

Epidemiological, Diagnostic, Therapeutic and Progressive Aspects of Arterial Hypertension in Children at the University Hospital Center of Bouaké (Côte d'Ivoire)

Richard Azagoh-Kouadio^{1*}, Yao Kossonou Roland Yeboua², Kouassi Christian Yao², John Patrick Yenan², Iburaima Alamun Akanji², Kouadio Vincent Assé²

¹Pediatric Department of Angré University Hospital, Abidjan, Ivory Coast

²Pediatric Department of Bouaké University Hospital, Bouaké, Ivory Coast

Email: *azagoh.richard@gmail.com, rolandyeboua13@gmail.com, snobychrist@hotmail.fr, johnnyenan@yahoo.fr, ibrahimakanji@gmail.com, assevinc2014@gmail.com

How to cite this paper: Azagoh-Kouadio, R., Yeboua, Y.K.R., Yao, K.C., Yenan, J.P., Akanji, I.A. and Assé, K.V. (2024) Epidemiological, Diagnostic, Therapeutic and Progressive Aspects of Arterial Hypertension in Children at the University Hospital Center of Bouaké (Côte d'Ivoire). *Open Journal of Pediatrics*, 14, 379-390.

<https://doi.org/10.4236/ojped.2024.142037>

Received: December 27, 2023

Accepted: March 18, 2024

Published: March 21, 2024

Copyright © 2024 by author(s) and Scientific Research Publishing Inc. This work is licensed under the Creative Commons Attribution International License (CC BY 4.0).

<http://creativecommons.org/licenses/by/4.0/>



Open Access

Abstract

Introduction: Arterial hypertension (AH) in children is under-diagnosed and often has a poor prognosis. The aim of this study was to describe the epidemiological, diagnostic, therapeutic and evolutionary aspects of hypertension in children at the University Hospital of Bouaké, with a view to improving the prognosis. **Methods:** This was a cross-sectional, analytical study carried out in the paediatrics department of Bouaké University Hospital. It concerned the medical records of children aged 4 to 15 hospitalised from 1 January 2017 to 31 December 2020 for hypertension. Diagnosis was based on the simplified blood pressure guidelines of the Expert Consensus of the French Society of Hypertension. The variables studied were epidemiological, diagnostic, therapeutic and evolutionary. Quantitative variables were compared at the significance level $p \leq 0.05$. **Results:** The hospital incidence of hypertension was 0.32% (69/21,642). The sex ratio was 0.72. 97.1% of the children were over five years of age. Oedema (49.3%) and breathing difficulties (20.2%) were the main reasons for consultation. Hypertension was classified as threatening (56.5%), confirmed (31.9%) and borderline (11.6%). The cause was renal in 66.7%, dominated by impure nephrotic syndrome (24.6%). Treatment for hypertension consisted mainly of a diuretic (79.7%) and a calcium channel blocker (47.8%). Outcome was favourable in 50.7% of cases. Mortality was 20.3%. No factor was significantly associated with death. **Conclusion:** Hypertension in children at Bouaké University Hospital is serious. The aetiology is mainly renal. Early diagnosis and management are key to improving prognosis.

Keywords

Hypertension, Children, Renal Pathologies, Prognosis, Côte d'Ivoire

1. Introduction

Arterial hypertension (AH) in children is defined as elevated blood pressure with systolic blood pressure (SBP) and/or diastolic blood pressure (DBP) above the 95^e percentile according to the American curves and the 97.5th percentile, according to the French Society of Nephropediatrics [1] [2]. The prevalence of paediatric hypertension has been rising in recent decades, making this condition a real public health problem. This prevalence rose from 1.3% between 1990 and 1999 to 6% between 2010 and 2014 [3] [4]. Worldwide, between 3% and 5% of children and adolescents suffer from hypertension and 10% to 14% have high blood pressure [3] [4] [5] [6]. In the presence of overweight or obesity, it can affect up to 24% of children, depending on the population [7]. In the United States and Europe, prevalence varies between 1.8% and 13.8% [8] [9]. It was 26.2% in Thailand [10], and in sub-Saharan Africa varied between 0.96% and 3.36% [11]. This is a serious condition that can be life-threatening or functionally crippling for children, due to the numerous complications, in particular acute pulmonary oedema and cerebral oedema with convulsive seizures. High blood pressure in children is most often secondary, necessitating investigations which may be extensive in order to find the underlying cause. These causes are dominated by renovascular pathologies [12]. In Côte d'Ivoire, the characterisation of hypertension in children suffers from several problems. In children, the condition is under-diagnosed and the data are old [13]. A hospital study carried out in Abidjan in 2012 found a prevalence of 0.22% [13]. In addition, the inadequacy of the technical facilities sometimes limits the investigations to be carried out when hypertension is discovered in children. Lastly, hypertensive children are usually admitted at a complication stage that threatens their functional and vital prognosis. To improve the prognosis of hypertensive children, it is becoming necessary to have a good knowledge of their profile. This study, carried out in Bouaké, the second largest city in Côte d'Ivoire, aims to contribute to a better understanding of childhood hypertension. The aim was to describe the epidemiological, diagnostic, therapeutic and evolutionary aspects of hypertension in children, with a view to improving prognosis and professional practice.

2. Methods

The study was carried out in the paediatrics department of the Bouaké University Hospital, the only tertiary-level referral centre located in the interior of Côte d'Ivoire, 350 km from Abidjan, the economic capital. The department provides day and night care for children from the central, northern and western regions of Côte d'Ivoire. Children are cared for on a daily basis by a team comprising six

paediatricians, four interns, twenty-two doctors with a diploma in specialised paediatric studies, including twelve permanent doctors, twelve nurses and ten care assistants. This was a retrospective study with descriptive and analytical aims. It covered a four-year period from 1 January 2017 to 31 December 2020. The study included all records of children aged 1 month to 15 years hospitalised during the study period. Children aged 1 to 15 years hospitalised for hypertension diagnosed according to the simplified blood pressure guidelines for the detection of hypertension according to age and sex of the Expert Consensus of the French Society of Hypertension (**Table 1**) [14]. Blood pressure in children was measured using a multi-brass pediatric sphygmomanometer on the right upper limb and then on the lower limb in the event of an abnormality. In the absence of an electric syringe pump, threatening hypertension was managed by slow infusion of a calcium channel blocker in 100 ml of physiological solution under strict monitoring of blood pressure. All children aged between 1 and 15 years hospitalised in the paediatric ward and presenting with hypertension were included, regardless of aetiology, sex or age. Children who died prematurely before the start of treatment were not included in the study. The sample size was determined by calculating the minimum number of subjects required using the

Table 1. Simplified blood pressure guidelines for the detection of hypertension according to age and sex from the Expert Consensus of the French Society of Hypertension [7].

Age (years)	Blood pressure (mmHg)			
	Boys		Girls	
	SBP*	DBP**	SBP	DBP
1	94	49	97	52
2	97	54	98	57
3	100	59	100	61
4	102	62	101	64
5	104	65	103	66
6	105	68	104	68
7	106	70	106	69
8	107	71	108	71
9	109	72	110	72
10	111	73	112	73
11	113	74	114	74
12	115	74	116	75
13	117	75	117	76
14	120	75	119	77
15	122	76	120	78
16	125	78	121	78
17	127	80	122	78

*Systolic Blood Pressure, **Diastolic Blood Pressure.

Schwartz formula: $n = Z^2 p(1 - p) / d^2$ [n = minimum sample size, $Z = 1.96$ for 95% confidence level, p = reported prevalence of paediatric hypertension which was 4% worldwide [7], d = margin of error set at 5%]. The minimum size calculated was 59 hypertensive children. To constitute the sample, all records of children aged 1 month to 15 years admitted to the units during the study period were recorded exhaustively. The variables studied covered epidemiological aspects (prevalence, age, sex, place of residence, parents' socioeconomic conditions), diagnostic aspects (history, reasons for admission, physical signs, complementary examinations, aetiologies of hypertension), therapeutic aspects (antihypertensive drugs) and evolutionary aspects (complications, mode of discharge). Socio-economic conditions were judged to be modest in terms of overcrowding, the absence of running water and/or electricity, and a daily food budget of less than or equal to 1500 CFA francs for more than 3 people with no food reserves. They were good if there was no overcrowding, if there was running water and electricity, if there were food reserves and if the daily food budget was at least 1000 F CFA/person. Data were collected using a standardised, computerised and structured survey form. Data were entered and analysed using SPSS 22 software. Quantitative variables were analysed in terms of mean, standard deviation and median. Qualitative variables were expressed as proportions. To measure the relationship between the dependent variables and children's hypertension, a univariate logistic regression analysis was performed. The threshold for statistical significance was set at $p < 0.05$ for a two-tailed test. This study was carried out after obtaining authorization from the Medical and Scientific Department of Bouaké University Hospital. Anonymity and confidentiality were respected by assigning an anonymity number to each survey form.

3. Results

- Epidemiological aspects

Out of 21,642 children hospitalised during the study period, 69 cases of hypertension were recorded, representing a hospital frequency of 0.32%. Hypertensive children diagnosed in 2020 accounted for 44.9% of cases. The children were 58% girls and 42% boys. The sex ratio was 0.68. They were aged five or over in 97.1% of cases. The average age was eleven, with extremes of three and fifteen. The children lived outside the city of Bouaké in 66.7% of cases. The socio-economic status of the parents was modest in 73.9% of cases.

- Diagnostic aspects

Children were referred from a peripheral centre in 75.4% of cases. The main reasons for admission were oedema (49.3%), respiratory difficulties (20.3%) and convulsions (13%). In 75.4% of cases, they showed good growth in height and weight. Overweight or obese children accounted for 15.9%. They had no pathological history in 68.1% of cases. A history of hypertension in the family was identified in 5.8% of cases. The immunisation schedule was not up to date for the age in 85.5% of cases. The main signs found on physical examination were

poor impression (79.7%), oedema (68.1%) and ascites (31.9%). High blood pressure was a threat in 56.5% of cases. Urine dipstick tests in 15 children revealed proteinuria with three crosses in 9. Blood counts in 66 patients showed moderate anaemia in 53%. In the renal work-up, abnormalities were observed in urea (69.1%), creatinine (67.8%) and 24-hour proteinuria (75%). Hypoproteidemia was noted in 79.4% of cases and ASLO positivity in 73.9%. Blood ionograms carried out in 22 patients revealed hyperkalaemia in 6 cases and hyponatraemia in 5 cases. As regards the cardiac work-up, chest X-rays carried out in 19 cases revealed cardiomegaly in twelve. Cardiac ultrasound in five children revealed dilated cardiomyopathy in two. The electrocardiogram performed in five cases revealed a repolarisation disorder (three cases), incomplete right bundle branch block (two cases) and sinus tachycardia (one case). The aetiologies of hypertension were dominated by renal causes (66.6%) represented by impure nephrotic syndrome (24.6%), acute glomerulonephritis (23.2%) and renal failure (18.8%). The main diagnostic characteristics of hypertensive children are shown in **Table 2**.

- Therapeutic aspects

Antihypertensive treatment was prescribed in 79.7% of children. Diuretics and calcium channel blockers were prescribed in 79.7% and 47.8% of cases respectively. Extra-renal purification was used in eight children. Other therapeutic modalities are described in **Table 3**.

Table 2. Distribution of hypertensive children according to the main diagnostic aspects.

Diagnostic aspects	<i>n</i> (69)	% (100)
Main reasons for admission		
Edema	34	49.3
Breathing difficulty	14	20.3
Convulsions	9	13.0
Nutritional status		
Normal	52	75.4
Delayed weight gain	6	8.7
Overweight/obese	11	15.9
Familial hypertension		
Yes	4	5.8
No	65	94.2
Main physical signs		
Poor general impression	55	79.7
Oedema of the lower limbs	47	68.1
Ascites	22	31.9
Coma	8	11.6

Continued

Classification of hypertension		
Borderline	8	11.6
Confirmed	22	31.9
Threatening	39	56.5
Bloody	11	4.9
Etiologies of hypertension		
Renal	46	66.6
Impure nephrotic syndrome	17	24.6
Acute glomerulonephritis	16	23.2
Chronic renal failure	13	18.8
Cardiovascular	9	13.0
Essential hypertension	14	20.3

Table 3. Distribution of hypertensive children according to treatment received.

Treatment*	n (69)	% (100)
Therapeutic class		
Antihypertensives	55	79.7
Antibiotics	35	50.7
Anthelmintics	17	24.6
Corticosteroids	14	20.3
Dialysis	8	11.6
Anti malaria	7	10.1
Anticonvulsants	3	4.3
Analgesics	2	2.9
Hygienic and dietary measures (strict rest. low-salt diet)	1	1.4
Other (macromolecules)	1	1.4
Antihypertensives		
Thiazide diuretics	55	100
Calcium channel blockers (Nifedipine)	33	60
Converting enzyme inhibitors (Captopril)	5	9.1
ACE inhibitors/calcium channel blockers	1	1.8
Centrally acting antihypertensives (Methyl dopa)	1	1.8
B-blockers (Bisoprolol)	1	1.8

*A child could receive one or more treatments at a time.

- Evolutionary aspects

The main complications were acute lung oedema (13%) and hypertensive encephalopathy (7.2%) (**Table 2**). Clinical outcome was favourable in 50.7% of

cases. Referral to an Abidjan teaching hospital and discharge against medical advice concerned 4.3% and 24.6% of children respectively. The death rate was 20.3%. The search for links between the death of hypertensive children and sociodemographic, diagnostic and therapeutic characteristics did not reveal any significant relationship either with sex, age, origin, pathological history, type of hypertension, treatment, socioeconomic conditions or with growth in height and weight (**Table 4**).

4. Discussion

This is a retrospective study with descriptive and analytical aims. The general objective is to describe the epidemiological, diagnostic, therapeutic and evolutionary aspects of arterial hypertension in children at Bouaké University Hospital. Overall, this study shows that paediatric hypertension is rare in the hospital setting and most often affects adolescents living in modest socio-economic conditions. The aetiologies are dominated by renal pathologies, and the course is marked by a high mortality rate. However, these results must be qualified because of the retrospective and monocentric nature of the study, with all that this

Table 4. Factors associated with death after univariate analysis.

	Evolution		<i>p</i> *
	Favourable	Deaths	
Age			
≤5 years	5	0	0.303
>5 years old	30	14	
Sex			
Male	17	5	0.617
Female	18	9	
Type of hypertension			
Borderline	2	0	1
Confirmed/threatening	33	14	
Socioeconomic conditions			
Favourable	14	3	0.322
Unfavourable	21	11	
Place of residence			
Bouaké	16	3	0.194
Outside Bouaké	19	11	
Conditions associated with hypertension			
Yes	9	2	0.47
No	26	12	

**p* significant at threshold <5%.

entails in terms of bias. Also, the lack of financial resources of some parents has also limited the availability of diagnostic paraclinical examinations and optimal care, and the frequent discharge of hypertensive children against medical advice has made treatment and follow-up difficult. The relationship between the rate of response to treatment, the time of diagnosis and the patient's age at onset of diagnosis, as well as the role of parental education and associated genetic abnormalities, could not be determined in the study. Despite the methodological limitations, the results obtained raise a number of epidemiological, diagnostic, therapeutic and evolutionary aspects of the disease. The prevalence of paediatric hypertension is increasing in hospitals in Côte d'Ivoire, rising from 0.22% in 2012 [13] to 0.32% in the study. The same observation was made in Libreville in Gabon, where it had risen from 21.5% to 28.1% in two decades [11]. In Congo in 2014, prevalence in schools was 10% [15]. A higher proportion (35.1%) was reported in Tunis in North Africa [16]. This increase in the prevalence of paediatric hypertension raises the alarm about the scale of this major public health problem. It could be attributed to the epidemiological transition in sub-Saharan Africa in general and Côte d'Ivoire in particular. This transition is characterised by a change in nutrition, with overnutrition and the consumption of refined foods with a high salt content being risk factors for hypertension in children and adolescents [17]. With regard to gender, the study showed that high blood pressure affects girls more than boys, with a sex ratio of 0.68. The same finding was made in Libreville. The same observation was made in Libreville in Gabon [11], Cameroon [18] and Lubumbashi in the Democratic Republic of Congo [19]. Numerous studies have described a male predominance [19] [20]. One of the main hypotheses is the appearance of pubertal hormones, which are thought to have a protective role (vasodilatation by oestrogen) in girls [21] [22]. The average age of hypertensive children was around 11 years. This is consistent with the literature [15] [23]. In addition, the incidence of hypertension in the study increased with the age of the child, as described in the literature [11] [24]. In the study, the predominance of adolescents could be explained by the fact that the technical platform for blood pressure measurement was better adapted to older children and adolescents. High blood pressure was associated with overweight/obesity in 15.9% of cases. According to the authors, the prevalence of hypertension in overweight or obese children varies between 4% and 23%. Obesity is a major risk factor for paediatric hypertension [25] [26]. The socio-economic conditions of hypertensive children were modest in 73.9% of cases. Living in unfavourable socio-economic conditions could have an impact on the onset of hypertension in children. An author in Poland observed higher blood pressure levels in adolescents with insufficient income compared with their more affluent peers [27]. The main reasons for admission of hypertensive children were oedema, breathing difficulties and convulsions. These signs have been reported in varying proportions by several authors in the literature [13] [28]. These symptoms associated with hypertension seem to be closely linked to its aetiology or its cardiac,

renal or neurological repercussions [29] [30] [31]. In this study, hypertension was threatening in more than half the cases. This is indicative of the late consultation of patients at the complication stage. The aetiology of hypertension was dominated by renal pathologies. In the literature, kidney disease accounts for 80% - 90% of the causes of secondary hypertension in children. There is a wide range of renal diseases that cause hypertension in children [12]. In this study, these were impure nephrotic syndrome and acute glomerulonephritis. In the United States, it was parenchymal and vascular renal diseases as well as congenital renal malformations [32]. Drug treatment for hypertension in children in Bouaké included antihypertensive drugs in the majority of cases. These were mainly diuretics and calcium antagonists used separately or in combination. These antihypertensives were introduced in collaboration with the hospital cardiologists. In the literature, it has been reported that calcium antagonists and converting enzyme inhibitors are more effective in secondary hypertension than in essential hypertension in children. However, there is a lack of experience with the use of ACE inhibitors in younger children, and they are contraindicated in cases of hyperkalaemia or renal-vascular pathology [2] [33]. The outcome was favourable in almost half the cases. The death rate was 20.3%. Authors in Nigeria have reported death rates in the same proportions [34]. This high case-fatality rate clearly illustrates the diagnostic and management difficulties associated with the inadequacy of technical facilities and the low socio-economic status of families. In this study, not all patients underwent investigations to assess the impact of hypertension and find its cause. In addition, it is important to bear in mind that most children are consulted late at the complication stage.

5. Conclusion

High blood pressure in children is a reality at Bouaké University Hospital. It most often affects school-age children. Diagnosis is made late at the complication stage. The cause is dominated by kidney disease. The mortality rate remains high. In order to improve prognosis, blood pressure should be systematically measured as part of routine consultations, and the technical facilities should be strengthened to ensure better management of complications. Efforts should also focus on primary prevention at community level, by promoting healthy lifestyles and combating malnutrition.

Authors' Contributions

- **Richard Azagoh-Kouadio**
 - Drafting and revision of the manuscript
- **Yao Kossonou Roland Yeboua**
 - Protocol writing and data collection
 - Drafting and revision of the manuscript
- **Kouassi Christian Yao**
 - Protocol feedback

- Drafting and revision of the manuscript
- **John Patrick Yenan**
- Drafting and revising the manuscript
- **Iburaima Alamun Akanji**
- Protocol writing and data collection
- Drafting and revision of the manuscript
- **Kouadio Vincent Asse**
- Protocol validation
- Drafting, revision and validation of the manuscript.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

References

- [1] André, J.L. (1993) Épidémiologie de l'hypertension artérielle. In: Loirat, C., Niaudet, P., Eds., *Progrès en néphrologie pédiatrique*, Doin, Paris, 193-202.
- [2] National High Blood Pressure Education Program Working Group on High Blood Pressure in Children and Adolescents. (2004) The Fourth Report on the Diagnosis, Evaluation, and Treatment of High Blood Pressure in Children and Adolescents. *Pediatrics*, **114**, 555-576.
- [3] Rosner, B., Cook, N.R., Daniels, S. and Falkner, B. (2013) Childhood Blood Pressure Trends and Risk Factors for High Blood Pressure: The NHANES Experience 1988-2008. *Hypertension*, **62**, 247-254.
<https://doi.org/10.1161/HYPERTENSIONAHA.111.00831>
- [4] Song, P., Zhang, Y., Yu, J., Zha, M., Zhu, Y., Rahimi, K., *et al.* (2019) Global Prevalence of Hypertension in Children: A Systematic Review and Meta-Analysis. *JAMA Pediatrics*, **173**, 1154-1163. <https://doi.org/10.1001/jamapediatrics.2019.3310>
- [5] Koebnick, C., Black, M.H., Wu, J., Martinez, M.P., Smith, N., Kuizon, B.D., *et al.* (2013) The Prevalence of Primary Pediatric Prehypertension and Hypertension in a Real-World Managed Care System. *The Journal of Clinical Hypertension*, **15**, 784-792. <https://doi.org/10.1111/jch.12173>
- [6] De Moraes, A.C.F., Lacerda, M.B., Moreno, L.A., Horta, B.L. and Carvalho, H.B. (2014) Prevalence of High Blood Pressure in 122,053 Adolescents: A Systematic Review and Meta-Regression. *Medicine*, **93**, Article e232.
<https://doi.org/10.1097/MD.0000000000000232>
- [7] Hansen, M.L., Gunn, P.W. and Kaelber, D.C. (2007) Underdiagnosis of Hypertension in Children and Adolescents. *JAMA*, **298**, 874-879.
<https://doi.org/10.1001/jama.298.8.874>
- [8] Vergnaud, P. and Bertail-Galoin, C. (2023) Découverte d'une HTA chez l'enfant. *Perfectionnement en Pédiatrie*, **6**, S6-S9.
[https://doi.org/10.1016/S2588-932X\(23\)00096-7](https://doi.org/10.1016/S2588-932X(23)00096-7)
- [9] Falkner, B., Gidding, S.S., Ramirez-Garnica, G., Wiltrout, S.A., West, D. and Rappaport, E.B. (2006) The Relationship of Body Mass Index and Blood Pressure in Primary Care Pediatric Patients. *The Journal of Pediatrics*, **148**, 195-200.
<https://doi.org/10.1016/j.jpeds.2005.10.030>
- [10] Rerksuppaphol, L. and Rerksuppaphol, S. (2021) Prevalence and Risk Factors of

Hypertension in Schoolchildren from Central Thailand: A Cross-Sectional Study. *International Journal of Preventive Medicine*, **12**, 1-6.

- [11] Kuissi Kamgaing, E., Allognon, M.C., Minto'o, S., Mboungou Ikouanga, R., Koumba Maniaga, R., Mintsami Nkama, E., *et al.* (2022) Aspects épidémiologiques et facteurs associés à l'hypertension artérielle de l'enfant en milieu scolaire à Libreville en 2021. *Health Sciences and Disease*, **23**, 11-15.
- [12] André, J.L. (2005) Hypertension artérielle chez l'enfant et l'adolescent. *EMC-Cardiologie-Angéiologie*, **2**, 478-490. <https://doi.org/10.1016/j.emcaa.2005.07.008>
- [13] Asse, K.V., Akaffou, E., Ake-Assi-Konan, M.H., Adonis-Koffy, L.Y., Timite-Konan, A.M. and Kouassi, F.L. (2012) Hypertension artérielle de l'enfant à Abidjan (Côte d'Ivoire): Aspects diagnostiques, thérapeutiques et évolutifs à propos de 30 cas. *Revue Africaine d'Anesthésiologie et de Médecine d'Urgence (RAMUR)*, **17**, 53-58.
- [14] Société Française d'Hypertension Artérielle (2020) HTA de l'enfant et de l'adolescent. Consensus d'Experts de la. <https://www.sfhta.eu>
- [15] Mbolla, B.F.E., Okoko, A.R., Babela, J.R.M., Bowassa, G.E., Gombet, T.R., Kimbally-Kaky, S.-G., *et al.* (2014) Prehypertension and Hypertension among School Children in Brazzaville, Congo. *International Journal of Hypertension*, **2014**, Article ID: 803690. <https://doi.org/10.1155/2014/803690>
- [16] Aounallah-Skhiri, H., El Ati, J., Traissac, P., Ben Romdhane, H., Eymard-Duvernay, S., Delpeuch, F., *et al.* (2012) Blood Pressure and Associated Factors in a North African Adolescent Population. A National Cross-Sectional Study in Tunisia. *BMC Public Health*, **12**, Article No. 98. <https://doi.org/10.1186/1471-2458-12-98>
- [17] Steyn, N.P. and McHiza, Z.J. (2014) L'obésité et la transition nutritionnelle en Afrique sub-saharienne. *Annals of the New York Academy of Sciences*, **1311**, 88-101. <https://doi.org/10.1111/nyas.12433>
- [18] Lemogoum, D., Kandem, F., Bika Lele, C., Guetchuin, S.C., Kenmegne, C., Luma, H., *et al.* (2016) Hypertension artérielle et facteurs de risque associés chez les adolescents en milieu scolaire au Cameroun. *Revue de Médecine et de Pharmacie*, **6**, 602-611.
- [19] Kakoma, P.K., Muyumba, E.K., Mukeng, C.K., Musung, J.M., Kakisingi, C.N., Mukuku, O., *et al.* (2018) Profil pressionnel de l'adolescent en milieu scolaire à Lubumbashi, République Démocratique du Congo. *Pan African Medical Journal*, **29**, Article 94. <https://doi.org/10.11604/pamj.2018.29.94.14537>
- [20] Nam, E.W., Sharma, B., Kim, H.Y., Paja, D.J., Yoon, Y.M., Lee, S.H., *et al.* (2015) Obesity and Hypertension among School-Going Adolescents in Peru. *Journal of Lifestyle Medicine*, **5**, 60-67. <https://doi.org/10.15280/jlm.2015.5.2.60>
- [21] Patel, A., Bharani, A., Sharma, M., Bhagwat, A., Ganguli, N. and Chouhan, D.S. (2019) Prevalence of Hypertension and Prehypertension in Schoolchildren from Central India. *Annals of Pediatric Cardiology*, **12**, 90-96. https://doi.org/10.4103/apc.APC_13_18
- [22] Ye, X., Yi, Q., Shao, J., Zhang, Y., Zha, M., Yang, Q., *et al.* (2021) Trends in Prevalence of Hypertension and Hypertension Phenotypes among Chinese Children and Adolescents over Two Decades (1991-2015). *Frontiers in Cardiovascular Medicine*, **8**, 627-741. <https://doi.org/10.3389/fcvm.2021.627741>
- [23] Gupta-Malhotra, M., Banker, A., Shete, S., Hashmi, S.S., Tyson, J.E., Barratt, M.S., *et al.* (2015) Essential Hypertension vs. Secondary Hypertension among Children. *American Journal of Hypertension*, **28**, 73-80. <https://doi.org/10.1093/ajh/hpu083>
- [24] André, J.L. (2006) Hypertension artérielle chez l'enfant et l'adolescent. *EMC-Cardiologie*, **19**, 1-10. [https://doi.org/10.1016/S1166-4568\(05\)39433-2](https://doi.org/10.1016/S1166-4568(05)39433-2)

- [25] Rutigliano, I., De Filippo, G., Pastore, L., Messina, G., Agostoni, C. and Campanozzi, A. (2021) Obesity-Related Hypertension in Pediatrics, the Impact of American Academy of Pediatrics Guidelines. *Nutrients*, **13**, Article 2586. <https://doi.org/10.3390/nu13082586>
- [26] Sun, S.S., Grave, G.D., Siervogel, R.M., Pickoff, A.A., Arslanian, S.S. and Daniels, S.R. (2007) Systolic Blood Pressure in Childhood Predicts Hypertension and Metabolic Syndrome Later in Life. *Pediatrics*, **119**, 237-246. <https://doi.org/10.1542/peds.2006-2543>
- [27] Kaczmarek, M., Stawińska-Witoszyńska, B., Krzyżaniak, A., Krzywinska-Wierowska, M. and Siwiriska, A. (2015) Who Is at Higher Risk of Hypertension? Socioeconomic Status Differences in Blood Pressure among Polish Adolescents: A Population-Based ADOPLNOR Study. *European Journal of Pediatrics*, **174**, 1461-1473. <https://doi.org/10.1007/s00431-015-2554-0>
- [28] Koueta, F., Ouedrogo-Yugbare, S.O., Some, A.M., Boly, C., Dao, L., Sawadogo, H., *et al.* (2013) Profil de l'hypertension artérielle de l'enfant en milieu hospitalier pédiatrique à Ouagadougou (Burkina Faso). *Sciences de la Santé*, **1**, 36-40.
- [29] Olson, D.L. and Lieberman, E. (1991) Renal Hypertension in Children. *Child Nephrology and Urology*, **11**, 152-158.
- [30] Aysun, K.B., Fatos, Y., Nilgun, C., Ali, D., Zelal, B. and Aysin, B. (2007) Reno-Vascular Hypertension in Childhood: A Nationwide Survey. *Pediatric Nephrology*, **22**, 1327-1333. <https://doi.org/10.1007/s00467-007-0520-4>
- [31] Sebire, G., Husson, B. and Lasser, C. (1995) Encéphalopathie induite par l'hypertension artérielle: Aspects cliniques, radiologiques et thérapeutiques. *Archives de Pédiatrie*, **2**, 513-518. [https://doi.org/10.1016/0929-693X\(96\)81193-6](https://doi.org/10.1016/0929-693X(96)81193-6)
- [32] Grinsell, M. and Norwood, V. (2009) At the Bottom of the Differential Diagnosis List: Unusual Causes of Pediatric Hypertension. *Pediatric Nephrology*, **24**, 2137-2146. <https://doi.org/10.1007/s00467-008-0744-y>
- [33] Douglas, M.S., Champoux, E., Diego, H.A. and Vehaskari, V.M. (2006) Treatment of Primary and Secondary Hypertension in Children. *Pediatric Nephrology*, **21**, 820-827. <https://doi.org/10.1007/s00467-006-0087-5>
- [34] Aderole, W.I. and Seriki, O. (1974) Hypertension in Nigerian Children. *Archives of Disease in Childhood*, **49**, 313-317. <https://doi.org/10.1136/adc.49.4.313>