

ORIGINAL STUDY

**INVESTIGATION OF HIGH BLOOD PRESSURE AS A
PREDISPOSITION FOR METABOLIC SYNDROME IN CHILDREN**

Aurel Nechita, Michaela Dobre, Madalina Matei

Faculty of Medicine and Pharmacy, "Dunarea de Jos" University of Galati

nechitaurel@yahoo.com

ABSTRACT

The pathophysiological origins of high blood pressure (HBP) are found in the increase of abdominal fat and/or insulin resistance, conditions which induce sodium reabsorption and vascular expansion. Through these causes, HBP is linked with obesity and diabetes in the metabolic syndrome, whose associated risk factor in the global context of cardiovascular disease is thusly elevated. Since HBP was found in a high percentage of children and adolescents with metabolic syndrome, this study looks at the impact of associated individual (family, physical and metabolic) parameters. Monitoring blood pressure may contribute to a more rapid diagnosis and treatment of this syndrome.

KEYWORDS: *high blood pressure, diabetes, obesity, metabolic syndrome*

1. Introduction

High blood pressure (HBP) is a major cause of morbidity and mortality in Romania as well as in many other countries in the world. Until recently, this condition was a staple of adult pathology, but it is becoming relatively common in children, soliciting further investigation.

It is a well-known fact that blood pressure is determined by the relationship between cardiac output and vascular resistance. Any increase of one of these factors without a corresponding adjustment from the other leads to an increase of arterial blood pressure. This balance is conditioned by hormonal-regulating or receptor proteins, such as baroreceptors,

atrial natriuretic hormones, mineralcorticoid hormones, angiotensin, vasopressin, catecholamines, endothelium-derived relaxing factor, kinines, E2 and I2 prostaglandins, as well as the by the sympathetic stimulation. Some of these factors are influenced by shifts of the electrolyte balance (especially by calcium, sodium and potassium) [1].

Type of diet has been shown in infants and young children fertile visceral fat that accumulates in the body in the early stages of development, it is not influenced by sex hormones then. Other studies show that pathogenic mechanisms from intrauterine environment, is exacerbated in the population with genetic predisposition. Visceral fat storage level creates a metabolic syndrome phenotype: children

have a low birth weight and develop insulin early [2]. In such cases, high insulin levels may lead to increased blood pressure by accelerating sodium reabsorption and stimulating the sympathetic nervous system, but the central mechanism causing this phenomenon is as yet unclear [3]. The simultaneous presence of these three risk factors is sufficient to put forward a diagnosis only recently brought into the attention of the scientific community: metabolic syndrome.

2. Material and methods

The current study regarded 86 patients with HBP under care at the “Sf. Ioan” Emergency Children’s Hospital of Galați between 2005 and 2010. The main symptoms taken into account for admission were headaches, epistaxis, palpitations and HBP.

The study analyzed blood pressure correlations with anthropometric, demographic and clinical data, personal and family history (HBP, obesity, diabetes) as well as paraclinical data – according to the method described by the USA National Cholesterol Education Program (NCEP). Results were analyzed using IBM’s Statistical Package for the Social Sciences software. Results are presented below.

3. Results

With the exception of 4 children, investigated subjects were aged between 10 and 18 (mean 13.98, SD = 2.74) (figure 1). The study lot was comprised of 61 boys and 25 girls – sex ratio 2.44 (*male/female*).

Case histories assign 47 patients to urban origins and 39 to rural lodgings (figure 3).

Relevant study results are summarized in Table I.

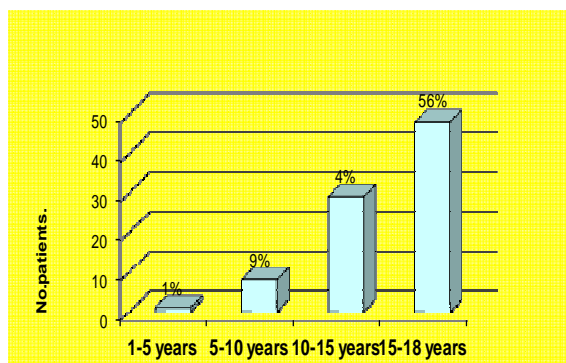


Figure 1. Distribution of subjects by age group

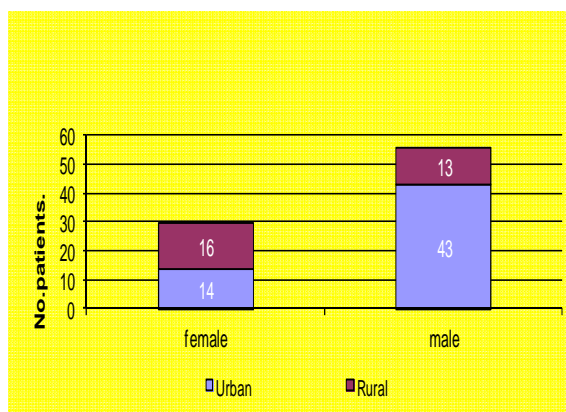


Figure 2. Distribution of subjects according to area of residence and sex

Average systolic blood pressures were between 120 and 140 mmHg in 32 investigated patients and surpassed 140 mmHg in 49 patients. Average diastolic pressures were below 80 mmHg in 55 patients and above this value in the remaining 31.

Of the designated study lot, 37 patients were classified as overweight, with body masses exceeding characteristic values for respective age and gender groups. Biochemical tests showed 7 cases of moderate hyperglycemia (serum glucose levels between 100 and 130 mg/dL) and 7 cases of moderately elevated cholesterol levels (between 200 and 230 mg/dL). Lipid balances identified three patients with HDL cholesterol below 40 mg/dL, one patient with a LDL cholesterol level of 165 mg/dL and 13 patients with elevated triglyceride levels: 5 with moderately high (150-200 mg/dL) and 8 with very high (above 200 mg/dL) triglyceride levels.

Patient information obtained from parents identified no family history of HBP in 14 of the study lot subjects.

Table I. Statistical description of analyzed parameters

Parameter	Min	Max	Mean	SD
systolic BP (mmHg)	100	180	139,56	12,25
diastolic BP (mmHg)	46	100	78,02	9,74
weight (kg)	45	108	69,82	14,95
glucose (mg/dL)	99	129	111,12	9,20
cholesterol (mg/dL)	132	229	187,50	26,23
HDL cholesterol (mg/dL)	30	80	53,71	21,99
LDL cholesterol (mg/dL)	140	165	152,50	17,67
triglycerides (mg/dL)	138	341	208,00	58,73

Out of the study lot of 86, only 10 children were diagnosed as prehypertensive (7 boys and 3 girls) (figure 3).

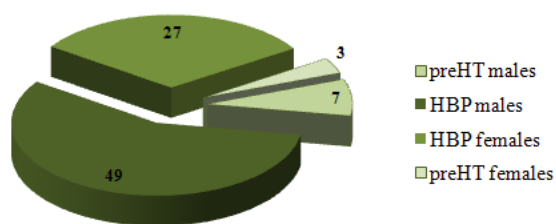


Figure 3. PreHT occurrences

In an attempt to identify the batch record family history in motor itself, i noticed that in 70% of cases there is no family history of hypertension (figure 4).

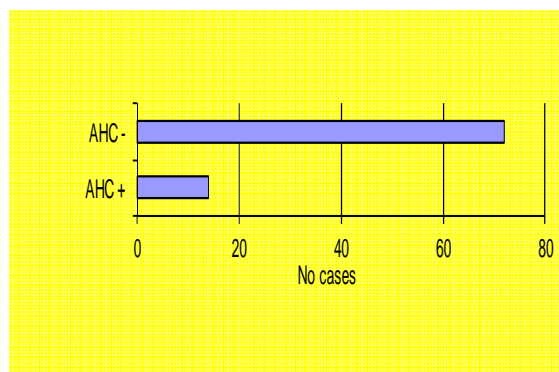


Figure 4. The incidence of family history of HTA in the studied group

37 patients are obese and abdominal circumference is increased to 42 subjects. Seven subjects presents hyperglycemia.

4. Discussions

Children’s blood pressure is considered normal when average systolic and diastolic readings fall within the 90th percentile of guideline values for the child’s age, sex and degree of development, according to clinical practice guidelines [4][5]. In 2003, the notion of *pre-hypertension (preHT)* was appended to the diagnosis list, which corresponds to cases when blood pressure averages surpass the 90th but are below the 95th percentile. Adolescents who consistently register blood pressures above de 120/80 mm Hg are also diagnosed with pre-HBP.

Compared to the general frequency – 31% of global population [6] – preHT occurs in around 20% of teenage boys and 13% of teenage girls [7]. The present study found a much more reduced frequency of preHP, probably due to errors associated with improperly sized sphygmomanometer cuffs for children.

We additionally see a rising trend in both systolic and diastolic BP with age and regardless of sex, again an aspect also identified by other studies [8]. The highest frequency of hypertension was in the

15 to 18-year age group (48/86 cases), followed by the 10 to 15 year-olds (29 cases), 5 to 10 year-olds (8 cases) and the 1 to 5 year-olds (one case).

Considering the fact that environmental factors contribute significantly to HBP, a correlation between diagnosis and patients' background was performed. The analysis revealed a higher number of HBP sufferers of urban origins. This can be explained by an accentuated urban activity of risk factors such as stress, an imbalanced lifestyle, smoking or drug and caffeine intake. Also, urban patients benefit from greater exposure to information and healthcare, making them more likely to be identified.

Nearly half of the investigated subjects suffer from obesity and register altered lipid balances.

Most cases have no family history of hypertension, which points to the fact that HBP is a complex disease of increasingly frequent occurrence, caused by interfering genetic and environmental factors.

Taking into account the factors that predispose to metabolic syndrome within the study group, two risk groups were established (figure 5):

- group 1, consisting of 20 subjects with two predisposing factors (obesity and HBP), mainly at risk to develop heart disease;
- group 2, consisting of 7 subjects with three predisposing factors (HBP, obesity and hyperglycemia). These children, aged between 11 and 17 years, accumulate the highest risk of progression to cardiovascular disease, diabetes and, subsequently, metabolic syndrome.

Hirschler and Maffeis showed that waist circumference is a predictor of insulin resistance in children and could be included in clinical practice as a simple tool for identifying children at risk. The combination of body mass index, waist circumference value may increase prediction of hypertension and metabolic syndrome. [9,10]



Figure 5. Associated risk factors among analyzed subjects

5. Conclusions

High blood pressure is a known risk factor for adult heart disease and HBP onset during childhood may promote earlier disease progression.

According to summarized data, early diagnosis and adequate treatment of HBP in children helps prevent long-term complications.

Patients meeting the criteria described in this study, which touch upon multiple risk factors are considered predisposed to diabetes, metabolic syndrome and cardiovascular disease and require careful follow-up.

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