Original Article

Pre-hypertension and hypertension in college students in Kuwait: A neglected issue

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ABSTRACT

Objective: To determine the proportion of pre-hypertension and hypertension in college students in Kuwait and their related risk factors. **Materials and Methods:** A total of 803, randomly selected students aged 17 to 23 years (346 male, 457 female) from different colleges in Kuwait, were included in the study between 2009 and 2010. Systolic and diastolic blood pressure measurements were taken by trained personnel. Pre-hypertension was defined as systolic pressure between 120 and 139 mm Hg or diastolic pressure between 80 and 89 mm Hg. Risk factor measurements that were determined, included smoking, body mass index (BMI), and family history of hypertension. Blood samples were collected and impaired glucose tolerance (IGT) and lipid profile levels were determined. **Results:** There were no hypotensive students. Normotensives constituted 53.5% (n = 430), pre-hypertensives formed 39.5% (n = 317), and hypertensive students comprised of 7% (n = 56). The overall proportions of hypertension and pre-hypertension were higher among male students (85.7 and 64.4%) than female students (14.3 and 35.6%), respectively. Hypertensive and pre-hypertensive students versus normotensive students had significantly higher levels of BMI-based obesity, smoking, glycated hemoglobin (HbA1c), and IGT. Also, hypertensive and pre-hypertensive, compared to normotensive students, had significantly higher proportions (21.4, 18.3, and 4.0%, respectively) of risky high-density lipoprotein (HDL) level (< 1 mg / dL), cholesterol (7.1, 3.8, and 1.4%, respectively), and triglycerides (TG) (17.9, 9.1, and 7.9%, respectively) where p was< 0.001, 0.016, and 0.051, respectively. **Conclusion:** Hypertensive and pre-hypertensive students showed elevated levels of lipids and BMI-based obesity more than normotensive students. TG, HDL, HbA1c, and cholesterol appeared to influence pre-hypertension.

Key words: BMI-based obesity, hypertension, high-density lipoprotein, Kuwait, pre-hypertension, triglycerides

INTRODUCTION

It is well-documented that there is an increase in the prevalence of hypertension (HTN) in developed and underdeveloped nations.[1-4]

Several studies have shown that HTN and pre-hypertension (pre-HTN) can start in adolescence, perhaps in the early stages of life, and continue into adulthood.[5,6]

A recent study found that the prevalence of pre-HTN increased with age.[7] A regional study concluded that levels

of blood pressure increased progressively with age in both boys and girls in Saudi Arabia.[8]

A number of studies have shown that baseline obesity is an independent risk factor for HTN.[9,10] A regional study, which reviewed the proportions of HTN and obesity in the Arabian Gulf States, showed that HTN levels in Kuwait, Oman, Bahrain, Qatar, and Saudi Arabia were very high and increased with age. It also demonstrated that the rate of increase in obesity was more pronounced in Saudi Arabia and Kuwait, especially among preschoolers (8 – 9%), with overweight and obesity in adolescents being among the highest in the world in Kuwait, with the worst estimates (40 – 46%).[11]

Moussa *et al.*, concluded that a positive relationship existed between systolic and diastolic blood pressure and increased BMI, in both male and female students aged 7 – 18 years in Al Ain city, UAE.[12] Moreover, a recent study showed that the change in BMI between the ages of seven and fifteen

years, had a significant effect on systolic blood pressure (SBP) at the age of 15.[13]

Several risk factors are well-recognized worldwide as contributors to the increase in blood pressure. They are a smoking habit, family history of hypertension, and increased glycemic and lipid levels.[14-16]

Most of the studies done in Kuwait, examined the prevalence of HTN in adults. Hence, little is known about the prevalence of HTN and pre-HTN in college students. In addition, it is well-known that HTN is an asymptomatic disease that is revealed only when there are complications. Hence, it is very important to diagnose elevated blood pressure (pre-HTN and HTN) at an early age. The purpose of this study was to examine the proportion of pre-HTN and HTN in college students, aged 17 – 23 years, and to determine the associated risk factors.

MATERIALS AND METHODS

The study was conducted during the academic year 2009 – 2010. The study population consisted of 803 students, aged 17 to 23 years, who were randomly selected from different colleges in Kuwait, and who agreed to participate by giving a written informed consent.

Sampling
To determine the sample size, the EPIINFO 6.0 program was used. Assuming that the prevalence of pre-HTN and HTN was 25%, within an accepted difference of 3% in the target population of 13,300 size, the estimated sample size at 5% level of significance and 80% power would be 755. Ten percent was added to the required sample for the sake of non-response. Out of a total of 825 students recruited for the study, who met the criteria for inclusion, 803 agreed to participate and were included in the analysis with a response rate of 97%.

Data collection
The study began with an early interview by trained personnel using a pre-designed questionnaire. Information such as: age, sex, history of chronic disease [epilepsy, asthma, respiratory allergy, migraine, thalassemia, chronic irritated colon, persistent colitis, and renal disease], family history of hypertension and / or diabetes mellitus, and history of smoking were collected. Height (cm) and weight (kg) were assessed using a scale (Detectoscale, MO USA). BMI was calculated using the formula [weight (kg) / [height (m)].[2] According to the definition by the World Health Organization (WHO), a BMI ≥25 kg / m^2 was overweight and a BMI ≥ 30 kg / m^2 was obese.[17]

A pilot study was carried out on 15 college students. Its aim was to test the suitability of the questionnaire to be used regarding its phrasing, the culture of interviewees, estimated time of completing the questionnaire, testing the analytic procedure, and the overall response of the students. This study revealed that the questionnaire was on the whole suitable. A urine analysis was omitted owing to a low response rate, especially among females.

The average of two readings of systolic and diastolic blood pressures was calculated using an electric sphygmomanometer (OMRON). According to the Joint National Committee (JNC) 7 report,[18] blood pressure (BP) categories were defined as normal blood pressure if the observed systolic blood pressure (SBP) was between 91 and 120 mm Hg or diastolic blood pressure (DBP) was between 61 and 80 mm Hg; pre-HTN if the observed SBP was between 121 and 139 mmHg or DBP was between 81 and 89 mmHg; and considered as HTN if the observed SBP was equal to or above 140 mmHg and DBP was equal to or above 90 mmHg; and finally hypotension was defined as SBP being equal to or less than 90 mm Hg or DBP being equal to or less than 60 mm Hg.[19]

Clinical measurements of blood glucose and lipid levels were completed. The students were asked to fast overnight for 12 – 14 hours before the day of the examination and an oral glucose tolerance test (OGTT) was completed using 75 g of glucose (Trutol™75, Glucose Tolerance beverage, Thermo Fisher Scientific Inc.). A first finger prick, 5 μl blood sample, was used for fasting blood glucose, fasting Hb1Ac and lipid measurements. Blood glucose levels were tested using the HemoCue Blood Glucose Analyzer (HemoCue Inc). According to the American Diabetes Association (ADA) criteria,[20] the students were considered normoglycemic if they had a fasting glucose < 5.6 mmol / l; pre-diabetic if it was between 5.6 and 6.9 mmol / l; and diabetic if it was ≥ 7 mmol / l. For the diagnosis of pre-diabetes, the measurement of glycated hemoglobin (HbA1c) was used. The desirable range of HbA1c between 5.7 and 6.4% was recently approved by the ADA. The HbA1c was calculated using the Afinion™ AS100 Analyzer (Norway). For the most part, lipid profiles of total cholesterol, triglycerides, high density lipoprotein (HDL), and low density lipoprotein (LDL) were measured using Reflotron ® Plus, (Roche Diagnostics GmbH, Germany). A second blood sample (5 μl) was drawn after two hours for postprandial blood glucose measurement. According to the ADA criteria, the study participants were considered to have impaired glucose tolerance (IGT) in the presence of one or more of the following; fasting plasma glucose of > 5.6 and < 7 mmol / L, two-hour postprandial glucose between 7.8 to 11.0 mmol / L, and HbA1c > 5.6% and

< 6.4%. Type 2 diabetes was diagnosed if any one of the following was found; fasting blood glucose ≥ 7 mmol / L, two-hour post prandial glucose ≥ 11.1 mmol / L and HbA1c ≥ 6.5%.

The study was approved by the Ethical Committee of the Ministry of Health of Kuwait, and informed consent was obtained from all the participants. The inclusion criteria were: (1) Kuwaiti students in college and (2) aged between 17 and 23 years, while the exclusion criteria were: (1) being pregnant and (2) being diabetic or having renal disease.

Statistical analysis

Data were collected, coded, and entered into an IBM compatible computer, using the SPSS version 17 for Windows. The entered data were checked for accuracy and then for normality, using the Kolmogorov–Smirnov test. Qualitative variables were expressed as numbers and percentages, while quantitative variables were expressed as median, mean $(\overline{X})$, and standard deviation (S). The arithmetic mean and median were used as measures of central tendency, while the standard deviation and interquartile range were used as measures of dispersion.

The following statistical tests were used:
1. The χ^2-test (or likelihood ratio = LLR) was used as a non-parametric test of significance, for comparison between the distribution of two qualitative variables.
2. The one-way ANOVA (F-test) was used as a parametric test of significance for comparison of more than two sample means, using either Scheffe's or Tamhane's post hoc tests for paired comparison according to the results of homogeneity testing.

A 5% level was chosen as a level of significance in all statistical significance tests used.

RESULTS

Students were classified into three groups according to the status of their blood pressure: normotensive, pre-hypertensive, and hypertensive. No hypotensive cases were found. Normotensive students constituted 53.5% (n = 430), prehypertensive 39.5% (n = 317), and hypertensive students represented 7% (n = 56). Some descriptive data of the SBP and DBP of normotensive, pre-hypertensive, and hypertensive students, such as, the arithmetic mean, 5% trimmed mean, standard deviation, median, interquartile range, minimum, maximum, and range, are shown in Table 1.

Table 2 shows that more male college students were found to be hypertensive than their female counterparts, 85.7 and 14.3%, respectively. The percentage of male normotensive students was 21.9%, while those pre-hypertensive and hypertensive were 64.4 and 85.7%, respectively.

Regarding the smoking habit, the percentage of students who smoked in relation to the status of blood pressure, that is, normotensive, pre-hypertensive, and hypertensive were 7.7, 17.4, and 17.9%, respectively, where $P < 0.001$. The percentage of positive family history of HTN among the hypertensives (53.6%) was higher than among both the pre-hypertensive (42.6%) and normotensive students (40%), where $P = 0.147$. History of chronic diseases and family history of diabetes mellitus (DM) were not statistically significant, as shown by the P-values.

It was found that general overweight was less among normotensives (42.3%), and high among hypertensive students (75%), while 62.1% of the pre-hypertensive students were overweight as shown in Table 3. These differences were statistically significant, $P < 0.001$.

Categorization of BMI on the basis of normal (< 25%), overweight (≥ 25 – < 30%), and obese (≥ 30%), showed

Table 1: Description of SBP and DBP of normotensive, pre-hypertensive, and hypertensive students					
Variable	Statistics	Normotensive (n = 430)	Prehypertensive (n = 317)	Hypertensive (n = 56)	Total (n = 803)
SBP	Mean	106.00	125.72	140.04	116.16
	SD	8.22	11.24	14.57	15.22
	Median	106.00	125.00	138.50	114.00
	Interquartile range	12	16	19	20
	Minimum	78	99	122	78
	Maximum	119	162	197	197
DBP	Mean	70.36	81.05	90.96	76.02
	SD	6.08	7.18	5.82	9.23
	Median	72.00	81.00	90.00	76.00
	Interquartile range	9	8	7	12
	Minimum	43	56	82	43
	Maximum	79	103	108	108

Table 2: Comparison among normotensive, pre-hypertensive, and hypertensive students according to some studied demographic variables

Variables		HTN status						Total		Test	P value
		Normal (n = 430)		Pre-HTN (n = 317)		HTN (n = 56)					
		n	%	n	%	n	%	n	%		
Sex	F	336	78.1	113	35.6	8	14.3	457	56.9	$X^2_{(2)}$ = 178.966	< 0.001
	M	94	21.9	204	64.4	48	85.7	346	43.1		
History of chronic diseases		27	6.3	29	9.1	4	7.1	60	7.5	$X^2_{(2)}$ = 2.182	0.336
Family history of HTN		172	40.0	135	42.6	30	53.6	337	42.0	$X^2_{(2)}$ = 3.829	0.147
History of smoking		33	7.7	55	17.4	10	17.9	98	12.2	$X^2_{(2)}$ = 17.739	< 0.001
Family history of DM		216	50.2	164	51.7	32	57.1	412	51.3	$X^2_{(2)}$ = 0.985	0.611

F: female, M: male, n: number, HTN: hypertension, DM: diabetes mellitus

Table 3: Comparison among normotensive, pre-hypertensive, and hypertensive students according to some studied anthropometric variables

Variables	HTN status						Total		Test	P value
	Normal (n = 430)		Pre-HTN (n = 317)		HTN (n = 56)					
	n	%	n	%	n	%	n	%		
Obesity / BMI < 25%	248	57.7	120	37.9	14	25.0	382	47.6	$X^2_{(4)}$ = 77.802	< 0.001
≥ 25 – < 30%	134	31.2	91	28.7	16	28.6	241	30.0		
> 30%	48	11.2	106	33.4	26	46.4	180	22.4		
General overweight	182	42.3	197	62.1	42	75.0	421	52.4	$X^2_{(2)}$ = 41.036	< 0.001

BMI: body mass index, n: number, HTN: hypertension

that the percentage of normotensive obese students was 11.2%, while the percentages of pre-hypertensives and hypertensives were 33.4 and 46.4%, respectively. These differences were statistically significant, where $P < 0.001$. Overweight according to waist circumference (WC) was not statistically significant, $P = 0.164$.

The percentage of high levels of TG in hypertensive students (17.9%) was significantly higher than was evident in the pre-hypertensive and normotensive students 9.1 and 7.9%, respectively, as shown in Table 4.

The percentage of dyslipidemia in hypertensive students (21.4%) was significantly higher than was found in both pre-hypertensives (12.9%) and normotensives (8.8%), where $P = 0.010$.

Hypertensive students showed significantly higher levels of cholesterol (7.1%) than pre-hypertensive (3.8%) and normotensive (1.4%) students, where $P = 0.016$.

The percentages of low levels of high HDL in hypertensive, pre-hypertensive, and normotensive students were 21.4, 18.3, and 4%, respectively, where $P < 0.001$.

There was an increased proportion of high fasting blood glucose (FBG), although not significant, in hypertensives (17.9%) than in pre-hypertensive (13.6%) and normotensive students (15.6%), where $P = 0.611$. Moreover, the highest percentage of postprandial blood glucose (PPBG), although not significant, was in hypertensive (3.6%) rather than in pre-hypertensive and normotensive students (1.9 and 0.9%, respectively), where $P = 0.298$.

High HbA1c levels (5.7 – 6.4%) were significantly higher in both hypertensive (14.3%) and pre-HTN (14.2%) as compared to normotensive (6.0%) students. Moreover, the percentage of hypertensive students (3.6%) with very high HbA1c levels (≥ 6.5%) was significantly higher than both pre-hypertensive (0.6%) and normotensive (0.9%) students, where $P = 0.001$.

It was found that the percentage of impaired glucose tolerance (IGT), as the sum of IGT and presence of DM, in hypertensives (46.4%) was significantly higher than in both pre-hypertensive (32.8%) and normotensive (30.0%) students. These differences were statistically significant, where $P < 0.045$.

Table 5 shows the mean, standard deviation, minimum, and maximum values of some studied laboratory results according to the state of hypertension.

Table 4: Comparison among normotensive, pre-hypertensive, and hypertensive students according to some studied clinical variables

Variables	HTN status						Total		Test	*P* value
	Normal (n = 430)		Pre-HTN (n = 317)		HTN (n = 56)					
	n	%	n	%	n	%	n	%		
TG (≥ 2.2)	34	7.9	29	9.1	10	17.9	73	9.1	$X^2_{(2)}$ = 5.938	0.051
Cholesterol(≥ 5.6)	6	1.4	12	3.8	4	7.1	22	2.7	$X^2_{(2)}$ = 8.292	0.016
HDL (< 1)	17	4.0	58	18.3	12	21.4	87	10.8	$X^2_{(2)}$ = 45.853	< 0.001
Dyslipidemia	38	8.8	41	12.9	12	21.4	91	11.3	$X^2_{(2)}$ = 9.154	0.010
FBG< 5.6	363	84.4	274	86.4	46	82.1	683	85.1	$X^2_{(2)}$ = 0.986	0.611
≥ 5.6	64	15.6	35	13.6	10	17.9	109	14.9		
PPBG < 6.5	368	85.6	276	87.1	44	78.6	688	85.7	$LLRX^2_{(4)}$ = 4.894	0.298
6.5 – 7.8	58	13.5	35	11.0	10	17.9	103	12.8		
> 7.8	4	0.9	6	1.9	2	3.6	12	1.5		
HbA1c < 5.7%	400	93.0	270	85.2	46	82.1	716	89.2	$LLRX^2_{(4)}$ = 17.987	0.001
5.7 – 6.4%	26	6.0	45	14.2	8	14.3	79	9.8		
≥ 6.5%	4	0.9	2	0.6	2	3.6	8	1.0		
IGT (IGT + DM)	129	30.0	104	32.8	26	46.4	259	32.3	$X^2_{(2)}$ = 6.193	0.045

TG: triglycerides, FBG: fasting blood glucose, PPBG: postprandial blood glucose, HbA1c: glycated hemoglobin, IGT: impaired glucose tolerance, DM: diabetes mellitus, HDL: high density lipoprotein

Table 5: The mean, standard deviation, minimum, and maximum values of some quantitative variables, according to some studied laboratory findings

Variables		n	Minimum	Maximum	Mean	SD	$F_{(2 / 800)}$	*P* value
FBG	Normal	430	3.40	8.40	5.00	0.65	2.195	0.112
	PreHTN	317	3.30	8.20	4.94	0.80		
	HTN	56	3.80	7.00	5.14	0.70		
	Total	803	3.30	8.40	4.98	0.71		
HbA1c	Normal	430	4.10	6.70	5.24	0.33	8.691	< 0.001
	PreHTN	317	4.30	6.80	5.29	0.35		
	HTN	56	4.80	7.40	5.44	0.47		
	Total	803	4.10	7.40	5.27	0.35		
PBPG	Normal	430	3.90	11.80	6.47	1.28	3.665	0.026
	PreHTN	317	3.00	15.00	6.38	1.66		
	HTN	56	4.40	12.70	6.95	1.63		
	Total	803	3.00	15.00	6.47	1.47		
Total Cholesterol	Normal	430	2.46	9.60	3.65	0.79	0.934	0.394
	Pre-HTN	317	2.08	6.66	3.68	0.85		
	HTN	56	2.56	6.62	3.81	1.08		
	Total	803	2.08	9.60	3.68	0.84		
TG	Normal	430	0.26	4.75	1.30	0.68	6.091	0.002
	Pre-HTN	317	0.80	4.84	1.45	0.71		
	HTN	56	0.80	3.69	1.53	0.86		
	Total	803	0.26	4.84	1.38	0.71		
HDL	Normal	430	0.26	2.29	1.55	0.29	33.214	< 0.001
	Pre-HTN	317	0.26	2.15	1.35	0.44		
	HTN	56	0.25	1.87	1.26	0.47		
	Total	803	0.25	2.29	1.45	0.39		

FBG: fasting blood glucose, PPBG: postprandial blood glucose, HbA1c: glycated hemoglobin, TG: triglycerides, HDL: high density lipoprotein

DISCUSSION

The present study found that the proportion of pre-hypertension (pre-HTN) and HTN in college students were 39.4 and 7%, respectively. These results were not much different from the recent results reported. Data from a study on university students, aged 18 – 24 years, indicated high rates of elevated systolic (47%) and diastolic blood pressures (39%).[21] A regional study on some Saudi military men aged 23 – 37 years, found that 17.3% were

pre-HTN. [22] Another study revealed that the prevalence of HTN was 23.8% in Iranian college students.[23] A local study in Kuwait showed that the proportion of hypertensive patients was 11.8%.[15]

The data of the present study show differences in the proportion of HTN and pre-HTN between the genders. Generally, both HTN and pre-HTN are significantly more prevalent in males than in females. This is possibly due to the differences in hormonal activity between boys and girls in early life.[24,25]

These results are in agreement with the other studies. Erem *et al.*, showed that the prevalence of HTN and pre-HTN were 44.0% (41.6% in women and 46.1% in men) and 14.5% (12.6% in women and 16.8% in men), respectively. [26] In addition, in a study of 2000 healthy adults Oladapo *et al.*, found that 20.8% were hypertensive with a BP of ≥ 140 / 90 mm Hg. Among the men, 42.3%, and among the women, 36.8%, had BP of ≥ 130 / 85 mm Hg.[27] A study in Saudi Arabia showed the prevalence of hypertension in males as 28.6%, while in females it was 23.9% ($P < 0.001$).[28]

The present data showed that a family history of HTN was high among college students (42.0%). Although not statistically significant, the percentage of family history of HTN was the highest among hypertensive compared to pre-hypertensive and normotensive students. These results were in accordance with many studies which showed that family history of HTN was an important contributor to HTN and pre-HTN.[29-31] Our data also showed that the habit of smoking was an important risk factor for hypertension in students. These results were in agreement with the previous studies.[26,32] Al-Safi's regional study concluded that blood pressure was higher among smokers than non-smokers.[33] Smoking and high blood pressure were known to accelerate the development of the process of atherosclerosis and increase the risk of all other coronary lesions. Therefore, it was very important to monitor blood pressure in Kuwaiti college students, while they were still young.

The literature indicates that an increase in blood pressure is related to diverse causes, but most studies have highlighted obesity as an important factor. Based on the BMI categories, our results show that 22.4% of all the students are obese. It also demonstrates significantly that the highest proportion of HTN is in students with BMI ≥ 30 rather than their pre-hypertensive counterparts, and the lowest in normotensives. These results reveal the positive relation between HTN and obesity in college students.

Data from the Israeli Air Force revealed that 48% of pilots, aged 18, had pre-HTN and were more obese than the normotensive subjects.[34] Another study in China showed that prevalence of elevated blood pressure (pre-HTN and HTN) and mean levels of systolic and diastolic pressure had a positive relationship with BMI in both males and females.[35] Two studies, in Kuwait and United Arab Emirates, showed an apparent correlation between systolic and diastolic pressure and an increase in BMI, in both male and female students.[12,36]

The data presented in our study found that general overweight was least presented in normotensive students (42.3%), was higher in pre-hypertensive students (62.1%), and the highest among hypertensive students (75%). A recent study concluded that pre-HTN was significantly high among Chinese men and women who were overweight, 38.4 and 27.8%, respectively.[37] A population-based study showed that the degree of weight change in infancy was equally important for SBP in both boys and girls, but growth during puberty showed a stronger association between weight change and SBP, more in boys than in girls.[38] This is generally explained, by several genetic, sexual, and hormonal differences during the different phases of life.[24,25] In this region, a significant linear relationship has been shown between increasing overweight and prevalence of hypertension in the Saudi population.[28] Finally, Sabra *et al.*, has demonstrated a relationship between the increased level of blood pressure and overweight in male students (aged 18 – 26 years) at King Faisal University (KFU) in Dammam, Saudi Arabia.[39]

One of the striking results in our study is the relationship between blood pressure and the proportions of lipids in the hypertensive students. It showed the significant increase in the percentage of the following components: Triglycerides, low levels of high HDL, cholesterol, and dyslipidemia among the hypertensive students. In support of these data, are several studies that have recognized the relation between higher levels of blood pressure and increased levels of lipids, weight, and BMI variables.[27,32] Gupta *et al.*, have showed a positive relationship between hypertensive Indian adults, aged 20 to 29 years, and high levels of TG, low HDL cholesterol, LDL cholesterol, and BMI.[29]

Our data revealed that the pattern of metabolic variability, especially glycemic levels, were just as important as overweight and / or obesity and / or lipidic profile in affecting the severity of blood pressure in our students. Although not statistically significant, the highest proportion of fasting blood glucose (FBG) was among the hypertensive rather than the pre-hypertensive or normotensive students; also the highest percentage of postprandial blood glucose (PPBG) was found in hypertensive students. Previous researches have similarly indicated a strong relationship between elevated fasting blood glucose levels and increased blood pressure.[40,41]

Our data demonstrated that unstable metabolic conditions were most likely to have a strong effect on blood pressure. It showed an increased proportion of IGT / diabetes in students with hypertension than in pre-hypertensive and normotensive students. Many studies had reported that metabolic abnormalities could be a major risk factor in hypertensive subjects.[42-44] Our study also showed that levels of glycated hemoglobin were significantly higher in hypertensive students. The reason was that metabolic abnormalities were likely to play a major role in the development of HTN in the pre-HNT students. This was because, with time, pre-HTN students would not be able to handle the oral glucose challenge, resulting in damaged endothelium-dependent vasodilation, and consequently, an increase in blood pressure.

Often, in college students, pre-hypertension may not be discovered until late. This is because college students are generally healthy and will only see a physician when they are very ill, but will not normally see a physician for a routine health check-up. The data from this study draws attention to the importance of examining the blood pressure of young persons.

CONCLUSION

We concluded that the increase in the proportion of HTN and pre-HTN in college students, a relatively understudied group, was due to two major factors: high levels of lipids and BMI-based obesity. TG, HDL, HbA1c, and cholesterol appeared to greatly influence pre-HTN. These results provided preliminary data on the high proportion of both HTN and pre-HTN, and its related risk factors in college students, in Kuwait.

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