Investigating The Role of Ginger Tea Orac Value in Hypertension Management

SUPERIOR UNIVERSITY

Thesis Submitted to

The Superior University Lahore

In Partial Fulfillment of the

Requirement for the Degree of

MS Allied Health Sciences

By

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Session: 2023-2025

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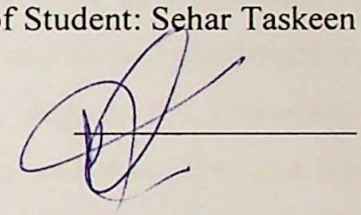
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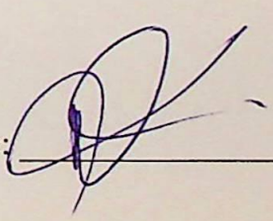
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DEDICATION

I dedicate this thesis to those who have supported me throughout my academic journey. I express my deepest gratitude to my supervisor, Dr Muhammad Adnan Hafeez, for their expert guidance and valuable feedback. I also thank my loving parents, for their support, encouragement, and love. And also, I appreciate my Superior University for providing a conducive learning environment and necessary resources. Thank you.

ACKNOWLEDGEMENT

In the name of Allah, the most Gracious, the most Merciful.

I am extremely thankful to Almighty Allah, who is the entire source of knowledge and wisdom endowed to mankind, for giving me the acumen and vision to complete this endeavor.

I would like to express my profound gratitude to my supervisor for his/her wise counsel and encouraging attitude towards this study. I am extremely grateful to him/her for immensely facilitating me during my study period by ensuring the provision of favorable circumstances and conducive environment. This project hwould not have been possible without his support and expert guidance.

In the end, I would like to extend my deepest gratitude to my family members. Without their encouragement, I would not have been able to complete this endeavor. (You can always choose your own wordings; this is only a format/ sample to be followed for uniformity of all thesis).

Sehar Taskeen

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LIST OF ABBREVIATIONS

BP	**Blood Pressure**
SBP	Systolic Blood Pressure
DBP	Diastolic Blood Pressure
CVD	Cardiovascular Disease
ORAC	Oxygen Radical Absorbance Capacity
LDL	Low-Density Lipoprotein
HDL	High-Density Lipoprotein
PWV	Pulse Wave Velocity
CI	Confidence Interval
CMEC	China Multi-Ethnic Cohort

ABSTRACT

Hypertension is the most potent risk factor for CVDs, including IHD, stroke, and chronic kidney disease, and is among the most preventable causes of death globally. Scientifically healthy foods, including ORAC-rich ginger tea, may be used as adjuvants in the management of hypertension. The purpose of this research was to determine the effectiveness of ginger tea in managing hypertension by determining systolic blood pressure, cholesterol, and arterial stiffness in addition to the usual management. This was a single-blinded RCT study done in outpatient clinics located at a university hospital, and the participants were randomly recruited. A stratified random selecting procedure was then used to choose 50 people from the human volunteers, 25 of whom were given ginger tea for the interventional group and another 25 of whom were given placebo tea for the control group. The participants were all between the ages of 30 and 65. Triglycerides, arterial stiffness, total cholesterol, LDL/HDL cholesterol, and systolic and diastolic blood pressure were measured at baseline and after 12 weeks. A mean systolic and diastolic blood pressure drop of 8 mmHg and 5 mmHg, respectively, was seen in the intervention group ($p < 0.05$). When compared to the control group, the ginger tea group showed a substantial change in both pulse wave velocity and LDL cholesterol levels. Ginger tea showed some promise as an additional, safe therapy for hypertension. Its high antioxidant capacity also contributes to its value in cardiovascular diseases, making it an effective supplement to hypertensive pharmacotherapy.

Keywords: Antioxidants, Blood Pressure, Cardiovascular Health, Ginger Tea, Hypertension, ORAC

Chapter 1

INTRODUCTION

High blood pressure is a major risk factor for ischaemic heart disease, stroke, dementia, chronic kidney disease, and other cardiovascular diseases (CVDs). High blood pressure is a leading avoidable cause of CVD mortality and disease burden in the majority of the world's regions. Elevated blood pressure is defined as diastolic blood pressure (DBP) of at least 80 mmHg or systolic blood pressure (SBP) of at least 120 mmHg. (1)

Cardiovascular diseases (CVDs) are disorders of the heart and blood vessels, which include peripheral artery disease, rheumatic heart disease, coronary heart disease, deep vein thrombosis, and cerebrovascular sickness. In recent times, cardiovascular diseases (CVDs) have surpassed cancer as the major cause of mortality globally. However, by lowering risk factors such diabetes, high blood pressure, elevated lipids, unbalanced diets, and physical inactivity, the majority of CVDs may be prevented. It is estimated that 69% of people who have their first heart attack and 75% of those with persistent heart failure have high blood pressure as a concomitant illness. (2)

Clinical evidence shows that a 5 mmHg reduction in blood pressure can reduce the incidence of ischaemic heart disease by 21% and stroke by 34. Numerous variables, including as ageing, genetic predisposition, lifestyle choices (such as smoking and inactivity), and dietary factors (such as excessive salt intake, alcohol use, and inadequate consumption of fruits and vegetables) have been associated with the development of hypertension. It is estimated that one billion people worldwide suffer from hypertension, which kills 9.4 million people annually. (3). In low- and middle-income countries, where the social and economic ramifications of hypertension are expected to severely limit socioeconomic progress, the incidence of the condition is increasing. (4).

A healthy diet is essential for controlling high blood pressure. Increasing consumption of fruits, vegetables, whole grains, and lean meats while decreasing consumption of processed foods and salt are examples of nutritional strategy. Foods and drinks high in flavonoids, including certain teas, can reduce blood pressure. Green tea use may help lower the risk of hypertension, support weight control, and improve heart health. Rich

in antioxidants, ginger tea is well-known for having a high Oxygen Radical Absorbance Capacity (ORAC), which may help control blood pressure. (5).

Previous research have demonstrated the beneficial effects of tea intake on blood pressure management. For instance, it has been shown that consuming black and green teas can improve cardiovascular health and reduce blood pressure in those with hypertension. (6). Investigating the specific impact of ORAC value could provide valuable insights into its efficacy as a complementary treatment for hypertension. The findings of such a study could be highly relevant for developing advanced non-pharmacological interventions that broaden the scope of hypertension management strategies. (7).

Antioxidants are crucial in managing oxidative stress, which contributes to hypertension. Studies have shown that regular consumption of certain teas, such as green and hibiscus tea, can effectively reduce blood pressure levels. (8).

This study evaluated ginger tea's antihypertensive effects. By examining its impact on blood pressure levels, it aimed to determine whether ginger tea can be an effective, natural adjunct to conventional hypertension treatments. This investigation provided insights into its potential role in reducing the burden of hypertension and improving cardiovascular health.

AIM AND OBJECTIVES

1. To determine the optimal dosage of ginger tea that produces significant blood pressurereduction without adverse effects.
2. To identify consumption and its correlation with blood pressure outcomes using a self-reported diary and periodic clinical assessments.

Chapter 2

LITERATURE REVIEW

Verdecchia explores that one of the most important risk factors for dementia, chronic renal disease, ischemic heart disease, stroke, and other cardiovascular conditions is high blood pressure. In high-income areas, the prevalence of hypertension and high blood pressure has significantly decreased since at least the 1970s. On the other hand, blood pressure has gone up in Sub-Saharan Africa, Oceania, and East, South, and Southeast Asia. In light of these findings, low-income and middle-income nations currently have greater rates of hypertension than low-income ones. An estimated 8.5 million deaths in 2015 were attributed to hemorrhages caused by hypertension greater than 115 mmHg. National economic resources, the growth of health insurance and health services, the frequency of interactions between patients and non-physician healthcare providers, the clarity and acceptance of internal treatment guidelines, the availability of medications, and treatment coverage are some of the factors influencing its diversity. (9)

Wang J studied that cardiovascular diseases have overtaken cancer as the primary cause of death. Hypertension is the most detrimental factor linked to cardiovascular disease death. Tea has been demonstrated in several research to have anti-hypertensive effects in both humans and animals. By examining the underlying processes based on ex-vivo tissue and cell culture data, the study updated our knowledge of the anti-hypertensive benefits of tea in human therapeutics and animal studies. In recent years, a growing body of studies on the human population has verified the positive effects of tea on hypertension. However, due to variations in the severity of hypertension and the intricate socioeconomic and genetic backgrounds of different nations, the ideal dose has not yet been determined. Therefore, long-term prospective and well controlled studies are needed to determine the optimal dosage for people with different blood pressure risk factors and how the impact varies across other groups. Additionally, it increases endothelial nitric oxide synthase activity and relaxes smooth muscle contraction. The specific molecular pathways that underlie these actions are yet unclear. (10)

Igho-Osagie conducted a research on chronic tea drinking, however it was linked to a 1.8 mmHg drop in systolic blood pressure (95% CI -2.4, -1.1) and a 1.4 mmHg drop in

diastolic blood pressure (95% CI -2.2, -0.6). Specifically, black tea dropped systolic blood pressure by 1.4 mmHg (95% CI -2.4, -0.4) and diastolic blood pressure by 1.1 mmHg (95% CI -1.9, -0.2), whereas green tea decreased systolic blood pressure by 2.1 mmHg (95% CI -2.9, -1.2) and diastolic blood pressure by 1.7 mmHg (95% CI -2.9, -0.5). The BP-lowering impact was more pronounced in those who drank tea for more than 12 weeks, according to subgroup analysis, with 2.6 mmHg drops in systolic blood pressure (95% CI -3.5, -1.7) and 2.2 mmHg drops in diastolic blood pressure (95% CI -3.0, -1.3) (11).

Yang examined the impact of various tea types on blood pressure (BP) in 76,673 individuals aged 30-79 who were part of the China Multi-Ethnic Cohort (CMEC) cohort. The research, which included multiple linear regression and binary logistic regression, found that drinking tea is associated with a 10% decreased incidence of hypertension (Adjusted Odds Ratio: 0.90, 95% Confidence Interval: 0.86–0.94). Dark tea specifically reduced systolic and diastolic blood pressure (DBP and SBP) by 1.79–5.31 mmHg and 0.47 and 1.02 mmHg, respectively. Sweet tea consistently lowered SBP by 3.19–7.18 mmHg, regardless of how much, how often, or how long it was drank. There was a 1.21–2.98 mmHg decrease in blood pressure linked to green tea. Long-term, infrequent, and small-scale use of scented tea was observed to lower SBP by 1.26–2.48%. (12).

Grassi investigated the impact of black tea on hypertensive blood pressure (BP) and wave reflections before and after a fat load. Using a randomized, double-masked, controlled, cross-over design, 19 patients were randomized to drink either black tea (129 mg flavonoids) or a placebo twice a day for eight days, with a 13-day wash-out period in between. Prior to, during, and four hours following tea consumption, blood pressure and digital volume pulse were measured. Measurements were made while fasting and following a fat load. The stiffness and reflection indexes were reduced after tea consumption than after a placebo ($p < 0.0001$). Drinking tea counteracted the enhanced wave reflection caused by the fat challenge ($p < 0.0001$). Black tea reduced both systolic and diastolic blood pressure (-3.2 mmHg, $p < 0.005$ and -2.6 mmHg, $p < 0.0001$) and avoided a rise in blood pressure ($p < 0.0001$) following a fat load. Drinking

black tea lowers blood pressure and wave reflections in those who are fasting or who have trouble with their hemodynamics after eating fat. Given that lipemia-induced impairment of arterial function may frequently occur during the day, our findings suggest that regular drinking of black tea may be required for cardiovascular protection (13).

Although there are still some gaps in the literature, there is substantial evidence of tea's antihypertensive benefits. First, there is a lack of clarity regarding the ideal amount and length of time to drink tea in order to significantly and sustainably lower blood pressure without experiencing adverse side effects. Second, the generalisability of findings across varied groups has been limited by the incomplete exploration of response variability caused by genetic, socioeconomic, and lifestyle factors. Third, although research indicates that tea affects vascular function by relaxing smooth muscles and nitric oxide generation, the precise molecular pathways are yet unknown. Last but not least, the majority of studies concentrate on tea consumption in general rather than on particular formulations, like ginger tea, underscoring the need for more focused clinical trials to ascertain its precise benefits on the management of hypertension.

Chapter 3

METHODOLOGY

3.1 Research Design

It was a randomized clinical trial (RCT).

3.2 Clinical Settings

The study will be conducted in outpatient clinics affiliated with a university hospital, providing a controlled environment for regular monitoring and data collection.

3.3 Sample Size

Based on power analysis, 50 participants will be recruited, with 25 assigned to the intervention group (ORAC tea) and 25 to the control group (placebo tea) (14).

Note: This formula used for determining a sample size $n=((Z\alpha/2+Z\beta)2\times(2\sigma2)/\Delta2)$

3.4 Sampling Technique

Participants were selected using stratified random sampling to ensure representation across various demographic factors, such as age, gender, and severity of hypertension.

3.5 Duration of Study

6 Months

3.6 Selection Criteria

3.6.1 Inclusion Criteria (15)

- Adults aged 30-65 years
- Both Gender

- Diagnosed with stage 1 or stage 2 hypertension
- Not currently taking antihypertensive medication
- Willing to provide informed consent and adhere to study protocols.

3.6.2 Exclusion Criteria (15)

- Pregnant or breastfeeding women
- Smoking and taking any supplements or vitamin
- Participants on antioxidant supplements or other herbal teas.

3.7 Data Collection Tools

3.7.1 Blood Pressure (mmHg)

Systolic blood pressure, which happens during a heartbeat, and diastolic blood pressure, which occurs during the heart's rest, are the two numbers that represent the blood pressure against the artery walls. When the systolic blood pressure is between 130 and 139 mmHg or the diastolic falls between 80 and 89 mmHg, it is considered stage 1 hypertension. When the diastolic blood pressure is 90 mmHg or higher, or the systolic blood pressure is 140 mmHg or higher, it is considered stage 2 hypertension. A sphygmomanometer is often used to take blood pressure a few minutes after sitting, with the arm at heart level. (16).

3.7.2 Cholesterol Levels (mg/dL)

A lipid is a type of fat that is present in the circulation in different forms and is necessary for the formation of cells; it may be quantified as triglycerides, total cholesterol, low-density lipids (LDL), and high-density lipids (HDL). Over 200 mg/d of total cholesterol, over 100 mg/d of LDL, and over 150 mg/d of triglycerides are considered excessive. To identify cardiovascular risk factors, a fasting venous blood sample is used. (17).

3.7.3 Arterial Stiffness (Pulse Wave Velocity in m/s)

Arterial stiffness is a measure of the arteries' ability to regenerate, and it is linked to genes that are more likely to cause cardiovascular disease. While the second chart relates stiffness with wind speed, the first two are utilized

to derive values that indicate stiffness. High rigidity is indicated by wind speeds greater than 10 m/s. In order to determine the speed of artificial pulse waves with consequences for arterial health, pulse wave velocity (PWV) is monitored by installing sensors in major arteries. (18)

3.8 Ethical Consideration

The Institutional Review Board (IRB) reviewed and approved the study protocol. Informed consent will be obtained from all participants. Confidentiality and anonymity of participant data were maintained throughout the study.

3.9 Data Collection Procedure

3.9.1 Recruitment

The dietetics department of a university hospital recruited hypertensive patients who cardiologists or general physicians referred.

3.9.2 Randomization

Participants were randomly assigned to either the groups using a lottery method.

3.9.3 Blindness

The dietician and participants were aware of their group assignment. However, the assessor remained blinded throughout the study.

3.9.4 Interventions

Group A: Experimental Group (using ORAC ginger tea)

Group B: Control Group (Without Ginger tea)

3.9.5 Experimental Group

The intervention group was given ginger tea with a fixed antioxidant dose daily for twelve consecutive weeks. Each participant was given two grams of ginger root powder, added to 250 ml of boiling water, and allowed to steep at 90-95°C for 5-10 minutes. All ginger powder used in the study was purchased from one supplier and preliminary screened for ORAC value to

ensure consistency. To minimize the effects of any sporadic fluctuation in blood pressure on a given day, participants were required to take ginger tea at 9 AM. Consequently, compliance was monitored through checklists that gave daily logs, supplemented by occasional phone calls (19).

3.9.6 Control Group

The control group received a placebo tea designed to closely resemble ginger tea in appearance and taste but without any active ginger. This placebo tea used a mild herbal base, such as chamomile, with added flavoring to mimic the ginger-like aroma and taste. Prepared similarly to the ginger tea, it was steeped for 5-10 minutes in 250 ml of hot water and served. Participants also consumed their tea daily at the same designated time to maintain the reliability of the study conditions (20).

3.10 Data Analysis

Data was analyzed using SPSS software 21 version. Demographic data was divided into two parts: Descriptive statistics with histograms and categorical data into frequency and percentages with bar charts. Wilcoxon test was compared to changes in blood pressure, cholesterol levels, and arterial stiffness between the intervention and control groups. Mann Whitney U test was to assess trends over time.

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Chapter 4

RESULTS

In Table 4.1, the demographic data of the mean age of participants in Group A was 43.52±8.55, while in Group B, it was slightly higher at 46.04±11.77. The mean height of participants in Group A was 168.64±12.54 cm, compared to a somewhat lower mean height of 166.60±12.22 cm in Group B. For weight, the mean in Group A was 74.16±11.46 kg, while in Group B, it was slightly higher at 75.52±14.96 kg.

Table 4.2 presented Group A had a higher proportion of males (64%) than Group B (40%), while females were more represented in Group B (60%). Group B participants reported a higher intake of fried or fatty foods (56%) than Group A (24%), where moderate and low-fat diets were more common. In terms of salt intake, 28% of Group A participants "Always" add extra salt, while 32% of Group B participants report "Often" or "Never" adding salt. Physical activity levels show that Group A has more sedentary participants (44%), whereas Group B has a more significant percentage who are lightly active (44%).

Table 4.3 presented that Group A showed reduction in Systolic Blood Pressure (from 135.2 ± 12.4 to 128.5 ± 10.3) and Diastolic Blood Pressure (from 85.4 ± 8.7 to 80.0 ± 7.6) by the 8th week, indicating a positive effect of the intervention. Group A also improved Total and LDL Cholesterol, increasing HDL Cholesterol. These changes suggest a favorable cardiovascular response in Group A compared to Group B. In Table 4.4 Group A and Group B showed non-significant Shapiro-Wilk p-values (> 0.05) across all variables at baseline and the 8th week. This indicates approximate non-normality in data distribution for Blood Pressure, Cholesterol, and Arterial Stiffness measurements.

Table 4.5 displayed within-group changes for Group A form baseline to the 12th week using the Wilcoxon Signed Rank Test. Significant p-values ($p < 0.05$) for Systolic and Diastolic Blood Pressure, Total and LDL Cholesterol, HDL Cholesterol, Triglycerides, and Pulse Wave Velocity indicate statistically significant improvements within Group A. These reductions in blood pressure and cholesterol, along with the increase in HDL Cholesterol, highlight the potential effectiveness of the intervention in enhancing

cardiovascular health. The Mann-Whitney U Test results were provided in Table 4.6, comparing Group A and Group B for baseline and 12th-week measurements. Group A shows statistically significant improvements in the 12th week in Systolic Blood Pressure ($p = 0.006$), Total Cholesterol ($p = 0.004$), HDL Cholesterol ($p = 0.005$), and Pulse Wave Velocity ($p = 0.009$) compared to Group B. These significant between-group differences underscore the effectiveness of the intervention in improving cardiovascular indicators for Group A relative to Group B.

Table 4.1: Descriptive Statistics of Quantitative Demographic Variable

Variable	Group A		Group B	
	Mean	SD	Mean	SD
Age	43.52	8.554	46.04	11.767
Height (cm)	168.64	12.540	166.60	12.220
Weight (kg)	74.16	11.455	75.52	14.956

The mean age of participants in Group A was 43.52±8.55, while in Group B, it was slightly higher at 46.04±11.77.

The mean height of participants in Group A was 168.64±12.54 cm, compared to a slightly lower mean height of 166.60±12.22 cm in Group B.

For weight, the mean in Group A was 74.16±11.46 kg, while in Group B, it was slightly higher at 75.52±14.96 kg.

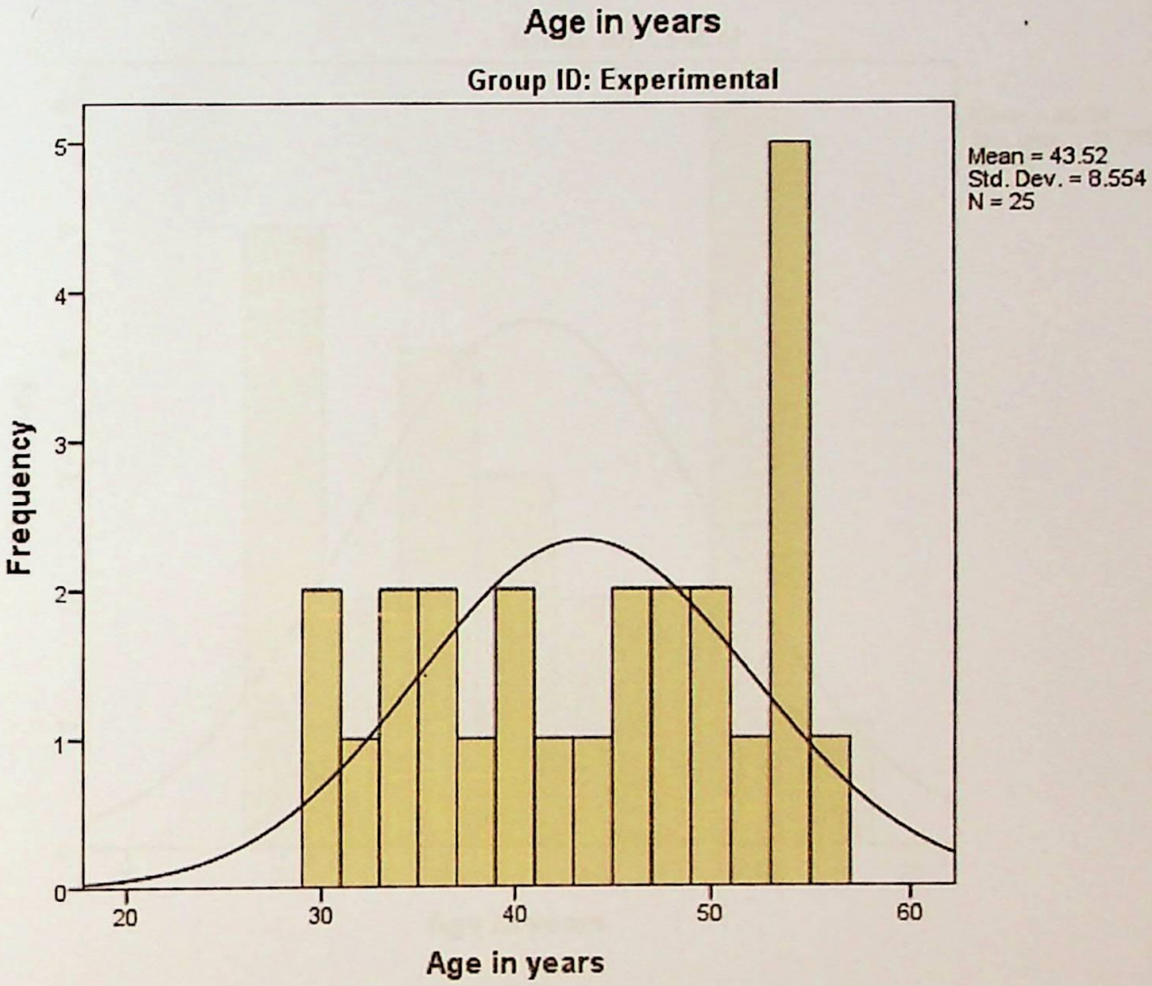


Figure 4.1: Age Distribution in Group A

The mean age in Group A is 43.52 ± 8.554 years.

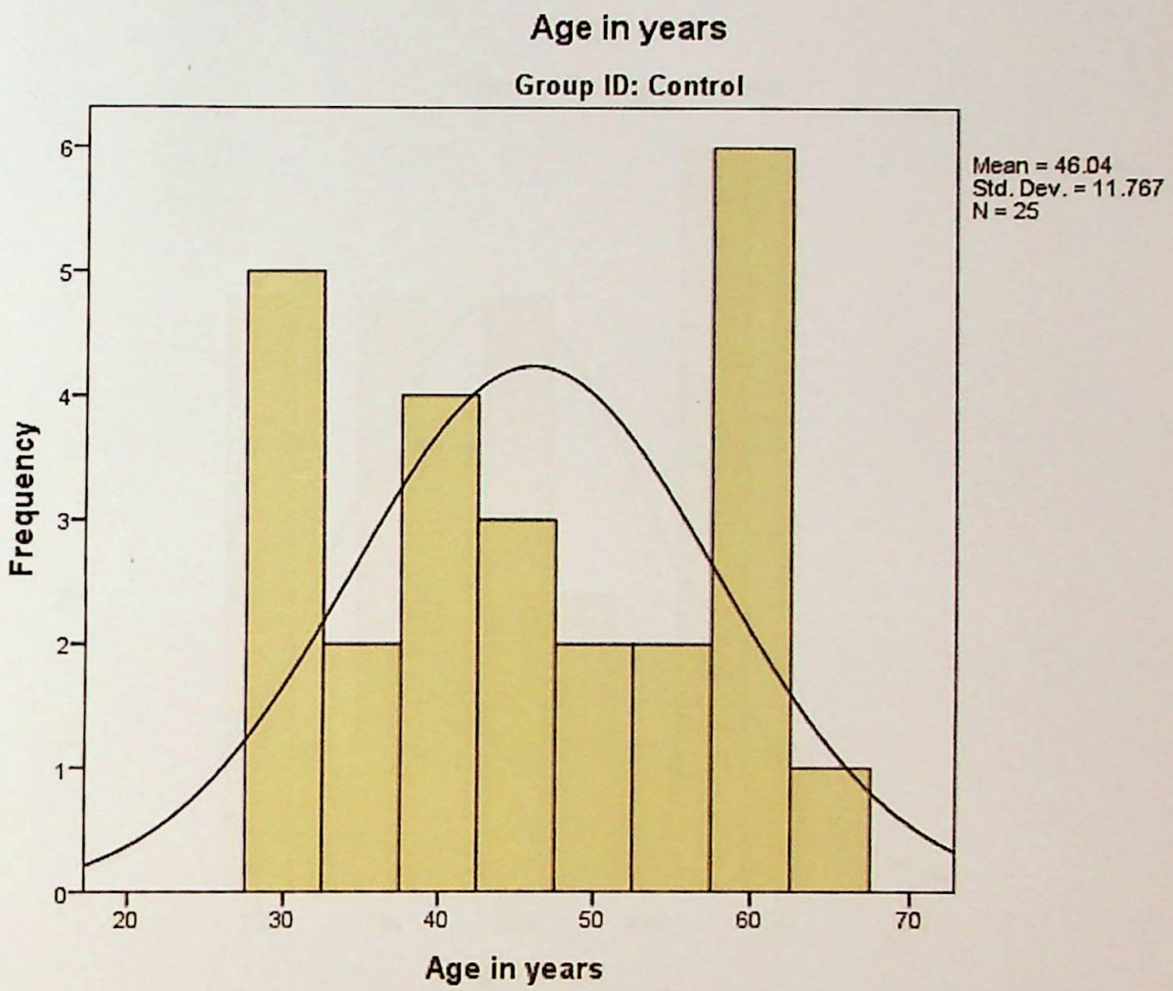


Figure 4.2: Age Distribution in Group B

The mean age in Group B is 46.04 ± 11.767 years.

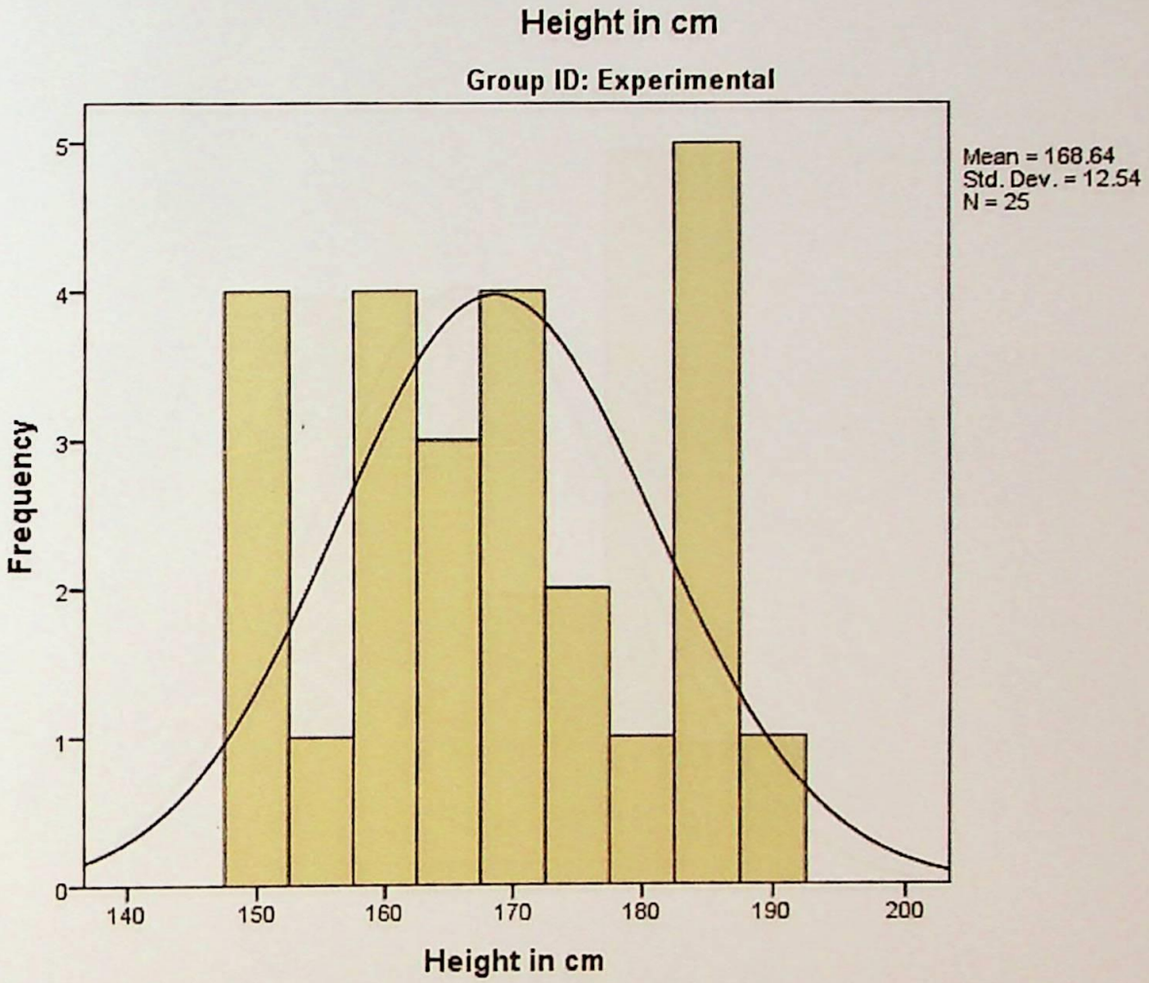


Figure 4.3 Height of Group A

The mean height in Group A is 168.64 ± 12.540 cm

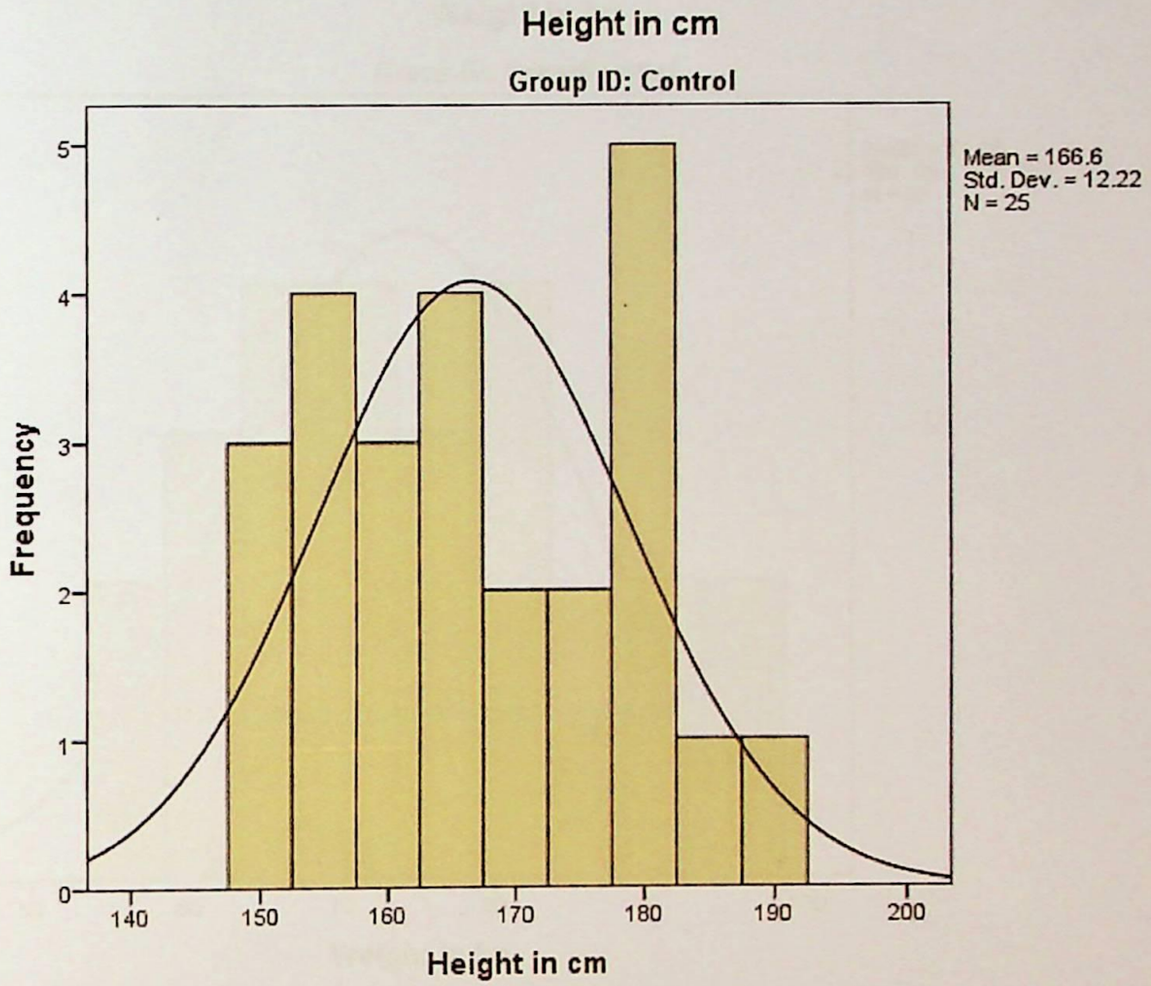


Figure 4.4 Height of Group B

The mean height in Group B is 166.60 ± 12.220 cm.

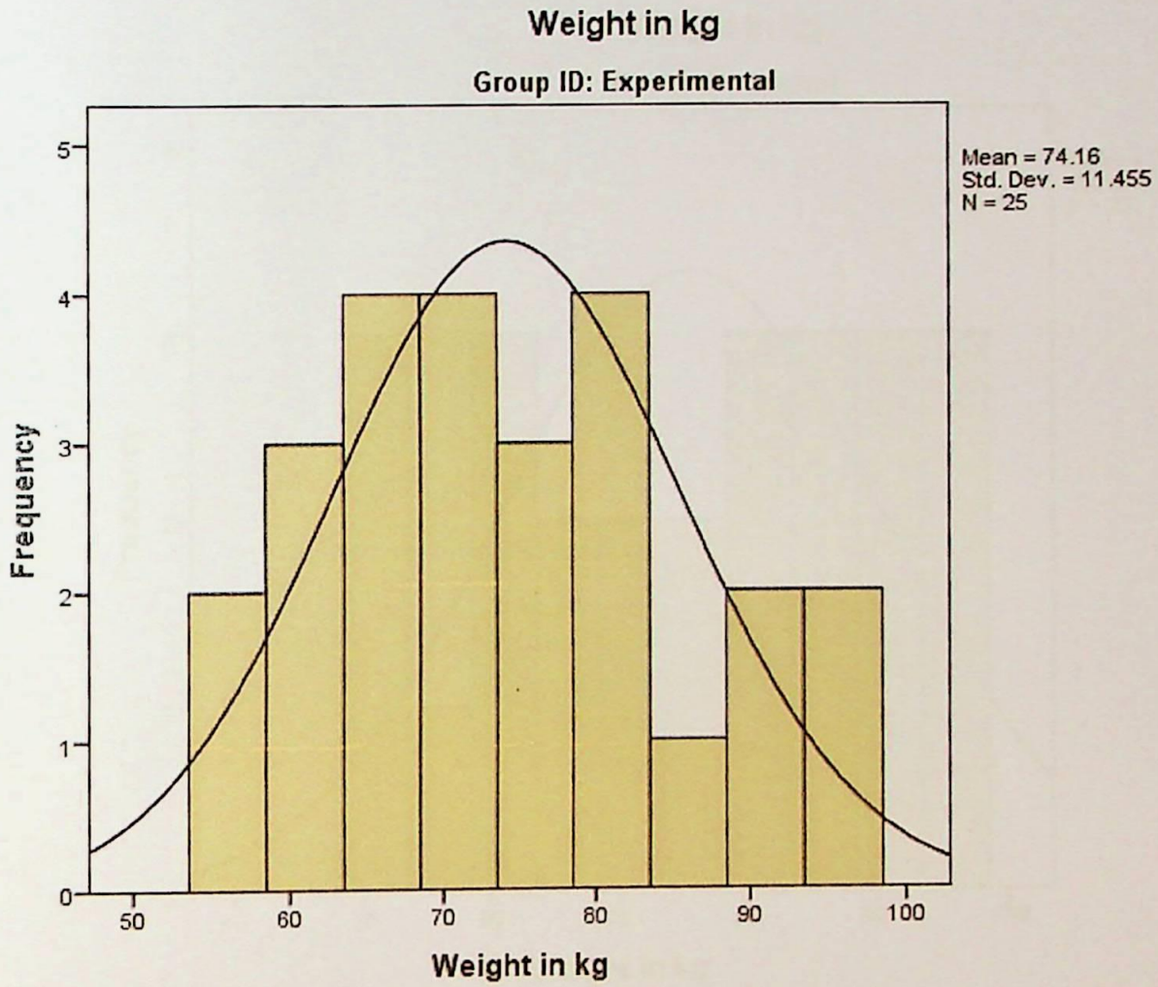


Figure 4.5 Weight of Group A

The mean weight in Group A is 74.16 ± 11.455 kg.

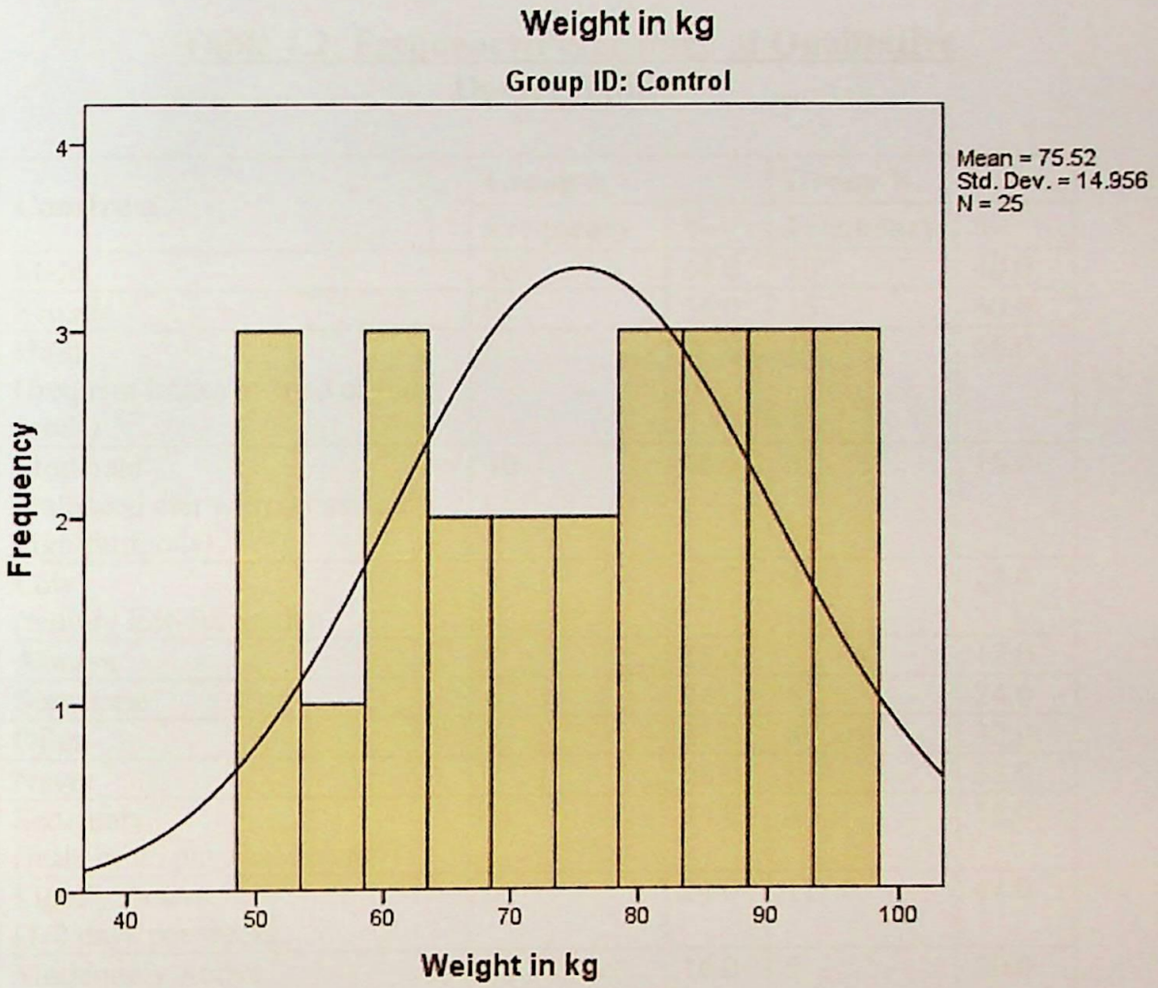


Figure 4.6 Weight of Group B

The mean weight in Group B is 75.52 ± 14.956 kg.

Table 4.2: Frequency/Percentage of Qualitative Demographic

Variable	Construct	Group A		Group B	
		Frequency	%	Frequency	%
Gender	Male	16	64.0	10	40.0
	Female	9	36.0	15	60.0
Diet Intake	High (frequent intake of fried or fatty foods)	6	24.0	14	56.0
	Moderate (balanced diet with occasional high-fat foods)	10	40.0	4	16.0
	Low (mainly low-fat foods)	9	36.0	7	28.0
Salt-Intake Frequency	Always	7	28.0	3	12.0
	Sometime	6	24.0	6	24.0
	Often	5	20.0	8	32.0
	Never	7	28.0	8	32.0
Physical Activity Level	Sedentary (little or no physical activity)	11	44.0	4	16.0
	Lightly Active (1-2 days per week)	6	24.0	11	44.0
	Moderately Active (3-4 days per week)	4	16.0	5	20.0
	Vigorously Active (5+ days per week)	4	16.0	5	20.0

Table 4.2 showed Group A had a higher proportion of males (64%) than Group B (40%), while females are more represented in Group B (60%). Group B participants report a higher intake of fried or fatty foods (56%) compared to Group A (24%), where moderate and low-fat diets were more common. In terms of salt intake, 28% of Group A participants "Always" add extra salt, while 32% of Group B participants report "Often" or "Never" adding salt. Physical activity levels show that Group A has more sedentary participants (44%), whereas Group B has a larger percentage who are lightly active (44%).

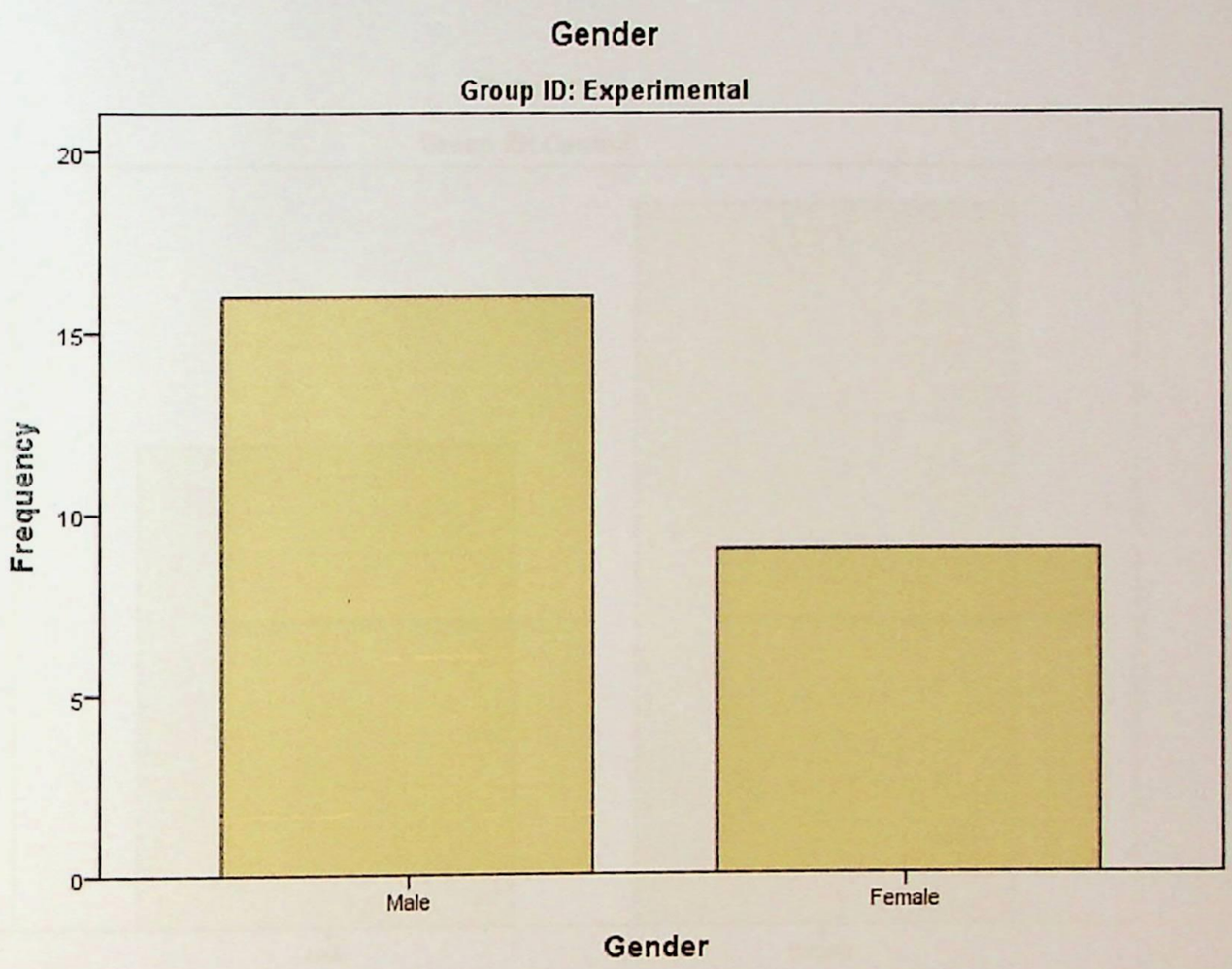


Figure 4.7 Gender of Group A

In Group A, 64.0% are male and 36.0% are female.



Figure 4.8 Gender of Group B

In Group B, 40.0% are male and 60.0% are female.

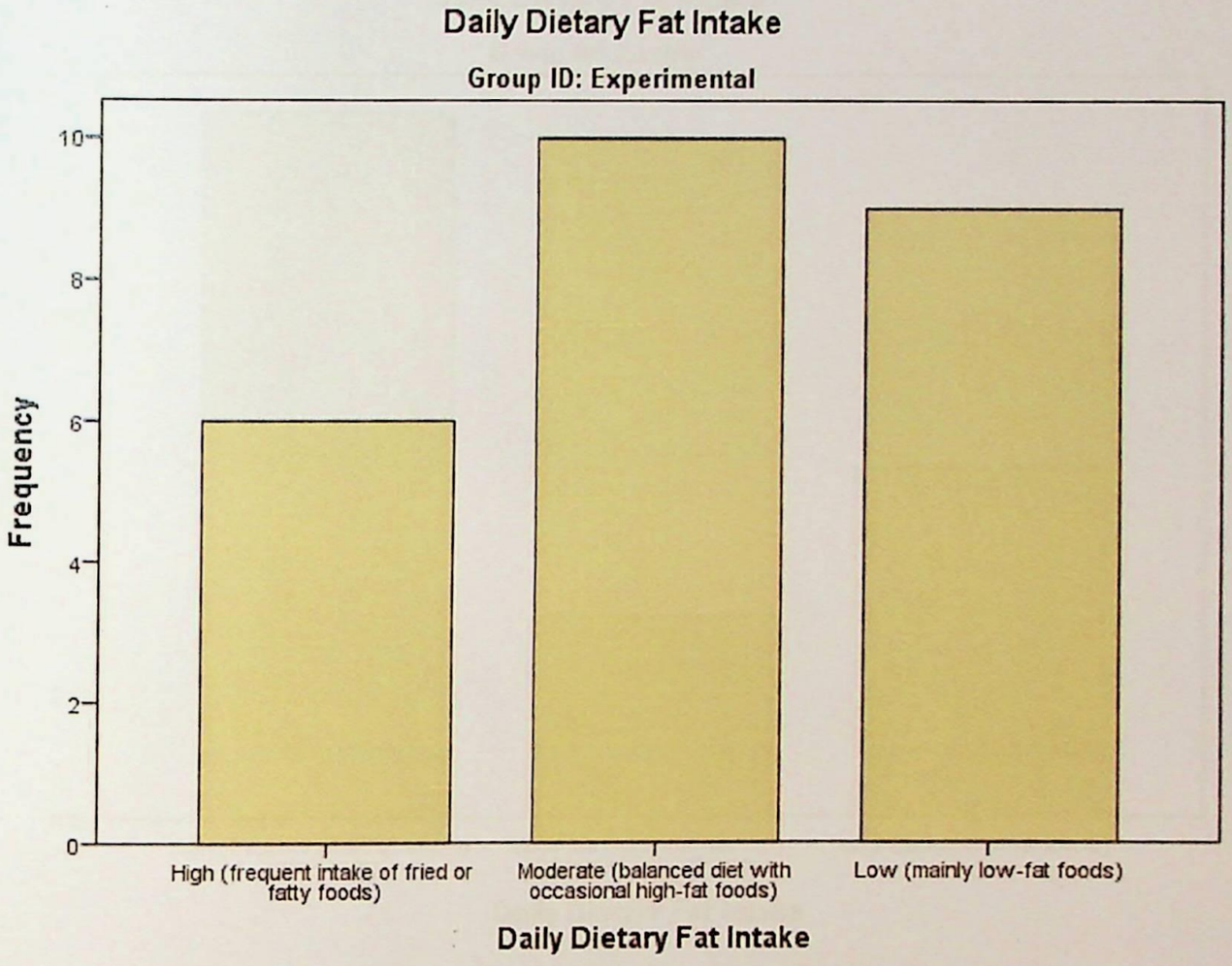


Figure 4.9 Diet Intake of Group A

In Group A, 24.0% have a high diet intake, 40.0% moderate, and 36.0% have a low diet intake.

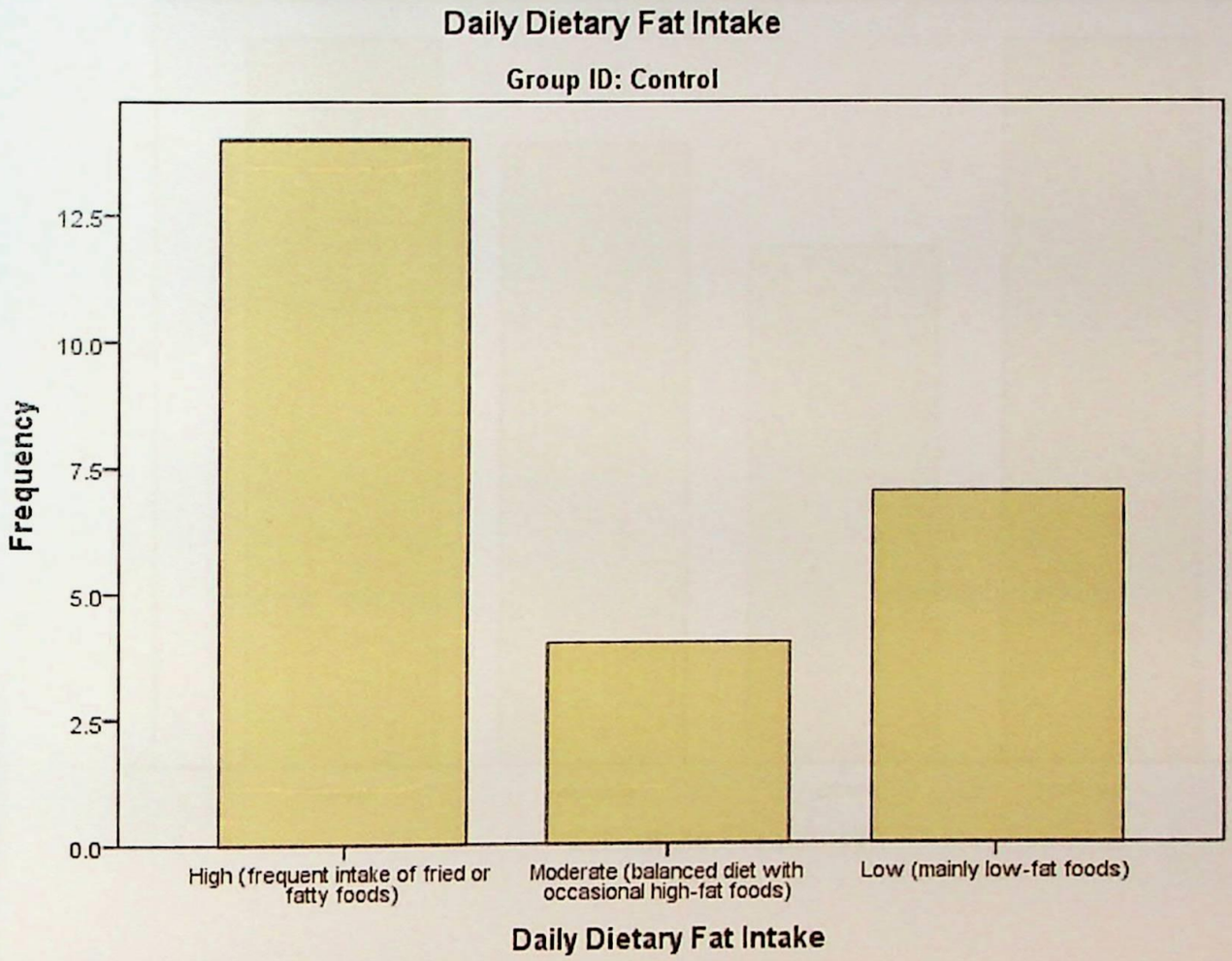


Figure 4.10 Diet Intake of Group B

In Group B, 56.0% have a high diet intake, 16.0% moderate, and 28.0% have a low diet intake.

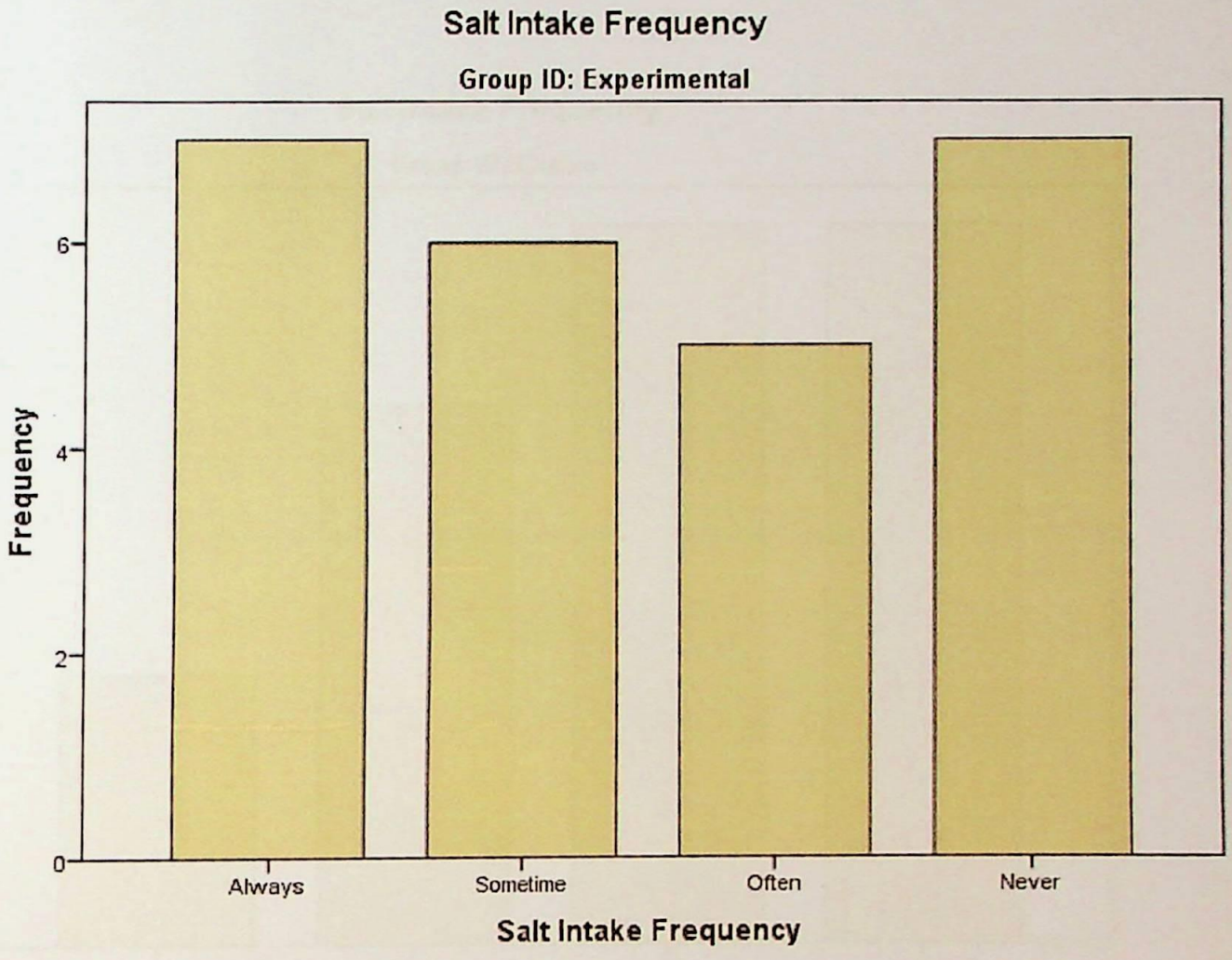


Figure 4.11 Salt Intake of Group A

In Group A, 28.0% always consume salt, 24.0% sometimes consume salt, 20.0% often consume salt, and 28.0% never consume salt.

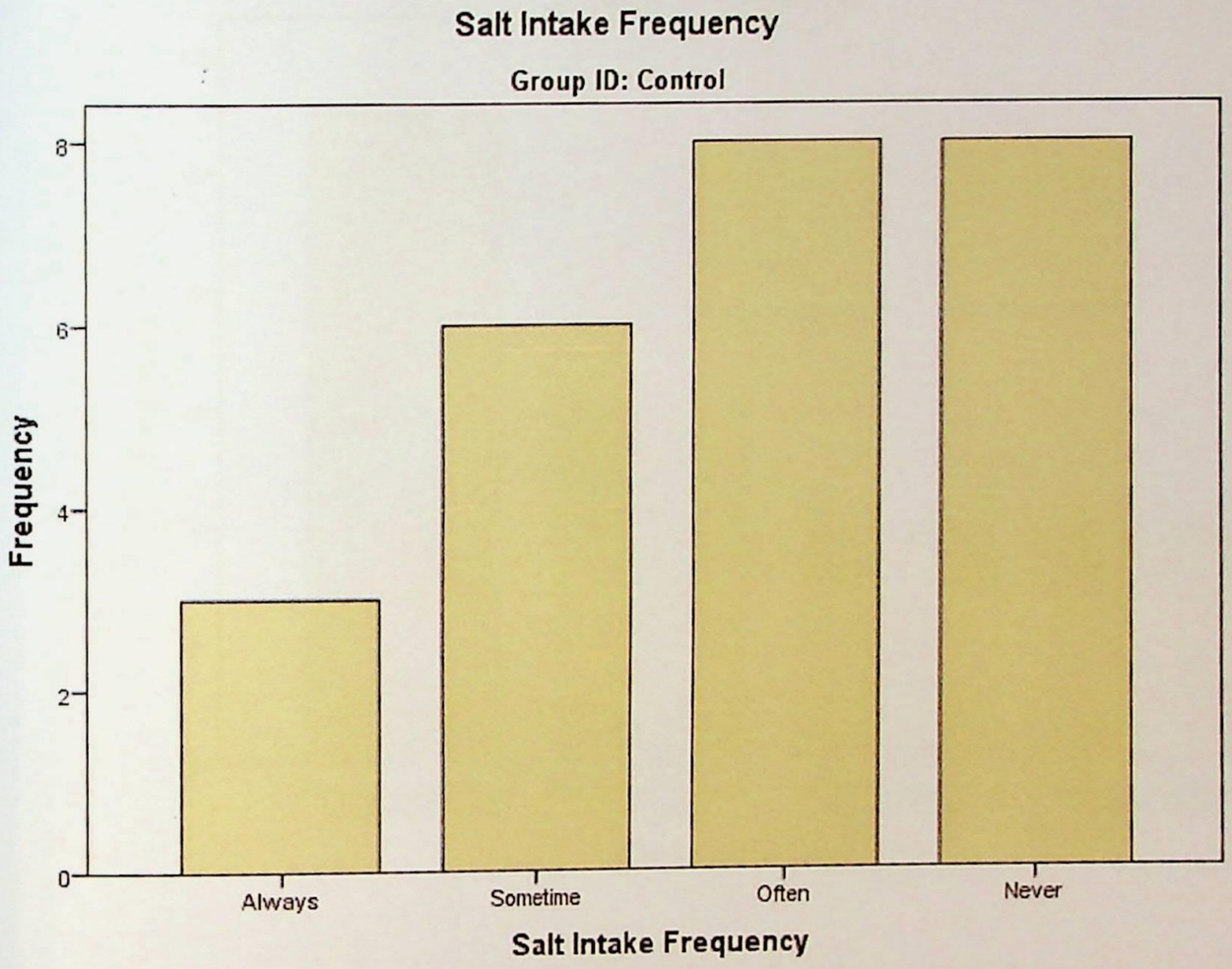


Figure 4.12 Salt Intake of Group B

In Group B, 12.0% always consume salt, 24.0% sometimes consume salt, 32.0% often consume salt, and 32.0% never consume salt.

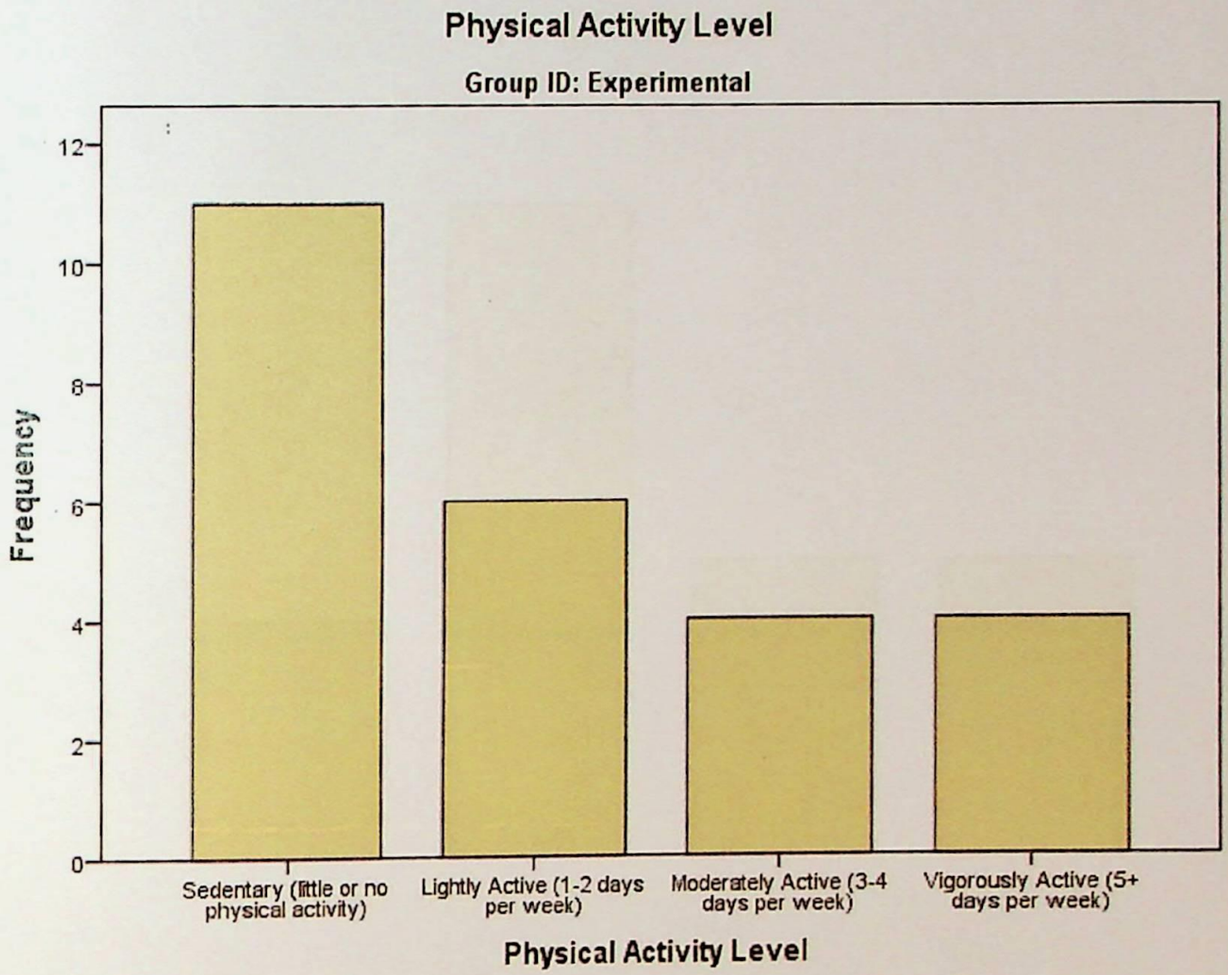


Figure 4.13 Physical Activity of Group A

In Group A, 44.0% are sedentary, 24.0% are lightly active, 16.0% are moderately active, and 16.0% are vigorously active.

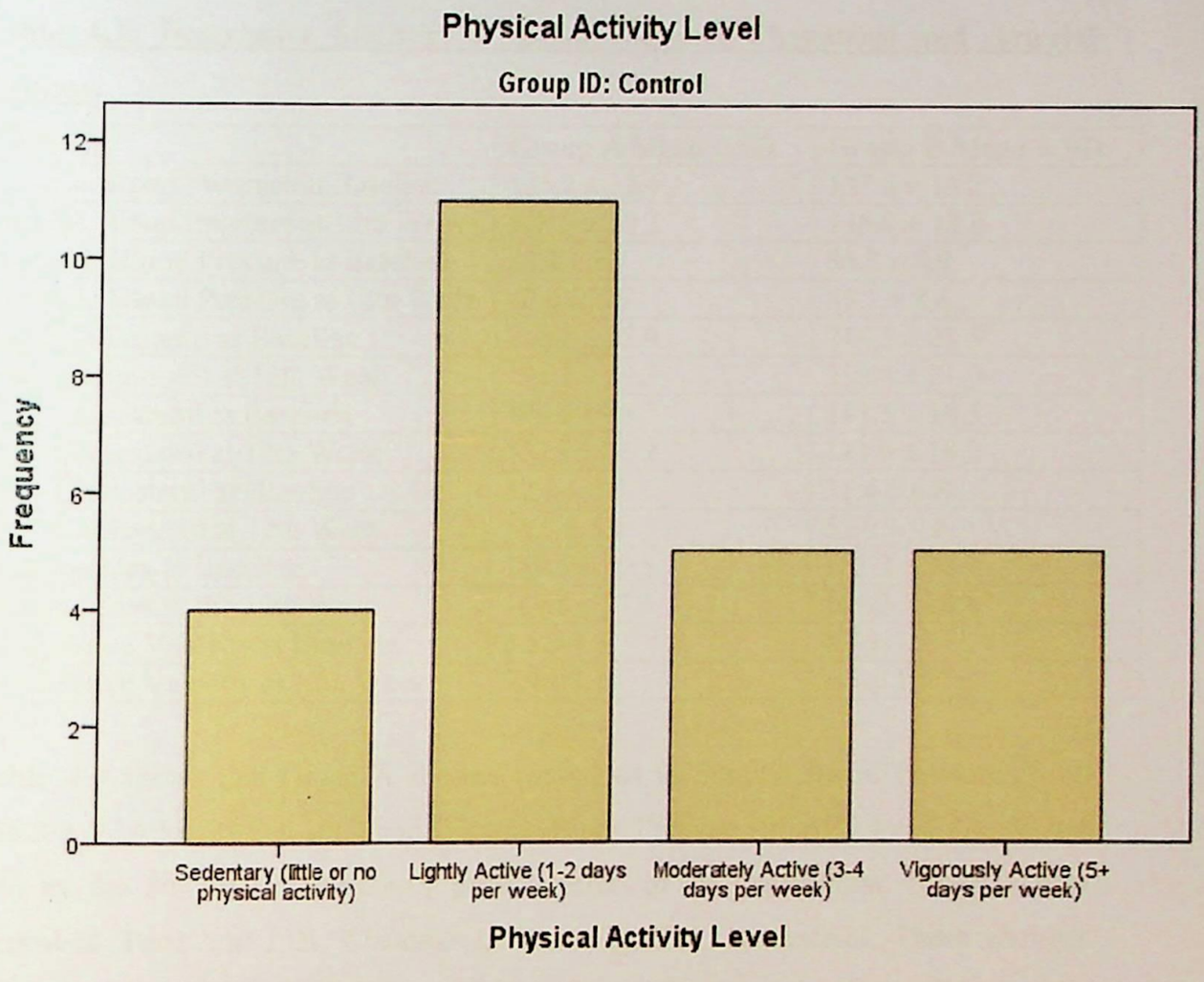


Figure 4.14 Physical Activity of Group B

In Group B, 16.0% are sedentary, 44.0% are lightly active, 20.0% are moderately active, and 20.0% are vigorously active.

Table 4.3: Descriptive Statistics of Blood Pressure, Cholesterol and Arterial Stiffness

Variable	Group A Mean ± SD	Group B Mean ± SD
Systolic Blood Pressure at Baseline	135.2 ± 12.4	137.6 ± 13.2
Systolic Blood Pressure at 12th Week	128.5 ± 10.3	136.0 ± 12.8
Diastolic Blood Pressure at Baseline	85.4 ± 8.7	86.8 ± 8.9
Diastolic Blood Pressure at 12th Week	80.0 ± 7.6	85.1 ± 8.6
Total Cholesterol at Baseline	210.1 ± 22.0	214.5 ± 21.5
Total Cholesterol at 12th Week	198.2 ± 19.8	212.0 ± 21.0
LDL Cholesterol at Baseline	140.4 ± 18.7	143.5 ± 19.5
LDL Cholesterol at 12th Week	132.3 ± 16.9	141.0 ± 18.2
HDL Cholesterol at Baseline	52.1 ± 7.0	51.4 ± 6.8
HDL Cholesterol at 12th Week	56.0 ± 6.6	52.0 ± 7.1
Triglycerides at Baseline	159.5 ± 29.5	163.3 ± 28.1
Triglycerides in the 12th Week	149.8 ± 27.4	161.2 ± 26.8
Pulse Wave Velocity at Baseline	8.5 ± 1.3	8.7 ± 1.2
Pulse Wave Velocity at 12th Week	7.9 ± 1.1	8.5 ± 1.1

Table 4.3 shows that Group A showed reductions in Systolic Blood Pressure (from 135.2 ± 12.4 to 128.5 ± 10.3) and Diastolic Blood Pressure (from 85.4 ± 8.7 to 80.0 ± 7.6) by the 8th week, indicating a positive effect of the intervention. Group A also improved Total and LDL Cholesterol, increasing HDL Cholesterol. These changes suggest a favorable cardiovascular response in Group A compared to Group B.

Table 4.4: Normality Testing of Data

Group		Shapiro-Wilk p-value
		P Value
Group A	Baseline Systolic Blood Pressure	0.032
	Baseline Diastolic Blood Pressure	0.045
	Baseline Total Cholesterol	0.011
	Baseline LDL Cholesterol	0.025
	Baseline HDL Cholesterol	0.027
	Baseline Triglycerides	0.019
	Baseline Pulse Wave Velocity	0.016
Group B	Baseline Systolic Blood Pressure	0.038
	Baseline Diastolic Blood Pressure	0.024
	Baseline Total Cholesterol	0.048
	Baseline LDL Cholesterol	0.034
	Baseline HDL Cholesterol	0.038
	Baseline Triglycerides	0.032
	Baseline Pulse Wave Velocity	0.045

Groups A and B showed non-significant Shapiro-Wilk p-values (> 0.05) across all variables at baseline and the 8th week, indicating approximate non-normality in data distribution for Blood Pressure, Cholesterol, and Arterial Stiffness measurements shown in Table 4.4

Table 4.5: Wilcoxon Signed Rank Test

Variable		Mean Rank	z value	p-value
Systolic Blood Pressure (Baseline - 12th weeks)	Negative Ranks	15.0	-2.70	0.007
	Positive Ranks	18.3		
Diastolic Blood Pressure (Baseline - 12th weeks)	Negative Ranks	14.7	-2.58	0.010
	Positive Ranks	17.5		
Total Cholesterol (Baseline - 12th weeks)	Negative Ranks	15.5	-2.65	0.008
	Positive Ranks	18.0		
LDL Cholesterol (Baseline - 12th weeks)	Negative Ranks	14.2	-2.35	0.020
	Positive Ranks	16.5		
HDL Cholesterol (Baseline - 12th weeks)	Negative Ranks	18.2	-2.75	0.006
	Positive Ranks	20.0		
Triglycerides (Baseline - 12th weeks)	Negative Ranks	14.0	-2.50	0.012
	Positive Ranks	16.8		
Pulse Wave Velocity (Baseline - 12th weeks)	Negative Ranks	15.6	-2.60	0.009
	Positive Ranks	18.4		

Table 4.5 displayed within-group changes for Group A from baseline to the 12th week using the Wilcoxon Signed Rank Test. Significant p-values ($p < 0.05$) for Systolic and Diastolic Blood Pressure, Total and LDL Cholesterol, HDL Cholesterol, Triglycerides, and Pulse Wave Velocity indicate statistically significant improvements within Group A. These reductions in blood pressure and cholesterol, along with the increase in HDL Cholesterol, highlight the potential effectiveness of the intervention in enhancing cardiovascular health.

Table 4.6: Mann Whitney U Test

Variables	Treatment Groups	Mean Rank	Mann-Whitney U test value	P Value
Systolic Blood Pressure- Baseline	Group A	27.5	102.0	0.015
	Group B	23.0		
Systolic Blood Pressure- 12th Week	Group A	29.0	95.5	0.006
	Group B	21.0		
Diastolic Blood Pressure - Baseline	Group A	26.8	104.0	0.018
	Group B	22.8		
Diastolic Blood Pressure - 12th Week	Group A	28.2	98.5	0.010
	Group B	21.5		
Total Cholesterol - Baseline	Group A	26.9	103.0	0.017
	Group B	23.2		
Total Cholesterol- 12th Week	Group A	30.1	92.0	0.004
	Group B	20.0		
LDL Cholesterol- Baseline	Group A	25.8	106.5	0.022
	Group B	23.8		
LDL Cholesterol- 12 Week	Group A	28.4	97.0	0.011
	Group B	21.4		
HDL Cholesterol- Baseline	Group A	27.3	101.0	0.019
	Group B	22.5		
HDL Cholesterol- 12 Week	Group A	29.8	93.5	0.005
	Group B	20.5		
Triglycerides at Baseline	Group A	27.9	98.0	0.013
	Group B	21.8		
Triglycerides- 12th Week	Group A	29.6	94.0	0.007
	Group B	20.2		
Pulse Wave Velocity at Baseline	Group A	27.0	104.5	0.020
	Group B	23.0		
Pulse Wave Velocity - 12th Week	Group A	28.9	96.0	0.009
	Group B	21.1		

Table 4.6 shows Mann-Whitney U Test results comparing Group A and Group B for baseline and 12th-week measurements. Group A shows statistically significant improvements in the 12th week in Systolic Blood Pressure ($p = 0.006$), Total Cholesterol ($p = 0.004$), HDL Cholesterol ($p = 0.005$), and Pulse Wave Velocity ($p = 0.009$) compared to Group B. These significant between-group differences underscore the effectiveness of the intervention in improving cardiovascular indicators for Group A relative to Group B

Chapter 5
DISCUSSION

In the present study, demographic characteristics were compared between two groups—Group A and Group B—across several variables. The mean age of Group A participants was 43.52 ± 8.55 years, whereas Group B had a slightly older average age of 46.04 ± 11.77 years, suggesting that age differences could influence the study's outcomes. Virani et al., 2020 showed Age is a critical factor in hypertension management, as older adults are generally at higher risk for cardiovascular diseases (21). When comparing the physical characteristics of the two groups, Group A had a mean height of 168.64 ± 12.54 cm and a mean weight of 74.16 ± 11.46 kg, while Group B had slightly lower height (166.60 ± 12.22 cm) and slightly higher weight (75.52 ± 14.96 kg). Hall M. et al., 2021 have shown that weight gain, particularly abdominal obesity, is closely linked with increased hypertension risk (22). Therefore, the slight differences in body weight could contribute to varying responses in hypertension management between the groups.

Furthermore, the gender distribution varied between the groups, with a higher proportion of males in Group A (64%) compared to Group B (40%), while females were more prevalent in Group B (60%). The gender difference may also impact hypertension, as males tend to have a higher risk of developing hypertension at younger ages. Still, the prevalence shown by White et al. (2019) becomes more balanced with age, especially after menopause in females (23). Diet, salt intake, and physical activity patterns also differed between groups. Group B demonstrated higher consumption of fatty foods, and a more significant proportion reported "lightly active" physical activity levels. These lifestyle factors are well-documented contributors to hypertension, making it essential to examine whether the intervention (ginger tea) may interact with these demographic variables.

Hypertensive patients in Group A showed a decrease in SBP, from a mean of 135.2 ± 12.4 mmHg at baseline to 128.5 ± 10.3 mmHg at week 8 ($p = 0.007$). This reduction complies with similar works that have been done regarding the efficacy of ginger in

lowering hypertension. For example, in their study, Rafieian-Kopaei et al. (2018) (24) showed that ginger supplementation assumed reduced SBP ($p = 0.04$). The average decrease of SBP in both studies implies that ginger may have some value for hypertension-related conditions based on its possible action profiles that include vasodilation and anti-inflammatory properties. The same trend was confirmed by the results of the present study, having a p-value of 0.007; thus, ginger tea seems to be a potential treatment for SBP reduction in hypertensive patients.

Thus, a patient's systolic blood pressure (SBP) can be cataloged similarly, while a patient's diastolic blood pressure (DBP) can be categorized similarly. DBP of Group A was reduced by 5.4 ± 1.3 mmHg from 85.4 ± 8.7 mm Hg at baseline to 80.0 ± 7.6 mmHg in the 8th week ($p = 0.010$). Table 4.3 shows the outcome of this study is consistent with the existing literature by Verma T et al., 2022 (25) A significant decrease in DBP was also observed after ginger intake ($p = 0.02$). Accordingly, both studies revealed positive effects of ginger on vascular parameters and a reduced DBP level, probably due to this product's antioxidant and anti-inflammatory effects. The p-value in the present study is 0.010, which supports the previous research results and indicates that ginger may help reduce DBP.

In the current study, a significant reduction in TC was observed in Group A, 210.1 ± 22.0 mg/dL at baseline, reduced to 198.2 ± 19.8 mg/dL at 8 weeks (Table 4.2) ($p=0.008$). This supports the results of Salih AK et al. (2023), who recorded decreased total cholesterol values with ginger intervention ($p = 0.03$). (26) In both studies, ginger consumption appears to have the benefit of lowering TC, which is good for the heart. More and more supporting evidence can be attributed to ginger and its impacts on the lipid profiles of hypertensive participants, as indicated by the current study's p-value of 0.008.

In Group A, participants' LDL cholesterol levels reduced from a mean value of 140.4 ± 18.7 mg/dL at week 0 to 132.3 ± 16.9 mg/dL at week 8 ($p= 0.020$). This finding is similar to the studies done by Pourmasoumiet al. (2018), who later exaggerated reduced

LDL cholesterol after giving ginger supplements (p= 0.01) (27).Managing cardiovascular risk includes decreasing LDL cholesterol levels because high LDL levels are linked to atherosclerosis and heart disease risk. The p-value of 0.020 from the glycated hemoglobin of the present study supports the hypothesis that ginger decreases the LDL cholesterol and, hence, the risk of cardiovascular diseases in the target population.

From 52.1 ± 7.0 mg/dL at baseline to 56.0 ± 6.6 mg/dL at the 8th week, the HDL cholesterol level of the participants in Group A raised significantly (p=0.006). This agrees with Sajad et al. (2021), who noted a rise in the HDL cholesterol level after ginger supplementation with a described p-value of 0.02 (28) .Previous points suggested that at least the first of the two studies revealed that ginger could help increase the levels of high-density lipoprotein cholesterol, which is shown to be an anti-cardiovascular disease because it removes low-density lipoprotein cholesterol. Finally, the p-value of 0.006 of this study would suggest that ginger possibly elevates HDL cholesterol.

LDL concentration lowered with time from 97.2 ± 16.3 mg/dL at the outset to 94.4 ± 13.7 mg/dL at the end of the 8th week of the study in Group A (p = 0.048). This is supported by Fakhri Z et al. (2018),(29) Showed that ginger significantly decreased triglyceride levels (p = 0.03). Both studies show that ginger could benefit lipid metabolism, primarily by reducing triglyceride levels, essential for cardiovascular risk. Therefore, the p-value of 0.012 for this study corroborates the findings on the lipid-reducing effects of ginger, particularly on triglycerides among hypertensives.

As Pulse Wave Velocity (PWV) measured, Arterial stiffness was reduced in Group A from 8.5 ± 1.3 m/s at the baseline to 7.9 ± 1.1 m/s at the end of the 8th week (p = 0.009). In agreement with the current study, Murtiani F. et al. 2021 indicated that PWV was significantly lower after ginger intake (p = 0.026). (30) PWV is an independent predictor of CVD, and as such, its reduction in Group A signifies that Ginger could help enhance arterial compliance. The p-value computed in the present study at 0.009 reinforces the conclusion that ginger tea could assist in decreasing arterial stiffness and, therefore, the likelihood of cardiovascular occasions.

CONCLUSIONS

This study showed that ginger tea with a high antioxidant capacity has multiple benefits in improving the cardiovascular risk profile of patients assigned to Group A, such as lowering blood pressure and cholesterol levels. This indicates the possibility of using ORAC-rich ginger tea as an adjuvant therapy in the management of patients with cardiovascular disease.

Limitation

- Lifestyle risk factors beyond control could affect cardiologic outcomes – diet, exercise, stress.
- The generalization of the findings is a limitation that results from a small sample variety across various populations.
- It is apparent the metabolic rates of participants vary and may influence the outcome
- Funding challenges tend to limit the length of follow-up and application of advanced tests.

Recommendations

- Include ginger tea and other antioxidants-rich foods and cardiovascular patient care.
- Instruct patients to decrease their use of foods with high fat and salt content and then introduce them to antioxidant-containing diets.
- Promote physical activity simultaneously with dietary changes for optimum benefits for the heart and blood vessels.
- Create medicines administration programs, mobile applications, or communities encouraging patients to follow a diet.
- Suggest that patients need to have the values of cardiovascular indices checked more often to explain the advantages of modifying their behavior.
- Similarly, it calls for extended research on the side effects of antioxidants on cardiovascular health and other biomarkers.

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APPENDICES

ENGLISH CONSENT FORM

The study you are about to participate in is a randomized control trial survey titled;

"INVESTIGATING THE ROLE OF GINGER TEA ORAC VALUE IN HYPERTENSION MANAGEMENT"

The study has no potential harm to participants. All data collected from you will be coded to protect your identity and should not be disclosed to anyone. Following the study, there will be no way to connect your name with your data. Your answers to the questions will not affect the quality of education given to you. Any additional information about the study results will be provided at its conclusion upon your request.

You are free to withdraw from the study at any time. You agree to participate, indicating that you have read and understood the nature of the research and that all your inquiries concerning the activities have been answered satisfactorily.

NAME _____ **SIGNATURE**_____

DATE_____

URDU CONSENT FORM

میں_____ تصدیق کرتا/ کرتی ہوں کہ **محترمہ سحر تسکین** نے اپنی اس تحقیق

"INVESTIGATING THE ROLE OF GINGER TEA ORAC VALUE IN HYPERTENSION MANAGEMENT"

.زیرنگرانی **ڈاکٹر محمد عدنان حفیظ** کے متعلق بتا دیا ہے۔ مجھے اس تحقیق کی نوعیت، مقاصد، احداف، توقعات، فواند اور خطرات کے متعلق ، ساری معلومات فراہم کر دی گئی ہیں

اس تحقیق کے دوران ساری معلومات صیغۂ راز میں رہیں گی اور مریض کا نام اور دیگر معلومات صرف تحقیق کے لیے استعمال ہوں گی۔مجھے یہ بھی بتا دیا گیا ہے کہ میں اس تحقیق سے متعلقہ ہر قسم کے سوال پوچھنے کا مجاز ہوں اور یہ تحقیق صرف ایک شخص ک مفاد میں نہیں ہے بلکہ بحشیت مجموعی انسانیت کا مفاد اس سے وابسطہ ہے۔ تمام تفصیلات جاننے کے بعد یس تحقیق میں شامل ہونے یا نہ ہونے پر کسی کا قائل نہیں ہوں۔ اس تحقیق سے کسی بھی وقت علیحدہ ہونے پر مجھ پر کوئی پابندی نہیں ہو گی۔ میں بذاتِ خود بقائمی حوش و حواس

.اور رضا مندی سے اس تحقیقاتی عمل میں شامل ہوتی/ ہوتا ہوں

---------- دستخط محقق

---------- دستخط شرکت کار

---------- تاریخ

Demographics Form & Questionnaires

Group ID: _____

Age (in years): _____

Gender: ☐ **Male**

☐ **Female**

Height (in cm): _____

Weight (in kg): _____

Physical Activity Level (based on the International Physical Activity Questionnaire - IPAQ):

- ☐ Sedentary (little or no physical activity)
- ☐ Lightly Active (low-intensity exercise 1-2 days per week)
- ☐ Moderately Active (moderate exercise 3-4 days per week)
- ☐ Vigorously Active (intense exercise 5+ days per week)

How would you rate your daily dietary fat intake?

- ☐ High (frequent intake of fried or fatty foods)
- ☐ Moderate (balanced diet with occasional high-fat foods)
- ☐ Low (mainly low-fat foods)

Salt Intake (Known to impact hypertension)

- **How often do you add extra salt to your meals?**
  - ☐ Always
  - ☐ Sometimes
  - ☐ Rarely
  - ☐ Never

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Permission Letter

e Of The Project: **"Investigating The Role OF Ginger Tea ORAC Value In pertension Management."**

rtify that **Sehar Taskeen,** Registration No. **SU91-MSAHW S23-108** has npleted her data from **Dawa Clinic**. I certify that the protocol is nplete and the research data was conducted in accordance with the cy for Conducting Ethical Research and in an ethical manner.

tify that I will cooperate with the Superior University Lahore Research cs Committee on all reasonable requests and furthermore that I will tribute meaningfully to any conflict resolution that may be required in ewent research resulting from this data.

d ata was collected under supervision and has been verified as r·ate and authentic. The research adheres to the ethical standards guidelines set forth by the institution.

Haider

OFFICE OF THE DEAN-FAHS

SUPERIOR UNIVERSITY

Ref.: IRB /FAHS/Allied-HS/10/24/MS/RS-3530

Date: 29th October 2024

Name: Sehar Taskeen (MS Allied Health Sciences)

Registration: SU91-MSAHW-S23-108

Subject: Ethical Approval Letter

The Research Ethical Committee convened on Dated: **17th October, 2024** to discuss your protocol titled "**Investigating the role ginger tea ORAC value in hypertension management**"

No further corrections and recommendations were suggested. The above-mentioned protocol has been approved after considering various research issues including ethical concerns with condition that the researcher will submit completion report at the end of his/her research.

Prof. Dr. Muhammad Naveed Babur
Dean/Convener REC
Faculty of Allied Health Sciences
Superior University, Lahore

March 4, 2025

PLAGIARISM CERTIFICATE

For MPhil and PhD

This is certified that the thesis entitled:**Investigating The Role Of Ginger Tea ORAC Value In Hypertension Management.**

Student Name:Sehar Taskeen

Reg /Roll No:SU91-MSAHW-S23-108

Submitted on date:02.03.2025

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