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Lung function, respiratory muscle strength and endurance, and quality of life in the morbidly obese

Função pulmonar, força e resistência muscular respiratória e qualidade de vida de obesos mórbidos

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Abstract

Introduction: Obesity may decrease the strength of respiratory muscles as well as pulmonary function. **Objective:** To analyze the influence of respiratory muscles and pulmonary function on the quality of life of morbidly obese individuals. **Methods:** Twenty-eight morbidly obese individuals of age ≥ 18 and Body Mass Index ≥ 40kg/m² were assessed for maximal respiratory pressures, pulmonary function, and quality of life. **Results:** The maximal respiratory pressures were 96.30% and 100.21% of the expected levels. Regarding pulmonary function, there were changes in the results of peak expiratory flow (PEF) and forced inspiratory vital capacity (FIVC), which were below the expected levels (92.32% and 89.14%, respectively). Quality of life results showed an average score of 50 on the items related to mental health, while the average score on physical health items was 46. **Conclusions:** MRP and pulmonary function do not seem to affect the quality of life in morbidly obese individuals. http://clinicaltrials.org - NCT01449643 - The Influence of Inspiratory Muscular Training (IMT) on Diaphragmatic Mobility in Morbidly Obese.

Key words: Obesity; Physiotherapy (Techniques); Quality of life; Respiratory function tests; Respiratory muscles.

Resumo

Introdução: A obesidade pode estar relacionada com diminuição da força dos músculos respiratórios e com a função pulmonar. **Objetivo:** Analisar a influência dos músculos respiratórios e da função pulmonar na qualidade de vida em indivíduos obesos mórbidos. **Métodos:** Vinte e oito indivíduos obesos mórbidos com idade ≥ 18, e Índice de Massa Corpórea ≥ 40kg/m² foram avaliados quanto às pressões respiratórias máximas, função pulmonar e qualidade de vida. **Resultados:** As máximas pressões respiratórias foram 96,30% e 100,21% do predito. A respeito da função pulmonar, houve alterações nos resultados do pico de fluxo expiratório e na capacidade vital inspiratória forçada, que ficaram abaixo do predito (92,32% e 89,14%, respectivamente). Os resultados para qualidade de vida mostraram escore médio de 50 pontos nos itens relacionados à saúde mental, enquanto o escore médio da saúde física foi 46. **Conclusão:** MPR e função pulmonar não parecem afetar a qualidade de vida de indivíduos obesos mórbidos. http://clinicaltrials.org - NCT01449643 - The Influence of Inspiratory Muscular Training (IMT) on Diaphragmatic Mobility in Morbidly Obese.

Descritores: Fisioterapia; Músculos respiratórios; Obesidade; Qualidade de vida; Testes de função respiratória.

Introduction

Obesity represents one of the main public health problems in the world, and it is simply described as a medical condition characterized by excessive body fat tissue[1]. The World Health Organization (WHO) recommends usage of the body mass index (BMI), which is defined as the individual's body weight in kilograms divided by the square of his or her height in meters. Individuals with BMI ≥ 30kg/m² are considered obese, while those with BMI ≥ 40kg/m² are considered morbidly obese[2].

In recent years, there has been an increase in morbidly obese individuals, and most of developed and developing countries are facing a real obesity epidemic. According to WHO, there are around 300 million obese people all over the world[1-3]. In 2010, the Brazilian Institute of Geography and Statistics published studies stating that over 14.8% of the Brazilian population (12.5% of the men and 16.9% of the women) have BMI ≥ 30kg/m² [4].

Obesity is related to an increase in the incidence of comorbidities that attack different areas of the organism and may cause cardiovascular diseases, such as hypertension, and strokes, as well as dyslipidemia, diabetes mellitus type 2, osteoarthritis, depression and some types of cancer[5]. Changes in the physiology of respiratory mechanics – gas exchange, breath control, strength, and respiratory resistance – are all found in the respiratory system[3-5].

Changes in pulmonary function are easier to notice in obese individuals and include reduction of forced expiratory volume in one second (FEV_1), forced vital capacity (FVC), and total lung capacity (TLC). Changes occur mainly in expiratory reserve volume and residual functional capacity[6-8]. The modifications in pulmonary function are closely connected to the lack of pulmonary compliance that comes from the mechanical action of body fat on the chest[7, 8]. This excess of body fat in the abdomen causes a negative impact on the diaphragm, which may decrease maximum inspiratory pressure (PImax) and maximum expiratory pressure (PEmax)[7-10].

Together with high energy waste due to lack of pulmonary compliance, lack of respiratory muscle strength, higher respiratory frequency, and elevated body weight may cause exercise intolerance, consequently affecting quality of life directly[10-12]. Regarding this point, the Medical Outcomes 36-Items Short-form Health Survey (SF-36) – translated to and validated for Portuguese – has been widely used to evaluate quality of life, contemplating eight aspects of physical and mental health[13, 14].

Even though the relation between obesity and maximum respiratory pressure[14-18] and lung function[19-21] has been described in some studies, that association remains unclear in morbidly obese individuals, and so does the possible impact on their quality of life. Therefore, our goal is to analyze the influence of respiratory muscle strength and endurance and lung function on the quality of life of these individuals.

Material and methods

This study was submitted and approved by Pernambuco's Federal University Ethics Committee on Human Research under number CAEE - 0280.0.172.000-10 and is in accordance with Resolution 196/96 of the National Health Council. It is a cross-sectional descriptive study. Twenty-eight morbidly obese volunteers were assessed. The individuals selected were all of age ≥ 18, BMI ≥ 40kg/m², without chronic pulmonary disease, and able to perform physical therapy "manoeuvres" (or physical therapy functional activities). Patients with chronic inflammatory processes or thyroid dysfunction were excluded.

After agreeing and signing an informed consent form, patients were evaluated with personal data, anthropometrics (weigh, height and BMI), and medical data and were then subjected to the SF-36 survey.

Pulmonary function was checked using a portable spirometer (Spirobank, MIR® – Rome, Italy). Each patient was instructed to take a deep breath to total lung capacity, followed by a forced and long expiration to the level of residual volume (RV); finally, patients performed forced breathing to TLC through an oral device connected to the spirometer, using a nose clip. Three manouevres were made, with a 2-minutes break between them, taking the best results of FVC, FEV_1, FEV_1/FVC, peak expiratory flow, forced inspiratory vital capacity, forced inspiratory volume in one second (FIV_1) and FIV_1/FIVC[22].

Using the same spirometer, maximal voluntary ventilation was checked. The patient was instructed to breath as quickly and deeply as possible in a 12- to 15-second interval. After the test, the volume in that period of time was calculated for a 1-minute interval[22].

The evaluation of the inspiratory and expiratory muscle strength was done through measurement of PImax and PEmax, respectively. A digital manuvacuometer (MVD-300; GlobalMed; Rio Grande do Sul; Brasil) was used. To check PImax, the patient was instructed to expire to residual volume, followed by maximum inspiration, using a nose clip; and to check PEmax, the patient was required to breathe to TLC followed by forced exhalation. Three manoeuvres were made with the patient sitting down, using the higher value manoeuvres for the records[22].

To determine the quality of life, the SF-36, validated by Ciconelli[13], was used. The SF-36 presents a scale of eight profiles, including physical components (physical functioning, role-physical, bodily pain and general health) and mental ones (vitality, social functioning, role-emotional and mental health). Results for each item range from 0 to 100, where higher numbers represent better quality of life.

Statistical analysis

Two software applications were used for analyzing the data: SPSS 13.0 for Windows and Microsoft Excel 2003. This study used the Kolmogorov-Smirnov test. For correlations between the SF-36 survey, maximum respiratory pressure, and lung function, the Spearman test was used. Differences were considered significant for values of $p<0.05$.

Results

The group consisted of 28 morbidly obese individuals, 24 of them female (85.71%). The anthropometrics – age, height, weight, and BMI – are described in Table 1.

Table 1: Anthropometric data of morbidly obese individuals

Variables	Morbidly obese (n=28)
Age,years	35.5 ± 9.4
Height, cm	165.8 ± 8.7
Weight, kg	121.8 ± 14.7
BMI, kg/m2	44.2 ± 3.3

Data presented as Mean ± SD. BMI – body mass index.

As seen in the results presented in Table 2, the group studied presents average values of PImax and PEmax nearer and higher, respectively, than expected[22]. Meanwhile, the average value of MVV is lower than predicted according to Pereira et al.[22]. Regarding the spirometric data described in Table 2, FVC, FEV_1, FEV_1/FVC and FIV_1 are in the normal range. However, FIVC and PEF are below 92% of the predicted values and the FIV_1/FIVC ratio is 14% higher than the value predicted by Pereira et al.[22].

The results of the SF-36 survey vary from 0 to 100, so the average value is 50 points. Thus, the individuals studied scored below average in the items physical functioning, role-physical, bodily pain, vitality, and role-emotional, while scores for general health, social functioning, and mental health were above average, as shown in Table 3. Hence, scores for physical health items were below average and those for mental health at average.

Table 2: Spirometric, maximal respiratory pressures, and maximal voluntary ventilation data of obese individuals

Variables	Morbidly obese (n=28)
PImáx, % pred	96.3 ± 24.2
PEmáx, % pred	100.2 ± 20.6
MVV, % pred	78.3 ± 17.7
FVC, % pred	98.1 ± 13.9
FEV_1, % pred	99.1 ± 13.2
VEF_1/FVC, % pred	101.1 ± 5.9
PEF, % pred	92.3 ± 12.8
FIVC, % pred	89.1 ± 13.6
FIV_1, % pred	102.0 ± 17.2
FIV_1/FIVC, % pred	114.0 ± 7.1

Data presented as Mean ± SD. PImax – maximal inspiratory pressure; PEmax – maximal expiratory pressure; MVV – maximum voluntary ventilation. FVC – forced vital capacity; FEV1 – forced expiratory volume in one second; PEF – peak expiratory flow; FIVC – forced inspiratory vital capacity; FIV1 – forced inspiratory volume in one second.

Table 3: SF-36 quality of life scores of the 28 morbidly obese individuals

Variables	Median (min-max)
Physical health components	
Physical functioning	55 (5-85)
Role-physical	37.5 (0-100)
Bodily pain	42 (0-100)
General health	56 (10-97)
Mental health components	
Vitality	40 (0-95)
Social functioning	62.5(0-100)
Role-emotional	33.3 (0-100)
Mental health	62 (0-96)

The Spearman test calculated between values of the SF-36 and PImax, PEmax, FVC, FEV_1, and FIVC did not show significant differences ($p > 0.05$), so there was no correlation between the parameters observed, as demonstrated in Table 4.

Discussion

Obesity does decrease lung function and may have negative effects on strength and resistance in respiratory mechanics[3]. However, in this study, in regard to maximum respiratory pressure, it was shown that the average results of PImax and PEmax were close to the results expected for the Brazilian population, according to Pereira et al.[22]. That probably means that the respiratory muscles are working chronically in overload, thereby gaining more strength.

The results corroborate previous studies made by Magnani et al.[15], Gonçalves et al.[17], and Paisani et al.[18], which evaluated maximum respiratory pressures of 99, 39 and 30 morbidly obese individuals, respectively, suggesting that obesity itself would not have negative impact on respiratory muscle strength.

However, in 2007, Castello et al.[16] analyzed PImax and PEmax in 12 morbidly obese women and found that the maximum respiratory pressures were clearly reduced, possibly due to low pulmonary compliance and compression and reduction in the mobility of the diaphragm.

Further regarding respiratory muscle efficiency, the MVV test is a global method and not specific for evaluating respiratory function and respiratory muscle resistance[17, 22]. In this study, MVV values were 21.75% below what was predicted, which can happen because MVV is not influenced solely by respiratory muscles, but also by abdominal thoracic system compliance, which is reduced in morbidly obese individuals due to the concentration of body fat.

Gonçalves et al.[17] and Silva et al.[23] evaluated obese patients who were scheduled to undergo bariatric surgery and found that MVV values were lower than 80% of what was predicted, corroborating the results of this study.

Pulmonary function in obese individuals may be reduced due to the compression of the respiratory system, caused by the excess of body fat in the thoracic-abdominal area[21, 24, 25]. However, in this study, the results of the spirometer revealed that the patients showed pulmonary function values close to what was expected, with some decrease happening in PEF and FIVC, probably due to lung restriction and a reduction in the size of the airways, which hap-

Table 4: Spearman's correlation coefficients between SF-36 quality of life scores, maximal respiratory pressures, and lung function of the 28 morbidly obese individuals

	PImax	PEmax	FVC	FEV_1	FIVC
	r - p	r - p	r – p	r - p	r - p
Physical functioning	-0.123; 0.531	-0.47; 0.813	0.275; 0.157	0.239; 0.22	0.263; 0.177
Role-physical	-0.192; 0.328	-0.244; 0.21	-0.096; 0.626	-0.024; 0.906	-0.032; 0.872
Bodily pain	0.218; 0.265	-0.194; 0.322	0.44; 0.822	0.132; 0.502	0.200; 0.307
General health	0.190; 0.333	-0.070; 0.724	0.119; 0.548	0.160; 0.415	0.023; 0.906
Vitality	0.014; 0.945	-0.281; 0.147	-0.133; 0.499	-0.122; 0.535	0.093; 0.639
Social functioning	0.44; 0.826	-0.309; 0.110	-0.110; 0.577	-0.107; 0.589	-0.054; 0.783
Role-emotional	-0.12; 0.950	-0.219; 0.263	-0.127; 0.519	-0.174; 0.376	-0.126; 0.522
Mental health	-0.39; 0.843	-0.105; 0.594	0.156; 0.428	0.105; 0.596	0.195; 0.320

PImax – maximum inspiratory pressure; PEmax – maximum expiratory pressure; FVC – forced vital capacity; FEV1 – forced expiratory volume in one second; FIVC – forced inspiratory vital capacity; p – P value, confidence interval = 95%; r – Coefficient Correlation

pened due to mechanical action of body fat in the thoracic-abdominal area.

The results of this study corroborate those of Costa et al.[19], who evaluated FVC, FEV_1 and FEV_1/FVC in 20 obese individuals and found that these spirometric variables are inside the range of normal values. The same was found by Ceylan et al.[20], who also checked PEF, and found that the lung function of the 23 obese individuals was inside the normal range.

However, Melo et al.[21] checked the pulmonary function of 140 individuals with different BMI levels and found that the values of FVC and FEV_1 of first-degree obese individuals were at 90% of what was expected. And as the BMI went up, decrease in lung function was noticed, such that values of FVC and FEV_1 were at 77% of what was predicted. Having shown this, Melo et al.[21] found that the higher the BMI, the lower the level of lung function, probably because of the mechanical changes that come about from the excess of body fat in the body.

Some studies demonstrate an inverse relationship between BMI and quality of life[26, 27], as was shown in the present study, when observing the SF-36 survey: the results related to mental health items were higher than those related to physical health. The results might be due to physical discomfort caused by excess weight, when compared to the impact on mental and psychological health.

These results are similar to those from Brilmann et al.[27], who measured and found average values of the physical component lower than those of the mental one, due to physical discomfort reported by the patients. The same was not reported by Vasconcelos et al.[26], who found better scores in the mental component due to psychological treatment provided to the individuals waiting in line for bariatric surgery.

Some studies relate pulmonary function values to quality of life evaluation; however, they refer only to patients with conditions such as chronic obstructive pulmonary disease[28, 29, 30]. In this study, no significant relation was found between the SF-36 survey results and maximum respiratory pressures and lung function, probably because the changes in respiratory muscles strength and pulmonary function were minimal or nonexistent, such that the quality of life of the individual is not affected.

This study has as a limitation the fact that the sample was small, hence, not able to capture a significant sample of the population. Another important fact is that most of the individuals – 85.71% – were female and, due to the particularity of female distribution of body fat, it was expected there would be less impact on pulmonary function.

Conclusion

This study shows in our sample that respiratory muscle strength and lung function do not affect the quality of life of morbidly obese individuals. Also, morbid obesity does not seem to affect respiratory muscle resistance negatively.

Therefore, new studies will be useful to verify the observed results of the effects of respiratory muscle strength and pulmonary function on the life of morbidly obese individuals.

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