EARLY DETECTION OF HYPERTENSION AMONG SCHOOL CHILDREN

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OBJECTIVE: Early detection of hypertension among school children, identification of exact etiology of secondary hypertension and find possible associations and influence of age, sex and anthropometric measures.

INTRODUCTION: Early diagnosis of hypertension in children and adolescents is of paramount importance. One rationale for screening for hypertension in children and adolescents is that early identification of primary hypertension could lead to interventions to reduce blood pressure during childhood and adolescence, resulting in a reduced risk for cardiovascular events. Measurement of blood pressure is a cost-effective, noninvasive, and relatively accurate method to identify pediatric hypertension. (2)

STUDY DESIGN: Efforts were made to examine all children in the age group 6-12 years in each selected school. The absentees could not be examined. The non-responder rate varied from 1-2% in various schools. The study sample comprised two schools covering about 300 children of whom 156 were boys and 144 were girls.

It has become clear that hypertension begins in childhood and adolescence, and that it contributes to the early development of cardiovascular disease. An individual's blood pressure is defined by two measurements: Systolic& Diastolic blood pressure. The diagnosis of high blood pressure can be based upon either measurement as they are of equal importance. (1) Body size is the most important determinant of BP in children and adolescents. Thus, classification of BP is more accurate when the values are adjusted for height as well as age and gender to avoid misclassifying children at the extremes of normal growth. The normal range is expressed as a percentile, similar to charts used to track children’s growth. (2) Blood pressure is separated into three categories based upon the child's blood pressure percentile. BP classification based on the Fourth Report on the Diagnosis, Evaluation, and Treatment of High Blood Pressure in Children and Adolescents:

1. Normal blood pressure: Both systolic and diastolic blood pressure <90th percentile.
2. Prehypertension: Systolic and/or diastolic blood pressure ≥90th but still <95th percentile.
3. Hypertension is defined as either systolic and/or diastolic blood pressure ≥95th percentile measured on three or more separate occasions. (2, 3)

Hypertension occurs in 2-5% of children, its prevalence has increased in recent years. The growing prevalence of obesity, physical inactivity, and more frequent intake of foods high in calories and salt are contributing to this trend. Younger children are more likely to have secondary hypertension, whereas older children and adolescents are more likely to have primary hypertension. In school-aged children, secondary hypertension accounts for 70% to 85% of cases. (4-6) Pediatric hypertension can be associated with primary renal parenchymal disease, may be a sign of an underlying pathologic condition (e.g., coarctation of the aorta, renal artery stenosis), usually persists into adulthood, and is a risk factor for cardiovascular disease. (7)

Early diagnosis of hypertension in children and adolescents is of paramount importance. One rationale for screening for hypertension in children and adolescents is that early identification of primary hypertension could lead to interventions to reduce blood pressure during childhood and adolescence, resulting in a reduced risk for cardiovascular events. (8, 9). Measurement of blood pressure is a cost-effective, noninvasive, and relatively accurate method to identify pediatric hypertension. (2)

SUBJECT AND METHODS:

Cross sectional study methodology was done on 2 phases:

The first for evaluation of BP & determination of risk factors related to development of hypertension, it was done on children in primary schools, the pupils attending 2 different schools of different socioeconomic levels located in Alexandria, these schools were:

1. Omar el Farooq primary school attended by children of parents of low socioeconomic level.
2. Future language school attended by children of parents of higher socioeconomic level.

Efforts were made to examine all children in the age group 6-12 years in each selected school. The absentees could not be examined. The non-responder rate varied from 1-2% in various schools. The study sample comprised two schools covering about 300 children of whom 156 were boys and 144 were girls.
The second phase was done for early detection of hypertension & identification of its exact etiology, it was done on Alexandria Main University Hospital & Italian Military Hospital.

Certain children were excluded from the study, the exclusion criteria were:

* Children with known history of hypertension due to renal, endocrinal or cardiac or other causes.
* Children under medications which may be responsible for high blood pressure e.g. steroids.

Attitude of the teachers of each school was assessed a day or two prior to commencement of the survey to enlist their cooperation. The objectives and the importance of the study were explained and a report was established with the school staff.

The screening was performed in the morning or early afternoon hours. To ensure relaxation and cooperation during examination, the various procedures to be carried out were explained to the children. The students were then interviewed to find out the educational level of the parents it was decided to equate the educational level and occupation with the socioeconomic level because of difficulty in estimating the actual income of the parents.

Children included in the study were subjected to

1. Complete history taking according to pre-designed questionnaire with focus on: Age, sex, socioeconomic status, family history of smoking, hypertension, obesity), presence of certain symptoms whether renal symptoms e.g. (renal mass, edema, hematuria, dysuria) or endocrinal symptoms e.g. (obesity, polyuria, polydipsia, hirsutism) or CNS e.g. manifestations of increased intracranial tension.

2. Full Clinical examination emphasizing: B.P measurement, anthropometric measurement (weight, height), detailed examination to exclude any chronic illness (cardiological examination for cardiomegaly or associated murmur, abdominal examination for abdominal masses, and examination of other systems.

The following procedures were followed in weight & height estimation and BP measurement:

Blood pressure was measured with a mercury sphygmomanometer in a controlled environment after 5 minutes of rest, the child seated and the right arm extended over a table at the level of the heart. A set of different sized cuffs was used. The cuff bladder was wide enough to encircle the arm completely without lapping.

The correct choice of cuff is important for accurate BP measurement. If too small a cuff is used, the pressure generated by inflating the cuff may not be fully transmitted to the brachial artery. In this setting, the pressure in the cuff may be considerably higher than the intra-arterial pressure, leading to overestimation of the systolic pressure. On the other hand, too wide a cuff may produce lower readings than the actual intra-arterial pressure.

The cuff size should have a bladder width that is approximately 40% of the circumference of the upper arm, measured midway between the olecranon and the acromion. The length of the cuff bladder should encircle 80% of the circumference of the upper arm midway between the olecranon and the acromion. The bladder width-to-length should be at least 1:2.

The first and the fourth korotokoff sounds were used for the systolic and the diastolic blood pressure levels respectively. A single reading of BP has been initially taken down. A new diagnosis of HTN should not be made until the systolic and/or diastolic BP measurement is ≥95 percentile on at least three separate visits, separated by days or weeks.

Blood pressure is separated into three categories based upon the child's blood pressure percentile. BP classification based on the Fourth Report on the Diagnosis, Evaluation, and Treatment of High Blood Pressure in Children and Adolescents:

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3. Hypertension is defined as either systolic and/or diastolic blood pressure ≥95th percentile measured on three or more separate occasions.

Average SBP and/or DBP values of 95th percentile or greater were fixed up for each age group as the cut off points to define hypertension, according to these criteria, the prevalence of systolic and/or diastolic hypertension in the different age group was determined.

Height and weight was also measured. The height was measured with the subject standing still without shoes, weight was measured without shoes, with the subject wearing light clothes on a portable weighing machine, balanced before each use. Body mass index (BMI) was calculated by weight in kilograms divided by square of height in meters.

Persistently hypertensive children (after 3 consecutive readings) referred to Alexandria Main University Hospital and Italian Military Hospital to control B.P and investigated to detect exact etiology of
hypertension whether primary or secondary, and to detect etiology of secondary hypertension.

The routine and special laboratory tests done were:
1-Complete blood picture: to detect anemia, or evidence of infection.
2- ESR: in suspected collagen diseases.
3- ASOT: for streptococcal GN & CRP.
4-Urine analysis, urine culture, urea, Creatinine, Uric acid: for renal parenchymal diseases.
5- Serum electrolytes (Na, K, and Ca): for hyperaldosteronism, renin producing tumors.
6-Plasma renin activity: for Renal vascular hypertension, renin producing tumors.

DISCUSSION

Hypertension in children can be associated with adverse health outcomes and may persist into adulthood, where it presents a significant personal and public health burden. Screening asymptomatic children has the potential to detect hypertension at earlier stages, so that interventions can be initiated which could reduce the adverse health effects of childhood hypertension in children and adults. (22)

The consensus–based guidelines of the NHBPEP (National High Blood Pressure Education Program) and National Heart, Lung, and Blood Institute define hypertension in children on the basis of percentiles according to age, height and sex. Hypertension is defined as SBP or DBP at or above the 95th percentile. Hypertension is classified as stage I (SBP or DBP from 95th to 99th percentile plus 5 mm Hg) or Stage II (SBP or DBP is greater than the 99th percentile plus 5 mm Hg). (13, 14)

One rationale that has been suggested for screening of hypertension in children is to identify secondary hypertension—a relatively rare condition resulting from another underlying cause, such as renal parenchymal disease or Reno vascular disease. Younger children are more likely than older children and adolescents to have a secondary cause of hypertension. Secondary hypertension is unlikely to be the only clinical manifestation of the underlying disorder in these cases, and management is primarily targeted at treating the underlying condition, as well as controlling hypertension. As children age in to adolescence, 85% to 95% of all hypertension diagnoses are considered primary. (14)

In the present study blood pressure was measured in 300 school children (6-12 years) 6 of them (2%) were hypertensive while the others were normotensives. There was no significant statistical difference between the hypertensive and normotensives regarding sex and socioeconomic status. (p=0.468)(p=0.237)

Obviously there was significant difference between different studied groups regarding age. (p=0.013)

Rohan and Bishan (15) reported that the prevalence of hypertension found to be 3.0% while Nirav Buch et al (92) reported in his study the prevalence of hypertension was 6.48%. In most of the cross-sectional studies in various populations of the world, an increase of SBP and DBP with age has been reported. The age related increase in BP may be attributed to the increase in body mass. (15-18)

Primary analysis showed that 33.4% of hypertensive children were obese and overweight while 16.6 % of hypertensive children were underweight which was statistically significant.(p=0.028)

This association between obesity and hypertension in children has been reported in numerous studies among a variety of ethnic and racial groups, with virtually all studies finding higher prevalence of hypertension in obese compared with lean children e.g.: Thompson M, (12) recently reported the prevalence of hypertension among obese children in the United States is estimated at 11%.

Manu Raj. (20) showed higher prevalence of hypertension among overweight and obese children when compared to their non-overweight counterparts, hypertension was seen in 10.10% of normal weight, 17.3% of overweight and 18.3% of obese children in his study. Furthermore Nirav Buch et al (16) studied the prevalence of hypertension in school going children in sorat city and reported that significant rise of hypertension with obesity in both sex groups and around 30% of obese children in this study had hypertension.

This positive correlation was found in several large epidemiological studies (15, 18, 21-23). The most robust evidence comes from a large study by Rosner and colleagues who analyzed data from 11 separate studies with a total of 58,698 children and adolescents ages 1 to 17 years. (22)

In our study there was significant statistical difference regarding correlation between SBP, DBP and anthropometric measures between normotensive children and hypertensive.

(p= <0.001), (p=0.002), (p=<0.001), (p=<0.001)
In agreement with our study Rohan and Bishan (15) showed positive correlation of SBP and DBP with height and weight which is consistent with the previously reported studies on BP in children. (24)

In contrast Moser (25) study showed weak correlations among all anthropometric parameters with SBP and DBP, which has been observed previously in another two studies. (26, 27)

In the present study, regarding the relation between childhood hypertension and family history significant difference was found between family history of hypertension and obesity \( (p=0.001)(p=0.050) \) while no significant difference was found between childhood hypertension and family history of smoking \( (p=0.125) \).

In agreement with our study Family history of hypertension was significant risk factor for hypertension in Margaret Riley&Brian Bluhm study. (26)

Amedeo Spagnolo et al (29) observed that 86% of adolescents with primary hypertension had a positive family history for hypertension.

Contradictory to our results Thompson et al (12) reported that it is unclear whether having one or both parents with hypertension increases the risk of hypertension in childhood or adolescence. Some small cross sectional studies have noted this association, while others have not. Based on current evidence, an association, if present, would be small.

In the present study all cases diagnosed as essential hypertension. Regarding the relation between hypertensive children and lab results, all hypertensive children showed normal values of Complete blood count, ESR, ASOT, CRP, Na, K, Ca, Plasma renin activity and serum aldosterone.

Thompson et al study (12) showed that prevalence of secondary hypertension is dependent on the populations of children studied, and there appears to be no accurate prevalence rates for asymptomatic children in ambulatory settings. Most evidence comes from children referred to pediatric specialty clinics following the detection of hypertension by screening or incidentally, or in children diagnosed with other conditions (e.g., renal abnormalities) in whom hypertension had also been noted. Among these populations, the prevalence of secondary hypertension varies inversely with age. (30)

By the time a child reaches adolescence, hypertension is predominantly primary (85% to 95% of cases); the prevalence of secondary hypertension in adolescents is about 5 percent. (31)

Manu Raj (20) found that probability of a diagnosis of essential hypertension increases with age from birth onward. The initiation of hypertension starts in childhood and continues through adolescence to persist in the remaining phases of life.

Japanese Society of Hypertension (32) showed that hypertension detected on blood pressure screening is mostly essential hypertension. A diagnosis of essential hypertension in children is made in consideration of age, degree of hypertension (mild), obesity, family history and lack of symptoms suggestive of secondary hypertension.

As regard the relation between systemic hypertension in school children and renal function tests the present study found that hypertensive children have normal values of blood urea and serum creatinine which while uric acid level was higher (serum uric acid > 5.5) in 33.3% of hypertensive children.

In agreement with our study, Mule G et al (33) showed that uric acid is an important emerging risk factor for hypertension in children. Studies done in the pediatric population also demonstrated a significant correlation between elevated uric acid levels and blood pressure. (34, 35)

Feig DI and Johnson RJ (36) demonstrated that uric acid levels were directly correlated with systolic and diastolic blood pressure in controls and in subjects with primary hypertension and were independent of renal function. Serum uric acid > 5.5 mg/dl were found in 89% of children with primary hypertension and in 30% with secondary hypertension.

Regarding plasma rennin activity and serum aldosterone, Martinez –Aguayo et al (37) detected that no significant differences in serum aldosterone and plasma rennin activity, which suggest that currently there is lack of evidence confirming an active role for renin-angiotensin system activation in pediatric essential hypertension. (20)

In the present study abdominal ultrasound and echocardiography of hypertensive children were free.

In contrast to our study Dobson CP (38) detected that 8% of patients with echocardiography had left ventricular hypertrophy (LVH), the study conducted during 2006 to 2011, studied an average of 1.3 million children aged 2 to 18 years per year. A total of 16,322 met the definition of hypertension and 5585(34%) underwent echocardiography. (39)

Samuels J (40) found that among children and adolescents with hypertension, one in three has target organ damage especially LVH. (41)

The difference between the present study and the others may be due to different sample size and age group differences of studied children as the present study
included children aged 6 to 12 year and end organ damage as LVH more in children and adolescents with hypertension as a long term health problem.

It should be noted that the US Preventive Services Task Force (USPSTF) concluded that evidence was insufficient to assess the balance of benefits and harms of screening for primary hypertension in asymptomatic children and adolescents to prevent subsequent cardiovascular disease in childhood and adulthood. The USPSTF comes second after the 2011 UK National Screening Committee statement which also did not support screening children for hypertension.

In agreement with our study, National High Blood Pressure Education Program (NHBPEP) recommended that all children greater than three years old should have their BP measured during routine office and emergency visits, the NHBPEP Working Group recommended that children and adolescents with prehypertension and hypertension be considered candidates for lifestyle interventions (weight reduction, increased physical activity) to reduce blood pressure, with pharmacologic approaches reserved for children and adolescents with hypertension that does not respond to lifestyle interventions or those who have secondary hypertension.

*Tej K Mattoo* showed that measurement of BP should remain a routine part of comprehensive clinical care of children and adolescents, even though some issues may exist with its interpretation. Routine BP monitoring identifies children with HTN or prehypertension who are at risk for HTN as adults. HTN in adults is a known contributor to CVD.

*Rohan and Bishan* showed that early identification of hypertension and prehypertension in children translates in to early interventions and possibly prevention of later morbidity and mortality.

## REFERENCES


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