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Aggregation of blood pressure in families: genetic and environmental influences

M. Espiga de Macedo,[1] D. Trigueiros[2] and A. Falcão Freitas[1]

[1]*Serviço de Terapêutica Médica da Faculdade de Medicina & Centro de Citologia Experimental, Universidade do Porto and* [2]*Instituto Superior de Ciências do Trabalho e do Ensino, Universidade Nova de Lisboa, Portugal*

Summary: **A study was undertaken to determine whether parent–child blood pressure (BP) resemblances reflect parent–child similarities in body build. Those studied were 889 children, 5–18 years old, their parents and relatives because of recognized correlations between body build and BP in individuals, along with familial clustering of these variables. To maximize the likelihood of demonstrating correlations between BP and body build in family members, BP and anthropometric variables of parents whose children were in the upper quintile (group I) and lower quintile (group II) of the same variables were compared. Variance analysis has shown that group I children were heavier ($P \leqslant 0.001$) and more obese ($P \leqslant 0.01$) than group II. The parents of group I had higher systolic BP ($P \leqslant 0.001$), diastolic BP ($P \leqslant 0.01$), were taller ($P \leqslant 0.0001$), heavier ($P \leqslant 0.001$) and more obese ($P \leqslant 0.01$), than the parents of group II. Parent–children BP resemblances reflect parent–children similarities in body build. The study of group I children and their families may give important information about determinants of high BP in children.**

Introduction

Hypertension contributes substantially to the increase of cardiovascular morbidity and mortality. Since early treatment could contribute to a decrease in the incidence of cardiovascular diseases in adults,[1,2] a better understanding of the early natural history of hypertension is important.[3] Blood pressure in developed countries tends to rise with age, but not in all populations.[4] Many studies have found a positive association between body size and BP in both paediatric and adult populations.[5–8] Other factors associated with a rise in BP include body weight, obesity, weight gain, vascular reactivity and a family history of high BP.[9–11]

Family aggregation of BP levels among first degree relatives has been repeatedly demonstrated.[11–13] Correlation coefficients for parent–child BPs have almost always been found to be positive, already at very early ages. Family members also tend to resemble one another in terms of body build.[14–16]

The present study was undertaken to evaluate the hypothesis that parent–child similarities in BP reflect the parent–child similarities in body build. This study examines familial anthropometric variables and BP relationships in adolescent children and their biological parents with whom they have shared a common environment for many years.

Correspondence: M. Espiga de Macedo, MD, Serviço de Terapêutica Médica, Faculdade de Medicina, Alameda Prof Hernani Monteiro, 4200-Porto, Portugal.

Material and methods

Schoolchildren aged 5 to 18 years from the North of Portugal, their siblings and parents were screened during two years. The sample of 889 children consisted of 389 boys and 500 girls.

Blood pressure was measured with a mercury sphygmomanometer on the right arm, with the subject seated and the arm extended over a table at heart level. A set of different-size cuffs were used. The cuff bladder used was wide enough to cover at least two-thirds of the arm and long enough to surround the arm completely, without overlapping.[17]

The mean of six readings taken by two observers was considered the BP value of each patient.[18] First and fifth phases of Korotkoff sounds were recorded as systolic and diastolic BP, respectively.[19]

Height was measured by a standard anthropo-

Table I One-way analysis of variance of anthropometric means according to the quintiles of systolic and diastolic BP of children

		Systolic			*Diastolic*		
		Means for quintiles			*Means of quintiles*		
Variables	*Sex*	Q_1	Q_5	*P*	Q_1	Q_5	*P*
Weight	M	29.5	34.4	0.104	29.7	35.4	0.001
	F	32.2	37.1	0.047	33.0	36.2	0.582
Height	M	130.8	136.8	0.168	129.5	138.1	0.004
	F	181.7	135.5	0.33	133.0	136.1	0.722
Skin fold	M	9.4	9.7	0.242	9.0	10.0	0.212
	F	12.1	14.1	0.05	11.4	13.3	0.021
BMI	M	16.7	17.7	0.046	17.0	17.7	0.053
	F	17.8	19.4	0.003	17.9	18.9	0.392

metric method with the person standing barefoot. Weight was obtained with the individual wearing only shorts and without shoes, by a balanced standard scale. Skinfold was measured with a Lange skinfold caliper.[20] To assess relative body heaviness, body mass index (BMI) (kg/m^2) was calculated for each individual.[21]

All variables were converted to age, sex and survey Z scores, and the quintiles determined for each of them. We compared the mean value of the first (Q_1) (group II) and fifth (Q_5) quintiles (group I) by means of analysis of variance (Anova) and by Duncan multiple-range test. All procedures used a SPSS statistical package.

Results

The mean values of anthropometric variables (Table I) in the first and fifth quintiles, according to the SBP, are quite different, and the difference was statistically significant for weight and skinfold in girls, and BMI in both sexes. The data on DBP (Table I) show the boys to be significantly taller, heavier, and with a greater BMI in the fifth quintile. The girls differ only in skinfold.

The same analysis for the parents' SBP and DPB is presented in Table II. Children with SBP and DBP in the upper quintile had parents with higher BP, and their values were always statistically different from those of the first quintile.

Finally, analysis of the parents' anthropometric variables, according to the first and last quintiles of the same variables in children (Table III), shows that fathers and mothers in the fifth quintile are taller, heavier and more obese than those in the first quintile.

Discussion

Blood pressure is well known as a trait with a complex and poorly understood pattern of inheritance and expression involving genetic, cultural and environmental factors.[22] Many studies have shown a positive and sometimes very strong corre-

Table II One-way analysis of variance of parents' systolic and diastolic BP according to each quintile of children's corresponding BP

		Systolic			*Diastolic*		
Blood pressure		*Means for quintiles*			*Means of quintiles*		
Parents	*Sex*	Q_1	Q_5	*P*	Q_1	Q_5	*P*
Fathers' SBP	M	126.7	136.0	0.02	57.7	87.6	0.01
	F	128.4	139.8	0.007	76.6	86.1	0.009
Mothers' DBP	M	129.2	136.4	0.05	79.1	85.0	0.002
	F	125.8	135.2	0.03	78.1	81.3	0.18

Table III One-way analysis of variance of fathers' and mothers' anthropometric variables according to the quintiles of the same variables in children

	Means for quintiles (Z-scores)					
	Fathers			*Mothers*		
Variables	Q_1	Q_5	*P*	Q_1	Q_5	*P*
Weight	−0.16	0.58	0.0002	−0.25	0.56	0.0001
Height	−0.43	0.41	0.0001	−0.32	0.56	0.0001
Skin Fold	−0.62	0.51	0.0001	−0.41	0.79	0.0001
BMI	−0.08	0.37	0.01	−0.01	0.57	0.0001

lation between anthropometric variables, mainly weight and BMI, and BP in both children and adults. At the same time a familial resemblance exists for the same variables.[23,24]

The present study was undertaken to determine whether familial BP resemblances reflect similarities in body build among family members. In this study, family clustering is defined as an agreement in the relative standing for either BP or anthropometric values of parents and children.

This survey shows that children whose BP is higher than their peers are taller, heavier and more obese. Those who maintain their BP at lower levels are shorter, lighter and less obese. In addition, the BP of parents of children in group I was higher than that of parents of children with relatively low pressure, group II. Similar results were found between parents and children for different ranks of anthropometric variables.

In conclusion, not only do the BP levels of children significantly reflect the BP of their parents, but this resemblance in BP can be explained by familial resemblance in body build.

Like other studies,[25–27] a positive family history is a predictor of the development of high BP and can provide the basis for a risk strategy in the prevention of high BP. Intervention in obese children to prevent the high incidence of cardiovascular disease should become the goal of medical professionals.[28]

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