Hypertension prevalence and associated risk factors among young adult females of a professional university

RITA SINGH RAGHUVANSHI and SHWETA SURI

Department of Foods and Nutrition, College of Home Science, G. B. Pant University of Agriculture and Technology, Pantnagar-263145 (U.S. Nagar, Uttarakhand)

ABSTRACT: The present study aimed to investigate the prevalence of hypertension and assess the relationship between diet, anthropometry, stress level, physical activity and occurrence of hypertension among young adult females. The participants were 350 young adult females of age 20-30 years. In this cross sectional study, data were analyzed using SPSS version 20 (Trial). Results showed that out of 350 participants, 10.29% were pre-hypertensive, 9.43% were classified under grade-I and about 2% were classified under grade-II hypertension. The overall prevalence of obesity and overweight was 9.43% and 18.57% respectively. Body Mass Index (BMI) showed a significant (95% CI; α=0.05) though weak positive correlation, with both Systolic Blood Pressure (SBP) and Diastolic Blood Pressure (DBP).High fat containing foods were having little impact on obesity and hypertension. Physical activity level of subjects was inversely associated with BMI and Waist Circumference (WC). A moderate association was found between stress level and high Waist- Hip Ratio (WHR). Correlation analysis suggests that the intake of high fat+sugar foods lead to increase in the waist circumference and waist hip ratio, thus, may be the contributory factor for obesity. Salt and salt containing foods didn't show any strong contribution towards high blood pressure.

Keywords: Dietary practices, females, hypertension, obesity, physical activity, stress

With the wide growing population of the world, non-communicable lifestyle diseases such as hypertension, obesity, diabetes and cardiovascular diseases are showing an upward swing and emerged as major public health problems. According to World Health Organization Report (2019), worldwide raised blood pressure is likely to cause 7.5 million deaths, which is about 12.8% of the total of all deaths. Across the globe, prevalence of raised blood pressure was found to be consistently high with low, lower middle and upper middle nations. High blood pressure or hypertension is strongly associated with obesity and was influenced by sex, diabetes, and age (Soriguer *et al.,* 2003). Also multiple dietary factors increase the risk for hypertension. A diet high in salt causes the body to retain fluid; and increased water movement raises the pressure within the vessel walls. The majority of the sodium in western-style diets is derived from processed foods. A high-salt diet can also increase the need for potassium. Potassium balances the amount of sodium within cells. If not enough potassium is consumed or retained, sodium accumulates in the blood. A diet low in potassium (<40mEq/day) produces sodium accumulation through decreased sodium excretion, thereby leading to hypertension. Potassium deficiency also increases the risk for stroke (Bacon *et al.*, 2004). Sedentary lifestyle is also associated with various risk factors that may contribute to the elevation of blood pressure, which, in the long run, can lead to the development of hypertension. A lack of physical activity and sedentary lifestyle produce an increase in heart rate. An increased heart rate requires that the heart works harder with each contraction, and it exerts a stronger force on the arteries, thereby raising blood pressure (Carson, 2010).

A study reported the overall prevalence of hypertension as 7.1% among college students. A total of 46.7% of the students were pre-hypertensive while 35.5% of students who were pre-obese or obese had high BP recordings, the same was found in only 7.1% of those in the normal weight range (Reddy *et al.*, 2015). The fourth series of National Family Health Survey (NFHS-4) reported that in the state of Uttarakhand, 12 % of females aged between 15-49 have hypertension. The survey revealed that prevalence of hypertension tends to increase suddenly with age. The survey also reported that 20 % of women in Uttarakhand are overweight or obese. Thus taking into consideration the growing incidence of hypertension, the present study was planned to estimate the prevalence of hypertension; also to look into the factors associated with occurrence of obesity and hypertension and among young adult educated females pursuing higher studies in a professional university and check the relationship of obesity, stress, physical activity level (PAL) and blood pressure with food intake.

MATERIALS AND METHODS

A community based cross- sectional study was conducted among young adult females residing in seven girl's hostel present inside the professional university campus of U.S. Nagar (Uttarakhand) in 2018.The study included a total of

350 young adult females of age 20-30 years selected randomly from hostels viz 50 females from each hostel. Written informed consent was obtained from the girls before study.

The anthropometric measurements included height, weight, waist circumference, hip circumference and waist to hip ratio. Height and weight was taken for all the females of 20-30 years of age and their (Body Mass Index) BMI was calculated to screen them as obese and overweight, normal and underweight. The subjects were classified based on World Health Organization (2000) and WHO/WPRO classification. Blood pressure was measured using a standard mercury sphygmomanometer. Readings were taken on the left arm. Three readings were taken over a period of 10 min. The average of all three readings is used to represent the individual's BP. The cut-off values for hypertension as per WHO/ISH guidelines were considered. The validity and reliability of all the tools used in the study was pre- assessed.

A well-structured questionnaire was used to assess the dietary habits, physical activity and stress level of young adult females of the professional university. For dietary habits, food frequency questionnaire was prepared. Food frequency for the commonly eaten foods of all the food groups were recorded for the respondents separately using a food frequency questionnaire particularly to see the consumption frequency of foods rich in fat, sugar and salt. Various food items such as biscuits, chocolates, fruit cakes, pastries, patties, namkeen, chips, chutney, pickles etc. were categorized into three categories namely: (i) high fat + sugar group,(ii) high fat group and (iii) high salt group. Scores were given based on their frequency of consumption. Score 3 was assigned when intake was daily or thrice a week, score 2 was assigned for once or twice a week whereas, score 1 was given for monthly, occasionally or rarely intake. For each subject high fat + sugar, high fat and high salt group intake score was calculated. The score thus obtained were categorized into low, moderate and high intake.High fat + sugar group included biscuits, chocolates, fruit cakes, pastries, doughnuts, cream roll and ice cream. High fat group included patties, pizza, burger, *samosas*, french fries, noodles, *momos, kachoris, puris, chat, pakora*. High salt group included *namkeen*, sauce, *chutney*, pickles, chips and *papads*.

The standard physical activity questionnaire viz; Global Physical Activity Questionnaire (GPAQ) developed by WHO was used to assess physical activity level of the subjects. Physical activity level of subjects was classified accordingly. The stress level was assessed using modified questionnaire of Student Stress Scale consisting 20 parameters Insel and Roth (1985).The scores used for scales were 0-5 for normal or no stress, 6-10 for mildly stressed, 11-15 for moderately stressed and 16-20 for highly stressed.

For the analysis, data collected was presented in numbers and percentage and their average and standard deviation were calculated. Statistical analysis was done using MS-Excel spreadsheet and SPSS software (IBM SPSS Statistics for Windows, Version 20.0 (Trial), Armonk, New York, USA). Z values were calculated to find the significant difference between the average anthropometric measurements and blood pressure of non-obese and obese young adult females. Correlation coefficients was calculated to study the association of anthropometric measurements, physical activity level, stress level and food consumed with each other and with the outcome i.e. obesity and hypertension.

RESULTS AND DISCUSSION

Out of 350 participants, overall prevalence for obesity was 9.43% (8.86% grade I and 0.57% grade II) and overweight prevalence was 18.57% as per WHO/WPRO BMI criterion for Asians. Results on prevalence of hypertension showed that 10.29% (n=36) were pre-hypertensive [SBP=130-139 mmHg and (or) DBP= 85-89 mmHg], 9.43% (n=33) were classified under grade-I [SBP=140-159 mmHg and (or) DBP= 90-99 mmHg] and only 2% (n=7) were classified under grade-II [SBP=160-179 mmHg and (or) DBP= 100-109 mmHg] hypertension. Distribution of participants by selected characteristics and frequency of consumption of specified food items are given in Table 1. About 8.86% and 0.57% participants fall in the category of obese grade I and II respectively. Regarding blood pressure, 3.43% females had high systolic whereas 8.86% females had high diastolic blood pressure. A majority (52%) of the females was non-vegetarian and 53% consume food four times a day. A majority of subjects (95%) were sedentary workers (students) according to their physical activity level.

Results of correlation analysis comparing anthropometric parameters and blood pressure showed that BMI had strong positive significant correlation with waist circumference (WC) and hip circumference (HC); a positive but weak significant correlation was found with SBP and DBP. Waist Hip Ratio (WHR) of an individual had statistically significant and strong positive correlation (95% CI; α=0.05) with WC which is well explained by the use of WC in calculating WHR (Table 2). It had non-significant negative correlation with SBP and positively weak significant association with DBP. While WHR has no significant correlation with BMI of an individual, it had a negative, weak but statistically significant (95% CI; α=0.05) correlation with HC of the individual.

Table 1: Distribution (N, %) of participants by selected characteristics and frequency of consumption of specified food items

Selected characteristics		Number (Percent)
Body mass index (BMI)		
Underweight		54 (15.43%)
Normal		198 (56.57%)
Overweight (at risk)		65 (18.57%)
Obese I		31 (8.86%)
Obese II		2 (0.57%)
Blood pressure		
Systolic BP (mmHg)		
Optimal (<120)		292 (83.43%)
Normal (120-129)		43 (12.28%)
High (130-139)		12 (3.43%)
Hypertension Grade I (140-159)		3 (0.86%)
Hypertension Grade II (160-179)		-
Hypertension Grade III ($\geq$180)		-
Diastolic BP (mmHg)		
Optimal (<80)		219 (62.57%)
Normal (80-84)		63 (18.00%)
High (85-89)		31 (8.86%)
Hypertension Grade I (90-99)		30 (8.57%)
Hypertension Grade II (100-109)		7 (2.00%)
Hypertension Grade III ($\geq$110)		-
Dietary habits		
Vegetarian		80 (22.86%)
Non-vegetarian		181(51.71%)
Ova-vegetarian		89(25.43%)
No. of meals/day		
Twice a day		14(4%)
Thrice a day		138(39.43%)
Four times a day		187(53.43%)
Five times a day		11(3.14%)
Specified food groups		
Grains	Low Consumption	5(1.42%)
	Moderate Consumption	18(5.14%)
	High Consumption	327(93.42%)
Legumes	Low Consumption	0
	Moderate Consumption	6(1.71%)
	High Consumption	344 (98.29%)
Dairy products	Low Consumption	170(48.57%)
	Moderate Consumption	62(17.71%)
	High Consumption	118(33.7%)
Fresh foods	Low Consumption	284(81.14%)
	Moderate Consumption	56(16%)
	High Consumption	10(2.85%)
Egg	High Consumption	140(40%)
	Low Consumption	122(34.86%)
	Moderate Consumption	88(25.14%)
Fruits and vegetables	High Consumption	22(6.28)
	Low Consumption	69(19.71)
	Moderate Consumption	259(74%)
Nuts	High Consumption	142(40.57%)
	Low Consumption	75(21.43%)
	Moderate Consumption	133(38%)
Consumption of specified food items		
Fruit juice	Low Consumption	230(65.71%)
	Moderate Consumption	75(21.43%)
	High Consumption	45(12.86%)
Fruit shake	Low Consumption	309(88.29%)
	Moderate Consumption	28(8%)

	High Consumption	13(3.71%)
Green tea	Low Consumption	238(68%)
	Moderate Consumption	30(8.57%)
	High Consumption	82(23.43%)
Soft drinks	Low Consumption	251(71.71%)
	Moderate Consumption	67(19.14%)
	High Consumption	32(9.14%)
Physical activity level		
Extremely inactive		9(2.57 %)
Sedentary		334.0(95.43%)
Moderately active		7(2%)
Stress level		
High		16(4.57%)
Moderate		46(13.14%)
Mild		131(37.43%)
Normal		157(44.86%)

SBP of females had a significant positive correlation (95% CI; α=0.05) with BMI, HC and DBP. No statistically significant correlation was found between SBP and WC and WHR. Results show that increase in BMI and DBP of an individual relates to higher SBP. DBP of females had a significant positive correlation (95% CI; α=0.05) with almost all the parameters (BMI, WC, WHR and SBP) except HC showing that DBP is unaffected of height and HC of an individual. More than 17% subjects had moderate to high level of stress.

A significant positive correlation ($p<0.05$) was found between waist circumference, waist hip ratio, total stress and the intake of high fat+ sugar foods. Association of waist hip ratio and total stress with consumption of high fat food was found significant (at 5% level of significance). Total stress was also found to be positively correlated with intake of high salt food. A significant inverse correlation of physical activity level with BMI and waist circumference indicate that BMI and waist circumference could decrease with increased physical activity levels while the correlation between all other factors with physical activity levels was also found inverse but not significant. A moderate association was found between stress level and high Waist- Hip Ratio (Table 2).

In the present study, 10.29% participants were pre-hypertensive, 9.43% were under grade-I and about 2% were classified under grade-II hypertension. This proportion was found to be higher than the prevalence of hypertension among similar age group females (Gupta *et al*., 2009). Obesity being the key risk factor for hypertension, study showed prevalence of 0.57% and overweight prevalence of 8.86% according to WHO classification; however in the recent reports on BMI classification it was identified that the Asian populations have a higher body fat deposit at a lower BMI than Caucasians, but showed an increasing trend toward obesity. It has been recognized that WHO criteria for classifying obesity in adult Caucasians may not be appropriate for Asian populations. The regional office for Western Pacific Region of WHO, the International Association for Study of Obesity and the International Obesity Task Force also proposed a separate classification for obesity in Asia in 2000. This led to the proposal that adult overweight be specified in Asian as a BMI over 23.0 and that obesity be specified as BMI over 25. In the present study more females were found to be overweight and obese when WPRO (2000) criterion (18.57% and 9.43%) was applied.

A similar study conducted on university girls of 18 to 28 years reported 29.73% females as underweight, 54.21 % as normal and 8.74 % as obese (6.68 % grade I and 0.64% grade II) (Raghuvanshi and Singhal, 2013**).** Another study done on 1303 females of age 18–26 years at University of Baroda reported that the prevalence of overweight and obesity was 9 and 12% respectively using Asian cut-offs. Overweight prevalence increased to 10.1% and obesity prevalence decreased almost 5 times to 2.5% when WHO cut offs were used. Percentage of females having waist circumference (WC) >80 cm was 12.7% and those having WHR >0.8 was 21.2 % (Dhruv *et al*., 2012).

Our study also reported that all the anthropometric parameters studied were significantly different in non-obese and obese subjects, although a strong positive correlation was seen between BMI and weight and a weak negative correlation between BMI and height. Therefore it can be inferred that BMI impacts the SBP and DBP of the individual.

The food consumption and its frequency data showed that pulse intake was satisfactory among subjects. Pulse consumption could potentially increase satiety and help with weight control when consumed regularly. Protein is more satiating than carbohydrates or lipids (Weigle *et al.,*

Table 2: Correlation matrix of various anthropometric parameters (BMI, WC, WHR), Blood Pressure, TEE (Total Energy Expenditure), BMR, Physical Activity Level, Total Stress and Type of Diet (High Fat+ Sugar, High Fat and High Salt)

	WC (Kg/m^2)	*WHR (cm)*	*SBP (mmHg)*	*DBP (mmHg)*	*TEE*	*BMR*	*PAL*	*Total stress*	*High fat + sugar*	*High fat*	*High salt*
BMI (Kg/m^2)	0.57*	0.06^{NS}	0.24*	0.13**	0.66*	0.87*	-0.24*	-0.76^{NS}	0.02^{NS}	-0.05^{NS}	-0.02^{NS}
WC (cm)		0.65*	0.06^{NS}	0.16*	0.46*	0.57*	-0.12**	0.08^{NS}	0.21*	0.10^{NS}	0.05^{NS}
WHR			-0.03^{NS}	0.22*	0.03^{NS}	-0.00^{NS}	0.05^{NS}	0.14*	0.14*	0.23*	-0.01^{NS}
SBP (mm Hg)				0.35*	0.18*	0.23*	-0.06^{NS}	0.04^{NS}	0.05^{NS}	-0.03^{NS}	0.01^{NS}
DBP (mm Hg)					0.10^{NS}	0.12**	-0.03^{NS}	0.06^{NS}	0.01^{NS}	0.05^{NS}	-0.05^{NS}
TEE						0.77*	0.41*	-0.08^{NS}	0.04^{NS}	-0.07^{NS}	0.00^{NS}
BMR							-0.27*	-0.07^{NS}	0.06^{NS}	-0.05^{NS}	0.00^{NS}
PAL								-0.02^{NS}	-0.02^{NS}	-0.03^{NS}	-0.00^{NS}
Total Stress									0.37*	0.24*	0.24*
High fat + sugar										0.50*	0.50*
High fat											0.37*

*95% CI (α=0.05) **99% CI (α=0.01) NS=Not Significant

2005). More specifically we found that consumption of fruits, milk and milk products were also satisfactory among subjects. Fruits have potential role in preventing overweight and obesity is related to their relatively low energy density, high content of dietary fibre, and associated increasing satiety effect (Tetens and Alinia, 2009). Many epidemiological studies have been conducted to test the beneficial effects of fruit and vegetable intake on many different disease states such as heart disease, cancer, and stroke (Bazzano, 2006).

Among non-vegetarian foods, meat, mutton/chicken, eggs and fish are commonly consumed. A study reported that red meat intake was positively associated, whereas poultry intake was not associated, with the risk of hypertension in middle-aged and older women (Wang *et al*., 2008). Meats are high in energy and fat content, and thus may be associated with higher risk of obesity and hypertension. There is a positive association between meat consumption and risk for obesity and central obesity (Wang and Beydoun, 2009). Positive correlation of high fat and sugar foods with waist circumference, waist hip ratio and total stress means that with intake of high fat+ sugar foods there is an increase in the waist circumference and waist hip ratio, thus, may be the contributory factor for obesity in the subjects. Also it was reported that with the increase in the stress, the tendency to consume foods high in fat, sugar and salt increases among subjects. Stress is also a contributory factor for overeating leading to overweight and obesity. A recent study done on female scholars of Uttarakhand showed that 48.5% girls were moderately stressed, 35.5% were highly stressed and remaining was mildly stressed. Around 38.7% girls had a craving for eating during stress. This study also demonstrated a very strong association between exposure (inactivity) and disease (obesity or hypertension) indicating that extreme inactivity could be a strong causal agent for development of obesity and hypertension (Thakur *et al.*, 2016). However, moderate association was found between extreme inactivity and stress level and a very weak positive association between physical inactivity and high Waist- Hip ratio. This signifies that extreme inactivity could be a causal factor for development of disease. Stress was weakly associated with obesity and hypertension in the present study. The main limitation of the study was the inability to assess the causality as this study used observational and cross-sectional data. In addition, since the study recruited participants that were studying in a professional university, therefore the authors are cautious before generalizing the findings to common people of same age group.

CONCLUSION

In the present study it was observed that about 10.29% (n=36) students were pre-hypertensive. The overall prevalence of obesity was 9.43% and overweight was 18.57% in young adult females. No direct association was found between obesity and consumption of high fat plus sugar, salt and salt containing foods. This low association could be because of the replacement of normal meal in hostel with small infrequent eating outside therefore the energy consumption is not very high though the major part of it comes from fat only. Also hypertension was found to be not strongly associated with the consumption of high salt foods. Although correlation analysis suggests that the intake of high fat+ sugar foods lead to increase in the Waist Circumference and Waist Hip Ratio, thus, may be the contributory factor for obesity. A very strong association was found between exposure (inactivity) and disease (obesity or hypertension) indicating that extreme inactivity could be a strong causal agent for development of obesity and hypertension. However, moderate association was found between extreme inactivity and stress level and a very weak positive association between physical inactivity and high Waist- Hip Ratio. This signifies that extreme inactivity could be a causal factor for development of disease. Stress was weakly associated with obesity and hypertension.

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