ARTERIAL HYPERTENSION IN PRE-SCHOOL CHILDREN AND SOME RISK FACTORS - PROSPECTIVE STUDY

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Abstract
BACKGROUND: Increased Blood Pressure (BP) in childhood is an important determinant of Arterial Hypertension (HTN) and cardiovascular disease in adulthood.
AIMS: Evaluation of the momentary prevalence of HTN cases in preschool children and the presence of risk factors for early diagnosis and the introduction of primary, secondary or tertiary prophylaxis.
MATERIAL AND METHOD: **The group** consisted of 431 pre-school children from the kindergartens with extended programs in Târgu Mureş (7 units) and Târnăveni (1unit), aged 3-6, 215 girls (50%) and 216 boys (50%), M: F = 1: 1, urban for 85.15% (n = 367), rural for 14.85% (n = 64), evaluation period 15.02.2017 - 30.03.2017. **Method**: measurement: weight (G), height (H), BMI, BP, anamnesis, personal pathologic history (APP), family medical history(AHC) (related to HTN, and Diabetes Mellitus DM) relatives grade 1 and 2, statistical methods.
RESULTS AND DISCUSSIONS: Harmonics 15.31% (n = 66), disharmonic (+ G) 16.24% (n = 70) and (-G) 68.44% (n = 295). HTNS 8.12% (n = 35) preHTNS 7.65% (n = 33) nBPS 84.22% (n = 363), HTNS (+ G) 31.42% , 0002, RR = 2.12), HTND 11.60% (n = 50), nBPD 88.40% (n = 381), preHTND 9.74% (n = 42) 27% (n = 18), (p = 0.0001, RR = 2.99), AHC-HTN 12.29% (n = 53) (p = 0.008, RR = 2.38), AHC-DM 6.26% (n = 27), of which with HTN and 48.15% HTN (n = 13) = 2.24), APP - preterm 5.56% (n = 24), 25% HTN (n = 13) (p = 0.39, RR = 1.75), APP - low birth weight 5.10% (n = 22), HTN 4.54% (n = 1), chronic disease 6 (3 HTN).
CONCLUSIONS: 1.) Pre-school HTN is under diagnosed; in our group we did not have any children with HTN but we found 16.47% (n = 71) pre-school children with HTN std 1 and 2.**2.)** HTN risk factors showed: weight surplus 15.31% (n = 66) (RR = 2.12 HTNS, RR = 3 HTND), HTN - AHC 12.29% (n = 53) ,(RR=2,38) and / or DM 6.26% (n = 27) (RR = 2.34), prematurity / low birth weight 10.67% (n = 46), (RR=1,75) **3.)** BP monitoring from the age of 3 years is required for the early diagnosis of essential and secondary HTN. 4.) Early initiation of prophylactic measures is essential for the prevention of HTN and cardiovascular disease in adolescents and adults.
KEY WORDS: **preschool children, blood pressure, risk factor**

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BACKGROUND

Arterial hypertension (HTN) is one of the most frequent adulthood medical conditions, but its origins often lie in childhood, when the neurohormonal mechanisms of cardiovascular modulation mature and when the foundation of the lifestyle is being laid. High blood pressure (BP) in childhood is an important predictive factor for HTN and cardiovascular diseases at an adult age. The prevalence of childhood HTN is rising and its determinism is multifactorial. The incidence of HTN in preschool-children is of 1-3%, in school-children of 4-5% and it can rise up to 10% in teenagers [1,2,3,4]. BP monitoring is recommended to start from age 3: once per year, for healthy children, and at

each visit for children suffering from obesity, renal illnesses, diabetes, obstruction of the aortic arch, aortic coarctation, or for children following a treatment with pharmacological agents that might increase BP (Table nr 1).

Table nr.1: Pharmacological agents that can rise BP values in children [1]

Sales regime	**Pharmacological agents that can cause HTN in**
OTC	Nasal decongestants Caffeine Non-steroidal anti-inflammatory drugs (NSAIDs) Alternative therapies (some phitotherapeutic products or nutritional supplements)
With prescription	Stimulants for Attention Deficit /ADHD Oral contraceptives Steroids Tricyclic antidepressants
Illicit substances	Amphetamines Cocaine

The technique of accurately measuring BP in preschool children should take into account the recommendations of the European Society of Arterial Hypertension (ESH) regarding the conditions for the patient (comfortable room, physical and mental rest for at least 5 minutes, 1 hour after meal, in a sitting position with the arm resting at same height as the heart and with the feet on the floor), the technology used (aneroid sphygmomanometer calibrated each 6 months, the size of the cuff according to the child's age: 9 cm wide, 18 cm long, for arm circumference of max. 22 cm) and the measuring technique itself. [1,2,3,4]

According to the standards of the American Academy of Pediatrics (AAP) and ESH, interpreting the BP values of pre-school children should always be correlated with the child's age (in months), with the height percentile (H) and with the body mass index (BMI), as detailed in Table 2). For the BP values between the 90th and the 95th percentile the AAP notation of "pre-HTN" has been changed by ESH into "normal-high BP". In 2017 AAP elaborated more simple and practical standards on how to interpret BP values in children, obviously respectful to the AAP and ESH percentiles. High values of systolic BP (SBP) and / or of diastolic BP (DBP) are considered HTN (see Table nr 2) [1,2,3,4,5,6]

TABLE nr.2: Interpretation of BP values in children aged 0-13 (AAP, 2017) [1]

BP in children aged 1-13	SBP and DBP percentiles (depending on sex, age, height, BMI)	BP values (mmHg)
NORMAL	$<$p90	
HIGH NORMAL (pre-HTN)	p90 $\leq$ BP $<$ p95	120/80 at percentile $<$95
HTN stage 1	p95 $\leq$ BP $<$ p95 +12 mmHg	130/80 – 139/89
HTN stage 2	BP $\geq$ p95+12 mmHg	$\geq$ 140/90

The etiology of HTN is multifactorial. The essential HTN form is quite rare in children, while the secondary HTN form is more common to be found as a syndrome of kidney affections (renovascular and parenchymatous renal diseases, Wilms tumor, perirenal hematoma), of cardiovascular diseases (obstruction of the aortic arch, aortic coarctation), of vasculitis, of endocrine disorders (hyperaldosteronism, mineralocorticoid hypersecretion, adrenal hyperplasia, Cushing's syndrome, thyroid disorders, pheochromocytoma), of central nervous system diseases (tumors, trauma), of type I von Recklinghausen neurofybromatosis, of prolonged exposures to toxic substances (lead, cadmium, mercury, phthalates) .

Risk factors for children's HTN include prematurity, low birth weight, sleep disorders related to breathing, inadequate sleep duration, obesity, unbalanced diet, parental smoking, family history of certain pathologies (HTN, Diabetes Mellitus) on grade 1 and 2 relatives.

In 20% of cases HTN in children is caused by chronic renal diseases. 7,3% of premature babies will develop HTN until they reach the age of 3. Parental smoking can be on its own the cause of high SBP, even after the correction of all other risk factors. Sleep disorders related to breathing that appear in childhood, inadequate sleep duration (less than 7 hours per night) or poor quality sleep have been linked to a higher risk of HTN. Preschool children's obesity, together with a higher abdominal circumference, especially in boys, could be an indicator of HTN. Overweight and obesity in preschool children that have a reduced level of physical activity are also risk factors for high values of SBP. Certain studies have shown that an intake of high sodium levels together with high values of the abdominal circumference / height ratio have a higher risk of developing high values of SBP.[1, 2, 5, 7, 8, 9, 10, 11, 12, 13, 14]

Studies in full-day kindergartens have shown that there is a significant correlation between the SBP values and the amount of caloric intake, protein and carbohydrates intake; on the other hand these studies showed a significant correlation between DBP values and the amount of protein intake, lipid, carbohydrate and caloric intake. A high intake, for a prolonged period, of proteins, carbohydrates, sodium, cholesterol and lipids, associated with a low fiber intake, is an important risk factor for HTN in children. [15,16].

AIMS

Assessing the current prevalence of HTN cases in preschool children and the presence of risk factors for early diagnosis and the introduction of primary, secondary or tertiary prophylaxis.

MATERIAL AND METHOD

The studied group consisted of 431 preschoolers that attend full-day kindergartens in Târgu Mureş (7 units) and Târnăveni (1 unit), aged between 3 and 6, the average age being of 61 months (5 years and 1 month). The group consisted of 215 girls and 216 boys, with a sex ratio of 1:1. 85,15% (n=367) of preschoolers live in the urban area and 14,85% (n=64) of them live in the rural area, with an Urban : Rural ratio of 5,7:1.

The evaluation period was 15.02.2017 – 30.03.2017.

The method that we used consisted in filling an Excel table with data about the children: age (months), sex, urban / rural, data regarding the personal medical history (low birth weight, prematurity, chronic diseases, acute disease at the time of examination, used medication), data regarding the family medical history of HTN and DM of grade 1 and 2 relatives, physiological parameters (SBP, DBP) and physiometric parameters (body weight – G (kg), height – H (m)). The body mass index BMI (kg/m^2) was calculated using the formula BMI (kg/m^2) = $G(kg)/H^2(m^2)$

The instruments used for measuring were: aneroid sphygmomanometer with a manometer and with two cuffs, one for children and one for babies, Elecson - HS20C, mechanical balance with stadiometer for medical offices. The measurement of BP values was done following the ESH recommendations (2009) for choosing the right cuff depending on the child's age.

The interpretation of BP values was made by determining the percentiles and the Z score of the SBP and DBP values, depending on age (months), sex and height, using the „Pediatric Percentile Calculator for Height, Weight, BMI, and Blood Pressure" charts for ages 2 to 20. The weight, height and BMI were interpreted according to the CDC charts as found on http://www.cdc.gov/growthcharts/percentile_data_files.htm. SBP and DBP values were interpreted based on sex, age (months) and the Z score of height (cm), according to the NHLBI's Fourth Report on the Diagnosis (Appendix B), Evaluation, and Treatment of High Blood Pressure in Children and Adolescents, May 2005: http://www.nhlbi.nih.gov/health/prof/heart/hbp/hbp_ped.pdf, with the 2017 updates.

The statistical methods used in the study were the arithmetic mean, minimum, maximum, percentage, ratios, chi square test, ratio, disease risk (R), disease risk of exposed or unexposed group (Re, Rn), relative risk (RR), odds ratio (OR).

RESULTS AND DISCUSSION

The interpretation of height values based on age and sex shows that 63,34% (n=273) of preschoolers have a medium statural development ($-1 \leq Z\ score \leq +1$), 10,44% (n=45) are small for their age ($Z\ score < -1$), out of which 4,41% (n=19) are too small for their age ($Z\ score \leq -2$), but no child had

a Z score ≤ -3. 26,22% (n= 113) of children were taller than the age average (Z score≥ 1), out of which 6,96% (n=30) had 3>Z score≥ 2, and 0,69% (n=3) had a Z score ≥ 3. (see Image 1 and Table 3). The average height value of the group was 115cm, the average percentile was 68% and the average Z score 0,48.

Image nr.1: Statural Development

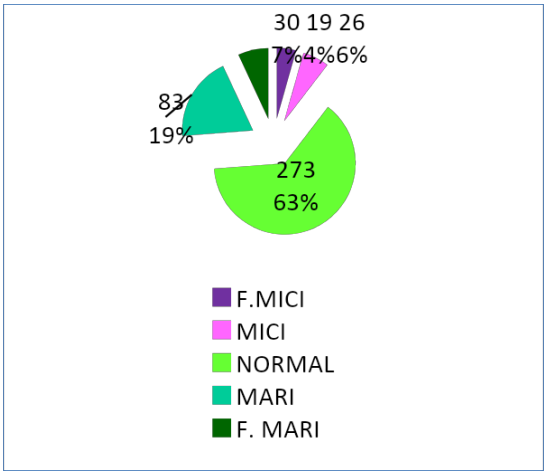
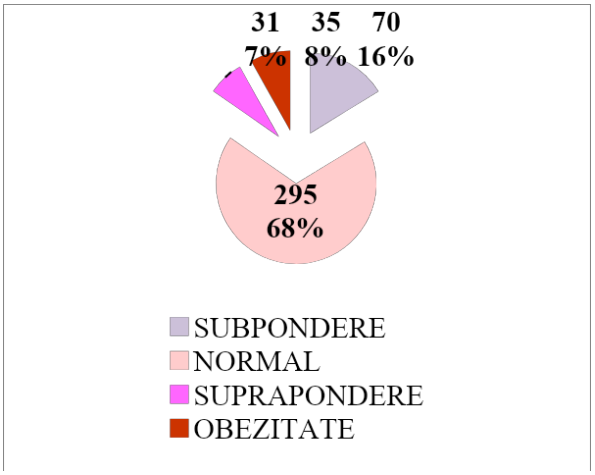


Image nr.2: Staturoponderal development (BMI)



The interpretation of weight values based on age, sex, height and BMI (percentiles, Z score) shows that preschoolers have a harmonic staturoponderal development in a proportion of 68,44% (n=295). 31,55% (n=136) of preschoolers have a disharmonious staturoponderal development , from which 16,24% (n=70) are underweight, and 15,31% (n=66) have an increased with relative to their height, from which 7,19% (n=31) were overweight and 8,12% (n=35) were obese. (see Image nr 2 and Table nr 3). The average weight in the studied group was 19,4kg, the average BMI was 15,58kg/m^2, the average percentile for weight was 51%, the average percentile for BMI was 46%, and the average Z score was -0,07 for weight and -0,27 for BMI.

Preschoolers with a harmonic staturoponderal development (n=295) are distributed as follows: 65,43% (n=193) of them have an average statural development, 11,86% (n=35) of them have a statural development below the age average, and 22,71% (n=67) of them have a statural development over the age average.

Preschoolers with a disharmonious development with low weight for height (n=70) are distributed as follows: 67,14% (n=47) of them have an average statural development, 12,86% (n=9) of them have a statural development below the age average, and 15,71% (n=14) of them have a statural development over the age average.

Preschoolers with a disharmonious development with high weight for height (n=66) are distributed as follows: 50% (n=33) of them have an average statural development, 1,51% (n=1) of them have a statural development below the age average, and 48,49% (n=32) of them have a statural development over the age average.

The analysis of the physiometric data of the preschoolers from the studied group (G, H, BMI), taking into account their age and gender, has a high statistical significance (p=0,0001) and gives a ratio Normal weight : Overweight : Underweight of 4,5 : 1,1 : 1. (see Table nr 3)

Table nr.3: Distribution of the staturoponderal development of preschoolers in the studied group

HEIGHT relative to BMI (n) (%)	**Z score < -1**	**Z scor > +1**	**-1 ≥Z score ≥ -1**	**TOTAL**
DISHARMONIOUS with +G (BMI percentile ≥ 85)	1 0,23%	32 7,42%	33 7,66%	66 15,31%

DISHARMONIOUS with – G (BMI percentile < 5)	9 2,09%	14 3,25%	47 10,90%	70 16,24%
HARMONIC (5≤ BMI percentile < 85)	35 8,12%	67 15,54%	193 44,78%	295 68,44%
TOTAL	45 10,44%	113 26,22%	273 63,34%	431 100%
p = 0,0001				

High values of SBP were measured in 8,12% (n=35) of preschoolers, and normal values in 91,88% (n=396) of them, with 7,65% (n=33) having high normal BP values (pre-HTN). The average value of SBP was 94,13 mmHg, the average percentile was 46,65% and the average Z score was 0,05.

Preschoolers with systolic HTN (n=35) come from three categories: 31,42% (n=11) from those overweight (BMI percentile ≥ 85), 2,85% (n=1) from those underweight (BMI percentile < 5) and 65,71% (n=23) from those with a normal weight (BMI percentile between 5 and 85).

30,30% (n=20) of preschoolers with overweight (+G) had BP values interpreted as systolic preHTN or systolic HTN, compared to 14,91% (n=44) of those with normal weight and with 1,35% (n=4) of those underweight (-G).

Preschoolers with normal SBP values (n=363), below the 90th percentile, represent 85,08% (n=251) of those with normal weight, 94,28% (n=66) of those underweight and 69,70% (n=46) of those overweight. Preschoolers with high-normal SBP values (pre-HTN) (n=33) represent 13,63% (n=9) of those overweight, 7,79% (n=23) of those with normal weight and 4,28% (n=3) of those underweight (p=0,04). (see Table nr 4)

Table nr.4: Distribution of SBP values relative to BMI in the studied group

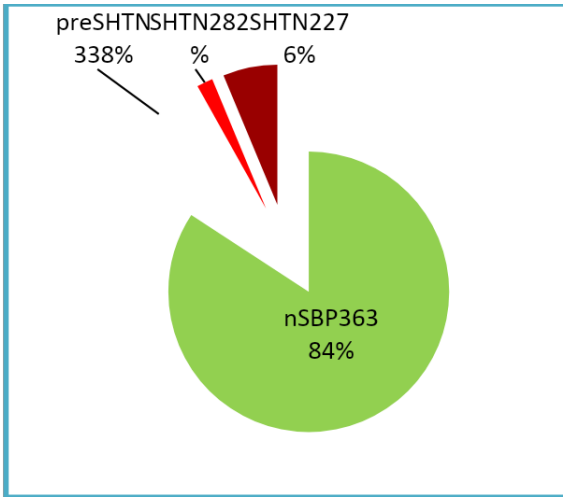
SBP relative to BMI (n) (%)		**normal SBP**		**SBP**	**TOTAL**
		Percentile < 90	90< Percentile <95 (normal – high BP / pre HTN)	Percentile ≥ 95	
+ G	**Overweight** (85 ≤ BMI percentile < 95)	23 5,34%	6 1,39%	2 0,46%	31 7,19%
	Obese (BMI percentile ≥ 95)	23 5,34%	3 0,69%	9 2,08%	35 8,12%
- G(BMI percentile <5)		66 15,31%	3 0,69%	1 0,23%	70 16,24%
Harmonic (5 ≤ BMI percentile < 85)		251 58,24%	21 4,87%	23 5,34%	295 68,45%
TOTAL		363 84,22%	33 7,65%	35 8,12%	431 100%
p =0,0002					

Analyzing the group of preschoolers with normal BP values (n=396) (p=0,04), we notice that the risk to develop normal-high BP values (preHTN) is 2,12 times higher in overweight children (+G) compared to those with normal weight (R_e=0,16, R_n= 0,08, RR=2,12, OR =2,34). The risk in underweight children is very low (-G) (R_e=0,04, R_n= 0,08, RR=0,52, OR =0,54).

The risk to develop systolic HTN is 2,14 times higher in overweight children (+G) compared with those with normal weight (R_e=0,17, R_n= 0,08, RR=2,14, OR =2,37). The risk in underweight preschoolers to develop systolic HTN is very low (R_e=0,01, R_n= 0,08, RR=0,18, OR =0,17).

Image nr.3: Systolic BP values

Image nr.4: Diastolic BP values



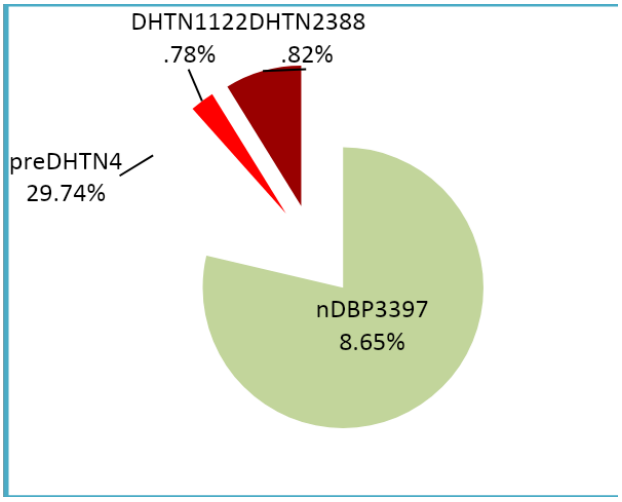


Table nr.5: Distribution of diastolic BP (DBP) values relative to BMI in the studied group

DBP relative to BMI (n) (%)		**Normal DBP**		**DBP**	**TOTAL**
		˂ percentile 90	p 90 < p ˂ p95 (normal high BP / preHTN)	≥ percentile 95	
+ G	**Overweight** (85≤ BMI percentile< 95)	17 3,94%	5 1,16%	9 2,08%	31 7,19%
	Obese (BMI percentile≥ 95)	21 4,87%	5 1,16%	9 2,08%	35 8,12%
- G (BMI percentile ˂5)		58 13,46%	6 1,39%	6 1,39%	70 16,24%
Harmonics (5 ≤ BMI percentile < 85)		243 56,38%	26 6,03%	26 6,03%	295 68,45%
TOTAL		339 78,65%	42 9,74%	50 11,60%	431 100%
p =0,00000000007					

High values of diastolic BP were measured at11,60% (n=50) of preschoolers, and normal values at 88,40% (n=381) of them, with 9,74% (n=42) having high normal BP values (pre-HTN). The average value of DBP was 64,95 mmHg, the average percentile was 78,57% and the average Z score was 0,91.

High values of DBP, above the 95th percentile (meaning diastolic HTN), were recorded in 27,27% (n=18) of overweight preschoolers (+G), in 8,57% (n=6) of those underweight and in 8,81% (n=26) of those with normal weight (p=0,0001).

The risk to develop DHTN is 3 times higher in overweight children (+G) compared with those with normal weight (R_e=0,27, R_n= 0,09, RR=2,99, OR =3,74). The risk in underweight preschoolers to develop DHTN is very low (R_e=0,09, R_n= 0,09, RR=0,94, OR =0,93).

The 339 preschoolers with normal DBP values, below the 90th percentile, are overweight (3,49% n= 38), underweight *17,11% n = 58) and with normal weight (71,68% n=243). Those with normal-high values of DBP are overweight(23,81% n=10, underweight (14,28% n=6) and normal weight (61,90% n=26) (p=0,06).

The risk of preschoolers with normal DBP values to develop normal-high DBP values (preDHTN) is 2,16 times higher in overweight children (+G) compared to those with normal weight (R_e=0,21, R_n= 0,1, RR=2,16, OR = 2,46). The risk in underweight children is very low (-G) (R_e=0,09, R_n= 0,1, RR=0,85, OR =0,83).

Arterial hypertension (HTN) is defined by SBP and / or DBP values equal or above the 95th percentile determined at three different measurements made at least one week apart.

16,47% (n=71) of the preschoolers from the studied group had SBP and / or DBP values above the 95th percentile: preSHTN 7,5%, pre DHTN 9,74%, SHTN 8,5%, DHTN 11,6%. This is one of the reasons why a long-term follow-up and reevaluation, in order to confirm or infirm the diagnosis of HTN, is required, the other one being that in our study the measurements were done only once for each child, and not twice or three times, especially for those children with BP values above the 90th percentile. Certain errors are likely to appear, not so much determined by the measurement technique but by the stress caused by the procedure and the presence in a medical office ("white coat" HTN); for some children it was the first time when their BP was being measured, some children did not stay still during the measurement, they talked or they moved as it was a bit difficult to maintain a quiet and relaxed ambiance in an education unit. Similar values were obtained by other studies on preschoolers aged 4 to 6: in Spain (12-18% that go up to 27,5% in regions like Castilla la Mancha), in China (22,2%), in Brazil (19,9%), in Australia (13,7%), in Africa (9-12% metaanalysis) and in Canada (7,4%). [11,12, 16,17]

The family medical history (AHC) is important in the multifactorial determinism of primary HTN and contains information about the presence at grade 1 and 2 relatives (parents, siblings, grandparents) of HTN, Diabetes Mellitus, obesity, dyslipidemia, eclampsia or other cardiovascular diseases. The polygenic determinism is transmitted paternally, with more than 50 genes identified in the etiology of primary HTN.

In this study we analyzed the presence of only HTN and DM in grade 1 and 2 relatives. AHC of HTN are present in 12,29% (n=53) of the children from the studied group, from which 22,64% (n=12) have high BP values, 26,41% (n=14) have normal-high BP values, and 50,94% (n=27) have normal BP values, below the 90th percentile (p=0,008).

The risk of preschoolers with AHC of HTN to have high BP values, above the 90th percentile, is 2,4 times higher than those without this type of family history (R_e=0,96, R_n= 0,41, RR=2,38, OR =2,38).(see Table nr.6). These result are in accordance with the hypothesis that the genetic determinism can influence 50% of cases.

Diabetes Mellitus in AHC is present at only 6,26% (n=27) of children from the studied group, and is associated with BP values above the 90th percentile in 48,15% (n=13) of children and with BP values below the 90th percentile in 51,85% (n=14) of children (p=0,5). The risk of preschoolers with AHC of DM to have high BP values, above the 90th percentile, is 2,34 times higher than those without this type of family history (R_e=0,93, R_n= 0,40, RR=2,34, OR =2,34).(see Table nr.6).

Table nr. 6: AHC as risk factor for HTN in preschoolers - HTN and DM at grade 1 and 2 relatives

AHC - HTN Gr 1,2 reltvs	Pre HTN	HTN	normal BP	TOTAL	**AHC - DM Gr 1,2 rltvs**	Pre HTN	HTN	Normal BP	TOTAL
HTN	14 3,25%	12 2,78%	27 6,26%	53 12,29%	DM	7 1,62%	6 1,39%	14 3,25%	27 6,26%
without HTN	50 11,60%	59 13,69%	269 62,41%	378 87,%	without DM	57 36,42%	65 15,08	282 65,42%	404 93,73%
TOTAL	64 14,85%	71 16,47%	296 68,67%	431 100/%	TOTAL	64 14,85%	71 16,47%	296 68,67%	431 100/%
p = 0,008					p = 0,5				

In the studied group prematurity was present in 5,56% (n=24) of preschoolers, from which 25% (n=6) had high SBP and / or DBP values, and 94% (n=22) had normal BP values, from which 8,33% (n=2) had normal-high BP values (preHTN) (p=0,04). Prematurely born preschoolers have a risk of developing HTN 1,75 times higher than those born on time (R_e=0,33, R_n= 0,19, RR=1,75, OR =1,75). From the preschoolers born on time but with low birth weight (5,10% n=22) 4,54% (n=1) had SHTN and / or DHTN and 95,46% (n=21) had normal BP values, from which 9,09% (n=2) had normal-high BP values.(p=0,16). (See Table nr.7)

Table nr. 7: APP as risk factors for HTN in preschoolers – prematurity and low birth weight

APP: PREMATURITY	Pre HTN	HTN	Normal BP	TOTAL

LOW BIRTH WEIGHT				
HTN	4 0,92%	7 1,62%	35 8,12%	46 10,67%
without HTN	60 13,93%	64 14,85%	261 60,55%	385 89,33%
TOTAL	64 14,85%	71 16,47%	296 68,67%	431 100/%
p = 0,39				

Chronic and congenital diseases were present in 1,39% (n=6) of studied children, as follows: 3 children with allergic asthma following chronic oral / inhaler treatment with antagonists of leukotriene receptors / glucocorticoids / antihistaminics – normal values of BP, 1 child with operated congenital heart malformation – normal values of BP, 1 child with right kidney agenesis and polycystic left kidney (without medical treatment) – systolic HTN stage 1 (95th percentile) and 1 child with polycystic kidney - systolic HTN / diastolic HTN stage 2 (98th percentile). No child from the study group experienced acute conditions and was not undergoing treatment with other drugs or dietary supplements.

Several studies suggest that high BP values in childhood are correlated with an increase of the intima-media thickness (ITM) of the carotid artery and with a decrease of the endothelial function in adulthood, thus being an important risk factor for HTN, left ventricular hypertrophy, atherosclerosis and kidney failure at an adult age.[17]

The so-called "masked" HTN (meaning normal BP values while hospitalized and high BP values in a medical office) is estimated to be present at 5,7% of children, and it usually progresses up to the appearance of clinical signs and of left ventricular hypertrophy. When measured in a medical office, approximately 20% of children have normal-high BP values (preHTN); these values should not be treated mildly seeing that in children with AHC of HTN the percent can go up to 50%. Even a medical history of perinatal events can lead to a rate of high-normal BP values higher than 20%. This high variability requires an end organ damage assessment in adulthood.[18]

Blood pressure monitoring in preschoolers is recommended yearly for the healthy children, and at each visit for those obese or overweight, for those with DM, congenital or acquired heart disease, congenital renal malformations or other kidney diseases, post-transplant conditions, endocrine and metabolic disorders, type 1 neurofibromatosis, Wiliams syndrome, Turner syndrome or children who use drugs that can increase BP values. These measurements have the purpose to detect masked HNT and to early diagnose HTN in children. [18]

Regular measurement of TA in children starting at the age of 3 can be a screening method for early diagnosis of chronic renal disease that ultimately leads to kidney failure. Thus, even normal BP values that constantly increase leading to HTN, alongside a series of other risk factors, can be important indicators to use in the early detection of chronic kidney diseases. [18, 19]

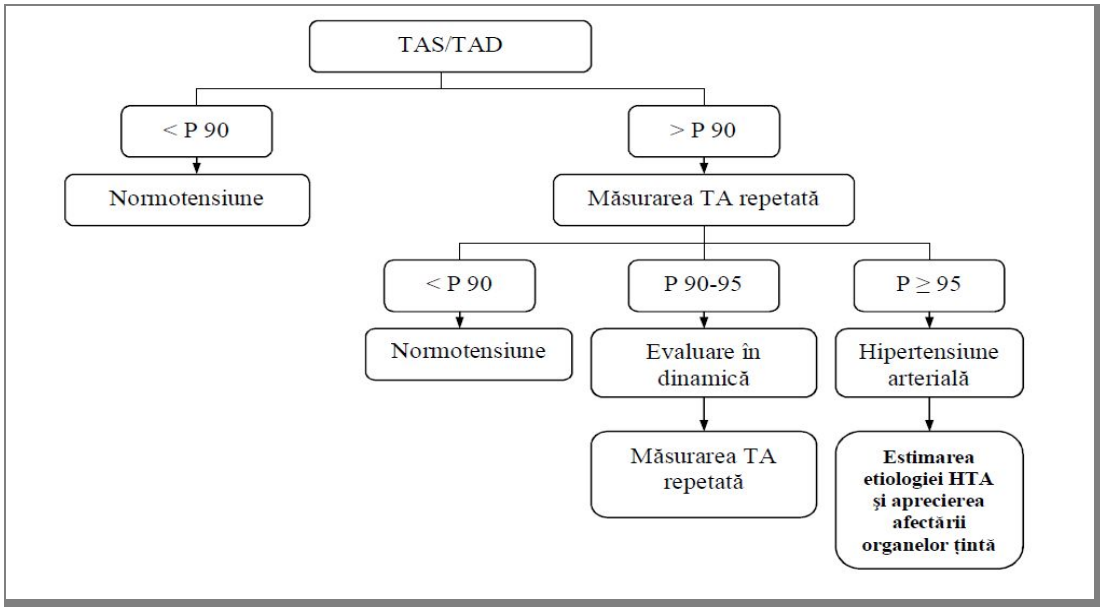
High BP values measured in one arm requires repeating the measurement at the other arm and at one leg. Normally the blood pressure values of a lower limb is 10-20mmHg higher than the one from an arm. If the BP values from a lower limb are smaller than the ones from the arm or if the femoral pulse is weak or even absent, one should consider the possibility of an aortic coarctation.

High BP values together with an increased pulse rate can indicate hyperthyroidism, pheochromocytoma or neuroblastoma. HTN together with a growth deficit requires an investigation of kidney problems, including chronic kidney failure. HTN together with chronic hypertrophic tonsillitis leads to possible sleep disorders. HTN together with truncal obesity suggest a Cushing syndrome or the insulin-resistant syndrome. HTN together with an elfin face suggest Williams syndrome. HTN together with cafe-au-lait spots suggest neurofibromatosis. HTN together with muscular weakness suggest hyperaldosteronism, Liddle syndrome. HTN together with abdominal palpable tumor masses suggest Wilms tumor, neuroblastoma, pheochromocytoma, polycystic kidney or hydronephrosis. [1,2,4,19]

The algorithm we present in Image number 5,aimed at evaluating the blood pressure values in children, implies a period of monitoring of six months for those with preHTN, of one month for those with HTN stage 1, and of one week for those with HTN stage 2, if they are asymptomatic, recording all BP values in a graphic method and by fixing the possible deviations from a healthy lifestyle

(alimentation, physical activity, rest, dietary supplements, stress factors). If the raised BP values persist the child shall be reffered to a pediatric or pediatric cardiology medical office for further investigations and diagnosis. If the children are symptomatic the cardiologic evaluation and treatment initiation should be done immediately. [4]

Image nr.5 BP evaluating algorithm in children [4]



HTN treatment in preschoolers is first of all hygienic-dietary, aiming at an age-adequate alimentation, both in terms of calories and food principles, in order to maintain an BMI below the 85th percentile, moderate to intense physical activity at least 30-60 minutes / day, avoiding a sedentary life-style. The goal is to have BP values below the 90th percentile. If all the measures aimed at changing the life-style do not succeed in lowering the BP values then the initiation of a medical treatment will be considered. If HTN is symptomatic (headache, fatigue, tachycardia, precordial chest pain, sleep disorders) or if the cardiac ultrasound shows left ventricular hypertrophy , the medical treatment shall be initiated right away.

Considering that the group we studied consisted of preschoolers from full-day kindergartens, where they spend 10 to 12 hours per day, ensuring a balanced energy supply and nutrition of high quality with adequate quantities of dietary fiber is essential because in kindergarten they receive 75% of their daily nutritional needs. It's in the kindergarten where the tastes, attitudes and responsible behaviors are formed, things that are needed to get a healthy diet and a healthy lifestyle for children, while in the same time influencing the community they live in. The nutritional factor is essential for a harmonious development of children, decreases the risk of childhood and adolescent illness, with long-term positive repercussions at adulthood. Nutritional education of children and their families, as well as sustained daily physical activity training for at least 30-60 minutes, is particularly important in preventing HTN at any age. The presence of nutritionist-dietitians in children's collectives, the need for nutrition guidelines for children's collectives, updated to current international standards, the need for appropriate cookbooks for these communities could make a difference in achieving these goals.

The BP screening program in children, starting at the age of 3, is highly important because HTN is asymptomatic for a long time, being detected when left ventricular hypertrophy and hypertensive angiopathy are already instituted. This would mean:

- endowment of medical school offices with aneroid sphygmomanometers with different sized cuffs, suitable for the children's age, with digital oximeters for children, with computers and internet access for the use of authorized international percentile software and the correct interpretation of data;
- the presence of qualified personnel in school medical offices (doctors and nurses) , both in rural and urban areas, according to the law;

- ensuring direct access for diagnosed children to specialized services by providing a free referral directly from the school physician's office that has measured the high BP values, thus reducing bureaucracy and earning precious time

CONCLUSIONS

1. HTN in preschool children is under-diagnosed; in our group we had no child with HTN but we actively discovered 71 preschool children (16,47%) with HTN stage 1 and 2.
2. Risk factors for HTN in the studied preschoolers group were: overweight 15,31%(n=66) (RR=2,12 SHTN, RR= 3 DHTN), AHC of HTN 12.29% (n=53) (RR=2,38) and / or DM 6,26% (n=27)(RR=2,34), prematurity / low birth weight 10,67% (n=46)(RR=1,75)
3. BP monitoring starting at the age of 3 is necessary for an early diagnosis of essential and secondary HTN.
4. Early initiation of prophylactic measures is essential for HTN and cardiovascular diseases' prevention in teenagers and adults.

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