

# Critic evaluation of arterial hypertension studies in children in Romania

Eliza CİNTEZA, MD

University of Medicine and Pharmacy "Carol Davila",  
2<sup>nd</sup> Pediatrics Department, IOMC "Alfred Rusescu", Bucharest, Romania

## ABSTRACT

Arterial hypertension is the most frequent important disease in adult. In children, its incidence is smaller than in adult, but remains important by diagnostic, prognostic and therapeutic consequences. This study compares the results of the children arterial hypertension studies in Romania, regarding prevalence. There are 10 studies confronted, published in Romanian journals in the last 33 years. We analyzed the number of children in each group, the age, the methodology and the results. We found a large variability of results. On this basis, we made an attempt to overview the prevalence of the children arterial hypertension in Romania.

**Key words:** hypertension, child, epidemiology

## INTRODUCTION

**D**efinition of the systemic hypertension respects other rules in children comparing with adults. In children, the normal and pathological values of arterial blood pressure (BP) have other limits, related with the age, sex and height. The BP values are expressed in percentiles. Some terms regarding hypertension in children have to be clarified.

In children, the normal BP is the systolic and diastolic BP smaller than 90 percentile for age, sex and height. The "prehypertensive" BP term replaces the before used term "high normal" and it consists of systolic and/or diastolic BP higher or equal with 90 percentile, but smaller than 95 percentile for age, sex and height. The "prehypertensive" term was introduced in 2004, in the last report of National High Blood Pressure Education Program – NHBPEP. In teenagers values higher than 120/80 mmHg are considered as prehypertensive, even if they are smaller than 90 percentile.

Hypertension is systolic and/or diastolic BP higher or equal with 95 percentile for age, sex and height at three determinations (1). There are authors who recommend for the general practice a formula to appreciate the normal values of BP (2) (systolic BP  $80 + 5 \times \text{age in years}$ ) and for the 95th percentile of BP (3):

- for systolic BP (1-17 years):  $100 + (\text{age in years} \times 2)$
- for diastolic BP (1-10 years):  $60 + (\text{age in years} \times 2)$
- for diastolic BP (11-17 years):  $70 + (\text{age in years})$ .

"White coat" hypertension is the term used for high values of BP when it is measured inside the medical office or in the hospital (>95 percentile), in contrast with normal values obtained at home or by 24 hours monitoring. "White coat" effect is definite as an additional hypertensive response in a hypertensive patient with stabilized BP values when is measured inside a medical institution (4). □

## The prevalence

The first studies regarding arterial hypertension were effectuated in adult. One of these studies is the World Health Organization study on a 10 years period, started in 1962, on 5000 subjects. It established the normal values for BP under the age of 40 years at 130/85 mmHg and 140/90 mmHg over this age (5). It was noticed a difference between countries with low economic status and industrialized countries. In the first group, the prevalence is 5-10% comparing with the second group, where the prevalence is 15-30% (6).

Arterial hypertension (HT) is less frequent **in children** than in adult, with an incidence of 1-5%. In adolescent, the prevalence of systemic hypertension may be of 10%. Normal values were evaluated in studies, published between 1964-1970 by Nadas, Nelson, Varonier. In a study published in 1964 by Varonier et al. *normal values of BP* in children 2 – 14 years were considered to be 130/80 mmHg (5). Variation in BP in pediatric population studies is between 0.6% and 11.2% (7,8). In USA, the HT prevalence in children is estimated at 1-3%. Comparing the values obtained in NHANES III study (National Health and Nutrition Examination Survey, 1988-1994) with those from NHANES 1999-2000 study, it can be noticed an increase of BP values in the interval between the two evaluations with 2.2 mmHg for DBP (diastolic blood pressure) and with 1.4 mmHg SBP (systolic blood pressure). This was attributed to the increased prevalence of obesity (9). Obesity and reduced time for physical activity were also identified to have a very important role in the prevalence of essential systemic hypertension in other studies (10,11,12,13,14,15,16,17) as well as in renal disease and renal hypertension,

**In Romania**, the first study regarding systemic hypertension in children was performed and published by Goldis et al. in 1973. He identified a prevalence of 3% in the schoolchildren population, of 6-14 years of age in Bucharest (5). In Iasi, a similar study was made by Chipail et al., 1977, and showed a prevalence of 11.1% (23). The most developed study effectuated in Romania was the "Oradea Study", with 27.500 children enrolled from Bihor, age 5-14 years. The prevalence of hypertension was of 3.3% (24,25).

HTA prevalence depends on the type of population studied, on the equipment, methodology used, and external factors. □

especially in men (18). The dysmetabolic syndrome seems to have an increasing value in children, too (19). On the other hand, there are studies regarding the role of malnutrition in increasing prevalence of pediatric systemic hypertension (20,21) Regarding the etiology of HT in children, the majority of the authors consider that HT in children is mostly secondary, but there are authors who affirm that essential HT is dominant in children (22) □

## The studies

The results of Romanian studies are very different regarding BP prevalence in children, with values between 1.5 (26) and 13.5% (27). The same happened in other countries. Some Romanian studies will be further analyzed in chronological order.

*Goldis et al.* made probably the first study on HT in children, published in Romania (5), in 1973. One thousand schoolchildren between 6 and 14 years, from Bucharest, were investigated to establish the limits for normal BP. Asymptomatic high BP prevalence was 3%. It was used an auscultatory method, as the American Society of Cardiology recommended in 1967. For SBP they considered the 1<sup>st</sup> Korotkoff sound, and for DBP the arithmetic media of the values for the 4<sup>th</sup> and the 5<sup>th</sup> Korotkoff sounds. Adequate cuffs were used. The BP was measured three times, at both arms, in orthostatism and in decubitus, at basal conditions, but also at increased psychic stress conditions. It was noticed an increase of BP values, with less than 10 mmHg in stress conditions. The percent of secondary BP was of 16.6% (5 children in 30 cases of HT, 2 with aortic coarctation and 3 with renovascular HT).

In *Chipail et al* study (23), performed in Iasi in 1977, on 1866 children between 6 and 20 years the main objective was to establish the medium values of BP and standard deviation (SD) on both sexes and age. There were considered as pathological values of BP those higher than 120/70 mmHg for the age 6 – 9, higher than 140/90 mmHg in boys aged 13-17 years and in girls aged 13-20 years and higher than 150/90 mmHg for the 17-20 boys. When the study was finished and all the values were registered, the abnormal values were considerate those higher than 2 SD over the medium BP in the studied group. In this group, the BP incidence was of 11.1%. The BP measure method was auscultatory, sitting, at the end of the school program.

The *Patiu et al* study (7), in 1978, included 4558 children from Bihor. The HT prevalence was 7.5%. In another study effectuated by the same authors in Cluj Napoca (27), on a 206 children group (100 having 8 years, 76 having 2 years and 30 infants having 6 months), the prevalence of HT was of 13.5% (28 children). The BP was measured auscultatory with a mercury sphygmomanometer. The limits of the normal BP were not defined in this paper.

*Pop et al.* in the "Oradea study" (24,25), in 1981, investigated a pediatric population of 27503 children aged 5 – 14 years, from Bihor, both rural and urban. The methodology for BP detection: decubitus 5 minutes before, mercury sphygmomanometer and adequate cuffs, three measures (the 3<sup>rd</sup> value was registered), than repeated two times for high BP values. For diastolic BP (DBP) the 5<sup>th</sup> Korotkoff sound was registered. The normal values of BP were considered those in the interval "BP media plus/minus 2 SD". In these conditions the prevalence of HT in the studied group was 3.3%. The DBP prevalence was higher than systolic BP (SBP) prevalence. The SBP prevalence was 2.3% (2.5% urban and 2.2% rural). DBP had a prevalence of 3.4%, with a big difference between urban (2.9%) and rural (3.7%). It was noticed that both SBP and DBP increase proportionally with weight. In the subgroup with obesity (over 30% from normal body weight for age and sex) the hypertension prevalence was 10%. In the same study, the essential hypertension proportion was established at 94.4% and it was compared with other reports in literature: in their studies, Aullen and Vidon found 95% essential hypertension, and Goldis 84.4% essential hypertension, respectively (24).

In *Brumariu et al.* study (28), in 1986, the etiologic profile in 293 hospitalized hypertensive children was analyzed. The total number of admissions was of 16208 children, aged 1-16 years, on a period of 8 years. Systemic hypertension was defined as BP higher than the 95<sup>th</sup> percentile for age, for a period of minimum 48-72 hours. They used the morning measurement of BP with an aneroid sphygmomanometer and an adequate cuff, in decubitus. The SBP was identified with the 1<sup>st</sup> Korotkoff sound, and DBP with the 4<sup>th</sup> Korotkoff sound. The hypertension prevalence was of 1.8%, with 68.8% secondary HT (62.8% renal, 2% vascular, 3.1% secondary to the corticosteroid therapy).

In the *Ivan et al* study (29), 7917 pupils, aged 10-19 years, were investigated in 1989. The BP was measured sitting, repeated at 10-30 minutes in case of increased values or oscillation, in decubitus and after physical exercise. The prevalence of "high normal" BP was 5.1%, defined as BP 125-130/70-75 mmHg in the 10-14 year group and 135-140/75-80 mmHg in the 15-19 year group. The hypertension prevalence (defined as higher than 130/75 mmHg in 10-14 year group and higher than 140/80 mmHg in 14-19 year group) was 5.4%. The proportion was 46.5% for diastolic HT, 44% for systolic-diastolic and 7.1% for systolic HT.

*Balla et al.* (30) investigated BP in 3460 school-children, aged 7 -14 year, in 1989, in Harghita county, both urban and rural area, during the classroom time. A mercury sphygmomanometer with adequate cuffs was used, in the sitting position. There were three measurements, on the right arm, performed by two physicians. For DBP the 4<sup>th</sup> Korotkoff sound was considered. An arithmetic media of the six measures was made. Hypertensive values were considered those higher than the 95<sup>th</sup> percentile. Borderline systemic hypertension was considered when BP values were only sometimes higher with 10 to 30 mm Hg than the 95<sup>th</sup> percentile.

In the *Moraru et al.* study (31), in 1990, in Iasi, the high SBP was 2.6%, high DBP was 1.7% and systolic-diastolic hypertension was 1.1% in a group of 942 children 10-17 years aged. A mercury sphygmomanometer with adequate cuffs was used. The BP was detected in the sitting position, after a 5 minutes rest period and the measurement was repeated twice. The 1<sup>st</sup> and the 5<sup>th</sup> Korotkoff sound were registered. The hypertension prevalence was 5.4%.

In the *Popescu Veronica* study (32) regarding the risk factors (1994 – 1998), a 2382 children group was investigated. The age was 7-18 years, and they were from both urban and rural areas. BP measurements were registered ambulatory in healthy children. A mercury sphygmomanometer with adequate cuffs was used. Measurements were made at the right arm, at the heart level, in the sitting position, after a 5 minutes rest. The first and the fifth Korotkoff sounds were registered. There were three measurements and the registered value was the arithmetic media of the last two measurements. The essential hypertension prevalence was 9.23%.

Another study was performed by *Gherghina et al.*<sup>26</sup> in 1999, on a group of 400 healthy children, aged 14 – 18 years, in Bucharest. Borderline HT was taken into account when SBP values were between 130 – 140 mmHg and when DBP values were between 80 – 90 mmHg and it was present in 10.75% of children for systolic and 5% for diastolic. True HT was defined when BP was higher than 140 and/or 90 mmHg, respectively. The HT prevalence was 0.75% (SBP) and 0.75% (DBP). □

population (19-20 years). The study where almost all pediatric ages were present was the *Brumariu et al.*'s study, from 1986, with a large number of children, 16208 hospitalized, a prevalence of HT of 1,8% but the methodology is not the recommended one (position – decubitus, diastolic BP – the fourth Korotkoff sound, definition of HT, over the 95<sup>th</sup> percentile for 48-72 hours) which can generate a number of false negative results.

3. The criteria used to define HT were different from one study to another. In consequence,

Study	Loc.	Year	N°	Age (years)	Prev (%)	2 <sup>nd</sup> sound	Pos.	HT def.	Sec. HT(%)	Ess. HT(%)
Goldis	Buch.	1973	1000	6-14	3	$\frac{K_4 + K_5}{2}$	ortho + decub	>2SD	16.6	83.4
Chipail	Iasi	1977	1866	6-20	11.1	?	sitting	>2SD	?	?
Patiu	Bihor	1978	4558	?	7.5	?	?	?	?	?
	Cluj N	1978	206	0.5-8	13.5	?	?	?	?	?
Pop	Bihor	1981	27503	5-14	3.3	K <sub>5</sub>	decub	>2SD	5.6	94.4
Brumariu	Iasi	1986	16208	1-16	1.8	K <sub>4</sub>	decub	>P <sub>95</sub> 48 hours	68.8	31.2
Ivan	Iasi	1989	7917	10-19	5.4	?	sitting	* **	?	?
Balla	HR	1989	3460	7-14	?	K <sub>4</sub>	sitting	>P <sub>95</sub>	?	?
Moraru	Iasi	1990	942	10-17	5.4	K <sub>5</sub>	sitting	>P <sub>95</sub>	?	?
Popescu Veronica	?	1998	2382	7-18	9.23	K <sub>5</sub>	sitting	>P <sub>95</sub>	?	100
Gherghina	Buch.	1999	400	14-18	1.5	K <sub>5</sub>	sitting	***	?	?

**TABLE 1.** Comparison between the published studies regarding HT in children

**Abbreviations:** Loc. (Location), No (number of patients) Prev. (Prevalence), Pos. (Position), HT def. (HT definition), Sec.HT (Secondary HT), Ess. HT (Essential HT), Buch. (Bucharest), ClujN (Cluj Napoca), HR (Harghita), ? (not mentioned in the study), K<sub>4</sub> (the fourth Korotkoff sound), K<sub>5</sub> (the fifth Korotkoff sound), ortho (orthostatic), decub. (dorsal decubitus), SD (standard deviation), P<sub>95</sub> (the 95<sup>th</sup> percentile).

\*>130/75mmHg for 10-14 years, \*\*>140/80mmHg for 14-19 years,

\*\*\*>140/90mmHg

## DISCUSSIONS

1. None of the analysed studies was in concordance with the actual recommendations made by the National High Blood Pressure Education Program Working Group on High Blood Pressure in Children and Adolescents. During that period other recommendations existed, many of them very different from the standard ones of today.
2. Although the number of the investigated children in these studies is impressive, none of these studies included all the ages of the pediatric population. This would allow to analyze both the general prevalence of HT in children and the age group prevalence. Children between 10 and 14 years were investigated for HT in eight of these studies. Some of the studies are extended to the young adult

no rigorous comparison between the studies can be performed.

4. Heterogenic population groups were investigated, including national minorities with a different prevalence in Romanian regions: Bucharest, Moldova (Iasi) and Transylvania (Bihor, Cluj, Harghita) and in rural and urban areas. The prevalence was estimated regardless this heterogeneity.
5. Methodology of blood pressure measurement varied from one study to another, in respect with the place of BP detection (in classrooms or in medical offices – “white coat” HTA), subject position, the moment of the day, the sphygmomanometer type or the method to estimate the value for the DBP (the 4<sup>th</sup>, the 5<sup>th</sup> or the arithmetic media between the 4<sup>th</sup> and 5<sup>th</sup> Korotkoff sounds).

6. The highest prevalence values were obtained in the studies of Chipail et al, from 1977 and Patiu et al, from 1978, and this kind of values are absent in the most recent studies.
7. There is an interesting similitude between the Goldis et al study and the largest study in Romania concerning this problem, Oradea study. The age of the group, the methodology of BP detecting and the prevalence are almost the same. But both studies did not include ages under 5 years and over 14 years and consider that essential HT in children is more frequent (83.4% and 94.4%) than the secondary HT (16.6% and 5.6%).
8. Another similitude is exactly the same prevalence (5.4%) obtained in Ivan et al study and Moraru et al study. They both analyzed almost the same age group of population (10-19 years and 10-17 years). The metho-

dology was similar between the studies but the definition of HT is different. □

### Conclusion

1. The studies cannot be compared because the methodology, the age groups, and the algorithm to define HT were different.
2. The hypertension prevalence in children was estimated at very different values (from 1.5 to 13.5%).
3. The first study was done 33 years ago and the latest 7 years ago.
4. The largest study, Oradea study, estimated hypertension prevalence in children at 3.3%. However, they considered the prevalence of essential HT at 94.4%, in contrast with most of the more recent pediatricians' opinion, which consider the secondary HT to be more often present in children.
5. In conclusion, the issue of HT prevalence in Romanian children is still under debate. □

## REFERENCES

1. **National High Blood Pressure Education Program Working Group on High Blood Pressure in Children and Adolescents** – The Fourth Report on the Diagnosis, Evaluation and Treatment of High Blood Pressure in Children and Adolescents. *Pediatrics*, 2004, Aug; 114 suppl, No 2, part 3 of 3:555-576
2. **Ciofu E, Ciofu C** – Hipertensiunea arteriala (HTA) la copil si adolescent. In *Esentialul in Pediatrie*, Bucuresti: Editura Medicala AMALTEA, 1999: 274-277
3. **Somu S, Sundaram B, Kamalanathan AN** – Early detection of hypertension in general practice. *Archives of Disease in Childhood* 2003; 88:302
4. **Anwar AY, White WB** – Ambulatory Monitoring of Blood Pressure, Devices, Analysis, and Clinical Utility In William B. White. *Blood Pressure Monitoring in Cardiovascular Medicine and Therapeutics*, Totowa, New Jersey: Humana Press, 2001; 57-75
5. **Goldis G, Caimacan D, Tocineanu E, et al** – Cercetari asupra presiunii arteriale la copiii intre 6-14 ani. Studiu statistic pe 1000 de elevi din Municipiul Bucuresti. *Pediatria* 1973; 22:397-408
6. **Gherasim L, Dorobantu M** – Hipertensiunea arteriala in L. Gherasim *Medicina Interna*, Editia a II-a vol. 2, Bolile cardiovasculare, bolile metabolice. Bucuresti: Editura Medicala, 2004; 1058-1235
7. **Popescu V, Arion C** – Hipertensiunea arteriala la copil. *Revista Muncitorul Sanitar*, 1988; 34:4-5
8. **Ghannem H, Trabeland L, Gaha R, Harrabi I, Essouand AS** – Study of cardiovascular disease risk factors among rural schoolchildren in Sousse, Tunisia. *East Mediterr Health J*. 2001, Jul-Sep; 7:617-624
9. **Sorof JM, Lai D, Turner J, et al** – Overweight, Ethnicity, and the Prevalence of Hypertension in School-Aged Children. *PEDIATRICS* 2004; 113:475-482
10. **Bouziotas C, Koutedakis Y, Nevill A, et al** – Greek adolescents, fitness, fatness, fat intake, activity, and coronary heart disease risk. *Archives of Disease in Childhood* 2004; 89:41-44
11. **Reilly JJ, Methven E, McDowell ZC, et al** – Health consequences of obesity. *Archives of Disease in Childhood* 2003; 88:748-752
12. **Dzerve V, Britcina N, Pakhomova J, et al** – Prevalence and control of hypertension in Latvia. *J Hum Hypertens*. 2004 Aug; 18:587-590
13. **Ihab Hajjar, Theodore A Kotchen** – Trends in Prevalence, Awareness, Treatment, and Control of Hypertension in the United States, 1988-2000. *JAMA*. 2003; 290:199-206
14. **Ribeiro JC, Guerra S, Oliveira J, et al** – Body fatness and clustering of cardiovascular disease risk factors in Portuguese children and adolescents. *Am J Hum Biol*. 2004 Sep-Oct; 16:556-562
15. **Randall OS, Retta TM, Kwagyan J, et al** – Obese African Americans: the prevalence of dyslipidemia, hypertension, and diabetes mellitus. *Ethn Dis*. 2004 Summer; 14:384-388
16. **Stevens VJ, Obarzanek E, Cook NR, et al** – Long-Term Weight Loss and Changes in Blood Pressure: Results of the Trials of Hypertension Prevention, Phase II. *Annals of Internal Medicine* 2001; 134:1-11
17. **Sorof J, Daniels S** – Obesity hypertension in children: a problem of epidemic proportions. *Hypertension*. 2002 Oct; 40:441-447
18. **Kunitoshi Iseki, Yoshiharu Ikemiya, Kozen Kinjo, et al** – Body mass index and the risk of development of end-stage renal disease in a screened cohort. *Kidney International* 2004; 65:1870-1876
19. **Falkner B, Hassink S, Ross J, et al** – Dysmetabolic Syndrome: Multiple Risk Factors for Premature Adult Disease in an Adolescent Girl. *PEDIATRICS* 2002 July; 110 No.1, pp. e 14
20. **Schutte AE, Huisman HW, van Rooyen JM, et al** – Associations between arterial compliance and anthropometry of children from four ethnic groups in south africa: the

- THUSA BANA Study. *Blood Press.* 2003;12:97-103
21. **Fernandes MT, Sesso R, Martins PA, et al** – Increased blood pressure in adolescents of low socioeconomic status with short stature. *Pediatr Nephrol.* 2003;18:435-439
  22. **Reid C, Chantler C** – Systemic hypertension In Anderson, Baker, Macartney, Rigby, Shinenbourne, Tynan *Paediatric Cardiology*, 2nd Edition, vol.II, Churchill Livingstone, 2002; 1809-1844
  23. **Chipail A, Schneer JH, Moraru D, et al** – Valorile tensiunii arteriale (TA) la un grup de elevi din Iasi. *Pediatria* 1977; 26:259-262
  24. **Pop E, Popa I, Costa A, et al** – Tensiunea arteriala la copilul de 5-14 ani (Cercetare prospectiva asupra unei populatii infantile neselectate, cuprinzand 27.500 copii din mediul urban si din cel rural, in cadrul “Studiului Oradea privind depistarea and epidemiologia factorilor de risc in cardiopatia ischemica”). *Pediatria* 1981; 30:245-310
  25. **Pop E, Popa I, Pop V, et al** – Prevalenta hipertensiunii arteriale la populatia infantila intre 5-14 ani (Studiu longitudinal la o populatie neselectata de 27.000 copii). *Pediatria* 1984; 33:311-327
  26. **Gherghina I, Matei D, Matei R** – Importanta masurarii tensiunii arteriale la copil, *Viata Medicala* 2000; 527:2
  27. **Patiu Z, Chisiu A, Pop D** – Investigarea factorilor de risc ai ateroscrozei la copiii in varsta de 6 luni, 2 ani si 8 ani, *Pediatria* 1978; 27-1:7-13
  28. **Brumariu O, Trifan N, Scumpu G, et al** – Aspecte epidemiologice in hipertensiunea arteriala a copilului. *Pediatria* 1986; 35:255-258
  29. **Ivan A, Duda R, Groll M, et al** – Unele aspecte din epidemiologia hipertensiunii arteriale esentiale in colectivitati scolare. Prevalenta modificarilor tensiunii arteriale. *Pediatria* 1989; 38:247-254
  30. **Balla A, Tamas M, Mester Z, et al** – Studiu statistico-epidemiologic al tensiunii arteriale la scolari in vederea stabilirii valorilor normale pentru judetul Harghita. *Pediatria*, 1989; 38:45-52
  31. **Moraru D** – Hipertensiunea arteriala la copil. In Teza de doctorat, 1990, Cond Stiintific: Prof Dr. V. Popescu, IMF Bucuresti
  32. **Popescu Veronica** – Factorii de risc in HTA la copil si adolescent. In Teza de doctorat, 1999, Cond Stiintific Prof Dr. Eugen Ciofu, UMF Bucuresti



Address for correspondence:

Eliza Cinteza, IOMC “Alfred Rusescu”, Lacul Tei Blvd., No. 120, SE 2, Bucharest, Romania  
email address: elizacinteza@yahoo.com