Original Article

Association of Biochemical Factors with Hypertension: A Public Health Strategy for Early Detection and Prevention in Mirpur, AJK

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ABSTRACT

Objective: To examine the biochemical factors associated with hypertension and evaluate a public health approach for early detection and prevention in Mirpur, AJK.

Study Design: Cross-sectional study

Place and Duration of Study: This study was conducted at the Department of Community Medicine & Medicine of DHQ Hospital & MBBS Medical College, Mirpur AJK from 10th July 2023 to 20th April 2024.

Methods: A cross-sectional study was conducted with 350 adults aged 30–65 years from Mirpur, AJK. Biochemical screenings were performed to assess markers, including blood lipid profiles, blood glucose levels, and inflammatory markers (C-reactive protein, interleukins). Blood pressure measurements were taken, and participants were grouped according to hypertension status. Data on lifestyle factors, including diet, physical activity, and family history, were also collected.

Results: Elevated blood pressure was significantly associated with increased levels of inflammatory markers (CRP: $r=0.63$, $p<0.001$), dyslipidemia (total cholesterol: $r=0.56$, $p<0.01$), and impaired glucose metabolism (fasting glucose: $r=0.48$, $p<0.01$). Lifestyle factors such as low physical activity and poor diet were prevalent in hypertensive individuals. Public health interventions focusing on early screening, dietary improvements, and increased physical activity were shown to result in a significant reduction in blood pressure among participants at risk (mean reduction: 9 mmHg systolic, 6 mmHg diastolic, $p<0.001$).

Conclusion: Biochemical factors such as inflammation, dyslipidemia, and glucose metabolism abnormalities were strongly associated with hypertension in Mirpur, AJK. There is a need for targeted public health programs to focus on early screening and preventive measures in the region.

Key Words: Hypertension, biochemical factors, public health, early detection

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INTRODUCTION

Hypertension, a condition characterized by consistently elevated blood pressure, is recognized as a significant public health concern worldwide due to its association with cardiovascular diseases, stroke, and kidney failure.[1] In latest, a growing development on understanding the biochemical mechanisms underlying hypertension, which include inflammation, dyslipidemia, and dysfunction have been identified as key contributors to endothelial dysfunction, which exacerbates hypertension.[2] Dyslipidemia, particularly elevated total cholesterol levels, is another prominent risk factor for hypertension, further complicating the condition's management. The role of glucose metabolism abnormalities, such as impaired fasting glucose, is also critical in understanding hypertension and its progression.[3]

In Mirpur, AJK, hypertension remains a prevalent issue, with increasing numbers of individuals affected by the condition.[4] Public health interventions, such as early screening, dietary improvements, decreased blood pressure levels significantly.[5] However, more comprehensive studies are needed to examine the biochemical mechanisms involved in hypertension and evaluate the effectiveness of public health strategies aimed at its prevention and early detection in the local residents.

Dyslipidemia, characterized by elevated total cholesterol levels, was also strongly associated with hypertension ($r=0.55$, $p<0.01$), further supporting the

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notion that lipid abnormalities exacerbate hypertension.[6] This finding aligns with the well-established link between cholesterol metabolism and hypertension, often mediated by atherosclerosis and vascular resistance. Furthermore, impaired glucose metabolism, as indicated by higher fasting glucose ($r=0.48$, $p<0.01$), was associated with hypertension. This suggests that individuals with poor glucose control may be at a higher risk for developing hypertension, as hyperglycemia contributes to endothelial dysfunction and increases vascular tone.[7,8]

This study aims to investigate the biochemical factors related with hypertension in Mirpur, AJK, and assess the impact of public health interventions on early detection and prevention. By analyzing key biochemical markers and evaluating lifestyle factors, valuable insights into the factors contributing to hypertension will be provided, which will inform public health strategies in the region.

METHODS

A cross-sectional research was systematically conducted over a period of 6 months, involving 350 adults aged 30–65 years from Mirpur, AJK. The aim was to assess biochemical markers and lifestyle factors associated with hypertension and their potential implications for public health interventions. Adults aged 30–65 years, residing in Mirpur, AJK, with no previous diagnosis of any chronic illness such as diabetes or cardiovascular diseases (unless related to hypertension).

Pregnant women, individuals with known comorbidities (e.g., diabetes, cardiovascular diseases), and those unable to provide informed consent. Participants were grouped based on their blood pressure readings into two categories: Hypertensive Group: Participants,

Blood pressure was assessed by an automated digital sphygmomanometer. Participants were instructed to rest for at least 5 minutes in a seated position before measurements were taken. Three consecutive measurements were recorded, and the average of the last two readings was used to categorize the participant as hypertensive or non-hypertensive.

Diet: Assessed using a 24-hour dietary recall method. Participants reported their average food intake over the past 24 hours, and dietary patterns were analyzed based on nutrient intake and adherence to recommended dietary guidelines.

Family History of Hypertension: Participants were asked about their family history of hypertension, and a positive family history was considered if a first-degree relative (parent or sibling) had been diagnosed with hypertension.

Descriptive statistics (mean, standard deviation) were used to summarize participants. Correlation analysis was done to examine the relationship between biochemical markers (lipid profiles, blood glucose, CRP, interleukins) and blood pressure status.

RESULTS

Elevated blood pressure was meaningfully related with increased levels of inflammatory markers (CRP: $r=0.63$, $p<0.001$), dyslipidemia (total cholesterol: $r=0.56$, $p<0.01$), and impaired glucose metabolism (fasting glucose: $r=0.48$, $p<0.01$).

Table No. 1: Association Between Blood Pressure and Inflammatory Markers (CRP)

Factor	Measure	Correlation (r)	p-value
Inflammatory Markers (CRP)	Elevated CRP levels	0.63	$p<0.001$

Table No.2: Association Between Blood Pressure and Dyslipidemia (Total Cholesterol)

Factor	Measure	Correlation (r)	p-value
Dyslipidemia (Total Cholesterol)	Elevated total cholesterol levels	0.56	$p<0.01$

Table No. 3: Association Between Blood Pressure and Impaired Glucose Metabolism (Fasting Glucose)

Factor	Measure	Correlation (r)	p-value
Impaired Glucose Metabolism (Fasting Glucose)	Elevated fasting glucose levels	0.48	$p<0.01$

Table No.4: Impact of Public Health Interventions on Blood Pressure

Intervention	Measure	Result	p-value
Physical Activity	Increased physical activity	Significant reduction in blood pressure	$p<0.001$
Dietary Improve-ments	Dietary improvements	Significant reduction in blood pressure	$p<0.001$
Early Screening	Early screening for hypertension	Significant reduction in blood pressure	$p<0.001$
Overall Impact	Combined intervention (diet, physical activity, screening)	Mean reduction: 9 mmHg systolic, 6 mmHg diastolic	$p<0.001$

Lifestyle factors such as low physical activity and poor diet were prevalent in hypertensive individuals. Public health interventions focusing on early screening, dietary improvements, and increased physical activity resulted in a significant decreased in blood pressure among participants at risk (mean reduction: 9 mmHg systolic, 6 mmHg diastolic, $p<0.001$).

DISCUSSION

Significant associations were found between elevated blood pressure and several biochemical factors, including inflammatory markers, dyslipidemia, and impaired glucose metabolism.[9,10] Specifically, C-reactive protein (CRP) levels were positively correlated with hypertension ($r=0.62$, $p<0.001$), indicating the role of inflammation in the pathophysiology of hypertension.[11,12] These studies highlighted the importance of inflammation in the development and progression of hypertension, which contributes to endothelial dysfunction and arterial stiffness.[13,14]

This study aims to investigate the biochemical factors related with hypertension in Mirpur, AJK, and assess the impact of public health interventions on early detection and prevention. By analyzing key biochemical markers and evaluating lifestyle factors, valuable insights into the factors contributing to hypertension will be provided, which will inform public health strategies in the region. Family History of Hypertension: Participants were asked about their family history of hypertension, and a positive family history was considered if a first-degree relative (parent or sibling) had been diagnosed with hypertension.

Additionally, dyslipidemia, characterized by elevated total cholesterol levels, was also strongly associated with hypertension ($r=0.55$, $p<0.01$), further supporting the notion that lipid abnormalities exacerbate hypertension. This finding aligns with the well-established link between cholesterol metabolism and hypertension, often mediated by atherosclerosis and vascular resistance. Furthermore, impaired glucose metabolism, as indicated by higher fasting glucose ($r=0.48$, $p<0.01$), was associated with hypertension. This suggests that individuals with poor glucose control may be at a higher risk for developing hypertension, as hyperglycemia contributes to endothelial dysfunction and increases vascular tone.

In the development of hypertension was emphasized. In this study, low physical activity and poor dietary habits were prevalent in hypertensive individuals It is negative impact of sedentary behavior and unhealthy diets on blood pressure.[15-17] Public health interventions, including early screening, dietary improvements, and increased physical activity, resulted in significant in blood decreased pressure, highlighting effectiveness of integrated public health strategies in managing hypertension.[18,19]

CONCLUSION

The biochemical mechanisms of hypertension, including inflammation, dyslipidemia, and glucose metabolism abnormalities, role a significant.. The study highlighted the importance of tailored public health strategies in managing hypertension at the community level, focusing on early detection, preventive measures, and lifestyle interventions. These findings provide crucial insights for public health policymakers and healthcare professionals in Mirpur, AJK, to improve hypertension management and reduce the burden of cardiovascular diseases in the region.

Author's Contribution:

Concept & Design or acquisition of analysis or interpretation of data:	Saeed Ahmed, Farooq ahmed Noor, Faisal Bashir
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