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ORIGINAL ARTICLE

BRONCHIAL ASTHMA AND BODY MASS INDEX

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Abstract

Objective: The research is focused on the relation between obesity and bronchial asthma, whose prevalence has been increasing.

Methods: The sample group consisted of 506 respondents at the age of over 19 years who were diagnosed with bronchial asthma. The research methods were a questionnaire, asthma control test and medical history analysis. The data were processed using a descriptive statistics method and cluster analysis.

Results: We discovered that a BMI increase does not depend on gender. A worsened asthma stabilization, which is monitored using ACT™, is related to obesity. Obesity occurred in respondents with lower income and education.

Conclusion: Obesity worsens the stabilization of bronchial asthma. Respondents with a lower socio-economic status tended to be obese.

Keywords: *bronchial asthma; obesity; BMI; socio-economic status*

INTRODUCTION

Bronchial asthma is defined as a chronic inflammatory disease of the airways. Many cells and cell elements have a role in the disease. The chronic inflammation is related to bronchial hyperactivity and leads to repetitive wheezing, difficulties with dyspnoe and coughing, especially at night and in the morning. Such episodes are frequently related to variable obstructions and often treated or spontaneously reversible (Kolek and Kašák 2010).

The multifarious clinical picture originates in multifactor disease aetiology. Genetic factors, which are largely responsible for the prevalence of this disease, cannot be used to explain its rapid increase in prevalence. It is the reason why outer influences, such as the lifestyle of developed western civilizations (westernalization), are considered the main cause of its increase in prevalence (Bergendiová and Drugdová 2007). It is a complex effect of a number of socially determined factors. The main changes are households, social relationships, nutrition or rapid changes of environment. Ironically, higher life standards lead to an increased prevalence of atopic diseases. Higher life standards are related to a higher level of hygiene (sometimes even exaggerated) or few children in the family. This phenomenon also led to the formulation of the so called hygienic and farmers' hypotheses, which claim that hygienic conditions or "a certain daily dosage of microbes", infectious diseases and contact with animals in

early childhood may affect the immunological process leading to atopic reactions (Okada et al. 2010).

Bronchial asthma is caused by a number of factors – exertion, infections, allergens (dust, pollen, feathers, mites, food etc.), work conditions (e.g. chemicals), medicines, smoking or stress. Obesity is one of the factors as well. It increases the risk of a number of diseases, such as arterial hypertension, diabetes, arthritis, hypercholesterolaemia or coronary cardiac diseases. It is related to cancer, respiratory disorders in sleep, etc. Bronchial asthma and obesity are included in one of the diseases of civilization and they exist around the world. It is assumed that 45–59% of the population in 2025 will be living in cities, which will lead to an increase in the number of people with asthma by another 100 million (Masoli et al. 2004). The latest recorded increase of people with asthma and allergies in developed countries is a serious contemporary problem (Crane et al. 2002).

An increased prevalence of obesity is obvious in women. In 1960, the percentage of obese women was 15.1%, but in 1994, it was 24.9% (Flegal et al. 1998). Some studies have focussed on the relation between obesity and asthma. The increasing BMI is related to a higher risk of the prevalence of asthma in adults (Camargo et al. 1999). Other studies concluded that it worsens the level of asthma, the quality of life (US Department 2002, Taylor et al. 2008), as well as the control of asthma (Lavoie et al. 2006).

MATERIALS AND METHODS

The research was carried out in the pulmonology and phthisiology out-patient clinic in the Pulmonology and Phthisiology Clinic of the Department of Internal Medicine of the University Hospital in Nitra. The sample group consisted of 506 respondents (30% were men and 70% were women) at the age of over 19 years who were diagnosed with bronchial asthma. The criteria for the inclusion into the sample group were: adult asthma patients (over 19 years) who had been diagnosed with bronchial asthma at least one year before the research, patients with asthma registered and examined in the Pulmonology and Phthisiology Clinic of the Department of Internal Medicine of the University Hospital in Nitra, filling in the prepared questionnaire, filling in the asthma control test, undergoing spirometry, willingness to co-operate in the research, signed approval and the approval of the research by the ethical board.

Besides the BMI, we monitored and analysed a number of variables, such as age, gender (man – 1, woman – 2), education (primary – 1, secondary– 2, university – 3), employment (unemployed – 1, person in disability retirement (PDR) – 2, old age pensioner (OAP) – 3, employed – 4) and income (0–200€ = 1, over 801€ = 11). We focused on the actual level of bronchial asthma of the respondents (light – 1, moderate – 2, severe – 3) and the control of its stabilization using the standardized asthma control test (ACT™).

The data was processed using quantitative and qualitative methods. For certain variables that could not be included in the type Normal (Gaussian distribution), we used the descriptive statistics. We decided to use the cluster analysis to confront all the acquired variables. We wanted to be able to find common characteristics of social features of people with asthma, which were positively and negatively related to anti-asthmatic treatment. The calculations were carried out using the FCM program from the statistics package SYNTAX.

RESULTS

The acquired data were processed using quantitative and qualitative methods. In the cluster analysis, we compared the variables. The first analysis focused on all respondents and, in the second analysis, we excluded age.

The respondents were made up of 30% men and 70% women. 18% of the men and 44.9% of the women were over 55 years old, 7.9% of the men and 19.4% of the women were 31–54 years old, and 4.1% of the men and 5.7% of the women were 21–30 years old. In the division by education, 50.6% of the respondents had secondary education, 32.8% had primary education and 16.6% had university education.

An important factor was the employment and income of the respondents. 47.2% were OAP's, 32.2% were employed, 11.9% were PDR and 8.7% were unemployed. The average income of the OAP's was 377.44€, the PDR

had 239.85€, the unemployed respondents had 309.47€ and the employed had 534.51€ (Table 1).

78.2% of the respondents had an income of up to 500€. 29% earned 301–400€ and 24.3% earned 401–500€. 17% earned 201–300€. 7.9% of the respondents earned the minimum up to 200€. 21.8% earned over 501€. The respondents at the age of under 50 earned over 700€. Those above 60 earned under 400€. Obese respondents (BMI above 30) belonged to the group with the income of under 350€. ACT™ of under 20 points was mostly achieved by the respondents with a higher BMI (above 28.87) and with an income of under 500€ (Table 2).

Table 1 – Employment, income (€) and age (years) of the respondents

	Employed	Unemployed	PDR	OAP	Total
n	163	44	60	239	506
%	32.2	8.7	11.9	47.2	100
Average income	534.51	309.47	239.85	377.44	405.8
Average age	47.07	42.32	51.00	71.03	58.5

Table 2 – Monthly income (€), age (years), ACT™ (points 0–25) and BMI of the respondents

Income		Number	%	Average age	BMI	ACT™
1	0–200	40	7.91	53.125	31.15	17.325
2	201–250	43	8.50	55.139	30.83	18.325
3	251–300	43	8.50	63.674	31.47	18.558
4	301–350	81	16.00	65.049	30.06	19.728
5	351–400	66	13.04	62.833	29.82	18.469
6	401–450	107	21.15	59.028	28.87	19.598
7	451–500	16	3.16	61.500	28.98	18.062
8	501–600	45	8.89	54.800	28.88	20.711
9	601–700	21	4.15	51.238	28.34	20.230
10	701–800	17	3.36	47.823	30.28	22.294
11	>801	27	5.34	47.000	27.54	21.074
Total		506	100.00	58.446	29.71	19.341

Results of the first cluster analysis

The first analysis, which included all respondents, was 6-dimensional. The best breakdown was achieved in two clusters with a separation coefficient of 367.75. 43.03% of the respondents were included in the first cluster and 28.48% of the respondents in the second cluster. 16.77% of the respondents were less clearly classified in the first cluster and 11.72% of the respondents in the second cluster. Thus, we acquired two groups: the first one comprising of 71.52% and the second one of 28.48% of the respondents.

The clusters did not differ by gender (difference of 0.06%). The difference was in their age, where the first cluster included respondents at the average age of 69.54 years, and the second cluster included respondents at the average age of 43.94 years. The younger respondents had a higher education (upper secondary) compared to the older respondents (difference of 22.10%). Older respondents in the first cluster had a higher level of bronchial asthma (moderate to severe with the value of 2.814), they reached the average of 18.59 points in the ACT™ and they had a

higher BMI (30.71). The second cluster included younger respondents with a lower level of bronchial asthma than the first cluster (moderate bronchial asthma with the value of 2.516). They reached the average of 19.1 points in the ACT™. Younger respondents' average BMI was 27.77. In the first cluster, the respondents were at the retirement age and the second mostly included the pensioners' age (Table 3).

The greatest difference in the monitored clusters was in education, which was higher in the second "younger" cluster with no relation to the stabilization of bronchial asthma. It is the reason why we decided to remove the age variable and learn which of the introduced variables influences the stabilization of bronchial asthma (Table 3).

Table 3 – Cluster analysis of the respondents – assessment by age, gender, education, BMI, ACT™ and the level of bronchial asthma (AB)

	Cluster average		Differences	
	1st cluster	*2nd cluster*	*% of the 2nd from the first*	*% difference*
Age	69.54	43.94	63.19	–36.81
Gender	1.701	1.700	99.94	–0.06
Education	1.69	2.06	122.00	22.10
BMI	30.71	27.77	90.43	–9.57
ACT™	18.59	19.1	102.74	2.74
AB level	2.814	2.516	89.41	–10.59
Employment	2.989	3.142	105.12	5.12

Results of the second cluster analysis

The following cluster, where age was omitted, reached the best separation coefficient (319.056) in the two clusters. The first cluster clearly included 23.23% of the respondents and the second included 12.32% of the respondents. 34.34% of the respondents were less clearly classified in the first cluster and 30.10% of the respondents in the second cluster. Thus, we acquired two groups: the first one comprising of 57.57% and the second one 42.42% of the respondents.

The first cluster included a comparable number of men and women (difference of 1.29%). There were respondents with an ideal BMI (the average was 26.99), whereas the second cluster comprised respondents with a significantly higher BMI (the average was 33.06). The respondents in the first cluster reached a significantly higher number of points in the ACT™ (the average was 21.28) than the second one (the average was 15.71), where the level of their bronchial asthma was relatively comparable (moderate to severe). Both clusters included the respondents at retirement age (Table 4).

Table 4 – Cluster analysis of the respondents – assessment by gender, BMI, ACT™ and AB level without the age variable

	Cluster average		Differences	
	1st cluster	*2nd cluster*	*% of the 2nd from the first*	*% difference*
Age	1.703	1.725	101.29	1.29
BMI	26.99	33.06	122.49	**22.49**
ACT™	21.28	15.71	73.83	**–26.17**
AB level	2.627	2.809	106.93	**6.93**
Employment	3.148	2.898	92.06	–7.94

DISCUSSION

The analysis did not confirm the relationship between gender and high BMI (Table 3). Women and men had a comparable BMI (e.g. average BMI in men was 29.89 and 29.53 in women). The study of Huovinen et al. (2003) highlights the connection of lifestyle to the risk of the prevalence of asthma in adults. They learned that obesity in men (BMI above 30) significantly increased the risk of asthma, when they were compared to those who had optimal BMI. The risk of asthma grew with increasing BMI. Physical activity or training had a protective effect on the risk of asthma in men and a higher education decreased the risk of asthma when compared to women. They also found a significant relationship between asthma and weight in women, where being overweight was not the only issue, but being underweight as well. In women, they did not prove the protective influence of physical activity and higher education. Other studies highlight the connection between asthma and obesity mostly in women (Shaheen et al. 1999, Beckett et al. 2001, Chen et al. 2002). However, Ford et al. (2004) highlight the connection between asthma and obesity regardless of gender. Coogan et al. (2008) learned that BMI in women with asthma is strongly related to age (grows from the age of 25), the syndrome of sleep apnoea (over 30 years), family asthma history (in every age group), quitting smoking (after the age of 25) or passive smoking. The results of our study show that older people with asthma have a higher level of asthma and higher BMI ($p = 0.0000$).

The average BMI, in our respondents, reached 29.71 and the average number of points in the ACT™ was 19.34. Respondents with light persistent asthma had a BMI level of 28.04, respondents with moderate asthma had 32.61, and respondents with severe asthma had 29.61. The increasing level of BMI significantly worsened the tolerance of exertion ($p = 0.0000$), where the tolerance decreased with age ($p = 0.0000$). Lavoie et al. (2006) learned that a higher BMI is related to worse asthma control and quality of life, but not to the level of asthma. This Canadian study analysed adult asthma patients that filled in standardized tests focused on the stabilization of asthma (ACQ – Asthma Control Questionnaire, AQLQ – Asthma Quality of Life Questionnaire) and underwent a spirometry. There were 60% of women of the average age of 49 years. 39% of the respondents were overweight and 25% were obese. Overweight and obesity had a statistically more significant effect on men than women. This fact confirmed the relationship between both standardized tests (high ACQ score, low AQLQ score) and a higher BMI. Obesity is associated with the increasing risk of asthma prevalence in control studies (Chen et al. 1999, Shaheen et al. 1999) and some prospective studies (Camargo et al. 1999, Chen et al. 2002) leave the causal relationship between asthma and obesity unclear (Schachter et al. 1984, Wilson and Irwin 1999).

Considering the respondents' socio-economic status in our study, we can say that a low social status (lower education, manual work, low income) is probably associated with the intake of low quality food, so that they feel full, thus, they tend to be obese. 50.8% of PDR, 38.1% of the unemployed and 10.3% of OAP's with bronchial asthma had an income of up to 250€. Cluster analysis showed that younger employed people with asthma (on average 36.61 years of age) had an ideal BMI (26). Younger unemployed people with asthma (on average 47.26 years of age) had an average BMI of 28.94. A significantly higher BMI (29.62 on average) was recorded in older employed people with asthma (on average 53.92 years). The highest BMI (30.61) was recorded in older unemployed people with asthma (OAP's) at the average age of 71.67. The BMI in employed people with asthma (32.12% in total, 47.23 years on average) was 28.4.

Education and income may be used as indicators of a socio-economic status. Low income is often associated with a lower quality of life, higher level of unemployment, lower financial compensation, professional demotion or escalated manual work, which is related to a higher prevalence of asthma (Jaakkola et al. 2002, Hedlund et al. 2006). The prevalence of asthma is higher in groups with a low quality of life and income. In people whose income was below 100% subsistence, it was 11.2%. If the income was below 200% subsistence, the prevalence of asthma was 8.7%. If the income was at least 200% subsistence, the prevalence of asthma was 7.3% (Akinbami et al. 2012).

After removing the variable of age as a possible important influence, we used the cluster analysis (Table 4) to learn that a lower BMI strongly affects the stabilization of asthmatic difficulties, but not the level of asthma. ACT of the respondents with an ideal BMI (26.99) reached an average of 21.28 points, while the test of the obese that had a 33.06 BMI dropped to an average of 15.71 points. According to the cluster analysis, they were mostly people with moderate asthma regardless of gender. The highest average BMI was reached by the respondents with moderate asthma (32.61) when it was compared to those who had light (28.04) and severe asthma (29.84). Increasing BMI significantly worsened the tolerance of exertion (p = 0.0000), where the tolerance decreased with age (p = 0.0000).

CONCLUSION

Obesity increases the risk of asthma. The analysis did not confirm the relationship between gender and a high BMI. In our study, a higher BMI worsened the quality of life of people with asthma as well as the stabilization of asthma, but it did not increase its level. The level of asthma rose with the respondents' age. Their BMI grew with their age, low education and income. A low socio-economic status also increased the risk of obesity.

CONFLICT OF INTERESTS

The authors have no conflict of interests to disclose.

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