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Analysis of eating behaviors and eating habits, body mass index and waist-to-hip ratio in association with spirometry results of young adults

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Abstract: Behavior and eating habits stands as an important factor in terms of maintaining a good health condition in every age group. This involves optimal digestion, maintaining proper metabolism of the entire organism and thus maintaining proper body weight. It is especially important for students, as the increased mental activity results in increased energy expenditure. The state of body weight can affect the respiratory efficiency measured in spirometry. The aim of the study was to assessthe relation between behavior and eating habits, body mass index (BMI), waist-to-hip ratio (WHR) and results from spirometry tests among young adults.

The study sample included 185 students from the University of Szczecin (mean age 21.2±1.3). Using a questionnaire prepared for the study, information on the eating plan of students for three consecutive days was collected. Dietary analysis was concerned with: eating in stressful situations, dieting, regularity of main meals, eating between main meals. Afterwards spirometry examination was performed along with a detailed measurement of body weight and height, waist and hip circumferences in order to calculate BMI and WHR index of each respondent. The data obtained was processed statistically. Significant correlations between FVC and "dieting" (Spearman's r_s=0.3) were recorded in the group of women. However, the association of other behavior and eating habits with spirometry parameters did reveal null results in both males and females.

Correct behaviors and eating habits at a young age affect spirometry parameters to a negligible extent. The absence of direct health related effects of bad consumption habits at a young age makes it all the more important to raise the awareness of students, that their current decisions will have an apparent effect in the future, maybe only after a few years.

Key words: eating behaviors, eating habits, respiratory function, young adults

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Introduction

Proper behavior and eating habits are an extremely important element of a proper diet. In very general terms, it allows the body to optimally regulate glucose metabolism and blood glucose levels. Regularity is defined as the resultant of the amount of food intake and the frequency of meals. There are also other very important aspects of diet, such as the composition of meals, the degree of their processing, and method of preparation, but this paper is primarily focused on the regularity of meals. Long breaks between meals leads to hypoglycaemia and triggers a cascade of biochemical changes adversely affecting metabolic processes. The increasing hunger caused by irregular food intake may eventually result in binge eating, and this in turn may lead to an overweight state or obesity, and indirectly to the development of type 2 diabetes. Negative changes in the immune system may also occur, leading to an increased susceptibility to the respiratory tract and other diseases. An increase in the BMI value often contributes to limited physical activity, which impairs fitness and decreases respiratory function. This is often reflected in impaired resistance to respiratory tract infections and may induce asthma or other medical conditions. The most unfavorable situations are those when the coexistence of several risk factors for developing chronic lung diseases is observed. There is no doubt that the most important factors are smoking and air pollution. Thus, smokers who live in a heavily industrialized area, follow a poor diet and are not physically active face a significantly higher risk of developing chronic obstructive pulmonary disease in future life. Spirometry is a test used for the objective evaluation of respiratory function. The detection of abnormalities can prevent the development of respiratory insufficiency. The most important parameters that are assessed during spirometry include: forced expiratory volume in one second (FEV_1), forced vital capacity (FVC), peak expiratory flow (PEF), and FEV_1 to FVC ratio, also known as the Tiffeneau index, which is used to assess whether abnormal spirometry values result from bronchoconstriction (airway obstruction, low index value) or if the disorder results from reduced volume of the lungs (normal or increased index value). Currently, the FEV_1/FVC index, also known as the pseudo-Tiffenau index, is used much more often.

Aim

This study presents an analysis of the relationship between behaviors and eating habits, BMI, WHR and results from spirometry tests among university students.

Materials and methods

The study group comprised 128 women (mean age = 21.3±1.4) and 57 men (mean age = 21.0±1.1) studying at the University of Szczecin. A special questionnaire prepared for the study was used to collect information on the eating habits and behaviors of students covering three consecutive days. Dietary analysis was concerned with: eating in stressful situations (no, yes), dieting (no, yes), regularity of main meals (no, yes), eating between main meals (no, yes), and the amount of all meals during the three analyzed days. Spirometry parameters, body mass and height were measured, and BMI and WHR index were calculated. Spiro-

metric measurements were taken using a Micro Plus spirometer from Micro Medical. Before spirometry all subjects were instructed on how to correctly perform the procedure, they were allowed to take a preliminary test, and the principles of device operation were explained. A spirometer measures four parameters: FEV_1 (forced expiratory volume in one second), FVC (forced vital capacity), PEF and FER. Three measurements in 2 minute intervals were taken for each subject in a relaxed standing body position.

Statistical analysis of behavior and eating habits in relation to spirometric scores was performed according to the category within each analyzed nutritional feature.

The normality of the distribution of collected parameter values was analysed using the W Shapiro-Wilk test. Spirometric parameters and anthropometric indices were compared using the U Mann-Whitney or t-Student tests. Pearson's correlation coefficients for the analysed variables were calculated for parametric variables. Whereas, the Spearman rank correlation was used to examine the relationships of nonparametric (categorized) variables. To investigate the extent to which behavioral and eating habits and BMI and WHR index have an effect on FEV1, FVC, PEF, and FEV_1/VC ratios, multiple regression analysis was performed. The regression model was constructed for FEV1, FVC, PEF, and FEV_1/FVC ratio as variables dependent on the analyzed nutritional characteristics and calculated somatic indices. Statistical calculations were performed using Statistica v. 12.0.

Results

Descriptive statistics for spirometric parameters (FEV_1, FVC, FEV_1/FVC and PEF) and anthropometric indices (BMI and WHR) for males and females by sex are presented in Table 1. All spirometric parameters, except for PEF ($W=0.991$, $p=0.286$), and anthropometric indices did not meet the criteria for normal distribution. There were significant differences between men and women in the values of spirometric parameters, except for FEV_1/FVC (Tiffeneau ratio), and anthropometric indices as it is shown by the *U* Mann-Whitney and *t*-Student tests.

Analysis of the Spearman's rank correlation between FVC and "dieting" showed a statistically significant correlation $r_s = 0.3$ ($p<0.00$) in the group of women. According to the U Mann-Whitney's test, "dieting" had a statistically significant effect on FVC scores in the category of "dieting" ($Z=-3.26$,

Table 1. Descriptive statistics of the study spirometric and anthropometric characteristics in males and females

Parameter	Females (n=128)			Males (n=57)			*p*-value
	Mean	SD	Min–Max	Mean	SD	Min–Max	
FEV_1	3.03	0.49	1.48–4.05	4.38	0.7	2.64–5.39	<0.001*
FVC	3.31	0.50	1.77–4.80	4.92	0.7	2.78–5.94	<0.001*
FEV_1/FVC	0.92	0.10	0.54–1.03	0.90	0.1	0.49–1.01	0.064*
PEF	317.08	94.06	100.67–593.00	476.42	107.9	172.33–703.67	<0.001**
BMI	21.54	2.71	16.87–33.78	24.48	3.4	17.80–32.00	<0.001*
WHR	0.76	0.08	0.65–1.28	0.84	0.1	0.761.01	<0.001*

* – *U* Mann-Whitney test; ** – *t*-Student test.

$p<0.001$). Analysis of the effects of other behaviors and eating habits (according to an established categories of traits) on spirometric scores did not show significant correlation either in the group of women or men

There was a positive correlation between body height, FEV_1 and FVC ($r_s=0.44$ and $r_s=0.44$, respectively) and between body mass, FEV_1 and FVC ($r_s=0.35$ and $r_s=0.33$ respectively).

The multiple regression analysis showed a slight association between behavioral and eating habits and BMI and WHR index on the explanation of spirometry variability. In females, the behavioral and eating habits and BMI and WHR indices explained only 7% of the total variation in FVC value ($R^2 = 0.07$). Of all variables, the "dieting" variable revealed statistically significant correlation in the equation. Other variables did not show statistical significance. The "dieting" variable affect to FEV_1/FVC ($R^2 = 0.004$) in univariate regression model. However, in the multiple regression model, after adjusting to all analyzed characteristics,the FEV_1/FVC lost its statistical significance. In the multiple regression analysis for PEF as a dependent variable on nutritional characteristics and somatic indices, statistical significance was obtained by BMI. However, the effect was low ($R^2=0.02$).

In males, a multiple regression analysis revealed a statistically significant effect of "regular eating of the main meals" on FEV_1 variability. The "regular eating of main meals" adjusted to all nutritional characteristics explained 13% of the total variation in FEV_1 ($R^2=0.13$). Another statistically significant association was found between BMI and FEV_1/FVC ($R^2=0.03$).

Discussion

Maintaining a healthy respiratory function in young adults is extremely important in order to prevent its decline later in life (James et al. 2005). Respiratory function, measured by forced expiratory volume per second (FEV_1) and forced vital capacity (FVC), is a strong predictor for the occurrence of almost all causes of premature death, including cardiovascular diseases (Young et al. 2007), and also mortality for cardiovascular causes (Tockman et al. 1995, Larsen et al. 2015). Respiratory function in adults can also indicate the risk of developing chronic obstructive pulmonary disease (COPD), which is now the third leading cause of death worldwide (Mannino and Buist 2007). Proper diet can help to maintain normal respiratory function in adults. Observational studies have suggested that higher intakes of antioxidants, i.e. a diet rich in fresh vegetables and fruits, improves respiratory function in the general population (Kelly et al. 2003, Butland et al. 1999, 2000, Shaheen et al. 2010). Epidemiological studies looking into the effect of balanced nutrition have shown that subjects on a diet rich in fruits, vegetables, fish and whole grains had much better respiratory parameters (Butland et al. 2000, Shaheen et al. 2010, Garcia et al. 2004). However, most studies/reports focus on the effect of individual nutrients, their groups or nutritional patterns, and this may offer a limited chance for the interpretation of diet's effect on lung health (Garcia et al. 2004). Studies looking specifically at the relationship between the regularity of meals and respiratory function are relatively scarce. Numerous reports on the lack of regular meals in young people are reflected in the results of research on

snacking habits (Ziółkowska et al. 2010, Gawlikowska-Sroka et al. 2015). For example, a study by Timlin (2008) carried out in the USA in a group of teenagers revealed that most of them do not have breakfast (36.5%), and even more do not eat any snacks between breakfast and lunch (61%). This trend was also reflected in results obtained by Ziółkowska (2010), which shows that over 80% of lower secondary school students from Warsaw and suburban villages not only snack between meals, but opt for fast foods to satisfy hunger. This type of diet is rich in sugar, saturated fatty acids, trans fatty acids and salt, and leads directly to an increase in body weight, but also contains very low levels of antioxidants. Fast food is also an important source of phosphates, which, often combined with calcium deficiency observed in children and adolescents, reduces the accumulation of this element in the bones and increases the risk of osteoporosis in adulthood (Prentice 2004).

The behavior and eating habits, BMI and WHR index showed a modest influence on spirometry parameters, although the "dieting" feature was statistically significant. The fact of applying diet can be interpreted in many ways. It can be assumed that people who are struggling to follow a diet (no matter what kind of diet) are characterized by a certain awareness and action in the field of health-promoting behaviors. These people set a goal, put effort into it, and then have the satisfaction of the right shape, well-being and better physical ability.

A statistically significant relationship between spirometry parameters (FEV_1 and FVC) and body height and weight observed in some female students had no significant relationship with the regularity of meals, but may be related to developmental allometry (allometric growth) exhibited by individuals during ontogenesis. Allometric studies of the relationship of body size to shape and anatomy reveal that as the body grows proportional changes are observed in other parts (Pellegrino et al. 2005).

The limitations in this work were the uneven size of the groups being compared: twice as many women as men. It was due to the fact that the research was conducted among students of clearly feminized field of studies.

Conclusions

Spirometry parameters seem to be only slightly associated with healthy eating behavior and eating habits in young adults. Despite this, it is important to educate young people about the need to maintain good overall fitness throughout life. Improper behavior and eating habits adopted at young age can deteriorate overall fitness and lead to health problems people face as they age.

Authors' contributions

D-BE idea for a research project, statistical applications, collection of bibliography, preparation of conclusions, work on full text; MM statistical calculation and statistcal applications; G-SA idea for a research project, preparation of conclusions; MK collection of data (material), choice of methodology; RME collection of data (material), statistical calculation and statistcal applications.

Conflict of interest

The authors declare that no conflict of interest regarding the publication of this paper.

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