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Respiratory function, physical activity and body composition in adult rural population

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Abstract

Objective. The aim of this study was to evaluate functioning of the respiratory system and to estimate the correlation between the function parameters of the respiratory system and the level of physical activity and body composition in the adult rural population. The study involved a group of 116 people from rural population aged 35–60 years, staying on 3-week rehabilitation camps. They were divided into two groups: men (29) and women (87). The somatic features: body height, body weight, Body Mass Index (BMI) and body copmposition were analysed, on the status of smoking and declared level of physical activity (PA) was checked. For the evaluation of the functional parameters of the respiratory system the pattern of flow volume curve was used. The following parameters were determined: vital capacity (VC), forced vital capacity (FVC), forced expiratory volume in one second (FEV1), peak expiratory flow (PEF), MEF50 (maximum expiratory flow at 50% of VC) and Tiffenau index. Hand grip and maximum torque of the knee join flexor and extensor muscles was measured. As expected, men had significantly higher levels of respiratory parameters. In analyzing the status of smoking cigarettes, it can be stated that the majority of subjects are smokers.

Conclusions. The values of functional parameters of the respiratory system were suitable for the age they were within the norm and did not show lung ventilation disorder. Most subjects of the study declared low physical activity which may be due to manual work on the farm. Smoking cigarettes significantly lowered the value of such parameters as FEV1, PEF and MEF50 only in the male group but the values did not indicate ventilatory disorder. Parameters of the respiratory system show the highest correlations with the parameters of muscle strength. Significant correlations with body compositions parameters (FFM, water) have been noticed too.

Key words

rural population, respiratory function, physical activity, body composition

INTRODUCTION

Regardless of the recent migration tendencies, the long lasting migration of people from the country to cities, and the specific features of farm work led to the development of biological, social and cultural differences between rural and urban populations. Numerous studies demonstrate the influence of socio-economic and cultural status on shaping life style indicators and diet as factors conditioning health [1].

Research evaluating the biological condition of the adult rural population is rare and was usually carried out on the employees of state-owned farms and farmers from farmers' associations [2, 3].

The positive correlation between physical activity and a treadmill test is much more consistent than that between physical activity and spirometric parameters [4]. There are few longitudinal studies on physical activity and respiratory function in the general population [5]. Most studies on the effects of physical activity on respiratory function are cross sectional ones on special populations such as athletes or patients with chronic obstructive pulmonary disease [6, 7].

The process of ageing causes lower efficiency of many body systems including the respiratory system. The main environmental factor that affects the ageing of lung functions is smoking [8,9]. There might be other factors causing worse functioning of the lungs. Many researchers point out that physical activity and good fitness level are connected with better ventilation of the lungs [10, 11]. It has been noted that obesity is a factor that inhibits functioning of the respiratory system, especially in adults [12].

Obese people are at increased risk of respiratory symptoms, such as breathlessness, particularly during exercise, even if they have no obvious respiratory illness [13]. Obesity has a clear potential to have a direct effect on respiratory well-being, since it increases oxygen consumption and carbon dioxide production, while at the same time it stiffens the respiratory system and increases the mechanical work needed for breathing. The association between obesity and asthma has also raised new concerns about whether the mechanical effects of obesity on the respiratory system contribute to airway dysfunction that could induce or worsen asthma [14].

Abdominal and thoracic fat are likely to have direct effects on the downward movement of the diaphragm and on chest wall properties, while fat on the hips and thighs would be unlikely to have any direct mechanical effect on the lungs. Both abdominal fat, measured by waist circumference, waist-to-hip ratio, or abdominal height, and thoracic or upper body fat, measured by subscapular skin fold thickness or biceps skin fold thickness, are associated with reductions in lung volumes [14].

Other previous cross-sectional studies demonstrate positive associations of fat-free mass and negative associations of centrally distributed fat deposits with respiratory function in older adults [15].

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Objective. The aim of the research was to evaluate the respiratory functional parameters, depending on the status of cigarette smoking and physical activity levels. Also to assess the relationship between pulmonary ventilation parameters, body composition and muscle strength.

MATERIALS AND METHOD

The research was carried out in the Rehabilitation Center for Farmers in Szklarska Poręba, Poland, on subsequent groups of patients from rural population. 116 people who stayed for 3-week-long rehabilitation periods were studied. All subjects have agricultural holdings which constitute the main source of income, it was a necessary condition under which they were qualified to the sanatorium treatment center designed exclusively for farmers. Most of the respondents had at least three or more children (60%). Only 4% of patients hold academic degree, the majority of respondents declared basic and vocational qualifications (53%), the remaining persons completed high school education.

They were divided into two groups according to sex. In the first group there were 87 women (median age – 47.5±6.1), the second group consisted of 29 men (median age – 49.3±5.9). All the participants agreed voluntarily and in writing to be subjects of the study. They could have withdrawn from the study at any time without giving a reason. They were informed that the results are anonymous and that they would have access to their own results.

The research study received permission from the Ethical Committee for Scientific Research at the University School of Physical Education in Wroclaw, and from the Biological Department of the Karkonosze Higher State School in Jelenia Gora, Poland.

The research report includes the measurements of somatic features which were conducted in accordance with the Martin-Saller technique [16]. They included height and body mass marked by The SECA measuring device, model 764, quality control number C-2017. The size of waist and hip was measured with a tape measure The measurements were used to calculate two indicators: Body Mass Index (BMI) and Waist-hip ratio (WHR).

The bioimpendance method was applied to measure the composition of the adipose tissue using the TANITA MC -180MA device. The analyzed parameters are as follows: the adipose tissue mass (in kilograms and the percentage of the body mass), the fat free mass FFM (kg), water (kg), muscle mass (kg). The measurements were carried out according to the requirements and recommendations specified in the instruction manual of the device. The study subject was standing straight, two measuring electrodes were attached to their feet, the other two electrodes were attached to their palms. The device measured electrical resistance and reactance using five different frequencies of electric current running through four limbs, which enabled us to analyze the proportion of the adipose tissue in each limb and the trunk.

As part of testing the functional respiratory system, the correlation of air flow and lung capacity was measured in all the subjects of the study with the use of the Flowscreen spirometer (780, 578, version 1.3) by the Jaeger Company, which enables direct evaluation of the results, instant monitoring of the result and their repetitiveness. The above-mentioned tests enable to calculate the following parameters: VC (vital capacity), FVC (forced vital capacity) FEV1 (forced expiratory volume in one second), Tiffenau indicator, MEF50 (maximum expiratory flow at 50% of VCmax) and PEF (peak expiratory flow). The measurements were conducted in a sitting position and the results were compared with normal values, taking into account sex, age and height [17]. The classification criteria of ventilation disorders from the Standardized Lung Function Testing [18] were applied in this research, in which the norm is 80% or more of FVC and FEV1 normal value, while a result below 80% of FVC means that there is a restrictive ventilatory disorder. A FEV1 below 80% means obstructive ventilatory disorder.

In both groups the information about smoking cigarettes was taken into account.

Current cigarette smokers were defined as participants who smoked cigarettes daily or who had stopped smoking <5 y before the date of spirometry. Former smokers were defined as participants who had smoked cigarettes daily and had stopped smoking ≥5 y before the date of spirometry. Nonsmokers were participants who had smoked <5–10 packs of cigarettes during their lifetime.

Hand grip of the dominant hand was tested on a hydraulic hand dynamometer DR-4R by the JB Staniak company.

A muscle strength test of the knee was carried out on a multifunctional diagnostic and rehabilitation chair, Ametyst 2, with a tensometric torque converter, which was produced in accordance with the Polish norm for medical devices no. 93/42/EEC. In this test the value of maximum torque (Nm) of the femoral quadriceps muscle and the knee join flexor and extensor muscles was measured.

The level of physical activity was evaluated on the basis of declared hours per week. It has been assumed that optimal activity is physical effort of one hour, at least three times a week. Low physical activity is less than three hours a week.

Descriptive statistics was used to analyze the results. Arithmetic mean ($\bar{x}$), standard deviation (SD) and student's t-test in order to evaluate the significance of differences between median values of tested variables in both men and women's groups. In order to compare groups distinguished regarding smoking cigarettes and the level of physical activity, an ANOVA variation analysis and NIR test were employed. Pearson correlation and multi-dimensional regression with choice were applied to evaluate correlations. The assumed statistical significance is $p \leq 0.05$.

RESULTS

As it was anticipated, men are taller and heavier in comparison with women. However, height and weight proportions are similar in both groups and demonstrate those who are overweight among the participants. Body composition parameters have higher values in men, except the amount of adipose tissue, which is significantly higher in women (Tab. 1). The analysis of functional parameters of the respiratory system showed that men have significantly higher values of volume parameters (VC, FVC, FEV1) in comparison to women. On the other, hand men have significantly higher flow parameters (PEF, MEF50).

In the parameters of muscle strength men dominate over women (Tab. 1).

In analyzing the status of smoking cigarettes it can be stated that the majority of subjects are smokers. The proportion of

Table 1. Statistical characteristics of measured parameters in men and women and evaluation of the significance of differences between median values

Parameters	Features	Men		Women		Student t-test	
		$\bar{x}$	s	$\bar{x}$	s	t	p
Age	age [years]	49.26	5.86	47.52	6.17	1.33	0.1872
Somatic	body height [cm]	173.82	6.95	162.22	5.80	8.86	**0.0000**
	weight [kg]	79.61	9.95	73.29	13.50	2.32	**0.0224**
	BMI [kg/m^2]	26.32	2.58	27.86	4.86	-1.62	0.1070
	WHR	0.94	0.05	0.82	0.06	10.40	**0.0000**
	Sum of 3 folds [mm]	30.72	11.39	46.09	17.43	-4.43	**0.0000**
	Fat [%]	21.97	6.34	31.46	5.66	-7.59	**0.0000**
	Water [%]	58.11	4.10	52.59	3.85	6.57	**0.0000**
	Fat [kg]	17.94	6.29	23.29	7.74	-3.37	**0.0010**
	FFM [kg]	62.53	6.60	49.62	7.42	8.33	**0.0000**
	Water [l]	46.58	4.77	38.09	5.62	7.31	**0.0000**
Respiratory parameters	VC [l]	4.10	0.69	3.02	0.60	8.04	**0.0000**
	VC %	89.66	7.71	98.15	16.51	-2.67	**0.0087**
	FVC [l]	4.23	0.77	3.21	0.62	7.18	**0.0000**
	FVC %	96.45	11.10	104.29	16.95	-2.33	**0.0218**
	FEV1 [l]	3.65	0.67	2.81	0.50	7.21	**0.0000**
	FEV1 %	102.14	11.83	106.63	15.40	-1.44	0.1540
	FEV1%VC	86.66	7.25	87.98	6.70	-0.90	0.3692
	PEF [l/s]	7.25	1.65	4.87	1.33	7.81	**0.0000**
	PEF %	82.79	16.49	75.79	20.02	1.70	0.0921
	MEF50 [l/s]	6.73	1.99	4.59	1.34	6.57	**0.0000**
	MEF50 %	88.59	22.50	80.90	22.80	1.58	0.1173
Muscle strength	Hand grip [N]	438.97	104.24	282.48	86.22	8.02	**0.0000**
	Knee extensor [kG]	72.14	33.04	41.60	16.04	6.62	**0.0000**
	Knee flexors [kG]	27.41	10.43	14.91	5.83	8.06	**0.0000**

Statistically significant values in bold

Table 2. The characteristics of smoking cigarettes and the level of physical activity of the tested groups

Status of smoking	Men N (%)	Women N (%)	Status of physical activity (PA)	Men N (%)	Women N (%)
Non-smoking	18 (62.07)	68 (78.16)	low	25 (86.21)	72 (82.76)
Smoking	11 (37.93)	19 (21.84)	optimal	4 (13.79)	15 (17.24)
Total	29 (25.00)	87 (75.00)	total	29 (25.66)	87 (74.34)

smokers is higher in man as women (Tab. 2). More than 80% of the subjects declared low physical activity (Tab. 2).

The analysis of the influence of smoking cigarettes on the value of respiratory parameters demonstrated significant differences only in the men's group (Tab. 3). It was observed that men who smoked cigarettes had lower values in forced expiratory volume in one second, peak expiratory flow and maximum expiratory flow at 50% of VCmax. Among women, differences due to smoking cigarettes have not been noticed.

The status of physical activity declared by the participants did not show significant differences regarding respiratory parameters neither among man nor women (Tab. 4).

Parameters of the respiratory system demonstrate the highest correlation with the torque of lower limbs in women and with hand grip in men, which is shown by the value of the correlation and regression factor (β). The correlation between ventilation parameters and body composition are significant more often in women than in men (Tab. 5, 6).

The same direction of chance is observed in the correlation of WHR indicator and measured values of volume respiratory parameters, which reflect the distribution of adipose tissue with all respiratory parameters in women but similar correlation do not exist in men.

Not only strength of muscles but also the parameters of body composition are important for well functioning of the respiratory system. The analysis demonstrated that

Table 3. Comparison of median values of measured parameters depending on the status of smoking

Feature	Men status of smoking				Women status of smoking				Probabilities for post-hoc tests values p	
	non-smoking		smoking		non-smoking		smoking		Men	Women
	$\bar{x}$	s	$\bar{x}$	s	$\bar{x}$	s	$\bar{x}$	s	non-smoking – smoking	non-smoking – smoking
VC [l]	4.28	0.68	3.81	0.64	3.00	0.55	3.08	0.78	0.0539	0.5997
VC %	91.61	7.00	86.45	8.08	97.25	15.32	101.37	20.38	0.3660	0.2873
FVC [l]	4.40	0.76	3.93	0.72	3.18	0.57	3.32	0.77	0.0623	0.3961
FVC %	98.78	10.46	92.64	11.53	103.10	15.71	108.53	20.73	0.3077	0.1847
FEV1 [l]	3.89	0.55	3.26	0.68	2.79	0.44	2.87	0.67	**0.0022**	0.5317
FEV1 %	106.94	6.74	94.27	14.31	105.90	14.44	109.26	18.64	**0.0228**	0.3678
FEV1%VC	89.06	6.79	82.73	6.45	88.32	6.84	86.74	6.15	**0.0150**	0.3630
FEV1%VC%	109.06	8.96	101.73	7.81	103.78	9.44	101.32	6.90	**0.0329**	0.2864
PEF [l/s]	7.78	1.57	6.37	1.43	4.80	1.24	5.15	1.64	**0.0086**	0.3314
PEF %	87.50	14.96	75.09	16.62	74.51	18.64	80.37	24.38	0.0911	0.2383
MEF50 [l/s]	7.57	1.56	5.35	1.88	4.52	1.24	4.81	1.65	**0.0001**	0.4342
MEF50 %	97.78	17.14	73.55	22.73	79.76	21.25	84.95	27.93	**0.0049**	0.3670
Hand grip [N]	453.94	82.91	414.45	132.94	279.50	79.95	293.16	107.57	0.2599	0.5647
Knee extensor [kG]	77.00	31.86	64.18	34.91	40.49	15.01	45.58	19.23	0.1200	0.3606
Knee flexors [kG]	28.56	10.56	25.55	10.44	14.90	5.78	14.95	6.17	0.2813	0.9788

Statistically significant values are in bold

Table 4. Comparison of median values of measured parameters depending of the declared level of physical activity (PA) – optimal and low levels

Feature	Men – physical activity				Women – physical activity				Probabilities for post-hoc tests values p	
	low		optimal		low		optimal		men	women
	$\bar{x}$	s	$\bar{x}$	s	$\bar{x}$	s	$\bar{x}$	s	low – optimal	low – optimal
VC [l]	4.09	0.71	4.14	0.64	2.99	0.56	3.16	0.57	0.8998	0.3424
VC %	89.24	7.07	92.25	12.04	97.77	15.03	102.71	18.68	0.6931	0.2346
FVC [l]	4.22	0.79	4.24	0.74	3.18	0.59	3.28	0.67	0.9741	0.6003
FVC %	95.76	10.55	100.75	15.17	104.26	15.97	105.86	20.08	0.5514	0.7252
FEV1 [l]	3.64	0.71	3.71	0.40	2.78	0.49	2.86	0.47	0.8103	0.6446
FEV1 %	101.76	12.37	104.50	8.50	106.73	15.39	107.57	14.79	0.7273	0.8436
FEV1%VC	86.36	7.45	88.50	6.45	87.86	6.51	88.07	7.73	0.5646	0.9154
FEV1%VC%	106.52	9.36	104.75	8.73	103.24	9.03	103.00	9.23	0.7193	0.9277
PEF [l/s]	7.20	1.64	7.53	1.92	4.79	1.33	5.28	1.40	0.6770	0.2451
PEF %	82.36	15.82	85.50	22.90	74.81	19.98	81.64	21.08	0.7640	0.2311
MEF50 [l/s]	6.64	2.06	7.27	1.63	4.48	1.30	5.09	1.42	0.4506	0.1720
MEF50 %	87.60	22.85	94.75	22.11	79.30	22.45	89.79	23.84	0.5598	0.1174
Hand grip [N]	434.56	109.84	466.50	60.94	282.79	84.01	285.79	93.87	0.5158	0.9105
Knee extensor [kG]	69.16	34.20	90.75	17.29	41.69	16.28	39.71	12.27	0.0619	0.7519
Knee flexors [kG]	26.72	10.57	31.75	9.60	14.74	5.84	15.71	5.73	0.2008	0.6484

Table 5. The value of Pearson correlation in men's and women's groups

Gender	Feature	VC	VC %	FVC	FVC %	FEV1	FEV1 %	FEV1%VC	PEF	PEF %	MEF50	MEF50 %
Women	age	**-0.47**	-0.03	**-0.40**	0.09	**-0.50**	0.07	-0.16	**-0.33**	-0.14	**-0.32**	-0.17
	body height	**0.48**	-0.04	**0.57**	0.02	**0.56**	-0.10	-0.14	**0.27**	0.05	**0.27**	0.12
	weight	0.10	0.02	0.17	0.10	0.17	0.09	-0.07	0.14	0.09	0.18	0.16
	BMI [kg/m^2]	-0.08	0.05	-0.04	0.12	-0.03	0.16	-0.01	0.03	0.08	0.08	0.11
	WHR	**-0.26**	-0.05	**-0.21**	-0.03	**-0.27**	-0.06	-0.10	-0.18	-0.11	-0.15	-0.09
	Sum of 3 folds [mm]	-0.07	-0.00	-0.12	-0.06	-0.07	0.03	0.13	0.05	0.08	0.11	0.13
	Fat [%]	**-0.25**	-0.16	**-0.25**	-0.16	-0.21	-0.08	0.15	-0.03	0.00	-0.03	-0.01
	Water [%]	**0.25**	0.13	**0.27**	0.16	**0.23**	0.08	-0.14	0.04	-0.00	0.04	0.01
	Fat [kg]	-0.07	-0.07	-0.03	-0.03	-0.01	0.01	0.04	0.08	0.07	0.10	0.10
	FFM [kg]	**0.22**	0.09	**0.31**	0.21	**0.29**	0.17	-0.15	0.17	0.11	**0.22**	0.19
	Water [l]	**0.21**	0.07	**0.31**	0.20	**0.29**	0.16	-0.14	0.18	0.12	**0.23**	0.19
	Hand grip [N]	**0.41**	**0.31**	**0.33**	**0.23**	**0.34**	**0.22**	-0.04	**0.33**	**0.28**	**0.34**	**0.31**
	Knee extensor [kG]	**0.38**	**0.28**	**0.33**	**0.22**	**0.34**	**0.21**	-0.03	**0.47**	**0.43**	**0.43**	**0.40**
	Knee flexors [kG]	**0.32**	0.14	**0.34**	0.13	**0.30**	0.05	-0.14	**0.36**	**0.27**	**0.38**	**0.32**
Men	wiek	**-0.61**	-0.29	**-0.60**	-0.25	**-0.65**	-0.26	-0.08	-0.36	-0.16	**-0.42**	-0.30
	body height [cm]	**0.84**	**0.45**	**0.74**	0.30	**0.75**	0.30	0.03	**0.59**	0.36	**0.49**	0.33
	weight [kg]	**0.54**	**0.41**	**0.48**	0.36	**0.48**	0.30	0.03	**0.42**	0.28	**0.42**	0.35
	BMI [kg/m^2]	-0.00	0.17	0.01	0.22	0.01	0.14	0.01	0.05	0.06	0.13	0.16
	WHR	0.06	0.23	0.01	0.14	-0.01	0.08	-0.04	0.05	0.07	-0.00	0.06
	Sum of 3 folds [mm]	0.12	0.12	0.09	0.08	0.16	0.20	0.17	0.12	0.08	0.18	0.17
	Fat [%]	-0.10	0.02	-0.05	0.13	-0.16	-0.11	-0.25	-0.24	-0.26	-0.15	-0.16
	Water [%]	0.11	-0.02	0.05	-0.15	0.16	0.09	0.24	0.24	0.26	0.14	0.14
	Fat [kg]	0.10	0.14	0.12	0.24	0.04	0.02	-0.18	-0.01	-0.08	0.05	0.02
	FFM [kg]	**0.62**	**0.38**	**0.52**	0.25	**0.61**	**0.38**	0.25	**0.61**	**0.48**	**0.56**	**0.49**
	Water [l]	**0.63**	**0.40**	**0.53**	0.26	**0.62**	**0.37**	0.22	**0.61**	**0.47**	**0.56**	**0.48**
	Hand grip [N]	**0.56**	**0.50**	**0.61**	**0.53**	**0.62**	**0.53**	0.09	**0.46**	**0.37**	0.29	0.25
	Knee extensor [kG]	**0.49**	**0.49**	**0.53**	**0.50**	**0.58**	**0.54**	0.18	**0.42**	0.33	**0.43**	**0.40**
	Knee flexors [kG]	**0.61**	**0.42**	**0.59**	0.35	**0.61**	**0.39**	0.10	**0.37**	0.23	0.34	0.28

Statistically significant values are in bold

Table 6. Result of regression analysis in tested groups according to gender

Gender	Feature	FVC			FEV1			PEF			MEF50		
		β	SE	p	β	SE	p	β	SE	p	β	SE	p
Women	WHR	-0.214	0.106	**0.046**	-0.275	0.104	**0.011**	-0.179	0.107	0.098	-0.150	0.107	0.167
	FM [%]	-0.248	0.105	**0.020**	-0.209	0.106	0.052	-0.031	0.108	0.777	-0.034	0.108	0.752
	FM [kg]	-0.026	0.108	0.810	-0.007	0.108	0.951	0.079	0.108	0.467	0.100	0.108	0.355
	FFM [kg]	0.312	0.103	**0.003**	0.288	0.104	**0.007**	0.172	0.107	0.111	0.221	0.106	**0.040**
	Water [%]	0.265	0.105	**0.013**	0.230	0.106	**0.032**	0.043	0.108	0.692	0.042	0.108	0.697
	Water [l]	0.311	0.103	**0.003**	0.290	0.104	**0.006**	0.183	0.107	0.090	0.230	0.106	**0.032**
	Hand grip [N]	0.334	0.102	**0.002**	0.344	0.102	**0.001**	0.328	0.102	**0.002**	0.343	0.102	**0.001**
	Knee extensor [kG]	0.330	0.102	**0.002**	0.339	0.102	**0.001**	0.465	0.096	**0.000**	0.425	0.098	**0.000**
	Knee flexors [kG]	0.340	0.102	**0.001**	0.302	0.103	**0.004**	0.366	0.101	**0.001**	0.377	0.100	**0.000**
Men	WHR	0.013	0.192	0.948	-0.012	0.192	0.949	0.052	0.192	0.788	-0.004	0.192	0.983
	FM [%]	-0.051	0.192	0.793	-0.159	0.190	0.409	-0.236	0.187	0.217	-0.152	0.190	0.431
	FM [kg]	-0.125	0.191	0.519	-0.043	0.192	0.826	_0.013	0.192	0.946	0.047	0.192	0.808
	FFM [kg]	0.519	0.164	**0.004**	0.611	0.152	**0.000**	0.611	0.152	**0.000**	0.558	0.160	**0.002**
	Water [%]	0.053	0.192	0.786	0.159	0.190	0.411	0.240	0.187	0.210	0.139	0.191	0.471
	Water [l]	0.534	0.163	**0.003**	0.616	0.152	**0.000**	0.614	0.152	**0.000**	0.556	0.160	**0.002**
	Hand grip [N]	0.609	0.153	**0.000**	0.617	0.151	**0.000**	0.458	0.171	**0.012**	0.290	0.184	0.127
	Knee extensor [kG]	0.530	0.163	**0.003**	0.576	0.157	**0.001**	0.416	0.175	**0.025**	0.425	0.174	**0.021**
	Knee flexors [kG]	0.595	0.155	**0.001**	0.612	0.152	**0.000**	0.369	0.179	**0.049**	0.344	0.181	0.068

Statistically significant values are in bold

ventilation parameters show the highest correlations with no-fat body mass and the amount of water in the body. The same direction of changes was observed in correlation with WHR, which (reflects the distribution of adipose tissue volume) and all the values of respiratory parameters in women, whereas analogous compounds do not occur in men.

DISCUSSION

Living conditions of the Polish population have significantly improved in the last few years. However, the changes are different in different social groups. The changes are slower in the rural environment than in the urban environment [19]. It refers not only to social position, the level of education, per capita income and living conditions. It can be expected that the kind of work, mainly manual and unlimited working hours will not encourage rural residents to take up physical activity in their free time. The results of the study confirm that more than 80% of the participants of the study do not take up any systematic physical activity in their free time. Maybe this is the reason why the subject evaluate their physical activity as low.

The second life style factor is smoking cigarettes. It is connected with risk factors of many diseases, including respiratory system diseases [20]. Przewozniak and Zatonski 1996 [20], demonstrate that at the end of the 20th century men were more often addicted to smoking (2/3 men and only 1/3 women smoked cigarettes every day). Thanks to prevention, smoking cigarettes has been significantly lower in the last few years, which can be linked to higher awareness of harmful influence of the addiction on our health. The results of this study confirm this tendency – nowadays more than 60% of men and 80% of women in rural areas do not smoke cigarettes. In smoking men it has been noted that t the parameters of the respiratory system which are connected with the flow of air through bronchi are lower. Smoking cigarettes has a direct influence on these parameters. Such changes have not been noticed in women.

It is possible that higher ecosensitivity of men than women causes lower respiratory parameters. Other researchers show similar results [19].

Among the adult rural population we can observe a high percentage of persons who are overweight or obese. High overweight and obesity is observed nowadays among most social groups in children and adults as well. It is considered to be a disease associated with the progress of civilization [21, 22]. It can be expected that significant increase of the adipose tissue among the subjects of the study is connected with the respiratory parameters.

Other researchers' data demonstrate that body composition and fat distribution are connected with lung functions in older man and central distribution of the adipose tissue has a negative correlation with lung functions but no-fat body mass has a positive correlation [23, 24]. The results of this study show higher parameters of the respiratory system correlate with better tissue composition of the body. That is why higher values of lean body mass and water produce the highest values of correlations among the subjects of the research. Similar correlation has been noticed between the strength of selected muscle groups and respiratory parameters. Correlation between the strength of muscles and functioning of lungs was suggested in people suffering from chronic obstructive pulmonary disease (COPD) and people of low body mass (<80% of normal body mass) and there was no significant association between respiratory muscle strength and lean body mass [25].

Significant correlations of muscle strength with functional parameters of the respiratory system observed in this study prove good condition of the respiratory system among the

subjects of the study. They achieved high values of the normal value and there was lack of lung ventilation disorders.

Summing up, the results of this study indicate positive correlation between lung ventilation, body composition and muscle strength. Contrary to declared by the participants low physical activity the results were very good, probably due to intensive manual work on the farm and environmental conditions.

CONCLUSIONS

1. The values of functional parameters of the respiratory system were suitable for the age they were within the norm and did not show lung ventilation disorder.
2. Most subjects of the study declared low physical activity which may be due to manual work on the farm. Due to the lower socio-economic status it would be reasonable to create a recreational activity programs adequate for the needs of the rural population.
3. Smoking cigarettes significantly lowered the value of such parameters as FEV1, PEF and MEF50 only in the male group but the values did not indicate ventilatory disorders.
4. Parameters of the respiratory system show the highest correlations with the parameters of muscle strength. Significant correlations with body compositions parameters (FFM, water) have been noticed too.

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