Przybylski G[1].,Pyskir M.[2], Pujszo R.[3], Pyskir J. [4], Bannach M. [5]

[1]Department of Respiratory Medicine and Tuberculosis, Nicolaus Copernicus University, Collegium Medicum in Bydgoszcz

[2]Department of Rehabilitation, Nicolaus Copernicus University, Collegium Medicum in Bydgoszcz

[3]Study Center for Physical Education and Sport, Kazimierz Wielki University in Bydgoszcz

[4]Department of Biophysics, Nicolaus Copernicus University, Collegium Medicum in Bydgoszcz.

[5]Department of Nursing and Obstetrics, Nicolaus Copernicus University, Collegium Medicum in Bydgoszcz

Corresponding author: Pujszo Ryszard Ph.D
Kazimierz Wielki University, Bydgoszcz, Poland.
e-mail: rychu54@interia.pl

Spirometric parameters of judo training and inactive young men - measured compared to predicted values as one of wellness indicators.

Parametry spirometryczne zawodników judo oraz nie trenujących młodych mężczyzn – wartości zmierzone na tle normatywnych jako jeden ze wskaźników dobrostanu fizycznego.

Abstract.

In September and October 2010 the anthropometric and spirometric measurements in two groups of men were done. The first group consist of professionally training members of the Poland national judo team. In the second group were inactive students of the vocational school in Bydgoszcz. In both groups the age of men was similar.

The obtained results show statistically higher percentage fat content in inactive group than in judo training. The next examined parameters: chest movement index, vital capacity (VC), vital capacity per unit of body mass are significantly higher in judo training group. In this group the increasing of BMI index is caused by muscle (not fat) mass gain.

The results also show that chest movement index can be one of the objective wellness parameters.

Key words: BMI, wellness, judo, students, spirometry

Streszczenie.

We wrześniu i październiku 2010 roku wykonano badania antropometryczne oraz spirometryczne w dwóch grupach mężczyzn. Pierwszą grupę stanowiły osoby trenujące wyczynowo judo, drugą młodzież szkolna – męska, deklarujący brak wyczynowej aktywności fizycznej.

W obu grupach rozpiętość wiekowa badanych była podobna. Uzyskane wyniki pokazały, że wśród nieaktywnych mężczyzn zawartość tkanki tłuszczowej jest istotnie większa niż w grupie trenującej. Jednocześnie wskaźnik ruchomości klatki piersiowej, swobodna życiowa pojemność, także w przeliczeniu na jednostkę masy ciała są istotnie większe u mężczyzn aktywnych fizycznie. U zawodników, jeżeli występuje przyrost wskaźnika BMI, to odbywa się on poprzez przyrost masy mięśniowej a nie ilości tłuszczu. Wykazano, że wskaźnik ruchomości klatki piersiowej obok parametrów spirometrycznych może stanowić obiektywny miernik jakości życia.

Słowa kluczowe: BMI, dobrostan, judo, młodzież szkolna, spirometria.

Introduction.

The problem of wellness assessing is widely discussed in scientific literature and during many scientific meetings and conferences [7,11]. The objective parameters of wellness are sought. Among them are often mentioned such parameters as BMI, percentage fat content, vital capacity (VC), forced volume vital capacity (FVC), forced expiratory volume in 1 second (FEV1), peak expiratory flow (PEF). Scientists try to asses the influence of different factors on the life quality [4,5,7,10]. There are proposed the normative values of many parameters, which often depend on age, height or gender of the examined person [1,2,3,6,8,9]. In order to avoid age and height dependence of parameters, in this paper the fraction of predicted values of VC, FVC, FEV_1 and PEF are discussed as independent wellness indicators. The predicted values do not take into account the everyday physical activity or kind of job (handwork or mental work). That is why in presented paper the impact of intensive judo training on values of spirometric parameters, fat content and chest movement index is assessed. Basing on the obtained results the difference between efficiency of the respiratory system inactive students and judo training men is shown.

Materials and methods.

In measurements conducted in September and October 2010 in following cities: Bydgoszcz, Mława, Wrocław and Warszawa took part 31 judo training men from the top of Polish judo national team and 30 randomly chosen students of Zespół Szkół Drzewnych in Bydgoszcz. All students from vocational school declared that they do not practice professionally any sport.

The measurements we performed in morning hours in a spacious, ventilated room of temperature about 20^0C Participants declared to have good physical form, no prior respiratory system diseases and undisturbed physiological state.

The initial measured parameters were body mass and height. The body mass index (BMI) was determined. The next measurement was percentage fat content. It was conducted using BF-300 produced by OMRON. The fat tissue mass and the difference between total mass and fat tissue mass (fat - free body mass) were calculated. Subsequently the chest circumference during inspiration and during expiration were measured. For each of examined men the chest movement index R was calculated. This parameter was earlier defined as [7]

$$R = \frac{O_{\max} - O_{\min}}{O_{\max}} * 100\%$$

where Qmax and Qmin are circumferences during inspiration and expiration.

Finally the spirometric parameters: vital capacity (VC), forced volume vital capacity (FVC), forced expiratory volume in 1 second (FEV_1), peak expiratory flow (PEF) were measured using Microlab ML 3500 spirometer. In scientific literature there are different ways of determining predicted values of spirometric parameters [1,2,3,6,8,9], especially adopted by European Respiratory Society (ERS). It is important that despite different methods of calculations, predicted values are very similar and depend on height and age of an examined person. In this paper the predicted values of measured parameters were calculated for all examined men using equations:

V_C =6,1*H-0,028*A-4,65

FVC =5,76*H-0,026*A-4,34

FEV_1 =4,3*H-0,029*A-2,49

PEF=6,14*H-0,043*A+0,15

In presented equations H is height of examined person and A – its age. Each examined parameter was calculated as a fraction of predicted value relevant to age and height of participant. All the values of spirometric parameters were calculated per unit of body mass of the examined volunteer. The obtained results were compared in both examined groups – judo training men and inactive vocational school students. Statistical analysis of all measurements data was done by means of Microsoft Office Excel 2003 and Statistica 5.0 software. The significance level p = 0,05 was adopted in calculations.

Results of measurements

The anthropometric data - body mass, height and age of both examined groups are presented in Table I. The presented table shows the statistically significant differences of average body mass and average height of examined men.

TABLE I. The anthropometric data of examined men with division for inactive group and judo training group.

Number	Body mass (kg)	Range of masses (kg)	Height (m)	Range of heights (m)	Age (years)	Range of ages (years)
Inactive students N = 30	(*) 75,7 ± 11,3	56 -105	(*) 1,77 ± 0,06	1,67 - 1,90	18,4 ±1,2	16,0 - 20,0
Judo training N = 31	81,8 ± 15,8	51,5- 114,5	1,81 ± 0,09	1,63 – 2,01	18,2 ± 1,0	16,7 - 20,0

(*) statistically significant difference $p < 0,05$

The average body mass and height in both groups are different. However, the average body mass index BMI and age in both groups are similar – it is shown in Table II. The is no statistically significant difference of average BMI index and age between both groups.

TABLE II. The BMI index in both examined groups.

	Students	Judo training men
BMI index (kg/m^2)	24,0 ± 3,6	24,8 ± 3,6
Range (kg/m^2)	19,4 – 37,7	18,8 – 31,4

In the following tables the results of measurements percentage fat content, chest movement index (table III) and percentage of predicted values of spirometric parameters: vital capacity (VC), forced volume vital capacity (FVC), forced expiratory volume in 1 second (FEV_1) and peak expiratory flow (PEF) are presented.

On the basis of the results the mass of fat was calculated for each examined volunteer. Next fat mass was subtracted from total body mass. The result is fat-free body mass. On the first graph the dependence of the fat-free body mass on the BMI index in both investigated groups is shown. In judo training group the strong dependence can be observed between analyzed parameters.

The equation of the best fit line is:

$$M = 61{,}9 \ln(BMI) - 126.$$

The R^2 coefficient for this dependence is equal 0,63 which implies the strong relationship between both parameters.

Table III. Percentage content of fat and chest movement index in both groups of examined men.

Number	FAT content (%)	Range of FAT content (%)	Chest movement index R	Range of R
Inactive students N = 30	13,4	4,2 – 21,7	10,2	7,1 – 13,2
Judo training N = 31	10,7	4,2 – 22,4	9,6	6,0 – 12,5

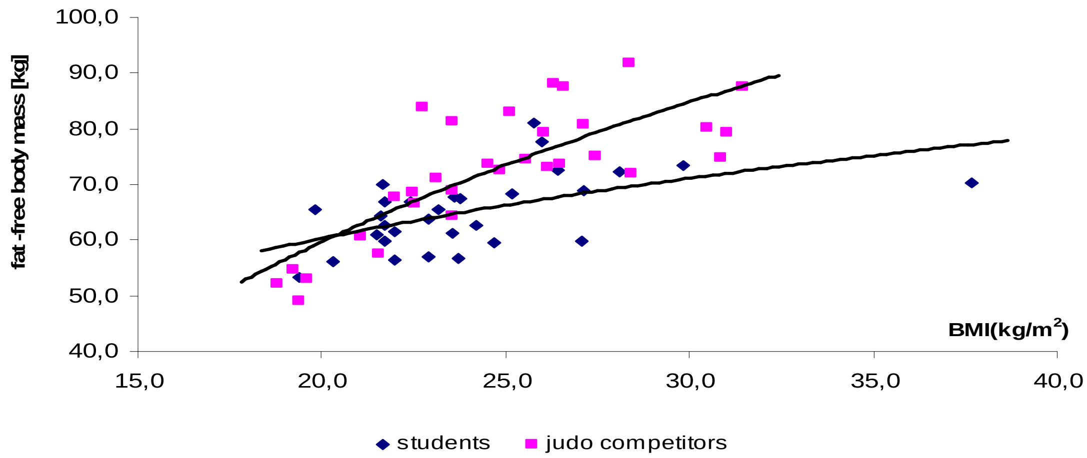

Fig1. The dependence of fat-free body mass on BMI index in judo training group (squares) and vocational school students (diamonds).

In the next part of data analysis the predicted values of all spirometric parameters for each participant were determined. The result of given parameter obtained by the volunteer was divided by the predicted value. In this way the fractions of predicted values of investigated parameters were calculated. The averages and the ranges of calculated fractions in both examined groups are shown in table IV.

Table IV. Fractions of predicted values of vital capacity (VC), forced volume vital capacity (FVC), forced expiratory volume in 1 second (FEV_1), peak expiratory flow (PEF) in both examined groups.

Group / Parameter	Inactive students N = 30	Judo training N = 31	Difference judo-inactive
Fraction of predicted VC	(*) 90,1± 8,5	(*) 92,7±10,1	2,6
Range of fraction VC	74,5 - 114,3	77,2 – 111,2	
Fraction of predicted FEV_1	(*) 91,7 ± 10,2	(*) 98,0 ± 10,9	6,3
Range of fraction FEV_1	69,5 – 121,9	82,1 – 128,9	
Fraction of predicted FVC	(*) 89,6±10,2	(*) 96,2 ± 9,8	6,6
Range of fraction FVC	59,4 – 116,1	78,0 – 115,1	
Fraction of predicted PEF	(*) 90,9±13,8	(*) 94,4 ±12,3	3,5
Range of fraction PEF	65,5 – 112,4	70,5 – 127,2	

(*) - significant differences between average values in the same column for $p< 0,05$

The presented results show that in professionally training group all fractions of predicted values of examined parameters are significantly higher than in inactive vocational school students. What is important the average fractions of values are smaller than 1. In both groups there are participants of examinations who obtained values better than predicted, but in the bigger part of each group spirometric parameters were smaller than predicted.

Analyzing vital capacity it can be seen that in the students` group only three men obtained result higher than predicted. In the judo training group there is eight person with results higher than predicted. The values of FEV_1 higher than predicted obtained 12 men in contestants group (almost 40%) and only 5 inactive students (17%). Similar situation is observed in forced volume vital capacity. Twelve of training men and only two students obtained fractions of predicted FVC bigger than 1. It should be emphasized than in training group 9 of men had both results: FEV_1 and FVC above expectations. The number of participants having value of peak exploratory flow higher than predicted in both groups is similar: 7 judo training and 8 vocational school students. The average values of investigated parameters for both group is shown on the Fig. 2.

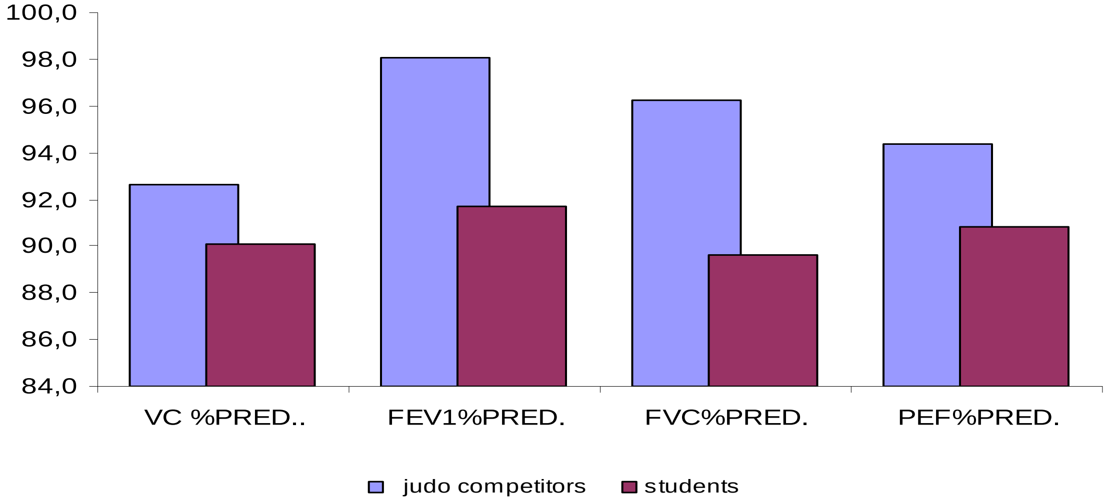

Fig.2. The percentage fractions of predicted values of investigated parameters for both groups.

The above graph shows, that bigger differences between training and inactive group are observed in FEV_1 and FVC.

As the next step the relationship between fraction of predicted value of forced vital capacity FVC and fat content was analyzed. The obtained results are presented on Figure 3. There is no clear dependence observed for the vocational school students group. It seems that the bigger fat content the smaller fraction of predicted value of FVC. However, it should be confirmed by investigations performed on bigger group. In the judo training group the dependence is not very strong, but clearly visible (R^2 coefficient equals 0, 42). The shape of observed dependence suggests that the highest results of investigated parameter are obtained by men having average values of percentage fat content.

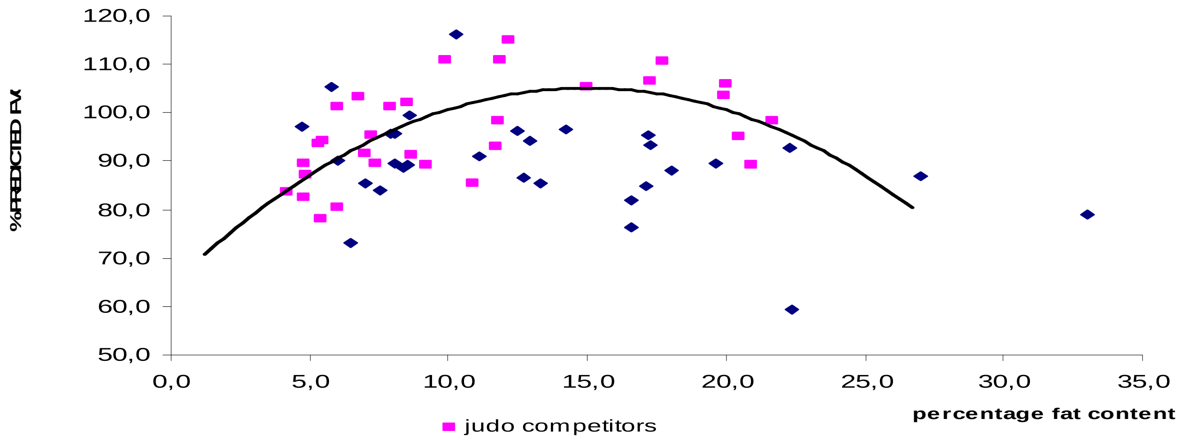

Fig. 3. The dependence of fraction of predicted value of forced vital capacity FVC on percentage fat content in both investigated groups.

Similar results are observed for fraction of predicted value of forced expiratory volume in 1 second (FEV_1). It is shown on Figure 4.

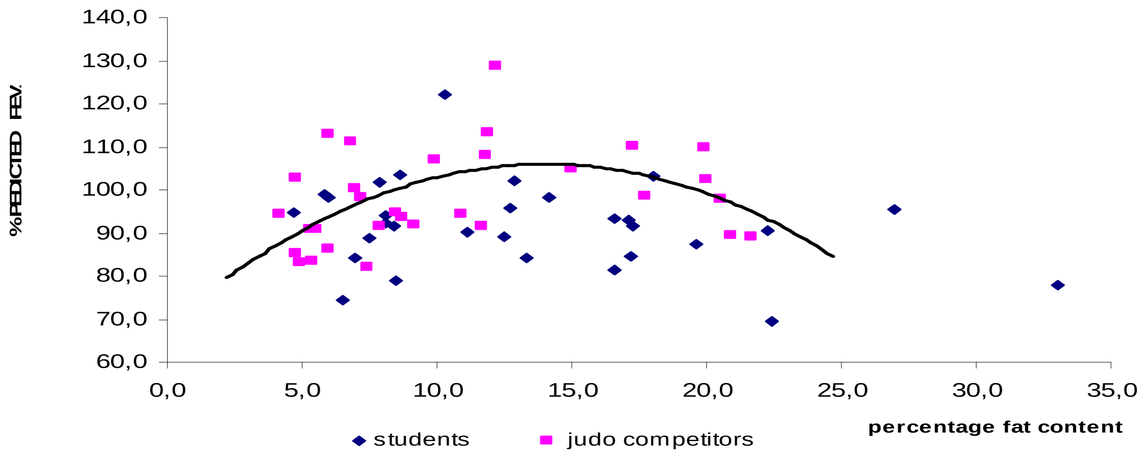

Fig.4. The dependence of fraction of predicted value of forced expiratory volume in 1 second on percentage fat content in both investigated groups.

There is no dependence between investigated parameters in students group. The training men have obtained higher results than vocational school students. It seems that the best fat content for training men oscillates around 12%.

In judo training group there are observed increasing dependences of fraction of predicted values of FVC and FEV_1 on fat-free body mass. The next presented graph shows details of this results.

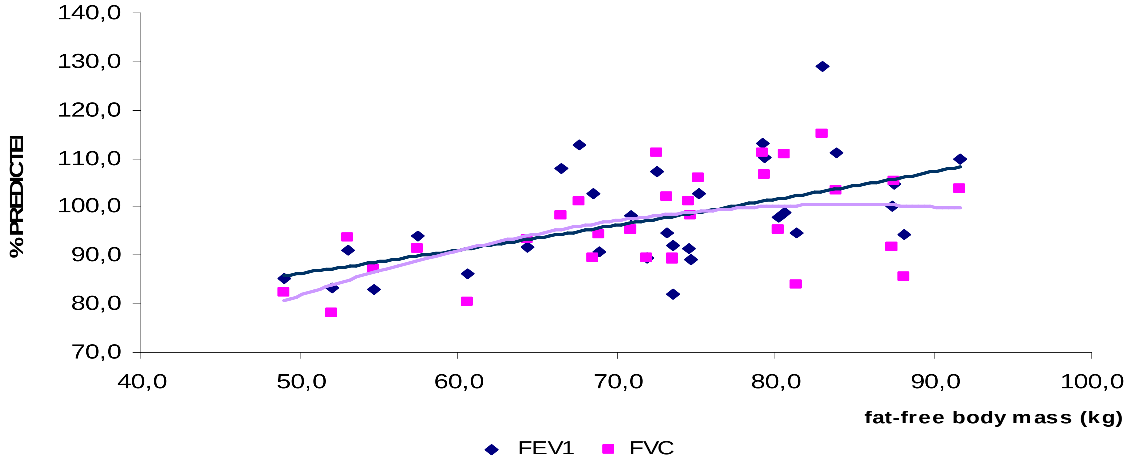

Fig.5. The dependence of fraction of predicted values of forced vital capacity FVC and forced expiratory volume in 1 second FEV_1 on fat-free body mass in judo training group.

On the next figure (Fig.6) the results obtained in the group of students is presented. There is no significant dependence between investigated parameters observed in this group.

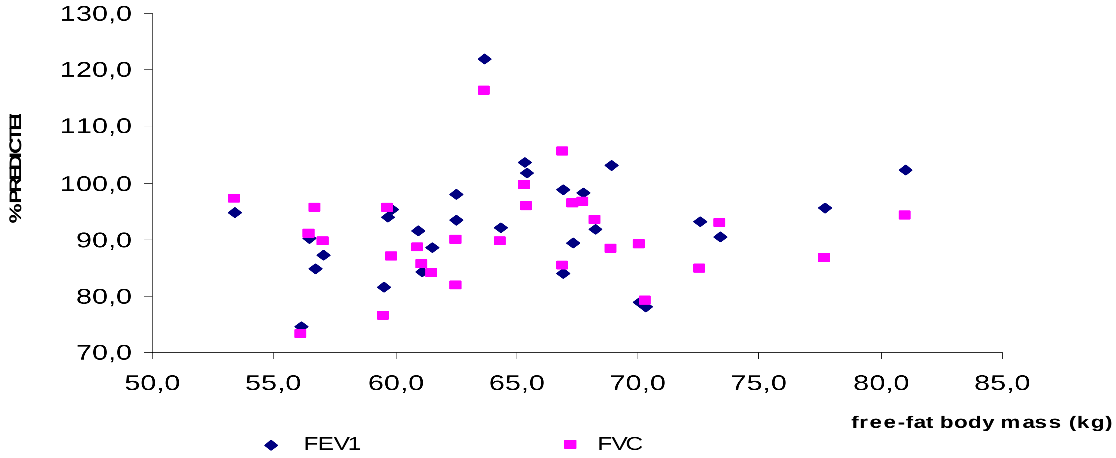

Fig. 6. The dependence of fraction of predicted values of forced vital capacity FVC and forced expiratory volume in 1 second FEV_1 on fat-free body mass of vocational school students.

Subsequently the relationship between fraction of predicted value of each spirometric parameter and total mass, height and chest movement index was also sought. There was no found any important dependence between this quantities. Simultaneously the fractions of predicted values obtained by judo training men is significantly higher than for inactive students. The chest movement index also does not depend on any anthropometric data. The strongest relationship was found between chest movement index and BMI in judo training group. It is shown on figure 7. The best fit is linear function, however the R^2 coefficient is very small – it is less than 0,3.

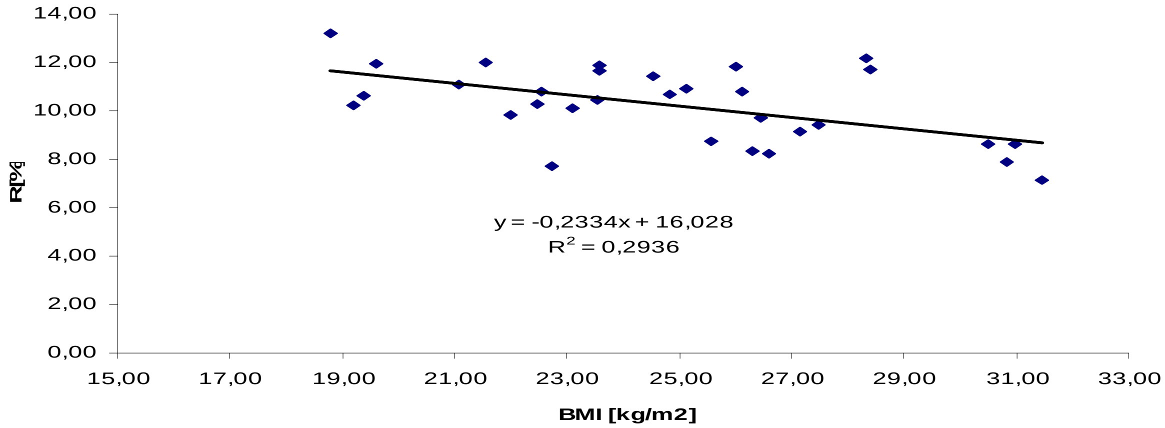

Fig.7 The chest movement index as a function of the BMI in judo training group.

Discussion.

There is no statistically important difference in average BMI index and age between both examined groups of investigated men. The result means that men in both groups have similar physique and they differ mainly in daily physical activity.

The fat free body mass increases with BMI in judo training group. It seems that BMI index of active men increases by building mussels' tissue. In the second group the similar dependence is not observed. This may indicate higher increase of fat tissue comparing with increase of mussels tissue in vocational school students group. Here is worth to emphasize that bigger body mass requires more energetic effort during the organism operation [6].

The same absolute value of given spirometric parameter can be too high or too low for different tested person. The predicted values of spirometric parameters depend on the age and height of investigated people [8]. That is why the percentage fraction of predicted value of each examined parameter was calculated. This fraction is independent on age and height. What is interesting in both investigated groups the average fractions of all spirometric parameters are smaller than 1. However, judo training men have obtained bigger fractions of predicted values than inactive students. The biggest differences are observed in FEV_1 and FVC - spirometric parameters obtained as a result of forced expiration. Those parameters depend on mussels forces and this in turn can be improved by training. The smallest difference is observed in vital capacity. This parameter depends mainly on anatomical structure but nevertheless can be enlarged as a result of training.

The fractions of FEV_1 and FVC seem to be depend on fat content in judo training group. However, the strength of relationships is rather weak. In the students' group there is no relationship observed between fractions of predicted FEV_1 and fat content or fat free body mass. The presented results suggest the necessity to repeat investigations on bigger men's group.

There were no found any relationships between fractions of predicted values of spirometric parameters and mass, age, BMI or chest movement index. It seems that fraction of predicted values of spirometric parameters can serve as a measure of young men wellness. The chest movement index can play similar role because does not depend on the other investigated parameters.

Conclusions.

The anthropometric and spirometric parameters are examined in two groups of men. In the first one were members of Poland national judo team, the second one was group of vocational school students. Both groups have similar anthropometric data, they differs mainly in the daily physical activity. The values of all spirometric parameters obtained by judo training men are higher than those for the group of vocational school students. The percentage fat content is higher in the group of students. The BMI index in the training group increases by building the muscle tissue, not by an increase of fat tissue. It seems that chest movement index can be independent measure of wellness of young men. Similarly the percentage fractions of investigated spirometric parameters are better measures of wellness than absolute values of those parameters. The results show that more judo training men than inactive students obtained predicted or higher that predicted values of spirometric parameters especially parameters obtained as a result of forced expiration.

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