

INPLASY PROTOCOL

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Corresponding author:
Xianliang Wang

wangxianliang@sdu.edu.cn

Author Affiliation:
Shandong University.

Support: Shandong University.

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High-intensity interval training on overweight or obese children and adolescents Meta-analysis of the effects of cardiorespiratory fitness and dose-effect relationships

Deng, YR¹; Wang, XL².

Review question / Objective: Collection of recent RCT studies to validate the effect of high-intensity interval training on cardiorespiratory fitness in obese or overweight children and adolescents by qualitatively synthesizing maximal oxygen uptake values and the dose-effect relationship between the two.

Eligibility criteria: (1) The intervention in the experimental group was HIIT. (2) The intervention in the control group was normal rest or traditional aerobic training. (3) The study type was a randomized controlled trial. (4) The outcome indicator was VO₂max or a test that could indirectly calculate the value of VO₂max. (5) Subjects are overweight or obese children and adolescents (7-17 years old) who are not professionally trained. (6) Subjects have no acute or chronic disease

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INTRODUCTION

Review question / Objective: Collection of recent RCT studies to validate the effect of high-intensity interval training on cardiorespiratory fitness in obese or overweight children and adolescents by qualitatively synthesizing maximal oxygen uptake values and the dose-effect relationship between the two.

Rationale: In recent years, the rate of overweight or obesity among children and adolescents in China has remained high, and the level of physical fitness and cardiorespiratory fitness is low. As an important intervention to improve cardiorespiratory fitness, exercise has been widely concerned. Although relevant studies have confirmed that high-intensity

interval training (HIIT) can improve cardiorespiratory fitness in overweight or obese children, the dose-related effects of HIIT are unclear.

Condition being studied: Obesity and overweight among children and adolescents have become one of the serious public health problems in the world. In recent decades, children and adolescents in China have been sedentary, studying and playing for a long time, resulting in a sharp decrease in physical activity time, a continuous decrease in physical activity level and an increasing proportion of obesity. Severe obesity and overweight will significantly reduce the cardiorespiratory fitness (CRF) of individuals. As an important measure of physical health, CRF is critical to maintaining health and quality of life, and numerous studies have shown that low levels of CRF are strongly associated with all-cause risk mortality and the incidence of many cancers. In addition, chronically low levels of cardiorespiratory fitness in developing children and adolescents will increase the incidence of cardiovascular and metabolic diseases in adulthood. It has long been believed that exercise is an important means to reduce fat and promote cardiorespiratory health, and that daily physical activity of more than 60 min can maintain cardiorespiratory fitness, while supplementing with diet control or medication will have a strong additive effect on the improvement of cardiorespiratory fitness and physical health of children and adolescents. However, due to the high pressure of school and the temptation of entertainment, it is difficult for modern children and adolescents to spare time for physical exercise outside of school physical education classes, so high intensity interval training (HIIT), as a time-consuming, efficient and effective way of exercise, is gradually coming into the public's view.

It is worth noting that HIIT, as an emerging and efficient time-saving exercise modality, has been shown to have a significant effect on obesity intervention and cardiorespiratory fitness enhancement in

adults. In recent years, studies and systematic reviews have shown that HIIT has improved cardiorespiratory fitness in obese or overweight children and adolescents, but the results of current studies on high-intensity interval training to improve cardiorespiratory fitness in obese or overweight children and adolescents are inconsistent. 14%, while Lau's results showed that the HIIT group had a CRF value nearly 25% higher than the control group. This consistent orientation of effect but different degree of study results may be the result of different exercise protocols and intervention doses in the experimental design. Exercise intervention dose refers to the rated amount of exercise based on the training program, which generally includes the intervention period, intervention frequency, single intervention time, and exercise intensity, etc. Generally speaking, different exercise intervention doses may produce different intervention effects, referred to as dose-effect relationships. At present, although the effect of high-intensity interval training on cardiorespiratory fitness has been confirmed, the dose-effect relationship of high-intensity interval training on improving cardiorespiratory fitness in overweight or obese children and adolescents has not been clarified. This study was conducted to examine the overall effect of high-intensity interval exercise on the improvement of cardiorespiratory fitness level, and to investigate the dose-effect relationship between high-intensity interval training and the improvement of cardiorespiratory fitness level in obese or overweight children and adolescents, in order to provide an objective basis for future exercise practice and health interventions to improve the cardiorespiratory fitness level in obese or overweight children and adolescents.

METHODS

Search strategy: Seven electronic databases, including Pubmed, Web of Science, Cochrane library, Embase, China Knowledge Network, Wanfang Data Knowledge Service Platform, and Wipu.com, were selected to search the

randomized controlled trial (RCT) on the effects of high-intensity interval training on cardiopulmonary fitness in overweight and obese children and adolescents. The search was conducted from March 31, 2023 to March 31, 2023, using a combination of subject terms and free words to construct a search formula. intermittent OR high-intensity intermittent OR HIIT) AND (cardiorespiratory fitness OR maximal oxygen uptake OR peak oxygen uptake OR CRF) AND (children OR adolescent) AND (obese OR overweight); Chinese search formula: SU=("high-intensity interval training" + "HIIT") AND SU=("children" + "adolescents" + "children OR adolescent") AND SU=("obese" + "overweight") AND SU=("cardiorespiratory fitness" + CRF").

Participant or population: Obese or overweight children and adolescents.

Intervention: High-intensity interval exercise.

Comparator: Ensure normal rest or traditional aerobic training.

Study designs to be included: RCTs.

Eligibility criteria: (1) The intervention in the experimental group was HIIT. (2) The intervention in the control group was normal rest or traditional aerobic training. (3) The study type was a randomized controlled trial. (4) The outcome indicator was VO₂max or a test that could indirectly calculate the value of VO₂max. (5) Subjects are overweight or obese children and adolescents (7-17 years old) who are not professionally trained. (6) Subjects have no acute or chronic disease.

Information sources: PubMed, Web of Science, Cochrane library, Embase, CNKI, Wanfang Data Knowledge Service Platform, VIP.

Main outcome(s): VO₂max (Maximum oxygen uptake).

Additional outcome(s): None.

Data management: Endnote、Excel、Review Manager 5.3、Stata 17.

Quality assessment / Risk of bias analysis:

The study quality assessment was conducted by 2 researchers alone with reference to the quality evaluation method designed by Buchheit et al. based on the revised PRISMA principles, and the included literature was classified into 3 levels of high risk (0-3 points), moderate risk (4-6 points), and low risk (7-8 points) by cumulative evaluation scores. The method has 8 evaluation items: 1) having clear inclusion criteria; 2) randomized grouping; 3) no significant differences in baseline values between groups; 4) blinding of outcome raters; 5) all subjects receiving the intended intervention or intentional analysis of the experimental results; 6) the proportion of dropouts or missed visits is <20% and detailed reasons are described; 7) the number of subjects meets the calculated sample size; and 8) The study reports the effect size, precision, and results for each group.

Strategy of data synthesis: Meta-analysis was performed in this study using Review Manager 5.3 and Stata 17 software. Given that the outcomes of the included studies were continuous variables and the outcome indicators were not uniform, the study was statistically analyzed using standardized mean difference (SMD) and its 95% Confidence Interval (95% CI), and statistical significance was considered when $P \leq 0.05$. Also, Cochran's Q test and I² statistic were used to determine the magnitude of between-study heterogeneity: I² < 25% was low heterogeneity, 25% < I² < 50% was moderate heterogeneity, and I² > 50% was high heterogeneity; $P < 0.05$ was significant heterogeneity, and $P \geq 0.05$ was not significant heterogeneity. Egger test and funnel plot were used to detect publication bias in the included studies, and if publication bias existed, the trim and fill method (trim and fill method) was used to test the stability of the combined results.

Subgroup analysis: In this study, to explore the optimal dose-effect relationship,

subgroup analyses will be conducted on the variables of intervention period, number of intervention groups, single intervention time, single interval time, and intervention/interval time ratio.

Sensitivity analysis: Sensitivity analyses were conducted using two methods to ensure the reliability of the study results: 1) a secondary analysis of all statistical results by flipping the effects model. 2) a test of whether there was a significant effect of a single piece of literature on the effect results by reducing the literature by one piece at a time.

Language restriction: None.

Country(ies) involved: China.

Keywords: High-intensity interval training; obesity; children and adolescents; cardiorespiratory fitness; dose-effect relationship.

Contributions of each author:

Author 1 - Yiran Deng - collects and organizes data, draws charts and graphs, and conceives and writes articles.

Email: dengyiran776@163.com

Author 2 - Xianliang Wang - designed the overall framework of the thesis, conducted data review, analysis and interpretation, and guided and managed the entire writing process.

Email: wangxianliang@sdu.edu.cn