Comparison of salt taste threshold in normotensive offspring of normotensive and hypertensive parents

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ABSTRACT

Objective: To compare the salt taste threshold in normotensive offspring of normotensive and hypertensive parents.
Study Design: A cross-sectional comparative study.
Place and Duration: Physiology Department of CMH Multan Institute of Medical Sciences, Multan, from 15th January to 15th March 2019.
Methodology: Age and Body Mass Index matched 80 normotensive MBBS students were divided into two groups of 40 students each based on the absence and presence of parental history of hypertension. Salt taste threshold was determined in both the groups and compared.
Results: Independent-Samples T-test showed that the salt taste threshold was significantly higher in normotensive offspring of hypertensive parents as compared to offspring of normotensive parents (p=0.004).
Conclusion: The salt taste threshold in offspring of hypertensive parents was higher as compared to offspring of normotensive parents.
Keywords: BMI, Students, Normotensive, Hypertension, Taste perception, Taste threshold

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INTRODUCTION

Hypertension is a serious health problem affecting the entire world with dire consequences. A meta-analysis of the published studies related to estimation of burden and prevalence of hypertension indicated that around 3 in 10 Pakistani residents older than 15 years are hypertensive[1]. Hypertension is a major risk factor for cardiovascular diseases[2].

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Research has not merely focused on the treatment of hypertension but has also identified the risk factors of the disease, with family history of hypertension being one of the non-modifiable risk factors for primary hypertension[3]. As genetic predisposition is non-modifiable, identification of other modifiable risk factors in individuals with family history of hypertension is important as preventive measures and necessary interventions can be undertaken to lessen the risk of development of disease.

Increased salt intake is linked to development of hypertension[4]. According to World Health Day Report 2013 by World Health Organization, increased dietary salt intake was highlighted as seventh leading risk for mortality and morbidity[5]. Sodium mediated changes in blood pressure are thought to be a result of disruption of renal functions, body fluid regulation, diminished endothelial functions, left ventricular hypertrophy and exaggerated responsiveness of sympathetic nervous system[6].

Salt taste threshold can influence the intake of salt in the diet[7]. The relationship between salt taste sensitivity and hypertension has been studied in various population groups. Reduced salt taste sensitivity and higher salt taste threshold were found in hypertensive as compared to normotensive individuals[8,9]. In addition, relationship between family history of hypertension and salt taste threshold has also been explored, and significant association was found between parental history of hypertension and salt taste threshold in adolescents,[10] however the results have been inconsistent[9,11].

Links between genetic predisposition to development of hypertension and salt taste perception have also been explored[7,12].

Due to prevalence of hypertension in Pakistan, it can be worthwhile to determine and compare the salt taste threshold between individuals with and without the family history of hypertension. As increasing age makes an individual more susceptible to development of high blood pressure[13,14] identification of reduced salt taste sensitivity in adolescence can be beneficial for decreasing the risk of development of hypertension as dietary modifications aimed at reduction of salt intake can be timely advised. Therefore, the objective of this study was to compare salt taste threshold between normotensive adolescent offspring of normotensive and hypertensive parents.

METHODOLOGY

This cross-sectional comparative study was conducted at department of Physiology of CMH Multan Institute of Medical Sciences, Multan from 15th January to 15th March 2019, after approval from Ethical Review Board of the Institute (Letter no. TW/25/CIMS, 7th January 2019). Ethical approval was obtained from Institutional Review Board & Ethical Committee (IRB&EC) of CMH Multan Institute of Medical Sciences, Multan, before commencing the research.

Sample size was calculated by OpenEpi, an online sample size calculator, with confidence interval and statistical power set at 95% and 80% respectively. The sampling frame comprised of 80 normotensive MBBS students of ages between 18-21 years (late adolescents), with blood pressure readings below 120/80 mmHg,[14] divided through purposive sampling into two study groups of 40 students (20 male and 20 female students) each- Hypertensive offspring group and Normotensive offspring group (control). The division into these two groups was done on the basis of presence or absence of parental history of hypertension. Only those students who had blood pressure readings lower than 120/80 mmHg (normotensive) were included in the study.

The Normotensive offspring group (n=40) consisted of those students whose parents (both) were normotensive and had blood pressure readings below 120/80 mmHg on three separate occasions (verified by written medical records and history obtained from students). On the other hand, the Hypertensive offspring group (n=40) consisted of those students whose parents (one or both) were either diagnosed with hypertension, taking anti-hypertensive medication or having systolic blood pressure greater than 130mmHg and diastolic blood pressure greater than 80mmHg on three separate occasions (verified by written medical records and history obtained from students).

Students with blood pressure readings equal and greater than 120/80 mmHg (hypertensive) on three separate occasions or those who had altered taste sensation due to smoking, recent drug usage or any disease, were excluded from the study.

The MBBS students who had met the above mentioned inclusion and exclusion criteria were approached to voluntarily participate in the study with a reassurance that there would be no repercussions otherwise. A detailed explanation of the procedure, safety and harmless nature of solutions to be used in the study were provided to the participants and a written consent was obtained.

Detailed personal and family history was obtained. Blood pressure was measured by sphygmomanometer in sitting position and Systolic Blood pressure (SBP) and Diastolic Blood Pressure (DBP) readings were used to calculate Mean Arterial Blood Pressure (MABP)(mmHg)[15]. Anthropometric parameters such as height (meters) and weight (kilograms) were measured using a height scale and weighing machine to calculate the Body Mass Index (BMI) using the formula BMI (kg/m^2)=Weight (kg)/Height (m^2).

To determine Salt taste threshold (STT) six different strengths of salt solutions, 15mM, 30mM, 45mM, 60mM, 75mM and 90mM, were prepared from 1M sodium chloride stock solution all of which were stored in clean bottles at room temperature and were prepared afresh after one week.[10] Students were blinded by not revealing to them that salt solutions in particular were being used for testing and were instructed to indicate the taste they perceived using cards labeled: sweet, salty, bitter, sour and water. Testing was initiated with the solution of minimum strength first and then subsequent higher concentrations were tested one by one, with two to three drops of a solution dropped on the tongue with the help of a dropper. The students were allowed to take their time to indicate the taste. Between testing two solutions, students were asked to rinse the mouth with water.

Data Analysis: Statistical analysis of the data was done using IBM SPSS Statistics 20. Mean, standard deviations and frequency distribution were calculated for the variables. Independent samples t-test was used as the statistical test and p value less than 0.05 was considered significant.

RESULTS

A total of 80 students participated in study. Table-I shows comparison of age and BMI of both groups which could have been possible confounders. The independent samples t-test showed insignificant difference in mean age and BMI of both groups, indicating that both groups were comparable in terms of these two parameters.

Table-I: Comparison of Age and BMI of both groups (N=80)

Variable	Group	n	Mean	Std. Deviation	t-value (at 95% CI)	p-value
Age (years)	Normotensive Offspring Group	40	19.45	1.04	0.746	0.458
	Hypertensive Offspring Group	40	19.28	1.06		
BMI (kg/m^2)	Normotensive Offspring Group	40	22.36	2.57	0.864	0.390
	Hypertensive Offspring Group	40	22.84	2.40		

Frequency distribution of different strengths of salt solutions used to measure Salt Taste Threshold (STT) (Table-II) revealed that more students in hypertensive offspring group (42.5%,

35.0% and 5.0%) perceived salt taste at higher concentrations (45mM, 60mM and 75mM) as compared to normotensive offspring group (32.5%, 20.0% and 0.0%).

Table-II: Frequency distribution of different strengths of salt solutions used to measure Salt Taste Threshold (STT) (N=80)

Group		STT (mM)						Total
		15	30	45	60	75	90	
Normotensive Offspring Group (n=40)	Frequency	2	17	13	8	0	0	40
	% within group	5.0%	42.5%	32.5%	20.0%	0.0%	0.0%	100%
Hypertensive Offspring Group (n=40)	Frequency	1	6	17	14	2	0	40
	% within group	2.5%	15.0%	42.5%	35.0%	5.0%	0.0%	100%

Table-III shows comparison of means of Mean Arterial Blood Pressure (MABP) and Salt Taste Threshold (STT) between two groups. Although the mean of MABP was higher in Hypertensive Offspring Group, there was no significant difference between the means of two groups by independent samples t-test. Mean STT was significantly higher in Hypertensive Offspring group as compared to Normotensive Offspring group (p=0.004).

Table-III: Comparison of Mean Arterial Blood Pressure (MABP) and Salt Taste Threshold (STT) of both groups by Independent-Samples T-test (N=80)

Variable	Group	N	Mean	Std. Deviation	t-value (at 95% CI)	p-value
MABP (mmHg)	Normotensive Offspring Group	40	83.64	6.36	0.467	0.642
	Hypertensive Offspring Group	40	84.33	6.93		
STT (mM)	Normotensive Offspring Group	40	40.13	12.88	2.975	0.004*
	Hypertensive Offspring Group	40	48.75	13.05		

mM- milimole, p-value marked with an asterick(*) is statistically significant

DISCUSSION

In this study more students in hypertensive offspring group perceived salt taste at higher concentrations as compared to normotensive offspring group, and mean Salt Taste Threshold (STT) was significantly higher (p=0.004) in Hypertensive Offspring group (48.75 ± 13.05) as compared to Normotensive Offspring group (40.13 ± 12.88).

A study held in India in 2015 involving MBBS students of the same age group had also compared STT between groups of similar characteristics and revealed that MABP and STT were higher in offspring of hypertensive parents as compared to normotensive parents[10]. In our study, although MABP was higher in offspring of hypertensive parents, the difference was not statistically significant. It can be explained by the fact that due to our inclusion criteria only those students were included in the study whose blood pressure readings were lower than 120/80 mmHg according to 2017 AHA guidelines for classification of hypertension which defines normal blood pressure as SBP<120 mmHg and DBP<80mmHg[14].

As South Asian cuisine relies heavily on salt for taste and flavor and consumption of processed food is on the rise,[16] Pakistani population is at a higher risk of developing hypertension and other adverse effects caused by high dietary sodium. Higher STT in adolescent offspring of hypertensive parents means that due to reduced salt taste sensitivity they are unknowingly taking excess salt in the diet and are increasing their chances of succumbing to hypertension[17].

Most of the studies have been aimed at finding a relationship between salt taste threshold and blood pressure. A study that explored the association between STT and blood pressure concluded that higher STT were associated with high systolic and diastolic blood pressures in adults[8]. The STT and salt usage behaviour scores of adults in Mayanmar and Korea revealed that STT correlated with systolic blood pressure[9]. However a study published in 2017[11] based on its findings had concluded that STT might not be related to blood pressure. Another study attempted to relate disruption between salty taste response and blood pressure to increased bodyweight[18]. Although the BMI of offspring of hypertensive parents was higher in our study, the difference was not significant. The findings of these studies indicate that salt taste threshold might be influenced by other factors apart from parental history of hypertension.

In our study, the frequency of students from hypertensive offspring group who had perceived salt taste at higher concentrations was greater as compared to those from normotensive offspring group. These findings support the existing theory that diminished salt taste sensitivity and genetic predisposition to development of hypertension may be genetically linked. One phenotype, Hp 1-1, of a gene encoding Haptoglobin (a hemoglobin binding plasma protein) has been linked to elevated blood pressure and salt sensitivity[12]. It was found out that single nucleotide polymorphisms in the genes encoding two of the salt taste receptors, ENaC (epithelial sodium channel) and TRPV 1 (transient receptor potential cation subfamily V member 1 channel), resulted in modification in salt taste perception and taste sensitivity[7].

This study was limited by the fact that it only took factors like age and BMI into consideration but could not take into account other factors that can also influence taste perception in human beings, for example, distribution and presence of different sub-types of taste receptors,[19] mental status[20] of students etc.

CONCLUSION

This study showed that the salt taste threshold in offspring of hypertensive parents was higher as compared to offspring of normotensive parents.

Recommendations: Based on the findings of this study, it is recommended that:

1. More studies should be conducted in Pakistan in order to

determine the salt taste thresholds in individuals susceptible to development of hypertension.
2. Further research should also be carried out in order to explain the mechanism of difference in salt taste threshold between individuals and how it is linked to family history of hypertension.

AUTHOR'S CONTRIBUTION

Arshad S: Designed research methodology, Data collection, Data analysis, Literature search, Manuscript writing
Bashir MU: Conceived idea, Critical revision of manuscript
Naeem S: Data analysis, Data interpretation
Faiza: Data collection, Literature search
Saleem M: Data collection, Literature search
Fatima S: Data collection, Literature search
All authors gave the final approval and agreed to be accountable for all parts of the work

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