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ORIGINAL ARTICLE

Intensified association between waist circumference and hypertension in abdominally overweight children

Bin Dong[a,b], **Zhiqiang Wang**[a,b], **Yide Yang**[a], **Hai-Jun Wang**[a,*], **Jun Ma**[a,*]

[a] *Institute of Child and Adolescent Health, School of Public Health, Peking University Health Sciences Center, Beijing, China*
[b] *Centre for Chronic Disease, School of Medicine, The University of Queensland, Herston, Queensland, Australia*

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KEYWORDS
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Summary
Background: Abdominal adiposity is an important risk factor for childhood hypertension. The present study aimed to compare the strength of the association between waist circumference (WC) and hypertension in children with different WC levels.
Methods: A total of 82,413 Chinese children aged 9—17 years were selected. An abdominally overweight child was defined as a child with WC ≥75th sex- and age-specific percentile. Hypertension was categorised as ≥95th sex-, age- and height-specific percentile. Logistic regression model was applied to calculate the odds ratio (OR) and 95% confidence interval (CI) of WC for hypertension after WC was transformed into sex- and age-specific *z*-score.
Results: Abdominally overweight children presented a higher risk of hypertension (OR: 2.39; 95% CI: 2.26, 2.54) than children with normal WC. In children with normal WC, one sex- and age-specific standard deviation increase in WC was associated with a 42% increase in odds of hypertension (OR: 1.42; 95% CI: 1.30, 1.55). That increase was elevated to 74% in abdominally overweight children (OR: 1.74; 95% CI: 1.66, 1.82). A similar pattern was also observed in different sex and area groups, and in children 9—14 years old.

* Corresponding authors at: Institute of Child and Adolescent Health, School of Public Health, Peking University Health Sciences Center, 38 Xueyuan Road, Haidian District, Beijing 100191, China. Tel.: +86 10 82801624; fax: +86 10 82801178.
E-mail addresses: whjun1@bjmu.edu.cn (H.-J. Wang), majunt@bjmu.edu.cn (J. Ma).

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Conclusions: An intensified association between WC and hypertension was observed in abdominally overweight Chinese children. The gain in WC was associated with greater increase in hypertensive risk in abdominally overweight children than that of children with normal WC. These findings could improve intervention strategies for hypertension risk reduction in children.

Background

As abdominal fat poses a greater cardiovascular risk than subcutaneous fat [1,2], there has been an increasing concern about the effect of abdominal adiposity on hypertension, dyslipidemia, diabetes mellitus and other cardiometabolic diseases in both children and adults [3—5]. Waist circumference (WC) is considered an ideal predictor of abdominal adiposity in children [6,7]. Previous studies have demonstrated that abdominal fat plays an important role in the pathogenesis of hypertension in childhood [8], and children with larger WC tend to show a higher level of blood pressure (BP) [9,10].

Successive surveys in children revealed that the prevalence of abdominal obesity increased dramatically during the recent two decades across the world [7,11,12]. In China, the prevalence of abdominal obesity (defined by WC) rose from 4.9% in 1993 to 11.7% in 2009 [11]. However, the risk of hypertension in children with excess abdominal fat still needs to be elucidated, specifically in terms of whether abdominal adipose tissue has the same effects on risk for hypertension in children with normal and large WC. A better understanding of the relationship between abdominal adiposity and hypertension can aid the improvement of targeted intervention strategies for hypertension in children.

In addition to the positive association between body mass index (BMI) and BP [13], Tu and colleagues found this association was intensified in American children with high BMI [14]. However, BMI does not take into account the heterogeneity of regional body fat deposition [2]. Because this may lead to inconsistent results among studies relating BMI to cardiovascular outcomes, researchers suggested indicators of body fat distribution, such as WC, should be evaluated [2]. In addition, it has been reported that ethnic differences in cardiovascular risks appear even in early life [15,16], and it is still not clear whether a similar association applies to different racial/ethnic groups. Therefore, it is necessary to assess the impact of abdominal adiposity on hypertension in different populations.

To our knowledge, there have been no studies performed to compare the association between WC and hypertension in children with different WC levels. In the present study, we analysed WC and hypertension data collected in a national cross-sectional survey, Chinese National Survey on Students' Constitution and Health (CNSSCH), conducted in 2010. The strength of the association between WC and hypertension in children with normal WC was compared with that in abdominally overweight children, to further understand the role of abdominal adiposity on hypertension in Chinese children.

Methods

Study design and subjects

The sampling procedures of CNSSCH 2010 have been published previously in detail [17]. In brief, this survey used a stratified multistage sampling method to select Han nationality students from primary and secondary schools from 30 of the 31 mainland provinces (Tibet was surveyed but not included in this study because only Tibetans were selected in Tibet). Subjects in each province were classified into two area groups (urban and rural) according to their residential regions in the national household registration system, which were further classified into sex—age specific subgroups. In each subgroup, equal numbers of participants were selected by stratified cluster sampling from some classes, as clusters were randomly selected from each grade in the selected school. In the present study, 82,437 children and adolescents aged 9—17 years with the complete records were included. Twenty-four participants with extreme BP or WC (>6 sex—age specific standard deviations on either side of the mean) were excluded. As a result, a total of 40,988 boys and 41,425