RELATIONSHIP BETWEEN OBESITY AND PULMONARY FUNCTION IN INDUSTRIAL SECTOR WORKERS

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SUMMARY

Introduction: obesity induces various respiratory adaptations to maintain an efficient level of gas exchange and tissue oxygenation. The reduction of thoracic mobility, decreased diaphragm excursion, and lower capacity for forced expiratory maneuvers are some of the factors of obesity that impact pulmonary function. **Objective:** to relate the presence of obesity with pulmonary function in workers in the industrial sector. Methods: This is a cross-sectional observational study conducted with 143 workers from the industrial sector, with 94 (67.5%) being male and 49 (34.3%) female. Obesity was assessed by body mass index (BMI) and waist circumference (WC). Lung function was assessed by spirometry. **Results:** Workers with a higher BMI showed a longer forced expiratory time (FET) (Δ= +0.54s, p=0.006), and those with a smaller waist circumference performed better in spirometric variables, with a lower forced vital capacity (FVC) (Δ= +0.43L, p=0.019), %FVC (Δ= +12.2%, p<0.001), and percentage of predicted forced expiratory volume in one second (%FEV1) (Δ= +7.3%, p=0.044). FVC (Δ= +0.43L, p=0.019), %FVC (Δ= +12.2%, p<0.001), and the predicted percentage of forced expiratory volume in the first second (%FEV1) (Δ= +7.3%, p=0.044). There was a positive correlation of BMI (r=0.17, p=0.042) and WC (r=0.31, p<0.001) with FEV1. CC showed a negative correlation with %FEV1 (r=0.21, p=0.014). Conclusion: The pulmonary function parameters indicated different results according to BMI and WC. It is important to emphasize the significance of encouraging the maintenance of CC within the expected values, as it can affect lung function and is a highly related marker for cardiovascular diseases.

Keywords: Obesity; respiratory function tests; industrial sector workers.

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Introduction

Obesity is capable of generating a restrictive respiratory syndrome due to the accumulation of perithoracic and abdominal fat, which reduces the expiratory reserve volume (ERV) and functional residual capacity (FRC) (SANT'ANNA et al., 2019). Furthermore, it causes imbalances in the ventilation-perfusion ratio, considering the hypoxemia at rest and in the supine position, which can probably be explained by the occlusion of smaller airways in people with this health condition (MASA et al., 2019).

On the other hand, the industrial work environment exposes workers to the inhalation of various particles, which can cause respiratory diseases or alterations in lung function (MOLANO; MERCHÁN; ARCINIEGAS, 2019). It is known that the prevalence of overweight among industrial workers is high, with rates exceeding 50% (NAKAHASHI; LEONI, 2020). However, there are few studies that correlate spirometric variables with obesity measures in industrial sector workers. Thus, the objective of the study is to relate the presence of obesity with pulmonary function in industrial sector workers.

Methodology

Sample

This is an analytical cross-sectional study conducted in an industry located in the Agroindustrial District of Anápolis (DAIA), in Goiás, with approximately 300 employees. The recruitment of participants was conducted via invitation. Workers with at least 6 (six) months of service in the industry, aged between 18 and 59 years, were included, excluding those with chronic or exacerbated cardiorespiratory diseases that interfered with pulmonary function. Of the 162 workers who agreed to participate in the study, only 143 completed all the stages. The sample power was calculated using the GPower software (version 3.1, University of Düsseldorf, Germany), which is freely available, considering the tests to be performed (group comparison and Pearson correlation) with a medium effect size (q) of 0.5; a significance level of 5%; 143 participants, achieving a sample power of 97%.

Study design

After signing the informed consent form (ICF), a form was filled out with data on age, sex, current position in the company, level of education, marital status, monthly income, medications in use, presence of comorbidities, and smoking history. Next, respiratory function was assessed using spirometry, and the presence of obesity was evaluated through waist circumference and body mass index (BMI).

Evaluation protocols

The presence of obesity was assessed by BMI and waist circumference (WC). The BMI will be calculated by dividing body mass by height squared (WHO, 2000). Eutrophic BMI was considered for workers with values $<25g/m^2$ and overweight for those with values $\geq 25kg/m^2$ (WHO, 2000). The waist circumference (WC) was measured at the midpoint between the last rib and the superior point of the iliac crest. For the waist circumference (WC), the expected values were considered to be ≤ 88 cm for women and ≤ 102 cm for men (WHO, 2011).

The spirometry was performed with a portable device (MIR, MiniSpir, Rome, Italy) and disposable mouthpieces. The conduct of the examination followed the guidelines of the American Thoracic Society/European Respiratory Society (GRAHAM et al., 2019; STANOJEVIC et al., 2022) and was interpreted according to Knudson (1983) (predicted values according to age). Lung function was assessed using the following parameters: peak expiratory flow (PEF), forced vital capacity (FVC), forced expiratory volume in the first second (FEV1), forced expiratory flow between 25-75% of the maneuver (FEF25-75%), the FEV1/FVC ratio, and forced expiratory time (FET).

Data analysis

The data were expressed as mean, frequency, percentage, and standard deviation. To verify the normality of the data, the Kolmogorov-Smirnov test was used. For comparison between groups, the t-Student test for independent samples (symmetric distribution) and the Mann-Whitney test (asymmetric distribution) were used. The correlation between obesity and pulmonary function variables was tested using the Pearson and Spearman correlation coefficients. It was considered p<0.05. The software used for the analysis was the Statistical Package for Social Science (SPSS, version 23.0, IMB, Armont, NY).

Results

Table 1 characterizes the study sample.

Table 1 – Profile of the study sample (n=143).

Variáveis	Total (n=143)	Masculino (n = 94)	Feminino (n = 49)	p*
Idade (anos)	33,06±9,84	33,87±9,86	31,49±9,69	0,163
Massa (kg)	78,47±15,86	80,90±15,60	73,79±15,44	0,015
Estatura (m)	1,72±0,10	1,76±0,07	1,64±0,09	<0,001
IMC (kg/m2)	26,65±4,94	21,02±8,64	18,99±10,07	<0,371
CC (cm)	88,29±13,48	89,41±12,01	86,44±15,89	0,212

IMC: índice de massa corporal; CC: circunferência de cintura. *Dados para p<0,05. Fonte: Elaborada pelo autor (2024).

The Tiffeneau-Pinelli index was higher in workers with excess weight (Δ= +0.54s, p=0.006). When stratification via CC was performed, workers with CC within the expected range had higher values for FVC (Δ= +0.43L, p=0.019), %FVC (Δ= +12.2%, p<0.001), and FEV1 (Δ= +7.3%, p=0.044).

Table 2 – Comparison of pulmonary function according to BMI and WC (n=143).

Lung function	IMC			CC		
	Eutrophic (n = 60)	Excess weight (n = 83)	p	Expected (n = 109)	Above expectations (n = 34)	p*
PFE (L/s)	6,59±0,26	6,64±2,24	0,875	6,64±2,13	6,55±2,28	0,823
CVF (L)	4,14±0,93	4,09±0,93	0,790	4,22±0,95	3,79±0,80	0,019
%CVF	87,29±15,45	85,41±17,71	0,509	89,10±16,02	76,90±15,91	<0,001
VEF1 (L)	3,59±0,81	3,53±0,87	0,642	3,63±0,86	3,31±0,74	0,054
%VEF1	77,92±16,54	73,16±18,50	0,115	76,83±18,12	69,80±15,81	0,044
VEF1/CVF	0,87±0,08	0,86±0,10	0,632	0,86±0,09	0,87±0,07	0,543
FEF25-75 (L/s)	4,43±1,29	4,51±1,37	0,717	4,52±1,36	4,34±1,26	0,489
%FEF25-75	107,11±28,09	112,41±28,74	0,274	109,25±28,75	113,20±27,85	0,782
TEF (s)	2,39±0,92	2,84±1,06	0,006	2,61±1,02	2,79±1,04	0,371

BMI: body mass index; WC: waist circumference; PEFR: peak expiratory flow rate; FVC: forced vital capacity; FEV1: forced expiratory volume in one second; FEF: forced expiratory flow. *Data for p<0.05. Source: Prepared by the author (2024).

Regarding BMI, it was observed that an increase in BMI (r=0.17, p=0.042) and WC (r=0.31, p<0.001) is related to an increase in forced expiratory time (FET). The WC showed a negative correlation with %FEV1 (r=0.21, p=0.014).

Table 3 – Correlation of BMI and WC measurements with lung function (n=143).

Variables	IMC (n = 143)		CC (n = 143)	
	r	p	r	p
PFE (L/s)	0,04	0,664	0,16	0,054
CVF (L)	0,10	0,231	0,06	0,465
%CVF	-0,09	0,302	-0,06	0,504
VEF1 (L)	-0,10	0,256	0,03	0,756
%VEF1	-0,12	0,151	-0,21	0,014
FEF25-75% (L/s)	0,01	0,906	0,05	0,570
%FEF25-75	0,16	0,053	0,03	0,678
TEF (s)	0,17	0,042	0,31	<0,001

BMI: body mass index; WC: waist circumference; PEFR: peak expiratory flow rate; FVC: forced vital capacity; FEV1: forced expiratory volume in one second; FEF: forced expiratory flow. TEF: forced expiratory time. *Data for p<0.05. Source: Prepared by the author (2024).

Conclusion

The pulmonary function parameters indicated different results according to BMI and WC. When stratified according to BMI, only the FEF showed differences. However, when CC was used as a marker for obesity, the FVC and FEV1 parameters, which indicate restrictive and obstructive components, respectively, were higher in workers with the predicted CC. The WC showed a negative correlation with %FEV1, while the BMI showed a positive correlation with FEF. It is important to emphasize the importance of encouraging the maintenance of CC within the expected values since it can affect lung function and is a highly related marker to cardiovascular diseases.

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