.76	0.24

Legend: SD- standard deviation; arithmetic mean; Min- minimum value  
Max- maximum value

Tab. 4. Physical fitness and learning outcomes of pilot cadets with an average score at the level of 100 points in group I (N-13).

Test	Mean	Min.	Max.	SD
Pull-ups / amount/	15.30	15	19	1.10
100m dash /s/	13.04	12.40	13.20	0.24
1000m run /min/	3.07	2.58	3.20	0.22
50m swim /s/	36.20	27.80	40.00	3.87
Average points of physical fitness	<b>100</b>	<b>100</b>	<b>100</b>	<b>0.00</b>
Average grade in learning in semester I	4.15	3.62	4.80	0.32

Tab. 5. Physical fitness and learning outcomes of pilot cadets with an average score at the level of 94.76 points in group I (N-13).

Test	Mean	Min.	Max.	SD
Pull-ups / amount/	14.69	11	21	2.68
100m dash /s/	13.07	12.00	13.50	0.41
1000m run /min/	3.16	3.10	3.20	0.02
50m swim /s/	38.41	25.90	47.70	6.47
Average points of physical fitness	<b>94.76</b>	<b>90</b>	<b>99</b>	<b>3.32</b>
Average grade in learning in semester I	4.13	3.59	4.41	0.23

Tab. 6. Physical fitness and learning outcomes in a semester of examined pilot cadets with an average score at the level of 84.92 points in group I (N-13).

Test	Mean	Min.	Max.	SD
Pull-ups / amount/	11.61	8	15	2.59
100m dash /s/	13.19	12.10	13.80	0.44
1000m run /min/	3.21	3.11	3.30	0.05
50m swim /s/	40.50	33.40	50.60	5.81
Average points of physical fitness	<b>84.92</b>	<b>80</b>	<b>89</b>	<b>3.09</b>
Average grade in learning in semester I	4.10	3.61	4.44	0.27

Tab. 7. Physical fitness and learning outcomes of pilot cadets with an average score at the level of 63.50 points in group I (N-14).

Test	Mean	Min.	Max.	SD
Pull-ups / amount/	11.14	1	15	4.43
100m dash /s/	14.07	13.30	14.80	0.48
1000m run /min/	3.25	3.07	3.46	0.12
50m swim /s/	46.17	35.90	64.20	8.08
Average points of physical fitness	<b>63.50</b>	<b>33</b>	<b>79</b>	<b>15.32</b>
Average grade in learning in semester I	4.02	3.36	4.41	0.27

Analysis of physical fitness outcomes and average semester final grades showed, for all examined persons in group II, the average physical fitness expressed in points at the level of 85.04 (32 - 100 points) and an average semester final grade of 4.05 (Tab. 8). It was observed that the examined persons, who received 100 points for physical fitness, obtained the highest average semester final grade of 4.06 (Tab. 9, Fig. 2). The observation of studies shows a similar tendency in the level of physical fitness and learning of cadets in group II as in group I.

Tab. 8. Physical fitness and learning outcomes of pilot cadets in group II (N-74).

Test	Mean	Min.	Max.	SD
Pull-ups / amount/	12.78	0	18	3.38
100m dash /s/	13.09	11.90	14.60	0.59
1000m run /min/	3.20	2.59	4.04	0.18
50m swim /s/	41.56	27.80	76.90	8.31
Average points of physical fitness	<b>85.04</b>	<b>32</b>	<b>100</b>	<b>16.30</b>
Average grade in learning in semester I	4.05	2.88	4.61	0.28

Tab. 9. Physical fitness and learning outcomes of pilot cadets with an average score at the level of 100 points in group II (N-9).

Test	Mean	Min.	Max.	SD
Pull-ups / amount/	15.33	15	18	1.00
100m dash /s/	12.56	11.90	13.20	0.43
1000m run /min/	3.07	3.02	3.14	0.04
50m swim /s/	36.50	32.3	40.00	3.06
Average points of physical fitness	<b>100</b>	<b>100</b>	<b>100</b>	<b>0.00</b>
Average grade in learning in semester I	4.06	3.69	4.56	0.24

Tab. 10. Physical fitness and learning outcomes of pilot cadets with an average score at the level of 94.96 points in group II (N-31).

Test	Mean	Min.	Max.	SD
Pull-ups / amount/	14.48	11	16	1.06
100m dash /s/	12.82	11.90	13.50	0.39
1000m run /min/	3.14	2.59	3.33	0.17
50m swim /s/	40.77	27.80	57.10	5.98
Average points of physical fitness	<b>94.96</b>	<b>90</b>	<b>99</b>	<b>2.77</b>
Average grade in learning in semester I	4.04	3.57	4.61	0.24

Tab. 11. Physical fitness and learning outcomes of pilot cadets with an average score at the level of 80.82 points in group II (N-23).

Test	Mean	Min.	Max.	SD
Pull-ups / amount/	11.91	7	15	2.55
100m dash /s/	13.22	12.20	14.00	0.45
1000m run /min/	3.24	3.00	3.39	0.10
50m swim /s/	43.13	32.10	62.10	8.14
Average points of physical fitness	<b>80.82</b>	<b>70</b>	<b>89</b>	<b>5.74</b>
Average grade in learning in semester I	4.04	3.69	4.44	0.20

Tab. 12. Physical fitness and learning outcomes of pilot cadets with an average score at the level of 53.63 points in group II (N-11).

Test	Mean	Min.	Max.	SD
Pull-ups / amount/	7.72	0.00	14	4.54
100m dash /s/	13.98	13.40	14.60	0.37
1000m run /min/	3.39	3.18	4.04	0.23
50m swim /s/	44.63	33.40	76.90	14.25
Average points of physical fitness	<b>53.63</b>	<b>32</b>	<b>69</b>	<b>14.61</b>
Average grade in learning in semester I	3.83	2.88	4.26	0.42

It was observed that the level of swimming skills is best in cadets who received 100 points on their physical fitness, while in the remaining cadets in the assumed score ranges, it is directly proportional to their physical fitness (Fig. 1 and Fig. 2).

## DISCUSSION

Obtained results of the presented studies showed that the physical effort of cadets stimulates cognitive processes, which is proved by the results of the examination session in an airline university. Analysis of the results also showed that cadets who received 100 points from physical fitness during the recruitment process and an average semester score not lower than the whole group in 2015 and 2016 (Tables 4 and 9). It should

be stressed that the first group had a significantly lower number of respondents than the second group, which could have had an impact on better selection in 2015. In group I, it was observed that in cadets who received 100 points on physical fitness during recruitment, their dominant skills were strength and endurance tests (Tab. 4). And in group II these were strength, endurance and speed tests (Tab. 9). This fact is significant as an important criterion in the selection of candidates for aviation, since these characteristics are based on genetic factors. It can be said that learning and acquiring knowledge is related to increased awareness of cadets of the role of physical fitness in the military pilot profession. Our observations correspond to the research of other authors [1,8].

The analysis of the physical fitness outcomes expressed in reference points as average grades on learning in the first semester suggests that the lower point threshold of physical fitness during recruitment in 2015 and 2016 (30 points out of possible 100 points), as a selection criterion, is far too low. Tables 7 and 12 show that it would be justified to raise the lower threshold to 60 points. Too wide a discrepancy between the selection criterion for physical fitness and academic achievement is linked to the problems within the scope of practical aviation (pilotage). The newest method of psychomotor evaluation of a pilots shows that pilots must maintain a balance between thinking and psychomotor efficiency in temporary criteria

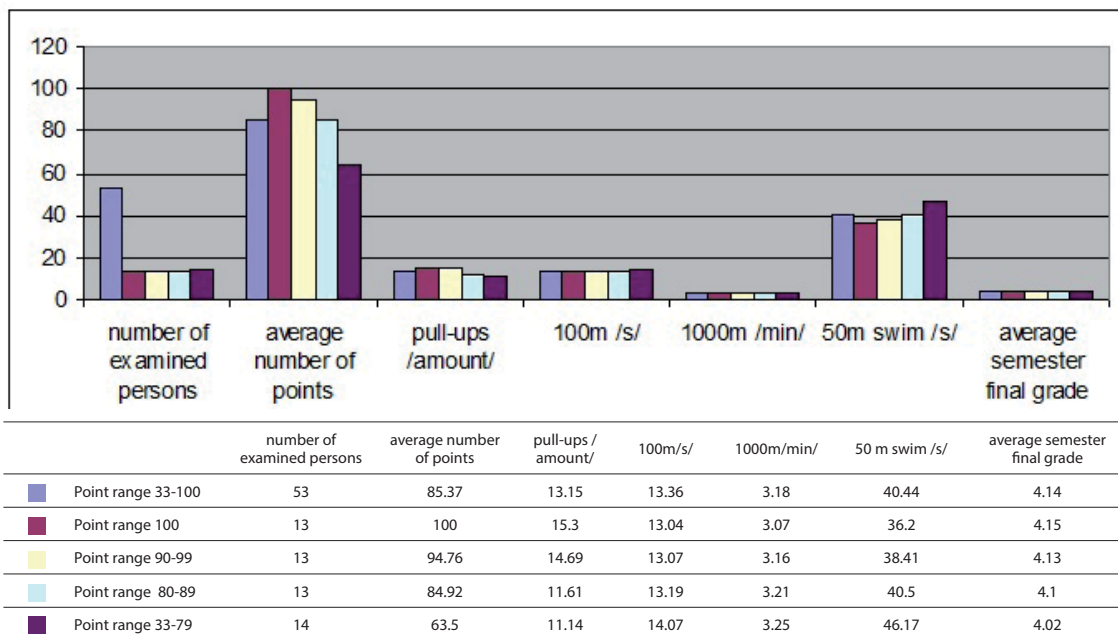
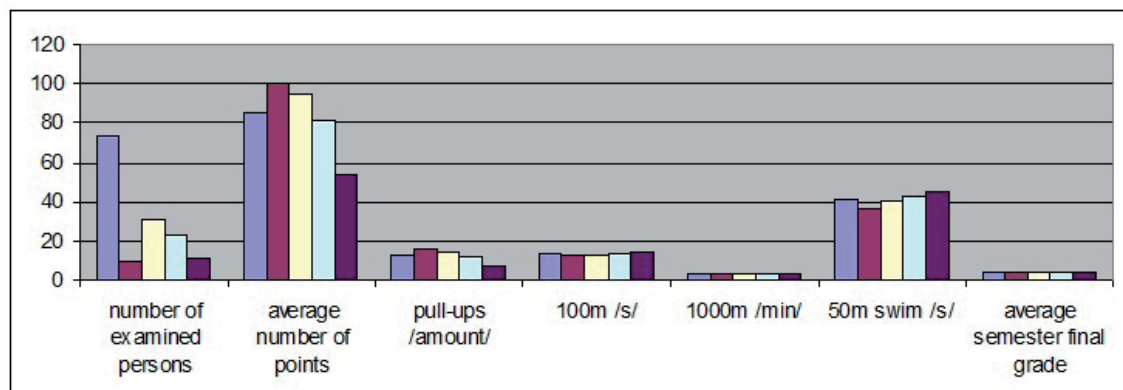


Fig. 1. Physical fitness and learning outcomes in group I.



Point range	number of examined persons	average number of points	pull-ups /amount/	100m/s/	1000m/min/	50 m swim /s/	average semester final grade
Point range 32-100	74	85.04	12.78	13.09	3.2	41.56	4.05
Point range 100	9	100	15.33	12.56	3.07	36.5	4.06
Point range 90-99	31	94.96	14.48	12.82	3.14	40.77	4.04
Point range 70-89	23	80.82	11.91	13.22	3.24	43.13	4.04
Point range 32-69	11	53.63	7.72	13.98	3.39	44.63	3.83

Fig. 2. Physical fitness and learning outcomes in group II.

in extreme conditions of their working environment [10]. Hence, the physical fitness of pilot cadets in the training process should not be very diversified. This is a basic condition for a high-quality psychomotor training of cadets.

In this study, which proves the urgent need for modification of the selection of candidates for aviation, a modern system of cadet training should be taken into account. As well as the selection of motor types, on which the effect of training depends.

The study found that endurance-power motor type is beneficial for aviation [10]. Cadets from both examined groups, who received the maximum number of points (100 points) on physical fitness, together with the highest average semester final grades in relation to the rest of the examined

persons, determine the direction of selection of candidates for aviation.

## CONCLUSIONS

The observations in both recruitments show that in the fittest candidates the level of learning is slightly higher than the average grade of the whole examined population.

The conducted studies are the basis for establishing a new minimum point threshold of 60 points per possible 100 points for PAFA candidates during the recruitment process.

## AUTHORS' DECLARATION:

**Study Design:** Piotr Krawczyk, Zdzisław Kobos, Paweł Marcinkowski, Robert Jędrzys, Zbigniew Wochoński; **Data Collection:** Piotr Krawczyk, Zdzisław Kobos, Paweł Marcinkowski, Robert Jędrzys, Zbigniew Wochoński; **Manuscript Preparation:** Zdzisław Kobos, Robert Jędrzys, Zbigniew Wochoński; **Funds Collection:** Robert Jędrzys, Zbigniew Wochoński; The Authors declare that there is no conflict of interest.

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