Big Mother or Small Baby, Which Predicts Hypertension?

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ABSTRACT

Introduction: According to the Barker Hypothesis, intrauterine growth restriction and premature delivery adversely affect cardiovascular health in adult life. The association of childhood hypertension as cardiovascular risk factor and birth weight has been understudied.

Methods: In a retrospective cohort study, we evaluated the effect of birth weight, gestational age, maternal pre-pregnancy body mass index (BMI) and child BMI z-score on the systolic and diastolic blood pressure (BP) z-score in 3,024 (1,373 female) consecutive outpatient clinic patients aged 2.05-18.58 years. The latest National Health and Nutrition Examination Survey (NHANES III) was used to calculate the age dependent z-scores.

Results: The median z-scores of BMI (+0.48, range -6.96 to 6.64), systolic blood pressure (+0.41, range -4.50 to 6.73) and diastolic blood pressure (+0.34, range -3.15 to +6.73) were all significantly greater than the NHANES III reference population. Systolic BP z-score did not correlate with birth weight or gestational age, but did correlate with maternal pre-pregnancy BMI ($r=0.090$, $p<0.0001$) and BMI z-score ($r=0.209$, $p < 0.0001$). Diastolic blood pressure z-score correlated positively with birth weight (0.037, $p=0.044$), gestational age ($r=0.052$, $p=0.005$), BMI z-score ($r=0.106$, $p<0.0001$) and maternal pre-pregnancy BMI ($r=0.062$, $p=0.0007$). In contrast to the Barker hypothesis, no negative correlation between blood pressure z-score and birth weight or gestational age was found.

Conclusion: This study suggests that a high BMI, a big mom and a high birth weight are more important risk factor for hypertension during childhood than low birth weight or gestational age.

METHODS

Height, age, weight, maternal BMI, systolic and diastolic blood pressure were measured directly. Z-scores were calculated for the age-dependent variables; height, weight, BMI and blood pressure, using a Box-Cox power transformation and the reference intervals from the NHANES III 2001 dataset. Data analysis done using frequency distribution plots, normality testing (Shapiro-Wilks), descriptive statistics and appropriate (±parametric) statistics, Wilcoxon signed rank test, correlation testing, t-testing and ANOVA testing applied. Agreement between variables was tested using Bland&Altman analysis. Multivariate analysis used to determine the significance of BMI z-score on systolic blood pressure.

RESULTS

Group statistics: Median child age was 9.43 years (2.0-18.85). Median blood pressure was 108/66 mmHg; systolic BP z-score +0.41 (-4.50-6.73); diastolic BP z-score +0.34 (-3.15-6.00)*;* child weight 32.4 Kg (8.0-17.0 kg); child height 136 cm (67.5-200.7); BMI z-score +0.48 (-6.96-6.64); birth weight 3,408 grams (485-5,794);

gestational age 37 wks (23-39 wks); maternal pre-pregnancy BMI 22.69 kg/m2 (13.5-58.21 kg/m2).

Validation of reported pregnancy variables by linkage with an existing database: Reported BMI and birth weight data of 651 mothers was linked with actual data from an existing data base. Pre-pregnancy BMI bias was 2.6±10.19% using Bland and Altman analysis (Spearman r = 0.8756, p <0.0001), whereas there was no bias for birth weight.

Group correlations: Systolic BP z-score correlated significantly with pre-pregnancy maternal BMI (r=0.090, p<0.0001) and BMI z-score (r=0.209, p<0.0001). Systolic BP z-score does not correlate with gestational age (r=0.030, p=0.098) or birth weight (r=-0.006, p=0.729). BMI z-score correlated significantly with birth weight (r=0.123, p<0.0001), maternal BMI (r=0.202, p<0.0001) and gestational age (r=0.060, p=0.001). Diastolic BP z-score correlated positively with birth weight (r=+0.037, p=0.044), gestational age (r=-0.052, p=0.005), BMI z-score (r=0.106, p<0.0001), maternal pre-pregnancy BMI (r=0.062, p=0.0007).

Group multivariate analysis: Multivariate analysis test was performed taking systolic and diastolic blood pressure as dependent variables and birth weight as a fixed variables controlling for BMI z-score. Results indicate a significant correlation between birth weight and blood pressure (0.008).

Children under 8 years of age: There was no correlation between systolic blood pressure z-score and birth weight (r=0.008, p=0.776), whereas BMI z-score correlated with systolic blood pressure (r=0.151, p<0.0001).

Children over 8 years of age: There also was no correlation between systolic blood pressure z-score and birth weight (r=0.013, p=0.590)

Mann-Whitney test: Indicated a significant difference in the medians of both age groups for systolic blood pressure (<8 yrs median=0.50, >8 yrs median=0.29, p<0.0001), diastolic blood pressure z-score (<8 yrs median=0.51, >8 yrs median=0.20, p<0.0001), and maternal BMI (<8 yrs median=23.3, >8 yrs median=23.4, p<0.0001).

Birth weight groups: Kruskal-Wallis ANOVA test was used to test the difference between medians of systolic blood pressure z-score and found a significant difference of probability = 0.0092, similarly for diastolic blood pressure z=score (p<0.0001), table 1**TABLES**

Variable/ Birth weight group	**< 1500 N= 89**	**1500-2500 N= 188**	**2500-4000 N= 2,296**	**4000-4500 N= 368**	**>4500 N= 82**
Systolic BP z-score	0.11 (-0.8, 0.7)	0.27 (-0.47, 1.27)	0.43 (-0.3, 1.3)	0.41 (-0.4, 1.2)	0.29 (-0.2, 1.2)
Diastolic BP z-score	-0.22 (-0.8, 0.4)	0.28 (-0.3, 0.9)	0.36 (-0.2, 0.9)	0.33 (-0.3, 1.04	0.48 (-0.0, 0.9)

Table 1: Comparison between birth weight groups blood pressure z-score, (25%, 75%).

Variable/ maternal pre-pregnancy BMI	**<18.5 N= 188**	**18.5-25 N= 1916**	**25-30 N= 600**	**>30 N= 320**	ANOVA Kruskal Wallis p-value
Systolic BP z-score	0.22 (-0.5, 1.2)	0.35 (-0.4, 1.1)	0.65 (-0.1, 1.4)	0.56 (-0.2, 1.4)	<0.0001
Diastolic BP z-score	0.24 (-0.3, 0.9)	0.30 (-0.3, 0.9)	0.44 (-0.1, 0.1)	0.41 (-0.2, 1.0)	=0.0005

Table 2: Comparison between pre pregnancy BMI groups blood pressure z-score, (25%, 75%).