Weight status, cardiorespiratory fitness and high blood pressure relationship among 5-12 years old Chinese primary school children

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DOI:
10.1038/jhh.2017.67

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Running title: Weight status, fitness and blood pressure in children

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Summary Table

What is known about this topic

- Cardiorespiratory fitness (CRF) and adiposity contribute to high blood pressure (HBP), but their relative importance is unknown.
- Data analyzed these relationships among Chinese children is lacking.

What this study adds

- Hypertension is common in Chinese children (prevalence 15.3%), with higher prevalence in obese (40.5% and 45.9% in boys and girls respectively) and overweight (27.6% and 30.2%).
- Weight status is strongly associated with likelihood of high blood pressure in Chinese primary school aged children.
- There was no evidence that increased CRF modified the risk of HBP in overweight and obese children.

Abstract

Cardiorespiratory fitness (CRF) and adiposity contribute to high blood pressure (HBP) in adults and children. However, their relative importance as risk factors is unknown. We examined the relationships between weight status, CRF and HBP among Chinese primary school children. A cross-sectional study was conducted with 4926 school children aged 5–12 years. CRF was estimated from a modified Cooper test, body mass index z-scores and weight categories were calculated from objective height and weight measurements, and BP was measured using an electronic sphygmomanometer. HBP was defined as >95th percentile based on reference cut-offs for Chinese boys and girls. Generalized Linear Mixed Models, adjusting for age, pubertal status and height, were developed for boys and girls to explore the independent and combined associations between fitness, weight status and HBP. 752 (15.3%) children had HBP, with a higher prevalence in obese (40.5% and 45.9% in boys and girls respectively) and overweight (27.6% and 30.2%) compared with non-overweight (9.0% and 13.8%) children. HBP prevalence was lower in boys with higher CRF (OR for highest vs. lowest CRF quartile in boys 0.64; 95%CI 0.46-0.89). This association was not seen in girls. With weight status and CRF in the same model, weight status, but not CRF, remained significantly associated with HBP (obesity in boys: OR 4.19; 95%CI 2.63-6.67; in girls: OR 2.49; 95%CI 1.19-5.19). The interaction effect for CRF and weight status was non-significant. Overweight/obesity was significantly associated with HBP among children. There was no evidence of modification of this relationship by CRF.

Keywords: Blood pressure; Cardiorespiratory fitness; Obesity, School children, China

Introduction

High blood pressure (HBP) is increasing in prevalence among children and youth, and there is evidence that HBP is present in Chinese children as young as 5 years old[1]. Serial cross-sectional studies in China indicate that the prevalence in adults has increased by 83.4% since 1991, affecting over a quarter of the population in 2007-2008[2-5]. There is increasing evidence of tracking of blood pressure (BP) levels from childhood to adult life and hypertension in childhood is associated with higher risk of cardiovascular disease and mortality in adulthood[6-10]. Two of the major modifiable risk factors for hypertension include obesity and low cardiorespiratory fitness (CRF)[11-14]. However, the exact pathophysiological mechanisms through which obesity and low CRF contribute to hypertension are not fully understood. Obesity is likely to act through inter-related complex mechanisms related to diet, and activation of the sympathetic nervous system causing vascular and renal injury[15]. Similarly there are multiple hypotheses to explain the mechanisms by which increased CRF alters blood pressure. Animal studies suggest that exercise training, which increases CRF, alters vasomotor tone through endothelial and smooth muscle adaptations[16]. In addition, a study in young adults has suggested that the relationship between CRF and arterial stiffness is mediated by resting heart rate[17]. There is some debate about the relative importance of CRF versus weight status as risk factors for HBP and whether they act independently. There is a wealth of evidence to suggest that low CRF is a potentially more important risk factor for premature all-cause mortality and cardiovascular mortality than obesity, and that amongst individuals with obesity, physical activity and CRF can significantly positively impact on obesity and the subsequent risk of cardiovascular disease[18-23]. Trials that compare the effects of diet only versus diet and physical activity interventions in obese adolescents, suggest that whilst both interventions result in reduction of BP, the addition of exercise results in normalization of forearm vascular conductance (similar to that seen in non-overweight children), whereas this is not seen in the diet only group[24]. Thus CRF may have effects on vascular health independently of weight status, although the exact mechanisms are not fully understood. Other studies suggest that higher levels of physical activity or CRF do not compensate for obesity in relation to cardiovascular risk[25-26]. Therefore, there is a need to further understand the relative importance of these two risk factors and their relationship with one another. A better understanding of the relationship between weight status, CRF and HBP in this age group would help to shape recommendations for interventions to improve the health of children and adolescents.

The prevalence of overweight and obesity in school-aged children in China (aged 5-12 years) has increased more rapidly than that seen in most Western countries[27-28], with the prevalence in some urban regions approaching those in developed countries[29-30]. In addition a report on the Physical Fitness and Health Surveillance of Chinese School Students in 2010 revealed that CRF in children has been decreasing during the past twenty five years[31]. Given the significant increases in these two major cardiovascular risk factors in Chinese children, we aimed to explore the prevalence of HBP and its relationship with these two risk factors, and also to examine the potential modification effect of CRF on the association between weight status and HBP. We hypothesized that both obesity and CRF would be associated with HBP in this population of children, and that CRF would attenuate the association between obesity and HBP.

Methods

We included a sub-group of participants who had the relevant measurements from a larger cross-sectional study that aimed to determine the prevalence and risk factors for childhood obesity in primary school-aged children in Guangzhou[32]. A multi-stage stratified cluster random sampling procedure was used to obtain a representative sample of primary school children in grades 1-5 (aged 5-12 years). Five of the ten urban districts were selected using a random number generator. Within each of these, all primary schools were stratified by public (residents) or private (migrant) status, and six were randomly chosen with a 2:1 ratio from each stratum. Permission for the study was not obtained for one of the private schools, leaving 29 participating schools. Within each school two classes per grade were randomly selected. The exclusion criteria included: children with invalid anthropometric measurements or questionnaire information and no parental consent.

Written informed consent was sought from the parents of 11445 eligible children through schools, resulting in 9917 (86.6%) participants (1403 children with no parental consent or invalid questionnaire; 125 children with invalid anthropometric measurements). Data collection took place from April to June 2014, with anthropometric, CRF (reduced Cooper test) and blood pressure measurements undertaken in school, by trained research staff using standardized procedures and instruments (see details below). All consented children had measurements of their height and weight, but more detailed measurements, including blood pressure and the reduced Cooper test, were undertaken on a subsample (children from one of the two classes per grade were randomly selected; n=4926 including 2725 boys and 2201 girls).

The study was approved by the Ethical Committee of the Guangzhou Center for Disease Control and Prevention and the University of Birmingham Research Ethics Committee. Permissions to conduct the study were granted by the Departments of Education and Health.

Anthropometric and BP measurements

Height and weight were measured with subjects wearing light clothing and without shoes. Weight was measured to the nearest 0.1 kg using an electronic scale (JH-1993T, weighing Apparatus Co. Ltd. Dalian). Height was recorded to the nearest 0.1 cm with a TGZ height tester (Dalian) according to the following protocol: no shoes, heels together, and student's heels, buttocks, shoulders, and head touching the vertical surface with line of sight aligned horizontally.

Blood pressure was measured by the same trained nurse using an electronic sphygmomanometer (Omron HEM-7211, Dalian) at the right arm with students in the seated position after at least 5 minutes of rest in a quiet classroom. The cuff size was based on the length and circumference of the upper arm and was chosen to be as large as possible without having the elbow skin crease obstruct the stethoscope. Two consecutive readings were taken on the same arm with a two-minute interval between each reading; the mean of the 2 measures was used for analysis. Systolic blood pressure (SBP) was defined by the first Korotkoff sound (appearance of sounds), and diastolic blood pressure (DBP) was defined by the fourth Korotkoff sound (sound muffling).

CRF measurements

CRF was assessed using a reduced Cooper test[33]. The full 12-minute Cooper test has been shown to be a very good predictor of maximum oxygen intake[34], but is inappropriate to administer to young children within a school setting[35]. We therefore opted for the reduced Cooper test (6-minute) which has been successfully used in primary school aged children and can be easily administered within school settings[33]. Children were asked to run counter clockwise along a track of fixed size (marked rectangle measuring 9×18m) as many times as they could within 6 minutes. The exercise was undertaken outdoors on level ground. Outdoor climate varies little from day to day in Guangzhou, where it is generally warm and humid. We incentivized children to make a maximal effort by explaining that the test results would be included in their school report. However, if they lacked the physical strength to run at any point, they were allowed to walk. The distance covered (measured in meters) was timed by a trained physical education teacher within school, using a stopwatch (CASIO, HS-70W stopwatch) to the nearest 0.1s. The physical education teacher recorded the number of complete laps done by each child, and estimated the distance for any incomplete laps at the end of the reduced Cooper test.

Other measurements

All children over the age of 9 years were assessed for whether or not they were pubertal by self-report, by asking girls if they had reached menarche and boys if they had experienced a first nocturnal emission. These questions were asked by a trained physician when the physical measurements were being undertaken.

Statistical Analysis

Body mass index (BMI; [weight (kg)]/[height (m)]^2), was calculated and standard deviation scores (BMI z-score) derived using the age and sex specific WHO growth reference for school-aged children[36]. BMI z-scores were used to classify participants as non-overweight (≤1SD), overweight (>1SD, ≤2SD) or obese (>2SD). HBP was defined as systolic or diastolic BP above the 95th percentile for age and gender specific reference cut-offs for Chinese children and adolescents[37]. As we were using a reduced Cooper test, we were unable to calculate the VO_2 max from the distance run using reference tables, therefore the distance covered was categorized into quartiles based on the child's age and sex, using the study data as the reference, with further categorization into higher (3rd and 4th quartiles) or lower (1st and 2nd quartiles) CRF.

Summary statistics (mean ±SD and percentages) were used to describe participant characteristics, prevalence of hypertension and the proportion of participants in the different CRF categories. Differences in characteristics between the sexes or weight status groups were determined using t-tests, analysis of covariance and Chi-square tests, where appropriate. Generalized linear mixed models, with school as a random effect to account for clustering, were used to examine the relationships between HBP as a dependent variable and CRF or weight status as independent variables by sex, both adjusted for age, pubertal status, and height (adjusted model I)[38]. A further model included both weight status, CRF and weight status×CRF as covariates (adjusted model II) by sex. We also examined differences in prevalence of HBP, mean SBP and mean DBP in those with high CRF compared to those with low CRF in each of the weight status subgroups to further explore the potential modification effect of CRF on the relationship between weight status and HBP. Finally, we carried out sensitivity analyses using the criteria introduced by international obesity taskforce (IOTF). Data were analyzed using SPSS 21.0 statistical software package (SPSS Inc., Chicago, IL). A 2-tailed P value less than 0.05 was considered statistically significant.

Results

Characteristics of the Study Sample

Among 4926 children in the sub-group who had BP measurements, 4,726 (2,725 boys and 2,201 girls) had complete data for the reduced Cooper test, BP, and weight and height, and so were included in the analysis. Descriptive characteristics of the sample are shown in Table 1. Overall 10.9% of children were overweight and an additional 6.9% were obese, with rates being higher in boys compared with girls.

Almost all children (100% of boys and 96.5% of girls) were pre-pubertal. Boys covered a greater distance in the reduced Cooper test (899.4 vs 864.8 m) and had a higher SBP compared with girls (107.6 vs 106.1 mmHg). SBP and DBP increased with increasing age in boys and girls. Around 15% of children had HBP, with prevalence rates being similar in boys and girls and no significant difference in prevalence by age.

Relationship between weight status and CRF among school children

There was a significant association between CRF and weight status (Table 2), with a higher proportion of non-overweight children being in the highest quartile for CRF (28.5% boys and 25.8% girls) compared with those who were obese (6.1% boys and 6.6% girls). Significant differences were clearly seen in the proportions of children in the high and low CRF categories across weight status groups, with 54.7% of non-overweight boys, 42.8% of overweight boys and 20.1% of obese boys in the high CRF group. The corresponding percentages of girls in the high CRF group were 51.5%, 39.2% and 19.7% for the non-overweight, overweight and obese categories, respectively.

Association between weight status, CRF and HBP among school children

There was a clear relationship between weight status and HBP, with prevalence of 9.0% (boys) and 13.8% (girls) in non-overweight children, 27.6% (boys) and 30.2% (girls) in overweight children, and 40.5% (boys) and 45.9% (girls) in obese children. Similarly there was a relationship between lower CRF and higher risk of hypertension in boys (prevalence of HBP 18.2% in the lowest versus 11.8%in the highest fitness quartile), although no clear relationship between fitness levels and BP was seen in girls (Table 3).

In the adjusted models (model I; adjusted for age, pubertal status, height), the likelihood of having HBP was significantly higher for boys and girls who were overweight (OR 3.51; 95%CI 2.62-4.70 and 1.93; 1.34-2.78 respectively) or obese (OR 5.55; 4.07-7.57 and 4.11; 2.37-7.13 respectively) compared with those who were non-overweight. There was also a statistically significant trend for reduced risk of HBP with increasing quartile of CRF in boys (OR for 4th vs 1th quartile CRF 0.64; 95%CI 0.46-0.89, $p<0.05$), but not in girls (OR for 4th vs 1th quartile CRF 0.70; 95%CI 0.43-1.13, $p>0.05$). In the combined weight status and CRF model, simultaneously adjusted for age, pubertal status, height and weight status × CRF (adjusted model II), weight status but not CRF remained significantly associated with HBP in both boys and girls. The likelihood of having HBP was significantly higher for boys and girls who were overweight (OR 2.96; 95%CI 1.71-5.11 and 1.75; 1.00-3.06 respectively; $p<0.05$) or obese (OR 4.19; 2.63-6.67 and 2.49; 1.19-5.19 respectively; $p<0.05$) compared with those who were non-overweight (Table 3). The interaction term for weight status and CRF was non-significant in the models.

Table 4 shows the mean SBP, DBP and prevalence of hypertension among those with high or low CRF within each weight status category (non-overweight, overweight, obese). All measures of BP were similar within the weight status categories irrespective of CRF level, and BP and prevalence of HBP were greater with increasing weight status in both boys and girls.

Sensitivity Analyses

Repeating the analyses for factors associated with HBP, using the IOTF categorization of weight status, did not alter the findings. The magnitude and direction of effect of all variables reported above remained similar to the main analysis, although the absolute values differed (likelihood of HBP for those in obese compared with non-overweight category in model II was 5.06 (95%CI 2.94 to 8.73, p<0.05) in boys and 2.34 (95%CI 1.38 to 4.09, p<0.05) in girls, whilst likelihood of HBP for those in highest vs lowest quartile for reduced Cooper test was 0.89 (95%CI 0.59 to 1.33, p>0.05) and 0.75 (95%CI 0.46 to 1.22, p>0.05) respectively).

Discussion

We found that weight status is strongly associated with the likelihood of HBP in primary school aged children, and that in boys, but not in girls, the level of CRF was also inversely associated with HBP. However, when both CRF and weight status were included in the same model, only the association between weight status and HBP remained significant. In contrast to our hypothesis, there was no evidence in our analyses that higher CRF attenuated the association between obesity and HBP. Our finding of a strong association between weight status and blood pressure in children is in line with reports from other studies and systematic reviews, and suggests that tackling obesity in childhood may help reduce the burden of cardiovascular disease in adulthood[39].

Previous studies have suggested that higher CRF could attenuate the effects of obesity on cardiovascular health and there is evidence from longitudinal studies to suggest that higher CRF is associated with lower cardiovascular mortality among those who are obese[21,40]. A recent large longitudinal study of adolescents in the US reported a significant interaction between CRF and weight status in predicting risk of hypertension, and an association between lower CRF and HBP, even among those who were not overweight[41]. Among the Chinese children in our study, we did not find any evidence that increasing fitness levels were associated with lower BP once weight status was taken into account. Our findings are similar to those from another study in 9-12 year old children in the USA[42]. These differences may be due to the cross-sectional nature of these two studies, with the effects of CRF on blood pressure becoming apparent in the longer term. There is some limited evidence to suggest that CRF in childhood predicts later increases in blood pressure[43-44]. It may also be related to the younger age of the children in these studies, suggesting that weight status is the predominant predictor of HBP in childhood[45], with CRF becoming more important in later life. The younger age of participants in this study sample may also potentially explain the observed difference between boys and girls in relation to the association between CRF and HBP. The majority of children in this study were pre-pubertal, and there is some evidence that pre-pubertal girls have stiffer large arteries compared with boys[46]. This could make them less responsive to blood pressure changes irrespective of CRF levels. However, even without the moderating effect of CRF on obesity and the risk of cardiovascular disease, CRF is an important factor in increasing longevity[18-21], and may positively impact on the prognosis of hypertension. Therefore improving CRF should be prioritized as an intervention target alongside obesity. Another important consideration is the role of physical activity, as this contributes to both CRF[47] and reduction in obesity, (particularly vigorous intensity physical activity[48-49]. Physical activity has also been shown to be important in protecting against all cause mortality in epidemiological studies[50].

Strengths of our study include the large representative sample of children, the inclusion of objective standardized anthropometric, blood pressure and CRF measurements, and adjustment for school level clustering, which accounts for potential confounding from important socioeconomic factors.

Limitations include the use of only one measure of physical fitness and the lack of a validated method of estimating VO2 max from the reduced Cooper test. We also did not have information on family history of HBP or on salt and dietary intake, which could be important confounding factors and ideally should be adjusted for within the analyses. Finally, the cross-sectional nature of the study limits interpretation of causal associations.

In conclusion, our results demonstrated that overweight/obesity is strongly associated with HBP in both boys and girls. This supports recent evidence in the US where the increasing prevalence of HBP is attributed to the rise in overweight and obesity among young children and youth[51-54]. Given the rising prevalence of childhood obesity in China, it is imperative that comprehensive strategies are put into place to tackle obesity in order to reduce the future burden of cardiometabolic disease.

Conflict of Interest

The authors declare that they have no competing interests.

Acknowledgements

The data used for this analysis came from a study funded by the Guangzhou Medical Foundation(20131A031001).The authors gratefully acknowledge the contribution of Yuexiu, Haizhu, Liwan, Luogang and Nansha Education Bureau and 29 elementary schools. None of the authors had any personal or financial conflicts of interest.

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Table 1: Anthropometric and physiological parameters in Chinese boys and girls aged 5 to 12 years (n=4926).

Variables	Boys (2725)	Girls (2201)	Total (4926)
Mean age, years (SD)	9.3±1.5	9.3±1.5	9.3±1.5
Pre-Pubertal, n (%)	2725 (100)	2125 (96.5)	4850 (98.5)
Overweight, n (%)	348 (12.8)	189 (8.6)*	537 (10.9)
Obese, n (%)	279 (10.2)	61 (2.8)*	340 (6.9)
BMI-z score	-0.01±1.37	-0.45±1.15*	-0.21±1.30
Reduced Cooper test (distance run in m)	899.4±133.4	864.8±163.0*	884.0±148.4
SBP, mmHg (**Mean ± SD**)	107.6±9.6§	106.1±9.7§	106.9±9.7
5-6 years (n=320)	101.8±8.8	101.9±8.1	101.9±8.5
7-8 years (n=1868)	105.6±9.3	103.3±9.0	104.6±9.2
9-10 years (n=1977)	109.0±9.1	107.6±9.7	108.3±9.4
11-12 years (n=761)	111.4±9.7	110.8±9.3	111.15±9.6
DBP, mmHg (**Mean ± SD**)	64.7±7.4#	65.0±7.4#	64.9±7.4
5-6 years (n=320)	61.1±7.1	61.9±6.4	61.5±6.8
7-8 years (n=1868)	63.3±7.2	63.3±7.2	63.3±7.2
9-10 years (n=1977)	65.8±7.1	66.2±7.4	66.0±7.2
11-12 years (n=761)	67.0±7.3	67.5±6.8	67.2±7.1
High SBP, n (%)			
Yes	367 (13.5)	327 (14.9)	694 (14.1)
High DBP, n (%)			
Yes	100 (3.7)	102 (4.6)	202 (4.1)
HBP, n (%)			
Yes	398 (14.6)	354 (16.1)	752 (15.3)

Note: Continuous variables were described by means ± standard deviation. Categorical variables are described by frequency (%). * Statistical significant between boys and girls, P<0.05. § SBP increased with increasing age in boys and girls, P<0.05. # DBP increased with increasing age in boys and girls, P<0.05.

Table 2: Relationship between weight status and cardiorespiratory fitness among school children in Guangzhou, China.

	N	Cardiorespiratory fitness (Reduced Cooper test)							
		1st Quartile	2nd Quartile	3rd Quartile	4th Quartile		Lower Fitness	Higher Fitness	
		%	%	%	%	P-value	%	%	P-value
Boys									
Non-overweight	2098	21.5	23.8	26.2	28.5		45.3	54.7	
Overweight	348	27.9	29.3	24.7	18.1	＜0.001	57.2	42.8	＜0.001
Obese	279	49.8	30.1	14	6.1		79.9	20.1	
Girls									
Non-overweight	1951	24.7	23.9	25.6	25.8		48.5	51.5	
Overweight	189	31.7	29.1	20.6	18.5	0.001	60.8	39.2	＜0.001
Obese	61	44.3	36.1	13.1	6.6		80.3	19.7	
		Mean distance (m) + SD	Mean distance (m) + SD	Mean distance (m) + SD	Mean distance (m) + SD		Mean distance (m) + SD	Mean distance (m) + SD	
Boys									
Non-overweight	2098	761.0±85.0	868.8±39.3	951.0±49.3§	1060.8±76.4		816.2±84.9§	997.4±82.5	
Overweight	348	750.3±86.4	865.5±38.5	941.5±44.8	1047.9±95.7		810.8±97.3	993.0±99.9	
Obese	279	740.3±85.7	863.3±41.7	933.4±43.0	1034.0±54.2		786.6±93.7	969.6±63.9	
Girls									
Non-overweight	1951	737.0±80.2	838.3±24.6	905.4±41.7	1151.6±98.2§		785.4±78.7	1021.9±65.8§	
Overweight	189	734.3±85.0	837.7±32.4	896.3±33.7	986.9±68.5		784.2±81.6	941.8±70.5	
Obese	61	735.8±73.2	835.7±29.4	896.0±34.7	976.0±79.1		781.6±77.4	922.7±63.4	

Note: weight status (defined using WHO 2007 reference standard); 1st Quartile: 1%-25% percentiles, 2nd Quartile: 26%-50% percentiles; 3rd Quartile: 51%-75% percentiles, 4th Quartile: 76%-100% percentiles. § Reduced Cooper test decreased with weight status in boys and girls, P<0.05. Lower Fitness (1st and 2nd Quartile); Higher Fitness (3rd and 4th Quartile).

Table 3: Generalized linear mixed model analysis of the association between weight status, cardiorespiratory fitness and HBP among school children in Guangzhou, China.

Characteristics	HBP	Likelihood of HBP		
		Unadjusted model	Adjusted model I	Adjusted model II
	Number (%)	OR(95% CI)	OR(95% CI)	OR(95% CI)
Boys(n=2725)				
Children's weight status				
Non-overweight	2098(9.0) **	Reference	Reference	Reference
Overweight	348(27.6)	3.94(2.97-5.22) **	3.51(2.62-4.70) **	2.96(1.71-5.11) **
Obese	279(40.5)	7.03(5.28-9.37) **	5.55(4.07-7.57) **	4.19(2.63-6.67) **
Reduced Cooper test				
1st quartile	688(18.2) **	Reference	Reference	Reference
2nd quartile	685(15.5)	0.81(0.61-1.09)	0.71(0.56-1.02)	0.69(0.44-1.07)
3rd quartile	675(12.9)	0.64(0.47-0.88)*	0.64(0.47-0.89) *	0.88(0.58-1.33)
4th quartile	677(11.8)	0.59(0.43-0.81)*	0.64(0.46-0.89) *	0.87(0.56-1.35)
Girls (n=2201)				
Children's weight status				
Non-overweight	1951(13.8) **	Reference	Reference	Reference
Overweight	189(30.2)	2.66(1.89-3.73) **	1.93(1.34-2.78) **	1.75(1.00-3.06) **
Obese	61(45.9)	5.16(3.04-8.75) **	4.11(2.37-7.13) **	2.49(1.19-5.19) **
Reduced Cooper test				
1st quartile	568(15.3)	Reference	Reference	Reference
2nd quartile	543(17.3)	1.14(0.83-1.59)	1.14(0.85-1.54)	1.14(0.83-1.57)
3rd quartile	547(18.6)	1.25(0.90-1.74)	0.92(0.66-1.29)	1.01(0.71-1.43)
4th quartile	543(13.1)	0.81(0.57-1.17)	0.70(0.43-1.13)	0.71(0.43-1.18)

Note: Adjusted model I: Adjusted for age, height and pubertal status. Adjusted model II: Model includes age, height, pubertal status, weight status (WHO 2007 categories), CRF quartiles and weight status×CRF quartiles.** P<0.001, * P<0.05.

Table 4: The mean SBP, DBP and prevalence of hypertension across weight status and cardiorespiratory fitness groups among Chinese schoolboys and girls in Guangzhou.

Characteristics	Boys(n=2725)				Girls(n=2201)			
	Hypertension		Mean ± SD		Hypertension		Mean ± SD	
	Number	%	SBP	DBP	Number	%	SBP	DBP
Reduced Cooper test								
Non-overweight								
Higher fitness	1147	8.7	105.49±8.77	63.28±6.99	1004	14.1	105.28±9.36	64.32±7.25
Lower fitness	951	9.4	105.86±8.75	63.81±6.81	947	13.4	105.12±9.36	64.52±7.18
P-value		0.61	0.33	0.08		0.64	0.71	0.54
Overweight								
Higher fitness	149	28.2	113.62±9.42	67.70±7.19	74	31.1	111.85±9.69	67.96±7.00
Lower fitness	199	27.1	111.92±9.55	67.65±7.27	115	29.6	111.79±9.19	69.28±6.50
P-value		0.83	0.10	0.95		0.83	0.97	0.19
Obese								
Higher fitness	56	44.6	116.46±9.96	70.62±6.80	12	66.7	117.63±5.96	72.33±6.22
Lower fitness	223	39.5	115.68±9.10	70.17±7.54	61	49.5	115.78±10.65	71.43±7.97
P-value		0.48	0.57	0.69		0.11	0.43	0.72

Note: Weight status (defined using WHO 2007 reference standard); Lower fitness refer to 1st Quartile and 2ndQuartile fitness and Higher fitness refer to 3rd Quartile and 4thQuartile fitness.