

# Current research status of non-pharmacological intervention for childhood obesity induced hypertension

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**Abstract:** Review the current research status of childhood obesity induced hypertension, including the relationship between childhood obesity and hypertension, criteria for assessing childhood hypertension, domestic and international status, and relevant intervention measures for childhood obesity induced hypertension. On this basis, we will understand whether corresponding intervention measures will have a certain improvement effect on childhood obesity induced hypertension, in order to further reduce the incidence of childhood obesity induced hypertension, improve the control effect of childhood obesity induced hypertension, and promote children's physical health.

**Keywords:** Children, Obesity, Hypertension, present situation

## 1. Introduction

The factors that affect childhood hypertension include overweight and obesity, diet, physical activity, sleep disorders, low birth weight, gestational hypertension, maternal obesity, smoking, etc. Among them, obesity is a global health problem<sup>[1,2]</sup>. Over the past 30 years, the global prevalence of overweight and obesity among children has increased by 47.1%. In 2010, nearly 6.7% or 43 million (35 million in developing countries) of children under the age of five were overweight or obese, with 92 million children at risk of overweight<sup>[3]</sup>. The research results of Leila Barati et al. show that the prevalence of overweight and obesity in girls aged 4-5 is 22% and 27.6%, respectively, and in boys it is 7.5% and 8.7%, respectively<sup>[4]</sup>. The proportion of obesity and overweight in 6-7 year old children in Makazi Province, Iran is 9.9% and 15.5%, respectively. Some studies have pointed out that among well nourished children, the incidence rate of hypertension is about 10.4%, but when it is related to obesity or overweight, the incidence rate can rise to 38% and 68% respectively<sup>[5-7]</sup>. Bonita Falkne and others pointed out that the goal of preventing hypertension in early childhood includes preventing and reducing obesity, and if the initial prevention of abnormal blood pressure in childhood is effective, it can reduce the incidence rate of hypertension in youth, and may inhibit the incidence rate of hypertension related cardiovascular diseases<sup>[1]</sup>. The study by Thomas Reinehrd et al. also found that the body mass index (BMI) of children and adolescents is significantly correlated with systolic and diastolic blood pressure, and the higher the degree of obesity, the higher the blood pressure<sup>[8]</sup>. There is also research data indicating that 31% of obese children suffer from hypertension<sup>[9]</sup>. From this, it can be seen that obesity is an important risk factor for the development of hypertension in children, and the increase in the incidence of hypertension is positively correlated with the increase in obesity and overweight. In addition, hypertension can lead to an increase in the incidence of other cardiovascular diseases. Therefore, how to better control obesity and overweight children's hypertension is currently a key issue that needs to be addressed. Therefore, this article mainly reviews the research status of childhood obesity induced hypertension, and understands the intervention status and effectiveness of childhood obesity induced hypertension.

## 2. The criteria for judging hypertension in children

The diagnostic criteria for hypertension in children and adolescents in China are based on the "Gender, Age, and Height Blood Pressure Reference Standards for Children and Adolescents Aged 3-17 in China" released by the Mijie team in 2017. Children and adolescents aged 6-17 are divided into two age groups: 6-11 and 12-17 years old, with high systolic blood pressure thresholds of 115mmHg and 125mmHg, and high diastolic blood pressure thresholds of 74mmHg and 79mmHg, respectively<sup>[10]</sup>.

The 2016 European Hypertension Association Guidelines for the Management of Hypertension in Children and Adolescents, released in Europe in 2016, have been adopted abroad to set the blood pressure threshold for adolescents over 16 years old to be the same as that of adults (139/89mmHg)<sup>[11]</sup>. The 2017 American Children's Association (AAP) released the Clinical Practice Guidelines for Screening and Managing Hypertension in Children and Adolescents, which defines hypertension in children and adolescents as clinically measured mean systolic and/or diastolic blood pressure  $\geq$  95 percentiles (based on age, gender, and height percentiles)<sup>[12]</sup>.

## 3. Epidemiology of childhood obesity and hypertension

The physical development level of children is linearly correlated with their blood pressure. Regardless of whether they are boys or girls, the systolic and diastolic blood pressure levels of children with normal body weight, overweight or obese are significantly higher than those of thin children. Moreover, body mass and blood pressure are closely related, and obesity related hypertension can further promote the aggregation of cardiovascular risk factors in obese children<sup>[13,14]</sup>. Ru Cuidan found in a survey of 122 children aged 10-12 that there were 28 obese children, accounting for about 22.95%. Among obese children, 17 had hypertension, accounting for 13.93%<sup>[15]</sup>. Wang Yilin et al. conducted a survey on school-age children in Shawan County, Xinjiang, and found that the detection rate of hypertension in the obese group was 4.90% (5/102), including 3 girls and 2 boys; The detection rate of super recombinant hypertension is 1.65% (4/242), with 2 cases in girls and 2 cases in boys; The detection rate of hypertension in the control group was 1.23% (13/1057), with 9 cases in girls and 4 cases in boys; The detection rate of hypertension in the obese group was significantly higher than that in the super recombinant group, and the detection rate of hypertension in the super recombinant group was significantly higher than that in the control group<sup>[16]</sup>.

A meta-analysis shows that the global prevalence of childhood hypertension increased by over 75% from 2000 to 2015, and the prevalence of hypertension among overweight children reached 15.27%<sup>[13]</sup>. A survey in Central Europe shows that the prevalence of hypertension in children and adolescents in Switzerland is 2.2%, in Hungary it is 2.5%, and in Poland it is 4.9%. The prevalence rate of children and adolescents in southern Europe is relatively high, about 9.0% in Türkiye, about 12.0% in Greece, and about 13.0% in Portugal. A screening of 52918 children and adolescents aged 3-19 in 10 countries in Africa showed that hypertension was 7.5%, prehypertension was 11.4%, and the prevalence of hypertension in the overweight and obese groups was 18.5%<sup>[11]</sup>. Compared to data before 2017, the prevalence of hypertension in African children and adolescents continues to increase, while emphasizing the potential impact of overweight and obesity on the incidence of hypertension<sup>[17]</sup>. South Korea investigated a total of 7804 children and adolescents from 2007 to 2009, 2010 to 2012, and 2013 to 2015, using American pediatric guidelines for analysis. The results showed an average increase in systolic blood pressure of 3.9 mmHg from 2007 to 2013 to 2015, with no significant change in diastolic blood pressure. The incidence rates of hypertension and prehypertension from 2013 to 2015 were 9.0% and 8.8%, respectively, which increased compared to the data from 2007 to 2009, Especially in the obese group, the prevalence of hypertension from 2013 to 2015 was 27.7%, indicating that obesity may be a risk factor for hypertension in children and adolescents<sup>[18]</sup>.

To sum up, in recent years, the number of overweight and obese children has increased internationally, and the incidence rate of childhood hypertension has also shown an upward trend. Overweight and obesity in children increase their risk of developing high blood pressure, placing a heavy burden on their bodies, and there is an urgent need for effective interventions.

## 4. Intervention strategies for obese hypertension

### 4.1 Exercise intervention

The global recommendation for promoting health through physical activity states that it is recommended to engage in at least 60 minutes of moderate intensity aerobic training every day to improve cardiovascular health, and sedentary activities should be reduced to less than two hours per day<sup>[19]</sup>. There is ample evidence to suggest that sedentary behaviors such as writing and watching electronic screens can put children at risk of elevated blood pressure<sup>[20,21]</sup>. Aguilar Cordero MJ et al.<sup>[22]</sup> research suggests that aerobic exercise can effectively reduce children's weight and lower blood pressure. The study by Whelton SP et al.<sup>[23]</sup> also pointed out that long-term adherence to aerobic exercise has a significant antihypertensive effect, but the antihypertensive effect of aerobic exercise itself is relatively weak. In addition, research by García Hermoso A has shown that planned physical activity has a good effect on reducing children's systolic and diastolic blood pressure<sup>[24]</sup>. From this, it can be seen that healthy exercise habits can reduce children's weight and have a good effect on controlling blood pressure in overweight and obese children. It is necessary to adhere to a healthy lifestyle and engage in appropriate physical exercise every day.

### 4.2 Dietary intervention

Lifestyle changes are the cornerstone of treating obesity and hypertension. Children should control their daily calorie intake appropriately and develop healthy eating habits. The study by Moore TJ et al.<sup>[25]</sup> suggests that a dietary method for preventing hypertension called DASH is a diet rich in vegetables and fiber, which can effectively reduce meat and fat consumption, especially when combined with low sodium intake, and has been proven to effectively lower blood pressure. In addition, avoiding sugary drinks can also lead to weight loss in children and is independently associated with decreased blood pressure in adults. A study on the impact of sugary drinks on weight in children and adults found that sugary drinks are positively correlated with weight gain, promoting an increase in BMI, emphasizing the importance of dietary adjustments<sup>[26,27]</sup>. Appel LJ et al.'s<sup>[28]</sup> study also pointed out that changing dietary habits, especially a low potassium and low sodium diet, has a better effect on reducing blood pressure. Therefore, changing dietary habits, controlling the content of sodium and potassium in the diet, eating more vegetables and fruits, and eating less carbohydrates and other foods with high sugar content can have a beneficial impact on controlling children's blood pressure.

### 4.3 Weight intervention

Cai L et al.<sup>[29]</sup> conducted a systematic review and meta-analysis on the impact of childhood obesity prevention plans on blood pressure, including nearly 19000 participants from 19 studies. The results showed that although obesity intervention plans were also effective in lowering blood pressure, plans targeting diet and physical activity had a more significant effect on lowering blood pressure. Similarly, the Obesity Working Group of the European Hypertension Association has concluded that achieving and maintaining long-term weight loss through lifestyle changes is more difficult, and therefore the beneficial effects of weight loss on blood pressure may not be sustained in the long term<sup>[30]</sup>. However, weight is closely related to blood pressure, and obesity related hypertension further exacerbates the aggregation of central vascular risk factors in obese populations. Therefore, first-line interventions should target weight loss and normalization of blood pressure, both of which are equally important<sup>[31]</sup>.

### 4.4 Timely monitoring

The American Heart Association and the American Academy of Pediatrics (AAP) emphasize the importance of primary and primary prevention in reducing the risk of cardiovascular disease in adolescents. An important component of this strategy is regular screening for elevated blood pressure and hypertension in children, and it is recommended that all children aged 3 and above measure their blood pressure at least once a year. Any increase in blood pressure should be confirmed through repeated measurements. For any child whose blood pressure continues to rise at the 95th percentile or above through artificial auscultation, a diagnosis of hypertension should be given. Timely monitoring of blood pressure has a good effect on preventing the occurrence of hypertension in children and preventing early hypertension<sup>[32-34]</sup>.

## 5. Conclusion

In summary, the influencing factors of hypertension in children are complex, among which obesity and overweight have a certain impact on the increase of blood pressure in children. Relevant data shows that the current population of obese children is large, so the incidence of childhood obesity induced hypertension will also increase. To control hypertension in children, attention should be paid to both weight loss and blood pressure reduction. Current research data shows that weight control, dietary management, and adherence to aerobic exercise all have a certain improvement effect on blood pressure reduction in overweight and obese children. However, maintaining weight loss in the long term is difficult and the effect of controlling blood pressure cannot be maintained in the long term. Similarly, aerobic exercise also needs to be persisted in the long term to have a good relieving effect on hypertension. In addition, the current literature lacks research on evaluation tools and predictive models related to childhood obesity induced hypertension. Timely monitoring of blood pressure helps to understand the condition of children's blood pressure in the early stage, and can reflect changes in children's blood pressure in a timely manner when hypertension has already occurred. Therefore, future research can focus on exploring ways and methods of exercise and long-term adherence to weight, as well as the study of related evaluation tools and predictive models, in order to provide better ways to reduce the occurrence of childhood obesity induced hypertension and control childhood obesity induced hypertension.

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