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Systemic hypertension and associated factors in school adolescents

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ABSTRACT

Background: Systemic hypertension is an endemic disease, which causes serious morbidities and mortality in all age groups. Hypertension of adults in Egypt is 26%. It can start in childhood and needs to be assessed in Egyptian children and adolescents.

Aim and objectives: This study aims to investigate the prevalence of systemic hypertension in 12-14 year old school children and associated factors.

Methods and study design: A cross sectional study was done in some preparatory public and private schools selected from a district of Cairo. The 234 children (167 females, 67males) in this study were 12 - 14 year of age. Their weight ranged from 30 – 100 kg Subjects with high blood pressure (BP) were identified according to the percentiles of Rosner, *et al.* Beside characteristics of the sample and blood pressure (BP), associated factors investigated were: - weight and body mass index (BMI), tea / coffee consumption, "added salt before tasting food", sleeping less than 8 hours per day and physical activity. Each student filled out stress and tension level tests. The school health team obtained informed parental consent to include their children in this study. Statistical analysis was done with EPI using chi-square, t-test, odd ratio (OR) with 95% confidence limits (Cl) and logistic regression with the 5% level for tests. The ethical committee of the faculty approved the study.

Results / Finding: The prevalence of systemic hypertension was 10%. Children with high BP (23) were compared to 211 subjects with normotensive BP. High stress and tension score, less sleeping hours / day, adding salt to food and higher BMI were found significantly associated ($p<0.05$) with high BP.

Study limitation: Researchers could assess preparatory schools children. However, primary and secondary school levels are separated in other schools and administrations. We used US standards for hypertension and BMI for children as local standards are not published.

Conclusions: One tenth of 12-14 year old school adolescents in this study have systemic hypertension. The main associated factors are obesity, overuse of salt and less sleeping hours. A larger study is needed to assess the prevalence of hypertension in all ages of school children. A population-based case-control study is recommended for the future. School physicians and pediatricians need to measure routinely blood pressure of children to prevent hypertension.

Keywords: Stress/ tension, sleep, salting food, hypertension, adolescent, overweight

Background

Several studies indicate that hypertension is the result of a process that starts early in life[1]. Hypertension in children is increasing. It is a predictor of cardiovascular and renal diseases[2]. Therefore, studying blood pressure levels in children can contribute to increasing its understanding as well as its etiology and associated factors. Furthermore, it is hoped that this knowledge might help open up venues leading to the prevention of hypertension and its related diseases.

Studies in children and youth have shown that there is a rise of blood pressure levels with age. In adolescence systolic pressure is higher in boys than in girls[3]. Beside genetic factors at time of maturation, endocrine and renal factors, body mass index, there are preventable associated factors such as dietary intake of sodium and tea / coffee, physical activity, noise as well as psycho-social influences[4]. Hypertension in the Egyptian adult population is estimated to be 26% [5] but it needs to be assessed in children and adolescents.

Aim and objectives

This study aims to investigate the prevalence of systemic hypertension in 12-14 year old school children and related associated factors.

Methods and study design

One district from 28 in Cairo was randomly chosen. Two private and two public preparatory schools were chosen by stratified randomization from the Ministry of Education District lists in order to include in the study children from different socio-economic standard (SES). Children in public schools are from low socio-economic standard. Preparatory schools have three class levels; children were taken from three class levels.

Some of the schools were mixed – boys and girls - and others were schools for girls.

From a total of 43 preparatory classes in the private and public schools, six classes were randomly included in this preliminary study – three classes from first and second grade.

Exclusion criteria

Children with renal, cardiac, diabetic and asthmatic history were excluded from the study.

After exclusion, all other students in the six classes were part of this study making 234 subjects (167 females, 67 males). Their ages ranged from 12 to less than15 year. Children absent (5) from their classes were not included in the study.

The research team obtained informed parental consent to include their children in the study through the school health team.

Clinical evaluation and blood pressure measurements

Weight and height were measured with a standard medical balance beam scale with a rigid vertical height rod. The stature-for-age and weight-for-age for boys and girls were used for 5% - 95%. The body mass index (BMI) was calculated using the formula weight / height^2 (kg / m^2). The BMI-for-age percentiles from 5% to less than 85% for boys and girls were used to assess normal versus overweight / obese children[6]. Underweight children were excluded from the study and the school health team was notified.

Systolic and diastolic blood pressure was measured using a mercury sphygmomanometer (Baumanometer) three consecutive times, 10 minutes apart with the subject seated. The mean of the second and third measurement of the fifth Korotkoff sounds were recorded. Before blood pressure was measured, the subject had been seated for

at least 10 minutes. The cuff bladder width was of approximately 40% of the upper arm circumference. The cuff was applied on the right upper arm with palm up and elbow on the table so that the antecubital fossa was at the same level with the heart. Care was taken that the cuff covered 2/3 of the right upper arm of the subject. A total mean of three measurements of blood pressure were done for each subject and the mean was taken for the evaluation.

As a guideline for normal or high blood pressure were taken according to the centiles of Rosner, *et al* [7]. For height and blood pressure percentile tables the 95th percentiles of systolic blood pressure and diastolic blood pressure in boys and girls (119-132 / 79-84mmHg) were taken into account for children with hypertension for heights ranging between the 5^{th} – 95^{th} percentiles.

Interviews and questionnaire

A structured interview was conducted with all subjects of the study including a modified "Stress and Tension Level Test" according to Farquhar[8]. The questionnaire comprised, besides demographic characteristics such as age, sex, crowding, parental education and occupation, also family history of hypertension, smoking in the family, pupil's own health history, medication intake, daily sleeping hours, automatically added salt before tasting the food referred to as "salting food", weekly times of pickle consumption, daily number of glasses of tea / coffee consumed, regularity of sports activity during a week as well as nine items in the modified abridged "Stress and Tension Level Test" and 20-stress items derived from Eysing personality Inventory (EPI) [9] adapted for children.

The modified "Stress and Tension Score Test" according to Farquhar comprises nine behavioral items in response to tension such as: - frequency of eating, drinking, sleeping, concentrating, relaxing, getting headaches, being aggressive during a week.

The range of scores is 0 (lowest) to 18 (highest). The intra-rater reliability correlation coefficient was 0.82. For analysis reasons the score 10 was used as the cut-off-point guided by the 'above average classified zones' mentioned by Farquhar [8]. The Eysing Personality Inventory (EPI) comprised 20 items for children about different emotional state with 'yes' and 'no' options. The maximum score is 20 and the minimum 0. The correlation of both scores was r=0.7 with a critical value of +0.13 as significant ($p<0.05$).

Schools facilities, Faculty of Medicine equipments and researchers contributions were used for this study. No grants were obtained. The ethical committee of the faculty approved the study.

A pilot study was done on 20 pupils in a public and a private school before the study. The parents did not accept the investigation of 24 hour ambulatory blood pressure monitoring.

Statistics tests

The statistical analysis was performed with the EPI program. Hypertensive adolescents were compared with normotensive using descriptive statistics, t-test, chi-square test (chi-sq), odd ratio (OR) with 95% confidence limits (Cl), Mantel Haenszel (MH) chi-sq and logistic regression. The 5% level was used for significance tests.

Results / Findings

A total of 23 subjects (10%) out of 234 pupils (12-14 year) were found to have hypertension. Table 1 compares characteristics of hypertensive and normotensive 12-14 year old school children**.** The mean systolic BP of children with hypertension is 131.6 mm Hg and normotensive children is 112.1 mm Hg; and the mean diastolic blood pressure of

children with hypertension is 90 mm Hg and normotensive children is 73.4 mm Hg. There is no significant difference between both groups as regards to the mean age (12.5 years for hypertensives, 12.8 years for normotensive) and between males and females. Also no difference was found being student in public (43.5% and 45.0%) and private (56.5% and 50.7%) schools. Family predisposition to hypertension is similar between groups as well as smoking distribution and crowding index.

Table2 demonstrates means, distributions and odd ratio of some physical and psychological factors of hypertensive and normotensive 12-14 year old school children.

There is a significant difference between hypertensive children and normotensive children regarding mean weight (62.9 versus 51.7 kg), and height (161.2 versus 156.5 cm) as well as the distribution BMI at over 85% and 5- 85% (OR = 3.87; 95% Cl (1.4 -10.37). The mean tension score (9.6 versus 6.8) and the EPI stress score (12.4 versus 10.5) were significantly higher in the hypertensive than in the normotensive group. A tension score higher than 10 (OR = 3.8; 95% Cl (1.48 -10.2) and an EPI score higher than 14 (OR = 3.2; 95% Cl (1.25 - 8.5) are associated factors.

Table3 displays means, distributions and odd ratio of some behavioral factors of hypertensive and normotensive 12-14 year old school children. The mean daily consumption of tea / coffee glasses (2.9 versus 1.3) and salting food (39.1 % versus 7.6%) were found to be more in hypertensive than in normotensive children. Daily sleeping hours (OR = 3.37; 95% Cl (1.1 - 10.5), salting food (OR = 7.8; 95% Cl (2.6 – 23.2), tea / coffee consumption (OR = 4.8; 95% Cl (1.1 - 31.1) seem to be associated factors.

Table4 shows odd ratio of tension scores of cases with hypertensive and normotensive 12-14 year old school children stratified on daily sleeping hours. The risk of hypertension is higher in those children sleeping less than 8 hours daily (OR=13.1) with an elevated tension score.

Table 5 presents the logistic regression analysis of the relevant factors to hypertensive versus normotensive 12-14 year old school children. Hypertension in adolescent school children is mostly associated with BMI, age, salting food and sleeping hours.

The correlation of BMI and coffee/tea drinking was r= 0.03 (p=0.43).

Discussion

Hypertension in children is rising in the world[10]. Systemic hypertension in 12-14 year old adolescents in some schools in Cairo was found to be 10%. According to the National High Blood Pressure Education Program Working Group on High Blood Pressure in Children and Adolescents[3] in the USA the prevalence of children and adolescents with high blood pressure is 4.5%. This study did not include younger children and those from rural areas. Cappuccio *et al* [11] indicate that the prevalence of hypertension is lower in rural than urban area. In addition, traffic noise levels in Cairo are high ranging between 72-110 dB [12]. Traffic noise elevates blood pressure in children[13].

Systemic hypertension is related to genetic, physical, life style and psychological factors starting early in childhood[14]. In this study, hypertensive students tend to drink more tea/ coffee, sleep less hours per day, are salting food, are obese /overweight and have higher tension and stress scores. No correlation was found between BMI and tea / coffee drinking, similar to *Bouchard et al*[15].

No gender differences were found in our study, contrary to Sorof *et al*[16] who reveal that males are more at risk of hypertension than female adolescents. Probably their sample size is bigger and the range of age is wider than our study. Sorof *et al* indicate that

hypertension will increase with the rising obesity in children.

Marty *et al* [17] reveal that physical activity in children lowers blood pressure level. In our study physical activity didn't show a significant difference between hypertensive and normotensive adolescents. Physical activity needs to be investigated in detail. Sodium consumption does affect hypertension[10]. Adding salt before tasting food was found more in hypertensive adolescents however not eating pickles. Is it a behavior that children learn from their parents? Or is it due to the hot climate in summer where the body is in need of salt?

With the increase of obesity due to a sedentary lifestyle, it is expected that hypertension in children will increase leading to more adult hypertension. Obesity is a associated factor not only for hypertension but, also, for diseases such as diabetes, cardiovascular disease, and stroke[18]. Weight, height and body mass index (BMI) were significantly higher in hypertensive than normotensive adolescents.

The risk (OR) of tension scores were higher in hypertensive adolescents sleeping daily less than 8 hours than those sleeping eight hours and more. Students need training for stress and tension management. If stress is sustained for a long period it turns to a problem for children. Tension and stress may well have an impact on adult health. A study on causes related to stress could clarify the higher scores in students with hypertension.

It is, therefore, necessary to have a comprehensive educational program to moderate dietary sodium intake and tea / coffee consumption, early prevention of obesity[19] as well as adequate daily sleep hours for the students. Teachers and school health teams can have an important role for guiding children.

Weight reduction, exercise, and dietary alteration are necessary to prevent hypertension in adult and the risk of coronary arterial diseases[1].

Essential hypertension not only has an impact on the single individual but also has an impact on the health care system and finances. The prevalence of hypertension is 26% in adults in Egypt. Therefore, it is important for school health care providers to detect hypertension early in children and also to treat it.

Study limitations

Researchers could assess preparatory schools children. However, primary and secondary school levels are separated in other schools and administrations. Information on the social environment was limited.

We used US standards for hypertension and BMI for children as local standards are not published.

Conclusion

One tenth of 12-14 year old school adolescents in this study have systemic hypertension. The main associated factors are obesity / overweight, salting and less sleeping hours.

A larger study is needed to assess the prevalence of hypertension in all ages of school children. A population-based case-control study is recommended for the future.

Luma et al[1] suggest routine checkup of blood pressure in children. School health teams, family doctors and pediatrician can screen for hypertension and prevent it.

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Table 1: Characteristics of hypertensive and normotensive 12-14 year old school children

	Hypertensive adolescents N=23	**Normotensive adolescents N=211**	**Significance test / p**
Mean systolic BP mm Hg ± SD	131.6 ± 4.7	112.1 ± 10.9	t-test=6.4 p = 0.00
Mean diastolic BP mm Hg ± SD	90.0 ± 3.5	73.4 ± 6.9	t-test= 8.6 p =0.00
Characteristics			
Type of school -public -private	 10 43.5% 13 56.5%	 104 49.3% 107 50.7%	 Chi-sq=0.28 p =0.59
Mean age ± SD (years)	12.5 ± 0.6	12.8 ± 0.7	t-test = 0.63 p =0.26
Sex - male - female	 5 21.7% 17 78.3%	 62 29.4% 149 70.6%	 Chi-sq= 0.59 p =0.44
Environmental and family			
Family history of high blood pressure	13 56.5%	82 39.3%	Chi-sq=2.53 p =0.11
Family member smoker at home	14 60.9%	106 50.2%	Chi-sq=0.94 p =0.33
Mean crowding index at home ± SD	1.2 ± 0.3	1.4 ± 0.9	t-test= 1.26 p =0.09

Table 2: Means, distributions and odd ratio of physical and psychological factors of hypertensive and normotensive 12-14 year old school children

Factors	Hypertensive adolescents N=23	Normotensive adolescents N=211	Odd ratio (OR)	Significance test / p
Physical				
Mean weight (kg) ± SD	62.9 ± 17.0	51.7 ± 12.0		t-test= 3.38 p 0.00
Mean height (cm) ± SD	161.2 ± 9.0	156.5 ± 8.0		t-test= 2.06 p =0.02
BMI-for-age 85 percentiles 5% to less than 85%	10 43.5 % 13 46.5%	35 16.6% 176 83.4%	3.87 Cl (1.4 -10.37)	Chi-sq=9.65 p =0.001
Psychological				
Mean tension score ± SD	9.6 ± 3	6.8 ±3.5		t-test= 3.07 p =0.001
Tension score 10 and above Less than 10	13 56.5% 10 43.5%	53 25.1% 158 74.9%	3.88 CI (1.48 -10.2)	Chi-sq=10.1 p =0.001
Mean EPI stress score ± SD	12.4 ± 4.9	10.5 ± 4.2		t-test= 1.71 p =0.04
EPI stress score 14 and above Less than 14	12 52.2% 11 47.8%	53 25.1% 158 74.9%	3.25 CI (1.25 - 8.5)	Chi-sq=7.57 p=0.006

Cl = 95% confidence limits

Table 3: Means, distributions and odd ratio of behavioral factors of hypertensive and normotensive 12-14 year old school children

Behavioral factors	Hypertensive adolescents N=23		Normotensive adolescents N=211		Odd ratio	Significance test
Mean sleeping hours ± SD per day	8.2 ± 1.9		8.7 ± 1.3			t-test= 1.4 p = 0.08
Daily sleeping hours						
less than 8 hours	6	26%	20	9.5%	3.37 CI	Chi-sq=5.79
8 hours and more	17	74%	191	90.5%	(1.1 - 10.5)	p =0.016
Mean daily glasses of tea / coffee consumption ± SD	2.9 ± 1.9		1.3 ± 1.3			t-test= 4.29 p =0.00
Tea / coffee drinker						
Yes	21	91.3%	144	68.2%	4.86 CI	Yates chi-sq=4.25
No	2	8.7%	67	31.8%	(1.1 - 31.1)	p = 0.039
Salting food						
Yes	9	39.1%	16	7.6%	7.83 CI	Chi-sq=21.63 p =0.00
No	14	70.9%	195	92.4%	(2.6 – 23.2)	
Mean pickle eating / week ± SD	4.8 ± 2.5		3.6 ± 2.5			t-test= 1.6 p=0.056
Eating pickles						
Yes	22	95.6%	184	87.2%	3.23 CI	Yates chi-sq=0.72
No	1	4.4%	27	12.8%	(0.4 – 66.8)	p =0.39
Weekly physical activity						
No	12	52.2%	100	47.4%	1.2 CI	Chi-sq=0.19
Yes	11	47.8%	111	52.6%	(0.5 - 3.1)	p =0.66

Cl = 95% confidence limits

Table 4: Odd ratio of tension scores of cases with hypertensive and normotensive 12-14 year old school children stratified on daily sleeping hours

	5-7 sleeping hours / day		8-12 sleeping hours / day	
Tension score	**Hypertensive adolescents N=7**	**Normotensive adolescents N=18**	**Hypertensive adolescents N=15**	**Normotensive adolescents N=186**
10 and above	5 71.4%	4 22.2%	5 33.3%	44 23.7%
Less than 10	2 28.6%	14 79.8%	10 66.7%	142 76.3%
	crude OR=8.75 Cl (0.9-108)		crude OR=1.6 Cl (0.4 – 5.5)	

Mantel Haenszel chi-sq=4.9 MH OR=2.7
p= 0.03

Table 5: Logistic regression analysis of the relevant factors to hypertensive versus normotensive 12-14 year old school children

variable	β-coefficient	P value	Expected risk (95% CI)
BMI	0.88	0.004	2.4 (1.3- 4.4)
Age	0.5	0.5	1.69 (0.34 – 8.2)
Salting food	1.5	0.09	2.8 (0.8 – 3.1)
Sleeping hours	0.2	0.7	1.25 (0.3 – 4.8)
Tension score	0.03	0.9	1.0 (0.5 -2.1)