



ORIGINAL ARTICLE

## Effect of exercise test on pulmonary function of obese adolescents<sup>☆,☆☆</sup>

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### KEYWORDS

Obesity;  
Lung function;  
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### Abstract

**Objective:** to investigate the pulmonary response to exercise of non-morbidly obese adolescents, considering the gender.

**Methods:** a prospective cross-sectional study was conducted with 92 adolescents (47 obese and 45 eutrophic), divided in four groups according to obesity and gender. Anthropometric parameters, pulmonary function (spirometry and oxygen saturation [SatO<sub>2</sub>]), heart rate (HR), blood pressure (BP), respiratory rate (RR), and respiratory muscle strength were measured. Pulmonary function parameters were measured before, during, and after the exercise test.

**Results:** BP and HR were higher in obese individuals during the exercise test ( $p = 0.0001$ ). SatO<sub>2</sub> values decreased during exercise in obese adolescents ( $p = 0.0001$ ). Obese males had higher levels of maximum inspiratory and expiratory pressures ( $p = 0.0002$ ) when compared to obese and eutrophic females. Obese males showed lower values of maximum voluntary ventilation, forced vital capacity, and forced expiratory volume in the first second when compared to eutrophic males, before and after exercise ( $p = 0.0005$ ). Obese females had greater inspiratory capacity compared to eutrophic females ( $p = 0.0001$ ). Expiratory reserve volume was lower in obese subjects when compared to controls ( $p \leq 0,05$ ).

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<sup>☆☆</sup> Study conducted at the Laboratory of Pulmonary Physiology of the Pediatric Investigation Center, Department of Pediatrics, Faculdade de Ciências Médicas, Universidade Estadual de Campinas, Campinas, SP, Brazil.

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**PALAVRAS-CHAVE**

Obesidade;  
 Função pulmonar;  
 Adolescência;  
 Exercício

*Conclusion:* obese adolescents presented changes in pulmonary function at rest and these changes remained present during exercise. The spirometric and cardiorespiratory values were different in the four study groups. The present data demonstrated that, in spite of differences in lung growth, the model of fat distribution alters pulmonary function differently in obese female and male adolescents.

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**Efeito do teste do exercício na função pulmonar de adolescentes obesos****Resumo**

*Objetivo:* verificar a resposta da função pulmonar ao exercício em adolescentes obesos, não mórbidos, nos diferentes gêneros.

*Métodos:* estudo transversal com 92 adolescentes (47 obesos e 45 eutróficos), divididos em quatro grupos de acordo com obesidade e gênero, submetidos à avaliação de parâmetros antropométricos, função pulmonar [espirometria e saturação de oxigênio (SatO<sub>2</sub>)], frequência cardíaca (FC), pressão arterial (PA), frequência respiratória (FR) e força dos músculos respiratórios. A função pulmonar foi avaliada antes, durante e após teste de esforço.

*Resultados:* a PA e a FC foram maiores nos dois grupos de obesos, durante teste de esforço ( $p = 0,0001$ ) enquanto os valores de SatO<sub>2</sub> diminuíram durante o exercício ( $p = 0,0001$ ) nestes grupos. Meninos obesos apresentaram maiores valores de pressão inspiratória e expiratória máxima ( $p = 0,0002$ ), quando comparados com as meninas obesas e eutróficas. A ventilação voluntária máxima, capacidade vital forçada e o volume expiratório forçado no primeiro segundo apresentaram menores valores em meninos obesos, quando comparados com meninos não obesos, antes e após exercício ( $p = 0,0005$ ). Os valores de capacidade inspiratória foram maiores em meninas obesas quando comparado com as eutróficas ( $p = 0,0001$ ). Os valores de volume de reserva expiratória foram menores em todos os obesos comparados com os controles ( $p < 0,05$ ).

*Conclusão:* adolescentes obesos apresentam alterações da função pulmonar no repouso e que não se alteram com o exercício. Os valores das variáveis espirométricas e cardiorrespiratórias foram diferentes nos quatro grupos estudados. Os resultados mostram; que além de diferenças no crescimento pulmonar o modelo de distribuição de gordura pode alterar a função pulmonar diferentemente em meninas e meninos obesos.

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**Introduction**

Obesity and pulmonary function have a historical association. Unlike investigations conducted in adults, studies of physical activity and cardiorespiratory fitness in obese adolescents are still scarce and inconclusive.<sup>1</sup>

Obesity is currently one of the most severe public health problems worldwide, and has attracted the attention of many researchers around the world.<sup>2</sup> Obese children and adolescents may have physical and metabolic disorders, psychosocial stress, and changes in respiratory function.<sup>3-5</sup>

Among the different systems affected by obesity, the respiratory system deserves special attention, as obesity can cause changes in respiratory function, exercise tolerance, pulmonary gas exchange, respiratory pattern, and strength and endurance of the respiratory muscles.<sup>6</sup>

It is known that obesity is an inflammatory disease, with cytokine expression that alters pulmonary function and results in a greater risk for cardiovascular disease and mortality.<sup>3,6</sup> There is enough evidence that obesity represents an important burden on the respiratory system, causing alterations in pulmonary volumes, pattern of breathing, and airway smooth muscle.<sup>6</sup>

The most frequent pulmonary function alteration in obese children is the reduction in functional residual capacity and diffusion capacity. One of the mechanisms of alteration in respiratory mechanics caused by obesity is the accumulation of fat in the chest, diaphragm, and abdomen.<sup>7</sup> The accumulation of fat can compress the chest wall, diaphragm, and lungs, reducing lung volumes and flow.<sup>8</sup> Fat distribution in children and adolescents differs from that in adults, and it is little studied between genders;<sup>7,8</sup> therefore, obesity may alter the lung function of children and adolescents differently from that of adults.

Changes in pulmonary function due to complications of obesity are well described in adults, and reductions in lung volumes and expiratory flow are often reported. In contrast, there have been few studies that correlate the effects of obesity with pulmonary function, cardiorespiratory alterations, and physical activity in children and adolescents.<sup>7,9,10</sup> Most studies retrieved in the literature associating lung function with obesity and exercise were performed in children and adolescents with asthma.<sup>11,12</sup>

Considering the high and increasing prevalence of obesity in Brazil, this study aimed to investigate the pulmonary response to exercise in non-morbidly obese adolescents of both genders, with no respiratory diseases.

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