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Артериальная гипертензия и связанные с ней факторы риска: исследование среди студентов-медиков в Ираке

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Цель. Оценить распространенность артериальной гипертензии (АГ) и прегипертензии среди студентов-медиков Университета Басры. Распространенность АГ среди молодого населения увеличилась за последние несколько десятилетий. Однако данные о специфической распространенности АГ в молодых возрастных группах в Ираке остаются ограниченными.

Материал и методы. Было проведено поперечное исследование с участием 762 студентов-медиков (414 мужчин и 348 женщин), отобранных с использованием многоступенчатой стратифицированной случайной выборки. Исследование проводилось в течение трех месяцев, с января по март 2024 года. Данные о социально-демографических характеристиках и факторах риска собирались с помощью самостоятельно заполняемой анкеты, адаптированной по принципу поэтапного подхода Всемирной организации здравоохранения. Обученный персонал измерял артериальное давление (АД) и индекс массы тела (ИМТ) в соответствии со стандартизированными протоколами.

Результаты. Средний возраст участников составил 21,15 года. Общая распространенность АГ составила 13,4%, и 42,5% студентов были классифицированы как имеющие прегипертензию. Как АГ, так и прегипертензия были значительно более распространены среди студентов мужского пола (16,7% и 55,1%, соответственно), чем среди студенток (9,5% и 27,6%, соответственно). Только 29,4% участников с АГ сообщили о наличии предшествующей осведомленности и лечении.

Заключение. Данное исследование выявило высокую распространенность АГ и прегипертензии среди студентов-медиков, большинство из которых ранее не были диагностированы. Полученные результаты подчеркивают острую необходимость в стратегиях раннего выявления патологии, включая внедрение национальных программ скрининга и расширение просветительской работы среди населения по профилактике и лечению АГ.

Ключевые слова: артериальная гипертензия, прегипертензия, студенты-медики, факторы риска, санитарное просвещение.

Отношения и деятельность: нет.

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Hypertension and its related risk factors: an assessment study among medical students in Iraq

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Objective. To assess the prevalence of prehypertension and hypertension (HTN) among medical students at the University of Basrah. The prevalence of HTN among younger populations has increased over the past few decades. However, data on the specific prevalence of HTN in younger age groups in Iraq remain limited.

Material and methods. A cross-sectional study was conducted involving 762 medical students (414 males and 348 females) selected using a multistage stratified random sampling technique. The study was conducted over a three-month period from January to March 2024. Data on sociodemographic characteristics and risk factors were collected using a self-administered questionnaire adapted from the World Health Organization's STEP-wise approach. Trained personnel measured blood pressure (BP) and body mass index (BMI) following standardized protocols.

Results. The mean age of participants was 21.15 years. The overall prevalence of HTN was 13.4%, and 42.5% of students were classified as prehypertensive. Both HTN and prehypertension were significantly more prevalent among male students (16.7% and 55.1%, respectively) than female students (9.5% and 27.6%, respectively). Only 29.4% of the participants with HTN reported prior awareness and treatment.

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Conclusion. This study revealed a notably high prevalence of HTN and prehypertension among medical students, most of whom were previously undiagnosed. These findings highlight the urgent need for early detection strategies, including implementation of national screening programs and enhanced community education on HTN prevention and management.

Keywords: hypertension, prehypertension, medical students, risk factors, health education.

Relationships and Activities: none.

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BMI — body mass index, BP — blood pressure, CVD — cardiovascular diseases, DM — diabetes mellitus, DBP — diastolic blood pressure, HTN — hypertension, kg — kilogram, m — meter, mmHg — millimeter mercury, SBP — systolic blood pressure, WHO — World Health organization.

Introduction

Cardiovascular diseases (CVD) and cerebrovascular diseases are among the leading causes of morbidity and mortality worldwide, with hypertension (HTN) emerging as a major determinant in the development of both [1]. A recent comprehensive global assessment estimated that 1.39 billion adults, representing 31.1% of the world's population, are affected by HTN [2]. Furthermore, HTN is responsible for approximately 9.4 million deaths annually [3].

In Iraq, HTN ranks as the sixth leading cause of mortality[1], with an estimated prevalence of 48% among adults according to the WHO 2023 report[2]. The Seventh Report of the Joint National Committee on Prevention, Detection, Assessment, and Treatment of High Blood Pressure (JNC7) established blood pressure (BP) values ⩾140/90 mmHg as the diagnostic threshold for HTN. Additionally, the report introduced the category of prehypertension, defined as systolic BP (SBP) between 120 and 139 mmHg and diastolic BP (DBP) between 80 and 89 mmHg, indicating individuals whose BP is elevated but does not yet meet the criteria for clinical HTN [4].

For consistency with widely used classifications, the present study applies the WHO age categories, defining young adults as individuals aged 18-24 years and adults of early middle age as those aged 25-44 years [5]. Ensuring consistent age definitions is essential, as discrepancies can lead to misclassifications and hinder accurate comparisons across studies. Increases in BP directly elevate the risk of serious complications, such as stroke, heart disease, diabetes mellitus (DM) type II, renal impairment, and premature death [6]. Moreover, an earlier onset of HTN is associated with a higher long-term risk of morbidity and mortality from CVD [7]. Evidence has consistently demonstrated that these adverse outcomes can be substantially reduced by effective BP control [8]. Consequently, early detection and management of HTN are critical for preventing future complications and reducing the overall burden on individuals and healthcare systems [9].

Multiple risk factors, both modifiable and non-modifiable, contribute to an elevated BP. These included age, sex, body weight, physical inactivity, smoking, family history of HTN, serum cholesterol levels, DM, and pre-existing vascular disease [10]. Awareness of these risk factors among healthcare professionals and the general population is essential for motivating targeted interventions aimed at preventing HTN development [11].

Most prior research conducted in Iraq has focused on HTN prevalence among the general adult population, with rates reported at 35.6% in 2016 [12] and rising to 45.82% six years later (p=0.003) [13]. Accordingly, limited data are available regarding the prevalence of HTN and prehypertension among university students. Additional national data indicate that the prevalence of HTN among Iraqi adults has shown an upward trajectory, rising by more than 55%, reflecting a growing public health challenge[2].

University students represent a particularly vulnerable subgroup, as many experience high academic stress, sedentary study habits, irregular sleep patterns, inadequate physical activity, and unhealthy dietary practices, all of which are recognized as contributors to elevated BP. Additionally, early adulthood is a formative period during which lifestyle behaviors are established, potentially influencing cardiovascular risk across lifespan. Despite these concerns, most prior research in Iraq has focused on adults in the general population, leaving limited data on the prevalence of HTN and prehypertension among university students.

This study aimed to assess the prevalence of HTN and prehypertension among medical students at the

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Ключевые моменты

Что известно о предмете исследования?

- Артериальная гипертензия (АГ) является одним из ведущих модифицируемых факторов риска сердечно-сосудистых заболеваний и преждевременной смертности во всем мире.
- Распространенность АГ растет во всем мире, в том числе среди молодого населения, отчасти из-за изменений образа жизни, таких как нерациональное питание, низкая физическая активность, ожирение и стресс.
- Прегипертензия также распространена среди молодых людей и связана с повышенным риском прогрессирования до АГ и будущих сердечно-сосудистых событий.
- Во многих странах, включая Ирак, уровень осведомленности, лечения и контроля АГ, особенно среди молодых людей, остается низким.

Что добавляют результаты исследования?

- Данное исследование впервые предоставляет исчерпывающие данные о распространенности как прегипертензии, так и АГ среди молодых людей в Ираке, в частности, среди студентов-медиков Университета Басры.
- Это подчеркивает значительную распространенность недиагностированной и нелеченной АГ в этой возрастной группе: более 55% участников страдают либо АГ, либо прегипертензией.
- В исследовании также были выявлены несколько ключевых факторов риска АГ среди молодых людей, включая мужской пол, семейный анамнез АГ, курение, высокое потребление соли и чрезмерное потребление напитков, содержащих кофеин.
- Это подчеркивает острую необходимость ранней диагностики и вмешательства, предлагая интегрировать скрининг на АГ в рутинные медицинские обследования в университетах и проведение санитарного просвещения населения.
- Эти результаты могут послужить основой для будущих стратегий общественного здравоохранения и национальных программ скрининга в Ираке, решая растущую, но недостаточно признаваемую проблему здравоохранения.

Key messages

What is already known about the subject?

- Hypertension (HTN) is a leading modifiable risk factor for cardiovascular diseases and premature mortality worldwide.
- The prevalence of HTN has been increasing globally, including among younger populations, partly due to lifestyle changes, such as poor diet, physical inactivity, obesity, and stress.
- Prehypertension, a precursor of HTN, is also prevalent among young adults and is associated with an elevated risk of progression to full hypertension and future cardiovascular events.
- In many countries, including Iraq, awareness, treatment, and control rates of HTN–especially among young adults–remain low.

What might this study add?

- This study provides the first comprehensive data on the prevalence of both prehypertension and HTN among young adults in Iraq, specifically medical students at Basrah University.
- This highlights the significant prevalence of undiagnosed and untreated HTN in this age group, with more than 55% of participants being either hypertensive or prehypertensive.
- This study also identified several key risk factors for HTN among young adults, including male sex, family history of HTN, tobacco use, high salt intake, and excessive consumption of caffeinated drinks.
- It underscores the urgent need for early detection and intervention, proposing the integration of HTN screening into routine university health assessments and advocating for public health campaigns aimed at raising awareness.
- These findings may inform future public health strategies and national screening programs in Iraq, addressing a growing but under-recognized health issue.

University of Basrah, College of Medicine, and identifying the significance of associated risk factors.

Material and methods

Study design and setting

This study was designed as a cross-sectional investigation of undergraduate medical students attending the College of Medicine, Basrah University. Data were collected between January and March 2024. The study population included all students enrolled in the college from the first to the sixth year of the study, for a total of approximately 3732 students.

Sampling and sample size

The study subjects were selected using stratified random sampling, and stratification was performed according to the year of education. Sample size was calculated using the following formula:

$$n = \frac{\frac{Z^2 \times P(1-P)}{e^2}}{1 + \frac{Z^2 \times P(1-P)}{e^2 N}},$$

where n — Sample size; N — Population size (3732 students); Z — Standard normal variant (1.96 for confidence level of 95%); E — Margin of error (5%); P — Population expected proportion by taking the most probable prevalence of HTN as 50% and permissible error as 5% with 95% confidence interval; the minimum sample size was calculated as n=344 students. As the sampling procedure was multistage, considering the design effect, the sample size was further increased by two times, and the final sample size in the study was fixed at 762 cases.

Data collection method

Five research assistants, all final-year medical students, were recruited for the data collection. The assistants received comprehensive training on standardized data collection procedures. Student participants were approached during their working hours in the college's hallways and classes. Following a brief verbal introduction, the research assistants explained the study objectives and obtained informed consent from each participant.

To calculate or report the response rate, the number of students approached (3732) and the number of students who agreed to participate (762) was calculated using the following formula:

Response Rate = Number of participants who completed the survey / Number of people approached × 100 = 762 / 3732 × 100 = 20.4%;

thus, the response was moderate.

a) **Self-administered questionnaire:** Participants completed a questionnaire based on the WHO STEPS instrument, which aimed to gather information on their sociodemographic characteristics (age, sex, education level, and body mass index, (BMI) as well as their smoking habits (smoking, passive smoking, electronic cigarette smoking), dietary habits (salt intake, fruits intake, vegetables intake, fast food consumption, energy drink consumption, and tea and caffeinated drinks consumption), lifestyle (days of sport practicing, and sleep hours) [14], as showed in Table 1, medical history (previous history of HTN, DM, and raised cholesterol level), and family history of HTN.

b) **BP measurement:** BP was recorded twice for each participant, with a minimum 2-minute interval between measurements, using an oscillometric electronic sphygmomanometer (BUa50; Medisana-AG, Neuss, Germany), with the patients in a seated position. In conclusion, the BP status of each participant was determined by calculating the mean of two recorded BP readings.

c) **Anthropometric measures**, such as weight, height, and BMI (weight (kg)/height (m^2)), were measured.

Statistical analysis. Statistical Package for the Social Sciences (SPSS) software (version 27.0, IBM Corp., 2020) was used. In this study, HTN and prehypertension were categorized according to the Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High BP (JNC-7) [4]. Prehypertension was defined as a SBP ranging from 120 to 139 mmHg or diastolic BP ranging from 80 to 89 mmHg. HTN was classified as systolic BP greater than or equal to 140 mmHg or DBP ⩾90 mmHg. BMI was classified according to the WHO adult BMI classification as underweight (<18.50 kg/m^2) normal (18.50-24.99 kg/m^2), overweight (⩾25 kg/m^2), and obese (⩾30 kg/m^2).

Results

Table 2 shows the sociodemographic characteristics and lifestyle indicators. Data from 762 medical students were collected and analyzed (mean age — 21.15±1.913 years). Slightly more than half were males, and the participants were distributed relatively evenly across educational years. Most students had a normal BMI. The mean height was 1.69±0.09 m. The majority of the participants were non-smokers. Less than half of the participants engaged in regular sports activities. Most participants consumed what they believed to be the correct amount of salt. A high proportion consumed at least two daily servings of fruits and vegetables, although fast food consumption was common. More than half did not consume energy drinks. Caffeinated drink consumption was very common. Additionally, 7.5% had been previously diagnosed with HTN, 3.1% had DM type II, and 50.8% reported a family history of HTN.

Table 1

Norms and criteria for each indicator [14]

Indicator	Norm	Criteria	Interpretation
Salt intake	<5 g/day	<5 g normal; 5-10 g moderate; >10 g high	High, linked to hypertension & heart disease
Fruits	⩾2 (300 g) servings/day	Adequate; insufficient (1 serving); poor (<1 serving)	
Vegetables	⩾3 (300 g) servings/day	Adequate; insufficient (1-2 servings); poor (<1 serving)	
Fast food	0-1/week	0-1 healthy; 2-3 moderate; >3 high	High, associated with obesity & metabolic risk
Energy drinks	0-2 (400 mg)/week	0 ideal; 1-2 moderate; >2 high. Most energy drinks contain 80-200 mg caffeine	High (risk of heart rhythm issues, anxiety, sleep disturbance)
Caffeinated drinks	1-3 cups (400 mg)/day	1-3 normal; 4-5 upper limit; >5 high	High, may cause health issues
Sport activity	3-5 days/week	Excellent/good/insufficient/sedentary 150 min/week	
Sleep hours	7-9 hours/day	Healthy; slightly low; deprived; excessive	

Table 2

Sociodemographic characters and all indicator of life style in the study

Variable		n (%) or M±SD
Mean age (year)		21.15±1.913
Gender	Male	414 (54.3)
	Female	348 (45.7)
Educational year	1st year	117 (15.4)
	2nd year	132 (17.3)
	3rd year	120 (15.7)
	4th year	141 (18.5)
	5th year	120 (15.7)
	6th year	132 (17.3)
BMI (kg/m^2)	Normal	498 (65.4)
	Overweight	186 (24.4)
	Obese	30 (3.9)
	Underweight	48 (6.3)
Mean height (m)		1.69±0.09
Smoking status	Smoker	126 (16.5)
	Non smoker	636 (83.5)
	Passive smoker	318 (41.7)
	Electronic smoking	117 (15.4)
Sport activity	Yes	342 (44.9)
	No	420 (55.1)
Have adequate sleep (7-9 h)	Yes	390 (51.2)
	No	372 (48.8)
Salt consumption	No salt	102 (13.4)
	The right amount (<5 g/day)	495 (65)
	>5 g/day	165 (21.7)
Fruits and vegetables intake	⩾2 (300 g) servings/day	602 (79.0)
	Poor (<1 serving)	155 (20.3)
	Not answer	5 (0.7)
Fast food	0-1/week	47 (6.2)
	2/week	249 (32.7)
	>3/week or daily	466 (61.2)
Energy drinks	0-2/week	59 (7.7)
	>2 high	285 (37.4)
	Not drinks	418 (54.9)
Tea or caffeinated drinks	1-3 cups (400 mg)/day	139 (18.2)
	>5	623 (81.8)
Previously diagnosed with HTN		57 (7.5)
Previously diagnosed with DM		24 (3.1)
Family history of HTN		387 (50.8)

Note: BMI — Body mass index, DM — diabetes mellitus, HTN — hypertension.

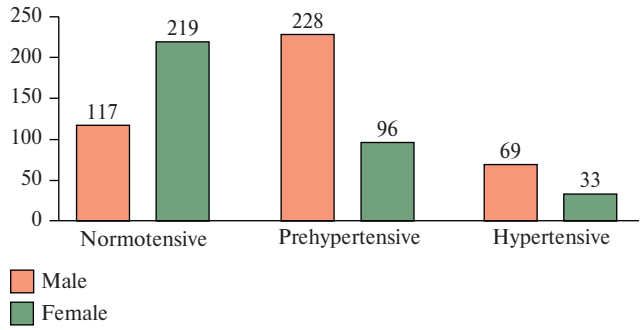

Figure 1 Illustrates the distribution of HTN prevalence by gender.
Note: HTN — hypertension.

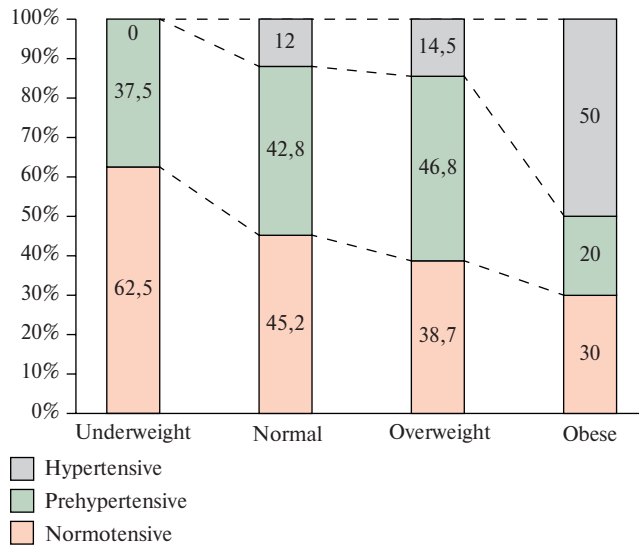

Figure 2 Illustrates the distribution of HTN across each BMI category.
Note: BMI — body mass index, HTN — hypertension.

The prevalence of HTN and prehypertension, of these 762 students, 102 (13.4%) were classified as hypertensive and 324 (42.5%) exhibited prehypertension. The remaining 336 (44.1%) students had normal BP readings.

Analysis of sex distribution in relation to BP revealed a statistically significant difference ($p<0.05$) in prevalence. There was a greater frequency of prehypertension among male participants (228, 55.1%) than among females (96, 27.6%). Similarly, HTN prevalence was slightly higher in men (69, 16.7%) than in women (33, 9.5%). Conversely, the proportion of normotensive individuals was substantially greater among females (219, 62.9%) than among males (117, 28.3%). Figure 1 visually illustrates the distribution of HTN prevalence by sex.

Correlation between BMI and HTN status. The data revealed a statistically significant correlation ($p<0.05$) between BMI and HTN prevalence. HTN rates were considerably higher among obese participants than among those with normal weight. Similarly, the prevalence of HTN was slightly higher in overweight participants (14.5%) than in normal weight participants (12%). Importantly, no cases of HTN were observed among the underweight participants. Figure 2 illustrates the distribution of HTN across BMI categories.

Data presented in Table 3 details the distribution of study participants across various risk factors known to influence BP, subjects were categorized into two subgroups: those with normal BP and those with elevated

Table 3

BP risk factors

Variable, n (%)		Normal BP (n=336)	High BP (n=426)	Total, n	p
Family history of HTN	Yes	147 (38)	240 (62)	387	0.001
	No	189 (50.4)	186 (49.6)	375	
Personal history of HTN	Yes	15 (26.3)	42(73.2)	57	0.005
	No	321 (45.5)	384 (54.5)	705	
Personal history of diabetes	Yes	9 (37.5)	15(62.5)	24	0.51
	No	327 (44.3)	411 (55.7)	738	
Smoking	Yes	33 (26.2)	93 (73.8)	126	0.001
	No	303 (37.6)	333 (52.4)	636	
Salt consumption	No	54 (52.9)	48 (47.1)	102	<0.001
	Norm	243 (49.1)	252 (50.9)	495	
	High	39 (23.6)	126 (76.4)	165	
Fruit and vegetables consumption	Adequate	339 (47.4)	306 (52.6)	645	0.79
	Inadequate	60 (25.6)	57 (74.4)	117	
Adequacy of sleep	Adequate	156 (40)	234 (60)	390	0.02
	Inadequate	180 (48.8)	192 (51.6)	372	
Cups of tea/coffee consumed per week	14 cups	260 (34.1)	345 (45.3)	605	0.01
	40-60 cups	48 (6.3)	109 (14.3)	157	
Days of sport practicing per week (3-5/week)	Yes	113 (14.8)	182 (23.9)	295	0.96
	No	365 (47.9)	102 (13.4)	467	
Energy drinks	2/week	289 (37.9)	118 (15.5)	407	0.05
	>2 week	252 (33.1)	103 (13.5)	355	
Fast food	>3 /week	180 (23.6)	105 (13.8)	285	0.008
	<2/week	174 (22.8)	303 (39.8)	477	

Note: BP — blood pressure, HTN — hypertension, n — number.

BP, encompassing both hypertensive and prehypertensive individuals. It is important to acknowledge that the observed correlations between the analyzed factors and elevated BP may have been inflated. This is because the prehypertensive group, encompassing 42.5% of the sample, was combined with the hypertensive group into a single category labeled "high BP" for analysis.

Several factors were significantly associated with BP status. Participants with a family history of HTN were more likely to have high BP (p=0.001). Similarly, individuals with a personal history of HTN demonstrated a higher prevalence of elevated BP than those without HTN (p=0.005). Smoking was also strongly associated with high BP (p=0.001). Salt intake showed a significant relationship with BP (p<0.001). Adequacy of sleep was also influential: individuals with inadequate sleep showed a higher prevalence of high BP (p=0.02). High consumption of tea or coffee (40-60 cups per week) was associated with a higher proportion of HTN (p=0.01). Fast food intake was also significantly linked to elevated BP, with those consuming it more than 3 times weekly showing higher rates of HTN (p=0.008). In contrast, fruits and vegetables intake, personal history of DM, sports activity levels, and energy drink consumption were not significantly associated with BP status.

The descriptive statistics for SBP and DBP among normotensive, prehypertensive, and hypertensive students. The analysis showed significant differences in SBP and DBP across the three BP categories. Normotensive participants had a mean SBP of 113.13±7.71 mmHg, compared with 129.22±4.511 mmHg among prehypertensive individuals, and 148.09±9.937 mmHg among hypertensive participants. Similarly, mean DBP increased across categories, from 75.21±6.575 mmHg in the normotensive group to 81.84±8.458 mmHg in the prehypertensive group and 96.94±10.557 mmHg in the hypertensive group. The standard deviations indicated greater variability in SBP and DBP among individuals with HTN. Overall, both SBP and DBP values increased progressively and significantly from normotensive to hypertensive status.

Discussion

The findings revealed a HTN prevalence of 13.4%. While limited research exists in Iraq on HTN prevalence among university students, our results were slightly greater than those of the national study conducted by Al-Taha M, et al. [15], who reported a 9.9% HTN prevalence among students of medical colleges in Al-Anbar City. Studies in neighboring regions have shown variations. A study conducted by AlWabel A, et al. [9] at Alqassim Medical College, Saudi Arabia, reported a higher prevalence (14.6%), whereas studies as [16] reported a lower prevalence (8 and 7%, respectively).

Notably, a study at Isfahan University of Medical Science [10] reported a significantly greater prevalence (17.5%).

Our study identified a prehypertension prevalence of 42.5% among the students. This prevalence aligns with findings from a university in Kuwait (39.5%) [17] and is slightly greater than those reported in Bahrain (30.7%) [13] and Saudi Arabia (29.2%) [15].

The prevalence of HTN in the Middle Eastern region varies considerably across different populations. This variation likely stems from a combination of biological, demographic, social, and environmental factors unique to each population [18, 19]. Additionally, discrepancies in prevalence rates observed across studies might be attributed to sampling methods, study settings, and timeframes of the studies [20, 21].

This study identified a concerning trend, among the 102 students who were found to be hypertensive, only 30 (29.4%) reported prior diagnosis and treatment. The remaining 72 students (70.6%) had never undergone a BP screening. This result can be attributed to the limited availability of preventive healthcare resources, which is a well-known challenge in Iraq's healthcare system. In this context, students generally do not undergo thorough health check-ups unless they exhibit noticeable symptoms. The study also revealed a high prevalence of prehypertension (42.5%), which is a significant finding. Prehypertension is a crucial risk factor for the development of HTN and cardiovascular diseases later in life. Early detection allows for lifestyle modifications to potentially lower BP without resorting to medication. Risk factors associated with HTN were sex (male), high BMI, family history of HTN, smoking, dyslipidemia, and excessive salt intake.

The present study identified a significant correlation between sex and BP. A greater proportion of male students (16.7%) were hypertensive as compared with females (9.5%). This trend extended to prehypertension, with a prevalence of 55.1% in males and 27.6% in females. These findings align with those of previous studies on the prevalence of HTN. For instance, El-Agroudy AE, et al. reported comparable sex disparities in Bahrain [16], with HTN prevalence of 13.8% in males and 2.8% in females and AlWabel A, et al. [9] in Saudi Arabia found a prevalence of 18.5% among males and 5.3% among females. While the precise mechanisms underlying this sex differences remain under investigation, some evidence suggests a potential role for androgens in regulating BP variations between the sexes [22].

This study revealed a strong positive correlation between the BMI and HTN. The prevalence of HTN was found to be 50% among obese students (BMI >30 kg/m^2), which aligns with previous research by Al-Taha M, et al. [15] at Al-Anbar University, who reported a prevalence of 45% in their obese student population. Similarly, AlWabel A, et al. [9] reported a prevalence of 34.4% among obese students in Saudi Arabia. The precise mechanism linking increased body weight to HTN remains unclear. However, prior research suggests that a combination in obese individuals of factors, including insulin resistance, heightened sympathetic activity, and elevated leptin levels, may contribute to this correlation [23]. Further research is required to elucidate the biological pathways involved.

The data presented in this study suggest a positive correlation between family history of HTN and elevated BP in college students. Among the participants with elevated BP, 56.33% reported a family history of the condition. Conversely, 62% of the students with a family history were found to have elevated BP during the examinations. These findings demonstrate a statistically significant correlation between family history and elevated BP, which is consistent with previous research by Al-Taha M, et al. [15] in Al-Anbar and El-Agroudy AE, et al. [16] in Bahrain. Consequently, screening for family members, especially those with a family history of HTN, is crucial for identifying individuals at increased risk.

This study also identified active smoking as a significant risk factor for HTN. Among 126 students who reported daily smoking, 73.8% exhibited elevated BP during the examinations. This finding aligns with previous research by Al-Taha M, et al. [15] and Moussa M, et al. [24] in Egypt. Furthermore, Abd El-Mohsen AS, et al.[3] established a link between smoking and HTN, highlighting their synergistic effect in accelerating atherosclerosis and increasing the risk of coronary complications. However, this observation contrasts with El-Agroudy AE, et al. [16] in Bahrain, who did not find a significant correlation between smoking and HTN in their student population. Interestingly, all 126 daily smokers in this study were males, which may contribute to the observed greater prevalence of HTN among males than among females.

This study observed a low prevalence of DM (3.1%) within the sample, as anticipated in a young population. Notably, 62.5% of those diagnosed with DM had a co-diagnosis of HTN. While the limited number of diabetic cases in our sample precludes definitive conclusions regarding the correlation between DM and HTN, prior research by Al-Majed H, et al. in Kuwait [17] supports a well-established link between these conditions. Smulyan H, et al. [25] proposed a potential mechanism underlying the co-occurrence of DM and HTN. Their study suggests a link between DM and increased arterial stiffness. Notably, arterial stiffness was significantly greater in diabetic subjects than in non-diabetic controls, and this stiffness further intensified with both

[3] Abd El-Mohsen AS, Abd El Maksoud MM, Shokier TT. Prevalence of Hypertension among Youth in Helwan University. Life Sci J. 2013;10(3):2304-8. https://www.researchgate.net/publication/288124818_Prevalence_of_hypertension_among_students_in_Helwan_University.

a longer duration of DM type II and the degree of insulin resistance.

The present study identified a positive correlation between HTN and specific dietary habits, including excessive salt and tea/coffee intake. These findings align with previous research conducted by Moussa M, et al. [24] and Al-Taha M, et al. [15], the discrepancy between the current observations, and those reported by El-Agroudy AE, et al. [16] in Bahrain, who did not find a significant correlation between salt intake and HTN in their cohort.

In contrast to previous research conducted by Moussa M, et al. [24] in Egyptian colleges, this study did not identify a statistically significant correlation between physical activity and the presence of HTN. Consistent with numerous previous studies, this study did not observe a statistically significant correlation between fruits and vegetables intake and HTN. It is worth noting that all research cited in the Discussion section used the same classification and cut-off points for HTN, as provided in the JNC7 report.

This study had several limitations. The cross-sectional design restricts the ability to establish causal relationships between HTN and associated risk factors. The sample was drawn exclusively from medical students at the University of Basrah, which may limit the generalizability of the findings to other universities or the wider young adult population in Iraq. Additionally, several variables were obtained through self-reported questionnaires and may have been subject to recall or social desirability bias. BP was measured during a single visit, which may have led to misclassification due to temporary factors such as stress or white-coat effects. Furthermore, potentially important confounders including dietary sodium intake, caffeine consumption, stress levels, sleep quality, and mental health status were not assessed. The study population consisted mainly of young adults, preventing comparison with older age groups and limiting insight into age-related trends in BP. Since the studied group refers to students of higher education who are medical students, the results cannot be compared to general students and extrapolated to the general public. In Iraq, the minimum age at which students start to enter universities is 18-years-old, this is why the range of young age was 18-25 years.

Conclusion

This study identified the prevalence of HTN and prehypertension among undergraduate medical students, the majority of whom were undiagnosed, and BP levels exhibited a positive correlation with established risk factors, including male sex, elevated BMI, family history of HTN, smoking status, dyslipidemia, and dietary habits (particularly salt intake and caffeinated drinks). These findings highlight the critical need to raise awareness of HTN risk factors among both medical students and the general public. Implementing interventions to promote healthy lifestyles and attenuating these risk factors is crucial for improving public health outcomes as well as lifestyle modification and infrastructure measures. The data cannot be extrapolated to the general public because it is not representative of the general population. Given the predominance of prehypertension among college students with abnormal BP, prioritizing preventative measures and appropriate treatment strategies with no delay is essential. interventions may delay the progression to full HTN, potentially reducing the incidence of cardiovascular and cerebrovascular events later in life. Finally, we propose the incorporation of a BP-screening program into routine university entrance physical examinations. This would serve as a first line of defense in identifying at-risk students and facilitating early intervention.

Ethical approval

This study was approved by the Medical Ethical Committee of the Department of Medicine (no. 449, 2024). The requirement for participant consent was waived by the committee because only the patient files were reviewed.

Отношения и деятельность: все авторы заявляют об отсутствии потенциального конфликта интересов, требующего раскрытия в данной статье.

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