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## ORIGINAL ARTICLE

# Association between cardiorespiratory fitness and body fat in girls

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### KEYWORDS

Adolescent;  
Physical fitness;  
Body composition

### Abstract

**Objective:** To estimate the prevalence of low cardiorespiratory fitness and its association with excess body fat, considering the sexual maturation and economic level in female adolescents. **Methods:** Cross-sectional, epidemiological study of 1223 adolescents (10–17 years) from the public school system of Cascavel, PR, Brazil, in 2006. We analyzed the self-assessed sexual maturation level (prepubertal, pubertal and post-pubertal), the economic level (high and low) through a questionnaire and body fat (normal and high) through triceps and subscapular skinfolds. The 20-meter back-and-forth test was applied to estimate maximum oxygen consumption. Cardiorespiratory fitness was assessed according to reference criteria and considered low when the minimum health criterion for age and sex was not met. Chi-square test and logistic regression were applied, with a significance level of 5%.

**Results:** The prevalence of low cardiorespiratory fitness was 51.3%, being associated with all study variables ( $p < 0.001$ ). At the crude analysis, adolescents with high body fat were associated with low cardiorespiratory fitness, when compared to those with normal body fat ( $OR = 2.76$ ; 95%CI: 2.17–3.52). After adjustment by sexual maturation, this association remained valid and showed an effect that was 1.8-fold higher (95%CI: 1.39–2.46) and after adjusting by economic level, the effect was 1.9-fold higher (95%CI: 1.45–2.61).

**Conclusions:** Approximately half of the assessed girls showed unsatisfactory levels of cardiorespiratory fitness for health, which was associated with high body fat, regardless of sexual

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## PALAVRAS-CHAVE

Adolescente;  
Aptidão física;  
Composição corporal

maturation level and economic level. Effective public health measures are needed, with particular attention to high-risk groups.

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## Relação entre aptidão cardiorrespiratória e adiposidade corporal em meninas

### Resumo

**Objetivo:** Estimar a prevalência de aptidão cardiorrespiratória baixa e sua associação com excesso de adiposidade corporal, considerando a maturação sexual e o nível econômico, em adolescentes do sexo feminino.

**Métodos:** Estudo epidemiológico transversal com 1.223 adolescentes (10-17 anos) da rede pública de ensino de Cascavel, PR, Brasil, em 2006. Analisou-se a maturação sexual (pré-púbere, púbere e pós-púbere) autoavaliada, o nível econômico (NE) (alto e baixo) por questionário e a adiposidade corporal (normal e elevada) por dobras cutâneas do tríceps e subescapular. Aplicou-se o teste de vaivém de 20 metros para estimar o consumo máximo de oxigênio. A aptidão cardiorrespiratória foi avaliada por critérios referenciados e considerada baixa quando não atingido o critério mínimo para a saúde segundo idade e sexo. Foram aplicados o teste de qui-quadrado e a regressão logística, com nível de significância de 5%.

**Resultados:** A prevalência de aptidão cardiorrespiratória baixa foi de 51,3% que se associou a todas as variáveis do estudo ( $p < 0,001$ ). Na análise bruta, as adolescentes com adiposidade corporal elevada associaram-se à aptidão cardiorrespiratória baixa, quando comparada com aquelas com adiposidade normal (RC=2,76; IC95% 2,17-3,52). Após ajuste pela maturação sexual, essa associação se manteve e mostrou efeito 1,8 vez maior (IC95% 1,39-2,46) e, após ajuste pelo NE, o efeito foi 1,9 vezes maior (IC95% 1,45-2,61).

**Conclusões:** Aproximadamente metade dos avaliados apresentou níveis insatisfatórios de aptidão cardiorrespiratória para a saúde, o que se associou à adiposidade corporal elevada, independentemente da maturação sexual e NE. Medidas efetivas de saúde pública são necessárias, com especial atenção para grupos de maior risco.

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## Introduction

Cardiorespiratory fitness is considered an important marker of health since childhood and adolescence.<sup>1</sup> It is defined as the capacity of the circulatory and respiratory systems to supply oxygen to the muscles during exercise of moderate to high intensity and involves large muscle groups for long periods of time.<sup>2</sup>

Studies indicate that cardiorespiratory fitness in children and adolescents has decreased in recent decades in 27 countries (reduction of 0.46%)<sup>3</sup> and in Brazil (reduction of 0.51%).<sup>4</sup> The proportion of adolescents that do not reach acceptable levels of this component of physical fitness for health varies from 37.8%<sup>5</sup> in Florianópolis to 60%<sup>6</sup> in Parana.

The low level of cardiorespiratory fitness is associated with increased cardiovascular risk factors and metabolic syndrome in young individuals,<sup>7</sup> as well as to increased cardiovascular risk in adulthood.<sup>8</sup> A meta-analysis showed that the overall risk of death from all causes or from cardiovascular disease was two-fold higher in individuals with low cardiorespiratory fitness levels, compared to those with high levels.<sup>8</sup> According to Azambuja et al.,<sup>9</sup> in 2004 the annual cost to public funds for the treatment of cardiovascular disease was R\$ 30.8 billion (36.4% for health, 8.4% for social security and reimbursement by employers and 55.2% as a result of lost productivity).

Another aggravating factor of low fitness levels is excess body fat even at early ages. Adolescents with excess body fat have lower cardiorespiratory fitness,<sup>6,10,11</sup> predominantly girls.<sup>10</sup> The increased gain in adiposity in adolescence is associated with the onset of puberty, at which stage girls, through action of the hormone estrogen, tend to accumulate higher amounts of body fat.<sup>12</sup> However, there is a study that reports a negative association between cardiorespiratory fitness and sexual maturation, which controlled the percentage of body fat in girls<sup>10</sup> and may indicate changes in cardiorespiratory fitness during the maturational and physical development.

Although the association between cardiorespiratory fitness and body adiposity has been explored in adolescents,<sup>6,13</sup> there is a gap in the literature on the association between these variables while considering the economic level. In adolescents of high economic level, better cardiorespiratory fitness was found in adolescents with less accumulation of body fat.<sup>6</sup>

When only the boys are assessed, the association between body fat and other physical fitness components is also inverse, but seems to differ between social strata.<sup>13</sup> Other authors, in a study involving both genders, reported no association between cardiorespiratory fitness and economic level.<sup>5</sup> These conflicting results emphasize the need for further studies to elucidate the association between

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