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ASSOCIATION OF FOOD HABITS WITH ADOLESCENT HYPERTENSION: A STUDY FROM MANIPUR

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ABSTRACT

Background: Hypertension is one of the major concerning health issues worldwide. Lately, adolescent hypertension has been on the rise with change in the diet and lifestyle as one of the probable contributing factors.

Aim of the study: To study the association of food habits with different parameters of hypertension among the adolescents of Manipur.

Material and Methods: This cross-sectional study included 728 adolescents of the age range 17–19 years comprising of 470 males and 258 females of Manipur, Northeast India. Blood pressure measurements were taken using a mercury sphygmomanometer, and the average value of three measurements was recorded. Statistical analyses were performed using IBM SPSS version 23.

Results: Statistical analysis showed significant association of hypertension with consumption of salty food ($P < 0.05$, $\chi^2 = 12.28$), junk food ($P < 0.05$, $\chi^2 = 6.07$) and sugar sweetened drinks ($P < 0.05$, $\chi^2 = 8.37$). Mean arterial pressure was also found to be significantly associated with sugar-sweetened drink consumption ($\chi^2 = 6.96$, $p < 0.05$).

Conclusions: The study highlighted the association of salt, sugar and junk food consumption with hypertension among the adolescents of Manipur.

Keywords: *adolescent hypertension; food habits; sugar; salt; junk-food consumption*

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INTRODUCTION

Hypertension or elevated blood pressure is a complex, multifaceted medical condition contributing to high morbidity and mortality. It is estimated to affect around 1.28 billion adults aged 30–70 years worldwide (WHO, n.d.). Hypertension is a major and common modifiable risk factor for developing cardiovascular disease, stroke, chronic kidney disease and cognitive impairment [1, 2]. Hypertension, in the form of cardiovascular stroke, accounts for high mortality in countries like India, Taiwan and Japan [3]. Though generally regarded as an adult health problem, hypertension among adolescents has been rising. Studies conducted in western countries report that prevalence of hypertension in children is around 7–19% [4]. Hitherto, the highest national reported figure of adolescent hypertension and elevated blood pressure, being 29.12% and 20.47%, respectively, was reported by Meitei et al. [5] from the population of Northeast India.

In addition to systolic and diastolic blood pressures, studies have implicated pulse pressure (PP) and mean arterial pressure (MAP) to be independent cardiovascular risk predictors. Pulse pressure and mean arterial pressure are respectively the pulsatile and steady components of the blood pressure curve. Pulse pressure is the difference between systolic and diastolic blood pressures, while mean arterial pressure is the average arterial pressure during a given cardiac cycle, and it consists of diastolic pressure plus one-third of pulse pressure [6, 7]. Pulse pressure reflects stiffening of large arteries and has been indicated to be associated with cardiovascular risks. High systolic blood pressure along with high pulse pressure indicates special risk [8]. MAP is considered an excellent way to evaluate stress on the vessel walls, and it gives an indication of the overall circulatory pressure load [9]. In a study conducted by Sulakova et al. [10], inclusion of MAP in the diagnosis of ambulatory hypertension has reported a significant increase in the detection of hypertensive patients by 19%, and that it would be helpful in detecting mild hypertension with normal or borderline SBP and DBP.

Diet is considered to be one of the important factors that influences blood pressure. Of all the dietary exposures, sodium or salt consumption has been the most investigated and has directly been correlated with blood pressure levels and prevalence of hypertension [11]. WHO and most national guidelines have strongly recommended to reduce the intake of salt to less than 6g/d (100 mmol/d) to tackle this non-communicable global crisis. Dietary Approaches to Stop Hypertension (DASH) showed that a diet rich in fruits, vegetables, low-fat dairy products, fibre and minerals, such as calcium, potassium and magnesium, produces a potent antihypertensive effect [12]. A similar dietary pattern rich in fruit, salad, cereal and fish was reported by McNaughton et al. [13] to be inversely associated with diastolic blood pressure among older adolescents. Considering the importance of diet in hypertension, the present study attempts to study the association of food habits with different parameters of hypertension among the adolescents of Manipur.

MATERIAL AND METHODS

The study was conducted among 728 adolescents aged 15 to 19 years comprising of 470 boys and 258 girls in Manipur, Northeast India. The data were collected from November 2017 to March 2018. The participants were recruited from schools chosen at random from a list of options in Imphal city. The school authorities were approached, and the study's objectives and goals were explained to them. Schools undergoing examinations and those failing to give consent were excluded from the study. Before the collection of data, students were informed of the study's purpose, and their approval to participate in the study was sought. The study has been reviewed and approved by the Ethical Committee of the Institute. Necessary bio-demographic information and food habits of the participants were collected using a questionnaire. Blood pressure measurements were made using a mercury sphygmomanometer on the right arm in a sitting position. Three measurements were taken with a regular interval and the average value was recorded. Adolescents aged 13 years and above with blood pressure of < 120 / < 80 mmHg were classified as normal, between 120 / < 80 mmHg and 129 / < 80 mmHg as elevated, between 130 / 80 mmHg and 189 / 89 mmHg as Hypertension Stage I and those above as Hypertension Stage II [14]. Pulse pressure (PP) was calculated as the difference between systolic blood pressure (SBP) and diastolic blood pressure (DBP). Mean arterial pressure (MAP) was calculated as DP + 1/3 PP. MAP values < 93.33 mmHg were classified as optimal MAP and values > 93.33 mmHg were classified as high MAP [15]. Relevant statistical data like frequency percentage, chi-square and t-test were calculated using IBM SPSS version 23.

RESULTS

Table 1 shows the association of food consumption with hypertension among the adolescents of Manipur. Sugar-free drinks were found to be associated with hypertension in the totality of both genders with a p value < 0.05 ($\chi^2 = 8.37$), as those who consumed sugar drinks (no sugar-free) significantly had hypertension. However, this association was not evident in males and females separately. Salty food consumption was also found to be associated with hypertension in males ($\chi^2 = 14.92$, $p < 0.05$) and in the totality of both genders ($\chi^2 = 12.28$, $p < 0.05$). Likewise, junk food consumption was found to be associated with hypertension, as those, irrespective of gender, who consumed junk food were significantly hypertensive ($\chi^2 = 6.07$, $p < 0.05$).

Table 2 shows the association of food consumption with systolic hypertension among the adolescents of Manipur. Sugar-free drinks were found to be associated with systolic hypertension in the totality of both the sexes with a p-value < 0.05 ($\chi^2 = 10.18$), where people consuming sugar-sweetened drinks (no sugar-free drinks) had significantly elevated SBP. Among males, consumption of sugar-sweetened drinks was found to be significantly associated with elevated SBP and systolic hypertension with a p-value < 0.05 ($\chi^2 = 7.44$); the same, however, was not evident among females. Consumption of salty food was also found to be associated with systolic hypertension in adolescent males ($\chi^2 = 13.01$) and in the totality of both sexes ($\chi^2 = 11.44$), although the same was not reflected in females. Junk food consumption, irrespective of gender, was found to be associated with systolic hypertension among the adolescents ($\chi^2 = 9.08$) where elevated systolic blood pressure and systolic hypertension were found to be significantly higher among those who consumed junk food.

Table 3 shows the association of food consumption with diastolic hypertension among the adolescents of Manipur. Diastolic hypertension among adolescents was found to be significantly higher among those who did not consume sugar free drinks, i.e., those adolescents who consumed sugar-sweetened drinks, as evident in the overall total of both the sexes with a p value < 0.05 ($\chi^2 = 4.86$). However, the same association was not reflected in males and females separately. Similarly, consumption of salty food, irrespective of sex, showed association with diastolic hypertension among adolescents with a p value < 0.05 ($\chi^2 = 4.26$).

Table 4 shows the association of food consumption with mean arterial pressure among the adolescents of Manipur. Adolescents who consumed sugar-sweetened drinks were found to have high MAP significantly more often than those who consumed sugar-free drinks ($\chi^2 = 6.96$, $p < 0.05$), though it was not reflected in males and females separately. Consumption of salty food was found to be associated with MAP in males and the totality of both sexes with a p value < 0.05, $\chi^2 = 9.88$ and $\chi^2 = 10.69$ respectively. A similar association of MAP with junk food was found in males and in the overall total with a p value < 0.05, $\chi^2 = 4.97$ and $\chi^2 = 8.76$ respectively. MAP in adolescents was also found to be associated with the consumption of egg ($p < 0.05$, $\chi^2 = 4.35$).

Table 1. Chi-square analysis of association of food habits with hypertension in Manipuri adolescents

Blood pressure		Male				Female				Total			
		Normal	Elevated	Hypertensive	X^2	Normal	Elevated	Hypertensive	X^2	Normal	Elevated	Hypertensive	X^2
Sugar free	Yes	32 (6.8)	37 (7.9)	44 (9.4)	5.78	36 (14.0)	2 (0.8)	16 (6.2)	2.99	68 (9.3)	39 (5.4)	60 (8.2)	8.37*
	No	146 (31.1)	98 (20.9)	113 (24.0)		153 (59.3)	12 (4.7)	39 (15.1)		299 (41.1)	110 (15.1)	152 (20.9)	
Milk	Yes	110 (23.4)	93 (19.8)	93 (19.8)	3.07	112 (43.4)	9 (3.5)	27 (10.5)	2.09	222 (30.5)	102 (14.0)	120 (16.5)	5.24
	No	68 (14.5)	42 (8.9)	64 (13.6)		77 (29.8)	5 (1.9)	28 (10.9)		145 (19.9)	47 (6.5)	92 (12.6)	
Salty	Yes	121 (25.7)	65 (13.8)	81 (17.2)	14.92*	116 (45.0)	11 (4.3)	30 (11.6)	2.78	237 (32.6)	76 (10.4)	111 (15.2)	12.28*
	No	57 (12.1)	70 (14.9)	76 (16.2)		73 (28.3)	3 (1.2)	25 (9.7)		130 (17.9)	73 (10.0)	101 (13.9)	
Egg	Yes	162 (34.5)	120 (25.5)	143 (30.4)	0.52	176 (68.2)	13 (5.0)	49 (19.0)	0.97	338 (46.4)	133 (18.3)	192 (26.4)	1.14
	No	16 (3.4)	15 (32)	14 (3.0)		13 (5.0)	1 (0.4)	6 (2.3)		29 (4.0)	16 (2.2)	20 (2.7)	
Non-Veg	Yes	171 (36.4)	123 (26.2)	145 (30.9)	3.48	172 (66.7)	13 (5.0)	51 (19.8)	0.19	343 (47.1)	136 (18.7)	196 (26.9)	0.78
	No	7 (1.5)	12 (2.6)	12 (2.6)		17 (6.6)	1 (0.4)	4 (1.6)		24 (3.3)	13 (1.8)	16 (2.2)	
Junk food	Yes	166 (35.3)	122 (26.0)	136 (28.9)	4.16	181 (70.2)	13 (5.0)	53 (20.5)	0.34	347 (47.7)	135 (18.5)	189 (26.0)	6.07*
	No	12 (2.6)	13 (2.8)	21 (4.5)		8 (3.1)	1 (0.4)	2 (0.8)		20 (2.7)	14 (1.9)	23 (3.2)	

Table 2. Chi-square analysis of association of food habits with systolic hypertension in Manipuri adolescents

Systolic blood pressure		Male				Female				Total			
		Normal	Elevated	Hyper-tensive	X^2	Normal	Elevated	Hyper-tensive	X^2	Normal	Elevated	Hyper-tensive	X^2
Sugar free drink	Yes	37 (7.9)	43 (9.1)	33 (7.0)	7.44*	37 (14.3)	16 (6.2)	1 (0.4)	1.72	74 (10.2)	59 (8.1)	34 (4.7)	10.18*
	No	163 (34.7)	125 (26.6)	69 (14.7)		157 (60.9)	45 (17.4)	2 (0.8)		320 (44.0)	170 (23.4)	71 (9.8)	
Milk	Yes	123 (26.2)	112 (23.8)	61 (13.0)	1.61	115 (44.6)	31 (12.0)	2 (0.8)	1.46	238 (32.7)	143 (19.6)	63 (8.7)	0.3
	No	77 (16.4)	56 (11.9)	41 (8.7)		79 (30.6)	30 (11.6)	1 (0.2)		156 (21.4)	86 (11.8)	42 (5.8)	
Salty food	Yes	132 (28.1)	88 (18.7)	47 (10.0)	13.01*	118 (45.7)	37 (14.3)	2 (0.8)	0.44	250 (34.3)	125 (17.2)	49 (6.7)	11.44*
	No	68 (14.5)	80 (17.0)	55 (11.7)		76 (29.5)	24 (9.3)	1 (0.2)		144 (19.8)	104 (14.3)	56 (7.7)	
Egg	Yes	183 (38.9)	150 (31.9)	92 (19.6)	0.52	180 (69.8)	55 (21.3)	3 (1.2)	0.7	363 (49.9)	205 (28.2)	95 (13.0)	1.27
	No	17 (3.6)	18 (3.8)	10 (2.1)		14 (5.4)	6 (2.3)	0 (0.0)		31 (4.3)	24 (3.3)	10 (1.4)	
Non-veg	Yes	192 (40.9)	153 (32.6)	94 (20.0)	3.93	177 (68.6)	56 (21.7)	3 (1.2)	0.3	369 (50.7)	209 (28.7)	97 (13.3)	1.24
	No	8 (1.7)	15 (3.2)	8 (1.7)		17 (6.6)	5 (1.9)	0 (0.0)		25 (3.4)	20 (2.7)	8 (1.1)	
Junk food	Yes	186 (39.6)	151 (32.1)	87 (18.5)	4.57	186 (72.1)	58 (22.5)	3 (1.2)	0.21	72 (51.1)	209 (28.7)	90 (12.4)	9.08*
	No	14 (3.0)	17 (3.6)	15 (3.2)		8 (3.1)	3 (1.2)	0 (0.0)		22 (5.0)	20 (2.7)	15 (2.1)	

Table 3. Chi-square analysis of association of food habits with diastolic hypertension in Manipuri adolescents

Diastolic blood pressure		Male			Female			Total		
		Normal	Hyper-tensive	X^2	Normal	Hyper-tensive	X^2	Normal	Hyper-tensive	X^2
Sugar free drinks	Yes	69 (14.7)	44 (9.4)	2.05	38 (14.7)	16 (6.2)	2.81	107 (14.7)	60 (8.2)	4.86*
	No	224 (51.9)	113 (24)		165 (64.0)	39 (15.1)		409 (56.2)	152 (20.9)	
Milk	Yes	203 (43.2)	93 (19.8)	1.41	121 (46.9)	27 (10.5)	1.96	324 (44.5)	120 (16.5)	2.41
	No	110 (23.4)	64 (13.6)		82 (31.8)	28 (10.9)		192 (26.4)	92 (12.6)	
Salty food	Yes	186 (39.6)	81 (17.2)	2.61	127 (49.2)	30 (11.6)	1.17	313 (43.0)	111 (15.2)	4.26*
	No	127 (27.0)	76 (16.2)		76 (29.5)	25 (9.7)		203 (27.9)	101 (13.9)	
Egg	Yes	282 (62.6)	143 (30.4)	0.12	189 (73.4)	49 (19.0)	0.97	471 (64.7)	192 (26.4)	0.09
	No	31 (6.6)	14 (3.0)		14 (5.4)	6 (2.3)		45 (6.2)	20 (2.7)	
Non-veg	Yes	294 (62.6)	145 (30.9)	0.42	185 (71.7)	51 (19.8)	0.14	479 (65.8)	196 (26.9)	0.03
	No	19 (4.0)	12 (2.6)		18 (7.0)	4 (1.6)		37 (5.1)	16 (2.2)	
Junk food	Yes	288 (61.3)	136 (28.9)	3.43	194 (75.2)	53 (20.5)	0.07	482 (66.2)	189 (260)	3.78
	No	25 (5.3)	21 (4.5)		9 (3.5)	2 (0.8)		34 (4.7)	23 (3.2)	

Table 4. Chi-square analysis of association of food habits with mean arterial pressure in Manipuri adolescents

Mean arterial pressure		Male			Female			Total		
		Optimal	High	X^2	Optimal	High	X^2	Optimal	High	X^2
Sugar free drinks	Yes	36 (7.7)	77 (16.9)	3.32	39 (15.1)	15 (5.8)	3.08	75 (10.3)	92 (12.6)	6.96*
	No	148 (31.5)	209 (44.5)		169 (65.5)	35 (13.6)		317 (43.5)	244 (33.5)	
Milk	Yes	110 (23.4)	186 (39.6)	1.32	124 (48.1)	24 (9.3)	2.22	234 (32.1)	210 (28.8)	0.60
	No	74 (15.7)	100 (21.3)		84 (32.6)	26 (10.1)		158 (21.7)	126 (17.3)	
Salty food	Yes	121 (25.7)	146 (31.1)	9.88*	129 (50.0)	28 (10.9)	0.61	250 (34.3)	174 (23.9)	10.69*
	No	63 (13.4)	140 (29.8)		79 (30.6)	22 (8.5)		142 (19.5)	162 (22.3)	
Egg	Yes	172 (36.6)	253 (53.8)	3.25	193 (74.8)	45 (17.4)	0.44	365 (50.1)	298 (40.9)	4.35*
	No	12 (2.6)	33 (7.0)		15 (5.8)	5 (1.9)		27 (3.7)	38 (5.2)	
Non-veg	Yes	177 (37.7)	262 (55.7)	3.82	190 (73.6)	46 (17.8)	0.22	367 (50.4)	308 (42.3)	1.02
	No	7 (1.5)	24 (5.1)		18 (7.0)	4 (1.6)		25 (3.4)	28 (3.8)	
Junk food	Yes	173 (36.8)	251 (53.4)	4.97*	199 (77.1)	48 (18.6)	0.01	372 (51.1)	299 (41.1)	8.76*
	No	11 (2.3)	35 (7.4)		9 (3.5)	2 (0.8)		20 (2.7)	37 (5.1)	

Table 5 shows the association of food consumption with pulse pressure. Salty food consumption was found to be significantly associated with pulse pressure as those who did not consume salty food had significantly higher pulse pressure – in males (38.98 ± 9.07 against those consuming salty food 36.07 ± 9.91) and in the totality of both genders (39.25 ± 7.74 against 37.77 ± 8.61). However, the same was not reflected in the female adolescents. Pulse pressure was not found to be associated with any other dietary habits than salt.

Table 5. t-test analysis of association of food habits with pulse pressure in Manipuri adolescents

Pulse pressure		Male	t	Female	t	Total	t
Sugar free drinks	Yes	38.07±9.82	0.92	41.00±3.80	1.19	39.02±8.45	1.03
	No	37.09±09		40.28±4.35		38.25±8.24	
Milk	Yes	37.27±9.01	0.17	40.32±4.23	0.5	38.28±7.88	0.57
	No	37.43±10.69		40.59±4.29		38.65±8.90	
Salty food	Yes	36.07±9.91	3.29*	40.65±4.53	1.05	37.77±8.61	2.59*
	No	38.98±9.07		40.10±3.78		39.25±7.74	
Egg	Yes	37.45±9.57	0.81	40.53±4.19	1.1	38.56±8.19	1.23
	No	36.13±10.45		39.30±4.82		37.11±9.17	
Non-veg	Yes	37.16±9.65	1.45	40.39±4.25	0.52	38.29±8.32	1.73
	No	39.74±9.54		40.90±4.31		40.21±7.75	
Junk food	Yes	37.24±9.79	0.71	40.49±4.29	1.42	38.43±8.35	0. 08
	No	38.17±8.30		39.09±3.14		38.35±7.37	

DISCUSSION

Diet is considered an important determinant of blood pressure. There is large evidence supporting the impact of dietary intake of salt and alcohol and body mass on blood pressure. A Dietary Approach to Stop Hypertension (DASH) trial revealed that a diet rich in fruit, vegetables, dairy products (low-fat content) along with reduction of fat and cholesterol and increase in protein substantially lowered blood pressure by 5.3/3.0 mmHg in normotensive and 11.4/5.5 mmHg in hypertensive individuals [16]. The substantial lowering of blood pressure with DASH diet showed a greater effect with reduction in salt intake [17]. Studies have reported salt or sodium intake to be directly associated with blood pressure levels and hypertension [11]. According to Parfrey et al. [18], blood pressure fell significantly on reducing sodium intake in patients with essential hypertension and not in normotensive individuals. Our present study also showed a significant association ($p < 0.05$ and $\chi^2 = 12.28$) of salty food consumption and hypertension. 15.2% of the total of adolescents consuming salty food were found to be hypertensive and 10.4% with elevated BP. The systolic and diastolic blood pressures separately were also found to be associated with salty food consumption where a significant difference of p value < 0.05, $\chi^2 = 11.4$ and $\chi^2 = 4.26$ respectively were recorded. MAP also showed a significant association with salty food consumption in males ($\chi^2 = 9.88$, $p < 0.05$) and in the totality of both sexes ($\chi^2 = 10.69$, $p < 0.05$). However, this association was incidentally seen only in the male adolescents and not among females. Moreover, among the male adolescents, consumption of salty food was associated with lower pulse pressure. The low pulse pressure recorded might possibly be due to the fact that 30.3% of the male adolescents consuming salty food had diastolic hypertension, which most likely resulted in lowering of pulse pressure. Also, the age factor plays a role, since high pulse pressure is naturally associated with old age and/or with prolonged hypertension, indicating the stiffening of the arteries. Of all the dietary changes, the most amenable change happens to be the dietary intake of salt, but about 80% of our salt intake is hidden in processed or junk foods [9]. Junk foods are high in salt, sugar, fat, calories and have a lower nutritional value [20]. In a cross-sectional study by Savitha et al. [21] conducted among 503 early and mid-adolescents, the hypertensives were recorded to have consumed more junk and oily foods, although the results were not significant. Our data showed a significant association of junk food consumption with hypertension, as the adolescents consuming junk food were significantly more hypertensive ($\chi^2 = 6.07$, $p < 0.05$). Additionally, MAP also showed significant association with junk food consumption among the adolescents ($\chi^2 = 8.76$, $p < 0.05$).

Studies have also shown associations between sugar intake and hypertension [22–24]. A cross-sectional study conducted by Mansoori et al. [25] reported a correlation between sugar intake and hypertension among female participants and concluded that a reduction of sugar intake by 2.3 teaspoons (~ ¼ of a can of soda) could potentially reduce the hypertension percentage of females recorded in their study from 47.1% to 21.4%. A significant increase of SBP and DBP by 7.6 mmHg and 6.1 mmHg respectively with higher intake of sugar has also been reported by a meta-analysis [23]. Based on a cross-sectional analysis of NHANES food questionnaire data from 2003–2006, conducted by Jalal et al. [26], the intake of 74g of fructose or more per day increased the risk of elevated SBP, and individuals with SBP between 140–159 mmHg were at a 36% greater risk, and individuals with SBP at least 160 mmHg had a double risk. The present study also showed a significant association of sugar free-drinks consumption with blood pressure, both systolic and diastolic. Adolescents who consumed sugar-sweetened drinks as compared to those who consumed sugar-free drinks were found to have significantly elevated blood pressure and hypertension ($p < 0.05$, $\chi^2 = 8.37$). Systolic and diastolic hypertensions were also significantly higher among those who opted for sugar-sweetened drinks. Furthermore, MAP was found to be associated with sugar consumption, as adolescents consuming sugar-sweetened drinks had significantly higher MAP than those consuming sugar-free drinks ($\chi^2 = 6.96$, $p < 0.05$).

STRENGTHS AND LIMITATIONS

Being a cross-sectional study, the major limitation would be the measurement of blood pressure during a single visit, although three measurements were taken on each participant to obtain the average value. The strength of the present study would be that it is the very first attempt to study the association of food habits with hypertension among the adolescents of Manipur.

CONCLUSION

Food is considered one of the major determinants of hypertension as it directly influences our blood pressure. Adolescent hypertension, although uncommon, has recently been on the rise as a result of our shift to modern lifestyle and food habits. The study highlighted the association of consumption of certain food, such as salt, sugar and junk food with hypertension among the adolescents of Manipur. Hence, along with recommendations to reduce the dietary intake of salt, a simultaneous check on consumption of processed foods is important as these foods are high in salt, sugar, trans fats, etc. Since adolescent hypertension poses a greater risk of cardiometabolic health problems later in adulthood, it is of absolute necessity to emphasize and draw attention to it at the earliest.

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