



Factors associated with borderline hypertension in medical students: a cross-sectional study

Factores asociados a presión arterial elevada en estudiantes de medicina: estudio transversal

80

Carlos S. Pérez-Cortés¹ Liliana S. Salas-Franco² Norma L. Solano-González³ Vianey G. Saldaña-Herrera⁴ Sergio Paredes-Solís⁵ Neil Andersson⁶

¹Master of Sciences, Unidad de Salud Jardín Mangos, IMSS Bienestar, Coordinación Guerrero, México. <http://orcid.org/0009-0004-5614-0536>. saul93p@gmail.com

²Master of Public Health, Centro de Investigación de Enfermedades Tropicales, Universidad Autónoma de Guerrero, Acapulco, Guerrero, México. <http://orcid.org/0000-0002-4226-4624>. 18372@uagro.mx

³Doctorate in Public Health, Centro de Investigación de Enfermedades Tropicales, Universidad Autónoma de Guerrero, Acapulco, Guerrero, México. <http://orcid.org/0000-0002-5094-9068>. 18194@uagro.mx

⁴Master of Public Health, Centro de Investigación de Enfermedades Tropicales, Universidad Autónoma de Guerrero, Acapulco, Guerrero, México. <http://orcid.org/0000-0001-8186-5855>. 17677@uagro.mx

⁵Doctorate in Epidemiology, Centro de Investigación de Enfermedades Tropicales, Universidad Autónoma de Guerrero, Acapulco, Guerrero, México. <http://orcid.org/0000-0002-3015-3038>. 09366@uagro.mx

⁶Doctorate in Epidemiology, CIET-PRAM, Department of Familiar Medicine, McGill University, Montreal, Quebec, Canada; and Centro de Investigación de Enfermedades Tropicales, Universidad Autónoma de Guerrero, Acapulco, Guerrero, México. <http://orcid.org/0000-0002-5220-2136>. neil.andersson@mcgill.ca

The study was carried out at the Faculty of Medicine, of the Autonomous University of Guerrero, in Acapulco, Guerrero, Mexico.

Corresponding author: Dr. Sergio Paredes Solís, email 09366@uagro.mx

Funding: The study received no funding.

Acknowledgements: We would like to thank the students of the Faculty of Medicine at the Autonomous University of Guerrero for participating in the study and sharing their experiences. We are also grateful to the university authorities for facilitating this study.

Received: 07/12/2025 Accepted: 09/02/2026 Published: 15/03/2026 DOI: <http://doi.org/10.5281/zenodo.19046489>

Abstract

Introduction. The number of people with borderline hypertension increases every year, this condition is associated with modifiable habits.

Objective. Assess the occurrence and factors associated with borderline hypertension in medical students at the Autonomous University of Guerrero.

Methods. A cross-sectional study was carried out in October 2023 on a sample of 190 medical students. A self-administered questionnaire collected sociodemographic information and potential associated factors, including the body mass index. We measured the systemic blood pressure twice to detect borderline hypertension. We used bivariate and multivariate analysis to identify the factors associated with borderline hypertension.

Results. The occurrence of borderline hypertension was 30%. A higher proportion of male students had borderline hypertension (55%, 42/76) than female students (13%, 15/114), $p < 0.01$. Factors associated with borderline hypertension were body mass index > 25 (ORa: 4.23, 95%CI 2.06 – 8.70) and male sex (ORa: 7.28, 95%CI 3.59 – 14.77).

Conclusions. Three out of ten students had borderline hypertension. The provision of comprehensive care for young individuals with borderline hypertension is of essential importance in the prevention of progression to systemic hypertension.

Keywords: blood pressure, borderline hypertension, medical students, body mass index, HTN

Resumen

Introducción. Cada año aumenta el número de personas con presión arterial límite, la condición está asociada a hábitos modificables.

Objetivo. Conocer la ocurrencia y factores asociados a presión arterial elevada en estudiantes de medicina.

Método. Estudio transversal en 190 estudiantes realizado en octubre de 2023. Un cuestionario auto administrado recopiló información sociodemográfica y de potenciales factores asociados, incluido el índice de masa corporal. Para la detección de presión arterial elevada se midió en dos ocasiones la presión arterial sistémica. Mediante análisis bivariado y multivariado se identificaron los factores asociados a presión arterial elevada.

Resultados. La frecuencia de presión arterial elevada fue 30%. Hubo mayor proporción de casos con presión arterial elevada en hombres (55%, 42/76) que en mujeres (13%, 15/114) ($p < 0.01$). Los factores asociados a presión arterial elevada fueron índices de masa corporal > 25 (ORa: 4.23, IC95% 2.06 – 8.70) y sexo masculino (ORa: 7.28, IC95% 3.59 – 14.77).

Conclusiones. Tres de cada diez estudiantes presentaron presión arterial elevada. Esta condición requiere de atención integral en personas jóvenes para evitar el progreso a hipertensión arterial sistémica.

Palabras clave: presión arterial, hipertensión arterial límite, estudiantes de medicina, índice de masa corporal, hipertensión.

The World Health Organization (WHO) estimates that 1.4 billion adults worldwide have systemic hypertension (HTN). Each year, approximately 1.6 million people die from HTN-related causes. Cardiovascular diseases account for 23% of deaths in Mexico, with HTN being one of the main contributing factors. The estimated prevalence of undiagnosed systemic arterial hypertension is 70%. Around 30% of adults in Mexico have HTN, including 11% of women and 20% of men. In the state of Guerrero, the prevalence of HTN was 18% in 2018, with 21% of women and 14% of men affected.

In 2024, the European Society of Cardiology (ESC) introduced the term 'borderline hypertension' to identify cases that could potentially progress to HTN. Borderline hypertension is a multifactorial condition characterized by increased systemic blood pressure. Individuals who drink alcohol and smoke tobacco, are not physically active, have a family history of high blood pressure (HBP) or have a body mass index (BMI) >25 are more likely to develop borderline hypertension. In Mexico, a BMI >25 is the main cause of systemic hypertension in young people. Regular aerobic exercise lowers systemic blood pressure. Reducing BMI favours normal blood pressure levels.

The development of HTN is linked to excessive alcohol consumption. Young people with borderline hypertension consume significant amounts of alcohol. Smoking at an early age increases the risk of HTN. Systemic hypertension is more likely to develop in women who smoke. Tobacco use increases the risk of peripheral vascular disease and elevated diastolic blood pressure. However, tobacco use is a modifiable risk factor. It can lower systemic blood pressure.

In Mexico, one-third of adults have HTN. However, only half of these individuals have their condition under control⁴. Access to healthcare services is significantly associated with the diagnosis and management of HTN. Maintaining a healthy weight, reducing alcohol consumption and increasing physical activity are lifestyle changes that can prevent systemic hypertension. Screening for high blood pressure at an early age could prevent it from progressing to HTN. Preventive habits are usually formed in childhood. Therefore, it is important that future healthcare providers, such as medical students, are aware of this so they can contribute to the early detection of hypertension and provide optimal care for their patients. The aim of our study was to determine the occurrence of borderline hypertension and its associated factors among medical students.

This was a cross-sectional study of students at the Faculty of Medicine of the Autonomous University of Guerrero, Mexico, conducted from October 19 to 24, 2023. The study population consisted of 197 students who attended a typical day of classes. We surveyed four groups and collected data from one group each day. With this sample size, we could detect an odds ratio (OR) of 2.0 with 95% confidence and 80% power.

Participants completed a structured questionnaire providing information on personal and sociodemographic details, comorbidities, smoking habits, alcohol consumption, physical activity levels, perceived stress level, and family history of HTN. The participants' weight and height were also recorded to calculate their BMI, and we measured their systemic blood pressure twice.

Participants selection criteria

Inclusion criteria: Enrolled students who attended an ordinary day of classes and agreed to participate in the study. **The exclusion criteria** were consuming alcohol on the day of the survey or the previous day; smoking, drinking coffee or exercising 30 minutes prior to having their blood pressure measured; reporting pregnancy; or taking medication that alters blood pressure. **Elimination criteria:** Students who did not have both blood pressure measurements taken. They were also eliminated if they did not answer the relevant questions for establishing associations.

Measurement procedure

The instruments used for measurement were: A 46-question questionnaire; digital sphygmomanometers for measuring systemic blood pressure; scales for measuring body weight and portable stadiometers for measuring height.

We explained the study objectives to the students, who were also given instructions on how to complete the questionnaire. We trained in advance the staff assigned to data collection. The questionnaire collected information on the following variables: age; sex; school year; marital status; ethnic group; employment; socioeconomic status; comorbidities; family history of HTN; alcohol or tobacco use; physical activity; stress; and BMI, estimated from weight and height. We used the AMAI 2022 questionnaire to measure socioeconomic status. We assessed physical activity using the short form of the International Physical Activity Questionnaire (IPAQ7), classifying individuals as having low physical activity if they scored ≤ 600 metabolic equivalent task minutes per week (METs-min/week).

We assessed tobacco and alcohol consumption using self-reporting. We assessed perceived stress using the 14-item Perceived Stress Scale (PSS-14) questionnaire, classifying individuals as experiencing no perceived stress if they scored ≤ 28 .

Once the students completed the questionnaire, the staff measured their systolic and diastolic blood pressures using an Omron HEM-7120® digital cuff sphygmomanometer. To avoid measurement bias, each student sat quietly for at least fifteen minutes with their feet on the floor and their left arm at heart level. We estimated the average of the systemic blood pressure using two systolic and diastolic blood pressure measurements taken five minutes apart.

We measured the students' weight, without shoes, heavy clothing, or accessories using a digital SECA® scale. We measured students' height using a SECA® portable stadiometer. We calculated BMI by dividing weight in kilograms by height in metres squared, following WHO classification.

Conceptual and operational definition of borderline hypertension

Conceptual definition. Borderline hypertension is a multifactorial condition characterized by an increase in systemic blood pressure¹².

Operational definition. Participants with borderline hypertension were those with an average of two blood pressure measurements equal to or greater than the following values: systolic blood pressure of 120–139 mmHg; and diastolic blood pressure of 70–89 mmHg¹¹.

Ethical considerations

The Ethics Committee of the Centre for Tropical Disease Research (CIET), reviewed and approved the study protocol, on 28 February 2023 (ruling number 2023-002). Participation was voluntary and all participants provided informed consent. All data collected were confidential and anonymous. We referred for medical consultation and care to those detected students with borderline hypertension or suspected HTN. The research posed minimal risk to the students. We shared the main findings with the participants and the academic authorities at the Faculty of Medicine.

Data analysis

We entered the data twice, to reduce typing errors, using the Epi Data 3.1 programme. Statistical analysis relied on the CIETmap 2.1 SE programme. We calculated simple frequencies of the study variables. Bivariate and multivariate analyses, as well as confounders control, relied on the Mantel-Haenszel procedure, using a significance level of 0.05. Odds ratios and 95% confidence intervals, as proposed by Miettinen, measured the strength of association.

We contacted 197 students to take part in the study. Seven students declined to participate, resulting in 190 useful observations. The interruption of school activities due to Hurricane Otis on 24 October 2023 prevented to contact additional students.

Sociodemographic data

The study revealed that 60% of the participants were female and 40% were male. The students were between 17 and 28 years old, with a mean age of 19.8. Of the students, 88 (46%) were in their first year, 77 (41%) in their second year, and 25 (13%) in their third year. Table 1 shows other sociodemographic characteristics of the students.

Table 1. Sociodemographic characteristics of students

Characteristic	Categories	n=190	%
Ethnic group	Mestizo	174	91
	Ñuu Savi	6	3
	Me'phaa	5	3
	Ñomndaa	2	1
	Náhua	2	1
	Other	1	1
Socioeconomic status	High	73	38
	Middle high	52	27
	Typical middle	30	16
	Emerging middle	22	12
	Extreme low	6	3
	Typical low	7	4
The student works	Yes	32	17
	No	158	83
Student's marital status	Single	185	97
	Married	5	3
Maternal history of systemic hypertension	Yes	22	12
	No	155	81
	Do not know	13	7
Paternal history of systemic hypertension	Yes	30	16
	No	138	73
	Do not know	22	11

Consumption of tobacco and alcohol

Thirty-six percent (71/190) of students reported tobacco use at some point in their lives, of whom 49 percent (35/71) already quit. Among those current smokers, 86 percent (31/36) use it occasionally and 14 percent (5/36) use it frequently. Seventy-three percent (138/190) of students consumed alcohol at some point in their lives, twelve percent (17/138) already stopped. Of those who currently consume alcohol, 93% (113/121) do so occasionally, while 7% (8/121) do so frequently.

Perception of stress

Fifty-seven percent (108/190) of students reported experiencing occasional stress, 32% (60/190) reported experiencing moderate stress, 10% (19/190) reported not experiencing stress, and only 1% (3/190) reported experiencing high stress.

Self-reported chronic degenerative diseases

Seventy-eight percent (148/190) of students reported normal blood cholesterol levels; 3% (5/190) reported high blood cholesterol levels; and 19% (37/190) did not know. 92% (175/190) of young people reported not having kidney disease; only one student reported having this condition, and 7% (14/190) did not know. 94% (179/190) of students said they did not have diabetes mellitus; only one student reported having this condition, and 5% (10/187) did not know. In terms of body weight, 58% (110 out of 190) of participants were of normal weight, 38% (74 out of 190) were overweight or obese, and 4% (6 out of 190) were underweight.

Factors associated with borderline hypertension

Thirty percent (57/190) of students met the operational definition of borderline hypertension. A higher proportion of males (55%, 42/76) had borderline hypertension than females (13%, 15/114), and this difference was significant ($p < 0.01$). Thirty percent (53/174) of mestizo students had borderline hypertension, compared to 25% (4/16) of indigenous students, a difference that was not significant ($p = 0.86$). Of first-year students, 29.5% (26/88) had borderline hypertension, compared to 29.9% (23/77) of second-year students and 32% (8/25) of third-year students. These differences were not significant ($p = 0.92$).

The bivariate analysis identified four potential risk factors for borderline hypertension: tobacco use, a BMI >25, male sex and self-reported high blood cholesterol (see Table 2). The final multivariate analysis model (Table 3) revealed that male sex and BMI >25 remained significantly associated to borderline hypertension. The variable with the greatest effect size was male sex (ORA 7.28, 95%CI 3.59 - 14.77).

Table 2. Bivariate analysis of factors associated with borderline hypertension

Factor		Borderline hypertension		ORun ¹	95%CI ²
		n	%		
Sex	Male	42/76	55	8.15	4 – 19.78
	Female	15/114	13		
Age	17 to 19 years	26/88	30	0.96	0.48-1.88
	20 to 28 years	31/102	30		
Marital status	Married	2/5	40	1.58	0.24–30.30
	Single	55/185	30		
Socioeconomic level	Low level	7/13	54	3.69	0.87–18.68
	High level	25/104	24		
Reporting high blood cholesterol levels	Yes	4/5	80	10.10	1.29–13.78
	No	42/148	28		
Maternal history of HNT	Yes	6/22	27	0.86	0.16 – 2.34
	No	47/155	30		
Paternal history of HNT	Yes	13/30	43	2.17	0.97– 5.38
	No	36/138	26		
Has ever smoked in their life	Yes	30/71	42	2.49	1.26-5.10
	No	27/119	23		
Has ever drunk alcohol in their life	Yes	40/138	29	0.84	0.42 – 1.89
	No	17/52	32		
Level of physical activity	Low physical activity	8/29	28	0.87	0.24-2.11
	High physical activity	49/161	30		
Body Mass Index	BMI >25	38/74	51	5.06	2.52– 11.35
	BMI <25	19/110	17		

¹ = Odds ratio unadjusted
² = 95% confidence interval

Table 3. Multivariate analysis of factors associated with borderline hypertension

Factor	ORun ¹	ORa ²	95%CI ³	X ² het ⁴	p ⁵
Body Mass Index >25	5.06	4.23	2.06 – 8.70	15.43	0.92
Male sex	8.31	7.28	3.59 – 14.77	30.21g	0.92

¹ = Odds ratio unadjusted, ² = Odds ratio adjusted, ³ = 95% confidence interval, ⁴ = Heterogeneity X², ⁵ = p value of heterogeneity X²

Discussion

The study found that three out of ten students had borderline hypertension and identified two associated factors: male sex and a BMI greater than 25. The study aimed to estimate the occurrence of borderline hypertension and its associated factors in medical students.

The occurrence of borderline hypertension in our study was 30%, which is a similar figure to that reported in other studies of university students (24%)¹⁴. However, research in Latin American countries reported higher figures: 32% and 37%,. In contrast, a study in countries of the Association of Southeast Asian Nations found low figures of 11% to 19%. Authors attributed these differences to income levels, dietary habits, and body weight in these countries.

A study in which participants had their blood pressure measured once found that 33% of them had persistently high blood pressure. We took blood pressure measurements twice from the students. The incidence of high

blood pressure increases with age, so it is alarming to observe relatively high readings in young medical students. Implementing a primary healthcare approach from an early age is crucial in preventing the progression to HTN.

Increased blood pressure is common among adults aged 20 and over, especially among those who are overweight or obese¹⁹. In developing countries, borderline hypertension is more common and progressing to HTN than is generally thought. This may be due to insufficient monitoring of the condition in the population. Early detection of HTN is essential for timely medical management. Therefore, young patients should have their blood pressure checked during routine physical examinations.

Our study revealed a significant difference in the occurrence of borderline hypertension between men and women. Overall, high blood pressure is more common in men than in women. The condition is especially prevalent among overweight or obese men. Hormonal differentiation and sexual dimorphism during adolescence may be the reason for this higher occurrence in men. The oestrogen's protective effect on the cardiovascular system is a plausible explanation of normal blood pressure levels in women. Inadequate knowledge or habits regarding the preparation of healthy food may contribute to elevated blood pressure among men.

Our study found an association between a BMI >25 and borderline hypertension. This finding is consistent with studies conducted on students of similar age groups. An increased BMI and abdominal circumference, caused by excessive body fat, predict elevated blood pressure and the development of hypertension¹⁵. The rise in blood pressure associated with a high BMI is a risk factor for cardiovascular disease¹⁴. The relationship between comorbidities and the development of cardiovascular complications underscore highlights the need to promote prevention strategies. Engaging in physical activity and adopting healthy eating habits are both essential to prevent increases in blood pressure.

Limitations

This was a cross-sectional study, which may involve a potential temporal bias. However, we consider that the associated factors identified precede the diagnosis of high blood pressure. The gender variable undoubtedly precedes the effect. Therefore, there is no temporal bias. Many studies conclude that being overweight or obese causes HTN. Hurricane Otis, category five, halted the research. We only interviewed 190 students, and the sample size is therefore limited. Nevertheless, the findings identified two factors associated with borderline hypertension in medical students. It is concerning that one in three future doctors has borderline hypertension. However, the results of our study only apply to public medical schools. This finding raises the question of what the prevalence of systemic hypertension will be among med-

ical professionals. In theory, doctors experience greater stress due to the demands of their profession. They are also older than medical students and some engage in less physical activity due to time constraints.

Ultimately, 30% of medical students had borderline hypertension, with the associated factors being male and a BMI >25. Providing comprehensive care for young people with borderline hypertension is essential for preventing progression to systemic hypertension.

References

- 1 World Health Organization. Hypertension [Internet]. 2025. Available from: <https://www.who.int/es/news-room/fact-sheets/detail/hipertension>
- 2 World Health Organization. Global report on hypertension. [Internet]. 2023. Available from: <https://www.who.int/publications/i/item/9789240081062>
- 3 Instituto Nacional de Estadística y Geografía. Características de las defunciones registradas en México durante enero a agosto de 2020 [Internet]. 2021. Available from: https://www.inegi.org.mx/contenidos/saladeprensa/boletines/2021/EstSociodem/DefuncionesRegistadas2020_Pnles.pdf
- 4 Campos-Nonato I, Hernández-Barrera L, Oviedo-Solís C, Ramírez-Vilalobos D, Hernández B, Barquera S. Epidemiología de la hipertensión arterial en adultos mexicanos: diagnóstico, control y tendencias. *Ensanut 2020*. *Salud Públ Méx* 2021;63(6): 692-704.
- 5 Vallejos-Mavila JC, Espinoza-Rojas R, De la Cruz-Vargas JA. Hipertensión arterial no diagnosticada en un país de Latinoamérica, 2019 a 2021. *Arch Cardiol Mex* 2025;95(1):9-17.
- 6 Instituto Nacional de Salud Pública, Epidemiología de la hipertensión arterial en adultos mexicanos: diagnóstico, control y tendencias. *Ensanut 2020*; Available from: https://ensanut.insp.mx/encuestas/ensanutcontinua2023/documentos_analiticos.php
- 7 Velázquez-Monroy O, Rosas-Peralta M, Lara-Esqueda A, Pastelín-Hernández G, Attie F, Tapia-Conyer R. Hypertension in Mexico: The Health National Survey (ENSA) 2000. *Arch Cardiol Méx* 2002;72(1):71-84.
- 8 Encuesta Nacional de Salud y Nutrición 2020 sobre Covid-19. Resultados nacionales. Instituto Nacional de Salud Pública [Internet]. 2021. Available from: ensanutCovid19ResultadosNacionales.pdf
- 9 Encuesta Nacional de Salud y Nutrición 2018. Resultados de Guerrero. Instituto Nacional de Salud Pública [Internet]. 2020. Available from: [230308_Guerrero_18_jul22.pdf](https://ensanut2018Guerrero_18_jul22.pdf)
- 10 McEvoy JW, McCarthy CP, Bruno RM, Brouwers S, Canavan MD, Cecconi C, et al. ESC Guidelines for the management of elevated blood pressure and hypertension: Developed by the task force on the management of elevated blood pressure and hypertension of the European Society of Cardiology (ESC) and endorsed by the European Society of Endocrinology (ESE) and the European Stroke Organization (ESO). *European heart journal*. 2024;45(38):3912-4018.
- 11 Williams B, Mancia G, Spiering W, Agabiti Rosei E, Azizi M, Burnier M. Guía ESC/ESH 2018 sobre el diagnóstico y tratamiento de la hipertensión arterial. *Rev Esp Cardiol* 2019;72(2):160.e1-160.e78.
- 12 Shah H., Patani, K. Prevalence of Prehypertension and Its Correlation with Body Mass Index in Undergraduate Students of Physiotherapy. *International Journal Of Health Sciences And Research*. 2022;12(7):62-69
- 13 Lojano-Altamirano D, Álvarez-Ochoa R, Garcés-Ortega JP, Cordero-Cordero G. Índice de masa corporal e Hipertensión Arterial en Adultos. *Revista Multidisciplinaria Investigación Contemporánea* 2024;2(1):102-131.

- 14 Bojórquez-Díaz CI, Castro-Robles AI, Mejía-León ME, Díaz-López KJ, Quintana-López VA. Asociación del índice de masa corporal y relación cintura/estatura con la presión arterial como factor de riesgo metabólico en estudiantes universitarios. *Archivos Latinoamericanos de Nutrición* 2021;71(3):178-188.
- 15 Insignares I, Roca R, Garcés-Barraza JD. Beneficios del ejercicio en las enfermedades cardiometabólicas. *Revista Ciencias Biomédicas* 2024;13(1):20-36.
- 16 Barrios-Gómez F, Miguel-Jarquín DI, Ortiz-Martínez J, Pérez-Santiago K., Sumano-Guzmán L, Ruiz-Dávila E. Prescripción de ejercicio físico por enfermería en pacientes con Hipertensión Arterial y Diabetes. *Revista Espacio Universitario*. 2021;3(5): 43.
- 17 Carbo-Coronel GM, Berrones-Vivar LF. Riesgos modificables relacionados a la hipertensión arterial. *Más Vida* 2022;4(2):196-214.
- 18 Xu T, Liu J, Zhu G, Liu J, Han S. Prevalence of prehypertension and associated risk factors among Chinese adults from a large-scale multi-ethnic population survey. *BMC Public Health* 2016;16:1-8.
- 19 Kini S, Kamath VG, Kulkarni MM, Kamath A, Shivalli S. Pre-hypertension among young adults (20–30 Years) in coastal villages of Udupi District in Southern India: an alarming scenario. *PLoS ONE* 2016;11(4):e0154538.
- 20 Acosta C, Sposito P, Torres Esteche V, Sacchi F, Pomies L, Pereda M, et al. Variabilidad de la presión arterial, hipertensión arterial nocturna y su asociación con tabaquismo. *Rev Urug Med Interna* 2021;6(1):54-65.
- 21 Kim SH, Lee JS. The association of smoking and hypertension according to cotinine-verified smoking status in 25,150 Korean adults. *Clin Exp Hypertens* 2019;41(5):401-408.
- 22 Fernandez de Bobadilla J, Sanz de Burgoa V, Morales G, Lopez de Sa E. Cardiovascular risk in Spanish smokers compared to non-smokers: RETRATOS study. *Aten Primaria* 2011;43(11):595-603.
- 23 Bandy A, Qarmush MM, Alrwily AR, Albadi AA, Alshammari AT, Aldawasri MM. Hypertension and its risk factors among male adolescents in intermediate and secondary schools in Sakaka City, Aljouf Region of Saudi Arabia. *Niger J Clin Pract* 2019;22(8):1140-1146.
- 24 Lee J, Wilkens J, Meijer E, Sekher TV, Bloom DE, Hu P. Hypertension awareness, treatment, and control and their association with healthcare access in the middle-aged and older Indian population: A nationwide cohort study. *PLoS Med* 2022;19(1): e1003855.
- 25 Álvarez-Ochoa R, Torres-Criollo LM., Garcés-Ortega JP, Izquierdo-Coronel DC, Cayamcela-Bermejo DM, Lliguisupa-Pelaez VR et al. Factores de riesgo de hipertensión arterial en adultos. Una revisión crítica. *Revista Latinoamericana de Hipertensión* 2022;17(2):129-137.
- 26 Zelocatecatl-Garza X, Domínguez-San-Martín E, Díaz-Tapia A, Rodríguez-Rodríguez M, Águila-Perez MI. Tamizaje y Seguimiento de Hipertensión Arterial en Unidad de Medicina Familiar. *Innovación y Desarrollo Tecnológico Revista Digital*. 2025;17(1):132-140.
- 27 Amai.org. ¿Qué es NSE? [Internet]. 2022. Available from: <https://www.amai.org/NSE/>
- 28 International Physical Activity Questionnaire. International Physical Activity Questionnaire – Turkish Manual [Internet]. 2019.
- 29 Reyna C, Mola DJ, Correa PS. Escala de Estrés Percibido: análisis psicométrico desde la TCT y la TRI. *Ansiedad y Estrés* 2019;25(2):138-147.
- 30 World Health Organization. Obesity and overweight [Internet].2024. Available from: <https://www.who.int/es/news-room/fact-sheets/detail/obesity-and-overweight>
- 31 Mantel N, Haenszel W. Statistical aspects of the analysis of data from retrospective studies of disease. *J Natl Cancer Inst* 1959;22:719-748.
- 32 Miettinen OS. The “case-control” study: valid selection of subjects. *J Chronic Dis* 1985 Jan 1;38(7):543-548.
- 33 Morales G, Guillen-Grima F, Muñoz S, Belmar C, Schifferli I, Muñoz A, et al. Factores de riesgo cardiovascular en universitarios de primer y tercer año. *Rev Med Chil* 2017;145(3):299-308.
- 34 VTorres-Molina A. Asociación entre factores de riesgo modificables e hipertensión arterial en adolescentes de Moa. *Revista Finlay*. 2024;14(1):55-62.
- 35 Bakheet TM, Khalaf A, Ali MM. Hypertension and prehypertension among undergraduate students in Sohag University. *The Egyptian Journal of Community Medicine*, 2025;43(1):1-11.
- 36 Vo HK, Nguyen DV, Vu TT, Tran HB, Nguyen HTT. Prevalence and risk factors of prehypertension/hypertension among freshman students from the Vietnam National University: a cross-sectional study. *BMC Public Health* 2023;23(1):1166.
- 37 Hidalgo JXG, Proaño DRE. Rol de la auto medida de la presión arterial (AMPA) y monitorización ambulatoria de presión arterial (MAPA) en el control terapéutico de pacientes con diagnóstico de hipertensión arterial. *Revista Latinoamericana de Hipertensión*, 2022;17(3):268-273.
- 38 Adetunji A, Uche-Orji C, Ezebialu C, Adebayo PC, Sanusi F, Imo U, Ajala T. The prevalence and risk factors of pre-hypertension and hypertension among clinical students at the university of Ibadan, Nigeria. *BMC Cardiovascular Disorders* 2025;25(1):393.
- 39 Manni D, Yorio M, Lagrutta N, Marchesán M, Saurín S, Martinelli M. Estilo de vida y factores de riesgo cardiovascular en estudiantes universitarios. *Acta Nutr* 2022:138-145.
- 40 Abd Alsamad YA., Jaffal BMS., Shuhait KRI., Alzaabi RKKK., Lataifeh SMM., Sadia, TT., Elmoselhi AB. High prevalence of elevated blood pressure (prehypertension) and hypertension among undergraduate university students in the UAE: a serious health concern. *J Hum Hypertens* 2025;39:442-447.
- 41 Shishkov S, Boyadzhieva M. Testosterone and cardiovascular disease - a literature review. *Scr Sci Medica* 2022;54(1):9-18.
- 42 Jackson LV, Thalange NK, Cole TJ. Blood pressure centiles for Great Britain. *Arch Dis Child* 2007;92(4):298-303.
- 43 Hurtado-Martínez L, Saldarriaga-Giraldo CI, Jaramillo-Jaramillo LI, Hormaza-Ángel MP. Riesgo cardiovascular durante la menopausia: una visión del cardiólogo y del ginecólogo. *Revista Colombiana de Cardiología* 2022;29(1):7-15.
- 44 Bernardo GL, Rodrigues-Mello V, Bastos BS, Lazzarin-Uggioni P, Barbieri-Hauschild D, Fernandes AC, et al. Association of personal characteristics and cooking skills with vegetable consumption frequency among university students. *Appetite* 2021;166-199.
- 45 Qaddumi J, Holm M, Alkhalwaleh A, Albashtawy M, Omari OA, Batiha AM, et al. Prevalence of hypertension and pre-hypertension among secondary school students. *Int J Adv Nurs Stud* 2016;5(2):240-245.
- 46 Manoppo JE, Abdullah AZ, Kesumasari C, Thaha RM, Nugrahaeni SA, Rahman SA, et al. The Relationship between Obesity and the Incidence of Hypertension in Young Adults (18-40 Years) in Tomohon City in 2019. *Indian J Forensic Med Toxicol* 2020;14(4):4325-4330.
- 47 Wilches-Serrano PA, Albarracín-Revelo CE, Pulgar-Silva RI, Iza-German KO, Córdova-Robles JC, Morillo-Castellano ND et al. Fisiopatología de la hipertensión arterial: ¿Qué hay de nuevo? *Revista Latinoamericana de Hipertensión* 2022;17(3):226-229.
- 48 Torres-Pérez RF, Quinteros-León MS, Pérez-Rodríguez MR, Molina-Toca EP, Ávila-Orellana FM, Molina-Toca SC, et al. Factores de riesgo de la hipertensión arterial esencial y el riesgo cardiovascular. *Revista Latinoamericana de Hipertensión* 2021;16(4):321-32.