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Assessment of breathing movements in subjects with and without depression

Ocena wzorca oddechowego u osób zdrowych i osób z depresją

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Keywords
depression, chest biomechanics, breathing patterns

Abstract
Background: Breathing is a complex process. Many factors, both external and internal and also including psychological factors, influence the course of respiration.
Objective: The aim of this study was to analyze the chest respiratory movements of people diagnosed with depression and those without depression.
Material and methods: The research material consisted of 33 persons diagnosed with depression, being in a state of partial remission and 23 healthy subjects. The average age of the person with depression examined was 53.1 years (±8.4) and without depression 55 years (±12.6). In the group of those examined obesity or postural defects, which might affect the outcome of the study, were not found. None of the evaluated subjects were treated for respiratory diseases. To examine the respiratory movements of the chest, Respiratory Belts were used. The assessment of chest movements included: the range of the respiratory motion of the upper and lower part of the chest, the number of breathes, the number of holded breathes during inspiration, the average time of the holded breathe during inspiration, the number of holded breathes during expiration, the average time of the holded breathe during expiration. An examination of chest mobility in a standing and sitting position was carried out. The recording time was 3 minutes.
Results: In patients with depression the amplitudes of chest respiratory movements were smaller. The breathe frequency was higher.
Conclusions: Depression affects the breathing pattern.

Słowa kluczowe
depresja, biomechanika klatki piersiowej, oddychanie, wzorzec oddechowy

Streszczenie
Założenia: Oddychanie jest procesem złożonym. Wiele czynników zarówno zewnętrznych jak i wewnętrznych ma wpływ na jego przebieg. Są to również czynniki psychiczne.
Cel: Celem prezentowanych badań była analiza ruchów oddechowych klatki piersiowej osób ze stwierdzoną depresją oraz osób bez depresji.
Materiał i metoda: Badano 33 osoby (22 kobiety, 11 mężczyzn) ze zdiagnozowaną depresją w okresie częściowej remisji (śr. wiek 53,1 ±8,4 lat) oraz 23 zdrowe osoby bez depresji (15 kobiet, 8 mężczyzn) (śr. wiek 55 ±12,6 lat). U badanych osób nie stwierdzono otyłości ani wad postawy mogących mieć wpływ na wynik badań. Żadna z badanych osób nie była leczona z powodu chorób układu oddechowego. Do badań ruchów oddechowych klatki piersiowej użyto urządzenie Respiratory Belts. W ocenie ruchów klatki piersiowej uwzględniono: zakres ruchów oddechowych górnej i dolnej części klatki piersiowej, ilość oddechów, ilość wstrzymywań oddechów na wdechu, średni czas wstrzymania oddechu na wdechu, ilość wstrzymań oddechu na wydechu, średni czas wstrzymania oddechu na wydechu. Badania ruchomości klatki piersiowej przeprowadzono w pozycji stojącej i siedzącej. Czas rejestracji wynosił 3 minuty.
Wyniki: U osób z depresją amplitudy ruchów oddechowych klatki piersiowej były mniejsze. Większa była też częstotliwość oddechów.
Wnioski: Depresja ma wpływ na wzorzec oddechowy.

The individual division on this paper was as follows: A – research work project; B – data collection; C – statistical analysis; D – data interpretation; E – manuscript compilation; F – publication search

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INTRODUCTION

The correct and efficient functioning of the respiratory system constitutes the basis for the effective working of the entire organism. Both external and internal factors affect the functioning of the respiratory system, the former concerning the lungs and bronchial tube directly while the latter are those determining the respiratory movements of the chest. Many reports state that a significant factor in the correct functioning of the respiratory system is correct body posture. Defects in the chest, lateral spinal curvature (scoliosis), and even momentary and minor disturbances to posture may influence the parameters in the working of the respiratory system.[1,2,3,4]

There are premises suggesting that the respiratory pattern is also conditioned by psychiatric factors. An example of which may be the results of Blazer's three-year observations[5]. Blazer suggests the appearance of a dependence between shallow breathing and depression. He claims that shallow breathing is not merely one of the frequent manifestations of depression, but also a significant factor in the risk of its appearance. Despite the weight of this matter there is an insufficient amount of studies within the subject literature taking in an evaluation of the dependence of respiratory movements and psychiatric factors.

The aim of the work

The aim of the work is a comparative analysis of the breathing patterns of healthy individuals and those suffering from depression.

Methods

The clinical material was composed of 56 patients aged from 40 to 75. Those tested did not have any deformations of the chest area or posture deficiencies, there was also no evidence of obesity (BMI lower than 30). None of the patients had been treated for respiratory diseases.

The group of healthy individuals was 23 strong (15 women, 8 men) (mean age 55 ±12.6 years), drawn from the general population, in whom there had been excluded the presence of depression and a lowering of self esteem and mood.

The group of individuals with depression made up the remaining 33 (22 women, 11 men); these being patients of the Psychiatric Ward of the 5th Military Clinical Hospital in Cracow, in whom depression in a period of partial emission had been diagnosed. The average age of the individual with depression was 53.1 ±8.4, while without depression 55 ±12.6.

Respiratory Belts were used in the testing of the respiratory movements of the chest. This is a device containing two belts on which are attached sensors reacting to chest movements. The device employs a resistance slide potentiometer to measure the changes in the length of the belts placed on the patient's chest. The resistance of the potentiometers is processed by a driver into a digital signal of a USB interface and sent to a computer, in which a specially devised program registers the signal and produces its visualisation on the monitor screen. The program allows one to follow in real time the mechanical action of the chest, giving the possibility for the easy noting down of the numerical values generated. The results of the measurements in the form of phase trajectories are displayed on the screen, while the signal prior to filtering is recorded on a disc. The device was constructed at Cracow Polytechnic.[6]

The testing of chest movements was conducted in two positions: standing and seated. The first sensor was placed on the upper part of the chest, at the height of the insertion of the fourth rib to the sternum, the second sensor measured the movements of the lower part of the chest and was to be found at the height of the costal arch. The registration time was 3 minutes. In the evaluation of chest movement there was taken into consideration: Ch1- the amplitude of the respiratory movements of the upper part of the chest, Ch2 - the amplitude of the respiratory movements of the lower part of the chest, the frequency of exhalation, the number of holded breathes into inhalation and exhalation, the average time breathe was held at the peak of inhalation and exhalation. The measurements were conducted for a period of three minutes.

The distribution of the variables was checked using the Shapiro-Wilk Test. The t test and analysis of variations were employed in the evaluation of differences.

The research protocol was confirmed by the bioethics commission (Nr 36/KBL/OIL/2011). The tests were conducted after obtaining written permission on the part of each of the participants.

Results

The tested variables had a normal distribution.

The comparison of the tested variables describing the respiratory pattern for healthy individuals and those with depression are presented in Tables 1 and 2.

In a standing position there occur statistically significant differences in the respiratory pattern of individuals with confirmed depression in comparison with healthy individuals. In those with confirmed depression the maximum inhalations on the Ch-1channel were significantly smaller. A significantly increased number of respirations accompanied a reduced amplitude in respiratory movements. These results indicate that the frequency in exhalation in individuals with depression was around 28.06, while in individuals with depression 18.26 per minute. In both groups the values in the first channel were significantly greater than in the second pointing to tendencies to respire through the upper-costal path. An additional differentiating feature was the number of holded breathes on exhalation.

Equally in a seated position there occur statistically significant differences in the respiratory pattern of those with confirmed depression when compared to healthy individuals. In individuals with confirmed depression the maximum inhalations both in the Ch1 and Ch2 channels were statistically smaller. Analogically to the standing position the number of respirations in the course of testing was significantly

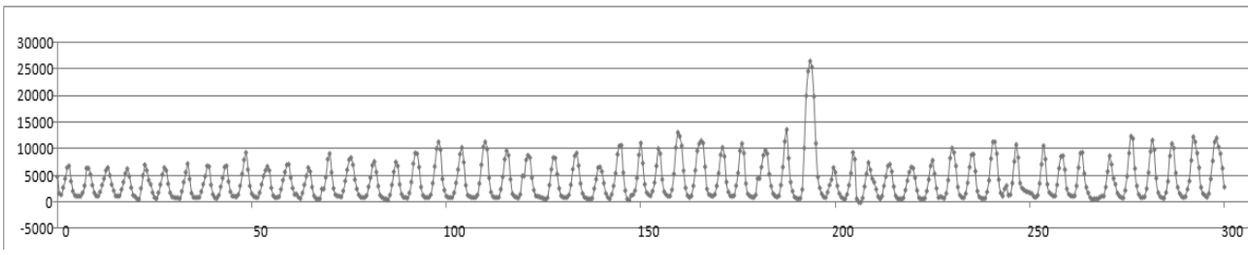

Figure 1
Example of the upper chest mobility in a healthy person in the first channel

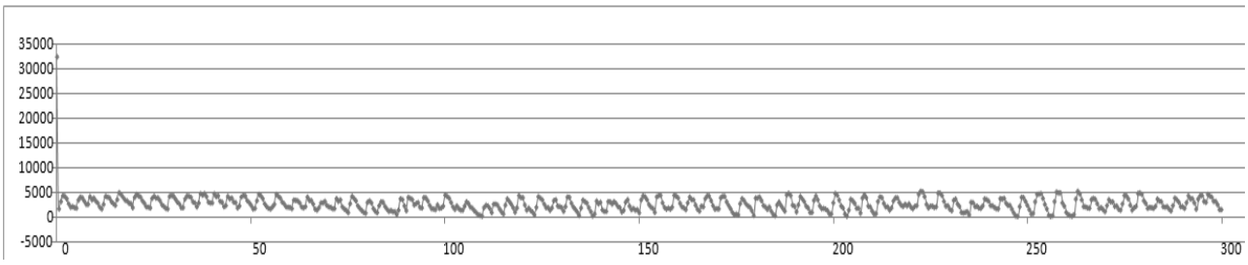

Figure 2
Example of lower chest mobility in a person with depression in the first channel

greater in individuals with depression. The mean time of holded breath while exhaling was significantly longer than was the case in healthy individuals.

Discussion

The breathing process is a complex one. A series of methods and testing systems are employed in the multi-layered evaluation of respiration. The most frequently used are: clinical evaluation, radiological and spirometrical tests. The mentioned methods of testing do not, however, find application in the evaluation of the kinematics of the chest. The currently applied spirometrical tests, the indicators of maximum inhalation and exhalation pressure supply fundamental information on the functioning of the respiratory system. Yet they do only to a limited degree and indirectly provide information on the respiratory movements of the chest. Decisively more information is provided by methods enabling an evaluation of the chest during exhalation. These include photogrammetric tests[7], tests employing a plethysmograph[8] or Respiratory Movement Measuring Instrument (RMMI)[9]. The tests presented were conducted using Respiratory Belts. Their employment

Table 1

Comparison of breathing patterns in a standing position in healthy and depressed individuals

	Healthy individuals	Individuals with depression	t	p	t separated by an estimation of variations	p bilateral	F quotient variations	p variations
Max inhalation Ch1	6772.990	3755.394	3.385	0.001	4.022	0.000	3.985	0.000
Max inhalation Ch2	2914.888	2181.061	1.756	0.082	1.805	0.075	1.214	0.560
Number of respirations [in 3 min.]	54.797	84.182	-6.660	0.000	-5.968	0.000	2.236	0.008
Average time of holded breathe in inhalation [s]	0.953	0.718	1.393	0.167	1.536	0.128	2.260	0.015
Average time of holded breathe in exhalation [s]	2.917	3.241	-0.653	0.515	-0.712	0.479	1.897	0.053
Number of times breathe holded in inhalation [in 3 min.]	13.610	15.636	-0.536	0.593	-0.478	0.635	2.328	0.005
Number of times breathe holded in exhalation [in 3 min.]	22.831	29.848	-2.155	0.034	-1.889	0.065	2.688	0.001

Max inhalation Ch1 – indicator of depth of inhalation recorded by a tensiometer sensor measuring the amplitude of respiratory movements of the upper part of the chest.
Max inhalation Ch2 – indicator of depth of inhalation recorded by a tensiometer sensor measuring the amplitude of respiratory movements of the lower part of the chest.

Table 2

Comparison of breathing patterns in a sitting position in healthy and depressed people

	Healthy individuals	Individuals with depression	t	p	t separated by an estimation of variations	P bilateral	F quotient. Variations	P Variations
Max inhalation Ch1	5609.193	3954.124	2.066	0.042	2.342	0.021	2.554	0.005
Max inhalation Ch2	3796.614	2527.376	2.675	0.009	2.992	0.004	2.283	0.013
Number of respirations [in 3 min.]	54.068	77.182	-4.463	0.000	-3.974	0.000	2.354	0.005
Average time of holded breathe in inhalation [s]	0.837	0.705	0.999	0.321	0.904	0.371	3.052	0.000
Average time of holded breathe in exhalation [s]	2.768	3.739	-2.811	0.006	-2.209	0.034	10.463	0.000
Number of times breathe holded in inhalation [in 3 min.]	13.169	11.727	0.407	0.685	0.399	0.691	1.148	0.635
Number of times breathe holded in exhalation [in 3 min.]	26.000	30.909	-1.462	0.147	-1.249	0.218	3.404	0.000

Max inhalation Ch1 – indicator of depth of inhalation recorded by a tensiometer sensor measuring the amplitude of respiratory movements of the upper part of the chest.
Max inhalation Ch2 – indicator of depth of inhalation recorded by a tensiometer sensor measuring the amplitude of respiratory movements of the lower part of the chest.

allowed for the obtainment of information not described through the application of other systems.

The respiratory centre is comprised chiefly of neurons in the area of the nuclei of the medulla oblongata and the sternum. This centre integrates and processes stimuli from the cortex and limbic system. Thanks to the connections with the cortex the activity of the respiratory centre may be modified by force of will. While the connections with the limbic system makes ventilation dependent on emotions. Many authors confirm this fact that respiration is dependent on those physiological processes which are strongly shaped by emotions[10-12]. Depending on the emotions felt our respiration has a tendency to deepen or become shallower, to speed up or slow down. It follows to mention in this respect the research of Masaok and Homm[13]. The results obtained by them point to personality differences connected with the rate of respiration during psychological stress. In other research these authors have proven that anxiety experienced increases the frequency of respiration[14]. Worthy of note is also the research of Blazer. Blazer suggests on the basis of replies obtained from patients that shallow breathing and the subjective sense of breathlessness is a significant and independent factor in the risk of depression occurring in older individuals over the course of three years of observation. Besides, he claims that questions on breathlessness should be incorporated into screening questions asked during diagnoses of depression, particularly that this is a factor of risk that can be eliminated through the use of appropriate treatment[5]. Neuman claims that the chance of breathlessness manifesting itself in individuals who during the course of nine years of observation had suffered from depression was 12.2 times more likely than in the case of those without depression[15].

The tests conducted by us have thrown up a series of differences in the respiratory pattern amongst healthy individuals and those with depression. First and foremost there was observed a differentiated amplitude in respiratory movements. In healthy individuals the amplitudes were greater. These results are uniform with the findings of Pasagić[16], who included shallow breathing within symptoms typical for depression.

In turn Blazer, while conducting observations, registered in a part of his patients disturbances in breathing in the form of shallow breathing. In these individuals depression was diagnosed within the course of the next three years. It follows to add that Blazer's research was based on a questionnaire. The above observations on respiratory disturbance in individuals with depression that were elicited from our research were by means of a specialist instrument. The significant differences concerned the number of exhalations during an observed time period of three minutes. In healthy individuals the number of exhalations was 54.7 (28.06/min) while for patients with depression 84.1 (18.26/min). These results show that the frequency in respiration amongst individuals with depression was greater than for those without depression. Longer was also the time of holded breathe while exhaling. These differences were the clearest in a seated position, less so in a standing position, which may be connected with the fact that the means of maintaining a seated position is characteristic for those with depression. Those examined in a seated position in accordance with the principles of the test were to sit up straight and were not to slouch on the chair's armrests and back. While the group of healthy individuals had no problem in fulfilling this condition those with depression adopted the proposition unwillingly. After a short period of time one could observe that the patients adopted a posture with typical features for depression i.e., greater slouching of the cervical spine and an increased chest ky-

phosis.[17] The increased chest kyphosis significantly influences the mobility of the chest, as has been shown in the research of Ker and Maruyam[18].

Breathing is a phase activity which represents the smooth transition from the phase of inhalation to the phase of exhalation. In the course of the research conducted for the needs of this work it was observed amongst certain individuals a momentary holding of breathe. This is a phenomenon sufficiently well known. Yet a search in the subject literature for information on this subject does not bring satisfactory results because of the minute number of academic pieces that discuss the matter. Certain authors consider the phenomenon to be natural in older people[19], others explain it by means of psychic factors, such as stress and exhaustion[13,14].

CONCLUSION

Depression has an influence on the respiratory pattern.

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