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Assessment of fasting blood glucose, serum electrolyte, albumin, creatinine, urea, and lipid profile among hypertensive patients and non-hypertensive participants at wolaita sodo university teaching and referral hospital, SNNPR, Ethiopia

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This is to certify that the thesis prepared by **Berhanu Haile**, entitled: ***assessment of fasting blood glucose, serum electrolyte, albumin, creatinine, urea and lipid profile in hypertensive patients and non-hypertensive participants at wolaita sodo university teaching and referral hospital, SNNPR, Ethiopia***; 2020 and submitted in partial fulfillment of the requirements for Master of Science degree in Clinical Laboratory Sciences (Clinical chemistry track) complies with the regulations of the University and meets the accepted standards concerning originality and quality.

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List of abbreviations

BMI	Body mass index
CLSI	Clinical Laboratory Standard Institute
DBP	Diastolic blood pressure
ESRD	End-stage renal disease
FBG	Fasting Blood glucose
HDL-C	High density lipoprotein cholesterol
HTN	Hypertension
IFCC	International Federation of Clinical Chemistry
ISO	International Organization for Standardization
Kg/m^2	Kilograms per square meter
LDL-C	Low density lipoprotein cholesterol
mg/dL	mill gram per deciliter
mm Hg	millimeters of mercury
NCD	Non-communicable diseases
OPD	Outpatient department
AOR	Adjusted Odd ratio
RPM	Revolution per Minute
SNNPR	South Nations Nationalities and Peoples Region
SBP	Systolic blood pressure
SOP	Standard Operating Procedure
SPSS	Statistical package for social science
TC	Total cholesterol
TG	Triglyceride
WHO	World health organization
WSUTRH	Wolaita Sodo university teaching and referral hospital

Abstract

Background: Hypertension is a silent killer that requires long term management to avoid complications. It is one of major public health problem in developing counties like Ethiopia. Hypertension increases the risk of morbidity and mortality and has negative consequences on the cognitive and physical fitness of productivity in adults.

Objective: To assess fasting blood glucose, serum electrolyte, albumin, creatinine, urea, and lipid profile among hypertensive patients and non-hypertensive participants at wolaita sodo teaching and referral hospital.

Methods: A comparative cross-sectional study was conducted from December 2019 to February 2020. On the study a total of 156 study participants (78 cases and 78 controls) were involved. Each study participant, after signing informed consent, interviewed about the socio-demographic and anthropometric characterstic features. Then 5ml of the blood sample was collected from each 78 patients with hypertension and each 78 samples from apparently healthy subjects from WSUTRH during the period. Fasting blood glucose, serum electrolyte, albumin, creatinine, urea, and lipid profile level were measured in each group. The Data were analyzed by using Epi data version 3.1 and SPSS version 25 software (IBM Corporation, USA) and results were summarized using means and percentages and presented by using figures and tables. P-value < 0.05 was considered to be significant at 95% confidence level. Any abnormal laboratory results of study subjects dispatched and communicated with physicians for better management.

Results: The mean age of hypertensives and control study groups were 50 ± 10.0 and 51 ±11.3 years respectively. The body mass index of hypertensives and control study groups were 53.4% and 34.2% overweighed respectively. The mean ± SD of fasting blood glucose, total cholesterol, LDL-C, TG, RFT were significantly increases while serum sodium, calcium, albumin, and HDL-Cholesterol significantly decreased in hypertensives when compared with non-hypertensives and serum potassium was no statistical significance among case and control groups.

Conclusion: In present study, we observed that the hypertensive group was at risk for developing biochemical alteration in creatinine, urea, fasting blood glucose, lipid profile, electrolytes, and albumin test parameters with an increased period of time.

Recommendation: Regular measurements of biochemical parameters strongly needed for hypertensive patients.

Keywords: Hypertension, blood glucose, serum electrolyte, albumin, Ethiopia

1. Introduction

1.1 Background:

Hypertension is higher pressure in blood vessels that harder the heart has to work to push blood around the body. If left uncontrolled, hypertension can lead to a heart attack, an enlargement of the heart, and eventually heart failure. Blood vessels may develop bulges (aneurysms) and weak spots due to high pressure, making them more likely to clog and burst. The pressure in the blood vessels can also cause blood to leak out into the brain. This can cause a stroke. Persistent hypertension is one of the risk factors for stroke, myocardial infarction, heart failure, and arterial aneurysm, and is a leading cause of chronic kidney failure. Dietary and lifestyle changes can improve blood pressure control and decrease the risk of associated health complications, although drug treatment may prove necessary in patients for whom lifestyle changes prove ineffective or insufficient. Normal adult blood pressure is defined as a blood pressure of 120 mm Hg when the heart beats (systolic) and blood pressure of 80 mm Hg when the heart relaxes (diastolic). However, the cardiovascular benefits of normal blood pressure extend to lower systolic (105 mm Hg) and lower diastolic blood pressure levels (60 mm Hg). (1)

Blood pressure is influenced by various genetic and lifestyle factors including nutrition. In this regard, sodium is an important mineral which, besides its functions in fluidbalance, action potential generation, digestive secretions, and absorption of many nutrients, also plays an important role in blood pressure regulation with a reduced sodium intake being associated with a reduction in systolic and diastolic blood pressure. Therefore, independent of body weight, sex, and age, too much dietary salt (sodium chloride) is regarded as an established risk factor for hypertension. Concomitant to sodium reduction, higher potassium intake, or supplementation has also been repeatedly shown to reduce the blood pressure of, especially hypertensive persons. (2)

High sodium and low potassium inhibit the sodium pump, increase intracellular sodium, and drive calcium into cells, which ultimately induce vascular smooth muscle contraction and increased peripheral vascular resistance. A new pathway of sodium storage in the human body has been identified. Excess sodium stored in the subcutaneous lymphatic system (on proteoglycans in interstitial space), where it becomes osmotically inactive, can act as a fluid buffering system to blunt the blood pressure increase during excessive salt intake. (3)

High blood pressure Hypertension has been associated with elevated atherogenic blood lipid fractions, but epidemiological surveys often give inconsistent results across population subgroups. A better understanding of the relation between blood pressure and blood lipids may provide insight into the mechanism(s) whereby hypertension is associated with an increased risk of coronary heart disease. (4)

The occurrence and development of hypertension is a continuous and long-term process. Blood pressure is a sensitive index for diagnosing hypertension, can reflect the progression of hypertension to some extent. (5)

Hypertension (High blood pressure) is above 140/90 mm/Hg and it's classified as either primary (essential) hypertension or secondary hypertension; about 90–95% of cases are categorized as "primary hypertension," which means high blood pressure with no obvious medical cause. The remaining 5–10% of cases (Secondary hypertension) are caused by other conditions that affect the kidneys, arteries, heart, or endocrine system. (6)

According to the WHO, approximately 1.13 billion people worldwide have hypertension, most (two-thirds) living in low- and middle-income countries(1). The main modifiable causes of high blood pressure are diet, especially salt intake, obesity, excessive alcohol intake, and smoking status. Hypertension is estimated to cause 7.1 million deaths, about 13% of the total worldwide(8).

1.2 Statement of the Problem

Hypertension is a global public health crisis, especially in developing countries and is a major risk factor for stroke, myocardial infarction, vascular disease, and chronic kidney disease. The WHO African Region has the highest prevalence of hypertension (27%) while the WHO Region of the Americas has the lowest prevalence of hypertension (18%). A review of current trends shows that the number of adults with hypertension increased from 594 million in 1975 to 1.13 billion in 2015 (7). Globally, hypertension is responsible for 62% of cerebrovascular disease and 49% of ischaemic heart disease. Hypertension is estimated to cause 7.1 million deaths, about 13% of the total worldwide. (8)

In South Africa, the risk of death from high blood pressure has increased by 25% in less than a decade. Serial surveys done in Tanzania with the same methods in 1987 and 1998 showed an increase in the prevalence of hypertension from 25.4% to 41.1% in males and from 27.2% to 38.7% in females for rural and urban populations. This high prevalence of hypertension and poor hypertension control are important factors in the rising epidemic of cardiovascular disease in developing countries. Deaths from a stroke in the Middle East and North Africa will nearly double by 2030. Between 1990 and 2020 mortality from ischaemic heart disease in developing countries is expected to increase by 120% for women and 137% for men. Two-thirds of all strokes and half of all coronary disease can be attributed to non-optimum blood pressure. (9)

The World Bank (2010) defines countries with gross national income per head of US$12 195 or less as developing countries, More than 80% of the world population lives in developing countries, where most of the worldwide burden of hypertension occurs. By 2025, almost three-quarters of people with hypertension will be living in developing countries. (9)

As late as 1940, hypertension was almost non-existent in non-developed populations - for example, a prevalence of 1.8% was reported in Ethiopian rural villages at this time (9). A recent study on the prevalence of hypertension among adult outpatient clients in hospitals was 34.7% in Addis Ababa (10). The prevalence of hypertension on urban dwellers of Durame was 37.8% in Kambata zone.(11)

Although the different studies had done on hypertensive patients in different parts of World, due to increasing number of hypertensive cases from time to time, and as well as biochemical tests differences in different population, it is needed to study in this area and used as updated data.

1.3 Significance of the study

Hypertension is a major risk factor for stroke, myocardial infarction, vascular disease, and chronic kidney disease. The significance of this study used to assess fasting blood glucose, serum electrolyte, albumin, creatinine, urea, and lipid profile among people with Hypertension attending our hypertension outpatient departement in wolaita sodo teaching and referral hospital as compared to apparently healthy participants. The result of this study used to program managers, health planners or policymakers and other concerned bodies to initiate the relevant intervention measures in hypertension at Ethiopia in general and specifically in the wolaita zone.

Finally, this study used to identify a gap that helps to design a strategy for the prevention of hypertension, draw the attention of stakeholders to focus on such life-threatening but preventable disease and it may also serve as updated data for the literature and coming researchers who are interested in related topics.

2. Literature review

2.1 Overview of Hypertension

Hypertension is a global public health issue. It contributes to the burden of heart disease, stroke and kidney failure, and premature mortality and disability. It disproportionately affects populations in low- and middle-income countries where health systems are weak. Globally Hypertension is responsible for at least 45% of deaths due to heart disease and 51% of deaths due to stroke. In 2008, worldwide, approximately 40% of adults aged 25 and above had been diagnosed with hypertension; the number of people with the condition rose from 600 million in 1980 to 1 billion in 2008. (1)

The WHO African Region has the highest prevalence of hypertension 27 percent while the WHO Region of the Americas has the lowest prevalence of hypertension 18 percent (7). Hypertension more prevalent in low- and middle-income countries, there are also more people affected because more people live in those countries than in high-income countries. Further, because of weak health systems, the numbers of people with hypertension who are undiagnosed, untreated, and uncontrolled are also higher in low- and middle- income countries compared to high-income countries. The increasing prevalence of hypertension is attributed to population growth, aging, and behavioral risk factors, such as unhealthy diet, harmful use of alcohol, lack of physical activity, excess weight, and exposure to persistent stress. The adverse health consequences of hypertension are compounded because many people affected also have other health risk factors that increase the odds of heart attack, stroke, and kidney failure. (1)

2.2 Complication of Hypertension

Diseases of hypertension are clinical outcomes that result from persistent elevation of blood pressure. Hypertension is a risk factor for all clinical manifestations of atherosclerosis since it is a risk factor for atherosclerosis itself. It is an independent predisposing factor for heart failure, coronary artery disease, stroke, renal disease, and peripheral arterial disease. It is the most important risk factor for cardiovascular morbidity and mortality in developed countries. (12)

2.2.1 HTN Complication affecting the Heart

Hypertensive heart disease is the result of structural and functional adaptations leading to left ventricular hypertrophy, diastolic dysfunction, CHF, abnormalities of blood flow due to atherosclerotic coronary artery disease and microvascular disease, and cardiac arrhythmias. Individuals with left ventricular hypertrophy are at increased risk for stroke, CHF, and sudden

death. Aggressive control of hypertension can regress or reverse left ventricular hypertrophy and reduce the risk of cardiovascular disease. Left ventricular hypertrophy is seen in 25% of the hypertensive patients and can easily be diagnosed by using echocardiography. (12)

Abnormalities of diastolic function, ranging from asymptomatic heart disease to overt heart failure are common in hypertensive patients. Patients with diastolic heart failure have a preserved ejection fraction, which is a measure of systolic function. Diastolic dysfunction is an early consequence of hypertension-related heart disease. (12)

2.2.2 HTN Complication affecting the Brain

Hypertension is an important risk factor for brain infarction and hemorrhage. Approximately 85% of strokes are due to infarction and the remainder is due to hemorrhage, either intra-cerebral hemorrhage or subarachnoid hemorrhage. The incidence of stroke rises progressively with increasing blood pressure levels, particularly systolic blood pressure in individuals >65 years. Treatment of hypertension convincingly decreases the incidence of both ischemic and cerebral hemorrhage. (13)

2.2.3 HTN Complication affecting the Eye

Hypertension (HTN) affects the eye causing 3 types of ocular damage: choroidopathy, retinopathy, and optic neuropathy. Hypertensive retinopathy (HR) occurs when the retinal vessels get damaged due to elevated blood pressure. Is a condition characterized by a spectrum of retinal vascular signs in people with elevated blood pressure? The retinal circulation undergoes a series of pathophysiological changes in response to elevated blood pressure. In the initial, vasoconstrictive stage, there is vasospasm and an increase in retinal arteriolar tone owing to local autoregulatory mechanisms. This stage is seen clinically as a generalized narrowing of the retinal arterioles. Persistently elevated blood pressure leads to intimal thickening, hyperplasia of the media wall, and hyaline degeneration in the subsequent, sclerotic, stage. This stage corresponds to more severe generalized and focal areas of arteriolar narrowing, widening, and accentuation of the central light reflex (14). These changes are manifested in the retina as microaneurysms, hemorrhages, hard exudates, and cotton-wool spots. Swelling of the optic disk may occur at this time and usually indicates severely elevated blood pressure (i.e., malignant hypertension). These changes are manifested in the retina as microaneurysms, hemorrhages, hard exudates, and cotton-wool spots. Swelling of the optic disk may occur at this time and usually indicates severely elevated blood pressure (i.e., malignant hypertension).

Because better methods for the control of blood pressure are now available in the general population, malignant hypertension is rarely seen. (15)

2.2.4 HTN Complication affecting the Kidneys

Hypertension is a risk factor for Kidney insufficiency and end-stage renal disease. The renal risk appears to be more closely related to systolic than to diastolic blood pressure, and black men are at greater risk than white men for developing the end-stage renal disease at every level of blood pressure; the atherosclerotic, hypertension-related vascular lesions in the kidney primarily affect the preglomerular arterioles, resulting in ischemic changes in the glomeruli and post glomerular structures. Glomerular injury may also be a consequence of direct damage to the glomerular capillaries due to glomerular hyper-perfusion. Glomerular pathology progresses to glomerulosclerosis, and eventually, the renal tubules may also become ischemic and gradually atrophic. The renal lesion associated with malignant hypertension consists of fibrinoid necrosis of the afferent arterioles, sometimes extending into the glomerulus, and may result in necrosis.(16)

2.3 previous studies on laboratory test parameters with HTN

The study was done in Korean(2015), showed that 1049 (14.7%) of the 7150 participants had newly developed diabetes. These findings showed that pre-hypertension and hypertension are significantly associated with the development of diabetes, independent of baseline glucose status, sex, and BMI. (17)

The study was conducted in Korean (2015) during the 10-years in the Korean Genome and Epidemiology Study, diabetes developed in 1,195 subjects (14.3%). The incidence of diabetes increased from 11.1% in the normal group to 17.0% in the pre-hypertension group, 17.7% in the stage 1 hypertension group, and 25.8% in stage 2 hypertension groups. (18)

A cross-sectional study done in Chinese (2016) shows that normal fasting glucose (NFG) had a significantly higher in hypertension patients (19). Another study conducted India(2014) a total of 120 volunteers was recruited for this study. The study stated that hypertensive patients had fasting blood glucose level higher than normal healthy controls. (20)

The study was conducted in USA (2018), addressed that a total of 163/273 (59.7%) patients had a documented serum albumin concentration. Hypoalbuminemia was present in 41 (25.2%) patients and serum albumin ≤3.3 g/dL represented the lowest quartile of serum albumin. Patients with hypoalbuminemia had higher rates of renal dysfunction (26.8% vs. 9.8%, P =0.0069) and

hepatic dysfunction (29.3% vs. 6.6%, P-value <0.001). Lower serum albumin concentrations in patients with PAH are associated with higher mortality and can serve as a marker of disease severity in this patient population (21). A study was done in Japan (2014), during four years of follow-up (mean; 3.1 years), 242 men (17.5%) and 89 women (10.4%) developed hypertension. A decreased serum albumin level was found to be a significant predictor of hypertension in a Japanese health screening population. (22)

The study was conducted in India(2014) addressed that 90 patients, clinically diagnosed to be hypertensive and who were under regular visits to OPD, were included in this study. 30 age and sex-matched healthy individuals were recruited as the control group in our study. Fasting venous blood samples were collected from the patients, as well as the controls and they, were analyzed by using an automated analyzer for blood urea, creatinine, and uric acid. The results were analyzed statistically by using the Student's "t" test and correlation coefficients. The levels of blood urea, creatinine, and uric acid were significantly higher in hypertensive patients as compared to healthy controls. (23)

A study was done in Cameroon (2015) stated that Individuals diagnosed with hypertension were consecutively recruited into this cross-sectional study over a period of four months commencing February 2015. The mean creatinine level was significantly higher in male participants with elevated uric acid levels compared to those with normal levels of 1.67(0.74) mg/dl versus 1.44(0.80) mg/dl. (24)

The study was conducted in Nigeria (2015) addressed that a total of 120 healthy staff and student adults between 18-50 years of the University community and 120 patients of the University teaching hospital. The mean values of potassium and chloride in hypertensive female patients were lower compared to those of control, while sodium and calcium showed no significant difference. The male category showed significantly lower values in sodium, chloride, and calcium while Phosphorous was higher in the hypertensive patients in both categories when compared to the healthy volunteers (control). The results obtained showed a significant difference at p-value < 0.05 significant level between hypertensive and healthy individuals for various blood electrolytes in both female male categories. (25)

The study was conducted in Bangladesh (2014) cross-sectional study were carried out among 234 participants including 159 hypertensive patients and 75 normotensive controls from January to December 2012. Data were collected on socio-demographic factors, anthropometric measurements, blood pressure, and lipid profile including total cholesterol (TC), triglyceride (TG), low-density lipoprotein (LDL), and high-density lipoprotein (HDL). The mean (± standard deviation) systolic blood pressure and diastolic blood pressure of the participants were 137.94±9.58 and 94.42±8.81, respectively, which were higher in the hypertensive patients. The serum levels of TC, TG, and LDL were higher while HDL levels were lower in hypertensive, which was statistically significant (*P-value* < 0.05).(26)

The study conducted in Algeria(2016) in hypertensive patients that detailed hypertensive patients with overweight/obesity had significantly higher TC, LDL-C, TG and lower HDL-C(27). The study was conducted in India (2016) Hypertensives showed a highly significant upper range of triglyceride (TG) with P < 0.01. Total cholesterol (TC) and very-low-density lipoprotein (VLDL) showed a partially significant upper range in hypertensives with P < 0.1, whereas high-density lipoprotein (HDL) and LDL showed no variations between these two groups with P-value > 0.4. (28)

The study was conducted in India(2013) showed that total cholesterol, LDL- C, VLDL-C and triglycerides were higher and statistically significant in hypertensive subjects than normotensive subjects (p<0.05). The mean HDL-C in hypertensive subjects was lower than normotensive subjects and statistically significant (p< 0.05). (29)

The study was conducted in Ethiopia(2014) showed that hypertensive subjects of serum lipids-total cholesterol, Triglycerides, and LDL- Cholesterol are significantly high and low levels of HDL- cholesterol as compared with Normo-tensive subjects. (30)

3. Objectives

3.1 General Objective

To determine fasting blood glucose, serum electrolyte, albumin, RFT, and lipid profile among hypertensive patients and non-hypertensive participants at wolaita sodo university teaching and referral hospital, SNNPR, Ethiopia from December 2019 to February 2020

3.2 Specific objectives

- To compare fasting blood glucose, serum albumin, electrolyte, creatinine, urea, and lipid profile among hypertensive and control group
- To assess factors associated with abnormal fasting blood glucose, serum albumin, electrolyte, creatinine, urea, and lipid profile in people with hypertension

4. Methods & Materials

4.1. Study area

The study was conducted at Wolaita Sodo University Teaching and Referral Hospital which was situated in southern Ethiopia, Wolaita Zone, Sodo town, 329 kilometers from Addis Ababa, the capital city of Ethiopia. It was serving people in catchment's area of three million people including neighboring Dawuro zone, Gamo zone, Goffa zone, Hadiya zone and Kambata Tambaro one. The former 'Otona Hospital' the current 'Wolaita Sodo University Teaching and Referral Hospital' was established in 1920 E.C as a small clinic by SIM (Sudan Interior Mission). The hospital served for about 50 years as a primary hospital and then become a general hospital for 30 years. In 2004 E.C, Wolaita Sodo University takeover the hospital as a teaching and referral hospital with academic, research, and community service responsibilities. The hospital organized in department, case-teams, and working hours is according to BPR standard. There are seven case teams, OPD, Emergency, Inpatient, Delivery, Dentistry, and Ophthalmology. The hospital had 200 beds for inpatient service which was on medical, surgical gynecology and obstetrics ward. (31)

4.2. Study design and period

A comparative cross-sectional study was conducted to assess the fasting blood glucose, serum electrolyte, albumin, creatinine, urea, and lipid profile in hypertensive patients and non-hypertensive participants at WSUTRH from December 2019 to February 2020.

4.3. Population

4.3.1. Source population

All Outpatients in WSUTRH from December 2019 to February 2020.

4.3.2. Study Population

All confirmed Hypertensive outpatients who were attending in WSUTRH; and all apparently healthy patients who were visiting the OPD during the study period. The study populations were recruited based on the following inclusions and exclusions criteria.

4.4. Inclusion and exclusion criteria

4.4.1. Inclusion criteria

Exposed group: Patients with hypertension

Study Participants who voluntarily participate in the study

Unexposed group: Apparently healthy non-hypertensive subjects

4.4.2. Exclusion criteria

Exposed group: Participants who had a history of renal disease, cardiac heart failure, pregnant women, and diabetes were excluded.

Unexposed group: Participants who had a history of renal disease, cardiac heart failure, pregnant women, and diabetes were excluded.

4.5. Study variables

4.5.1. Dependent variable:

Fasting blood glucose, serum electrolyte, albumin, creatinine, urea, and lipid profile

4.5.2. Independent variables:

- ✓ Socio-demographic characteristics
- ✓ Lifestyle factors (Smoking status, Alcohol drinking)
- ✓ Duration of HTN
- ✓ BMI

4.6. Sample size calculation and Sampling method

4.6.1. Sample size calculation

To determination of sample size two population sample size using Open Epi info, version 7.2.2.6, and open source calculation was used as follows:

$$n = \frac{(1+r)(p)(1-p)(Z\beta+Z\propto/2)2}{r \qquad (p1-p2)2} \quad \text{.....(32)}$$

Where: r = ratio of control to exposed (1:1),

r =1 for equal number of exposed and unexposed groups

P = proportion of exposed groups + proportion of unexposed groups/2

Zβ = standard normal variety for power (typically 0.84 or 80%)

$Z\alpha/_2$ = standard normal variety at 5% type 1 error ($p<0.05$) is 1.96

$P_1 - P_2$ = different in proportion expected based on previous studies

P_1 is proportion in exposed groups and P_2 is proportion in unexposed groups.

Exposed (P_1) = 14.7% = 0.147; ……..…..…. (18)

Unexposed (P_2) = 34.7% = 0.347; ……..…. (10)

$$P = \frac{0.147 + 0.347}{2} = 0.247$$

$$(P_1 - P_2)^2 = (0.147 - 0.347)^2 = 0.04$$

$$n = \frac{(1+r)(p)(1-p)(Z\beta+Z\propto/2)2}{r \qquad (p1-p2)2} = \frac{2(0.247)(1-0.247)(0.84+1.96)2}{0.04} = \frac{(0.494)(0.753)(7.84)}{0.04}$$

n = **73**

A total of **146 * 10%** non-response participants where **81** for exposed groups and **81** for unexposed groups were enrolled

4.6.2. Sampling Method:

The consecutive sampling method was used to include 81 Hypertensive outpatients who visiting the Hypertensive outpatients' department during the study period and 81 apparently healthy patients who were visiting the outpatient department. Sampling duplication was controlled by coding or labeling on the medical cards for study groups.

4.7. Measurement and Data collection

4.7.1. Data collection procedure:

The Hypertensive patients and apparently healthy individuals were interviewed with an administered questionnaire that was originally prepared in English and then translated to Amharic language questionnaire mainly consisted of closed and open-ended questions and delivered to eligible subjects after consent is taken to collect data face to face interview, and Physical measurements obtained by trained clinical nurses. Height and weight were measured by using a seca stadiometer and a seca weight floor scale (GMPH &CO.KG, Germany) which was placed on flat floor. During the measurement of height and weight the study subject asked to remove her/his shoes, hats and any bulky clothing and the subject looking straight ahead, face forward and the readers eye at the level of the head piece. Then the height and weight were recorded (33,34). The body mass index (BMI) was calculated as weight divided by height square (kg/m^2). According to the WHO classification of BMI can be underweight, < 18 kg/m^2; normal weight, > 18.5 – 24.9 kg/m^2; overweight, > 25.0 – 29.9 kg/m^2 and obese > 30 kg/m^2 (35).

Blood pressure (BP) was measured by using mercury sphygmomanometer (Henry Schein inc. Melville, NY, USA) and stethoscope from left upper arm and positioned at the heart level. After five minutes of rest, three consecutive blood pressure readings were taken at interval of at least one minute and the mean Blood Pressure was taken. (36)

Physical activity assessed and categorized according to international physical activity questionnaire (IPAQ) of one week or seven days physical activities of study groups.(37)

Furthermore, medical records /charts of Hypertensive participants were reviewed to obtain clinical data such as focusing on socio-demographic data,and duration of Hypertension.

4.7.2. Laboratory analysis

4.7.2.1 Specimen collection and processing

Consent from all subjects who were included in the study and by giving detailed information about the study, instruct the study subject about the procedure and the site was selected preferably at the median cubital vein. Warming the arm with hand or hanging the hand down made it easier to see the veins. The area was palpated to locate the anatomic sites. Apply a tourniquet, about 4–5 finger-widths above the select vein puncture site. The sites were disinfect using 70% alcohol swaps for 30 seconds in a circular motion from inside to outside fashion and allow to dry completely for 30 seconds. Then, the needle was entering swiftly at a 30-degree angle.

About 5 ml of venous blood was collected aseptically from the median cubital vein from each study participant by trained Laboratory Technologists in the morning after 8:00 hours of the overnight fast. The blood sample was dispensed into jell coated serum separator test tube or plain tube label with a unique ID number. The collected blood sample was left for 30 minutes to facilitate clotting at room temperature.

Then the clotted blood samples were centrifuged for 5 minutes at 3000 revolutions per minute (rpm) to separate serum from formed elements. The fasting blood glucose, serum albumin, urea, creatinine, and lipid profiles were analyzed by Mindray BS-200 and serum electrolyte analyzed by diamond diagnose(smartlyte) fully automated clinical chemistry analyzers are up to date with the regional and national standards. However, the serum was kept in Refrigerator at -20 ^{0}C by Nung tubes still the time of analysis greater than Seven days.

4.7.2.2. Principles of Laboratory analysis

Biochemical tests such as fasting blood glucose, serum albumin, urea, creatinine, and lipid profiles were analyzed by Mindray BS-200 and serum electrolyte analyzed by diamond diagnose(smartlyte) fully automated clinical chemistry analyzers are up to date with the regional and national standards. The instruments Mindray BS-200 and diamond diagnose (smartlyte) chemistry analyzer was calibrated using Autocal and quality control samples were run each day before running Patients samples.

a. Determination of fasting blood glucose

Fasting glucose is measured by the GOD-PAP enzymatic method with deproteinization on a fully automated Mindray BS-200 clinical chemistry analyzer. Glucose present in the serum is oxidized by the enzyme glucose oxidase (GOD) to gluconic acid with the liberation of hydrogen peroxide, which is converted to water and oxygen by the enzyme peroxidase. 4-amino antipyrine [4-AA], an oxygen acceptor, takes up the oxygen, and together with phenol forms a red-colored chromogen proportional to the concentration of glucose in the sample can be measured at 500nm.

Calculation: $C = \frac{\text{Absorbance of sample}}{Absorbance\ of\ STD}$ x C standard = Glucose (mg/dL)

b. Determination of Serum Urea

Serum urea concentration is determined by enzymatic kinetic method on a fully automated Mindray BS-200 clinical chemistry analyzer. Urea is hydrolyzed by water and urease to produce ammonia and carbon dioxide. The ammonia produced is further acted with ketoglutarate and NADH in the presence of GLDH to reproduce glutamate and NAD+. There has been optimized so that the GLDH is the rate-limiting enzyme. The decrease in absorbance due to the decrease of NADH concentration in unit time is proportional to the urea concentration.

Urea + H2O $\xrightarrow{\text{Urease}}$ $2NH_3 + CO_2$

$2NH4^+$ + 2 **α** ketoglutarate $\xrightarrow{\text{GLDH}}$ **γ** - Glutamate + $2NAD^+ + H_2O$

Calculations: $C = \frac{\text{O.D1}-\text{O.D2 sample}}{O.D1-O.D2\ STD}$ x Standard concentration = mg/dL Urea

Conversion factor for BUN/Urea [mg/dl]

C (BUN) =0.47xC (Urea)

C (Urea) =2.14x C (BUN)

c. Determination of Serum Albumin

Serum Albumin in the presence of Bromocresol green at pH 4.2 produces a color complex. The intensity of the color is proportional to the albumin concentration at 628 nm

Calculations: $C = \frac{\text{O.D sample}}{O.D\ STD}$ x Standard concentration = g/dL Albumin

d. Determination of creatinine

Creatinine present in serum or plasma directly reacts with alkaline picrate resulting in the formation of red color, the intensity of which is measured at 505nm/green filter.

Protein interference is eliminated using sodium lauryl sulphate. A second absorbance reading after acidifying with 30% acetic acid corrects for non-specific chromogens in the samples.

e. Determination of serum electrolytes (Sodium and potassium principle)

When a solution of an inorganic salt such as sodium chloride is sprayed into the flame, the elements in the compound are partly converted into the atomic state. Due to the heat energy of the flame a very small proportion of these atoms is excited and the electrons move to a higher energy level.

The proportion of the atoms that are excited depends upon the concentration of the particular element and on the temperature of the flame. In the excited state, the electrons are unstable and they rapidly revert to their former lower energy level. As they change from the excited state or higher energy level back to the lower energy level, they emit the light in the form of a fixed wavelength, to produce a spectrum. Under carefully controlled conditions the amount of light emitted is directly proportional to the number of atoms that are excited, which in turn is proportional to the concentration of the substance in the sample.

Calcium (Ca^{2+}) principle

Calcium forms a purple-colored complex with ortho-cresolphthalein complexone in an alkaline medium. The inclusion of HCl helps to release calcium bound to proteins and 8 hydroxy-quinoline eliminates the interference by magnesium. 2-amino, 2-methyl, 1propanol (AMP) provides the proper alkaline medium for the color reaction. The intensity of the color is measured at 540nm/yellow-green filter.

f. Determination of lipid profiles

i. **Total Cholesterol** is measured enzymatically in serum or plasma in a series of coupled reactions that hydrolyze cholesteryl esters and oxidize the 3-OH group of cholesterol. One of the reaction byproducts, H2O2 is measured quantitatively in a peroxidase catalyzed reaction that produces color. Absorbance is measured at 500 nm. The color intensity is proportional to cholesterol concentration.

The reaction sequence is as follows:

Cholesteryl ester + H2O -- cholesteryl ester hydrolase-->cholesterol + fatty acid

Cholesterol + O2 --cholesterol oxidase--> cholest-4-en-3-one + H2O2

2H2O2 + 4-aminophenazone + phenol --peroxidase--> 4-(p-benzoquinonemonoimino)-phenazone + 4 H2O

ii. **Triglycerides** are measured enzymatically in serum or plasma using a series of coupled reactions in which triglycerides are hydrolyzed to produce glycerol. Glycerol is then oxidized using glycerol oxidase, and H2O2, one of the reaction products, is measured as described above for cholesterol. Absorbance is measured at 500 nm. The reaction sequence is as follows:

Triglycerides + 3H2 O -- lipase --> glycerol + fatty acids

Glycerol + ATP -- glycerokinase --> glycerol-3-phosphate + ADP

Glycerol-3-phosphate + O2--glycerophosphate oxidase--> dihydroxyacetone phosphate + H2O2

H2 O2 + 4-aminophenazone + 4-chlorophenol—peroxidase--> 4-(p-benzoquinone-monoimino)- phenazone + 2H2 O + HCl.

iii. High-density lipoprotein (HDL) cholesterol

The apoB containing lipoproteins are thus effectively excluded from the assay and only HDL-C is detected under the assay conditions. The method uses sulfated alpha-cyclodextrin in the presence of Mg+2, which forms complexes with apoB containing lipoproteins, and polyethylene glycol-coupled cholesteryl esterase and cholesterol oxidase for the HDL-cholesterol measurement. The reactions are as follows:

(1) ApoB containing lipoproteins + α-cyclodextrin + Mg+2 + dextran SO4 ---> soluble non-reactive complexes with apoB-containing lipoproteins

(2) HDL-cholesteryl esters $\xrightarrow{\text{PEG-cholesteryl esterase}}$ HDL-unesterified cholesterol + fatty acid

(3) Unesterified cholesterol + O2 PEG$\xrightarrow{\text{-cholesterol oxidase}}$ > cholestenone + H2O2

(4) H2O2 + 5-aminophenazone + N-ethyl-N-(3-methyl phenyl)-N'_succinyl ethylene diamine + H2O + H+ peroxidase > qunoneimine dye + H2O

Absorbance is measured at 600 nm.

iv. LDL-cholesterol

Most of the circulating cholesterol is found in three major lipoprotein fractions: very low-density lipoproteins (VLDL), LDL, and HDL.

[Total cholesterol] = [VLDL-C] + [LDL-C] + [HDL-C]

LDL-cholesterol is calculated from measured values of total cholesterol, triglycerides, and HDL-C according to the relationship:

[LDL-C] = [total cholesterol] – (HDL-cholesterol + TG/5). Where [TG]/5 is an estimate of VLDL-cholesterol and all values are expressed in mg/dL.

4.8. Data Quality Assurance

4.8.1. Pre-analytical

The Questionnaires were translated from English to Amharic version and the data collection after questioner was Pre-testing on 10% individuals in the Outpatient department to see the validity and completeness. Then correction was taking and these participants were excluded from the study. Training for data collectors were given by the investigator and the consistency of the data was checked.

For the laboratory sample which was analyzed by Mindray BS-200 chemistry analyzer, its quality was checked by previously documented SNNP, Regional Laboratory, and EQA sample result feedback report every three months. Concerning sample collection, transportation, and processing the principal investigator was assemble blood sample collection materials. The principal investigator was strictly following SOP to assure that sample was collecting on serum separator tube, labeling with the participant identification number, allow the sample for a minimum of 15 minutes to clot, transportation, and centrifuging sample for 5 minutes at 3000 revolutions per minute.

4.8.2. Analytical

Standard quality control (normal and pathological) protocols were performing and passing before run the participants' sample analyzing to assure the accuracy and functionality of the instrument. The participants' sample was analyzed after both controls were passed and interpreted using Westgard multi-rule algorithm.

4.8.3. Post-analytical

All necessary procedures and steps were followed based on the clinical chemistry SOP. Laboratory results were rechecked repeatedly for completeness and recorded carefully on the provided space by seeing its labeling and it was attached with its questionnaire and interpretations by choosing appropriate statistical tests.

4.9. Data analysis

All questionnaires were checked daily for completeness by the investigator and pre-coded data was entered into the computer using Epi data version 3.1, and then data was transferred to SPSS version 21.0 software(IBM Corporation, USA) for further data cleaning so that to allow consistency and eliminate discrepancies, categorizing of a continuous variable and finally analysis. P-value < 0.05 was considered statistically significant at 95% of Cl. Any abnormal findings of study groups reported and communicated with the physician for better management.

4.10. Ethical considerations

The study was approved by Addis Ababa University College of health sciences department of medical laboratory sciences Ethical review committee. Permission letter was written from Addis Ababa University to Wolaita Sodo University teaching and referral hospital managing director. For reasons of privacy, all data was kept confidential. The anonymity of result records was maintained by using client registration number and unique code numbers used by service providers at Wolaita Sodo University teaching and referral hospital Laboratory. The abnormal laboratory findings of study subjects were dispatched and communicated with physicians for better management.

4.11. Operational definitions

Alcohol consumption: participants who have alcohol consumption history during the study

Cases: Adult hypertensive patients who are on follow up and participated in the study.

Cigarette smoking: participants who have Cigarette smoking history during the study.

Controls: participants who have no history of other chronic diseases and hypertension participated in the study.

Herbal medication: participants who had ever taken any traditional healers.

Hypertension: repeated measurement and confirmed high blood pressure above 140/90 mm Hg.

Low physical activity: No activity or some activity but not enough

Moderate physical activity:- walking of at least 30 minutes per day or 5 or more days of any combination of walking, moderate-intensity or vigorous intensity activities achieving a minimum of at least one hour and 30 minutes per week

High physical activity: - 7 days of any combination of walking, moderate- or vigorous-intensity activities accumulating at least 2 hours and 30 minutes per week

4.12 Dissemination of the result

The result of this study was submitted and presented to Addis Ababa University, College of Health Sciences, Department of Medical Laboratory Sciences, as partial fulfillment of the requirement of master's degree in clinical chemistry and the result was shared with Wolaita Zone Health Office and WSU Health sciences and medicine. The manuscript of the research was prepared and submitted to the appropriate scientific Journal for publication.

5. Results

5.1 Socio-demographic Characteristics of study participants

Among the total expected162 study participants, 156 (78 hypertensive patients and 78 non-hypertensive) were included in the study with a response rate of 95.9% . Among Hypertensive patients, 40(51.3%) were females. The age range of Cases were from 30 -78 years old with mean age 50 ± 10.0 years. The majority of study participants 43(55.1%) from urban areas, 51(65.4%) married, 26(33.3%) no formal education, 35(44.9%) had public/private employed and 50(64.1%) had monthly income below1000 Ethiopian Birr (**Table-1**).

Table-1: Socio-demographic Characteristics of hypertensive patients and controls at WSUTRH, SNNPR, Ethiopia, from December 2019 to February 2020.

Variables		**Study Participants (n=156)**	
		Hypertensive patients	**Controls**
		n=78 (50%)	**n= 78 (50%)**
Age in years	<50	28(35.9%)	30(38.4%)
	≥50	50(64.1%)	48(61.6%)
Gender	Female	40(51.3%)	40(51.3%)
	Male	38(48.7%)	38(48.7%)
Residence	Urban	43(55.1%)	44(56.4%)
	Rural	35(44.9%)	34(43.6%)
Marital Status	Married	51(65.4%)	42(53.8%)
	Single	14(17.9%)	11(14.1%)
	Separated	6(7.7%)	10(12.8%)
	Widowed/widower	7(9.0%)	15(19.3%)
Educational level	No formal education	26(33.3%)	22(28.2%)
	Primary	13(16.6%)	17(21.8%)
	Secondary	16(20.5%)	11(14.1%)
	College or University	23(29.6%)	28(35.9%)
Occupation	Public /Private servant	35(44.9%)	34(43.6%)
	Merchant	11(14.1%)	14(17.9%)
	Farmer	20(25.6%)	19(24.4%)
	Unemployed	12(15.4%)	11(14.1%)
Monthly income level(ETB)	≤ 1000	50(64.1%)	43(55.1%)
	> 1000	28(35.9%)	35(44.9%)

Regarding lifestyle factors, anthropometric and salt dietary habits of Hypertensive patients; the majority of 70(89.9%) non-smoked, 31(39.7%) consumed alcohol, 39(53.4%) overweighed and 3(4.1%) obese (Table-2). Similarly, non-hypertensive participants; the majority of 74(94.9%) non-smoked, 17(21.8%) consumed alcohol, 25(34.2%) overweighed and 47(64.4%) normal weight (**Table-2**).

Table-2: Lifestyle factors, anthropometric, and salt dietary habits of study participants at WSUTRH, SNNPR, Ethiopia, from December 2019 to February 2020.

Variables	**Study Participants (n= 156)**		**P-value**
	Hypertensive group(n=78)	**Non-hypertensive group(n=78)**	
Smoking status			
Yes	8(10.2%)	4(5.1%)	0.232
No	70(89.7%)	74(94.9%	
Smoking frequency			
Daily	4(50%)	2(50%)	0.224
Frequently	3(37.5)	1(25%)	
Rarely	1(12.5)	1(25%)	
Alcohol consumption			
Yes	31(39.7%)	27(21.8%)	0.511
No	47(60.3%)	51(78.2%)	
Alcohol drinking frequency			
Daily	9(29.0%)	4(14.8%)	0.587
Frequently	15(48.4%)	6(22.2%)	
Rarely	7(22.6%)	17(63.0%)	
Dietary salt consumption			
Yes	27(34.6%)	62(79.5%)	< 0.001
No	51(65.4%)	16(20.5%)	
Physical exercises activity			
Low	36(52.6%)	11(14.1%)	< 0.001
Moderate	32(34.6%)	52(66.7%)	
High	10(12.8%)	15(19.2%)	
BMI status			
Normal weight	31(39.8%)	50(64.1%)	0.015
Over weight	42(53.8%)	27(34.6%)	
Obese	5(6.4%)	1(1.3%)	

5.2 Comparison of laboratory test parameters among study groups

Hypertensive patients were significantly increased mean ± SD of FBG, RFT, TC, LDL-C, TG ($p < 0.001$) respectively; while significantly lower mean ± SD serum albumin, sodium, calcium and HDL-C ($p < 0.001$) respectively. when compared with non-hypertensive participants and serum potassium and calcium were no statistical significance among cases and controls (**Table-3**).

Table-3: Comparison of laboratory test parameters among study groups at WSUTRH, SNNPR, Ethiopia, from December 2019 to February 2020.

Test Parameters	**Study Participants (n= 156)**		**t-test for Equality of Means**		
	Hypertensives (n = 78) Mean ± SD	**Non-hypertensives (n = 78) Mean ± SD**	p-value	95% CI.	
				Lower	Upper
FBG (mg/dL)	122.93 ± 9.10	109.68 ± 10.31	< 0.001	8.336	14.869
Albumin (g/dL)	4.27 ± 0.59	5.09 ± 0.96	< 0.001	-1.205	-0.661
Sodium (mmol/L)	135.82 ± 4.05	138.90 ± 3.23	< 0.001	-4.172	-1.854
Potassium(mmol/L)	4.05 ± 0.46	4.12 ± 0.64	0.403	-0.2494	0.10076
Calcium(mmol/L)	2.12 ± 0.37	2.24 ± 0.23	0.299	-8.1561	2.52074
Creatinine(mg/dL)	1.14 ± 0.46	0.85 ± 0.15	< 0.001	0.16565	0.40050
Urea (mg/dL)	44.65 ± 18.56	33.21 ± 11.43	< 0.001	5.8032	15.3506
T.Cholestrol (mg/dL)	172.10 ± 33.33	154.53 ± 26.24	< 0.001	22.877	40.379
HDL-C (mg/dL)	43.36 ± 7.20	48.92 ± 6.54	< 0.001	-7.670	-3.407
LDL-C (mg/dL)	105.55 ± 29.35	84.19 ± 23.29	< 0.001	16.025	33.000
Triglyceride (mg/dL)	123.19 ± 27.77	107.14 ± 21.48	< 0.001	20.559	37.493

SD- standard deviation and student t-test was used to compare means.

5.3 The laboratory test parameters and associated factors among study groups

5.3.1 Duration of hypertension with laboratory parameters among hypertensive patients

The FBG, RFT, TC, LDL-C, and TG of hypertensive patients above five years showed significantly higher when compared with hypertensive patients below five years while serum albumin, sodium, calcium, and HDL-C significantly lower observed on above five years of hypertensive patients. serum potassium was no statistical significance with in two groups (**Table-4**).

Table-4: Duration of hypertension with laboratory test parameters among hypertensive patients at WSUTRH, SNNPR, Ethiopia, from December 2019 to February 2020.

Test Parameters	**Below 5 years (n = 45) Mean ± SD**	**Above 5 years (n =33) Mean ± SD**	**t-test for Equality of Means**		
			p-value	95% CI.	
				lower	Upper
FBG (mg/dL)	114.90 ± 15.95	122.56 ± 9.19	0.030	6.760	14.558
Albumin (g/dL)	5.32 ± 1.04	4.19 ± 0.58	0.001	-0.457	1.801
Sodium (mmol/L)	140.70 ± 7.16	135.34 ± 2.86	0.001	-7.820	-2.904
Potassium(mmol/L)	4.02 ± 0.63	4.04 ± 0.44	0.929	-0.302	0.331
Calcium(mmol/L)	2.43 ± 0.91	2.08 ± 0.16	0.004	-0.582	-0.113
Creatinine(mg/dL)	1.00 ± 0.32	1.24 ± 0.58	0.035	0.018	0.463
Urea (mg/dL)	39.26 ± 12.42	48.34 ± 20.64	0.026	1.093	7.059
T.Cholestrol (mg/dL)	160.86 ± 25.30	178.10 ± 28.90	0.039	3.851	18.760
HDL-C (mg/dL)	43.04 ± 5.27	39.83 ± 8.30	0.022	-5.956	-0.479
LDL-C (mg/dL)	86.81 ± 22.03	99.07 ± 30.60	0.018	2.112	11.406
Triglyceride (mg/dL)	127.03 ± 30.43	134.51 ± 31.19	0.046	1.241	8.715

SD - standard deviation, and student t-test was used to compare means.

5.4 Prevalence of abnormal laboratory test parameters among study groups

A total of 78 hypertensive patients were included in this study, where 13(16.7%) hyperglycemia, 12(15.4%) hypoalbuminemia, 14(17.9%) hyponatremia, 8(10.3%) hyperkalemia, 15(19.2%) hypocalcemia,11(14.1%) higher creatinine, 11(14.1%) high urea, 7(8.9%) hypercholesterolemia, 5(6.4%) lower HDL-C, 8(10.3%) high LDL-C, and 10(12.8%) hypertriglycemia (**Figure-1**).

Similarly, total of 78 non- hypertensive participants 6(7.7%) hyperglycaemia, 2(2.6%) hypoalbuminemia, 3(3.8%) Hyponatremia, 7(8.9%) hyperkalemia, 4(5.1%) hypocalcemia, 2(2.6%) higher creatinine, 2(2.6%) high urea, 1(1.3%) hypercholesterolemia, 1(1.3%) lower HDL-C, 2(2.6%) high LDL-C, and 3(3.8%) hypertriglycemia (**Figure-1**).

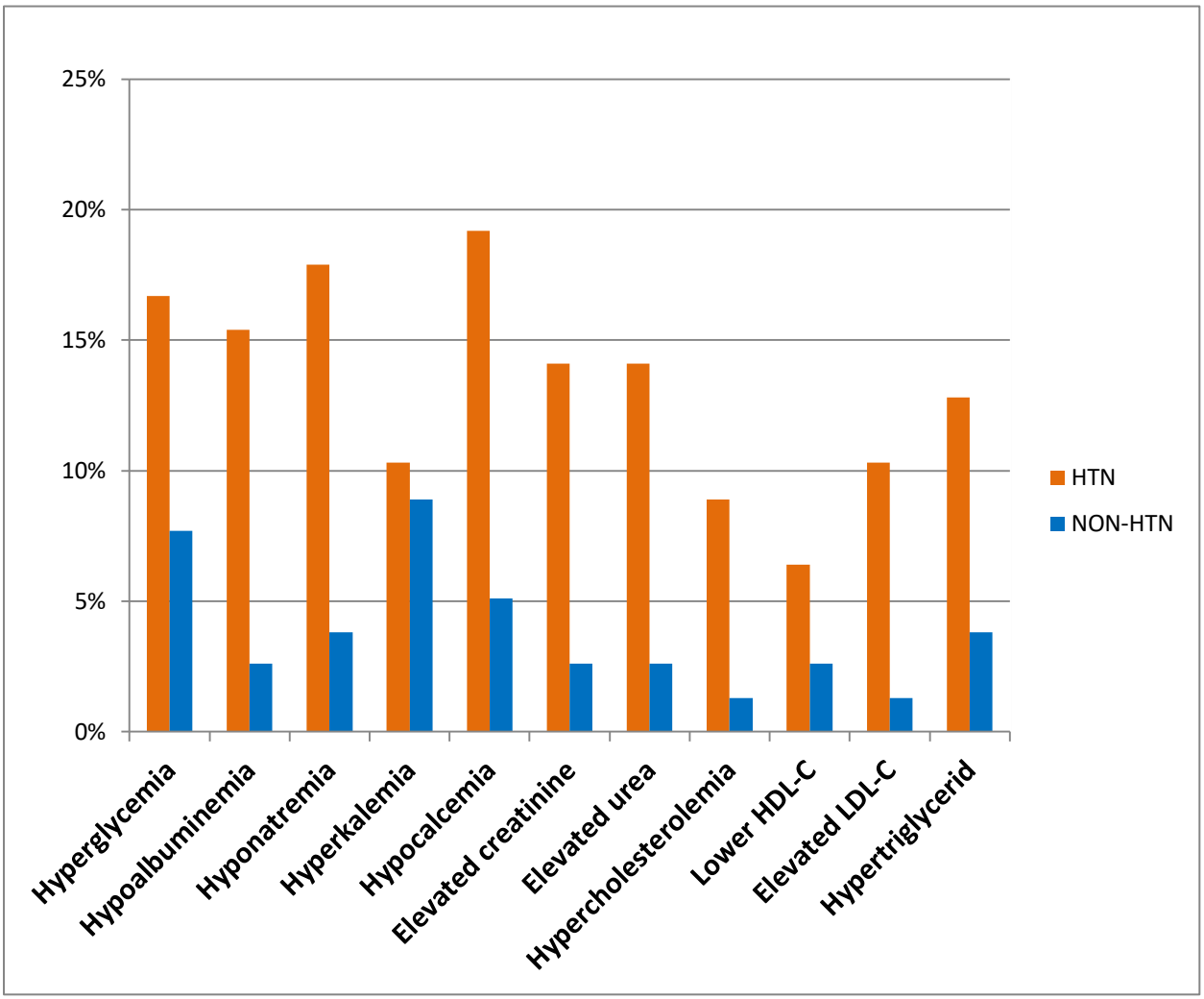

Fig-1 Prevalence of abnormal biochemicals among study groups at WSUTRH from December 2019 to February 2020

5.5 Factors associated with abnormal laboratory parameters in people with hypertension

Logistic regression analysis age, gender,smoking, alcohol drinking, body mass index, physical activity were independent variables and biochemical tests were dependent variables ($p< 0.05$).

Physical activity, and BMI were independent variables significantly associated with fasting blood glucose. Hypertensives were low physical activity (0.042), and obese(0.026) times less likely to have hyperglycemia than high physical activity and normal weight (AOR = 0.042;95% CI = 0.002 - 0.080, AOR = 0.026; 95% CI=0.001 - 0.036). (**Table-5**)

Alcohol drinking and BMI were independent variables significantly associated with serum albumin. Hypertensives were rarely acohol consumer (0.29), and underweight (1.99) times more likely to have hypoalbuminia than daily alcohol consumer and normal weight (AOR = 0.29;95% CI = 0.05 - 0.35, AOR = 1.99; 95% CI=0.07 - 2.06) rescpectvely.**(Table-5)**

Table-5: Shows binary logistic regression analysis with factors associated with abnormal hyperglycemia, and hypoalbuminia among hypertensive patients at WSUTRH, Ethiopia, from December 2019 to February 2020.

Variables	**Fasting blood glucose**			**Serum Albumin**			
	COR	AOR(95% CI)	p-value	COR	AOR	95% CI	p-value
physical activity							
Low	1.87	0.04(0.02, 0.08)	0.036	0.46	1.94	0.25, 1.34	0.999
High	1*			1*			
Alcohol drinking							
Yes	0.05	2.20(0.58, 2.79)	0.247	2.58	0.29	0.05, 0.35	0.032
No	1*			1*			
Smoking status							
Yes	0.20	6.06(1.13, 7.92)	0.098	1.09	7.81	0.18, 7.99	0.999
No	1*			1*			
Gender							
Male	1*		0.773	1*			0.998
Female	1.83	1.70(0.08, 1.83)		0.34	1.86	0.07, 1.93	
Age							
Above 50	0.67	1.75 (0.54, 2.65)	0.346	0.79	1.38	0.45, 1.83	0.569
Below 50	1*			1*			
BMI							
>25kg/m2	0.94	0.026(0.01, 0.036)	0.045	1.36	1.99	0.07, 2.06	0.008
<25kg/m2	1*			1*			

P < 0.05 statistical significant, 1*= Reference category, COR= crude odd ratio, AOR= adjusted odd ratio

Age was independent variables significantly associated with serum sodium. Hypertensives were younger 0.09 times more likely to have hyponatremia than elder hypertensives (AOR = 0.09; 95% CI = 0.014 - 0.104). (**Table-6**)

Body mass index was independent variable significantly associated with serum Total Cholesterol. Hypertensives were obese (4.91) times more likely to have hypercholesterolemia than normal weight (AOR = 4.91;95% CI = 2.04 – 6.95). (**Table-6**)

Table-6: Shows binary logistic regression analysis with factors associated with abnormal hyponatremia, and hypercholesterolemia among hypertensive patients at WSUTRH, Ethiopia, from December 2019 to February 2020.

Variables	**Serum sodium**			**Serum total cholesterol**		
	COR	AOR(95% CI)	p-value	COR	AOR(95% CI)	p-value
physical activity						
Low	0.56	2.96(2.13, 5.05)	0.059	3.55	0.060(0.003, 0.09)	0.058
High	1*			1*		
Alcohol drinking						
Yes	0.0508	1.68(.31, 1.99)	0.544	1.15	0.29(0.04,1.16)	0.229
No	1*			1*		
Smoking status						
Yes	3.38	0.33(0.048, 0.376)	0.273	0.26	1.84(0.18, 2.12)	0.603
No	1*			1*		
Gender						
Female	1.78	0.09(0.014, 0.109)	0.789	0.35	1.91(0.001, 2.11)	0.998
Male	1*			1*		
Age						
Above 50	0.67	0.095(.005, 0.186)	0.020*	0.89	1.72(0.34, 2.80)	0.512
Below 50	1*			1*		
BMI						
>25kg/m2	0.94	0.026(0.01, 0.036)	0.121	9.17	4.91(2.04, 6.95)	0.048*
<25kg/m2	1*			1*		

P < 0.05 statistical significant, 1*= Reference category, COR= crude odd ratio, AOR= adjusted odd ratio

Age and physical activity were independent variables significantly associated with serum creatinine. Hypertensives were elder (1.95), and high physical activity (0.015) times more likely to have elevated creatinine level than young and low physical activity (AOR = 1.95; 95% CI = 0.39 - 2.33, AOR = 0.015; 95% CI=0.001 - 0.16) respectively. **(Table-7)**

Age and physical activity were independent variables statistical significant associated with serum urea. Hypertensives were elder (3.27), and high physically activity (0.028) times more likely to have elevated urea level than young and low physical activity (AOR = 3.27; 95% CI = 0.80 – 4.06, AOR = 0.028; 95% CI=0.002 - 0.031) respectively. (**Table-7)**

Table-7: Shows binary logistic regression analysis with factors associated with abnormal creatinine and urea results among hypertensive patients at WSUTRH, Ethiopia, from December 2019 to February 2020.

Variable	**Serum Creatinine**				**Serum Urea**			
	COR	AOR	95% CI	p-value	COR	AOR	95% CI	p-value
Alcohol drinking								
Yes	0.160	3.05	0.61, 3.66	0.175	0.160	5.67	5.12, 10.79	0.078
No	1*				1*			
Smoking status								
Yes	2.817	0.19	0.07, 0.26	0.999	2.817	1.09	0.91, 2.45	0.999
No	1*				1*			
Gender								
Female	0.502	2.73	0.91, 3.78	0.998	0.502	1.18	1.02, 2.23	0.998
Male	1*				1*			
Age								
>50	0.593	1.96	0.39, 2.23	0.014	0.593	3.27	0.29, 3.56	0.008
<50	1*				1*			
BMI								
>25kg/m2	0.575	0.18	0.01, 1.19	0.314	0.575	4.80	1.01, 5.92	0.327
<25kg/m2	1*				1*			
Physical activity								
Low	3.068	0.15	0.01, 0.16	0.004	3.068	0.028	0.008, 0.036	0.009
High	1*				1*			

P < 0.05 statistical significant, 1*= Reference category, COR= crude odd ratio, AOR= adjusted odd ratio

Age and BMI were independent variables significantly associated with serum HDL-C.

Hypertensives were young (0.15), and normal weight (0.29) times more likely to have lower HDL-C level than elders and obese (AOR = 0.15;95% CI = 0.02 - 0.14, AOR = 0.29; 95% CI=0.03- 0.31) rescpectvely. (**Table-8**)

Body mass index was independent variable significantly associated with serum LDL-C. Hypertensives were obese (1.51) times more likely to have elevated LDL-C level than normal weight (AOR = 1.51;95% CI = 0.15 - 1.66) (**Table-8**)

Table-8: Shows binary logistic regression analysis with factors associated with abnormal HDL-C and LDL-C results among hypertensive patients at WSUTRH, Ethiopia, from December 2019 to February 2020.

Variables	**Serum HDL-C**			**Serum LDL-C**			
	COR	AOR(95% CI)	p-value	COR	AOR	95% CI	p-value
physical activity							
Low	1.64	5.29(0.214, 5.64)	0.308	1.87	0.19	.018, 2.04	0.172
High	1*			1*			
Alcohol drinking							
Yes	0.23	7.12(0.43, 8.54)	0.176	1.591	0.28	0.045,1.49	0.130
No	1*			1*			
Smoking status							
Yes	1.093	0.45(0.20, 1.65)	0.999	0.342	1.99	0.28, 2.47	0.488
No	1*			1*			
Gender							
Male	1*		0.999	1*			0.998
Female	0.667	0.84(0.31, 1.25)		0.547	0.66	0.13, 1.79	
Age							
Above 50	2.480	0.15(0.023, 0.14)	0.043	0.371	4.14	0.92, 5.61	0.064
Below 50	1*			1*			
BMI							
>25kg/m2	0.950	0.29(0.03, 0.31)	0.009	3.013	1.51	0.15, 1.66	0.026
<25kg/m2	1*			1*			

P < 0.05 statistical significant, 1*= Reference category, COR= crude odd ratio, AOR= adjusted odd ratio

Body mass index was independent variable significantly associated with serum triglyceride. Hypertensives were obese (6.08) times more likely to have hypertriglycemia than normal weight (AOR = 6.08;95% CI = 2.10 - 8.18). (**Table-9**)

Table-9: Shows binary logistic regression analysis with factors associated with hypertriglycemia among hypertensive patients at WSUTRH, Ethiopia, from December 2019 to February 2020

Variables	**Triglyceride**				
	COR	AOR	95% C.I.		p-value
			Lower	Upper	
Alcohol consumption					
Yes	1.500	0.457	0.097	2.148	0.322
No	1*				
Smoking status					
Yes	0.472	0.916	0.093	2.059	0.916
No	1*				
Gender					
Female	0.606	8.336	0.658	9.634	0.102
Male	1*				
Age					
Above 50	1.944	0.559	0.147	2.127	0.394
Below 50	1*				
BMI					
>25kg/m2	3.080	6.082	2.103	8.18	0.042
<25kg/m2	1*				
Physical activity					
Low	1.665	0.198	0.017	2.240	0.191
High	1*				

P < 0.05 statistical significant, 1*= Reference category, COR= crude odd ratio, AOR= adjusted odd ratio

6. Discussion

The current study assessed fasting blood glucose, serum albumin, electrolytes, creatinine, urea, and lipid profiles among hypertensive and non-hypertensive participants. The fasting blood glucose, creatinine, urea, total cholesterol, LDL-cholesterol, and triglyceride are significantly higher among hypertensive study participants when compared to the non-hypertensive study group. Sodium, calcium, albumin, and HDL-Cholesterol concentration was significantly lower among hypertensive study participants when compared to the non-hypertensive study group.

The significantly increased fasting blood glucose level of the hypertensive study participants, when compared to the non-hypertensive study group in our study, was agreed with the findings in previous studies conducted in Korean, Chinese, Cameroon, and India (16, 17, 18, 19). Hypertension was to induce microvascular dysfunction, which may contribute to the pathophysiology of diabetes development (39, 40). Endothelial dysfunction which is related to insulin resistance is also closely associated with hypertension, and biomarkers of endothelial dysfunction were found to be independent predictors of hyperglycemia. (41)

Serum creatinine and urea level were significantly higher in the hypertensive study participants when compared to the non-hypertensive study group in this study. This finding was similar to previous studies conducted in India, and Cameroon (23, 24). This may be a result of a progressing glomerular damage, endothelial dysfunction, renal microvascular disease (42, 43). Age-related decline in the glomerular filtration rate is common and highly prevalent in the elderly. In elderly individuals, reduced renal function is accompanied by the decreased in renal blood flow, decrease in kidney mass, particularly from the renal cortex, the glomerular hemodynamic changes and an increase in glomerular basement membrane permeability.(50, 51)

The serum albumin was significantly decreased in hypertensive study patients when compared to the non-hypertensives.this study was agreed with the previous studies conducted in Japan, USA and Turkey (21, 22, 56). Decreased serum albumin levels and hypervolemia have been suggested to contribute to the association between impaired nutritional status and elevated blood pressure (57). Hypertension is associated with endothelial dysfunction, insulin resistance, inflammation and oxidative stress, while albumin possesses both anti-inflammatory and antioxidant properties (44, 45, 46, 47).

Albumin inhibits copper-stimulated peroxidation and hemolysis as well as the production of free hydroxyl radicals from systems containing copper ions and H2O2. It may also inhibit endothelial apoptosis (48, 49).

Serum sodium and calcium were significantly decreased in hypertensive participants when compared to the non-hypertensive participants while serum potassium was no significant difference between study groups with the findings in previous studies conducted in Nigeria (25).

The total cholesterol, LDL-cholesterol, and triglyceride were significantly elevated while HDL-Cholesterol level was lower in hypertensive study participants when compared with non-hypertensive participants with the findings in previous studies conducted in India, and Bangladesh (26, 27). The direct mechanisms leading from hypercholesterolemia to hypertension are not fully understood (52). During the early phases of obesity, renal tubular reabsorption results in primary sodium retention and increased extracellular-fluid volume. Subsequently, plasma renin activity, angiotensinogen, angiotensin II, and aldosterone values increase significantly (52). Furthermore, increased renal tubular reabsorption and increased arterial pressure lead to higher values of glomerular capillary wall stress, activation of neuro-humoral systems, increased serum lipid level, and glucose intolerance (53). Several other mechanisms, including oxidative stress, autonomic dysregulation, and mechanical compression on the kidneys are all activated by obesity (54).

The duration of hypertension on fasting blood glucose, potassium, creatinine, urea, total cholesterol, LDL-Cholesterol, and Triglyceride concentration of hypertensive patients above five years showed significantly higher when compared with hypertensive patients for below two years. Hypertensive patients significantly lower level of serum albumin, sodium, calcium, and HDL-Cholesterol observed on the duration of hypertension occurred below two years.

Prevalence of hyperglycemia, hypoalbuminemia, hyponatremia, hypokalemia, elevated serum creatinine, elevated serum urea, hypercholesterolemia, lower HDL-C, high LDL-C, and hypertriglycemia in hypertensive patients were increased when compared with non-hypertensive subjects.

Factors that associated with abnormal biochemical findings in this study were; overweight (obese), age, physical activity, smoking, and alcohol drinking in hypertensive patients.

The present study show that overweight (obesity) was significantly associated with serum triglyceride, total cholesterol and LDL-C. A person who was overweighed (obese) had hypertriglyceredemia, hypercholesterolemia, and elevated LDL-C. Body mass index was independent variable significantly associated with serum Total Cholesterol. Hypertensives were obese (4.91) times more likely to have hypercholesterolemia than normal weight (AOR = 4.91;95% CI = 2.04 – 6.95). Age and BMI were independent variables significantly associated with serum HDL-C. Hypertensives were young (0.15), and normal weight (0.29) times more likely to have lower HDL-C level than elders and obese (AOR = 0.15;95% CI = 0.02 - 0.14, AOR = 0.29; 95% CI=0.03- 0.31) rescpectvely. Body mass index was independent variable significantly associated with serum LDL-C. Hypertensives were obese (1.51) times more likely to have elevated LDL-C level than normal weight (AOR = 1.51;95% CI = 0.15 - 1.66). Body mass index was independent variable significantly associated with serum triglyceride. Hypertensives were obese (6.08) times more likely to have hypertriglycemia than normal weight (AOR = 6.08;95% CI = 2.10 - 8.18). The study conducted in Algeria in hypertensive patients similar with this finding that detailed subjects with overweight/obesity had significantly higher TC, LDL-C, TG and lower HDL-C (28). This may be due to metabolic abnormalities linked to overweight and obesity.

Age was independent variables significantly associated with serum sodium, creatinine and urea in hypertensive patients in this study. Hypertensives were elder (1.95), and high physical activity (0.15) times more likely to have elevated creatinine level than young and low physical activity (AOR = 1.95; 95% CI = 0.39 - 2.33, AOR = 0.015; 95% CI=0.001- 0.16) respectively. Hypertensives were elder (3.27), and high physically activity (0.028) times more likely to have elevated urea level than young and low physical activity (AOR = 3.27; 95% CI = 0.80 – 4.06, AOR = 0.028; 95% CI=0.002- 0.031) respectively. Age was independent variables significantly associated with serum sodium. Hypertensives were younger 0.09 times more likely to have hyponatremia than elder hypertensives (AOR = 0.09; 95% CI = 0.014 - 0.104). Age-related decline in the glomerular filtration rate is common and highly prevalent in the elderly.

In elderly individuals, reduced renal function is accompanied by the decreased in renal blood flow, decrease in kidney mass, particularly from the renal cortex, the glomerular hemodynamic changes and an increase in glomerular basement membrane permeability(59,60).

Lifestyle modifications including weight loss, exercise, and healthy diets are proved to be important predictors to lower blood pressure or the risk for hypertension, respectively. For example, the Canadian hypertension education program guidelines (2016) proposed health behavior management for the prevention of hypertension such as physical exercise, weight management, limited alcohol consumption, stress management, reduce sodium intake and recommended dietary modification as the preferred method of increasing potassium intake (in patients who are not at risk of hyperkalemia) to get additional nutritional benefits of whole foods over prescribed supplements. (55)

7. Strengthens and Limitations of the Study

7.1 The strength of the study

- Data and sample collection was done by well-experienced nurses and laboratory technologists with the strict following of SOPs.
- Data entry process and data analysis were done with Epi data version 3.1 and SPSS software version 21.
- Analyses of laboratory tests were done with fully automated clinical chemistry instruments.

7.2 Limitations of the study

- A single day blood pressure measurement used for new hypertensive cases
- Dietary habits were not in depth assessed
- Urine electrolytes not assessed

8. Conclusion and Recommendation

8.1 Conclusion

Hypertensive participants showed a significantly elevated level of fasting blood glucose, TC, TG, LDL-C, creatinine, and urea test parameters. In this study, we observed that the hypertensive group was at risk for developing biochemical abnormality in creatinine, urea, fasting blood glucose, total cholesterol, triglyceride, LDL-cholesterol, electrolytes, and albumin test parameters. The fasting blood glucose, total cholesterol, triglyceride, LDL-C, creatinine, and urea tests were significantly higher while serum albumin, sodium, calcium, HDL-C significantly decreased in the hypertensive patients with an increased period of time.

8.2 Recommendation

- The hypertensive patients need to follow up with fasting blood glucose, serum albumin, electrolytes, lipid profile, and renal function tests for regular assessment to prevent cardiovascular disease, stroke, and kidney failure.
- Regular measurements of laboratory test parameters strongly needed for hypertensive patients.
- Further similar studies need to be conducted on hypertension that includes different study sites.

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10. Annexes

Annex 1 (A): Information sheet (English Version)

Title of the Research Project: Assessment of blood glucose, serum electrolytes, albumin, creatinine, urea, and lipid profile in hypertensive patients and non-hypertensive participants at wolaita sodo university teaching and referral hospital, SNNPR, Ethiopia

Principal Investigator: Berhanu Haile (BSc, MSc candidate)

Name of the Organization: Addis Ababa University College of Health Science, School of Allied Health Science Department of Medical Laboratory Science

Introduction

You are kindly invited to participate as a study subject in a research conducted by Addis Ababa University College of Health Science, Department of Medical Laboratory Masters student thesis. Your participation is voluntary. The research teams will include one principal investigator, two advisors from Addis Ababa University. Please take as much time as you need to read or listen to the information sheet.

Purpose of the Research Project

We are asking you to take part in this study because we will try to assess blood glucose, serum electrolytes, albumin, creatinine, urea, and lipid profile tests in hypertension patients and recommending tangible solutions to prevent hypertension disease.

Procedures and the expected participation

If you are willing to participate, you need to understand the purpose of the study and give your consent. Not only this but also a specimen collected from you will be used for the research purpose, and the results of your sample will be exposed to some concerned professional staff as it is needed. The required clinical sample will be collected by residents of the clinical chemistry department. Then, you are requested to give your consent to the sample collector.

After consent, a sample will be taken from capillary and venous puncture. Moreover, there will be a face-to-face interview for additional questions.

Potential risks and Discomforts

During the collection of specimens from you, appropriate precaution will be taken and all samples will be collected by trained health professionals. If anything happened, appropriate medical care will be provided to you.

Confidentiality

We respect your privacy and confidentiality. Any information that identifies you will not be shared with anyone else outside the study team. The information we will collect from you as part of the study will be kept in a locked file cabinet, or be protected by a password on the computer only accessible to personnel involved in the study. There is no sensitive issue that you will be asked related to your social desirability but any information that is obtained in connection with this study and that can be identified with you will remain confidential.

Potential benefits to subjects and/or to the society

You will not receive any payment for your participation in this research study as compensation. However, based on the diagnosis result you will be treated in view of that. Hence, you are indirectly benefiting other patients and society in this respect.

Participation and Withdrawal from the Study

Participation is voluntary and you have the right not to participate in this study. You may withdraw at any time and place without consequences of any kind. You may also reject to give any sample. You can ask any questions regarding this study and you have a right to get a laboratory diagnosis result free.

Contact information:

If you have any questions about this study you can contact the following principal investigators and advisors for further information.

Berhanu Haile	Phone: +251-916-350-525	E-mail: birex06@gmail.com
Dr. Mistire Wolde	Phone: +251-911-699-710	Email: mistire08@gmail.com
Tatek Gebregziabiher	Phone +251-911-644-338	Email: tatekgeher@yahoo.com

Annex 1(B): Information sheet (Amharic version)

የተሳታፊዎች ፈቃድና መተማመኛ ቅፅ

በአዲስ አበባ ዩኒቨርሲቲ ጤና ሳይንስ ኮሌጅ የሕክምና ላቦራቶሪ ሳይንስ ት/ክፍል በማስተርስ ድግሪ ተማሪ የመመረቂያ ጥናት ላይ እዲሳተፉ ተጋብዘዋል፡፡ እባክዎ በዚህ ጥናት ለመሳተፍ ከመስማማትዎ በፊት ከዚህ ቀጥሎ የሚገኘዉን ምንባብ በጥሞና ያንብቡና ግልጽ ያልሆነልዎትን ማንኛዉም ሃሳብ ይጠይቁ፡፡

መግቢያ

የጥናቱ ርዕስ “Assessment of blood Glucose, Serum Electrolytes, Albumin, RFT and Lipid profile in Hypertensive Patients and non-hypertensive participants at Wolaita Sodo University Teaching and Referral Hospital, SNNPR, Ethiopia”

የእርስዎ በዚህ ጥናት ላይ የሚኖርዎት ተሳትፎ ሙሉ በሙሉ በበጎ ፈቃደኝነት ላይ የተመሰረተ ነዉ፡፡ በዚህ ጥናት ዉስጥ ላለመሳተፍ ወይም ለመሳተፍ ከወሰኑ በኃላ ለማቋረጥ የሚወስኑ ቢሆንም እንኩዋ በዚህ ሆስፒታል የሚሰጠዉ ማንኛዉም አገልግሎት አይቋረጥም፡፡ በጥናቱ ለመሳተፍ የሚስማሙ ከሆነ የስምምነት ቅጹ ላይ በጹሁፍ ወይም በጣት ፊርማ ማስቀመጥ ይጠበቅዎታል፡፡

የጥናቱ ተሳታፊ ለመሆን የሚጠበቅበዎት ምንድን ነው?

በዚህ ጥናት ለመሳተፍ የሚስማሙ ከሆነ ናሙናዎ ለጥናቱ እንዲሚዉል መስማማት ይጠበቅብዎታል፡፡ከተወሰደዉ ናሙና ላይ የሚገኙ መረጃዎች ከዚህ ሆስፒታል ዉጭ ለሚገኙና ለስራዉ አግባብነት ላላቸዉ ሰዎች ቢነገር የማይቃወሙ መሆኑን መስማማት ይጠበቅብዎታል፡፡ይሁን እንጅ ይህ አይነቱ መረጃ የርስዎን ማንነት የሚገልጡ መረጃዎችን ማለትም ስም፤ አድራሻና የስልክ ቁጥር የመሳሰሉትን መረጃዎቸን አይጨምርም፡፡ ይልቁንም ለዚህ አገልግሎት ብቻ የሚዉል እርስዎን ለማወቅ የሚያስችል መለያ ቁጥር ጥቅም ላይ እንዲዉል ይደረጋል፡፡በተጨማሪም ስለርስዎ አጠቃላይ የጤና ሁኔታ ለሚቀርቡ አንዳንድ ተጨማሪ ጥያቄዎች መልስ መስጠት ይኖርብዎትአል፡፡

በዚህ ጥናት መሳተፍ የሚያስከትላቸዉ ችግሮች ምንድን ናቸዉ?

ናሙና በሚሰበሰብበት ወቅት ምንም አይነት የከፋ ችግር አያጋጥምዎትም፡፡ ሆኖም ግን ናሙናዉን ለመሰብሰብ ልምድ ያለዉ ባለሙያ ስለሚመደብና አስፈላጊዉ የጥንቃቄ እርምጃ ስለሚወሰድ የህመም ስሜት አይኖርም፡፡

የህክምና መረጃ በሚስጥር ተጠብቆ መቆየት የሚችለዉ እንዴት ነዉ?

ስለራስዎ የሰጡት ማንኛዉም መረጃና ከተወሰደዉ ናሙና ላይ የተገኘዉ የላቦራቶሪ ዉጤት የሚዉለዉ ለጥናቱ አላማ ብቻ ነዉ፡፡ ይህን ማህደር ሊያገኙ የሚችሉት የተወሰኑ የጥናቱ ተባባሪ ሰዎች ብቻ ናቸዉ፡፡ከዚያም በላይ ስለ እርስዎ ያለውን ማንኛውንም መረጃ የተለየ የይለፍ ቃል ባለው የኮምፒውተር የመረጃ ማህደር ውስጥ እንዲቀመጥ ይደረጋል ፡፡

በዚህ ጥናት መሳተፍ የሚያስገኛቸው ጥቅሞች ምንድን ናቸዉ ?

ይህ ጥናት የማስተርስ ድግሪ መመረቂያ እንደመሆኑ መጠን በዚህ ጥናት በመካፈልዎ በገንዘብ የሚያገኙት ጥቅም ባይኖርም ከጥናቱ በሚገኘው ውጤት ግን ተጠቃሚ ነዎት፡፡ የእርሶዎ ተሳትፎ የእርስዎንና የወገንዎትን የደም ስኳር፣የኩላሊት ህመም እና የኮሌስትሮል መጠን ለማወቅና ለማከታተል ከፍተኛ ጥቅም ይኖረዋል፡፡

በዚህ ጥናት ተሳታፊ የመሆንዎ መብቶች ምንድን ናቸዉ ?

በዚህ ጥናት መሳተፍ ሙሉ በሙሉ በእርስዎ ፈቃደኝነት የተመሰረተ በመሆኑ በማንኛውም ሰዓትና ቦታ የማቋረጥ ሙሉ መብት የተጠበቀ ከመሆኑም በላይ እራስዎን ከጥናቱ በማግለልዎ ምክንያት የሚቀርብዎት ምንም አይነት የሆስፒታል አገልግሎት አይኖርም ፡፡ከዚህም በተጨማሪ ጥናቱን በተመለከተ ማንኛውንም አይነት ጥያቄ የመጠየቅና ገለጻ የማግኘት መብት አለብዎት፡፡የላብራቶሪ ምርመራ ውጤቱንም በነጻ ማግኘት ይችላሉ፡፡ ነገር ግን እርስዎ በሚሰጡን መረጃ የችግሩን ስፋት ለመከላከል እና ለመቆጣጠር ጠቃሚ ስለሆነ ለሚቀርብልዎት ጥያቄ ቀጥተኛ መልስ ይሰጡን ዘንድ በታላቅ አክብሮት እንጠይቃለን፡፡

ጥያቄ ካለኝ ወይም ችግር ቢያጋጥመኝ ምን ማድረግ ይገባል?

ይህንን ጥናት በተመለከተ ወይም ከዚህ ጥናት ጋር በተዛመደ መልኩ ስለሚያጋጥሙ ድንገተኛ አደጋዎች ወይም ጥያቄ ካለዎት በሚመለከተው አድራሻ ይጠቀሙ፡፡

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Annex 2 (A): Informed consent form (English version)

Unique code:_____ Date:_____

I had been informed that the objective of this study is to assess blood Glucose, Serum Electrolytes, Albumin, RFT and Lipid profile in Hypertensive Patients and non-hypertensive participants. The results of this study have an importance to treat me and other patients, and to be used as an input for the future development of strategies or guidelines for diagnosing of Hypertension in Ethiopia. I had been also informed about the confidentiality of this study. The principal investigator requested me to participate in the study that would require my willingness to provide the required data that include blood sample, and filling questionnaire. Therefore, with full understanding of the importance of the study, I agreed voluntarily to provide the requested samples and my benefit will be only from the free laboratory investigation result/s.

I_____ hereby give my consent for providing the requested information and specimens as the doctors find best for me.

Signature: _____ Date_____

Annex 2 (B): Informed consent form (Amharic version)

የተሳታፊዎች ስምምነት ማረጋገጫ

የሚስጥር ቁጥር ----------

እኔ የሚስጥር ቁጥር ከላይ የተጠቀሰው ተሳታፊ "Assessment of blood Glucose, Serum Electrolytes, Albumin, RFT and Lipid profiles in Hypertensive Patients and non-hypertensive participants" **ጥናት ላይ በቂ ገለጻ ተደርጎልኛል፡፡ ለጥናቱም የደም ናሙና እንደሚያስፈልግ ተገልጸልኛል፡፡የጥናቱንም አላማዎችም ተረድቻለሁ፡፡**

በቃለ መጠይቁ ላይ የገለጽኳቸው መረጃዎች በሙሉ በሚስጥር የተጠበቁ እንደሚሆኑ ተነግሮኛል ፡፡ በጥናቱ ላይ ያለመሳተፍና ማንኛውንም መረጃ ያለመስጠት እንዲሁም በማንኛውም ጊዜ ከጥናቱ ራሴን የማግለል መብቴ የተጠበቀ እንደሆነ ተገልጸልኛል፡፡

ስለዚህ ለዚህ ጥናት መረጃና የስምምነት ቃሌን የሰጠሁት በአጠቃላይ ሁኔታውን በመረዳትና በፍጹም ፍቃደኝነት ነው፡ በተጨማሪም ጥያቄ ለመጠየቅ ተፈቅዶልኝ ለማወቅ የፈለኩትን ያህል ማብራሪያ አግኝቻለሁ ፡፡የዚህ ጥናት ተሳታፊ በመሆኔ የማገኘው ጥቅም የሁሉንም ምርመራ ውጤት በነጻ ማግኘት እንደሆነ ተረድቻለሁ፡፡

በአጠቃላይ እኔ ከላይ በመተማመኛ ቅፅ የተጠቀሱትን ሁሉ በሚገባና በተረጋጋ መንፈስ አንብቤዋለሁኝ፡፡ ስለዚህ በዚህ ጥናት ለመሳተፍ ፈቃደኛ መሆኔን በፊርማዬ አረጋግጣለሁ፡፡

ፊርማ---------- ቀን -------/---/----------

(የስምምነት ቅጹን ማንበብ ለማይችሉ ተሳታፊዎች)

የአማካሪ ነርስ ስም ---------- ፊርማ ----------ቀን----------

Annex 3 (A): Structured Questionnaire for HTN Study participants (English Version)

Participant's identification code: _____ Date _____

SECTION-1: SOCIO-DEMOGRAPHIC FACTORS

Note: please encircle or write the appropriate answer on the space provided.

S.No	QUESTIONS	RESPONSES
1	Age	_____years old.
2	Sex	1. Male 2. Female
3	How much is your monthly income	_____Ethiopian birr
4	Marital Status	1. Single 2. Married 3. Separated 4. Widowed/r
5	Religion	1. Orthodox 2. protestant 3. Muslim 4. other, specify_____
6	Educational Level	1. No formal education 2. Primary 3. Secondary 4. College or University
7	Occupation	1. Public/private servant 2. Merchant 3. Farmer 4. unemployed

SECTION-2: AWARNESS ABOUT HYPERTENSION DISEASE

S.No	QUESTIONS	RESPONSES
8	How often do you see your Doctor?	1. Monthly 2. Every 3 months 3. Every 6 months 4. Yearly
9	Do you know when hypertension occurred	_____months _____years
10	Have you ever seen a traditional healer for treatment of diseases?	1. Yes 2. No
	SECTION-3: BEHAVIORAL RISK FACTORS	
11	Do you currently smoke any tobacco products, such as cigarette, Gaya?	1. Yes 2. No
12	If yes, in Q11, how many times do you smoke it?	1. Daily 2.Frequently 3. Rarely
13	On average, how many times do you smoke each day?	_____
14	Have you ever consumed any alcohol such beer, Tella, Bordie, Tej, Arake, wine,?	1. Yes 2. No
15	How many times do you drink alcohol?	1. Daily 2. Frequently 3. Rarely

SECTION-4: ***PRACTICE ABOUT DIETARY SALT AND PHYSICAL ACTIVITIES***

S.No	QUESTIONS	RESPONSES
	Do you add salt to your food?	1. Yes 2. No
16	How often do you add salt to your food?	1. Daily 2.Frequently 3.Rarely 4.Never
17	How often do you eat processed food high in salt? such as salty food prepared at a fast food restaurant, cheese, Mitmitta, and processed meat like Quantta	1. Always 2.Often 3.Sometimes 4. Rarely 5. Never 6. Don't know
18	How much salt do you think you consume?	1. Far too much 2.Too much 3. Just the right amount 4.Too little 5. Far too little
19	Do you think that too much salt in your diet could cause a health problem?	1. Yes 2. No 3. Don't know
20	Do you walk for at least 30 minutes continuously to get to and from places? For e.g. to work, for shopping, to market, to place of worship, to place of meeting.	1. Yes 2. No
21	In a typical week, on how many days do you walk for at least 30 minutes continuously to get to and from places?	----------days …….Hours : …….minutes
22	Do you do any vigorous-intensity sports, fitness activities that cause large increases in breathing or heart rate like running or football, local dancing for at least 30 minutes continuously?	1. Yes 2. No
23	In a typical week, on how many days do you do vigorous-intensity sports, fitness or recreational (leisure) activities?	----------days …….Hours : …….minutes

Annex 3 (B): Structured Questionnaire for HTN patients Study participants (Amharic Version)

የተሳታፊዉ ሚስጥራዊ ቁጥር፡- ---------- ቀን----------

ለክቡራን ተሳታፊዎች ከዚህ በታች የተዘረዘሩት ጥያቄዎች ከእናንተ የሚፈለጉ ናቸው፡፡ ጥያቄው በአዲስ አበባ ዩኒቨርስቲ ጤና ሳይንስ ኮሌጅ በህክምና ላቦራቶሪ ድፓርትመንት ለድህረ ምረቃ ጥናት የሚያስፈልጉ ናቸው፡፡ የዚህ ጥናት አላማዉ በደም ግፍት ታካሚዎች እና ደም ግፍት ታካሚ ያልሆኑት ሰዎች ላይ የደረጃ ሁለት የስኳር ፣ኩላሊት ህመም ሁኔታ እና ኮለስትሮል መጠን ማጥናት ነው፡፡ የእናንተ መልስ መስጠት ለዚህ ጥናት አላማ ዕውን መሆን አስፈላጊ ነው፡፡

ለትብብርዎ እናመሰግናለን!!!

ክፍል አንድ: የተሳታፊዎች አጠቃላይ መረጃ

ከዚህ በታች እርስዎን በትክክል የሚገልጽዎትን ክብ ያድርጉ

ተ.ቁ	ጥያቄ	መልስ
1	ፆታ	ሀ. ወንድ ለ. ሴት
2	ዕድሜ	_____ዓመት
3	የወር ገቢዎ	_____ የኢትዮጵያ ብር
4	መኖሪያ ቦታ	ሀ. ከተማ ለ. ገጠር
5	የትዳር ሁኔታ	ሀ. ያገባ/ች ለ. ያላገባ/ች ሐ. የተፋታ/ች መ. የሞተበት(ባት)
6	ሐይማኖት	ሀ. ኦርቶዶክስ ለ. ፕሮተስታንት ሐ. ሙስሊም መ. ለሎች.....
7	የትምህርት ደረጃ	ሀ. የቀለም ት/ት ያልተማሩ ለ. አንደኛ ደረጃ ሐ. ሁለተኛ ደረጃ ሐ. ዲፕሎም ና ከዛ በላይ የተማሩ
8	የተሰማሩበት የሥራ መስክ	_____

ክፍል 2፡ ስለደም ግፍት በሽታ ያለዎት እዉቀት

ተ.ቁ	ጥያቄ	መልስ
9	በሀኪም ለመታየት በምንያህል ጊዜ ይሄዳሉ	ሀ. በየወሩ ለ. በየ 3 ወሩ ሐ. በየ 6 ወሩ መ. በዓመት
10	የደም ግፍት በሽታ ከጀመርዎት ምንያህል ጊዜ ይሆኖታል	_____
11	ከዚህ ቀደም የባህል መድሃኒት የመጠቀም ልምድ አልዎት ?	ሀ. አዎ ለ. አይ ሐ. አላዉቅም
ክፍል 3፡ አጋላጭ ሁኔታዎች		
12	በአሁን ሰዓት ምን ዓይነት የትምባሆ ምርት ይጠቀማሉ ለምሳሌ፡- ስጋራ፤ ጋያ...ወዘተ	ሀ. አዎ ለ. አይ
13	ተ.ቁ 12 መልስ አዎ ከሆነ፤ የትምባሆ ምርት ስጠቀሙ መቼ መቼ ነዉ;	ሀ. በየ ቀኑ ለ. አንዳንድ ጊዜ ሐ. በአጋጣሚ
14	በአማካይ በየቀኑ ምን ያህል የትምባሆ ምርት ይጠቀማሉ	_____
15	ምን ዓይነት የአልኮል መጠጥ ይሞክራሉ ለምሳሌ፡ጠላ፤ቦርዴ፤አራቁ፤ጤጅ፤ቢራ፤ወይን...ወዘተ	ሀ. አዎ ለ. አይ
16	ተ.ቁ 15 መልስ አዎ ከሆነ፤ አልኮልን (መጠጥን) የምጠጡት መቼ መቼ ነዉ	ሀ. በየ ቀኑ ለ. አንዳንድ ጊዜ ሐ. በአጋጣሚ

ክፍል 4፡ ጨዉን መጠቀም እና አካላዊ እንቅስቃሰ የማድረግ ልምድ

ተ.ቁ		
17	በምግብዎ ዉስጥ ጨዉ ይጨምራሉ ወይ	ሀ. አዎ ለ. አይ
18	ምግብዎ ዉስጥ ጨዉ የምጨምሩት መቼ ነዉ	ሀ. ሁል ጊዜ ለ. አንዳንድ ጊዜ ሐ. አልፎ አልፎ መ. በፍጹም
20	የእግር ጉዞ በቀን ለ30 ደቅቃ ያህል ያደርጋሉ	ሀ. አዎ ለ. አላደርግም
21	የእግር ጉዞ በሳምንት ለ30 ደቅቃ ለምንያህል ቀን ያደርጋሉ	_____ ቀናት _____ሰዓት፡ከ_____ደቅቃ
22	የልብ ምት እና ትንፋሽን የምጨምሩ ስፖርታዊ እንቅስቃሴ ያደርጋሉ	ሀ. አዎ ለ. አላደርግም
23	ስፖርታዊ እንቅስቃሴ በሳምንት ዉስጥ በየቀኑ ለ30 ደቅቃ ያህል ያለመቸረጥ ያደርጋሉ	ሀ. አዎ ለ. አላደርግም
24	ስፖርታዊ እንቅስቃሴ በሳምንት ለ30 ደቅቃ ለምንያህል ቀን ያደርጋሉ	_____ ቀናት _____ሰዓት፡ከ_____ደቅቃ

Annex 4: WSUTRH Outpatient Department form for study participants physical Measurements (filled by Nurse)

Participant's identification code: _____ Date _____

25. Height: _____cm

26. Weight: _____kg

27. BMI: _____kg/m^2

28. BP: _____mmHg

Annex 5: WSUTRH Medical Laboratory request form for study participants (filled by Lab. Technologist)

Participant's identification code: _____ Date _____

S.No.	Parameters		Results	Laboratory Personnel Comment
29.	Fasting blood glucose		mg/dL	
30.	Serum Albumin		g/dL	
31.	Serum Electrolytes	Sodium	mmol/L	
		Potassium	mmol/L	
		Calcium	mg/dL	
32.	RFT	Creatinine	mg/dL	
		Urea	mg/dL	
33.	Lipid profile	T.Cholestrol	mg/dL	
		HDL	mg/dL	
		LDL	mg/dL	
		Triglyceride	mg/dL	

Reported by: Name of lab technologist_____ Date of report_____ Signature___

Annex 6: Laboratory SOPs

Mindray BS-200 chemistry analyzer

This instrument has been designed to perform spectroscopic measurement at predetermined wavelengths of analyte concentrations and enzyme activity using various reagents. We can perform any combination of tests up to 36-sample pipetting, incubations, photometric measurements and calculations. Programming and operating the analyzer is simple and made easy by windows software. The software, which is supplied with the analyzer, should be installed on a PC connected to the instrument.

Its sophisticated software allows us to program and permanently store in the memory of your PC almost unlimited number of tests and up to 40 test profiles, calibrators and controls. We can create routine sample request by assigning patients data and test and / or profiles to sample. Once the results have been obtained, you can request reports organized per patient or per test or examine the quality control data.

The analyzer can perform end-point or equilibrium method (one or two reagents, monochromatic or dichromatic), fixed time reaction (namely, first-order kinetic method or initial rate method) and kinetic mode method (namely, zero-order kinetic or continuous-monitoring method). The analyzer provides two calibration methods: linear calibration and non-linear calibration.

The linear calibration includes one-point linear calibration, two-point linear calibration and multi-point linear calibration. They are mainly used for tests determined by colorimetry.

The non-linear calibration includes Log it-Log 4P, Log it-Log 5P, Exponential 5P, Polynomial 5P, Parabola and Spline. They are mainly used for tests determined by turbidity.

General working procedures

1) Check the connections among the analyzing unit, operation unit and printer.
2) Ensure a detergent is in position 39 and sufficient distilled water is in position 40 on the reagent disk.
3) Check how much deionized water is left in the tank. If not much, add deionized water to the tank.
4) Check how much wash solution is left in the tank. If not much, add wash solution to the tank.
5) Ensure the waste tank is empty. If it is not empty, empty the waste tank.
6) Place the Power to ON.
7) Press the power button on the monitor of the operation unit
8) Press the power button on the monitor of the operation unit
9) Press the power button on the computer of the operation unit
10) After you have logged on the Windows operating system, double-click the shortcut icon of the operating software on the desktop or select the program of the operating software from [Start] to startup the operating software.
11) After startup, the analyzer will check automatically the operation system and resolution of the screen, close screen saver, check color configuration, initialize database and examine the printer
12) When checking is finished, the following dialog box will pop up to ask you to enter the username and password, and then click OK.
13) Select a serial port from Serial Port in the Startup dialog box, and then click Start to initialize the system. After that, operate according to the screen prompt until the main screen of the operating software is displayed.
14) Wait the analyzer's working temperate reaches at 37oc.
15) Select and click the QC request button on group buttons area to request the QC samples
16) Click the QC request button on group buttons area to request the QC samples
17) Then click in "sample request" button in the group button area to prepare work list by entering the sample id or patient's name and to enter which test you want to perform on each sample.

18) Click the arrow buttons to view sample programming information at the bottom on the left side of the sample disk.
19) After preparing the work list, go to the next step and click “Status” to enter the screen, which is used to display the current status of the sample disk, reagent disk and reaction disk.
20) Then close plexiglass (front glass cover of the instrument), and click on “start” button on the short cut button area of the main screen. It lets you start the session of measurement.

Declaration

I, the undersigned declare that this MSc thesis complies with the regulations of the University and meets the accepted standards concerning originality and quality. I also agree to accept responsibility for the scientific ethical and technical conduct of the research project and the provision of required progress reports.

M.Sc. candidate: **Berhanu Haile (BSc)**

Signature: _____

Date of submission: _____

This MSc thesis has been submitted with our approval as advisors.

Advisor: **Mistire Wolde (MSc, PhD)**

Signature: _____

Date: _____

Place: Addis Ababa, Ethiopia.

Advisor: **Tatek Gebregziabiher (MSc, PhD fellow)**

Signature: _____

Date: _____

Place: Addis Ababa, Ethiopia