Natural Resources for Human Health

eISSN: 2583-1194

Original Research

Received 22 May 2026
Revised 25 June 2026
Accepted 22 July 2026

Natural Resources for Human Health 2026, Vol. 6 (9s): 1127–1134

KEYWORDS:
Hypertension-Range Blood Pressure, Adolescents, School Health, Egypt, Cross-Sectional Study.

Prevalence of Hypertension in Adolescents in Egyptian Secondary School

Magdy Mohamed Elsharkawy[1], Walaa Abd Elsamea Elsawy Elbendary[2], Ahmed Abdelmoniem Emara[3], Khaled Gouda Abdelwahab[4]

[1]Professor of Internal Medicine and Nephrology, Faculty of Medicine, Ain Shams University, Cairo, Egypt. Email: magdyelsharkawy@med.asu.edu.eg .
[2]Nephrology Specialist, Samannoud Hospital, Egypt. Email: welsawy085@gmail.com .
[3]Associate Professor of Internal Medicine and Nephrology, Ain Shams University, Cairo, Egypt. Email: Ahmed_emara@med.asu.edu.eg .
[4]Associate Professor of Internal Medicine and Nephrology, Ain Shams University, Cairo, Egypt. Email: Khaled.gouda@med.asu.edu.eg | ORCID: 0009-0004-1341-551X
* Corresponding author : Khaled Gouda Abdelwahab

ABSTRACT:

Background: Adolescent hypertension-range blood pressure is an important early cardiovascular risk marker. This study aimed to estimate the prevalence of hypertension-range blood pressure among adolescents at one Egyptian secondary school and evaluate associated demographic and lifestyle factors.

Methods: This cross-sectional study used census sampling and included 337 students aged 13–17 years at El-Sadat Secondary School, El-Gharbia, Egypt; the minimum required sample was 114. Blood pressure was measured three times under standardized conditions during one school assessment and classified according to the 2017 American Academy of Pediatrics guideline. Prevalence with a 95% confidence interval (CI), exact tests, and modified Poisson regression with robust variance were used.

Results: The mean age was 15.02 ± 1.34 years; 204 students were male (60.53%). Mean SBP was 109.9 ± 12.4 mmHg and mean DBP was 67.7 ± 6.6 mmHg. Hypertension-range BP was detected in 50 students (14.84%; 95% CI, 11.45%–19.02%). In unadjusted analyses, male sex, parental smoking, salty diet, and physical inactivity were associated with hypertension-range BP (all P<0.001). In the adjusted model (n=336), parental smoking (adjusted prevalence ratio [aPR], 4.05; 95% CI, 2.12–7.72) and physical inactivity (aPR, 3.40; 95% CI, 2.04–5.65) remained independently associated; sex, age, and BMI were not significant.

Conclusions: Hypertension-range BP was common among adolescents at the participating school. Parental smoking and physical inactivity were independently associated with the outcome. Multicenter studies using repeated-visit or ambulatory confirmation are needed before generalizing these findings.

INTRODUCTION

Hypertension is a major global public health problem, with a steadily increasing burden over recent decades [1]. Blood pressure (BP) levels in childhood and adolescence are strongly linked to BP levels in adulthood, suggesting that early-life BP elevation may represent the beginning of a lifelong cardiovascular risk trajectory. This is clinically important because hypertension during youth has been associated with later atherosclerotic cardiovascular disease, premature mortality, and subclinical target organ damage (TOD) [2].

Recognition of pediatric and adolescent hypertension has improved substantially after the publication of the 2017 American Academy of Pediatrics (AAP) clinical practice guideline for screening and management of high BP in children and adolescents. This guideline updated normative BP tables by excluding overweight and obese children and introduced simplified static BP thresholds for adolescents aged 13 years or older, aligning adolescent BP classification more closely with adult recommendations from the American Heart Association (AHA) and American College of Cardiology (ACC). These changes have increased the sensitivity of detecting adolescents with elevated cardiometabolic risk, including obesity, dyslipidemia, prediabetes, and BP-related TOD [3, 4].

Accurate diagnosis of hypertension in adolescents remains essential because clinic BP measurements may be influenced by measurement conditions and transient physiological or emotional factors. For this reason, ambulatory blood pressure monitoring (ABPM), which records multiple BP readings over 24 hours, is recommended by the AAP to confirm hypertension in children and adolescents suspected to have high BP on clinic measurements [5]. Nevertheless, school-based BP screening remains a practical and important approach for early detection, particularly in settings where routine adolescent cardiovascular risk assessment is limited [6].

Despite the growing recognition of adolescent hypertension worldwide, data from Egyptian school populations remain limited [7, 8]. School-based estimates can support local screening, but their interpretation should reflect the sampling frame and the need for confirmatory BP assessment. Therefore, this study aimed to estimate the prevalence of hypertension-range BP among adolescents at El-Sadat Secondary School and examine associated demographic and lifestyle factors.

PARTICIPANTS AND METHODS

Study design and setting

This cross-sectional study was carried out among 337 adolescent students at El-Sadat Secondary School, El-Gharbia, Egypt, from October 2022 to May 2023. All students in the school-level sampling frame who met the eligibility criteria were approached using census sampling. The minimum sample size was calculated with the single-population proportion formula, $n=Z^2p(1-p)/d^2$, using 95% confidence ($Z=1.96$), an anticipated prevalence of 7.6% from Daniel et al. 19, and 5% absolute precision. The initial estimate was 108; after a 5% allowance for nonresponse, the minimum required sample was 114. The 337 enrolled students exceeded this requirement. The study was approved by the Ethics Committee of the Faculty of Medicine, Ain Shams University (Approval number: ________). Written informed consent was obtained from all participants before enrollment, and adequate measures were taken to maintain privacy and confidentiality of the collected data.

Eligibility criteria

Adolescent students aged 13 to 17 years of both sexes were eligible for inclusion. Students with congenital heart disease and those receiving medications that could increase or decrease BP were excluded from the study.

Clinical assessment

All enrolled students underwent full history taking, with special emphasis on student smoking, parental smoking, physical activity, and dietary salt intake. Lifestyle-related factors were recorded for comparison according to BP status.

Blood pressure (BP) assessment

BP was measured under standardized conditions during one school visit. Students were calm before measurement, had an empty bladder, and were not smoking before assessment. BP was measured three times using both palpatory and auscultatory methods. Measurements were performed using a Riester standard clinical aneroid sphygmomanometer and a Littmann Classic II stethoscope, with the student in a sitting position and the right arm supported on the table.

BP was classified according to the 2017 American Academy of Pediatrics (AAP) clinical practice guideline [3]. Because all participants were aged 13 years or older, hypertension-range BP was defined as systolic BP of 130 mmHg or higher and/or diastolic BP of 80 mmHg or higher. Stage 1 hypertension-range BP was defined as 130–139/80–89 mmHg, and stage 2 as 140/90 mmHg or higher. Because measurements were obtained during a single school assessment without ambulatory or separate-visit confirmation, the outcome is reported as hypertension-range BP rather than confirmed hypertension.

Natural Resources for
Human Health
eISSN: 2583-1194

Anthropometric assessment

Body weight was measured using a Seca digital scale with a capacity of 200 kg and an accuracy of 0.1 kg. Body height was measured using a Seca microtoise with a capacity of 200 cm and an accuracy of 0.1 cm. Students were asked to remove footwear and hair accessories before measurement.

Body mass index (BMI) was calculated and assessed according to the World Health Organization (WHO) growth reference for children and adolescents aged 5–19 years using WHO AnthroPlus software version 1.0.4. Nutritional status was classified according to BMI-for-age as normal weight, overweight, or obese.

Physical activity assessment

Physical activity was assessed using the Physical Activity Questionnaire for Adolescents (PAQ-A). This self-administered 7-day recall questionnaire evaluates participation in different physical activities, including activities during physical education classes. Students were classified as less active when the PAQ-A score ranged from 1 to 2 points and active when the score ranged from 3 to 5 points.

Laboratory investigations

Laboratory investigations included urine analysis, kidney function tests, albumin/creatinine ratio, and serum albumin.

Outcomes

The primary outcome was the prevalence of hypertension-range BP, defined as systolic BP of 130 mmHg or higher and/or diastolic BP of 80 mmHg or higher during the school assessment, according to the 2017 AAP guideline [3]. Secondary outcomes were associations of hypertension-range BP with sex, age, BMI, parental smoking, dietary salt intake, and physical activity.

Statistical methods

Statistical analysis was performed using SPSS version 26 (IBM Inc., Chicago, Illinois, United States). Continuous variables were presented as mean and SD and compared between groups using Welch's t-test. Categorical variables were presented as frequency and percentage and compared using Pearson's Chi-square test or Fisher's exact test when any expected cell count was less than five. Hypertension-range BP prevalence was reported with a 95% Wilson confidence interval. Crude prevalence ratios (PRs) and 95% CIs were calculated, and adjusted PRs were estimated using modified Poisson regression with robust variance 9. The prespecified adjusted model included sex, age, BMI, parental smoking, and physical inactivity. Dietary salt intake was not entered into the adjusted model because no hypertension-range BP events occurred in the non-salty-diet group, producing complete separation. Complete-case analysis was used for parental smoking (n=336), with no imputation. Student-smoking values were missing for 278 of 337 participants and were excluded from between-group analyses. A two-tailed P-value less than 0.05 was considered statistically significant.

RESULTS

Demographic and lifestyle characteristics of the studied students are shown in **Table 1**.

Table 1: Demographic and lifestyle characteristics of the studied students (n = 337; available-case denominators shown)

Demographic & lifestyle characteristics		
Age (years)	Mean ±SD	15.02 ±1.34
Sex		
Males	n (%)	204 (60.53)
Females	n (%)	133 (39.47)
Weight (kg)	Mean ±SD	68.0 ±4.57
Height (cm)	Mean ±SD	165.4 ±3.37
BMI (kg/m²)	Mean ±SD	24.89 ±2.03
Parental smoking	n (%)	175/336 (52.08)
Student smoking (available n=59)	n (%)	35 (59.32)

Salty diet	n (%)	137 (40.65)
Regular physical activity	n (%)	249 (73.89)
Missing student-smoking data	n (%)	278 (82.49)

n: number, SD: standard deviation, BMI: body mass index.

The mean systolic BP was 109.9 ± 12.4 mmHg, while the mean diastolic BP was 67.7 ± 6.6 mmHg. Hypertension-range BP was identified in 50 students, representing 14.84% of the study sample (95% CI, 11.45%–19.02%), whereas 287 students (85.16%) had BP below the hypertension threshold (**Table 2).**

Table 2: Blood pressure profile and prevalence of hypertension-range BP among the studied students (n = 337)

BP profile & prevalence of hypertension-range BP		
SBP (mmHg)	Mean ±SD	109.9 ±12.4
DBP (mmHg)	Mean ±SD	67.7 ±6.6
Hypertension-range BP (95% CI, 11.45–19.02%)		
Yes	n (%)	50 (14.84)
No	n (%)	287 (85.16)

n: number, SBP: systolic blood pressure, DBP: diastolic blood pressure, SD: standard deviation, CI: confidence interval.

Age was similar between students with and without hypertension-range BP (15.06 ± 1.19 vs. 15.01 ± 1.36 years; P=0.791). Weight, height, and BMI also did not differ significantly. Males represented 86.00% of students with hypertension-range BP and 56.10% of those below the threshold (unadjusted P<0.001), although male sex was not independently associated after adjustment (aPR, 1.17; 95% CI, 0.60–2.28; P=0.636) (**Table 3).**

Table 3. Demographic characteristics according to hypertension-range BP status

		Hypertension-range BP (n=50)	**Below threshold (n=287)**	**P-value**
Age (years)	Mean ±SD	15.06 ±1.19	15.01 ±1.36	0.791
Sex				
Males	n (%)	43 (86.00)	161 (56.10)	**<0.001***
Females	n (%)	7 (14.00)	126 (43.90)	
Weight (kg)	Mean ±SD	68.91 ±4.68	67.85 ±4.55	0.143
Height (cm)	Mean ±SD	166.20 ±3.19	165.27 ±3.38	0.061
BMI (kg/m²)	Mean ±SD	24.99 ±2.15	24.88 ±2.01	0.734

n: number, SD: standard deviation, BMI: body mass index, aPR: adjusted prevalence ratio, CI: confidence interval.

Hypertension-range BP prevalence was higher among students exposed to parental smoking than among unexposed students (24.57% vs. 4.35%; crude PR, 5.65; 95% CI, 2.62–12.20) and among physically inactive compared with active students (34.09% vs. 8.03%; crude PR, 4.24; 95% CI, 2.55–7.07).

All 50 hypertension-range BP events occurred among students reporting a salty diet (Fisher's exact P<0.001). In the adjusted model, parental smoking (aPR, 4.05; 95% CI, 2.12–7.72; P<0.001) and physical inactivity (aPR, 3.40; 95% CI, 2.04–5.65; P<0.001) remained independently associated, whereas male sex, age, and BMI did not. Student smoking was excluded from between-group analysis because of extensive missing data (**Table 4).**

Table 4: Crude and adjusted associations with hypertension-range BP

Factor	**Category/status**	**Hypertension-range BP, n/N (%)**	**PR (95% CI); P-value**
Sex			
	Male	43/204 (21.08)	
	Female	7/133 (5.26)	

eISSN: 2583-1194

	Crude association		4.00 (1.86–8.64); P<0.001
Parental smoking			
	Yes	43/175 (24.57)	
	No	7/161 (4.35)	
	Crude association		5.65 (2.62–12.20); P<0.001
Salty diet			
	Yes	50/137 (36.50)	
	No	0/200 (0.00)	
	Exact comparison		PR not estimable; Fisher P<0.001
Physical activity			
	Inactive	30/88 (34.09)	
	Active	20/249 (8.03)	
	Crude association		4.24 (2.55–7.07); P<0.001
Adjusted modified Poisson model (n=336)			
Parental smoking	Yes vs. no	aPR 4.05 (2.12–7.72)	**<0.001**
Physical inactivity	Inactive vs. active	aPR 3.40 (2.04–5.65)	<0.001
Male sex	**Male vs. female**	**aPR 1.17 (0.60–2.28)**	0.636

n: number, PR: prevalence ratio, aPR: adjusted prevalence ratio, CI: confidence interval. The adjusted model included sex, age, BMI, parental smoking, and physical inactivity (complete-case n=336). Salt intake was excluded from the adjusted model because of complete separation. Student-smoking values were missing for 278 participants and were excluded from inferential analysis.

DISCUSSION

This cross-sectional study included 337 adolescent students aged 13–17 years from one Egyptian secondary school using a school-level census approach. The mean age was 15.02 ± 1.34 years, with males representing 60.53% and females 39.47% of the sample. The mean weight was 68.0 ± 4.57 kg, mean height was 165.4 ± 3.37 cm, and mean BMI was 24.89 ± 2.03 kg/m². Hypertension-range BP was identified in 50 students, corresponding to 14.84% (95% CI, 11.45%–19.02%). The mean SBP was 109.9 ± 12.4 mmHg, while the mean DBP was 67.7 ± 6.6 mmHg.

In line with our findings, Hassan et al. [10] conducted a cross-sectional study among 618 school adolescents aged 12–17 years in three villages in Fayoum Governorate to estimate the prevalence of elevated BP according to the American Academy of Pediatrics guideline. They reported that males represented 58.9% and females 41.1%, which was close to the sex distribution in the present study. However, their reported demographic distribution differed from the present study regarding age and BMI categories, as most adolescents were within the older adolescent age group and most had BMI values within the normal range.

In parallel, Kurnianto et al. [11] conducted a cross-sectional study on 1200 adolescents aged 13–18 years from twelve senior high schools in Palembang, South Sumatera, Indonesia. They evaluated hypertension prevalence using the new AAP guideline and assessed associated factors. Their participants were aged 14–17 years, which was comparable to the age range in the present study. However, their sex distribution differed, as males represented 36.8% and females 63.2%, while the present study included a higher proportion of males.

Farrag et al. [12] conducted a cross-sectional observational study on 2895 students from 10 public Egyptian universities representing different geographic areas, including Cairo, the Nile Delta, coastal regions, and Upper Egypt. They evaluated obesity and cardiovascular risk factors among university students and reported that most students had BMI below 25 kg/m². The mean BMI in the present school sample was 24.89 ± 2.03 kg/m²; direct comparison is limited by the different age groups and BMI assessment approaches.

Against the present study, Galal et al. [13] conducted a cross-sectional study among 234 preparatory school children aged 12–14 years in Cairo. Their sample included 167 females and 67 males, which contrasts with the male predominance in the present study. They also reported a lower mean age of 12.5 ± 0.6 years compared with the present study. Their mean weight was 62.9 ± 17.0 kg and mean height was 161.2 ± 9.0 cm, which were lower than the corresponding mean values in the present study.

In the unadjusted analyses, male sex, parental smoking, salty diet, and physical inactivity were associated with hypertension-range BP. After adjustment for sex, age, BMI, parental smoking, and physical inactivity, parental smoking and physical inactivity remained independently associated, whereas sex, age, and BMI did not. Salt intake could not be included in the adjusted model because no events occurred among students reporting no salty diet. Student-smoking data were too incomplete for a valid between-group comparison, and family-history results were not retained because that variable was absent from the master dataset.

Comparably, Hassan et al. [10] reported a high frequency of parental smoking and physical activity among school adolescents. They found that 58.9% of parents were smokers and 90.1% of students practiced physical activity. This agrees with the importance of assessing parental smoking and physical activity in adolescent BP studies, although the exact percentages differed from the present study.

In addition, Kurnianto et al. [11] reported that 48.6% of parents were smokers and 50% of adolescents practiced physical activity. Their findings similarly show that parental smoking and physical activity are relevant lifestyle variables in adolescent BP studies, although the proportions differed from those in the present school sample.

Farrag et al. [12] reported lower frequencies of parental smoking and physical activity than those observed in the present study. They found that 6.3% of parents were smokers and 15.7% of students practiced physical activity, compared with 52.08% and 73.89%, respectively, in the available data from the present school sample.

Abolfotouh et al. [8] conducted a cross-sectional study among 1500 school adolescents aged 6–19 years from preparatory and secondary schools in Alexandria, Egypt, to assess the relationship between high BP and obesity. They reported that 20% consumed salty food and 15.8% had smoking parents, lower than the available proportions in the present school sample.

Galal et al. [13] reported that 60.9% of parents were smokers and 39.1% of children consumed salty food. Their parental-smoking frequency was somewhat higher than the 52.08% observed among participants with available data in the present study, while their salty-food proportion was close to the present overall estimate of 40.65%.

The prevalence of hypertension-range BP in the present school sample was 14.84% (95% CI, 11.45%–19.02%). Soua et al. [14] studied Tunisian adolescents with a mean age of 17 ± 1.5 years and reported a hypertension prevalence of 15.4%, close to the present screening estimate. Yang et al. [15] used health-surveillance data from school-aged students aged 9–17 years in Yunnan and reported a total hypertension prevalence of 13.45%, also within the confidence interval of the present estimate.

Lu et al. [16] studied primary hypertension among children and adolescents in the Taicang area and reported a prevalence of 4.1%–6.3%, lower than the present screening estimate. Shokunbi and Ukangwa [17] conducted a cross-sectional survey among 488 secondary school students aged 10–19 years and reported a prevalence of 10.5%, while Chelo et al. [18] reported 1.6% among 822 pupils in Cameroon. Differences in populations, sampling, measurement schedules, and diagnostic confirmation may account for part of the variation across studies.

Daniel et al. reviewed hypertension prevalence among adolescents aged 10–19 years in India and reported a pooled prevalence of 7.6%, with individual-study estimates ranging from 2% to 20.5% 19. The present screening estimate falls within that range. Kurnianto et al. [11] reported hypertension in 8% of adolescents, with mean SBP of 109 ± 10.6 mmHg and mean DBP of 72 ± 8.5 mmHg; their mean SBP was close to the present value of 109.9 ± 12.4 mmHg, although prevalence and measurement contexts differed.

Abolfotouh et al. [8] reported a hypertension prevalence of 19.6% among adolescents in Alexandria, higher than the present estimate but within a broadly comparable range. Farrag et al. [12] reported 2.1% among Egyptian university students, whereas Galal et al. [13] reported 56.5% among their studied children, with mean SBP of 131.6 ± 4.7 mmHg and mean DBP of 90.0 ± 3.5 mmHg. These contrasts reinforce the importance of population selection and BP ascertainment when prevalence estimates are compared.

Age, weight, height, and BMI were not significantly different between students with and without hypertension-range BP. Male sex was associated with the outcome in unadjusted analysis but not after multivariable adjustment. Kurnianto et al. [11 similarly] found that age was not significantly different between hypertensive and normotensive adolescents, although they reported a different sex pattern. Hassan et al. [10] found significant differences in age and BMI but not sex, further indicating that demographic associations may vary across settings and sampling frames.

This study has several limitations. First, it was conducted at one secondary school; the school-level census improves coverage of that sampling frame but does not make the findings representative of El-Gharbia Governorate or Egypt. Second, the cross-sectional design precludes temporal or causal inference. Third, BP was assessed during one school visit without ambulatory monitoring or confirmation on separate visits, so the reported prevalence reflects hypertension-range screening measurements rather than confirmed clinical hypertension. Fourth, student-smoking values were missing for 278 participants, preventing a valid between-group analysis, and one parental-smoking value was missing. Fifth, self-reported salt intake and physical activity may be affected by recall or reporting bias, and residual confounding is possible. Multicenter studies using probability sampling and confirmatory BP assessment are needed.

CONCLUSIONS

Hypertension-range BP was identified in 14.84% (95% CI, 11.45%–19.02%) of adolescents at the participating school. Parental smoking and physical inactivity remained independently associated after adjustment, whereas sex, age, and BMI did not. The single-school sampling frame and single-visit BP assessment limit generalizability and diagnostic interpretation. These findings support local BP screening and confirmatory referral while underscoring the need for multicenter studies with repeated-visit or ambulatory confirmation.

REFERENCES

[1] NCD Risk Factor Collaboration (NCD-RisC). Worldwide trends in hypertension prevalence and progress in treatment and control from 1990 to 2019: a pooled analysis of 1201 population-representative studies with 104 million participants. *Lancet*. Sep 11 2021;398(10304):957-980. doi:10.1016/s0140-6736(21)01330-1

[2] Jacobs D, Woo J, Sinaiko A, et al. Childhood Cardiovascular Risk Factors and Adult Cardiovascular Events. *N Engl J Med*. May 19 2022;386(20):1877-1888. doi:10.1056/NEJMoa2109191

[3] 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*. Sep 2017;140(3)doi:10.1542/peds.2017-1904

[4] Whelton P, Carey R, Aronow W, et al. 2017 ACC/AHA/AAPA/ABC/ACPM/AGS/APhA/ASH/ASPC/NMA/PCNA Guideline for the Prevention, Detection, Evaluation, and Management of High Blood Pressure in Adults: A Report of the American College of Cardiology/American Heart Association Task Force on Clinical Practice Guidelines. *J Am Coll Cardiol*. May 15 2018;71(19):e127-e248. doi:10.1016/j.jacc.2017.11.006

[5] Macumber I. Ambulatory Blood Pressure Monitoring in Children and Adolescents: a Review of Recent Literature and New Guidelines. *Curr Hypertens Rep*. Oct 25 2017;19(12):96. doi:10.1007/s11906-017-0791-5

[6] Glenning J, Sheeran F, Quinlan C, Mynard J. School-based screening for high blood pressure in children and adolescents: a systematic scoping review. *Hypertens Res*. Apr 2026;49(4):1304-1314. doi:10.1038/s41440-025-02542-z

[7] El-Shafie A, El-Gendy F, Allhony D, et al. Establishment of blood pressure nomograms representative for Egyptian children and adolescents: a cross-sectional study. *BMJ Open*. Jul 25 2018;8(7):e020609. doi:10.1136/bmjopen-2017-020609

[8] Abolfotouh M, Sallam S, Mohammed M, Loutfy AA, Hasab AA. Prevalence of elevated blood pressure and association with obesity in egyptian school adolescents. *Int J Hypertens*. Mar 8 2011;2011:952537. doi:10.4061/2011/952537

[9] Zou G. A modified Poisson regression approach to prospective studies with binary data. Am J Epidemiol. Apr 1 2004;159(7):702-706. doi:10.1093/aje/kwh090

[10] Hassan S, Abdel Wahed W, Mabrouk S. Elevated blood pressure and its associated demographic factors among rural school adolescents in Fayoum governorate, Egypt. *Egypt J Community Med*. 06/20 2022;12(3):150-66. doi:10.21608/ejcm.2022.124759.1210

[11] Kurnianto A, Kurniadi Sunjaya D, Ruluwedrata Rinawan F, Hilmanto D. Prevalence of hypertension and its associated factors among indonesian adolescents. *Int J Hypertens*. 2020/09/16 2020;2020:150-77. doi:10.1155/2020/4262034

[12] Farrag A, el Eraky A, Aroussy W, et al. Obesity and other cardiovascular risk factors in egyptian university students: Magnitude of the problem. *Epidemiology: Open Access*. 01/01 2015;5(1):2-5. doi:10.4172/2161-1165.1000181

[13] Galal S, Fahmy S, Lashine S, Abdel-Fattah N, Galal M. Systemic hypertension and associated factors in school adolescents. *Int J Collab Res Intern Med Public*. 02/01 2011;3(2):167-176.

[14] Soua S, Ghammam R, Maatoug J, et al. The prevalence of high blood pressure and its determinants among Tunisian adolescents. *J Hum Hypertens*. Apr 2024;38(4):371-379. doi:10.1038/s41371-022-00677-x

[15] Yang Y, Min J, Chang L, et al. Prevalence trends of hypertension among 9–17 aged children and adolescents in Yunnan, 2017–2019: a serial cross-sectional surveillance survey. *BMC Public Health*. 2021/02/12 2021;21(1):338-44. doi:10.1186/s12889-021-10258-1

[16] Lu Z, Teng Y, Wang L, Jia L, Chen Z, Ding S. Analysis of the prevalence and related factors of primary hypertension among adolescents and children in the Taicang area. *BMC Pediatrics*. 2023/05/26 2023;23(1):265-77. doi:10.1186/s12887-023-04061-7

[17] Shokunbi OS, Ukangwa NA. Relationship of blood pressure status, dietary factors and serum electrolytes of in-school adolescents in Ilishan-Remo, Ogun State, Nigeria. *Afr Health Sci*. Dec 2021;21(4):1754-63. doi:10.4314/ahs.v21i4.32

[18] Chelo D, Mah EM, Chiabi EN, et al. Prevalence and factors associated with hypertension in primary school children, in the centre region of Cameroon. *Transl Pediatr*. 2019;8(5):391-397.

[19] Daniel RA, Haldar P, Prasad M, et al. Prevalence of hypertension among adolescents (10-19 years) in India: A systematic review and meta-analysis of cross-sectional studies. *PLoS One*. 2020;15(10):115-33. doi:10.1371/journal.pone.0239929