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Risk factors associated with arterial hypertension in university students in southern Sonora

Factores de riesgo asociados con hipertensión arterial en estudiantes universitarios del sur de Sonora

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Abstract

The aim of this study was to identify the risk factors associated with hypertension (HT) using a logistic regression model in university students from southern Sonora. A total of 296 students took part (60.1 % female sex, 18.7 ± 0.8 years, 69.5 ± 12.5 kg) who had their blood pressure evaluated for preclinical (≥120-140/<90) and clinical (≥140/≥90) range classification and were administered the risk factor questionnaire participated. The association between explanatory factors and HT was performed by stepwise binary logistic regression. The model developed indicated that the probability of preclinical and clinical HT was 4.65 times in overweight and obese students, 7.94 times those who reported one to two histories of chronic noncommunicable diseases (NCD), 8.29 times those who indicated three to four family histories of NCD, 2.66 times those who indicated intermittent sleep, and as a protective factor a lower probability of 2.89 times those who drink coffee regularly at breakfast. It is concluded that overweight and obesity in combination with family history, poor sleep quality, and non-consumption of coffee are risk factors for HT in university students.

Hypertension, risk factors, Regression

Resumen

El objetivo del presente estudio fue identificar los factores de riesgo asociados a la hipertensión arterial (HTA) mediante un modelo de regresión logística en estudiantes universitarios del sur de Sonora. Participaron 296 estudiantes (60.1 % sexo femenino, 18.7 ± 0.8 años, 69.5 ± 12.5 kg) a quienes se les evaluó la presión arterial para la clasificación de rangos preclínicos (≥120–140/<90) y clínicos (≥140/≥90) y se les aplicó el cuestionario de factores de riesgo. La asociación entre los factores explicativos e HTA se llevó a cabo mediante regresión logística binaria por pasos. El modelo desarrollado indicó que la probabilidad de HTA preclínica y clínica fue de 4.65 en estudiantes con sobrepeso y obesidad, 7.94 veces los que reportaron uno a dos antecedentes de enfermedades crónicas no transmisibles (ECNT), 8.29 veces quienes señalaron tres a cuatro antecedentes familiares de ECNT, 2.66 veces quienes indicaron un sueño intermitente y como factor protector una probabilidad menor de 2.89 veces quienes desayunan café habitualmente. Se concluye que el sobrepeso y obesidad en combinación con antecedentes familiares, mala calidad de sueño y el no consumo de café son factores de riesgo para HTA en estudiantes universitarios.

Hipertensión arterial, factores de riesgo, regresión

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Introduction

This study addresses the problem of arterial hypertension (AHT) and its relationship with various risk factors such as overweight and obesity. In this sense, according to the World Health Organization (WHO) in its report on health statistics for the year 2023, cardiovascular diseases (CD) are positioned as the leading cause of death worldwide registering in 2019 a total of 17.9 million deaths attributable to this problem (WHO, 2023). In Mexico, according to the National Institute of Statistics and Geography (INEGI), from January to June 2022, CD was the leading cause of death in both men and women (INEGI, 2023). Accordingly, it is important to note that, as the age group increases, deaths due to CD also increase, since in the 15 to 24 age group they ranked fifth, moving to third place in the 25 to 34 age group and to second place in the 35 to 44 age group (INEGI, 2023).

As a result, the main risk factors attributable to this condition are alcohol consumption and tobacco use, hypertension, obesity, diabetes, among others (Tsao et al., 2022). Globally, obesity has become one of the greatest public health challenges worldwide, increasing dramatically in almost all countries during the last decades (Strüven, Holzapfel, Stremmel, & Brunner, 2021). In Mexico, according to the 2018 National Health and Nutrition Survey (ENSANUT), both overweight and obesity show a rising trend since in the 12 to 19 years age group there was a 3.5% increase in the prevalence of overweight and obesity compared to 2012 and in the population aged 20 years and older these same indicators represented an increase of 3.9% (Martínez et al., 2021).

In the state of Sonora, Mexico, according to the state survey on prevalence of overweight and obesity conducted by the National Institute of Public Health (INSP) that was carried out in 2012 the results indicated a prevalence of overweight and obesity in adults of 73.7% within which were classified with overweight in this age group a total of 37.6% and a prevalence of obesity of 36.1% (INSP, 2013). This same survey revealed that, as for the group of children and adolescents, the prevalence of overweight and obesity was 14.1% and 35.2% respectively.

Regarding adult central obesity, Sonora ranked fifth nationally in 2013 with a prevalence of 78.3% (Barquera et al., 2013). In this same vein, with respect to obesity in children and young people aged 5 to 19 years in 2020, the State Development Plan of the State of Sonora 2021-2027 reported a prevalence of 46.30% of overweight and obesity with the goal of reducing it to 43.30% in 2027 (Gobierno del Estado de Sonora, 2021).

As a result of the above, a critical period in life for establishing good habits and reducing the risk factors for CHD occurs during adolescence and youth, so it is necessary to have timely diagnoses to detect cardiovascular risk factors that allow young people to make better decisions in their lives. Based on this and the results of previous studies carried out with university students in the southern region of Sonora, where the presence of high rates of obesity, diabetes, history and poor lifestyle habits is observed, an analysis of which factors are more likely to be related to HT in this group is proposed.

The added value of this study lies in the explanation of the phenomenon by means of multivariate statistical models and techniques to identify which factors are most relevant and thus be able to intervene to improve them.

Objective

To identify the risk factors associated with arterial hypertension (AHT) by means of a logistic regression model in university students from southern Sonora.

The specific objectives were: (1) to identify the prevalence of hypertension in preclinical and clinical ranges by taking blood pressure; (2) to determine the level of overweight and obesity using the Body Mass Index (BMI); (3) to identify the risk factors associated with family history and lifestyles using the risk factor questionnaire.

Method

Design. The study design was observational cross-sectional, retrospective with measurements in one semester at the undergraduate level.

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Participants. A convenience sample of 296 university students (60.1% female, 18.7 ± 0.8 years, 69.5 ± 12.5 kg) was used for the present study. These students belonged to the first semester of university and decided to participate voluntarily without any inclusion or exclusion criteria.

Instruments

Risk factor questionnaire (RF). The instrument is made up of 135 items. It consists of dichotomous questions that inquire about hereditary and family history of diabetes, cancer, obesity and CD. It also collects information about eating habits, physical activity, sleep habits, alcohol consumption and health. Cronbach's alpha was 0.78 in an application with 181 subjects (Pancich et al., 2011).

For the measurement of blood pressure, an Omron wrist monitor model hem6127 was used. Body weight was also assessed with a Tanita scale model Um-081 and height with a Seca portable stadiometer model 213.

Procedure

During the application of physical tests to new students, the objective of the study and the details of the assessments were explained to them to make it clear that participation was voluntary and confidential. Subsequently, the students who agreed to participate were given the informed consent letter to fill out. Subsequently, blood pressure, weight and height measurements were taken by qualified nursing personnel. At the end of these measurements, the physical form risk factor questionnaire was administered, which they completed in pencil. This research adhered to the ethical principles of the Declaration of Helsinki and by the Institutional Research Ethics Committee of the Instituto Tecnológico de Sonora, opinion No. 215.

Data analysis

In this study, a multivariate binary logistic regression model was used to estimate the effect of the independent variables on the dichotomous results of normal and elevated arterial hypertension in university students.

The dependent variable in this study was blood pressure (BP) level, which was transformed into a variable of a binary nature with two levels of outcomes: a first group of students with normal BP (<120/90) and a second group with students with preclinical (≥120-140/<90) and/or clinical (≥140/≥90) elevated BP, and the descriptive values are shown in Table 1. Groups were also categorized into normal weight according to BMI (<25) and overweight or obese (≥25).

	Normal BP (n =243)	Elevated BP (n = 53, 17.9%)	P-value*
Age (years)	18.0 (18.0 – 20.0)	19 (18.0 – 19.0)	0.938
Weight (kg)	67.3 (58.0 – 75.5)	79.0 (69.5 – 87.0)	<0.001
Size (cm)	166.0 (161.0 – 172.3)	172.0 (163.0 – 177.0)	<0.01
BMI (kg/m^2)	23.9 (21.4 – 26.8)	26.7 (24.4 – 28.9)	<0.001
PS (mmHg)	110.0 (100.0 – 120.0)	130.0 (120.0 – 130.0)	<0.001
PD (mmHg)	70.0 (60.0 – 80.0)	90.0 (80.0 – 90.0)	<0.001
BP = blood pressure, SBP = systolic blood pressure, DBP = diastolic blood pressure, BMI = body mass index. * P value when comparing medians with Mann-Whitney U test.			

Table 1 Descriptive statistics of quantitative variables in participants with normal blood pressure and elevated blood pressure
Source: own elaboration

Therefore, a binary logistic regression analysis was performed to model the association between blood pressure level and potential factors by estimating probabilities using a logistic function. In the first phase, univariate analysis was performed to estimate the crude prevalence odds ratio (OR) with their 95% confidence intervals and then each variable identified as a possible factor associated with elevated hypertension was studied, selecting for multiple analysis those variables with a significance level of less than 0.25 ($p<0.25$). In this case, a Pearson's Chi-square test was performed to examine the relationship between the level of arterial hypertension and each of the factors presented in Table 2.

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	Normal BP (%)	Elevated BP (%)	IC 95%	p-value*
Overweight and obesity (No, yes)	56.8	24.5	1.00	
	43.2	75.5	4.04 (2.05 – 7.94)	<0.0001
Family history: hypertension, obesity, diabetes, cancer (No history, One to two history, Three to four history)	33.7	7.5	1.00	
	49.8	67.9	1.33 (1.18 – 1.50)	<0.001
	16.5	24.5	1.36 (1.14 – 1.62)	<0.01
Do you practice physical activity (No, Yes)	14.4	17.0	1.00	
	85.6	83.0	1.21 (0.54 - 2.71)	0.633
Do you usually have coffee for breakfast (No, Yes)	65.4	81.1	1.00	
	34.6	18.9	2.27 (1.08 – 4.73)	0.026
Sleep (Continuous, intermittent)	87.0	80.4	1.00	
	13.0	19.6	1.63 (0.74 – 3.59)	0.217
Alcoholic beverages (No, Yes)	45.3	50.9	1.00	
	54.7	49.1	1.25 (0.69 – 2.27)	0.453
Smoke (No, Yes)	86.0	90.6	1.00	
	14.0	9.4	1.56 (0.58 -4.20)	0.374
BP = blood pressure, OR = Odds Ratio, CI = confidence intervals. * P value when comparing proportions by Pearson's Chi-square test.				

Table 2 Univariate test results of possible categorical independent variables for the identification of elevated blood pressure
Source: Own elaboration

The behavior of the data was identified using the Kolmogorov-Smirnov normality test. The Mann-Whitney U test was used to identify the differences in the quantitative variables between the normal and elevated blood pressure groups. The model was constructed using the forward stepwise method, where at each step those variables whose B coefficient was not significantly different from zero were eliminated, using the Wald test as a selection criterion. The model verification was assessed using the Hosmer and Lemeshow goodness-of-fit test in which if p>0.05 the model is adequate, meaning that there are no significant differences between the observed results and those predicted by the model (Rueda et al., 2018). Adjusted odds ratios (OR) with their 95% Confidence Intervals (95% CI) were identified. All analyses were performed with the statistical program for social sciences SPSS version 24 for Windows and the JASP program version 0.17.2.1 and a significance level of 0.05 was established.

Results

The prevalence of ETS in preclinical and clinical ranges was 17.9% of the total number of students, of which 16.9% were women and 19.5% men.

There were significant differences between the normal and elevated BP groups in the weight, height and BMI variables (p<0.01), and only in the age variable there were no significant differences (Table 1). Forty-nine percent of the students were classified as overweight or obese.

The variables that were selected to enter in the ETS risk model were those that resulted with a p value < 0.25 (Table 2). 75.5 % of the overweight or obese students were classified as having elevated BP (p<0.0001). 67.9 % of students with one to two family history with hypertension, obesity, diabetes or cancer were classified in the group with elevated BP (p<0.001), while 24.5 % with family history with three to four of these conditions were classified in the same group (p<0.01). 81.1 % of students who do not usually consume coffee at breakfast were classified with elevated BP (p<0.05).

The four variables that remained in the model were overweight and obesity, family history, usually have coffee for breakfast and sleep is intermittent (Table 3). The Hosmer and Lemeshow goodness-of-fit test indicated that there were no significant differences $\chi 2 = 3.209$ and $p_{value} = 0.921$.

Factor	Coef (B)	Odds Ratio (OR)	CI 95% for OR Bottom	Top	p-value *
Constant	-4.05	0.01			<0.001
Overweight and obesity (ref: no)	1.21	4.65	2.25	9.62	<0.001
Background (ref: none)					<0.01
With one or two antecedents	2.07	7.94	2.58	24.47	<0.001
With three or four antecedents	2.11	8.29	2.27	30.25	<0.001
Usually have coffee for breakfast (ref: no)	-1.06	2.89	1.28	6.53	<0.01
Sleep is intermittent (ref: no)	0.98	2.66	1.06	6.70	<0.05
Model summary: n=296, $\chi 2 = 46.469$, gl = 2, p-value < 0.001, Log likelihood -2 = 223.266, Nagelkerke's R2 = 0.245, Correctly classified = 82.4%. Hosmer and Lemeshow test: $\chi 2 = 3.209$, gl = 8, p value = 0.921. CI = confidence interval, ref = reference. * p-value when comparing the normal distribution of the factor with the Wald test.					

Table 3 Results of the binary stepwise logistic regression model developed (Probability of high blood pressure). Source: own elaboration.

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In summary, the model, is significant ($\chi 2$ = 46.469, gl = 2, p-value < 0.001 with a Nagelkerke's R^2 = 0.245 which presents an overall accuracy percentage of 82.4 %, i.e. there is 17.6 % error, therefore, the model is acceptable. However, the sensitivity was low at 17.6 % (the model identified 9 of 51 participants at risk of HT) with a high specificity of 95.8 % (the model identified 229 of 239 with normal BP) (Table 3).

The developed model indicated that students with overweight or obesity (BMI ≥25) (OR 4.65, 95% CI 2.58-24.47, p<0.001), with one to two family history with chronic non-communicable diseases (NCDs) (OR 7.94, 95% CI 2.25-9.62, p<0.001), with three to four family history with NCDs (OR 8. 29, 95% CI 2.27-30.25, p<0.001), who do not regularly drink coffee at breakfast (OR 2.89, 95% CI 1.28-6.53, p<0.01) and who present with intermittent sleep (OR 2.66, 95% CI 1.06-6.70, p<0.05) were more likely to present with ETS in preclinical and clinical ranges (Table 3).

Discussion

According to the results shown, 17.9% of the university students presented signs of HT in preclinical and clinical ranges, these data are slightly higher than those presented by Landazábal et al. (2019) where a combined prevalence of 13.8% was found in university students in Barranquilla, Colombia. Regarding the prevalence of overweight and obesity, also in this study a higher percentage of 49% was found in relation to the 36.38% reported by Gómez-Landeros et al. (2019) in a sample of 1168 university students from Mexico City. These higher values in the prevalence of the NCDs analyzed in the present study coincide with the high values of the state of Sonora reported in the National Health Survey 2018-19, where that state of the Mexican republic was positioned within the first five entities with higher percentages at the national level in hypertension (24.6% of the population aged 20 years and older) and with obesity (22.2% of the population aged 12 to 19 years) (Shamah-Levy et al., 2020).

Derived from these results, the causes can be attributed to a diet characterized by a high consumption of saturated fats and sugary drinks, as well as a low consumption of fruits and vegetables as pointed out in the study by Castillo et al. (2020) in a sample of first and fourth year university students from Navojoa. The relationship between obesity and HTN can be explained because the former is a complex clinical pathophysiology that due to its long-term action triggers a thickening in the endothelium of veins and arteries that elevates BP (Sánchez Delgado et al., 2020).

Regarding the risk factor of sleep, the results of the present study coincide with those of Bojórquez-Díaz et al. (2019) where they also reported few hours of sleep and which can translate into the occurrence of stress. It has been identified that poor sleep quality is associated with elevated levels of arterial stiffness in hypertensive patients (Hu et al., 2020). Similarly, sleep dysfunctions such as sleep disruption during the night affect sleep quality in college students and has to do with bad lifestyle habits such as going to bed late at night or using smartphones in bed before sleeping (Favela Ramirez et al., 2022).

On the other hand, it is relevant that in this study coffee consumption had a protective role against HTN. In this sense, a recent literature review highlights that the consumption of moderate amounts of coffee up to three cups a day does not present a risk of association with HT, on the contrary, there may be a beneficial effect against the development of this disease (Tomás Delgado, 2018). In the same vein, another study that aimed to prospectively assess the association of coffee consumption with the risk of HTN in a cohort of university graduates found that there was no significant association between regular consumption of coffee with and without caffeine and the risk of HTN, and in the subgroup of women, the consumption of coffee with caffeine was associated with a lower risk of HTN (Navarro-Echeverría, 2019). These same authors point out that coffee is an important source of antioxidant and anti-inflammatory substances that act with a reverse remodeling effect on the cardiovascular system.

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In relation to the association of family history with the presence of NCDs found in this study, they can be related to the epigenetic theory in which the gene-environment influence is recognized with the appearance of complex diseases when genes interact with habits and lifestyles that cause changes at the cellular level in the long term and that can become hereditary risk factors (Sánchez Delgado et al., 2020).

On the other hand, it is important to include more specific sociodemographic and economic variables such as parents' level of studies, place of origin and economic income since this information is relevant in the development of diseases such as diabetes and obesity that are co-participants in the appearance of HT (Castro-Porras et al., 2023).

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Conclusions

In summary, the presence of overweight and obesity in combination with family history, poor sleep quality and non-consumption of coffee are risk factors for the presence of ETS in this sample of university students from southern Sonora, Mexico so it is necessary to reinforce the prevention of these issues through cross-cutting education programs during their academic career.

The possibilities for improvement of the study focus on complementing the measurements with fasting glucose, heart rate recording and body composition analysis.

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