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BIRTH WEIGHT AND CARDIOVASCULAR RISK FACTORS IN CHILDREN: WHICH IS ITS PLACE?

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Abstract: *In the last decades low birth weight (LBW) has been associated with increased risk for cardiovascular pathology in adulthood. This parameter is closely related with hypertension, high levels of uric acid and impaired level of lipidic film. In our study we have determined whether it exist any correlation between LBW and variables such sistolic blood pressure, diastolic blood pressure, uric acid level, glucose level, lipidic film. We evaluated 81 children with hypertension and 61 children with normal blood pressure. Birth weight was positively correlated with diastolic blood pressure (p<0,0401) but with no other variables although, children with LBW had higher values of sistolic blood pressure, higher levels of total cholesterol and LDL-Cholesterol and also was positively correlated with BMI. We concluded that children with LBW should be followed up during childhood for blood pressure, weight, and metabolic status to prevent the instalation of cardiovascular pathology.*

Key words: *low birth weight, children, hypertension.*

1. Introduction

Cardiovascular risk factors like hypertension, obesity, dislipidemia and type 2 dabetes mellitus became quite frequent in the childhood in the last decades. Between these diseases exist a strong conection such as obesity is the most common cause of insulin resistance and hyperinsulinism in children, it is frequently associated with essential hypertension, dyslipidemia and type 2 diabetes mellitus [1]. In paralell with these observation, a lot of studies have been reported a strong conection between low body weight (LBW), which characterizes fetal malnutrition, and hypertension, obesity and diabetes mellitus [2]. Probably, an explanation can be that factors present in the intrautherine enviroment affect fetal development and programm the pathology that will take place later in adult life.

2. Material and Methods

2.1. Study Sample

We examined 81 children, ages between 5 and 18 years, with essential hypertension which had constitued ”study group” and 61 children, ages between 5 and 17,10 years, with blood pressure in normal range which had constitued ”witness group”. All the children were admitted in Children Hospital Brasov between January 2006 and January 2010.

2.2. Inclusion Criteria

Values of systoli and/or dyastolic blood pressure above the 95 percentiles for age,

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gender and high. Blood pressure was measured in the right arm with the child seatted and the arm in supine position at the level of the heart. It had been used a sphigmomanometer with mercury (Fazzini, Italy), and it had been procede two measurements at 2 minutes interval and in the study had been used the average of the two values. The diagnosis of essential hypertension was estabilished based on the values above 95 percentiles for age, gender and heigh which were confirmated at three separate determinations at one week interval.

2.3. Exclusion Criteria

Any acute infectious or inflammatory disease, chronic illness which has hypertension as clinical sign such as renal diseases, chronic renal failure, hypertiroidism, hypotiroidism, cushing syndrome, coarctation of aorta, acute or chronic therapy with medication with hypertensive effect (corticosteroides, bronchodilatation drugs).

2.4. Measurements of Anthropometric and Biochemical Variables

The protocol had been applied to all children, study group and witness group, and included: identification of weight at birth, measurements of the weight (with a electronic scale, EKS, deviation 0,1 kg), height (with Electrometal stadiometer, deviation 0,1cm). Body mass index (BMI) was calculated with formula: BMI = Weight (kg)/ Height $(m)^2$. For all children were collected blood samples early in the morning after a night period of fasting. The biochemical determination were made in the laboratory of Children Hospital Brasov and there were: glucosis, total cholesterol (TC), tryglycerides (TG), high density lipoproteins cholesterol (HDL-C) and low density lipoproteins cholesterol (LDL-C).

The values were statistically analyzed.

3. Results and Discussion

3.1. Baseline Characteristics

Clinical, anthropometric and metabolic features of the children are shown in the Table 1.

Clinical, anthropometric and metabolic characteristics of the two groups Table 1

Characteristics	Normal Blood Pressure (NBP), n = 61	High Blood Pressure (HBP), n = 81
Gender		
% Male	46	46
% Female	54	57
Birth weight (BW) (kg)	3,11	3,19
Gestational age (wk)	39,9	39,2
Age (years)	13,55	13,84
Weight (kg)	55,57	65,08
Height (m)	1,51	1,54
BMI (Kg/m^2)	26,05	26,89
Glucose (mg/dl)	90,43	88,39
Uric acid (mg/dl)	4,84	5,28
Serum creatinine (mg/dl)	0,71	0,78
Total cholesterol (mg/dl)	179,35	182,44
Tryglycerides (mg/dl)	109,30	129,19
LDL-C (mg/dl)	96,91	106,93
HDL-C (mg/dl)	51,53	46,92

Regarding anthropometric features there were some differences between hypertensive group and normal BP group. Weight was significant higher, 65,08 kg in HBP, and 55,57 kg in NBP group. BMI was slightly increased in HBP, 26,89 kg/m^2 and in NBP was 26,05 kg/m^2.

Biochemical parameters variations between the NBP group and HBP group was significant for the uric acid (4,84 vs 5,28), total cholesterol (179,35 vs 182,44), tryglycerides (109,30 vs 129,19), LDL-cholesterol (96,91 vs 106,93) and HDL-cholesterol (51,53 vs 46,92).

In Table 2 are presented the correlation between the weight at birth and the clinical, anthropometric and biochemical parameters at both groups.

Statistic correlation between BW and the other variables Table 2

	SS Effect	df Effect	MS Effect	SS Error	df Error	MS Error	F	p
Age	1,1262	1	1,1262	1162,0	130	8,938	0,125994	0,723197
Height	0,0005	1	0,0005	3,0	130	0,023	0,020312	0,886891
Weight	45,8849	1	45,8849	49212,7	130	378,559	0,121209	0,728290
BMI	0,3744	1	0,3744	10459,1	130	80,455	0,004654	0,945718
SBP	247,4934	1	247,4934	42553,3	130	327,333	0,756090	0,386157
DBP	642,3130	1	642,3130	19426,7	130	149,436	4,298253	**0,040126**
Glucose	5,4447	1	5,4447	25333,5	130	194,873	0,027940	0,867510
Creatinine	0,0281	1	0,0281	5,1	129	0,040	0,707555	0,401813
Uric acid	0,4639	1	0,4639	223,0	130	1,716	0,270394	0,603952
TC	74,8261	1	74,8261	195150,9	130	1501,161	0,049846	0,823683
TG	177,3426	1	177,3426	421548,2	130	3242,679	0,054690	0,815462
LDL-C	213,9334	1	213,9334	124162,6	130	955,097	0,223991	0,636809
HDL-C	166,5067	1	166,5067	26813,5	130	206,258	0,807275	0,370588

SBP = systolic blood pressure, DBP = diastolic blood pressure, TC = total cholesterol, TG = tryglycerides, LDL-C = low density lipoprotein cholesterol, HDL-C = high density lipoprotein cholesterol

Low weight at birth is considered one of the risk factors for development of hypertension. In our study we had found that the children with BW less then 2400g had the mean value of the diastolic blood pressure higher then children with normal weight at birth (72,39 mmHg vs 66,11 mmHg) with a statistic significance (*p = 0,0401*) (Table 3, Figure 1).

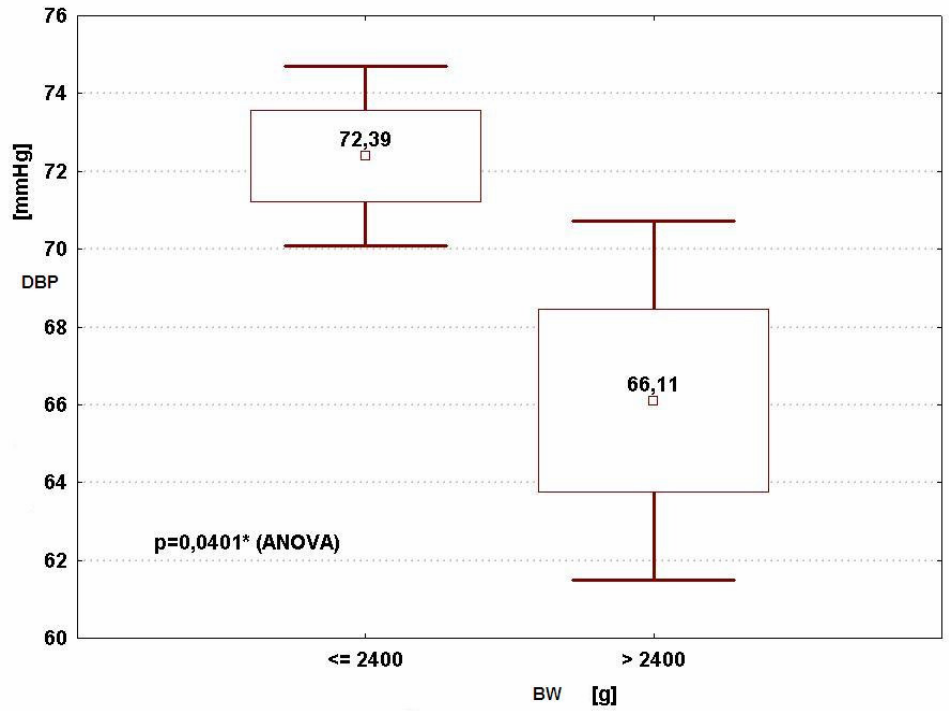
We did not find other significant correlation between birth weight and the other variables but we have to mention that SBP was also higher in the LBW group compared with NBW group (124,69 mm Hg vs 120,79 mmHg).

The metabolic features had different variations as it follows: TC was higher in LBW group (181,51 mg/dl) vs NBW group (179,37 mg/dl). TG mean values was higher in children with NBW (123,97 mg/dl) then LBW group (120,67 mg/dl). LDL-C was higher in LBW group (103,34 mg/dl) vs NBW group (99,72 mg/dl). HDL-C mean values were almost the same in both groups.

Correlation between birth weight and diastolic blood pressure Table 3

	LBW (<2400g)			NBW (>2400g)			
	Mean 0	**Std. Dev. 0**	**Valid N 0**	**Mean 1**	**Std. Dev. 1**	**Valid N 1**	**p**
Height	1,54	0,15	113	1,54	0,14	19	0,8869
Weight	60,63	19,41	113	62,31	19,74	19	0,7283
BMI	**25,94**	9,44	113	25,78	5,19	19	0,9457
SBP	**124,69**	18,49	113	**120,79**	15,40	19	0,3862
DBP	**72,39**	12,51	113	66,11	10,24	19	**0,0401**
Glucose	89,16	14,42	113	88,58	10,68	19	0,8675
Creatinine	0,75	0,20	113	0,79	0,21	18	0,4018
Uric acid	4,95	1,22	113	5,12	1,79	19	0,6040
TC	**181,51**	39,15	113	**179,37**	36,10	19	0,8237
TG	120,67	57,34	113	123,97	54,42	19	0,8155
LDL-C	**103,34**	31,51	113	**99,72**	26,83	19	0,6368
HDL-C	49,45	14,60	113	46,25	12,79	19	0,3706

SBP = systolic blood pressure, DBP = diastolic blood pressure, TC = total cholesterol, TG = tryglycerides, LDL-C = low density lipoprotein cholesterol, HDL-C = high density lipoprotein cholesterol



DBP = diastolic blood pressure, BW =birth weight

Fig. 1. *Correlation between birth weight and diastolic blood pressure*

3.2. Discussion

Birth weight is a measure of growth in utero and its importance comes from the previous observations that it is closely related to endothelial function in the systemic arteries of young adults, in the third decade of life [3]. Intrauterine retardation of development is associated with structural and functional changes in organs as a adaptative response of the certain conditions. The final result is represented by permanent alterations of the metabolic status of the fetus [4] and moreover of the child in the next 10 years of life. In our study we could not find significant differences between anthropometric parameters (weight, height and body mass index) and the weight at birth. However, the LBW group, both girls and boys, had BMI higher then normal birth weight group. This observation indicate that children with intrauterine groth retardation have a higher risk for development of obesity during childhood. Body mass index tends to ”track” from age around 6 years into adult life [5] so it can be predicted that a child with low birth weight which shall acumulate during his life other cardiovascular risk factors has a significant risk for coronary heart disease mortality [6, 7].

Some studies have shown that intrauterine growth retardation and LBW could be linked to a higher risk for essential hypertension [4, 8]. It is difficult for us to sustain such a hypothesis in this study. We had observed that mean values of SBP were higher in children with LBW comparing with children with NBW but the results did not have a statistic significance. On the other hand, SBP was closely related with BMI suggesting that the nutritional status could be genetic ”programmed” in utero and strongly related with growing retardation and low weight at birth. Now it is well recognized the fetal programming theory that birth weight has influence on the blood pressure in childhood and adulthood [2, 8]. We found a correlation between diastolic blood pressure and LBW (statistic significance, $p<0,0401$). Children who had birth weight under 2400 g had higher levels of DBP comparing with NBW group in whom mean values of DBP were in normal range. Other studies had shown that DBP is negatively correlated with birth weight and positively with weight to birth weight ratio and this is due to ”programming” effect which is followed by an inappropiate weight gain [4].

Our data don’t sustain the hypothesis that children with LBW also presented high levels of serum uric acid, like other studies [2]. In our groups the values of uric acid were in normal range, in LBW group lower than in NBW group. Additional, the renal function was normal in all the children included in study. Some previous papers had shown that the level of uric acid is high predictive for future development of cardiovascular degenerative pathology; it had been described a inversely correlation between uric acid level in fetal cord blood and birth weight [2], and also that serum uric acid level higher than 5,5 mg/dl is predictive for essential hypertension in adolescents [9]. In our study children with hypertension had the level of uric acid higher than normotensive group but still with normal mean values.

We tried to evaluate a possible relationship between birth weight and other risk factors. Any disturbance in the intrauterine medium that can influence the development has also influence on the nutritional status and ”programming” the metabolic status of the child producing insulin resistance, and impaired level of cholesterol, tryglycerides, LDL-c and HDL-C. Unfortunatly, in our study we could not perform insulin resistance test for all the children due to low compliance

at investigations and also, we found no significant correlation between BW and lipidic film but for total cholesterol and LDL-C the mean values were higher in children with LBW than NBW.

It is clear that birth weight, as a marker of the fetal malnutrition, is involved in future pathology of the child and adult and has to be included in the panel of the cardiovascular risk factors. BW is correlated with the SBP, DBP, obesity, insulin resistance, high levels of cholesterol and therefore children who were LBW or VLBW should be followed up closely during childhood for a proper physical and nutritional development and to detect early the acumulation of other risk factors for future cardiovascular pathology.

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