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Review

# Is it the time to screen for high blood pressure all children and adolescents in Ireland?

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## Abstract

Similar to other kinds of chronic diseases, hypertension tends to develop many years before the onset of its clinical signs and symptoms. In this respect, children with higher blood pressure values are more likely to become hypertensive during adulthood. According to literature data, the averaged prevalence of paediatric hypertension is around 5% in Europe and 3.5% in the USA. A strong relationship with familial history, smoking, overweight/obesity, salt intake, and diabetes has been demonstrated as well.

Conversely, similar evidences are substantially still lacking in Ireland, and only sporadic data are available. What is known is the fact that a large number of adults in the Island are affected by high blood pressure and their number is expected to raise notably, with significant adverse consequences for these subjects and their families, the health and social care system and the economy of all Ireland. Based on these premises, preventive measures are strongly needed to identify those Irish children and adolescents with high blood pressure, as an early modification of their unhealthy lifestyle may be still effective to normalize its values with no drugs administration.

## Keywords

Blood pressure, hypertension, children, adolescents, prevention, Ireland.

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## Introduction

Hypertension (HTN) is considered a leading modifiable risk factor for premature cardiovascular disease worldwide, Ireland included [1].

It is now commonly known among doctors that the high arterial blood pressure (BP) detected in adults may have already been manifested in childhood and/or adolescence, as occasional increases in BP or excessive BP response to physical or psychological distress. Similar to other kinds of chronic diseases, HTN tends to develop many years before the onset of its clinical signs and symptoms [2, 3]. In this respect, children with higher BP values are more likely to become hypertensive during adulthood. It is the so-called "tracking" of BP [4]. The strength of the tracking relationship is stronger in older children and adolescents [5].

Tables reporting BP normal values in children and adolescents are available in the United States as well as in Europe. The first paediatric BP nomograms – expressed as gender-specific percentile curves describing the distributions of systolic and diastolic BPs for an age range between 5 and 17 years, with corrections for height and weight – were published in the USA in 1987 [6]. They were periodically updated in 1996, 2004, and 2017 [7-9]. For the first time in Europe, in an update to the HTN guidelines published by the European Society of Hypertension in 2009, a new chapter totally committed to HTN in children was added [10].

In the last American Guidelines for Screening and Management of High Blood Pressure in Children and Adolescents released in 2017, the previous definitions of normal BP and HTN were modified. In this respect, before the age of 13 years, BP was considered elevated when the systolic and/or diastolic values are major than the 90$^{th}$ percentile. Again, BP values were categorized in terms of stage 1 HTN (≥ 95$^{th}$ percentile), and stage 2 HTN (≥ 95$^{th}$ percentile + 12 mmHg). These values were based on auscultatory measurements obtained from around 50,000 children and adolescents. In case of discrepancy between systolic and diastolic BP with respect to classification, children's condition should be categorized using the higher value [9]. In adolescents ≥ 13 years of age a simplified BP classification that aligns with the American Heart Association and American College of Cardiology adult BP guidelines was preferred, so that a threshold of 120/80 mmHg was used in the simplified tables, regardless of gender, for the detection of elevated BP [9, 11].

Furthermore, unlike the 2004 Fourth Report, the 2017 BP nomograms did not include overweight/obese children and adolescents, but they represented BP values for youth with a normal weight. This decision relied on evidence of the strong association among overweight/obesity and elevated BP/HTN. Including overweight and obese individuals in normative BP tables were thought to create a bias [9].

The European Guidelines in 2009 offered an algorithm for the diagnosis of HTN in paediatric age, which was based on systolic and/or diastolic BP values > 95$^{th}$ percentile. Again, HTN was subdivided into stage 1 (from 95$^{th}$ to 99$^{th}$ percentile + 5 mmHg) and stage 2 (> 99$^{th}$ percentile + 5 mmHg). Values between 90$^{th}$ and 95$^{th}$ percentile (high-normal BP) require accurate follow-up based on repeated BP measurements over a period of months and without the need for immediate pharmacological therapy. BP percentiles for boys and girls were adapted from the Fourth Report of the US Task Force [10].

The European Guidelines were updated in 2016. A general consensus was given that, for boys and girls aged 16 or older, the definition of HTN should no longer be based on percentiles, but graded as for adults (i.e. high-normal BP: 130-139/85-89 mmHg and HTN: 140/90 mmHg). In addition, HTN was further classified as grade 1 (95$^{th}$-99$^{th}$ percentile + 5 mmHg) and grade 2 (> 99$^{th}$ percentile + 5 mmHg) [12].

To sum up, the most striking differences between the American and European Guidelines are the criteria for the diagnosis and classification of HTN in children and adolescents, with a subsequent strong impact on the estimation of its prevalence [13].

## Prevalence of paediatric high blood pressure and hypertension in the USA and Europe

Estimation of paediatric HTN in the USA is mainly due to data coming from the National Health and Nutrition Examination Survey (NHANES), which was based on a single BP measurement. According to NHANES, HTN is more common in the male gender, Hispanic and African American children, and adolescents as well [9].

However, with repeated BP measurements, the prevalence of HTN usually drops gradually because of BP variability itself as well as an increase in the expertise in BP measuring technique (the so-called accommodation effect). Overall, this prevalence in US children and adolescents seems to be around

3.5% [9]. Furthermore, regarding the prevalence of persistently elevated paediatric BP (formerly defined "prehypertension," i.e. BP values from the 90th to 94th percentiles or between 120/80 and 130/80 mmHg in adolescents), it ranges from 2.2% to 3.5%, with higher rates among those who are overweight and obese [9].

Data on paediatric HTN prevalence in Europe vary a lot, depending on the fact that the survey was based on a single or repeated measurement [14]. Summing up, the averaged prevalence of paediatric HTN in Europe is about 5% [12]. Recently, a screening conducted in Greece concluded that the prevalence of HTN in Greek children was shocking and among the highest reported in European countries, as stage 1 HTN involved 15.7% of the sample and stage 2 HTN involved 7.3%. Isolated systolic HTN was the most common subtype [15].

However, this alarming finding was based on a single measurement and so that strongly criticized. In fact, not only BP was assessed by means of a single visit, but also not population-specific BP nomograms were used as references, thus probably leading to an overestimation of the number of those being hypertensive [16].

In a previous survey carried on in another Southern European country, i.e. Italy, with higher methodological accuracy and by means of many measurements rather than a single detection before defining a subject as hypertensive, the prevalence of HTN was 9.4% of the study sample. Isolated diastolic HTN was the most common type (4.6%) in children [14]. A strong relationship with overweight/obesity, prematurity birth/low birth weight, familial history of HTN, and sedentary life was detected as well [17-19].

In the UK, specific-population nomograms were developed, taking into account the analysis of BP data gathering from a few nationally representative surveys: Health Surveys for England 1995-8, Scottish Health Surveys 1995 and 1998, and National Diet & Nutrition Survey 1997. High BP for age was defined as BP above the 98th percentile, and high-normal BP as BP between the 91st and 98th percentiles. BP was measured by means of an oscillometric device after a 10-15 min rest period in triplicate, at minute intervals. The first reading was discharged and the mean between the second and third readings used for analysis. Based on these premises, the prevalence of paediatric HTN was 8.5% for high systolic BP and 0.5% for diastolic [20].

Paediatric HTN appears to be more frequent and BP higher in Southern European countries than in the North of Europe, probably because of an earlier transition to maturity in the first. In this respect, it would be better that each country develop its own nomograms. Clinicians from every ethnic group or geographic area in the world, through recording BP routine, should produce their own national nomograms relating to age, gender and height, derived from their genetic, nutritional, cultural, ethnic and social backgrounds [14, 21-23].

## Prevalence of paediatric high blood pressure and hypertension in Ireland

In the Republic of Ireland, *Changing Cardiovascular Health: National Cardiovascular Health Strategy 2010-2019* identified the detection and management of HTN as playing a pivotal role in the prevention of stroke [24].

Also in Northern Ireland, the *Service Framework for Cardiovascular Health and Wellbeing* identified detection, control, and management of HTN as an essential component of national strategies in the prevention of coronary heart disease, stroke, diabetes and chronic kidney disease [25].

HTN has become a significant public health issue for the Health Service in all the Island. In the Republic of Ireland the prevalence of self-reported, doctor-diagnosed HTN among adults aged more than 18 was 12.6%, while when considering those major than 45, it was 46.8% in men and 31.2% in women [26]. In Northern Ireland, the number of people currently affected by high BP is 14% of the population, decidedly less than in the Republic of Ireland [27].

Notwithstanding these premises and what it was reported in many other European countries, evidences about paediatric HTN prevalence and distribution in Ireland are substantially still lacking, and only sporadic data are available.

In this respect, in a research conducted in Cork ten years ago, a strong relationship between obesity and high BP at baseline was showed as easily hypothesized, since overweight/obese boys (51%) and girls (49%) had initial BP measurements in the hypertensive range [28]. More recently, a close relationship with type 2 diabetes arising in childhood was demonstrated as well, as 85% of the sample had complications, most frequently HTN [29].

Another interesting study is the ongoing Cork Children's Lifestyle Study (CCLaS), which started in 2012 enrolling participants attending schools from all parts of Cork city, to evaluate diet, physical

activity, lifestyle behaviors, the prevalence of obesity and related comorbidities (including high BP) in children. The primary objective of the CCLaS is to explore the individual, familial, and environmental factors contributing to childhood overweight and obesity, with a specific interest for diet and physical exercise. Secondary aims are to determine the averaged salt intake and distribution of BP in Irish children [30].

It was anticipated that, based on an interpretation of the British Hypertension Society guidelines, 11% of the children who took part in the study were suffering from HTN. Twice as many overweight/obese children had high BP when compared to normal-weight children. Over half of the hypertensive children (55%) reported adding salt to their food every day [31].

Regarding Northern Ireland, an encouraging decrease in systolic and diastolic BPs over a given period of 10 years in adolescents was registered. Specifically, a mean decrease from 7.7 to 10.0 mmHg in systolic BP, and from 8.8 to 11.0 mmHg in diastolic BP was found. Interestingly, these decreases were not influenced after adjustment for potential confounders, including weight, body mass index, smoking, and physical activities and seemed to reflect the significantly reduced prevalence of HTN in adulthood in Northern Ireland compared with the Republic of Ireland [32].

## Conclusions

BP in children and adolescents may vary significantly between examinations and even during the same examination, because of such factors like anxiety, recent caffeine intake, and errors in measurement. BP generally decreases gradually with repeated assessments. Thus, it is very important to obtain multiple measurements over time before diagnosing BP in childhood and adolescence. These subjects should not be classified as hypertensive until they have shown clear evidence of sustained BP elevation, at least in three separate occasions [12].

Cuffs adequate to the diameter of the arm need to be used, to avoid BP overestimation (in case of cuffs too tight) or underestimation (cuffs too large) [33]. Population-specific nomograms should be developed as well, again not to run the risk of underestimation/overestimation of BP values.

Regarding therapy, it is only when healthy measures aimed at reducing BP (i.e., bodyweight reduction, aerobic physical exercise, low sodium intake) have failed, that pharmacological treatment is required [34, 35].

What is known is the fact that a large number of adults in the Island, mostly in the Republic of Ireland, are affected by high BP, and their number is expected to rise notably, with significant adverse consequences for these subjects and their families, health and social care system, and the economy of all Ireland. Based on these premises, preventive measures are strongly needed to identify those Irish children and adolescents with high BP, as an early modification of their unhealthy lifestyle may be still effective to normalize its values without administering drugs [36].

## Declaration of interest

The Authors declare that there is no conflict of interest.

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