# ANALYSIS OF VISCERAL FAT IN PATIENTS WITH CHRONIC OBSTRUCTIVE PULMONARY DISEASE (COPD)

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## ABSTRACT

**Background.** Cigarette smoking is a major public health problem, which leads to the formation of chronic obstructive pulmonary disease (COPD) and is one of the main causes of avoidable death and disability worldwide.

**Objective.** The aim of study was analysis and comparison of the visceral fat in the body of the three groups of subjects (non-smokers, smokers and COPD patients) by Tanita Viscan 140.

**Material and Methods.** The control group was composed of: (1) non-smokers (n=30), consisted of 13 males (43.4%) and 17 women (56.6%) - the average age was $52 \pm 6.51$ years and (2) smokers (n=30), consisted of 12 men (40%) and 18 women (60%) – the average age $46.53 \pm 9.22$ years. Study group consisted of patients with COPD (n=60), which consisted of 48 men (80%) and 12 women (20%). Mean age was $69.25 \pm 9.90$ years. The measurement of visceral fat by Tanita Viscan device 140, which uses bioelectrical impedance analysis to measure fat in the abdomen of the patient in the supine position.

**Results.** High levels of visceral fat (women from 36.9% to 52.3% and more, men from 27.1% to 40.3% or more) were observed in 19 patients (3 women and 16 men), with 19 smokers (10 women and 9 men) and non-smokers in 22 subjects (10 women and 12 men). The average value of waist circumference measured with a Tanita Viscan 140 was in the group of patients $96.38 \pm 12.27$ cm, in the group of smokers $95.23 \pm 10.12$ cm and in group of non-smokers $96.86 \pm 10.88$ cm.

**Conclusions.** The results of our work are of great importance for the health assessment not only among patients with COPD but also in the group of smokers. Therefore it would be appropriate to remind the general public, eg. by campaign for chronic obstructive pulmonary disease and its serious complications and reduce the life quality of these patients and thus help protect human health and in particular young people from the harmful effects of tobacco products.

**Key words:** *visceral fat, smokers, chronic obstructive pulmonary disease*

## STRESZCZENIE

**Wprowadzenie.** Palenie papierosów jest poważnym problemem zdrowotnym, który prowadzi do powstawania przewlekłej obturacyjnej choroby płuc (POChP) i jest jednym z głównych przyczyn śmierci i niepełnosprawności na całym świecie.

**Cel badań.** Dokonano pomiaru zawartości w organizmie tłuszczu trzewnego za pomocą urządzenia Tanita Viscan 140, który wykorzystuje metodę bioelektrycznej impedancji do pomiaru tkanki tłuszczowej w jamie brzusznej pacjenta w pozycji leżącej.

**Materiał i metody**. Grupa kontrolna składała się z osób niepalących (n = 30), w tym z 13 mężczyzn (43,4%) i 17 kobiet (56,6%) - średni wiek wynosił $52 \pm 6,51$ roku. Grupa palaczy papierosów (n = 30) składała się z 12 mężczyzn (40%) i 18 kobiet (60%) - średni wiek $46,53 \pm 9,22$ roku. Badaniem objęto również grupę pacjentów z POChP (n = 60), która składała się z 48 mężczyzn (80%) i 12 kobiet (20%). Średni wiek wynosił $69,25 \pm 9,90$ roku. Dokonano pomiaru w organizmie zawartości tłuszczu trzewnego za pomocą urządzenia Tanita Viscan 140, który wykorzystuje metodę bioelektrycznej impedancji do pomiaru tkanki tłuszczowej w jamie brzusznej pacjenta w pozycji leżącej.

**Wyniki.** Wykazano wysoki poziom tłuszczu trzewnego (w zakresie od 36,9% do 52,3% u kobiet i w zakresie 27,1% do 40,3% u mężczyzn) u 19 chorych (3 kobiety i 16 mężczyzn) na przewlekłą obturacyjną chorobę płuc zaobserwowano, u 19 palaczy (10 kobiet i 9 mężczyzn ) i w grupie 22 niepalących osób (10 kobiet i 12 mężczyzn). Średnia wartość obwodu talii

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mierzona za pomocą urządzenia Tanita Viscan 140 wynosiła: w grupie pacjentów z POChP 96,38 ± 12,27 cm, w grupie palaczy 95,23 ± 10,12 cm, a w grupie niepalących 96.86 ± 10,88 cm.

**Wnioski.** Wyniki pracy mają istotne znaczenie dla oceny stanu zdrowia nie tylko wśród pacjentów z POChP, ale także w grupie osób palących. Wskazana byłaby edukacja społeczeństwa poprzez organizowanie kampanii na temat poważnych powikłań zdrowotnych i obniżeniu jakości życia pacjentów z POChP, aby w ten sposób chronić zdrowie ludzi, szczególnie młodych, przed szkodliwym działaniem palenia produktów tytoniowych.

## INTRODUCTION

Obesity is a global public health threat, it is generally recognized as a risk factor for cardiovascular disease, arterial hypertension, diabetes and many other health problems [27].

The frequency and severity of endocrine and metabolic disorders in obese individuals increased with the over accumulation of visceral fat as compared to subjects with fat accumulation in the skin [21].

Available data indicate a prevalence of obesity (defined by BMI > 30 kg.m$^{-2}$) in mild-to-moderate chronic obstructive pulmonary disease (COPD) patients of about 20% [26].

In addition, about 40% of male and 20% of female patients with COPD are obese. With regard to fat distribution about 70% of the men and 45% of the women showed abdominal obesity (defined by waist circumference >102 cm for men, >88 cm for women). These data indicate that there is a subgroup of patients with normal weight but abdominal obesity [19].

Accumulation of visceral fat plays a role also in the metabolic syndrome. As to the relationships between the different risk factors of metabolic syndrome and insulin sensitivity, fat and abdominal subcutaneous stored, as visceral fat is correlated with the risk of metabolic syndrome [3]. Overleaf of this problem is smoking, which is connected to lower body weight and a reduction in appetite [2]. Therefore is smoking commonly used as a weight control strategy, especially among young people and women [7]. It appears that the effect of smoking on the appetite is mediated by nicotine [9]. Cigarette smoking is a further important public health, leading to the formation of chronic obstructive pulmonary disease and is a leading cause of death and avoidable disability in the world [18].

Uncontrolled weight gain after stopping smoking is another reason preventing people stop smoking, therefore more than 75% of former smokers achieved weight gain after smoking cessation [15, 17]. Obesity has recently been identified as a major risk factor for the development of asthma. Asthma tends to be more severe in obese individuals, and it does not respond adequately to treatment. As a result, the combination of obesity and asthma is becoming a major public health issue in many countries [5].

It was traditionally thought that COPD patients were less likely to be obese. The rationale was that systemic inflammation, in the more advanced stages of disease, would lead to cachexia [6] rather than overweight. However, in the most recent studies, looking at the association of high BMI and COPD, approximately two thirds are overweight or obese [25]. Chronic obstructive pulmonary disease is generally characterized by excessive production of mucus, cough, progressive airways obstruction and change in pulmonary function [8]. The reasons for limiting the flow in the airways are various combinations of chronic bronchitis, emphysema and chronic bronchiolitis [24]. Whereas the definition is based on purely morphological criteria, its diagnosis in vivo is possible indirectly, only on a correct interpretation of the findings obtained in the physical, X-ray and functional examination [1].

In patients with COPD may be present in any of these. Their relative contribution to the disease process, it is often difficult to see. Asthma differs from COPD in its pathogenic and response rate and thus should be considered as distinct clinical phenomenon [22].

We hypothesize, that in subjects with abdominal obesity the determinant of lung function impairment is the presence of visceral fat. Therefore, it is important to gain insight in the association between visceral fat and lung function in selected groups peoples with/without COPD as a pulmonary damage. We used the bioelectric impedance analysis technique that allows the measurement of visceral fat distribution.

## MATERIAL AND METHODS

The research was conducted in three experimental groups. The first group was composed of 30 patients from Specialized Hospital sv. Svorada-Zobor Nitra, who were treated by means of hospitalization or outpatient basis. Observation group consisted of clinically stable patients, acute deterioration of the patients were excluded from the reference file. The control group consisted of probands from the general population without chronic obstructive pulmonary disease, acquired by random selection, who were divided into two subgroups. The first control subgroup - smokers (n = 30) and a second subset of non-smokers (n = 30) were men and women to be represented individuals of both sexes.

To the measurement of visceral fat was used a device Tanita ViScan 140 (Tanita® Corporation, Tokyo, Japan), which uses the bioelectric impedance

analysis to measure fat in the abdomen in lying position proband. The device uses the most advanced way of measuring the electrical resistance, which allows analyze changes in cellular structures in the abdomen. It shows the concentration of fat on scale 1 to 59 (0.5 increments), abdominal fat in % from 0.5 to 75% (in steps of 0.1%), waist circumference in the range of 50-130 cm (increased in 1 cm). Measuring waist circumference reaches a high level of repeatability and reliability of the laser and several no contact sensors. The measured values were statistically processed and evaluated in a statistical program STATISTICA Cz version 7.1. The most preferred of tests for statistical evaluation of our experiment, which has a comparative nature, the *Kruskall-Wallis* test.

## RESULTS AND DISCUSSION

The amount of visceral fat is the best criterion for monitoring long-term changes in effective health care. There is a strong link between the diseases associated with lifestyle and % body fat in the abdominal area. For example, obesity does not determine the actual weight, but the fat percentage in the body, which is differentiated by gender. An above body fat content is the cause of various lifestyle diseases, such as hypertension, cardiovascular diseases, disorders of serum lipids, diabetes etc.

On the other hand, even below the average value of the body fat are not appropriate. Body fat is not only a source of energy but also has a protective function and thermoregulation and ensures physiological hormonal activity. For the foregoing reasons, we consider significant determining % body fat and determining the level of fat in the whole study group of a very substantial. The Ministry of Health, Labour and Welfare in Japan to used these criteria in the routine health examination since 2008 [20].

Recommended values of waist circumference for European population is for men > 94 cm for women and > 80 cm. This stricter criterion laid down by the International Diabetes Federation 2005 (International Diabetes Federation) [11].

Visceral fat (in the percentage; level of visceral fat) and waist circumference were measured in 30 patients with COPD, 30 smokers and 30 non-smokers (Table 1). To measure those indicators we used the device Tanita ViScan 140.

Since subcutaneous fat and visceral fat differ in composition and function, and both contribute to abdominal obesity [10], it is relevant to establish the contribution of each to the association between abdominal obesity and lung function. Recently, it has become clear that adipocytes present in visceral fat produce more proinflammatory mediators than adipocytes present in subcutaneous fat [13].

Several studies have reported that body mass index (BMI), especially central obesity, was significantly associated with impaired lung function [14, 16].

For different level of visceral fat in the women and men body we present results separately for each of the gender.

Table 1. Analysis of visceral fat by device Tanita Viscan 140

| | COPD patients | Smokers | Non-smokers |
|---|---|---|---|
| **Fat (%)** | | | |
| N | 30 | 30 | 30 |
| | 32.84 | 34.67 | 35.74 |
| ± SD | 11.03 | 8.66 | 7.87 |
| median | 36.95 | 32.95 | 34.75 |
| maximum | 48.80 | 51.20 | 52.60 |
| minimum | 10.90 | 11.90 | 18.90 |
| **Waist circumference (cm)** | | | |
| N | 30 | 30 | 30 |
| $\bar{x}$ | 96.38 | 95.23 | 96.86 |
| ± SD | 12.27 | 10.12 | 10.88 |
| median | 98.00 | 95.5 | 95.00 |
| maximum | 117.00 | 118.00 | 125.00 |
| minimum | 75.00 | 80.00 | 73.00 |
| **Level of visceral fat** | | | |
| N | 30 | 30 | 30 |
| $\bar{x}$ | 14.53 | 10.23 | 10.86 |
| ± SD | 7.51 | 3.99 | 4.86 |
| median | 14.00 | 11.25 | 11.50 |
| maximum | 26.00 | 18.50 | 24.50 |
| minimum | 3.50 | 4.00 | 2.50 |

*Group of women*

The average values from indicators of visceral fat analysis in women by device Tanita Viscan 140 describes Table 2.

Low values of visceral fat percentage (21.5% in women) was measured only in one female in non-smokers group. The average values of visceral fat percentage (women from 21.5% to 36.9%) were detected in 2 women with COPD, in the group of smokers in 8 women and non-smokers in 6 women. High values of visceral fat percentage (36.9% of women to 52.3% or more were observed in 3 patients, the 10 women – smokers and 10 non-smokers women. Graphical representation of visceral fat (%) in observed women groups (P – patients; S – smokers; N – non-smokers) are presented in Figure 1.
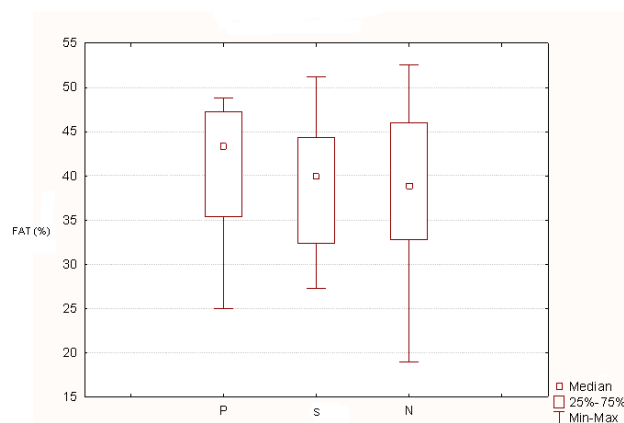


Figure 1. Analysis of visceral fat (%) in women by device Tanita Viscan 140

Table 2. Analysis of visceral fat in women by device Tanita Viscan 140

|  | COPD patients | Smokers | Nonsmokers |
|---|---|---|---|
| **Fat (%)** | | | |
| N | 5 | 18 | 17 |
| $\overline{x}$ | 39.94 | 39.05 | 38.20 |
| ± SD | 9.82 | 7.28 | 8.64 |
| median | 43.30 | 39.90 | 38.90 |
| maximum | 48.80 | 51.20 | 52.60 |
| minimum | 25.00 | 27.30 | 18.90 |
| **Waist circumference (cm)** | | | |
| N | 10 | 18 | 17 |
| $\overline{x}$ | 98.00 | 95.44 | 96.00 |
| ± SD | 16.06 | 12.29 | 13.32 |
| median | 101.00 | 94.50 | 92.00 |
| maximum | 117.00 | 118.00 | 125.00 |
| minimum | 75.00 | 80.00 | 73.00 |
| **Level of visceral fat** | | | |
| N | 5 | 18 | 17 |
| $\overline{x}$ | 10.00 | 8.66 | 8.47 |
| ± SD | 4.19 | 3.82 | 3.83 |
| median | 11.00 | 7.75 | 7.75 |
| maximum | 14.00 | 17.00 | 17.00 |
| minimum | 3.50 | 4.00 | 2.50 |

The average value of waist circumference measured with a Tanita Viscan 140 in the women group of patients was 98.00 ± 16.06 cm, in the group of smokers 95.44 ± 12.29 cm and a group of non-smokers 96.00 ± 13.32 cm (Figure 2).
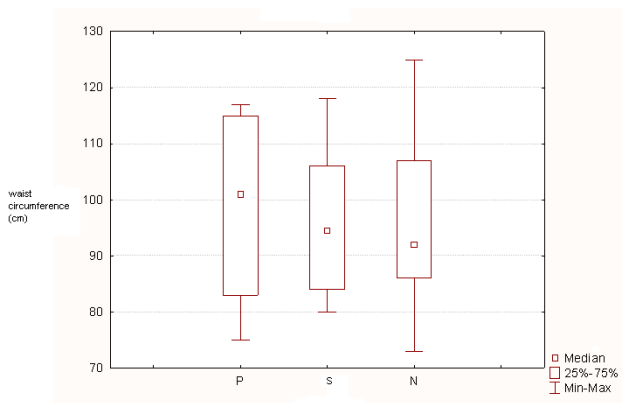
Figure 2. Analysis of waist circumference (cm) in women by device Tanita Viscan 140

The average level of visceral fat (1.0 to 5.0 or from 5.5 to 9.5) corresponding to the 1th resp. 2th grade, we observed by measurements in 2 women; in 11 subjects in the group of smokers and in the group of non-smokers in 11 women. A slightly above average value of visceral fat (10.0 to 12.0 and from 12.5 to 14.5) which corresponds 3th resp. 4th degree, we have found in a group of patients in 3 female, in a group of smokers of 6 women and 5 non-smokers females. Visceral fat above the average (15.0 to 17.0 or 17.5 or more) corresponding to 5th respectively 6th grade, was found in 0 women with COPD, in the group of smokers by 1 female and 1 subject in the group of non-smokers.

The Figure 3 presents graphs similar levels of fat in the groups studied (P - patients; S - smokers; N - non-smokers). Multiple comparison P-values have between all the groups found each other at endpoints (% fat, waist circumference, visceral fat level) no significant differences ($P \geq 0.05$).
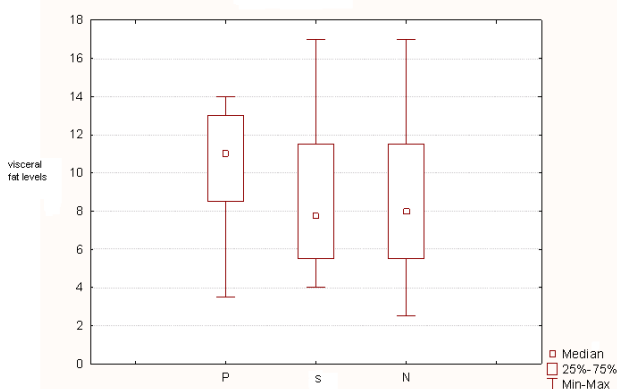


Figure 3. Evaluation of visceral fat levels in women by device Tanita Viscan 140

*Group of men*

The average values from indicators of visceral fat analysis in women by device Tanita Viscan 140 describes Table 3.
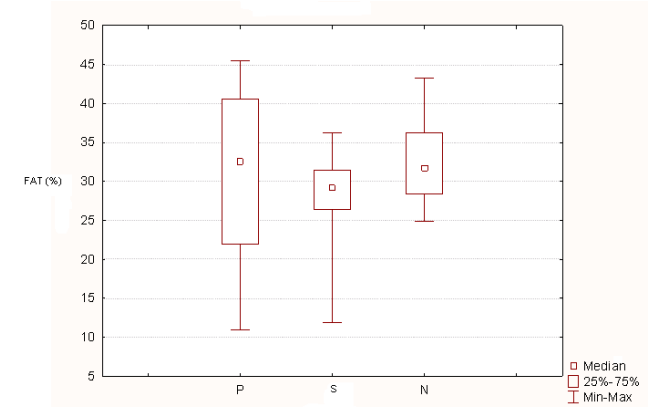


Figure 4. Analysis of visceral fat (%) in men by device Tanita Viscan 140

Low values of visceral fat percentage (13.9% in men) were measured in 2 men from group of COPD patients and smoking for one proband. In the group of non-smokers at 0 proband. The average values of visceral fat percentage in men (from 13.9% to 27.1%) were detected in 7 patients with COPD; in the group of smokers in 2 subjects and non-smokers in 1 man. High values of visceral fat percentage (27.1% to 40.3% or more) were observed in 16 patients, the 9 smokers and non-smokers in 12 subjects. Graphical representation of visceral fat (%) in observed groups (P – patients; S – smokers; N – non-smokers) are presented in Figure 4.

The average value of waist circumference measured with a Tanita ViScan 140 in the group of patients was $95.97 \pm 11.32$ cm, in the group of smokers $94.91 \pm 6.03$ cm and a group of non-smokers $98.00 \pm 6.84$ cm (Figure 5).

The average level of visceral fat (1.0 to 5.0 or from 5.5 to 9.5) corresponding to the 1th resp. 2th grade, we observed by measurements in 9 patients; in 2 subjects in the group of smokers and in the group of non-smokers in 2 subjects. A slightly above average value of visceral fat (10.0 to 12.0 and from 12.5 to 14.5) which corresponds 3th resp. 4th degree, we have found in a group of patients in 2 patients, in a group of smokers of 8 subjects and 7 non-smokers. Visceral fat above the average (15.0 to 17.0 or 17.5 or more) corresponding to 5th respectively 6th grade, was found in 14 patients (males), in the group of smokers by 2 subjects and 4 subjects in the group of non-smokers.

Table 3. Analysis of visceral fat in men by device Tanita Viscan 140

| | COPD patients | Smokers | Nonsmokers |
|---|---|---|---|
| **Fat (%)** | | | |
| N | 25 | 12 | 13 |
| $\bar{x}$ | 31.42 | 28.10 | 32.52 |
| ± SD | 10.88 | 6.11 | 5.52 |
| median | 32.60 | 29.15 | 31.70 |
| maximum | 45.50 | 36.20 | 43.30 |
| minimum | 10.90 | 11.90 | 24.90 |
| **Waist circumference (cm)** | | | |
| N | 39 | 12 | 13 |
| $\bar{x}$ | 95.97 | 94.91 | 98.00 |
| ± SD | 11.32 | 6.03 | 6.84 |
| median | 97.00 | 95.50 | 12.00 |
| maximum | 117.00 | 104.00 | 110.00 |
| minimum | 78.00 | 86.00 | 91.00 |
| **Level of visceral fat** | | | |
| N | 25 | 12 | 13 |
| $\bar{x}$ | 15.44 | 12.58 | 13.76 |
| ± SD | 7.75 | 3.08 | 4.51 |
| median | 16.50 | 12.25 | 12.00 |
| maximum | 26.00 | 18.50 | 24.50 |
| minimum | 4.00 | 6.00 | 7.00 |
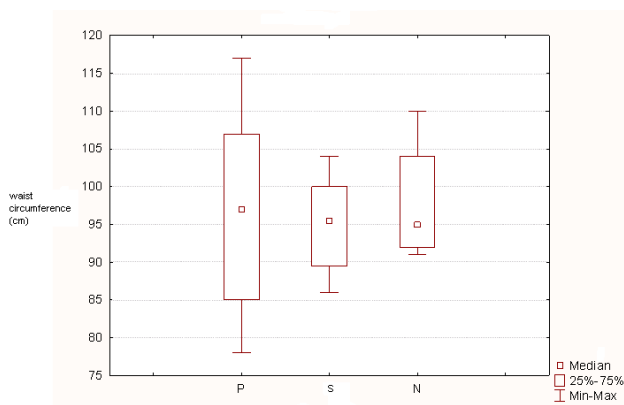


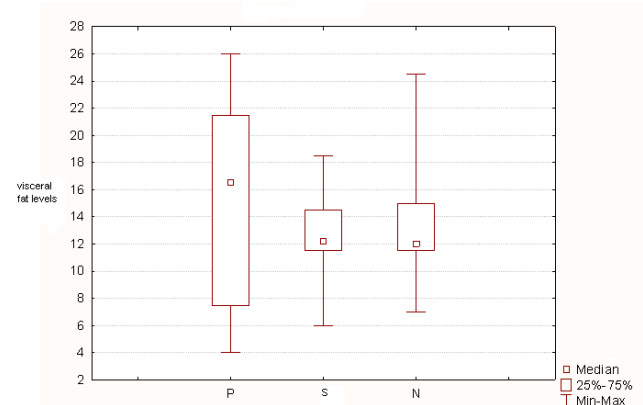Figure 5. Analysis of waist circumference (cm) in men by device Tanita Viscan 140



Figure 6. Evaluation of visceral fat levels in men by device Tanita Viscan 140

Figure 6 presents graphs similar levels of fat in the groups studied (P - patients; S - smokers; N - non-smokers). Multiple comparison P-values have between all the groups found each other at endpoints (% fat, waist circumference, visceral fat level) no significant differences (P ≥ 0.05).

Waist circumference is highly correlated with visceral adipose tissue [4] and thus is used in combination with BMI to further refine the assessment of the level of cardiovascular risk associated with obesity.

From the results analyzing in the group of women we have found, that in terms of content abdominal fat were achieved the highest average value among patients with COPD (39.94±9.82%), mean values in the group of smokers (39.05±7.28%) and the lowest average in the group of nonsmokers (38.20±8.64%). The same finding, we have reached the parameters waist circumference and the level of visceral fat. The interaction between BMI and asthma is stronger in women than men, and thus it has been suggested that increased levels of female sex hormones may play a role in the increased prevalence of asthma among obese women [12].

In the group of men we recorded the highest average value in a group of patients with COPD, in the parameter for the visceral fat (15.44 ± 7.75) as compared to the level of visceral fat in smokers and non-smokers (12.58 ± 3.08 and 13.76 ± 4.51).

Abdominal obesity is a major risk factor for the development of the metabolic syndrome and this problems also has a young generation [23].

## CONCLUSION

The health risks related to obesity, including its effects on respiratory function, are linked not only to the magnitude of obesity but also to the presence of abdominal fat. The results of work are of great importance for the assessment of health not only among patients but also in the group of smokers. Therefore it is necessary to alert the general public for example through campaigns for chronic obstructive pulmonary disease and its severe complications and reduce the quality of life of these patients and thus protect the health of people and especially young people from the harmful effects of tobacco products.

In the prevention of chronic obstructive pulmonary disease is recommended to create conditions for education of patients and healthy people without the presence of systemic disease. The aim of education should be education for healthy lifestyle with regard to absolutely eliminate active and passive smoking, changes in diet with sufficiency of exercise in the fresh air as well as improving the environment.

### Conflict of interest
*The authors declares no conflict of interest.*

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