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A comparative study of serum zinc levels in male hypertensive and non-hypertensive individuals in Peshawar Khyber Pakhtunkhwa, Pakistan

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ABSTRACT

Background: Numerous studies have shown that serum levels of trace elements including zinc play an essential role in regulation of hypertension. **Objective:** The objective of current study is to evaluate the differences in serum zinc levels among hypertensive and non-hypertensive male participants from Peshawar Khyber Pakhtun Khwa in Pakistan. **Method:** The study comprised of 140 adult males (70 hypertensive and 70 non-hypertensive). The subject's age, weight, heights, and medical histories were acquired with informed consent on a well-designed proforma. Fresh blood samples were taken from 140 male participants in a Gel tube. The lipid profile test assessed total cholesterol, triglycerides, low-density lipoprotein, and high-density lipoprotein. An atomic absorption spectrophotometer with an acetylene flame was used for determination of serum zinc levels under normal conditions (Model Perkin Elmer AAS 700). **Results:** The mean serum zinc level (0.07115mg/dL) was lower in hypertensive subjects in comparison with non-hypertensive subjects (0.3428mg/dL).**Conclusion:** The mean serum zinc level in hypertensive subjects was lower than in non-hypertensive subjects.

Keywords: Hypertension, Zinc, Lipid profile, Trace elements

INTRODUCTION

Hypertension is a severe global public health issue predicted to cause 7.5 million fatalities worldwide, accounting for around 12.5% of deaths1. Several surveys reveal that hypertension is rising in developing nations due to urbanization, population aging, changes in dietary patterns, limited access to health services, and high prescription costs 2. According to the National Health Survey, hypertension affects 18% of adults in Pakistan and 33% of those over 45 years old. It was also claimed that only half of those diagnosed with hypertension were ever treated, and only half of those diagnosed were ever treated 3. Hypertension is a syndrome with several causes rather than a single illness4. As defined by the Seventh Joint National Committee on High Blood Pressure (JNC VII) in the United States, hypertension is a persistent systolic blood pressure of ≥140mmHg and diastolic blood pressure of ≥ 90mmHg on at least two readings taken at least 8 hours apart5. Hypertension is classified as either primary or secondary. Primary (essential) hypertension is defined as high blood pressure for no apparent reason. On the other hand, secondary hypertension is defined as high blood pressure caused by a particular and possibly curable cause, such as renal illness, endocrine reasons, or medications6. Hypertension is a significant modifiable risk factor for stroke, congestive heart failure, end-stage renal disease, and vascular disease 7. Trace elements account for less than 0.1% of the body's dry weight8. A total of 28 elements have been linked to blood pressure regulation. However, the significance of these elements in the etiology and regulation of blood pressure is yet unknown9. In addition, there have been conflicting findings on the relationship between trace elements such as Zn, Cu, and Mn and blood pressure regulation10.

Zinc is a transition metal with significant catalytic, structural, and regulatory functions11. The human body has two to four grams of zinc12. Zinc is a cofactor and structural component found in around 10% of human proteins11, 13. Zn is essential in a variety of biochemical and metabolic activities in humans. For example, Zn is involved in the energy metabolism of carbohydrates, proteins, and lipids14. Zinc influences blood pressure. It has been proposed that a disruption in the equilibrium of Zn metabolism might result in elevated blood pressure15. Numerous human studies suggest a link between zinc levels and hypertension, such as that hypertensive people have lower zinc levels and a lower Zinc/Copper ratio as compared to normal individuals 16-17. In specific hypertensive individuals, Zinc has been reported to reduce blood pressure18. According to few studies, deficiency of Zn, Cu, or Mn may be linked to an increased risk of hypertension 19-20. Another study found that hypertensive Lacto-vegetarians had lower erythrocyte membrane zinc than normal Lacto-vegetarians21. Additional study found reduced zinc levels in the hair of obese hypertensive people22. The relevance of zinc in blood pressure regulation has been strongly shown in human studies by modification of dietary zinc levels. Zinc deficiency has been suggested to have a role in blood pressure regulation by modifying the taste of salt23. In healthy young females, increasing dietary zinc consumption improves salt taste acuity24. As a result, those deficient in zinc prefer to eat more salt, raising blood pressure 23. As zinc and copper are necessary for various enzymatic tasks involved in maintaining the circulatory system's integrity, it has been postulated that zinc and copper may be implicated in the pathophysiology of hypertension25.

The current research assessed serum zinc levels in hypertension and non-hypertensive male individuals in Khyber Pakhtunkhwa, Pakistan.

MATERIALS AND METHODS

3.1 Study subjects:

The study population (n=140) comprises of 70 hypertensive and 70 non-hypertensive males individuals, aged 18-65. The research participants' age, weights, heights, BMI, and medical histories were obtained on a well-designed proforma. The research data was conducted between March 19, 2020, and April 5, 2020, at AIMS (Abaseen Institute of Medical Sciences), Phase 5, Hayatabad Peshawar, Pakistan, a tertiary care hospital and research Centre. The research was authorized by letter number 18/006.

3.2 Collection of blood

5 mL of venous blood was collected in a gel tube from 140 male volunteers (Hypertensive and Non-Hypertensive). The blood samples were centrifuged at room temperature for 10 minutes. The resultant blood serum was effectively separated using centrifugation. After centrifugation, the samples were transferred to serum cups using a dropper and then refrigerated in the refrigerator to prevent the loss of trace components contained in the samples.

3.3 Measurements

Participants' height and weight were assessed while they stood without shoes or heavy outerwear. BMI was computed by dividing weight in kilograms by height in meters squared (kg/m2). After 5 minutes of rest, doctor measured the patient's blood pressure using conventional blood pressure testing techniques. A mercury sphygmomanometer was used to collect two measurements separated by at least eight minutes, which were then averaged. According to the WHO classification for hypertension, persons with a blood pressure of 140/90 mmHg were labeled hypertensive. 70 of the 140 individuals were found hypertensive, whereas the other participants comprised the control group. 14 hypertensive were between the age range of 18 and 39, 33 were between the age of 40 and 59, and 23 were older than 60.

3.4 Biochemical tests

A volume of 5 mL of venous blood was collected, and serum was used for biochemical tests. Enzymatic colorimetric methods estimated lipid parameters (TC, TG, LDL, and HDL). Every sample was then diluted with deionized water at a ratio of 1.5:13.5. Under standard conditions, serum zinc (Normal Serum Level of zinc: 0.5-1.2mg/L) was measured using an atomic absorption spectrophotometer with an acetylene flame (Model Perkin Elmer AAS 700). Zinc standards were made by diluting the stock standard solution with 5% (v/v) glycerol to 0.5ppm, 1.0ppm, and 1.5ppm, as indicated in the "Standard Conditions" for zinc. A 5% (v/v) glycerol solution was employed as a blank.

3.5 Statistical analysis

SPSS for Windows 21.0 software (SPSS Inc. Chicago, IL, USA) and Microsoft Excel were used to analyze the data. The results were expressed as Mean ± Standard Deviation (SD). Pearson's correlation analysis was used to assess the relationship between the necessary parameters. Statistical significance was defined as a two-tailed p-value of less than 0.05.

RESULTS

4.1 Comparison of baseline parameters of study subjects

Table 01. show the baseline and biochemical parameters of the study population. The mean BMI (26.320kg/m2) and mean level of LDL (131.95mg/dB), Triglyceride (218.85mg/dB), and Total Cholesterol (215.90mg/dB), was high in hypertensive subjects as compare to mean BMI (24.315kg/m2) and mean level of LDL (107.38mg/dL), Triglyceride (186.92mg/dL), and Total Cholesterol(187.69mg/dL) in non-hypertensive subjects. The mean level of HDL (33.35mg/dL) and Serum Zn (0.07115mg/dL) was low in hypertensive subjects as compare to mean level of HDL (39.31mg/dL) and Serum Zn (0.3428mg/dL) in non-hypertensive subjects.

Table 1. Comparison of baseline and biochemical characteristics of the study population.

S. No	Parameter	Hypertensive (n=70)				Non-hypertensive (n=70)			
		Min	Max	Mean	SD	Min	Max	Mean	SD
1	BMI(Kg/m2)	22.1	31.1	26.320	2.175	21.6	29.1	24.315	2.601
2	HDL(mg/dL)	27	39	33.35	3.392	32	52	39.31	5.736
3	LDL(mg/dL)	109	154	131.95	11.896	97	121	107.38	7.827
4	TG(mg/dL)	161	347	218.85	53.649	109	243	186.92	44.858
4	TC(mg/dL)	173	263	215.90	30.197	96	288	187.69	51.787
5	Zn (mg/dL)	0.009	0.178	0.0712	0.0416	0.186	0.757	0.3428	0.1553

SD= Std. Deviation, Max= Maximum, Min= Minimum

4.2 Correlation analysis of various parameters in hypertensive and non-hypertensive subjects

Table 02 shows the Bivariate Pearson's correlation analysis of Serum Zn with BMI, HDL, LDL, Triglyceride, and total cholesterol in hypertensive and non-hypertensive subjects. No significant correlation was found for serum Zn level in both study populations with any parameter.

Table 2. Bivariate Pearson's correlation analysis of Serum Zn with BMI, HDL, LDL, Triglyceride, and total cholesterol in hypertensive and non-hypertensive subjects.

S. No	Variable	Serum Zn(mg/dL)			
		Hypertensive (n=70)		Non-hypertensive (n=70)	
		r	p	r	p
1	BMI	0.140	0.555	-0.132	0.668
2	HDL	0.053	0.824	-0.334	0.265
3	LDL	0.221	0.350	-0.345	0.248
4	TG	0.039	0.870	-0.148	0.630
5	TC	0.138	0.561	-0.486	0.092

DISCUSSION

Low consumption of fruits, vegetables, and potassium, excessive salt (NaCl) intake, excess body weight, and insufficient physical exercise are significant dietary and metabolic variables for raised blood pressure 26, 27. It is vital to note other variables, such as trace elements like copper and zinc, play significant role in regulation of hypertension 28. Numerous human population based studies have found a direct link between zinc and hypertension. Bergomi, Rovesti, et al. (1997) hypothesizes the presence of a trace element imbalance including zinc, in path physiology of hypertension29.

Endogenous and exogenous variables may cause changes in zinc metabolism, contributing to arterial hypertension. For example, zinc deficiency causes increasing arterial blood pressure and a deteriorating loss of zinc homeostasis. On the other hand, excessive zinc consumption may cause increased zinc absorption after passing the intestinal barrier, leading to intracellular zinc accumulation, enzyme, signaling pathway failure, elevated arterial blood pressure, and loss of zinc homeostasis30. Zinc deficiency results in hard, brittle, and inflammatory arteries rather than soft and flexible, which leads to hypertension, especially systolic pressure 31. Furthermore, an increase in intracellular zinc inside the cell is hypothesized to generate an increase in free calcium ion levels in the smooth muscle layer of blood vessels, resulting in vasoconstriction, peripheral resistance, and hypertension. 31.

Numerous human population based studies have found a direct link between zinc and hypertension. However, the findings of these studies are contradictory. This contradiction implies that the link between zinc and hypertension varies, depending on exposure amounts, duration, and geographic location. Henrottei et al.,1990 and Davydenkoi et al., 1995 discovered a link between high zinc levels in the blood and primary hypertension 32, 33. Some studies found high zinc levels in certain hypertensive patients 34, whereas others found no significant difference in blood zinc levels between people with essential hypertension and normal controls35. Another study found that the mean blood zinc levels in hypertensive participants were considerably more significant than in control subjects and increased gradually from pre hypertension to stage II hypertension 31.

To analyze the serum zinc level and seek a possible link between these trace elements and hypertension, we did a cross-sectional examination of 70 hypertensive and 70 non-hypertensive male individuals. We found that the mean serum Zn level in hypertensive participants (0.0715 mg/dL) was lower than that in non-hypertensive subjects (0.3428 mg/dL). This is consistent with prior research, which found that hypertensive people had the same low Zn levels as compared to control group. Bergomi, Rovesti, et al. (1997) did case-control research with 120 people, 60 hypertensive and 60 non-hypertensive, and discovered that hypertensive participants' mean serum zinc level (850 µg/L) was lower than non-hypertensive subjects' (866 µg/L) 29. Dawelbait, Rabo, et al. (2018) conducted a case-control study in Khartoum, Sudan, with 100 participants hypertensive (n=50) and non-hypertensive (n=50), and found that the hypertensive had a lower level of zinc (0.121 mg/L) than the control group (0.856 mg/L) 28. Similarly, Tubek (2005) and Tomat et al. (2005) discovered a lower serum zinc level in hypertensive patients in comparison to controls30, 36.

Our study also indicates hyperlipidemia in hypertensive subjects as their serum has a higher level of TC, TG, LDL-C, and a lower level of HDL-C than non-hypertensive, which have a lower level of TC, TG, LDL-C, and a higher level of HDL-C. A few studies showed an association between hypertension and hyperlipidemia37. Serum lipid profiles, especially total cholesterol, triglycerides, LDL-C, and HDL-C, are significantly associated with hypertension. A study in Bangladesh showed a higher level of LDL-C, TG, TC, and lower HDL-C in hypertensive subjects, as per our findings 38. TC, TG, and LDL-C levels are high in hypertensive subjects with a low level of serum zinc. This shows the role of Zinc as an antioxidant. As mentioned in earlier research39, lipid peroxidation will be increased when the level of Zinc is decreased, and the level of TC, TG, and LDL-C will be increased.

We believe that our study is the first in Pakistan to highlight the role of zinc in hypertension However; there are some inevitable limitations to the research. First, to begin with, the small sample size consists of just 140 young male hypertensive and non-hypertensive participants who visited only one tertiary care health center in Peshawar. Since the population of this city is exceedingly diversified due to the inflow of Afghan refugees, the results of this study cannot be considered typical of Khyber-Pakhtunkhwa residents. Second, limited source of funding for the study. Consequently, further research with more significant populations is needed for improved outcomes.

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CONFLICT OF INTEREST

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

AUTHOR CONTRIBUTIONS

Each author has contributed significantly to, and is willing to take public responsibility for, one or more aspects of the study: its design, data collection, analysis and interpretation of data, drafting the manuscript, and revising it for important intellectual content. All authors have read and approved the final version of the manuscript to be published.

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