**Biochemical Profiles in Hypertensive Patients Attending Adeoyo Teaching Hospital, Ibadan: Insights for Improved Management Strategies.**

**Abstract**

**Introduction:** A leading cause of cardiovascular disorders and metabolic dysregulation, hypertension continues to pose a serious threat to global health. Urbanization, dietary changes, and sedentary lifestyles are some of the factors contributing to the rising prevalence of hypertension in Sub-Saharan Africa, including Nigeria. Understanding the biochemical profiles of hypertensive people is critical for devising successful management regimens, particularly in resource-limited situations.

**Aim/Objective:** The purpose of this study was to compare the biochemical analytes of hypertension patients at Adeoyo Teaching Hospital in Ibadan, Nigeria, with those of non-hypertensive controls. By examining these profiles, the research aims to clarify metabolic trends and lay the groundwork for better control of hypertension.

**Method:** Fifty hypertension patients and fifty non-hypertensive controls, matched by age and sex, participated in a cross-sectional comparative study. Biochemical indicators such as electrolytes (sodium, potassium, chloride, and bicarbonate), fasting glucose, lipid profiles (triglycerides, total cholesterol, HDL, and LDL), albumin, creatinine, and total protein were measured in blood samples. IBM SPSS version 26 was used to analyze the data, and t-tests, Pearson's correlation, and descriptive statistics were used.

**Results:** In comparison to controls, hypertensive patients had significantly lower sodium levels (138.32 ± 2.59 mmol/L, p < 0.0001), significantly higher fasting glucose (101.96 ± 27.51 mg/dL, p < 0.0001), triglycerides (125.44 ± 21.96 mg/dL, p < 0.0001), and total cholesterol (225.04 ± 40.39 mg/dL, p = 0.0358). Positive correlations between triglycerides and total cholesterol (r = 0.54, p = 0.0001) and between triglycerides and fasting glucose (r = 0.30, p = 0.0365) were found by correlation analysis, indicating linked metabolic changes.

**Conclusion:** The study's findings emphasize the metabolic complexity of hypertension and call for multidisciplinary approaches to patient management, community-based dietary interventions, and routine biochemical monitoring. It also emphasizes the significance of thorough biochemical profiling in hypertensive care.

**Keywords:** Hypertension, Biochemical Profile, Electrolytes, Lipid Profile, Nigeria

1. **Introduction**

Often referred to as the "silent killer," hypertension is a widespread worldwide health concern that greatly increases the risk of cardiovascular illnesses like heart attacks, strokes, and renal failure. The World Health Organization (WHO) estimates that 1.4 billion people worldwide suffer from hypertension, and estimates indicate that number could increase to 1.5 billion by 2025 [1][2]. It is concerning to note that only 14% of people with hypertension are able to adequately manage their disease. In low- and middle-income nations, where control rates might fall below 5%, this number is especially concerning [3]. Modifiable lifestyle factors, such as poor food habits, obesity, and physical inactivity, aggravate the illness [4]. A mix of pharmacological treatments and lifestyle changes is essential for the effective management of hypertension. But there are still significant gaps in knowledge, early diagnosis, and availability to efficient therapies [5]. In order to lessen the serious health effects of hypertension, recent WHO publications highlight the urgent need for comprehensive public health initiatives that prioritize education, early diagnosis, and better access to treatment [3].

Hypertension is becoming more common in Sub-Saharan Africa, especially in Nigeria, as a result of sedentary lifestyles, dietary changes, and urbanization. Around 38.1% of Nigerian adults suffer from hypertension; prevalence rates vary by area and rise sharply with age, peaking at 63% among those over 70 [6]. Poor eating habits, such as consuming a lot of salt and relying on highly processed foods, as well as genetic predispositions and a lack of understanding of hypertension, are contributing factors [7][8]. The issue is made worse by systemic obstacles, such as disjointed healthcare systems, which result in just 10% of hypertension patients obtaining proper care [7]. The significance of culturally specific approaches to improve public health outcomes in the area is shown by the potential of community-based health promotion initiatives to raise awareness and lower the prevalence of hypertension [9][6].

In order to manage hypertension, biochemical profiling is essential since it can be used to detect metabolic changes that raise the risk of cardiovascular disease. Research indicates that people with hypertension frequently have dyslipidemia, which is defined by higher triglyceride and lower HDL cholesterol levels. More than half of patients with hypertension exhibit numerous lipid abnormalities at the time of presentation [10][11]. Additionally, compared to normotensive controls, hypertensive people frequently have higher fasting blood glucose levels, suggesting serious abnormalities in glucose metabolism [11][12]. In order to direct individualized therapies and enhance clinical outcomes, these metabolic anomalies highlight the importance of early identification and thorough biochemical evaluations.

According to certain reports, the prevalence of hypertension in some communities might reach 32.2% [13], which highlights the need for focused approaches to treat related metabolic disorders. A multimodal strategy that incorporates medication, lifestyle changes, and routine biochemical marker monitoring is necessary for the effective management of hypertension in order to reduce cardiovascular risks [14][12]. Evaluating the biochemical profiles of hypertension patients that visit Adeoyo Teaching Hospital in Ibadan is the goal of this study. The main goals are to determine the prevalence of metabolic abnormalities linked to hypertension in the study population, evaluate changes in important biochemical markers, such as lipid profiles, electrolyte levels, and glucose metabolism, among hypertensive patients, and offer evidence-based insights to guide successful hypertension management strategies.

**2. Materials and Methods**

**2.1 Study Design and Setting:**  This cross-sectional comparative study was undertaken at Adeoyo Teaching Hospital, Ibadan, Oyo State, Nigeria. The hospital's diverse patient base makes it a perfect place to assess biochemical changes linked to hypertension.

**2.2 Study Population**: Fifty hypertension patients and fifty non-hypertensive controls made up the study's 100 participants. Age and sex matching was used to reduce confounding variables.

**2.3 Inclusion and Exclusion Criteria**

**Inclusion Criteria:**

* Adults aged 18 years and older
* Diagnosed hypertensive patients (for the hypertensive group)
* Non-hypertensive individuals with normal blood pressure readings (for controls)

**Exclusion Criteria:**

* Pregnant or lactating women
* Individuals on lipid-lowering or diuretic medications
* Patients with known diabetes, renal disease, or other significant comorbid conditions

**2.4 Sample Size Determination**: A conventional procedure for comparing two independent means was used to determine the sample size, taking into account a 95% confidence level and an 80% power level. To identify statistically significant differences, each group has to have at least 50 participants.

**2.5 Ethical Considerations:** Ethical permission was received from the hospital’s ethical review board. Prior to being enrolled in the study, each participant gave written informed consent. Throughout the research process, strict adherence to confidentiality and data protection protocols was maintained.

**2.6 Data Collection**

**2.6.1 Clinical and Demographic Data:** A standardized questionnaire was used to gather data on lifestyle characteristics, medical history, age, and sex. A calibrated sphygmomanometer was used to assess blood pressure.

**2.6.2 Sample Collection:** Sterile syringes were used to draw venous blood samples in an aseptic setting. To preserve the integrity of the biochemical markers, samples were processed within two hours of collection.

**2.6.3 Biochemical Analysis:** Serum was separated by centrifugation and analyzed for:

* **Electrolytes:** Sodium (Na), Potassium (K), Chloride (Cl), Bicarbonate (HCO3)
* **Lipid Profiles:** Total cholesterol, Triglycerides, HDL, LDL
* **Fasting Blood Glucose (FBG)**
* **Renal Function Markers:** Creatinine, Albumin, and Total Protein

Automated spectrophotometry and standardized enzymatic techniques were used for the analyses. The correctness and dependability of the results were guaranteed by internal and external quality control procedures.

**2.7 Statistical Analysis:** Software called IBM SPSS version 26 was used to examine the data. Demographic and biochemical data were compiled using descriptive statistics (means, standard deviations). The means of the hypertension and non-hypertensive groups were compared using independent t-tests. Relationships between biochemical markers were evaluated using Pearson's correlation coefficient. The threshold for statistical significance was p < 0.05.

**3.0Results**

# **Table 1: Distribution of Demographic Characteristics of Participants**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Variable** | **Category** | **Hypertensive**  **N (%)** | **Non-hypertensive**  **N (%)** | **P-value** |
| Age Group(years) | 0-20 | 1 (2.00%) | 0 (0.00%) | 0.0037\* |
|  | 21-30 | 6 (12.00%) | 0 (0.00%) |  |
|  | 31-40 | 7 (14.00%) | 0 (0.00%) |  |
|  | 41-50 | 7 (14.00%) | 4 (8.00%) |  |
|  | 51-60 | 11 (22.00%) | 17 (34.00%) |  |
|  | 61-70 | 12 (24.00%) | 14 (28.00%) |  |
|  | 71-80 | 4 (8.00%) | 13 (26.00%) |  |
| Total | 81-90 | 2 (4.00%)  50 (100%) | 2 (4.00%)  50 (100%) |  |
| Gender | Male | 13 (26.00%) | 27 (54.00%) | 0.008\* |
| Total | Female | 37 (74.00%)  50 (100%) | 23 (46.00%)  50 (100%) |  |
| Place of Residence | Ibadan | 50 (100.00%) | 50 (100.00%) | N/A |
| State of Origin | Oyo | 31 (62.00%) | 50 (100.00%) | 0.002\* |
|  | Ebonyi | 5 (10.00%) | 0 (0.00%) |  |
|  | Enugu | 4 (8.00%) | 0 (0.00%) |  |
|  | Ogun | 3 (6.00%) | 0 (0.00%) |  |
|  | Kogi | 3 (6.00%) | 0 (0.00%) |  |
|  | Benue | 1 (2.00%) | 0 (0.00%) |  |
|  | Ekiti | 1 (2.00%) | 0 (0.00%) |  |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Kwara | 1 (2.00%) | 0 (0.00%) |  |
|  | Osun | 1 (2.00%) | 0 (0.00%) |  |
| Nationality | Nigerian | 50 (100.00%) | 50 (100.00%) | N/A |
| Marital Status | Single | 5 (10.00%) | 1 (2.00%) | 0.05 |
|  | Married | 27 (54.00%) | 33 (66.00%) |  |
|  | Widow | 10 (20.00%) | 6 (12.00%) |  |
|  | Divorced | 3 (6.00%) | 10 (20.00%) |  |
| Educational Status | No formal education | 12 (24.00%) | 18 (36.00%) | 0.003 |
|  | Primary six certificate | 3 (6.00%) | 0 (0.00%) |  |
|  | Junior school | 9 (18.00%) | 21 (42.00%) |  |
|  | Senior school  certificate | 10 (20.00%) | 8 (16.00%) |  |
|  | Graduate | 15 (30.00%) | 3 (6.00%) |  |
|  | Postgraduate | 1 (2.00%) | 0 (0.00%) |  |
| Unemployed | Yes | 18 (36.00%) | 41 (82.00%) | 0.00 |
|  | No | 32 (64.00%) | 9 (18.00%) |  |
| Profession | Self-employed | 30 (60.00%) | 6 (12.00%) | 0.11 |
|  | Civil Servant | 2 (4.00%) | 3 (6.00%) |  |

**Dietary History**

**Table 2 Distribution of the Dietary History of the Participants**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Variable** | **Response** | **Hypertensive**  **N (%)** | **Nonhypertensive N**  **(%)** | **P-value** |
| Fruits and vegetables | Daily | 15 (30.00%) | 28 (56.00%) | 0.004\* |
|  | Severally a week | 23 (46.00%) | 20 (40.00%) |  |
|  | Rarely | 12 (24.00%) | 2 (4.00%) |  |
| Total |  | 50 | 50 |  |
| Whole grain | Daily | 35 (70.00%) | 22 (44.00%) | 0.02\* |
|  | Severally a week | 9 (18.00%) | 12 (24.00%) |  |
|  | Rarely | 6 (12.00%) | 16 (32.00%) |  |
| Total |  | 50 | 50 |  |
| Lean protein sources | Daily | 34 (68.00%) | 22 (44.00%) | 0.02\* |
|  | Severally a week | 11 (22.00%) | 12 (24.00%) |  |
|  | Rarely | 5 (10.00%) | 16 (32.00%) |  |
| Total |  | 50 | 50 |  |
| Dairy products | Daily | 15 (30.00%) | 14 (28.00%) | 0.00004\* |
|  | Severally a week | 16 (32.00%) | 34 (68.00%) |  |
|  | Rarely | 19 (38.00%) | 2 (4.00%) |  |
| Total |  | 50 | 50 |  |
| Processed meat | Daily | 10 (20.00%) | 11 (22.00%) | 0.07 |
|  | Severally a week | 4 (8.00%) | 12 (24.00%) |  |
|  | Rarely | 36 (72.00%) | 27 (54.00%) |  |

Total 50 50

Add salt to food Always 10 (20.00%) 20 ([[1]](#footnote-1)0.00%) 0.000\*

Sometimes 8 (16.00%) 22 (44.00%)

Rarely 32 (64.00%) 8 (16.00%)

Total 50 50

Sugary drinks Daily 16 (32.00%) 13 (26.00%) 0.60

**Hypertension Awareness**

# Participants’ Hypertension Awareness

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Variable** | **Category** | **Hypertensive N**  **(%)** | **Non-hypertensive N**  **(%)** | **Pvalue** |
| Diagnosed with high blood  Pressure | Yes | 20 (40.00%) | 10 (20.00%) | 0.05 |
|  | No | 30 (60.00%) | 40 (80.00%) |  |
| Know current blood  Pressure | Yes | 18 (36.00%) | 0 (0.00%) | 0.00\* |
|  | No | 32 (64.00%) | 50 (100.00%) |  |
| Are you currently receiving treatment? | Yes | 12 (24.00%) | 5 (10.00%) | 0.11 |
|  | No | 8 (16.00%) | 5 (10.00%) |  |

**Laboratory Results Analysis**

# Table 5: **Comparison between Blood Chemistry Biomarkers of Hypertensive and Non-hypertensive Group**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Biomarker** | **Hypertensive**  **SD** | **Mean** | **±** | **Non-hypertensive**  **SD** | **Mean** | **±** | **P-value** |
| Tc(mg/dl) | 225.04 ± 40.39 |  |  | 204.69 ± 54.16 |  |  | 0.0358\* |
| Trig(mg/dl) | 125.44 ± 21.96 |  |  | 102.20 ± 28.23 |  |  | 0.000016\* |
| HDL(mg/dl) | 71.57 ± 15.52 |  |  | 69.52 ± 30.96 |  |  | 0.6765 |
| LDL(mg/dl) | 90.78 ± 17.83 |  |  | 94.84 ± 35.89 |  |  | 0.4759 |
| FBG(mg/dl) | 101.96 ± 27.51 |  |  | 80.07 ± 14.15 |  |  | 0.000004\* |
| Alb(g/dl) | 4.12 ± 0.58 |  |  | 6.27 ± 9.66 |  |  | 0.1253 |
| Creatinine(mg/dl) | 0.95 ± 3.10 |  |  | 1.42 ± 3.42 |  |  | 0.0006\* |
| Tp (g/dl) | 6.93 ± 0.91 |  |  | 9.63 ± 11.90 |  |  | 0.1193 |
| Na (mmol/L) | 138.32 ± 2.59 |  |  | 141.88 ± 3.80 |  |  | 0.0000004\* |
| K (mmol/L) | 4.34 ± 0.63 |  |  | 4.69 ± 5.55 |  |  | 0.6648 |
| Cl – ( mmol/L) | 103.92 ± 3.91 |  |  | 115.09 ± 132.35 |  |  | 0.5537 |
| Hco3-( mmol/L) | 23.16 ± 3.41 |  |  | 24.81 ± 16.00 |  |  | 0.4830 |

**Table 6: Correlation Analysis between the Blood Chemistry Biomarkers of Hypertensive Group**

|  |  |  |  |
| --- | --- | --- | --- |
| **Biomarker 1** | **Biomarker 2** | **Correlation Coefficient** | **P-value** |
| Trig | TC | 0.54 | 0.0001\* |
| HDL | TC | 0.28 | 0.0461\* |
| LDL | TC | 0.45 | 0.0009\* |
| Glu | TC | 0.37 | 0.0076\* |
| Alb | TC | 0.20 | 0.1538 |
| Tp | TC | 0.10 | 0.4874 |
| Na | TC | 0.12 | 0.3961 |
| K | TC | 0.48 | 0.0005\* |
| Cl- | TC | 0.10 | 0.4826 |
| Hco3- | TC | -0.25 | 0.0774 |
| HDL | TG | 0.50 | 0.0003\* |
| LDL | TG | 0.53 | 0.0001\* |
| Glu | TG | 0.30 | 0.0365\* |
| Alb | TG | 0.08 | 0.5951 |
| Tp | TG | 0.31 | 0.0290\* |
| Na | TG | 0.20 | 0.1643 |
| K | TG | 0.36 | 0.0104\* |
| Cl- | TG | 0.19 | 0.1885 |
| Hco3- | TG | 0.04 | 0.8040 |
| LDL | HDL | 0.53 | 0.0001\* |
| FPG | HDL | 0.04 | 0.7606 |
| Alb | HDL | -0.29 | 0.0379\* |
| Tp | HDL | 0.31 | 0.0259\* |
| Na | HDL | -0.06 | 0.6712 |
| K | HDL | 0.09 | 0.5169 |
| Cl- | HDL | 0.11 | 0.4580 |
| Hco3- | HDL | 0.20 | 0.1575 |
| Glu | LDL | 0.38 | 0.0065\* |
| Alb | LDL | 0.09 | 0.5545 |
| Tp | LDL | 0.06 | 0.7018 |
| Na | LDL | 0.13 | 0.3858 |

|  |  |  |  |
| --- | --- | --- | --- |
| K | LDL | 0.28 | 0.0526 |
| Cl- | LDL | 0.03 | 0.8165 |
| Hco3- | LDL | -0.01 | 0.9369 |
| Alb | FPG | 0.09 | 0.5237 |
| Tp | FPG | 0.18 | 0.2020 |
| Na | FPG | 0.18 | 0.2204 |
| K | FPG | 0.43 | 0.0018\* |
| Cl- | FPG | 0.29 | 0.0403\* |
| Hco3- | FPG | -0.03 | 0.8358 |
| Tp | ALB | 0.17 | 0.2310 |
| Na | ALB | 0.24 | 0.0891 |
| K | ALB | 0.54 | 0.0001\* |
| Cl- | ALB | 0.33 | 0.0209\* |
| Hco3- | ALB | -0.29 | 0.0425\* |
| Na | Tp | 0.17 | 0.2310 |
| K | Tp | 0.10 | 0.4936 |
| Cl- | Tp | 0.16 | 0.2663 |
| Hco3- | Tp | 0.05 | 0.7421 |
| K | Na | 0.24 | 0.0891 |
| Cl- | Na | 0.02 | 0.9021 |
| Hco3- | Na | -0.18 | 0.2240 |
| Cl- | K | 0.45 | 0.0009\* |
| Hco3- | K | -0.23 | 0.1156 |
| Hco3- | Cl- | 0.38 | 0.0059\* |
| Tc | Creatinine | -0.27 | 0.0606 |
| Trig | Creatinine | 0.03 | 0.8294 |
| HDL | Creatinine | -0.26 | 0.0698 |
| LDL | Creatinine | 0.03 | 0.8258 |
| Glu | Creatinine | 0.04 | 0.8013 |
| Alb | Creatinine | 0.13 | 0.3784 |

|  |  |  |  |
| --- | --- | --- | --- |
| Tp | Creatinine | 0.12 | 0.4178 |
| Na | Creatinine | 0.05 | 0.7504 |
| K | Creatinine | -0.06 | 0.6912 |
| Cl- | Creatinine | -0.10 | 0.4962 |
| Hco3- | Creatinine | -0.17 | 0.2338 |

**4. Discussion**

Significant biochemical and demographic differences between hypertensive and non-hypertensive individuals were found in this study, which is important because it sheds light on the metabolic disruptions associated with hypertension. Hypertensive patients had higher fasting glucose levels (101.96 ± 27.51 mg/dL) than controls (80.07 ± 14.15 mg/dL, p < 0.0001). Elevated glucose levels are indicative of impaired glucose regulation, which is a common feature of hypertensive patients and significantly increases cardiovascular risk. This finding is consistent with global research showing that hypertension frequently coexists with prediabetes or diabetes [15][16]. The link between diabetes and other metabolic diseases highlights the importance of hypertension as a cardiovascular risk factor, which accounts for over 7.1 million deaths globally each year [17]. Furthermore, metabolic profiling has revealed a number of metabolites associated with hypertension, underscoring the complex relationship between metabolic dysregulation and hypertension [18]. In order to reduce cardiovascular risks, these findings highlight the significance of early screening for glucose regulation in hypertension patients [16].

Similarly, hypertensive subjects had considerably higher triglycerides (125.44 ± 21.96 mg/dL) than controls (102.20 ± 28.23 mg/dL, p < 0.0001). The interconnectedness of lipid metabolism was highlighted by the positive correlations found between elevated triglycerides, a defining feature of dyslipidemia, and both total cholesterol (r = 0.54, p = 0.0001) and LDL cholesterol (r = 0.53, p = 0.0001). Additionally, hypertension people had significantly higher total cholesterol levels (225.04 ± 40.39 mg/dL) than non-hypertensives (204.69 ± 54.16 mg/dL, p = 0.0358). These results highlight how crucial it is to keep an eye on lipid profiles in hypertension patients because high cholesterol and triglyceride levels greatly increase the risk of cardiovascular disease [19].[20]. In hypertension care, routine lipid profiling is essential for identifying high-risk patients and directing focused interventions.

It's interesting to note that hypertension patients had considerably lower sodium levels (138.32 ± 2.59 mmol/L) than controls (141.88 ± 3.80 mmol/L, p < 0.0001). The effects of antihypertensive drugs or dietary salt limitations may be to blame for this decrease [22]. Sodium levels and lipid characteristics did not significantly correlate, according to correlation studies, indicating separate regulatory processes. Although reduced sodium levels may help control blood pressure, more research is necessary to fully comprehend their wider significance in the treatment of hypertension [22].

The interaction between glucose and lipid metabolism is shown by positive correlations between fasting glucose and triglycerides (r = 0.30, p = 0.0365), which show how hypertension affects several biochemical processes systemically [23]. The occurrence of dyslipidemia in hypertension individuals is further supported by lower HDL cholesterol levels, even if these values are not substantially different between the hypertensive and non-hypertensive groups [24]. The need for integrated metabolic assessments to guide comprehensive hypertension management regimens is further supported by these biochemical disruptions.

Public health interventions should focus on addressing these underlying factors, emphasizing community-based education, early biochemical screening, and improved access to healthcare services to enhance hypertension management outcomes [25]. The results of this study are in line with regional and international research, providing specific insights pertinent to the Nigerian context. Dietary patterns marked by high salt intake and limited consumption of nutrient-dense foods, along with restricted access to healthcare services, likely contribute to the observed metabolic disturbances.

The significance of routine biochemical profiling in the treatment of hypertension is highlighted by this study. Increased levels of biochemical markers, including cholesterol, triglycerides, and glucose, are known risk factors for cardiovascular disorders. Finding these indicators and their relationships lays the groundwork for individualized treatment plans that try to lessen the long-term effects of hypertension and enhance patient outcomes in general.

**5. Conclusion**

Hypertension is associated with severe metabolic abnormalities, including dyslipidemia, poor glucose regulation, and altered electrolyte levels. The significance of regular biochemical profiling in detecting these anomalies, which can direct individualized treatment plans, is illustrated by this study. The results highlight the necessity of comprehensive care strategies that incorporate patient education, frequent biochemical parameter monitoring, and dietary changes. By addressing these characteristics, healthcare professionals can enhance hypertension management and lower the associated burden of cardiovascular illnesses in resource-limited countries like Nigeria.

**6. Recommendations**

To alleviate the burden of hypertension and its repercussions, this study proposes using community-based nutritional interventions to boost the consumption of fruits, vegetables, and whole grains while reducing salt intake. Regular screening programs should be implemented to enable early diagnosis and ongoing monitoring of hypertension and critical biochemical indicators, particularly in high-risk groups such as older persons and women. Public health campaigns should promote exercise and improve patient education regarding the significance of following treatment plans and changing one's lifestyle. Finally, to address the complex nature of managing hypertension and enhance patient outcomes overall, an integrated multidisciplinary care strategy involving nutritionists, pharmacists, and primary care physicians is crucial.

**Disclaimer (Artificial intelligence)**

Option 1:

Author(s) hereby declare that generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

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1. **Table 3: Distribution of Health History of the Participants**

   |  |  |  |  |  |
   | --- | --- | --- | --- | --- |
   | **Pre-existing Health Conditions** | **Category** | **Hypertensive**  **N (%)** | **Nonhypertensive N**  **(%)** | **P-value** |
   | Family history of hypertension | Yes | 11 (22.00%) | 9 (18.00%) | 0.47 |
   |  | Unsure | 17 (34.00%) | 23 (46.00%) |  |
   |  | No | 22 (44.00%) | 18 (36.00%) |  |
   | Diabetes | Yes | 0 (0.00%) | 0 (0.00%) | 0.05 |
   |  | No | 50 (100.00%) | 50 (100.00%) |  |
   | Heart Disease | Yes | 0 (0.00%) | 0 (0.00%) | N/A |
   |  | No | 50 (100.00%) | 50 (100.00%) |  |
   | Kidney Disease | Yes | 0 (0.00%) | 0 (0.00%) | N/A |
   |  | No | 50 (100.00%) | 50 (100.00%) |  |
   | Stroke | Yes | 0 (0.00%) | 0 (0.00%) | N/A |
   |  | No | 50 (100.00%) | 50 (100.00%) |  |
   | Obesity | Yes | 0 (0.00%) | 0 (0.00%) | N/A |
   |  | No | 50 (100.00%) | 50 (100.00%) |  |
   | Sleep Apnea | Yes | 0 (0.00%) | 0 (0.00%) | N/A |
   |  | No | 50 (100.00%) | 50 (100.00%) |  |
   | High Cholesterol | Yes | 1 (2.00%) | 0 (0.00%) | 0.001\* |
   |  | No | 49 (98.00%) | 50 (100.00%) |  |

   **Table 4: Distribution of Health Behavior and Lifestyle of Participants**

   |  |  |  |  |  |
   | --- | --- | --- | --- | --- |
   | **Variable** | **Category** | **Hypertensive N**  **(%)** | **Non-hypertensive**  **N (%)** | **P-value** |
   | Smoke cigarettes | Yes | 1 (2.00%) | 8 (16.00%) | 0.04\* |
   |  | No | 49 (98.00%) | 42 (84.00%) |  |
   | Drink regularly | Yes | 3 (6.00%) | 1 (2.00%) | 0.61 |
   |  | No | 47 (94.00%) | 49 (98.00%) |  |
   | Follow regular  exercise routine | Yes | 6 (12.00%) | 25 (50.00%) | 0.0001\* |
   |  | No | 44 (88.00%) | 25 (50.00%) |  |

   [↑](#footnote-ref-1)