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REVIEW ARTICLE

Effects of obesity on lung volume and capacity in children and adolescents: a systematic review

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KEYWORDS

Lung function tests;
Lung volume
measurements;
Total
plethysmography;
Obesity;
Pediatrics

Abstract

Objective: To assess the effects of obesity on lung volume and capacity in children and adolescents.

Data source: This is a systematic review, carried out in Pubmed, Lilacs, Scielo and PEDro databases, using the following Keywords: Plethysmography; Whole Body OR Lung Volume Measurements OR Total Lung Capacity OR Functional Residual Capacity OR Residual Volume AND Obesity. Observational studies or clinical trials that assessed the effects of obesity on lung volume and capacity in children and adolescents (0–18 years) without any other associated disease; in English; Portuguese and Spanish languages were selected. Methodological quality was assessed by the Agency for Healthcare Research and Quality.

Data synthesis: Of the 1,030 articles, only four were included in the review. The studies amounted to 548 participants, predominantly males, with sample size ranging from 45 to 327 individuals. 100% of the studies evaluated nutritional status through BMI (z-score) and 50.0% reported the data on abdominal circumference. All demonstrated that obesity causes negative effects on lung volume and capacity, causing a reduction mainly in functional residual capacity in 75.0% of the studies; in the expiratory reserve volume in 50.0% and in the residual volume in 25.0%. The methodological quality ranged from moderate to high, with 75.0% of the studies classified as having high methodological quality.

Conclusions: Obesity causes deleterious effects on lung volume and capacity in children and adolescents, mainly by reducing functional residual capacity, expiratory reserve volume and residual volume.

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PALAVRAS-CHAVE

Testes de função pulmonar;
Medidas de volume pulmonar;
Pletismografia total;
Obesidade;
Pediatria

Efeitos da obesidade sobre os volumes e as capacidades pulmonares em crianças e adolescentes: uma revisão sistemática

Resumo

Objetivo: Avaliar os efeitos da obesidade sobre os volumes e as capacidades pulmonares em crianças e adolescentes.

Fontes de dados: Trata-se de uma revisão sistemática, através das bases de dados Pubmed, Lilacs, SciELO e PEDro, por meio das seguintes palavras-chave: Plethysmography, Whole Body OR Lung Volume Measurements OR Total Lung Capacity OR Functional Residual Capacity OR Residual Volume AND Obesity. Foram selecionados estudos observacionais ou ensaios clínicos que avaliaram os efeitos da obesidade sobre os volumes e as capacidades pulmonares em crianças e adolescentes (0 a 18 anos), sem qualquer outra doença associada, nos idiomas inglês, português e espanhol. A qualidade metodológica foi avaliada através da Agency for Healthcare Research and Quality.

Síntese dos dados: Dos 1.030 artigos, apenas quatro foram incluídos nesta revisão. Os estudos totalizaram 548 participantes, com predomínio do sexo masculino e tamanho amostral entre 45 e 327 indivíduos; 100% dos estudos avaliaram o estado nutricional através do IMC (escore-z) e 50% informaram os dados da circunferência abdominal. Todos demonstraram que a obesidade causa efeitos negativos sobre os volumes e as capacidades pulmonares, causa redução, principalmente, da capacidade residual funcional em 75% dos estudos, do volume de reserva expiratório em 50% e do volume residual em 25%. A qualidade metodológica variou entre moderada e alta, com 75% dos estudos classificados com alta qualidade metodológica.

Conclusões: A obesidade causa efeitos deletérios sobre os volumes e as capacidades pulmonares em crianças e adolescentes, com redução principalmente da capacidade residual funcional, volume de reserva expiratório e volume residual.

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Introduction

Childhood obesity is currently a major public health problem and increases at an alarming rate in the world's population, including the Brazilian population.¹ It is estimated that 150 million adults and 15 million children are obese.² Recently, epidemiological data indicated that the prevalence of obesity in the United States is approximately 17% and affects about 12.7 million children and adolescents.³ In Brazil, some studies show that the prevalence of obesity ranges from 2.4 to 19.2%, affecting more the South and Southeast regions.⁴

According to the World Health Organization, obesity can be defined as an abnormal condition of body fat or excess fat tissue, which causes damage to the individual's health.¹ Some situations or clinical conditions seem to be associated with its development, such as sedentary lifestyle, asthma, diabetes, hypertension, cardiovascular and respiratory diseases. Among these, the respiratory system deserves special attention, as excess weight brings direct changes to ventilatory mechanics.^{1,5,6}

In recent decades, previous studies suggested that obesity causes a major change in the respiratory system, resulting in loss on thoracoabdominal synchronism.⁷ The increase in body weight causes limitation of diaphragmatic mobility and reduced back movement, with impaired pulmonary gas exchange and breathing pattern control.⁷⁻¹⁰ Moreover, excess adipose tissue is associated with increased inflammatory mediators and cytokines, which could alter the

pulmonary airways of these subjects and contribute to the development of bronchial hyperreactivity.¹¹

In addition to the abovementioned changes, the research on the subject points to the presence of important lung function alterations in children and adolescents with excess fat, including reduced forced expiratory volume in one second (FEV₁), forced vital capacity (FVC) and forced expiratory flow between 25 and 75% of FVC (FEF_{25-75%}).^{12,13}

A systematic review published in 2012¹⁴ showed, through a critical analysis of five studies, that obesity leads to losses mainly in FEV₁ and FVC. However, this study only evaluated the effects of body weight on spirometric variables.¹⁴ Taking into account that the spirometry test directly investigates obstructive pulmonary parameters and that the obesity factor seems to affect more the restrictive pattern,^{1,5} the importance of investigating, through plethysmography, the effects of body mass on lung volume and capacity in children is emphasized. Moreover, to date, the results are contradictory in terms of the impact of obesity on these pulmonary outcomes in samples of young individuals.¹⁵

Therefore, considering the increasing prevalence of obesity in the pediatric population, the effects of this chronic condition on ventilatory mechanics and the conflicting information on the impact of excess weight on lung volume, we feel the necessity to obtain more information on the topic. Thus, the aim of this review was to evaluate the effects of obesity on the lung volume and capacity in children and adolescents.

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