Egyptian Journal of Community Medicine

Elevated Blood Pressure and Its Associated Demographic Factors Among Rural School Adolescents In Fayoum Governorate, Egypt

Safaa Khamis Hassan; Wafaa Yousif Abdel Wahed; Shimaa Elsayed Mohammed Mabrouk

Public Health and Community Medicine Department, Faculty of medicine, Fayoum University, Egypt

Submission Date: 2022-03-03

Revision Date: 2022-06-02

Acceptance Date: 2022-06-02

Key Words: Adolescents; hypertension; risk factors; school; Egypt

A B S T R A C T

Background: Elevated Blood Pressure (EBP) in adolescence may progresses to hypertension in adulthood. **Objective**: to estimate the prevalence of EBP among school adolescents and to test association with certain possible demographic factors. **Method:** A cross-sectional study was conducted among school adolescents in three (3) villages in Fayoum governorates between October and December, 2021. The prevalence of EBP was determined according to the American Academy of Pediatrics guidelines. **Results:** A total 618 students were included. The mean age was 14.6±1.5 and 58.9% of the children were males. Overweight and obese students were 17.6% and 6.8% respectively. The prevalence of smoking and physically active students represented 15.4% and 13.1%, respectively. The prevalence of EBP and hypertension were 14.7% and 8.6%, respectively. The significant predictors for EBP and hypertension were waist circumference ≥90th percentile (odds ratio [OR] =5.3, 95% confidence interval [CI] 1.6-17.1), overweight and obesity (OR=9.1, 95% CI 5.4-15.4), presence of family history of hypertension (OR=3.0, 95% CI 1.7-5.16), and increasing age (OR=9.0, 95% CI 5.13-16.0). **Conclusion:** The study showed high prevalence of elevated blood pressure among adolescents in Fayoum Governorate with significant associations with a number of modifiable risk factors. Children with high blood pressure should be encouraged to practice healthy lifestyle changes, such as weight loss, regular and continuous physical activity, avoidance of smoking, and a diet rich in fresh fruits, vegetables, and fiber and low in fat, dairy products, and sodium.

INTRODUCTION

High blood pressure is a major global health problem that affects more than 1 billion adults and causes more than 9 million deaths each year.[1, 2] Hypertension was the leading cause of universal disability-adjusted life-years (DALYs) in 2015.[3] At present, hypertension in children and adolescents is considered a major health concern not only because of its rising incidence but also because blood pressure (BP) levels in adulthood are strongly linked to BP levels in childhood, leading to adult hypertension.[4,5] Nearly half of hypertensive adults had high blood pressure as a child.[6,7] Essential hypertension is more common among children in developed countries than secondary hypertension.[8] In addition, several types of researches have suggested that high blood pressure in childhood is linked to adulthood left ventricular hypertrophy, atherosclerosis, carotid intima-media thickness, and renal failure.[9,10] As a result, early prevention and control of children's hypertension have a significant impact on the long-term outcomes of hypertension-

Corresponding Author: Shimaa Elsayed Mohammed Mabrouk , Department of Public Health and Community Medicine Department, University, Faculty of Medicine, Fayoum University, Egypt. Email: shimaa.mabrouk@yahoo.com

related cardiovascular problems, as well as the disease burden associated with it.[11]

Previous epidemiological studies have found that the prevalence of high blood pressure (HBP) among children and adolescents in several Western nations ranges from 1% to 5%.[12] According to the CDC, one in every 25 young people aged 12 to 19 has hypertension, and one in every ten has high blood pressure. Obese children and adolescents are also more likely to develop hypertension.[13]

According to the World Health Organization, Africa has the highest prevalence of hypertension by age, with roughly 46 percent of adults affected.[14] However, few studies on children in developing countries have been conducted. In Kuwait, school children had a frequency of 5.1 percent,[15] whereas Egyptian adolescents in Alexandria had a prevalence of 4.0 percent.[16]

The predisposing factors for high blood pressure differ from country to country and even from urban to rural areas urbanization, alcoholic consumption, tobacco smoking elderly people, socioeconomic conditions, lifestyle factors, obesity, abdominal obesity, and positive family history were associated with high blood pressure[17,18],[19] In Egypt, there are limited researches that estimate the prevalence of HBP among teenagers, so the present study aimed to identify the prevalence of HBP among school adolescents and to test association with certain possible demographic factors.

METHOD

A descriptive cross-sectional study was conducted among school adolescents in three villages in Fayoum governorates between October 1st and December 31, 2021.

Fayoum governorate has 6 districts. We select 3 districts by simple random sample then three villages were conveniently selected one from each village. The districts included Benisaleh, Tatoun, and Manshit-El-Gamal—in Fayoum, Etsa, and Tamya districts, respectively. The total schools in these rural areas were seven preparatory and three secondary schools, with one secondary school in each village.

The study targeted male and female children between 12 and 17 years old, enrolled in preparatory and secondary schools in the chosen districts.

Three preparatory schools were randomly selected; one in each village and the three secondary schools were included in the study. In each school, one class per grade was randomly selected and then all students in the selected classes were included in the study after giving consent. Out of 820 registered students in these classes, 618 were our participants with a response rate of 75%.

Sample size was calculated based on the following assumption; the prevalence of hypertension among adolescents in Egypt is 4.3%,[16] precision level is 2%, and the confidence level is 95%. Then estimated sample size, design effect 2 due to multistage sampling. A total of 690 students were estimated, and only 618 students agreed to participate in this study.

Data covered the following characteristics (sex, age, type of school, parents' educational level, fathers' occupation and working status of mothers. history of hypertension and diabetes in family, and duration of sleep). Self- administered pretested questionnaires were distributed before the examination date.

Each student was examined in a separate room (depending on class sections) and was asked to rest for 15 minutes to reduce any nervousness or worry. After removing shoes, jackets, heavier clothing, and pocket contents, weight was determined using a standardized weighing machine. Weighing equipment was calibrated against a range of standard weights and regularly checked for accuracy. Using a calibrated tape, height was measured, and the student was asked to stand upright, barefoot, with heels together and weight equally distributed on both feet. The calculation of body mass index by dividing the weight of the child in kilograms by the square of height in meters

Before blood pressure was measured, children were encouraged to urinate. Blood pressure was measured by a standard mercury sphygmomanometer which is calibrated (the mercury column reads zero when no pressure is applied) and has two parts: an inflatable cuff and a mercury manometer. The blood pressure was measured by using a standard auscultation method and on the bare right arm with the student in a seated position, hands resting on the examination table and the cubital fossa at heart level. An appropriately sized cuff (cuff width 40% of mid-humeral circumference), with the cuff bladder covering 80–100% of the arm circumference and about two-thirds of the length of the upper arm, was

Table (1): Socio-demographic characteristics of study subjects

Characteristics	Characteristics levels	(N=618)	Percent
Sex	Male	364	58.9
	Female	254	41.1
Age group in years	12 –less than 15	320	51.8
	15-17	298	48.2
	Mean ±SD = 14.6 ±1.5		
Father education	Less than secondary education	374	60.5
	Secondary and higher education	244	30.5
Mother education	Less than secondary education	479	77.5
	Secondary and higher education	139	22.5
Smoking	yes	95	15.4
Exercise	yes	81	13.1
Body mass index (BMI)	Underweight	3	.5
	Normal	464	75.1
	Overweight	109	17.6
	Obese	42	6.8
Waist circumference	≥90 th percentile	26	4.2
Blood pressure classification	Normal	474	76.6
	Elevated blood pressure	91	14.7
	Hypertension	53	8.6
	Stage1 hypertension	38	6.2
	Stage11 hypertension	15	2.4

used, without overlap. The stethoscope bell was placed above the brachial artery pulse, near the cubital fossa, and just below the lower edge of the cuff (e.g. ≈ 2 cm above the cubital fossa). The systolic reading was taken as the level of mercury at which the first sound (Korotkoff I) was heard in a succession of sounds. The diastolic reading (Korotkoff V) was taken as the first level at which sound absence was expected. Three BP readings were taken for each child with an interval of 5 minutes between each recording. The average of three consecutive readings of the student's BP was recorded. Normal BP values were based on the American Academy of Pediatrics (AAP) which updated its clinical practice guidelines for the detection and management of hypertension in children and adolescents.[20, 21] Blood pressure results for children aged one to twelve years were based on the standard blood pressure distribution of healthy children of normal weight and should be interpreted according to age, height, and sex. [20, 21] From age 13, absolute BP values were used. Normal blood pressure <120/<80 mmHg; elevated blood pressure was defined as systolic blood pressure of 120 to 129 mm Hg and less than 80 mm Hg for diastolic in these adolescents, while high blood pressure was defined as blood pressure of 130/80 mm Hg or higher stage I hypertension: 130/80 to 139/89mmHg and stage II hypertension: ≥140/90 mmHg.[20,21] Underweight: When a child's BMI is less than or equal to the fifth percentile for this age and sex, the child was considered underweight.[22,23] Overweight: When a child's BMI exceeds 85 percent for this age and sex, the child was considered obese.[22,23] Obesity: When the BMI exceeds the 95th percentile for age and sex, a child was considered obese. A child was considered centrally obese when the waist circumference exceeded 95 percent for this age and gender.[22,23] A family history of hypertension was determined by having a documented history of hypertension or current treatment with antihypertensive medication in parents, grandparents, or siblings. Smokers were those who smoke cigarettes regularly at the time of the study.[16] Physically active adolescent pupils were defined as those who reported exercising for at least one hour three times per week.[16] Sleep time was rated as inadequate (less than 7 hours per night) and adequate (greater than or equal to 7 hours per night).[24]

Statistical analysis: Data administration and analysis was performed using the Statistical Package for Social Science (SPSS) version "17" software (Chicago, Illinois, US). Data were established, tabulated, and presented in the form of frequency, mean, and standard deviation (SD). Data were analyzed using Chi- square test for comparing categorical data between normal and EBP. Logistic regression analysis was to identify predictors of EBP. P- Value < 0.05 was considered significant.

RESULTS

A total of 618 students were included. The mean age was 14.6±1.5 (ranging from 12 to 17 years old). Slightly more than half (58.9%) of them were males. The majority of study parents had lower education

Table (2): Age and sex comparison of systolic and diastolic elevated blood and hypertension among study participants

Variables	Categories	Normal N (%)	Elevated blood pressure N (%)	Hypertension N (%)	p value
Sex	Male	266 (73.1)	59 (16.2)	36 (9.9)	0.103
	Female	208 (81.9)	32 (12.6)	17 (6.7)	
Age	12-less than 15years	289 (90.3)	18 (5.6)	13 (4.1)	<0.001*
	15-17years	185 (62.1)	73 (24.5)	40 (13.4)	
Mother education	Less than secondary education	372 (77.7)	65 (13.6)	42 (8.8)	0.320
	Secondary and higher education	102 (73.4)	26 (18.7)	11 (7.9)	
Father education	< secondary education	283 (75.7)	58 (15.5)	33 (8.8)	0.743
	≥ Secondary and higher education	191 (78.3)	30 (13.5)	20 (8.2)	
Family history of Hypertension	Yes	395 (79.5)	63 (12.7)	39 (12.7)	0.003*
	No	79 (65.3)	28 (23.1)	14 (11.6)	
Family history of Diabetes	Yes	394 (79.6)	61 (12.3)	40 (8.1)	0.001*
	No	80 (65.0)	30 (24.4)	13 (10.6)	
Smoking	Yes	56 (58.9)	22 (23.2)	17 (17,9)	<0.001*
	No	418 (79.9)	69 (13.2)	36 (6.9)	
Exercise	Yes	73 (90.1)	5 (6.2)	3 (3.7)	0.009*
	No	401 (74.7)	86 (16.0)	50 (9.3)	
Sleep duration	< 7 hours per night	377 (75.9)	74 (14.9)	46 (9.3)	0.438
	≥7 hours per night	97 (89.2)	17 (14.0)	7 (5.8)	

(The level of significance if p<0.05)

Table (3): Prevalence of elevated blood pressure among study sample of school adolescents in relation to Anthropometric measurements

Anthropometric measurements	Anthropometric classification	Normal BP N (%)	Elevated blood pressure N (%)	Hypertension N (%)	Total students N (%)	p value
BMI	Under and normal weight< 85th percentile	402 (86.1)	54 (11.6)	11 (2.4)	467 (75.6)	<0.001
	Overweight and obese (≥85th percentile)	72 (47.7)	37 (24.5)	42 (27.8)	151 (24.4)	
WC percentiles	Non obese <90th	466 (78.7)	84 (14.2)	42 (7.1)	592 (95.8)	<0.001
	Obese ≥90th	8 (30.8)	7 (26.9)	11 (42.3)	26 (4.2)	

(The level of significance if p<0.05)

level less than secondary education (60.5% among fathers, 77.5% among mothers). The percentage of smokers and physically active students represented 15.4% and, 13.1% respectively. Overweight and

Corresponding Author: Shimaa Elsayed Mohammed Mabrouk , Department of Public Health and Community Medicine Department, University, Faculty of Medicine, Fayoum University, Egypt. Email: shimaa.mabrouk@yahoo.com

obese students were 17.6% and 6.8% respectively. Abdominal obesity (waist circumference ≥90th percentile) represented 4.2%. The prevalence of EBP and hypertension were 14.7% and 8.6% respectively. (Table 1)

Table (4): Multiple Logistic regression analysis of predicators of HBP (elevated and hypertension)

Variables	B	p-value	Adjusted odds ratio	95% Confidence Interval	
				Lower limit	Upper limit
BMI (overweight and obesity versus normal weight and underweight	2.21	<0.001	9.13	5.40	15.41
Waist circumference (≥90th percentile versus <90th percentile	1.67	0.005	5.32	1.65	17.12
Family history of hypertension (yes versus no)	1.09	<0.001	2.97	1.70	5.17
Family diabetes (yes versus no)	0.26	0.367	1.30	0.74	2.28
Smoking (yes versus no)	0.37	0.222	1.45	0.80	2.62
Exercise (no versus yes)	1.48	0.002	4.40	1.75	11.08
Aging (15-17 years versus 12-less than 15 years)	2.21	<0.001	9.07	5.14	16.00

(The level of significance if p<0.05)

There was no significant relation between gender and elevated blood pressure. A significantly increased prevalence of elevated blood pressure with the advancement of adolescent age was detected; the prevalence of EBP and hypertension among the participants increased from 5.4% and 4.1% among those aged 12-less than15 years old to 24.5% and 9.4% in those aged 15 years old and above. A significant relation between EBP and family history of hypertension and diabetes was reported (p= 0.03 and p=0.001, respectively). Smokers and non-physically active students showed a higher proportion of EBP and hypertension compared to non-smoker and physically active students (p<0.001 and p=0.009). No significant relation between father, mother education or sleep duration and hypertension and EBP was revealed. (Table 2)

A significant association between waist circumference ≥90th percentile and BMI with elevated blood pressure were reported; compared with those of normal weight students, overweight and obese students had a significantly increased percentage of elevated blood pressure and hypertension (p- value < 0.001, Table 3).

The significant predictors for HBP were waist circumference ≥90th percentile, overweight and obesity, presence of a family history of hypertension, and increasing age with odds ratios; of 5.3 (1.6-17.1), 9.1 (5.4-15.4), 3.0 (1.7-5.16), 9.0 (5.13-16.0) respectively (Table 4)

DISCUSSION

Elevated blood pressure in children and adolescents is a major and often overlooked public health problem. Starting at the age of three, children should be screened for hypertension once a year or at every visit if risk factors are present. Pre-hypertensive and hypertensive prevalence rates vary widely among children and adolescents of different age groups and sample sizes, according to several studies.[25] The current study found the prevalence of elevated blood pressure and hypertension was 14.7% and 8.6% respectively among the school adolescents aged 12 to 17 years old. This finding was more than reported by other studies conducted previously in Egypt among teenagers at school; Abolfotouh et al, 2011 found that pre-hypertensive and hypertensive prevalence rates were 5.7% and 4.0%, respectively, among 1500 adolescents (11-19 years) from middle and high schools in Alexandria[16] while others found that 42.86% of males and 38.80% of females were in the pre-hypertensive stage while no cases of high blood pressure were detected between the ages of 12 to 18 years.[17] In Sohag Governorate, researchers found that hypertension was 7.7%, and pre-hypertension was 34% among male and female school students aged 12-18 years.[26] However, our findings were lower than those reported by others among adolescents.[25,27-30] The increased prevalence of elevated pressure and hypertension in our study

than those studies conducted in Egypt, despite the prevalence of reported obesity based on a BMI scale, was 10.3%[16] and a quarter of young people were overweight, and more than 10% were obese, [17] may be explained by using the new guidelines in hypertension classification among adolescents aged ≥13 years old.[20]

The updated guidelines were used in a study that showed a significant increase in the diagnosis of hypertension using the updated guideline in at-risk youth 10 to 18 years old and found that the prevalence of hypertension was 13% using the new guide, compared to 8% using the old guideline.[31] Yang et al, 2021 report that the hypertension epidemic has increased rapidly in rural children and adolescents. [32]

A study has already demonstrated a significant increase in hypertension diagnoses using the updated guideline in at-risk youth 10 to 18 years and found that the prevalence of hypertension was 13% using the new guideline, compared with 8% using the old guideline.[31] Also, Yang et al, 2021 reported that the hypertension epidemic increased rapidly in rural children and adolescents.[32]

Regarding sex, the study showed that the prevalence of elevated blood pressure and hypertension was higher among males than females with no sex difference. This was consistent with other national studies. As they revealed that the prevalence was more among boys than girls.[16, 33] It may be related to heredity, hormones, activity level, and dietary factors. [32]

The prevalence of elevated blood pressure and hypertension in the present study increased with a significant difference ($p<0.001$) from (5.4%) and (4.1%) respectively in adolescents aged (12-less than15) years old to (24.5%) and (13.4%) respectively in adolescents aged 15 years old and above. However, others reported an increased prevalence of hypertension during the age of 12 to 14 years than among the age group from 15 to 17 years old over the years from 2000 to 2015.[34] Others found that systolic and diastolic BP increased with age[35], while others reported, a decrease in the prevalence of hypertension among adolescents aged 13 to 17 years, from 6.6% in 1999-2002 to 2.5% in 2011-2014 and then increased to 3.7% in 2015-2018 ($P < .001$).[36] This variance across countries and studies may be explained by differences in socio-demographic, economic and nutritional intake and the guidelines used for screening and management of hypertension in children and adolescents.

Overweight and obesity are serious and growing global public health problems among children and adolescents. [37] The study showed a significant prevalence of elevated blood pressure and hypertension among overweight, obese students, and abdominal obesity ($p<0.001$). Several studies that examined the relationships between overweight, obesity, and pre-hypertension have shown that overweight and obesity were significantly associated with hypertension or high BP among children and adolescents.[25, 31, 38, 39]

BMI, abdominal obesity, history of family hypertension, and increasing age were significant predictors of high blood pressure among adolescents. Others reported that after adjusting for all other measures of body composition, WC and BMI were the only significant predictors of hypertensive among the adolescents,[16] on the other hand, others have found significant associations between gender, family history of hypertension, a father with hypertension, nutritional status, physical activity, perceived stress, and hypertension among Indonesian adolescents ($p<0.05$). [27]

Limitation of the study: There were some limitations in the study. Cross-sectional design cannot establish a cause-and-effect relationship, the blood pressure was measured throughout one visit, the dietary pattern of the children was not examined, and only the rural areas were covered

CONCLUSION AND RECOMMENDATION

The study showed high prevalence of high blood pressure among adolescents in Fayoum Governorate and significant correlations with several factors, especially overweight and obesity, the risk of high blood pressure, and pre-hypertension among adolescents. Children with high blood pressure should be encouraged to practice healthy lifestyle changes, such as weight loss, regular and continuous physical activity, avoidance of smoking, and a diet rich in fresh fruits, vegetables, and fiber and low in fat, dairy products, and sodium.

Ethical Approval

This study was conducted according to the guidelines laid down for medical research involving human subjects and was approved by the Ethics Committee, faculty of medicine, Fayoum University

(R231). Permission has been obtained previously from the relevant school authorities. A simple explanation of the study aim was provided to the students to obtain their initial approval. An informed consent including a simple explanation about the aim of the study was sent with each student to be signed by the student's parent/guardian. A simple idea of the real importance of BP was told to the students. The students were told their BP readings and the hypertensive students were advised to check their BP regularly along with their lifestyle. All data collected is kept confidential. All study subjects have the right not to participate. All the targets had the right not to participate in the study.

***Funding source*:** "The authors received no financial support related to this research"

***Conflict of interest*:** All authors have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper

***Author contributions*:** Safaa Hassan: Idea, literature search, and writing; Wafaa Abdel Wahed: Idea, literature search, and writing; Shimaa Mabrouk: analysis, critical review, and literature search.

Acknowledgment: We thank the community health workers (Raedat Reefaat) and the nurses who helped in data collection, blood pressure measuring, and reassurance of students. We are also grateful to the teachers and students for their cooperation.

REFERENCES

1. Erem C, Hacihasanoglu A, Kocak M, Deger O , Topbas M. Prevalence of prehypertension and hypertension and associated risk factors among Turkish adults: Trabzon Hypertension Study. J Public Health 2009; 31(1): 47-58. doi: 10.1093/pubmed/fdn078. Epub 2008 Sep 30.
2. World Health Organization (WHO). A global brief on hypertension: silent killer, global public health crisis. World Health Day 2013, World Health Organization Press
3. Global Burden of Diseases 2015 Risk Factors Collaborators. Global, regional, and national comparative risk assessment of 79 behavioural, environmental and occupational, and metabolic risks or clusters of risks, 1990–2015: a systematic analysis for the Global Burden of Disease Study 2015 Lancet, 388 (2016), pp. 1659-1724). DOI: 10.1016/S0140-6736(16)31679-8
4. Sun SS, Grave GD, Siervogel RM, et al. Systolic blood pressure in childhood predicts hypertension and metabolic syndrome later in life. Pediatrics 2007; 119:237. DOI: 10.1542/peds.2006-2543
5. Chen X, Wang Y. Tracking of blood pressure from childhood to adulthood: a systematic review and meta-regression analysis. Circulation 2008; 117:3171. DOI: 10.1161/CIRCULATIONAHA.107.730366
6. Bucher BS, Ferrarini A, Weber N, Bullo, M, Bianchetti MG, Simonetti GD. Primary hypertension in childhood Curr Hypertens Rep 2013:15(5):444-452. DOI: 10.1007/s11906-013-0378-8
7. Redwine KM, Acosta AA, Poffenbarger T, Portman RJ, Samuels J. Development of hypertension in adolescents with pre-hypertension J Pediatr 2012; 160 (1):98-103. DOI: 10.1016/j.jpeds.2011.07.010
8. Feber J, Ahmed M. Hypertension in children: new trends and challenges. Clin Sci Lond Engl 2010;119:151–61. DOI: 10.1042/CS20090544
9. Hartiala O, Magnussen CG, Kajander S, Knuuti J, Ukkonen H, Saraste, A, et al. Adolescence risk factors are predictive of coronary artery calcification at middle age: the cardiovascular risk in young Finns study J Am Coll Cardiol 2012; 60 (15):1364-1370. DOI: 10.1016/j.jacc.2012.05.045
10. Litwin M, Niemirska A, J Sladowska-Kozlowska, J, Wierzbicka A, Janas R, et al.Regression of target organ damage in children and adolescents with primary hypertension Pediatr Nephrol 2010;25 (12): 2489-2499. DOI: 10.1007/s00467-010-1626-7
11. .Labarthe DR. Prevention of cardiovascular risk factors in the first place Prev Med. 1999 Dec; 29(6 Pt 2):S72-8. DOI: 10.1006/pmed.1999.0539
12. Santi M, Simonetti BG, Leoni- Foglia CFP, Bianchetti MG, Simonetti GD. Arterial hypertension in children) Curr Opin Cardiol 2015; 30: 403-410. DOI: 10.1097/HCO.0000000000000191
13. CDC, High Blood Pressure in Kids and Teens. February 24, 2020.avilable at : https://www.cdc.gov/bloodpressure/youth.htm.

14. World Health Organization. A global brief on hypertension: silent killer, global public health crisis. World Health Day 2013, World Health Organization Press,
15. Saleh EA, Mahfouz AA, Tayel KY, Naguib MK, Bin-al-Shaikh NM . Hypertension and its determinants among primary-school children in Kuwait: an epidemiological study. East Mediterr Health J 2000; 6(2-3):333-337.
16. Abolfotouh MA, Sallam SA, Mohammed MS, Loutfy AA, Hasab AA. Prevalence of Elevated Blood Pressure and Association with Obesity in Egyptian School AdolescentsInt J Hypertens. 2011: 952537.Published online 2011 Mar 8. doi: 10.4061/2011/952537
17. Hassana NE, El Shebinib SM, El-Masrya SA, Ahmedb NH, Alia MM, El-Saeedc GSM , El-Lebedy D .Association between dietary sodium, calcium, saturated fat and blood pressure in obese Egyptian adolescents Egyptian Pediatric Association Gazette 2019 ; 67:6 https://doi.org/10.1186/s43054-019-0007-5
18. Bonita F. Hypertension in children and adolescents: epidemiology and natural history. Pediatr Nephrol 2010 ;25:1219–1224. DOI: 10.1007/s00467-009-1200-3
19. Singh S Shankar R and Singh GP. prevalence and associated risk factors of hypertension: Across-sectional study in Urban Varanasi. International Journal of Hypertension 2017; Article ID 5491838,1-10:,http://doi.org/10.1155/2017/5491838
20. Flynn JT, Kaelber DC, Baker-Smith CM, et al. Clinical practice guideline for screening and management of high blood pressure in children and adolescents Pediatrics 2017;140 (3):e20171904. DOI: 10.1542/peds.2017-1904
21. Hauk L. Screening and management of high BP in children and adolescents: an updated guideline from the AAP [Practice Guideline]. Am Fam Physician 2018;97(8):543–544.
22. World Health Organization (WHO). Growth reference 5-19 years – Application tools: Anthroplus Software . WHO. 2016 http://www.who.int/growthref/en/. Accessed on December 13, 2016
23. World Health Organization (WHO) and United Nations Children's Fund (UNICEF). WHO Child Growth Standards and the Identification of Severe Acute Malnutrition in Infants and Children. Department of Child and Adolescent Health and Development, World Health Organization Press, Geneva.2009.
24. .Hirshkowitz M, Whiton K, Albert SM, et al., "National Sleep Foundation's updated sleep duration recommendations," Sleep Health 2015; 1(4):233–243. DOI: 10.1016/j.sleh.2015.10.004
25. Dulskiene V, Kuciene R, Medzioniene J, Benetis R. Association between obesity and high blood pressure among Lithuanian adolescents: a cross-sectional study, Italian Journal of Pediatrics 2014;40(102):1-10.
26. Tayel D, El-Sayed NA, El-Sayed NA. Dietary pattern and blood pressure levels of adolescents in Sohag, Egypt J Egypt Public Health Assoc 2013;88(2):97-103. doi:10.1097/01.EPX.0000430963.78876.0a.
27. Kurnianto A , Sunjaya DK, Rinawan FR, Hilmanto D. Prevalence of Hypertension and Its Associated Factors among Indonesian Adolescents International Journal of Hypertension 2020, Article ID 4262034, 7 pages. https://doi.org/10.1155/2020/4262034
28. Guo X, Zheng L, Li Y, Yu S, Zhou X, Wang R, Zhang X, Sun Z, Sun Y: Gender-specific prevalence and associated risk factors of prehypertension among rural children and adolescents in Northeast China: a cross-sectional study. Eur J Pediatr 2013, 172: 223-230. doi:10.1007/s00431-012-1873-7
29. Ramos E, Barros H: Prevalence of hypertension in 13-year-old adolescents in Porto, Portugal. Rev Port Cardiol 2005; 24: 1075-1087.
30. Silva D, Matos A, Magalhães T, Martins V, Ricardo L, Almeida H: Prevalence of hypertension in Portuguese adolescents in Lisbon, Portugal. Rev Port Cardiol 2012; 31: 789-794. doi:10.1016/j.repc.2012.02.022
31. Khoury M, Khoury PR, Dolan LM, Kimball TR, Urbina EM. Clinical Implications of the Revised AAP Pediatric Hypertension Guidelines. Pediatrics 2018; 142(2):e20180245 doi: 10.1542/peds.2018-0245
32. Yang Y, Min J, Chang L, Chai J, Song Z, ,Zha S, .Zhang M, , Liu H, Yang F. Prevalence trends of hypertension among 9–17 aged children and adolescents in Yunnan, 2017–2019: a serial cross-sectional surveillance survey BMC Public Health 2021 ; 21 (338) :1-9.

33. 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 [J]. Pediatrics 2004;114:555–76.
34. Song P, Zhang Y, Yu J, Zha M, Zhu Y, Rahimi K, Rudan I, Global prevalence of hypertension in children A Systematic Review and Meta-analysis JAMA Pediatr. 2019;173(12):1154-1163. doi:10.1001/jamapediatrics.2019.3310.
35. İrgil E, Erkenci Y, Aytekin N, Aytekin H. Prevalence of hypertension among schoolchildren aged 13–18 years in Gemlik, Turkey. Eur J Public Health. 1998;8:176–8.
36. Hardy ST, Sakhuja S, Jaeger BC, Urbina EM, Suglia SF, Feig DI, Muntner P. Trends in Blood Pressure and Hypertension Among US Children and Adolescents, 1999-2018 JAMA Network Open. 2021;4(4):1:14. DOI: 10.1001/jamanetworkopen.2021.3917
37. Wang Y, Lobstein T. Worldwide trends in childhood overweight and obesity. Int J Pediatr Obes 2006, 1: 11-25. DOI: 10.1080/17477160600586747
38. Lu X, Shi P, Luo CY, Zhou YF, Yu HT, Guo CY, Wu F. Prevalence of hypertension in overweight and obese children from a large school-based population in Shanghai, China. BMC Public Health 2013; 11: 13-24. doi:10.1186/1471-2458-13-24
39. Serrano M, Armesilla C, Moreno C, González-Montero de Espinosa M, López-Ejeda N, Álvarez MJR, Martínez PC, Romero-Collazos JF: Association between adiposity and blood pressure levels between the ages of 6 and 16 years: analysis in a student population from Madrid, Spain. Rev Esp Cardiol 2013; 66: 110-115. DOI: 10.1016/j.rec.2012.08.007

Cite this article as: Hassan S. K., Abdel Wahed, W., Mabrouk, S. E. Elevated Blood Pressure and Its Associated Demographic Factors Among Rural School Adolescents In Fayoum Governorate, Egypt. *Egyptian Journal of Community Medicine*, 2022;41(1):18-26.

DOI: **10.21608/ejcm.2022.124759.1210**