ASSOCIATION BETWEEN CARBOHYDRATE INTAKE AND NON - COMMUNICABLE DISEASES

PROJECT SUBMITTED

In partial fulfillment of requirement for the award of the degree of

B. Sc. NUTRITION AND DIETETICS

BY

AIN ZAYAN T MAJRU, ANAMIKA S NAIR, DHIYA M S,

FATHIMA SHANA K K, MALAVIKA K S

(Register No: SB22ND04, SB22ND08, SB22ND014, SB22ND017, SB22ND029)

DEPARTMENT OF CLINICAL NUTRITION AND DIETETICS

ST. TERESA'S COLLEGE (AUTONOMOUS)

ERNAKULAM

APRIL 2025

CERTIFIED AS BONAFIDE RESEARCH WORK

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Signature of Internal Examiner

ST. TERESA'S COLLEGE (AUTONOMOUS) DEPT. OF CLINICAL NUTRITION AND DIETETICS ERNAKULAM

Signature of External Examiner

DECLARATION

I hereby declare that the project entitled **"ASSOCIATION BETWEEN CARBOHYDRATE INTAKE AND NON COMMUNICABLE DISEASES"** submitted in partial fulfilment of the requirement for the award of the degree of B.Sc Nutrition and Dietetics is a record of original research work done by me under the supervision and guidance of **Ms.Surya M Kottaram**, Assistant Professor and HOD, Department of Clinical Nutrition and Dietetics, Women's Study Centre, St. Teresa's College (Autonomous), Ernakulam and has not been submitted in part or full of any other degree/diploma/fellowship or the similar titles to any candidate of any other university.

Place:
Date

Name : Ain Zayan T Majru
Anamika S Nair
Dhiya M S
Fathima Shana K K
Malavika K S

CERTIFICATE

I hereby certify that the project entitled "**ASSOCIATION BETWEEN CARBOHYDRATE INTAKE AND NON COMMUNICABLE DISEASES"** submitted in partial fulfilment of the requirement for the award of the degree of B.Sc Nutrition and Dietetics is a record of original work done by Ms. **Ain Zayan T Majru, Anamika S Nair, Dhiya M S, Fathima Shana, Malavika K S** during the period of the study under my guidance and supervision.

Signature of the HOD **Signature of the Research Guide with designation**

ACKNOWLEDGEMENT

This project has been kept on track and has been seen through to completion with the support and encouragement of numerous people especially our friends and colleagues. We thank everyone who made the completion of this project, possible. We would like to thank all those who had contributed in ways they can, to complete our study.

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CHAPTER 1
INTRODUCTION

Non-communicable diseases (NCDs), also known as chronic diseases, are not transmissible from person to person. They are of long duration and generally progress slowly. They are also referred to as a "lifestyle" disease because the majority of these diseases are preventable illnesses with risk factors including tobacco use (smoking), alcohol abuse, poor diets (high consumption of sugar, salt, saturated fats, and trans fatty acids), and physical inactivity. NCDs are the leading cause of death globally, responsible for 71% of all deaths each year. They are associated with various risk factors, including genetic, physiological, behavioural, and environmental elements. (WHO 2024)

According to the World Health Organization, Tobacco accounts for around 6 million deaths every year (including from the effects of exposure to second-hand smoke) and is projected to increase to 8 million by 2030. About 3.2 million deaths annually can be attributed to insufficient physical activity. More than half of the 3.3 million annual deaths from harmful drinking are from NCDs.
These diseases are driven by forces that include aging, rapid unplanned urbanization, and the globalization of unhealthy lifestyles. Globalization of unhealthy lifestyles such as unhealthy diets may show up in individuals as raised blood pressure, increased blood glucose, elevated blood lipids, and obesity. (Ranabir Salam et al. 2016)

In our study we will be focusing more on Diabetes, Cardiovascular diseases, hypertension and obesity and their link to carbohydrate consumption and other risk factors.

Non-communicable diseases (NCDs) are one of the biggest global health challenges. Globally, NCDs are increasing each year, accounting for approximately 60% of all causes of death annually. Notably, approximately 25% of these deaths occur before the age of 60 years. Some studies estimate that approximately 52 million deaths occur around the world each year, with significant variations observed from region to region. (Beaglehole et al. 2012)

Lifestyle-related, environmental, and genetic factors are the major risk factors associated with NCDs. Additionally, changes in the population pyramid and globalization contribute to an increased prevalence of these risk factors across all regions. Cardiovascular diseases (CVDs), cancers, respiratory diseases, and diabetes are the most important NCDs, accounting for more than 60% of all deaths. Approximately a 30% increase in mortality rates was reported for CVDs as NCDs from 1990 to 2016, and the prevalence of this disease increased by approximately 15% in this same period. Chronic respiratory diseases, another group of NCDs, have also seen significant increases, with deaths rising by approximately 18% and prevalence by approximately 40% from 1990 to 2017. (Moslem Taheri Soodejani 2024)

NCDs are currently responsible for 8.9 million deaths or 64% of all deaths in south east asia, of which, tragically, 4.4 million deaths occur prematurely between the ages of 30 and 69. Among NCDs, CVDs are responsible for almost 3.8 million deaths, which is almost 28% of all the deaths (~13.8 million) and 43% of all the NCD-related deaths (~8.9 million deaths) in the SEAR as per Global Health Estimates, 2015.

Non-communicable diseases (NCDs) caused nearly two thirds of all deaths in countries of World Health Organization (WHO) South-East Asia Region (SE Asia Region) in 2021, with half of these deaths in the age group 30–69 years. Cardiovascular diseases (CVDs) (3.9 million), account for most NCD deaths, followed by cancers, chronic respiratory diseases and diabetes. (Palitha Mahipala et al. 2018)

In 2017, India reported around 4.7 million deaths and 226.8 million DALYs due to non-communicable diseases (NCDs), which accounted for nearly 60% of all deaths. India also contributed to over two-thirds of NCD-related deaths in the WHO Southeast Asia Region. Major NCDs include cardiovascular diseases, cancer, chronic respiratory diseases, and diabetes. Key risk factors such as tobacco use, unhealthy diets, physical inactivity, alcohol consumption, obesity, and elevated glucose and cholesterol levels are on the rise. This trend places a significant burden on the healthcare system. With high alcohol consumption and sedentary behavior among adolescents, the NCD burden is expected to grow. A coordinated, multi-sectoral approach is essential for prevention and control. (Mayank Sharma et al. 2017)

Compared with other states in India, the state of Kerala is relatively in an advanced stage of epidemiological transition. For example, over 90% of premature mortality in Kerala (mortality in the 15–69 years' age group) could be attributed to NCDs. Nearly a quarter of the total disease burden in DALYs is due to four major NCDs (ischaemic heart disease, stroke, chronic obstructive pulmonary disease and diabetes). The increasing proportion of elders (12.6%3) and the adoption of sedentary lifestyles in Kerala might have contributed to the increase in NCDs. (P S Sharma et al. 2019)

Non-communicable diseases (NCDs), including diabetes, cardiovascular diseases, obesity, and metabolic disorders, have become a global health concern. High intake of sodium, low intake of whole grains, high intake of sugar and low intake of fruits were the leading dietary risk factors for NCDs globally. Among various dietary factors, carbohydrate intake plays a significant role in the development and management of these diseases. The type, quantity, and quality of carbohydrates consumed directly impact blood sugar levels, metabolism, and overall health. (European journal of public health volume 29,2019)

Excessive consumption of refined carbohydrates, such as white rice, white bread, and sugary foods, leads to rapid spikes in blood sugar and insulin resistance, a key factor in type 2 diabetes. Additionally, high carbohydrate intake contributes to weight gain, which increases the risk of obesity, hypertension, and heart disease. Studies have shown that diets high in processed carbohydrates and added sugars elevate triglyceride levels and inflammation, further increasing the likelihood of cardiovascular complications.

On the other hand, consuming complex carbohydrates, such as whole grains, legumes, and fiber-rich foods, helps regulate blood sugar levels and improves insulin sensitivity. A diet rich in fiber slows down glucose absorption, reducing the risk of diabetes and aiding in weight management. Moreover, fiber supports gut health, which is essential in preventing chronic inflammation linked to various NCDs.

Balancing carbohydrate intake by replacing refined sugars with whole, nutrient-dense options is crucial for preventing and managing NCDs. Public health initiatives should focus on promoting awareness of the impact of carbohydrate consumption and encouraging healthier eating habits to reduce the burden of these diseases globally. (Harvard T.H. Chan School of Public Health. (n.d.). Carbohydrates. The Nutrition Source)

Significance of Study:

This study is significant as it explores the impact of carbohydrate consumption on the prevalence and progression of non-communicable diseases (NCDs) such as diabetes, obesity, cardiovascular diseases, and metabolic disorders. Understanding this relationship is crucial for public health awareness, disease prevention, and dietary recommendations.

NCDs are responsible for nearly 71% of global deaths, making them a major health concern. Lifestyle factors, including excessive carbohydrate intake, play a significant role in their prevalence. The type and quantity of carbohydrates consumed directly influence metabolic health. Excessive intake of refined carbohydrates and high-glycemic foods can lead to insulin resistance, obesity, and diabetes. Understanding how different types of carbohydrates (simple vs. complex) affect metabolic health helps in designing effective dietary strategies.

By identifying dietary patterns linked to NCDs, this study helps develop guidelines for balanced carbohydrate intake. Public health programs can use this information to promote low-GI foods, fiber-rich diets, and portion control to reduce NCD risks. The findings can aid nutritionists, healthcare providers, and policymakers in creating targeted interventions to combat NCDs. This research also encourages awareness campaigns on the dangers of high sugar and processed food consumption.

Aim:

To study the link between carbohydrate intake and non-communicable diseases.

Objectives:

- To evaluate the nutritional status of the selected subjects using anthropometric measurement, biochemical analysis and dietary assessment.
- To identify non-communicable diseases (NCDs) among the study participants.
- To investigate the correlation between carbohydrate intake and the prevalence of NCDs.

CHAPTER 2

REVIEW OF LITERATURE

The review of study entitled **"Association between carbohydrate intake and non-communicable diseases"** is discussed under the following heading:

2.1 Definition of NCD

2.2 Prevalence of NCD

2.3 Carbohydrate intake

2.4 Dietary management

2.1 Definition of NCD

"Non-communicable diseases (NCDs), also known as chronic diseases, tend to be of long duration and are the result of a combination of genetic, physiological, environmental and behavioural factors." (World Health Organisation,2024)

"The term NCDs refers to a group of conditions that are not mainly caused by an acute infection, result in long-term health consequences and often create a need for long-term treatment and care." (Pan American Health Organisation, 2024)

"Non-communicable diseases (NCDs), also known as chronic diseases, are medical conditions that are not caused by infectious agents and are characterized by long duration and slow progression, often resulting from a combination of genetic, physiological, environmental, and behavioural factors." (Indian Council of Medical Research,2023)

"Non-Communicable Diseases (NCDs) are chronic diseases that are not transmissible from one person to another." (Ministry of Health and Family Welfare,2023)

2.2 Prevalence of Non-Communicable Diseases (NCDs)

According to the World Health Organization (2024), non-communicable diseases (NCDs) are the leading cause of mortality globally, responsible for approximately 43 million deaths in 2021—accounting for 75% of all non-pandemic-related deaths. Cardiovascular diseases contributed the most, with 19 million deaths, followed by cancers (10 million), chronic respiratory diseases (4 million), and diabetes (over 2 million, including kidney-related complications). Of these, 18 million deaths were considered premature (before age 70), and notably, 82% of them occurred in low- and middle-income countries. The major modifiable risk factors include tobacco use, harmful use of alcohol, unhealthy diets, physical inactivity, and air pollution exposure.

In Asia, particularly in the South Asian region, NCD risk factors among women have been documented to be significantly high. According to Zaman et al. (2015), who analysed data from WHO STEPS surveys conducted across Bangladesh, India, Nepal, and Sri Lanka, the prevalence of NCD risk factors among women aged 15–49 was substantial. Tobacco use among women ranged from 1% in Sri Lanka to 36% in Nepal. A high proportion of women had low fruit and vegetable consumption (above 95% in all countries), and physical inactivity was observed in over 50% of women in Bangladesh and India. Raised blood pressure was present in 20–30% of the population, while overweight and obesity were more common in urban areas. These findings emphasise the urgent need for gender-sensitive NCD prevention strategies in South Asia.

A study by Reddy et al. (2012) found that NCDs accounted for over 53% of all deaths and 44% of disability-adjusted life years (DALYs). The nationwide survey, conducted using the WHO STEPS approach, identified significant behavioural risk factors: high tobacco use (especially smokeless), low fruit and vegetable intake, alcohol consumption, and physical inactivity. Physiological factors such as high blood pressure, overweight/obesity, and raised fasting blood glucose were also prevalent. These findings emphasised the urgent need for effective prevention and control strategies at the national level.

In Kerala, Sarma et al. (2019) conducted a cross-sectional study involving 12,012 adults aged 18–69 years from all 14 districts, which revealed a particularly high burden of NCD risk

factors. Abdominal obesity was widespread, especially among women (72.6%). Raised blood pressure and fasting blood glucose were recorded at 30.4% and 19.2%, respectively. Among men, tobacco and alcohol use were reported at 20.3% and 28.9%. Only 12.4% of hypertensive individuals and 15.3% of diabetics had their condition under control. Alarmingly, just 13.8% of urban and 18.4% of rural participants were free from the seven key risk factors examined. These findings underscore the urgent need for robust preventive and management strategies to address the growing NCD epidemic in Kerala.

These studies highlight the widespread and growing prevalence of NCDs and their associated risk factors. The high levels of overweight, hypertension, diabetes, and unhealthy lifestyle behaviours in both urban and rural areas demand immediate, integrated, and scalable interventions at the community and policy levels to reduce the long-term burden of chronic diseases.

2.3 Carbohydrate intake

In a study conducted by Mohan et al., (2018) evidence suggests that excessive carbohydrate consumption is associated with both increased susceptibilities to type 2 diabetes (T2D) and poor glycemic control, particularly among Asian populations. However, the study emphasizes that carbohydrate quality is more crucial than quantity in determining diabetes risk and management. The researchers categorize carbohydrates into ‘good carbs,’ which include whole grains, legumes, vegetables, whole fruits, nuts, and seeds, and ‘bad carbs,’ such as refined cereals (e.g., white rice and white bread), sugar-sweetened beverages, fruit juices, cookies, and pastries, which should be restricted.

The study further recommends that Indian and Asian diets should reduce carbohydrate intake from the current 65–75% to approximately 50–55%, while increasing protein intake to 20–25%, preferably from plant-based sources like legumes and pulses.

In a comprehensive series of systematic reviews and meta-analyses published in The Lancet, Reynolds et al. (2019) investigated the relationship between carbohydrate quality and various health outcomes. The study analyzed data from 185 prospective studies and 58 clinical trials, encompassing 4,635 adult participants.

The findings indicated that higher intakes of dietary fiber and whole grains were associated with a reduced risk of several non-communicable diseases. Specifically, individuals consuming the highest amounts of dietary fiber had a 15–30% decrease in all-cause and cardiovascular-related mortality compared to those with the lowest fiber intakes. Additionally, higher fiber consumption was linked to a lower incidence of coronary heart disease, stroke, type 2 diabetes, and colorectal cancer.

The study also highlighted a dose-response relationship, suggesting that for every 8-gram increase in dietary fiber consumed daily, there was a 5–27% decrease in the risk of developing these diseases. Similarly, higher consumption of whole grains was associated with a 13–33% reduction in the risk of developing non-communicable diseases.

These results underscore the importance of carbohydrate quality in the diet. The authors recommend increasing dietary fiber intake and replacing refined grains with whole grains to improve health outcomes and reduce the prevalence of non-communicable diseases globally.

2.4 Dietary management

Schwingshackl et al. (2021) stated that low carbohydrate or low-fat diets, Mediterranean type diets, and vegetarian or vegan diets are considered to be healthy dietary patterns compared to western-based diets. The traditional Mediterranean diet is distinguished by using an abundance of vegetables, minimally processed wholesome whole grain bread, including cereals and legumes as the staple food, fresh fruit, and cold-pressed extra-virgin olive oil instead of refined oils. Apart from the dietary pattern, regular physical activity is also a part of the Mediterranean healthy lifestyle. This regular pattern of exercise can also be beneficial to lighten stress as well.

Increased intakes of ultra-processed or fast foods reduce the intake of plant-based and henceforth lack the consumption of fiber foods. The fact is that processed or refined products are low in fiber, but plant foods that are not processed have an abundance of fiber. In addition, the grained millets packed with fiber, once processed, have been removed and considered low fiber products. In a nutshell, fruits and vegetables are the prime sources of

soluble fibers. Thomas et al. stated that perhaps fiber intake helps overall metabolic health and reduces the risk of CVD.

The Mediterranean diet is strongly connected with a significant improvement in overall health status and a substantial reduction in mortality and morbidity from chronic diseases. The cardiovascular risk factors and inflammatory markers including high-sensitivity C-reactive protein have reduced consuming Mediterranean diet and low-fat diet. Other systematic reviews have accumulated the evidence from both observational studies and randomized controlled trials (RCTs) in regard to Mediterranean dietary pattern and its favourable effect on metabolic syndrome. Other dietary patterns such as high fiber intake and Dietary Approaches to Stop Hypertension are other effective approaches in reducing CVD risk. - (Lunghar et al. 2021)

A scoping review focusing on the Indian context emphasizes the importance of limiting exposure to risk factors and highlights preventive interventions in managing NCDs. Notably, 70.3% of new Type 2 diabetes cases globally can be attributed to suboptimal dietary factors. Key contributors include insufficient whole-grain intake, excessive consumption of refined grains, processed meats, sugary beverages, and inadequate intake of fruits and vegetables. The growing market for ultra-processed foods (UPFs) in India is particularly concerning, as high consumption of UPFs is linked to worsened cardio metabolic risk profiles and increased risks of cardiovascular diseases, depression, and all-cause mortality.

Plant-Based Diets: These diets, rich in fruits, vegetables, legumes, seeds, grains, and nuts, have shown benefits in improving glycemic and lipid profiles, aiding in weight loss, and reducing inflammation. The high fiber content regulates postprandial glucose response and enhances insulin sensitivity.

Low-Carbohydrate and Mediterranean Diets: Studies have demonstrated that low-carbohydrate diets can lead to significant weight loss and improvements in triglyceride levels. The Mediterranean diet, which includes high consumption of fruits, vegetables, whole grains, legumes, nuts, and seeds, has been effective in decreasing fasting glucose levels in patients with diabetes. - (Sarah et al. 2020)

CHAPTER 3
METHODOLOGY

The methodology adopted for the present study entitles **"Association between carbohydrate intake and non-communicable diseases"** is discussed under the following headings:

3.1 Selection of subjects

In this study, the focus was on Non communicable diseases and their correlation with carbohydrate consumption in both males and females within the age group of **30–60 years**. NCDs such as diabetes, obesity, and cardiovascular conditions, are significantly influenced by dietary habits, particularly carbohydrate intake. To analyse this relationship, a total of **250 participants** within the specified age group were selected. The study aims to assess dietary patterns, carbohydrate consumption levels, physical activity, genetic predisposition, stress levels and their impact on the prevalence of lifestyle-related health conditions.

3.2 Selection of Area

The present study was conducted in and around Ernakulam. The convenience and availability of the required subjects, 'sedentary adults aged between 30 and 60 years' led to the selection of this area for the study.

3.3 Selection of tool

The tool selected for the study was a Questionnaire consisting of a set of questions circulated in the form of Google Form which were filled up by the subjects. The questions collected the information about General Profile, Anthropometric Measurement, biochemical parameters like lipid profile, Food Frequency Questions, Clinical Symptoms, Lifestyle Habits, Details of existing diseases and 24 hour recall of 3 days

3.4 Collection of data:

Data for the study was collected from a total of 250 individuals, all falling within the age group of 30 to 60 years. The participants were selected through online circulation of Google Forms. The questionnaire was designed to gather comprehensive information across multiple domains. The collected data included the participants' general demographic profile, anthropometric measurements, risk factor assessments, levels of physical activity, dietary habits, clinical symptoms, lifestyle practices, and the presence of any pre-existing medical conditions. Additionally, a 24-hour dietary recall was conducted for three non-consecutive days to gain insights into their nutritional intake and eating patterns.

3.4.1 General Profile:

General profile included basic information about the subjects such as name, age, sex, religion, marital status, education qualification, employment nature, monthly income and occupation status. This information was collected from the subjects.

3.4.2 Anthropometric Details:

Anthropometric details of the subject such as height and weight were taken to calculate the BMI, Waist and hip measurement of the subjects were also taken.

3.4.2.1 Height - It was measured using a stadiometer. Participants stood straight with their buttocks, shoulder blades, and heels touching the back, feet angled outward at 60 degrees, and arms relaxed with palms facing their thighs. The bar was lowered to touch the crown of the head, and measurements were recorded to the nearest 0.1 centimeter.

3.4.2.2 Weight - A weighing machine was used to measure weight. Participants removed footwear and items like wallets or keys, wore light clothing, stood still in the centre of the platform, and evenly distributed their weight. Measurements were recorded to the nearest 0.1 kilogram.

3.4.2.3 Waist circumference - The waist circumference is measured at the narrowest part of the torso, between the lower rib and the iliac crest, while the subject stands upright in light clothing. The measurement is taken to the nearest 0.1 for accuracy.

3.4.2.4 Hip circumference - The individual wore light clothing, stood upright with a relaxed posture, and had their arms at their sides and feet together. A tape was placed around the widest part of the buttocks, ensuring it was straight and not touching the skin, and measurements were taken to the nearest 0.1 centimeter.

3.4.2.5 Waist - hip ratio - The waist hip ratio (WHR) measures body fat distribution by dividing waist circumference by hip circumference, indicating risk of metabolic problems, with WHO cut-off points determining risk levels.

Table 1: World Health Organization cut-off points and risk of metabolic complications (2011) – For Asians

Indicator	Cut off	Risk of metabolic complications
Waist circumference	≥ 90 cm (M), ≥80 cm (W)	Increased risk
Waist circumference	≥ 102 cm (M), ≥ 88 cm (W)	Substantially increased risk
Waist – Hip ratio	> 0.90 (M), > 0.85 (W)	Increased risk
Waist – Hip ratio	≥ 1.00 (M), ≥ 0.90 (W)	Substantially increased risk

Table 2 : International Diabetes Federation cut-off points for different ethnic groups

	Men	Women
Europids	≥ 94	≥ 80
South Asians, Chinese, Japanese	≥ 90	≥80

Table 3 : Cutoffs for Waist Hip Ratio (WHO)

Gender	Normal	At risk
Male	< 0.85	> 0.85
Female	< 0.90	> 0.90

3.4.2.6 BMI - The body mass index (BMI) was computed by dividing the body weight by height (in meter) squared (kg/m2) and is used to determine each subject's weight status. It is also known as the Quetelet Index.

Table 4 : Comparison of BMI recommendations according to WHO and Asia Pacific Guidelines

Level	WHO Cutoff for BMI (kg/m²)	Asia-pacific cutoff for BMI (kg/m²)
Underweight	< 18.5	< 18.5
Normal	18.5 – 24.9	18.5 – 22.9
Overweight	25 – 29.9	23 – 24.9
Obese	≥ 30	≥ 25

3.4.3 Biochemical Parameters :

3.4.3.1 Fasting Blood Sugar (FBS) - FBS measures the level of glucose in the blood after a period of fasting (usually 8–12 hours). Elevated FBS is an indicator of impaired glucose metabolism and is often associated with insulin resistance and the risk of developing type 2 diabetes mellitus, a common non-communicable disease (NCD).

3.4.3.2 Total Cholesterol - Total cholesterol includes all cholesterol types in the blood. High levels may indicate an increased risk of cardiovascular diseases. It reflects overall lipid status and is influenced by dietary intake, especially carbohydrate and fat consumption.

3.4.3.3 High-Density Lipoprotein (HDL) Cholesterol – It is known as "good" cholesterol, HDL helps remove excess cholesterol from the bloodstream. Higher HDL levels are protective against heart disease, whereas low HDL levels are a risk factor for NCDs, particularly coronary artery disease.

3.4.3.4 Low-Density Lipoprotein (LDL) Cholesterol – It is often referred to as "bad" cholesterol, elevated LDL contributes to plaque buildup in arteries, leading to atherosclerosis and cardiovascular complications. Diets high in refined carbohydrates can influence LDL levels unfavorably.

3.4.3.5 Triglycerides - Triglycerides are a type of fat found in the blood. High levels are linked to increased risk of cardiovascular diseases and are often associated with high carbohydrate intake, especially from sugars and refined grains.

Table 5 : Reference range level of biochemical parameters

Fasting blood sugar	70 – 99 mg/dl	Normal
	> 100 mg/dl	High
Total cholesterol	< 200 mg/dl	Normal
	200 – 239 mg/dl	Borderline
	≥ 240 mg/dl	High

HDL	< 40 mg/dl (M), < 50 mg/dl (W)	Low
	≥ 40 mg/dl (M), ≥50 mg/dl (W)	Normal
LDL	<100 mg/dl	Normal
	100 – 129 mg/dl	Borderline
	≥130 mg/dl	High
Triglycerides	< 150 mg/dl	Normal
	150 – 200 mg/dl	Borderline
	> 200 mg/dl	High

3.4.4 Genetic Risk Factor Assessment :

Risk factor assessment was taken by assessing the genetic risk factor of the subject also by taking the smoking and alcohol consumption status of the subject.

3.4.5 Dietary Pattern:

Participants' dietary habits were evaluated based on meal frequency and the intake of high-carbohydrate foods, fruits, vegetables, proteins, fried items, sugary drinks, and processed foods. The focus was to identify patterns that may increase the risk of obesity, insulin resistance, and other components of metabolic syndrome.

3.4.6 Physical Activity:

Physical activity was assessed in terms of timing, type, frequency, and duration of exercise. Participants reported their involvement in activities like walking, yoga, or gym workouts. Reasons for inactivity—such as lack of time or interest—were also recorded. The data aimed to highlight sedentary behaviours linked to metabolic health risks.

3.5 Analysis and interpretation of data

Data collected from the subjects were tabulated and interpreted. Percentage analysis was used to analyse data

CHAPTER 4

RESULT AND DISCUSSION

The results and discussions of the study entitled "**Association between carbohydrate intake and non-communicable diseases**" are presented under the following headings:

4.1 General profile

4.1.1 Age

4.1.2 Gender

4.1.3 Religion

4.1.4 Occupation

4.2 Anthropometric measurements

4.2.1 Weight

4.2.2 Height

4.2.3 BMI

4.2.4 Hip waist ratio

4.3 Biochemical Parameters

4.3.1 Fasting blood sugar

4.3.2 Total Cholesterol

4.3.3 HDL

4.3.4 LDL

4.3.5 Triglycerides

4.3 Personal habits of the subjects

4.4.1 Smoking

4.4.2 Alcohol

4.4.3 Tea/coffee consumption

4.4.4 Sleep pattern

4.4.5 Physical activity

4.5 Dietary Pattern of the Subjects

4.5.1 Type of diet followed

4.5.2 Meal pattern

4.5.3 Meal skipping pattern

4.5.4 Appetite

4.5.5 Regular consumption pattern

4.5.6 Consumption of food from outside

4.5.7 Pattern of junk food consumption

4.5.8 Cooking method

4.6 24 hour recall

4.6.1 Average energy and carbohydrate intake

4.7 Food Frequency

4.8 Relation between carbohydrate and NCDs

4.1 General profile

4.1.1 Age

Age (Year)	No. of subjects	Percentage (%)
30-39	92	36.8
40-49	91	36.4
50-59	67	26.8
Total	250	100

Table 6

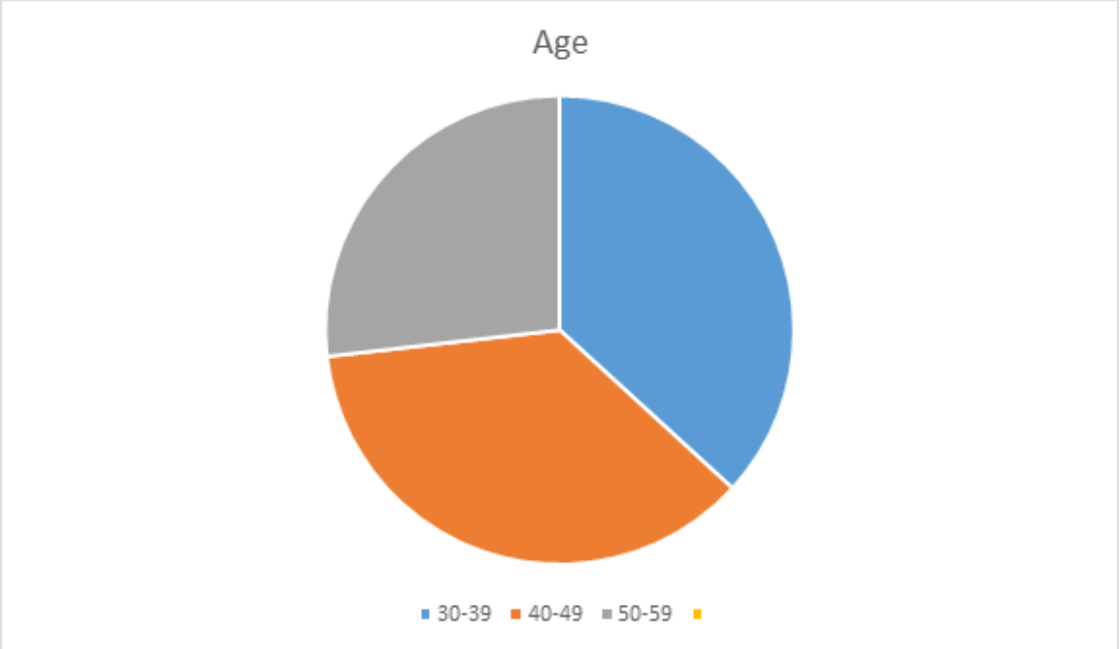

Fig. 1

From the above figure it is clear that 36.8 % of the subjects belonged to the age group of 30-39 years, 36.4 % belonged to the age group of 40-49 years and 26.8 % belonged to the age group 50-59 years.

4.1.2 Gender

Gender	No. of subjects	Percentage (%)
Male	112	44.8
Female	138	55.2
Total	250	100

Table 7

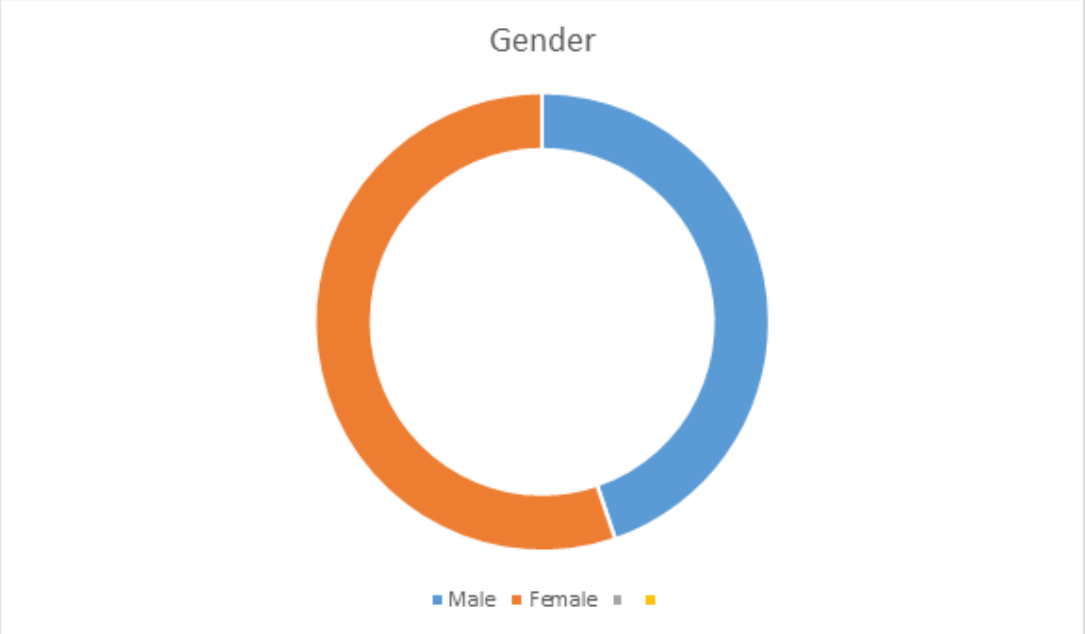

Fig. 2

From the above figure it is clear that 55.2% of the selected subjects were females and 44.8 % were males.

4.1.3 Religion

Religion	No.of subjects	Percentage (%)
Hindu	81	32.4
Muslim	132	52.8
Christian	37	14.8

Table.8

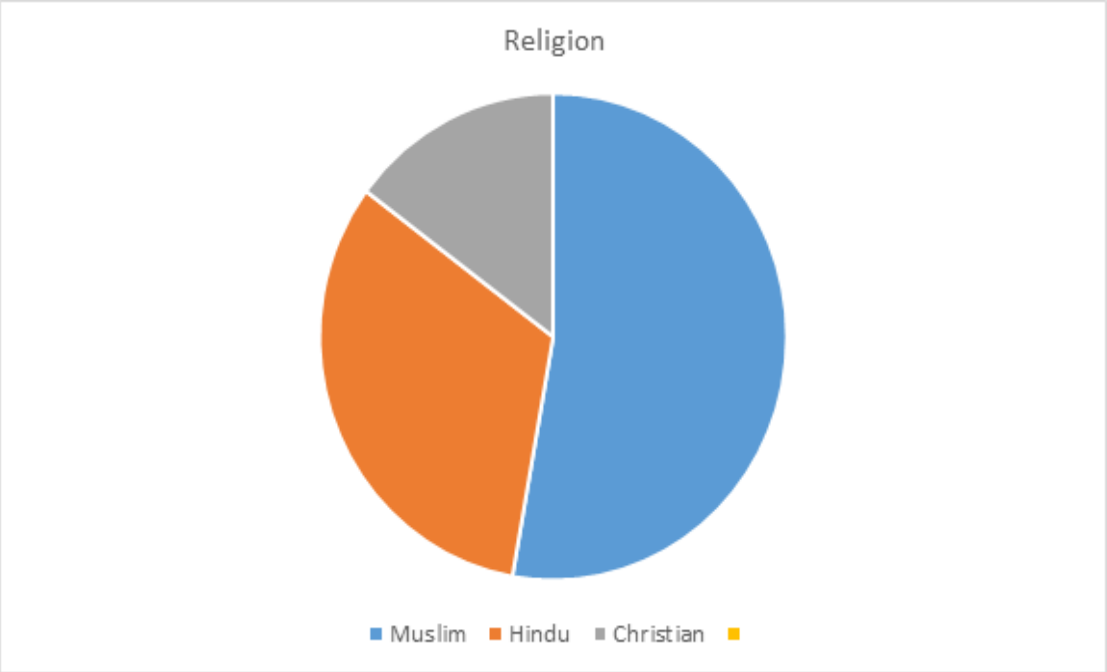

Fig. 3

From the above figure it is clear that 52.8% of the selected subjects were Muslim, 32.4% were Hindu and 14.8 % were Christian.

4.1.4 Occupation

Occupation	No.of Participants	Percentage (%)
Full-time	133	53.2
Part-time	35	14
Homemaker	54	21.6
Unemployed	20	8
Retired	8	3.2

Table 9

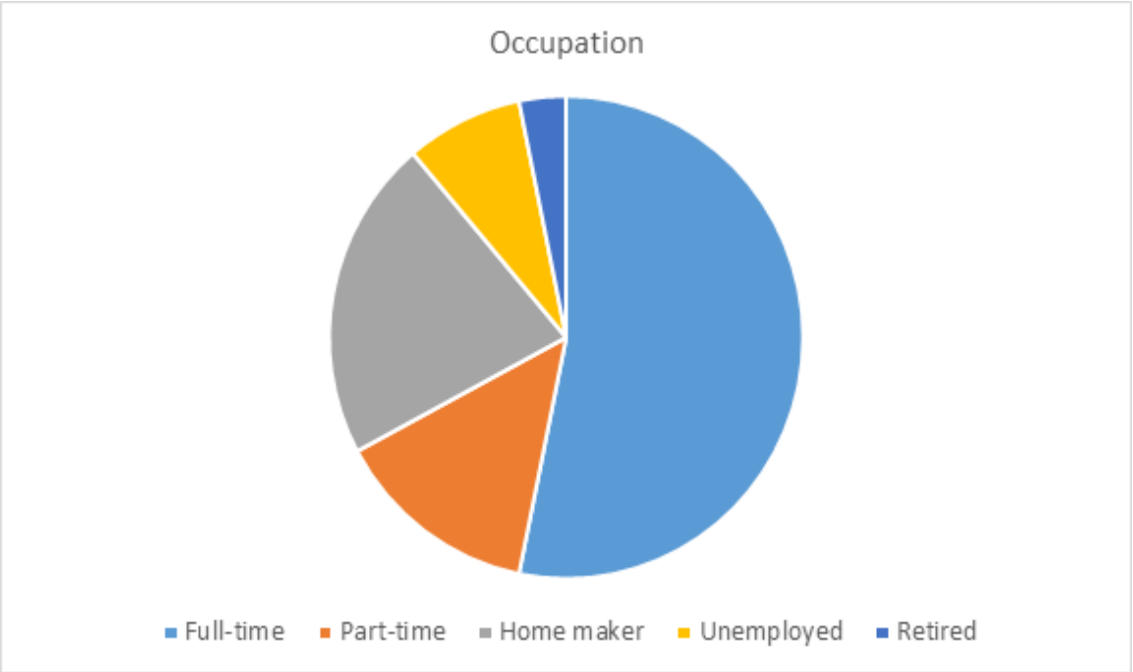

Fig. 4

From the above figure it is clear that 53.2% of subjects were Full-time workers, 21.6% were homemakers, 14% were part-time workers, 8% were unemployed and 3.2 % were retired.

4.2 Anthropometric measurements of subjects

4.2.1 Weight

Weight	Frequency	Percentage
45-55	28	11.2%
55-65	83	33.2%
65-75	69	27.6%
75-85	53	21.2%
85-95	12	4.8%
95-105	5	2%

Table 10

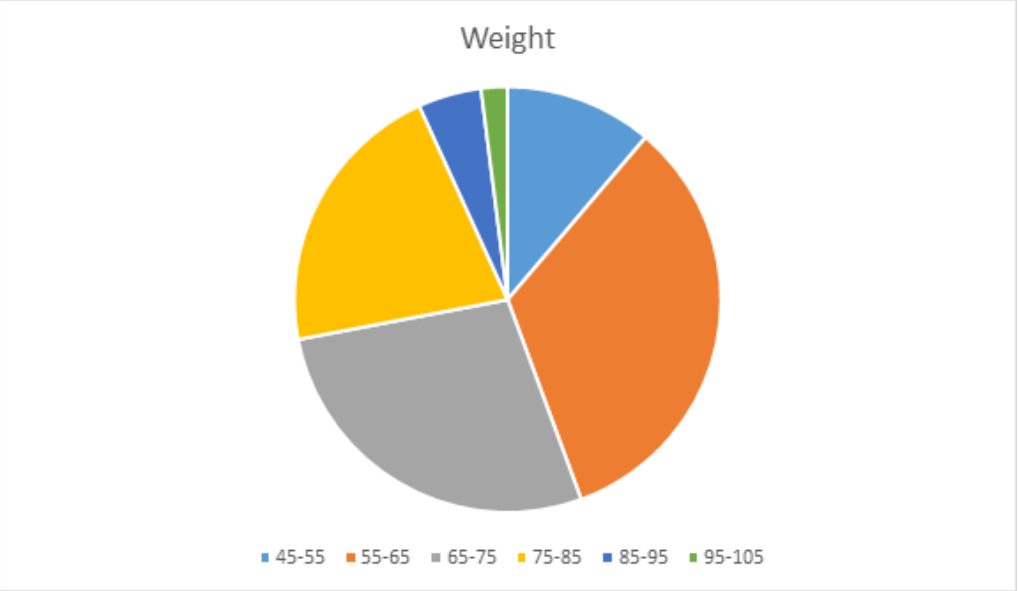

Fig. 5

From this chart, it was shown that the majority of the subjects, comprising 33.2%, had a weight between 55 and 65. Furthermore, 27.6% of the subjects had a weight between 65 and 75, while 21.2% had a weight between 75-85. Additionally, 11.2% of the subjects had a weight between 45 and 55, 4.8% had a weight between 85 and 95, and only 2% had weight between 95-105.

4.2.2 Height

Height	Frequency	Percentage (%)
140-149	8	3.2
150-159	100	40
160-169	76	30.4
170-179	61	24.4
180-189	5	2

Table 11

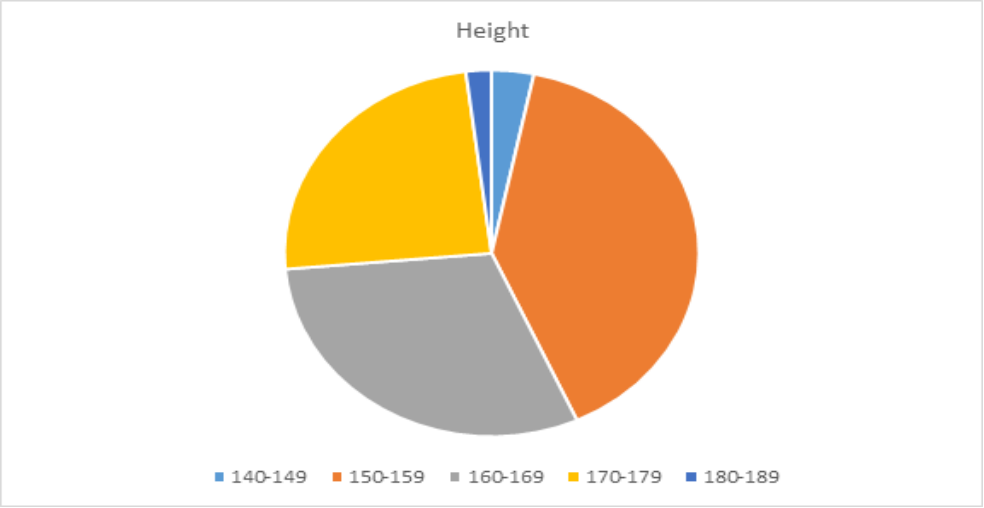

Fig 6

It is given that majority of the subject that is 36.4% of the subjects had the weight of 150-160cm, 30.8% of the subjects had 160-170cm of height,23.6% of subjects had 170-180cm of height,16% of the subjects had 140-150cm and 2.8% of the subjects had 180-190 cm of height.

4.2.3 BMI

BMI	No.of participants	Percentage (%)
Underweight	3	1.2
Normal	97	38.8
Overweight	150	60

Table 12

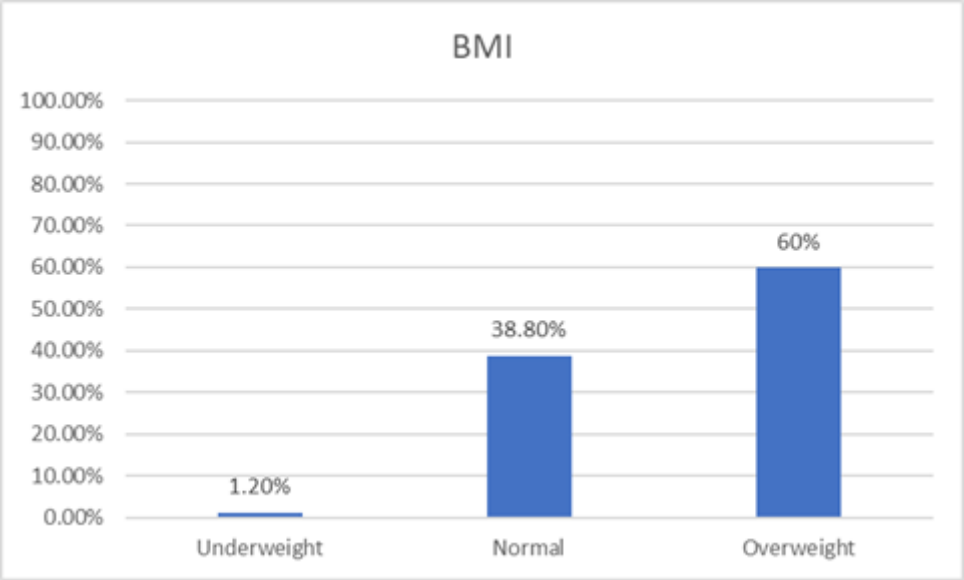

Fig 7

The Body Mass Index (BMI) of the participants was determined based on the provided height and weight measurements. A majority of the subjects, comprising 60%, fell within the overweight BMI category. Among participants, 38.80% were classified as normal, while 1.2% were underweight.

4.2.4 Waist Hip ratio

Sex	Category	Frequency	Percentage (%)
Female	≤ 0.85	78	56.52
	>0.85	60	43.47
Male	≤ 0.9	91	81.25
	>0.9	21	18.75

Table 13

The Waist-Hip ratio of the participants was determined based on the provided Hip and waist circumference. Among women, 56.62% had a normal waist-hip ratio, while 43.47% had elevated waist-hip ratio. Among men, 81.25% had a normal waist-hip ratio, while 18.75% had elevated waist-hip ratio.

4.3 Biochemical Parameters

4.3.1 Fasting blood sugar

Fasting blood sugar	No. of participants	Percentage (%)
Normal	144	57.60
High	106	42.40

Table 14

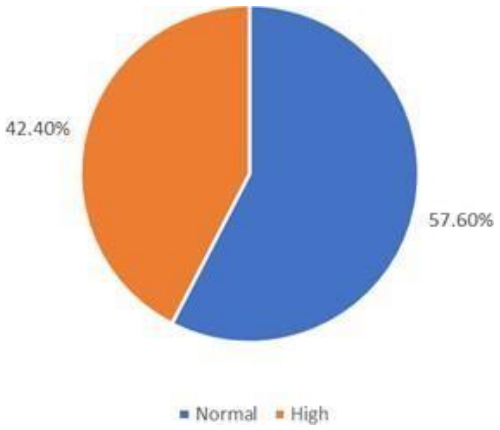

Fig 8

The figure above shows that the majority 57.60% of the participants have normal fasting blood sugar level while the remaining 42.40% of the participants have high fasting blood glucose level.

4.3.2 Total cholesterol

Total cholesterol	No. of participants	Percentage (%)
Normal	123	49.20
High	127	50.80

Table.15

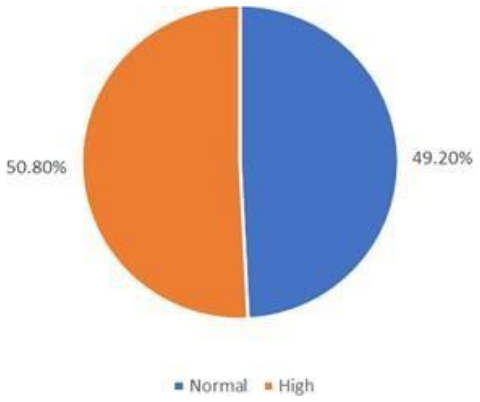

Fig 9

The above chart clearly shows that 50.8% of the participants have high total cholesterol level and the rest 49.2% participants have normal total cholesterol level.

4.3.3 HDL

HDL	No. of participants	Percentage (%)
Low	118	47.20
Normal	132	52.80

Table.16

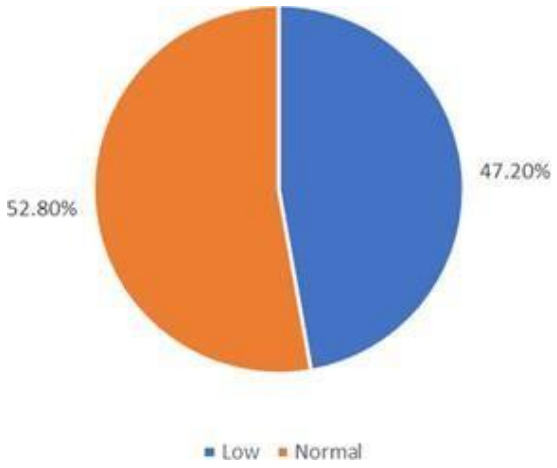

Fig 10

The chart shows that about 52.8% of the participants have low HDL i.e., majority have low good cholesterol and the remaining 47.2% of the participants have normal HDL level.

4.3.4 LDL

LDL	No. of participants	Percentage (%)
Normal	124	49.60
High	126	50.40

Table.17

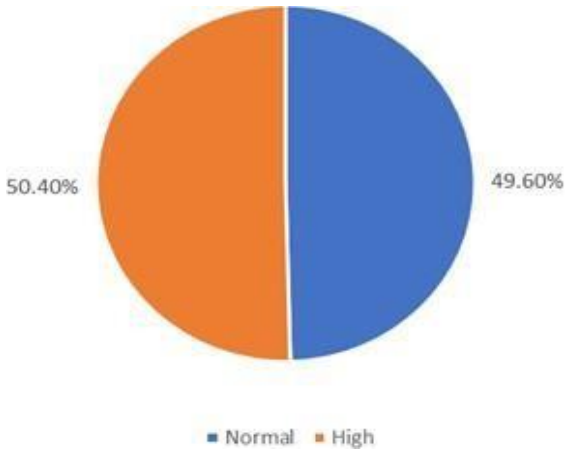

Fig.11

The chart clearly shows that around half of the participants, 50.4% have high LDL and the rest 49.6% of the participants have normal LDL i.e., good cholesterol.

4.3.5 Triglycerides

Triglycerides	No. of participants	Percentage (%)
Normal	105	42
High	145	58

Table.18

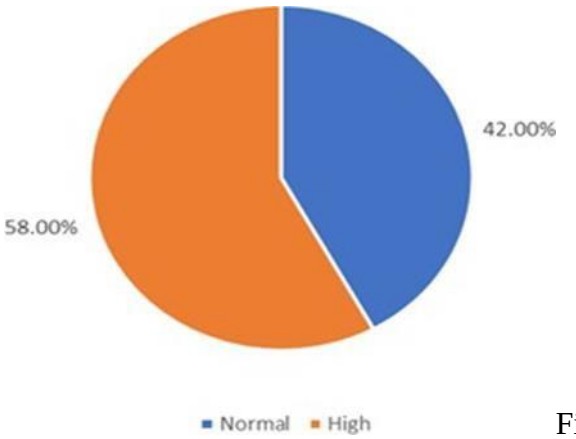

Fig 12

The majority 58% of the participants have high triglycerides level and the remaining 42% of the participants have normal triglyceride level

4.4 Personal Habits Of The Subjects

4.4.1 Smoking

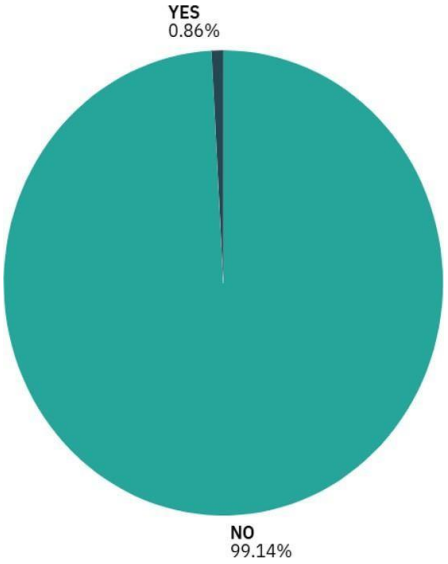

Fig 13

From the above figure it is clear that the majority 99.14% of the respondents do not smoke cigarettes and the rest 0.86% of the respondents smoke cigarettes.

4.4.2 Alcohol Consumption

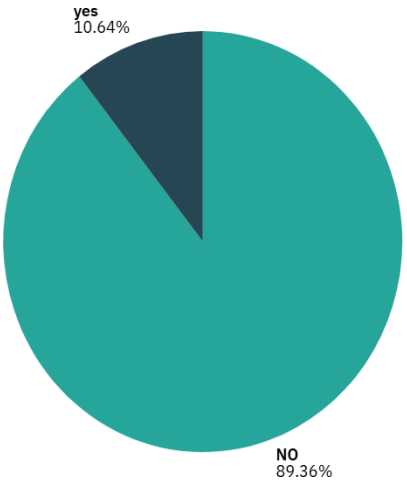

Fig 14

The figure clearly shows that the majority 89.36% of the respondents do not consume alcohol and the rest 10.64% of the respondents have shown the intake of alcohol.

4.4.3 Tea/Coffee Consumption

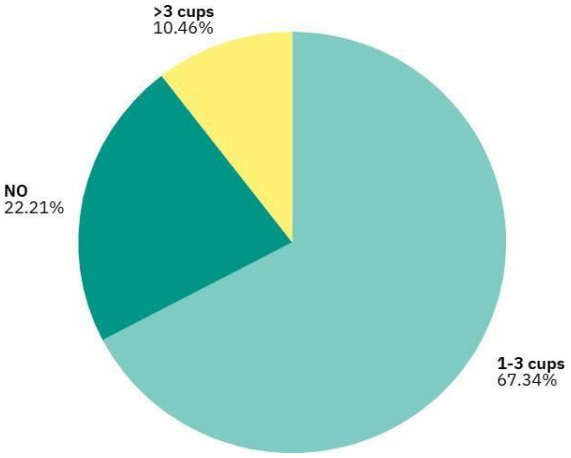

Fig. 15

The chart clearly shows that the majority 67.34% of the respondents consume about 1-3 cups of tea/coffee per day. About 22.21% of respondents do not consume at all and the rest 10.46% of respondents consume >3 cups per day.

4.4.4 Sleep Pattern

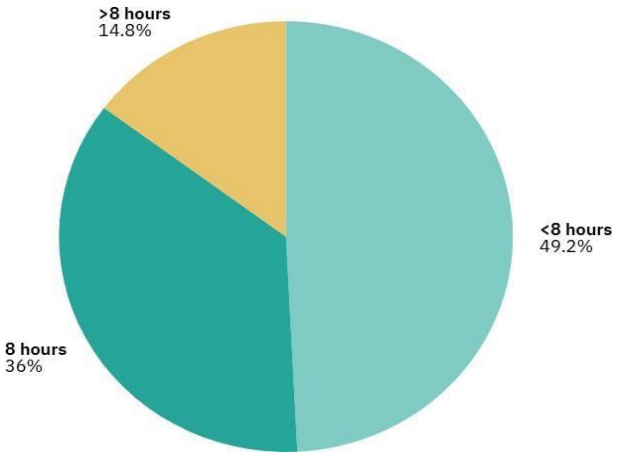

Fig. 16

The chart shows that the majority 49.2% of the respondents sleep about more than 8 hours and 14.8% of the respondents sleep for less than 8 hours. The rest 36% of respondents sleep for a complete 8 hours.

4.4.5 Physical Activity

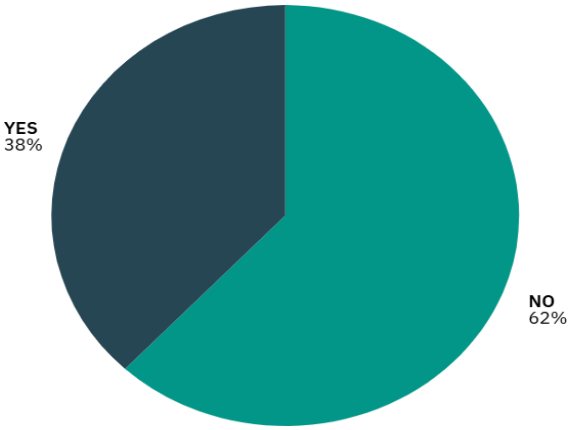

Fig. 17

The above chart shows that the majority 62% of the respondents do not engage in doing exercise and the rest 38% of respondents are engaged in daily exercise.

4.5 Dietary Pattern of the Subjects

4.5.1 Type of diet followed

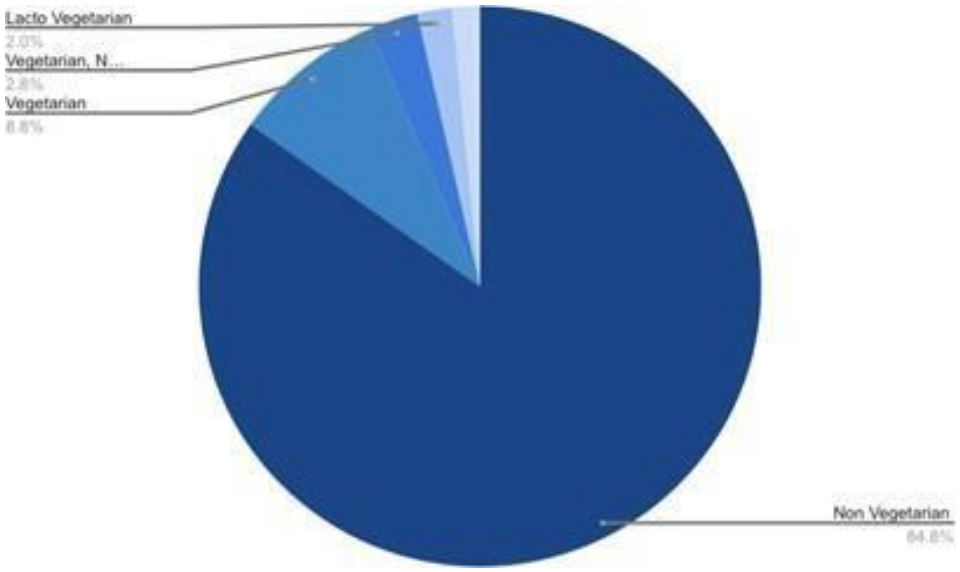

Fig. 18

The majority of respondents (84.8%) follow a non-vegetarian diet, while smaller groups follow vegetarian (8.8%), lacto-vegetarian (2%), ovo-lacto vegetarian (1.2%), or mixed patterns (0.4%). This highlights a strong preference for non-vegetarian food.

4.5.2 Meal patterns

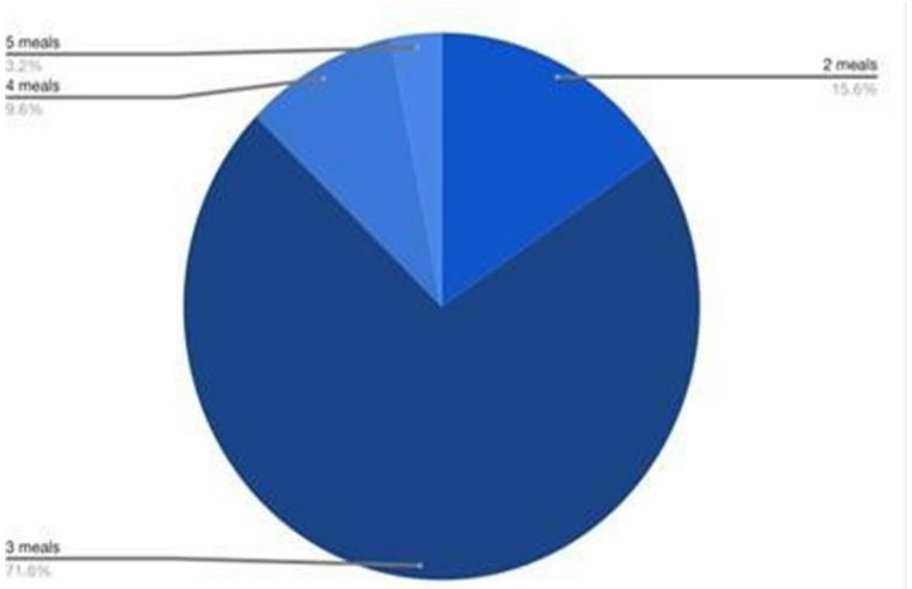

Fig 19

The analysis of meal frequency among the subjects revealed that the majority, 71.6%, consumed three meals per day, indicating adherence to the conventional eating pattern. A smaller proportion, 15.6%, reported having only two meals per day, which may reflect meal skipping, fasting habits, or time constraints. About 9.6% of the respondents had four meals daily, while 3.2% consumed five meals per day, possibly indicating a preference for smaller, more frequent meals throughout the day. Overall, the data suggests that while most individuals follow the standard three-meal routine, there exists a notable variation in meal frequency among the population.

4.5.3 Meal skipping pattern

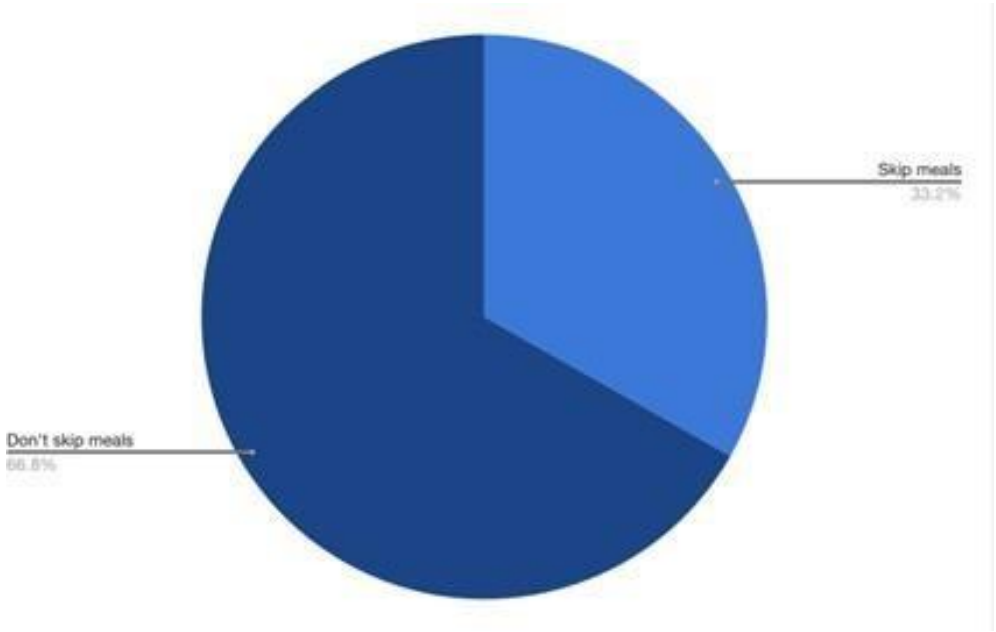

Fig. 20

The figure clearly shows that the majority 66.8% of the respondents do not skip meals, whereas the remaining 33.2% of the respondents reported that they skip meals.

4.5.4 Appetite

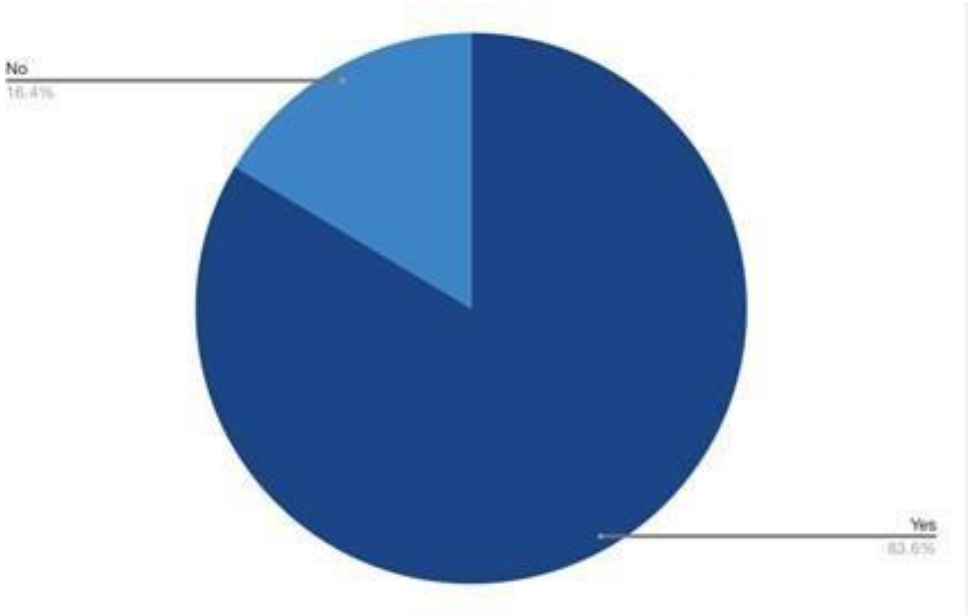

Fig. 21

The figure clearly shows that the majority 83.6% of the respondents reported having a good appetite, whereas the remaining 16.4% of the respondents reported not having a good appetite.

4.5.5 Regular consumption pattern

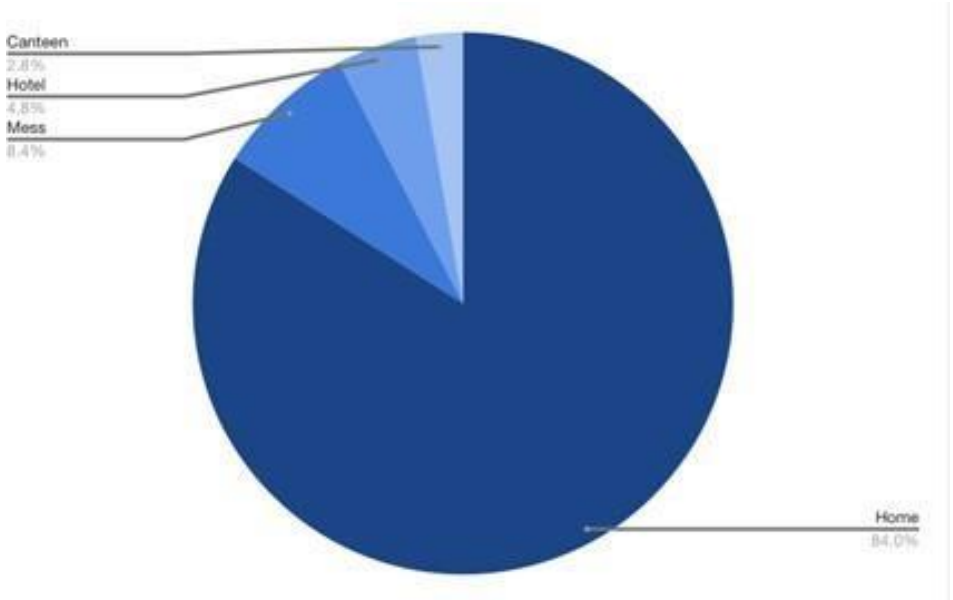

Fig. 22

The figure clearly shows that the majority 84.0% of the respondents regularly consume food from home. A smaller percentage, 8.4%, consume from a mess, 4.8% from a hotel, and only 2.8% from a canteen.

4.5.6 Consumption of food from outside

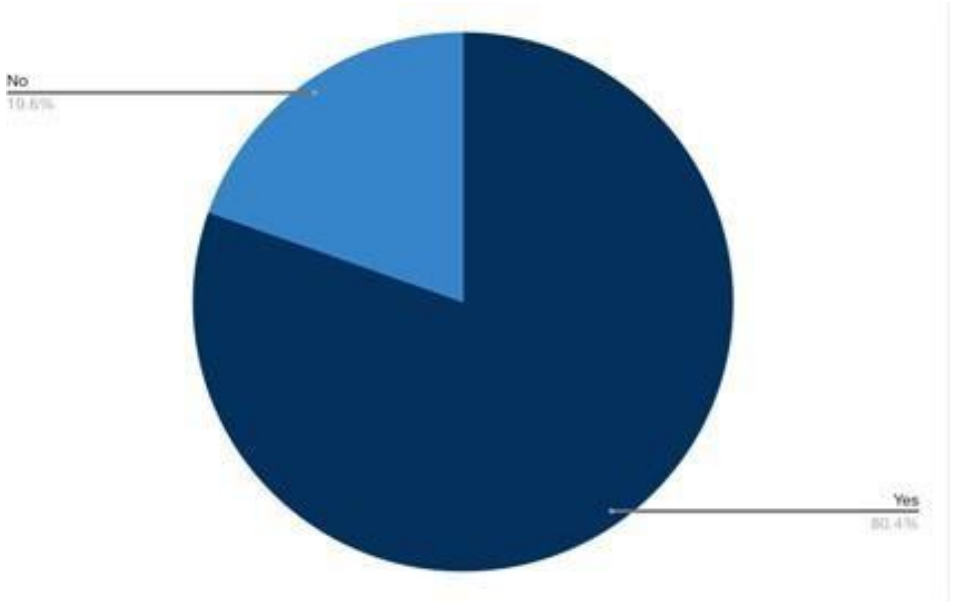

Fig. 23

The figure clearly shows that the majority 80.4% of the respondents consume food from outside, while only 19.6% of the respondents reported that they do not consume food from outside.

4.5.7 Pattern of junk food consumption

Food Category	Per Week	Per Month	Per Year	Never
Fast Foods	33.33%	42.64%	13.18%	10.85%
Carbonated drinks	39.39%	37.88%	12.12%	10.61%
Fried Foods	32.89%	49.34%	9.87%	7.89%
Sweets	34.01%	43.15%	12.18%	10.66%

Table.19

4.5.8 Cooking method

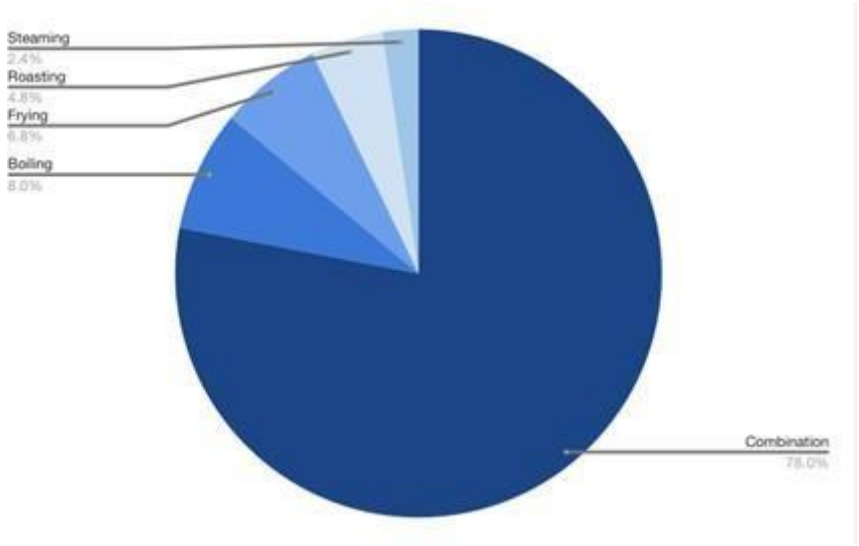

Fig 24

The figure clearly shows that the majority, 78.0% of the food items, were prepared using the combination method. Boiling was the next most common method, used for 8.0% of the items. Frying accounted for 6.8%, followed by roasting at 4.8%, and steaming at 2.4%.

4.6 24-hour recall

The average intake of calories and carbohydrates of a day was calculated and was compared with the RDA of energy and carbohydrates.

4.6.1 Average energy and carbohydrate intake

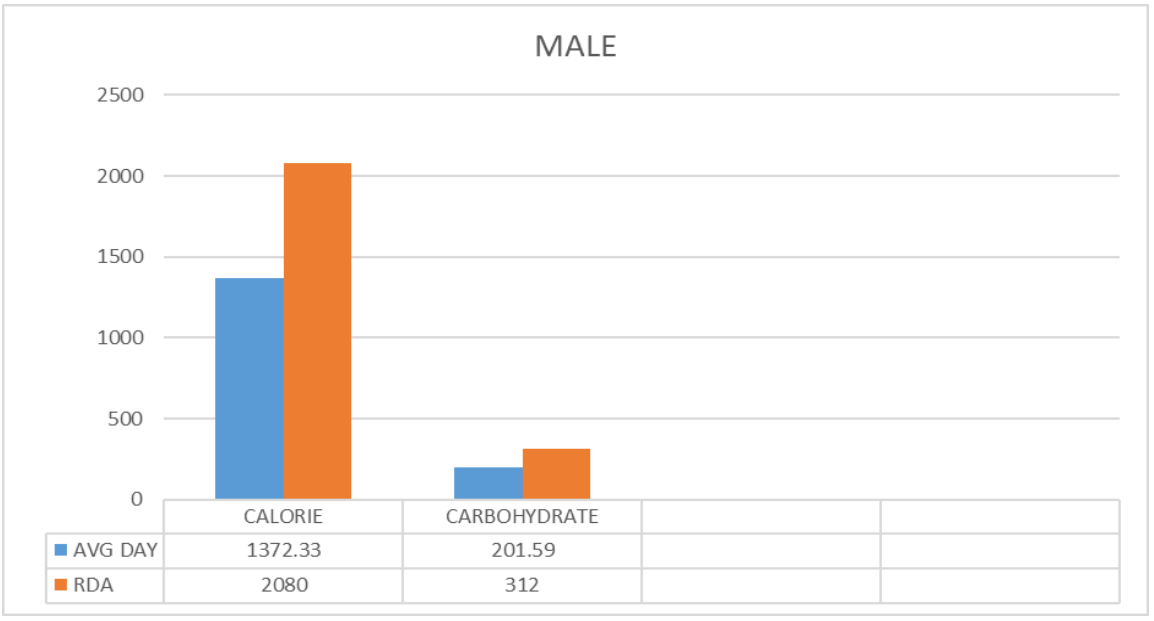

Fig 25

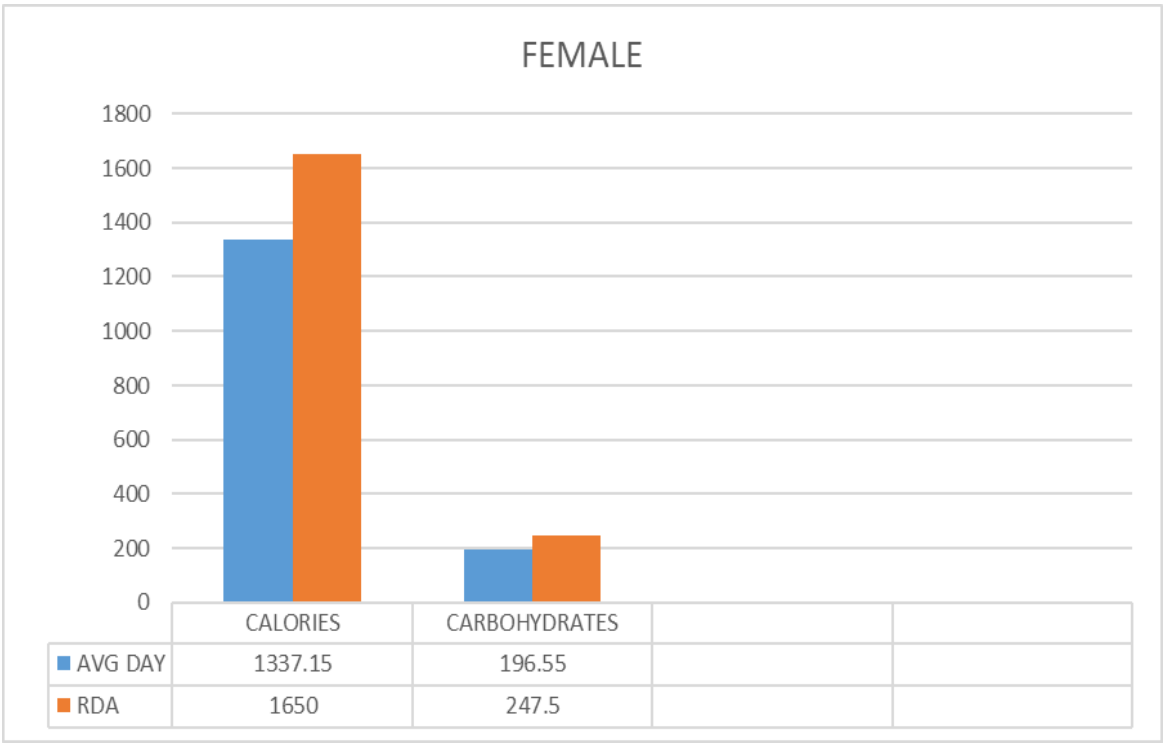

Fig 26

From the graph, it is clear that the average intake of energy and carbohydrate is less than RDA required for both Male and Female. They were not meeting their daily dietary requirements for energy and carbohydrates.

4.7 Food frequency

Food group	**Consumption frequency**	**Frequency**	**Percent%**
Cereals			
Rice	Daily	224	89.6
Wheat	Weekly	138	55.2
Ragi	Monthly	140	56
Oats	Occasionally	156	62.4
Roots & Tubers			
Potato	Weekly	135	54
Tapioca	Weekly	112	44.8
Yam	Weekly	108	43.2
Colocassia	Weekly	88	35.2
Sugars			
Sugar	Daily	180	72
Honey	Weekly	132	52.8
Jaggery	Weekly	120	48

Table.20

The table clearly shows the frequency of consumption of various cereals and roots and tubers among participants. Rice was consumed daily by 89.6% participants, wheat was consumed weekly by 55.2% participants, ragi was consumed monthly by 56% participants and oats was occasionally consumed by 62.4% participants. Among roots and tubers, Potato was consumed weekly by 54% participants, tapioca was consumed weekly by 44.8% participants, yam was consumed weekly by 43.2% participants and colocasia was consumed weekly by 35.2% participants. Among sugars, table sugar was consumed daily by 72% participants, honey was consumed weekly by 52.8% participants and jaggery was consumed by 48% participants.

4.8 Relation between carbohydrate and NCD

Carbohydrate	Male(%)	Female(%)
Consumption> RDA	27.67	21.01
Consumption<RDA	72.32	78.98

Table 21

From this table it is clear that only 27.67% males and 21.01% females were consuming more Carbohydrate than is required.

After analysing the data, it was observed that 114 study participants had NCD and among them only 29 had high carbohydrate intake along with NCD. This suggests that there is no significant relation between high carbohydrate intake and Non - communicable diseases in the selected study population. Most individuals with NCDs had a lower-than-recommended carbohydrate intake, indicating no strong or direct correlation between excess carbohydrate consumption and the prevalence of NCDs in this group. The lower association observed with carbohydrate intake may be due to the limited sample size, unique characteristics of the study population, and the possibility that individual diagnosed with NCDs had already begun modifying their diets.

CHAPTER 5

SUMMARY AND CONCLUSION

The study entitled "Association between carbohydrate intake and non-communicable diseases " was undertaken with the objectives to assess the anthropometric measurement, biochemical , dietary assessments, food consumption pattern, physical activity and identify non-communicable diseases (NCDs) among the study participants and the correlation between carbohydrate intake and the prevalence of NCDs. For the study, 250 participants between the ages of 30 to 60 were selected as samples.

- After analyzing and interpreting the collected data, it became evident that there is no significant association between high carbohydrate intake and the prevalence of non-communicable diseases, which appears to be influenced by various factors such as poor dietary habits, physical inactivity, irregular meal patterns, and imbalanced nutrient intake
- A larger proportion of the study subjects were female (55.2%), while males accounted for 44.8% of the total sample.
- With regard to the anthropometric measurements, the majority of the subjects, comprising 60%, fell within the overweight BMI category, while 38.80% were classified as having a normal BMI and 1.2% were underweight.
- In terms of waist-hip ratio, 56.62% of the women had a normal ratio, while 43.47% had an elevated waist-hip ratio. Among men, 81.25% exhibited a normal waist-hip ratio, whereas 18.75% had an elevated ratio.
- With regard to the biochemical parameters, 57.60% of the participants had normal fasting blood glucose levels, while the remaining 42.40% had elevated levels. In terms of total cholesterol, 50.8% of the participants had high levels, whereas 49.2% had normal levels. HDL levels were found to be low in 52.8% of the participants, indicating that the majority had reduced levels of good cholesterol, while 47.2% had normal HDL. Similarly, LDL levels were elevated in 50.4% of the participants, with

49.6% showing normal levels. A majority of 58% had high triglyceride levels, whereas 42% had normal triglyceride levels.

- With regard to lifestyle practices, the majority of the respondents (99.14%) reported not smoking cigarettes, while only 0.86% were smokers. A total of 89.36% of the participants did not consume alcohol, whereas 10.64% reported alcohol intake.
- In terms of tea/coffee consumption, 67.34% consumed about 1–3 cups per day, 22.21% did not consume at all, and 10.46% consumed more than 3 cups daily.
- Sleep duration analysis revealed that 49.2% of the respondents slept more than 8 hours, 36% reported exactly 8 hours of sleep, and 14.8% slept for less than 8 hours. Additionally, 62% of the respondents were not engaged in any form of daily exercise.
- With regard to dietary habits, the majority of the respondents (84.8%) followed a non-vegetarian diet, while 8.8% identified as strictly vegetarian. A smaller portion (2.8%) reported alternating between vegetarian and non-vegetarian patterns, 2.0% followed a lacto-vegetarian diet, and 1.2% followed an ovo-lacto vegetarian diet. Interestingly, 0.4% indicated adherence to all dietary styles.
- Meal frequency analysis revealed that 71.6% of the participants consumed three meals per day, reflecting a conventional eating pattern, while 15.6% had two meals, 9.6% had four meals, and 3.2% consumed five meals daily. A majority of 66.8% reported not skipping meals, whereas 33.2% admitted to skipping them. In terms of appetite, 83.6% of the respondents reported having a good appetite, while 16.4% did not
- Regarding the source of meals, 84.0% regularly consumed food from home, 8.4% from a mess, 4.8% from a hotel, and 2.8% from a canteen. Notably, 80.4% of the participants consumed food from outside, while 19.6% did not. Cooking methods revealed that 78.0% of the food items were prepared using the combination method, followed by boiling (8.0%), frying (6.8%), roasting (4.8%), and steaming (2.4%).
- Rice was the most frequently consumed cereal, with 89.6% of participants consuming it daily. Wheat followed, with 55.2% of participants consuming it weekly. Ragi was consumed monthly by 56% of participants, indicating limited but regular use. Oats were the least frequently consumed, with 62.4% reporting only occasional intake.
- Among the roots and tubers, potato was consumed weekly by 54% of participants, making it the most commonly consumed in this category. Tapioca and yam were consumed weekly by 44.8% and 43.2% of participants, respectively, while colocasia

was consumed weekly by 35.2%. This reflects a moderate to low frequency of consumption of these tuber varieties.

- Among sugar sources, table sugar was the most commonly consumed, with 72% of participants using it daily. Honey was consumed on a weekly basis by 52.8% of participants, while 48% reported consuming jaggery, indicating moderate use.
- With regard to the 24-hour dietary recall, the average intake of both calories and carbohydrates was found to be lower than the Recommended Dietary Allowance (RDA) among both male and female participants. Specifically, 27.67% of males and 21.01% of females were consuming carbohydrates above the RDA, while 72.32% of males and 78.98% of females consumed less than the recommended amount. A total of 29 participants diagnosed with Non-Communicable Diseases (NCDs) were found to have high carbohydrate intake, suggesting a less significant relationship between excessive carbohydrate consumption and the prevalence of NCDs in the study population.

CONCLUSION

The study titled “Association between Carbohydrate Intake and Non-Communicable Diseases” assessed individuals aged 30 to 60 years to explore links between dietary intake and NCDs. Most participants were female and overweight, with women showing a higher prevalence of elevated waist-hip ratios. Biochemical findings revealed that a significant proportion had abnormal levels of fasting glucose, total cholesterol, LDL, HDL, and triglycerides, indicating a high risk of metabolic disorders. While smoking and alcohol consumption were uncommon, most participants did not engage in regular exercise and had inconsistent sleep patterns. Dietary assessments showed a strong preference for non-vegetarian diets, frequent consumption of food from outside, and reliance on less healthy cooking methods. Despite three-meal patterns being common, many skipped meals, and a substantial percentage reported low carbohydrate intake compared to RDA, though a portion, particularly those diagnosed with NCDs, consumed excess carbohydrates. In conclusion, the study could not establish a significant association between high carbohydrate intake and the prevalence of NCDs in the selected area of study. The lower association observed with carbohydrate intake may be due to the limited sample size, unique characteristics of the study population, and the possibility that individual diagnosed with NCDs had already begun modifying their diets.

REFERENCES

1. Salam, R. (2016). Expanding the definition of noncommunicable disease. Journal of Social Health and Diabetes, 4(2), 67–70. https://doi.org/10.4103/2321-0656.187990

2. Sarma, P. S., Sadanandan, R., Thulaseedharan, J. V., Soman, B., Srinivasan, K., Varma, R. P., Nair, M. R., Pradeepkumar, A. S., Jeemon, P., Thankappan, K. R., & Kutty, R. V. (2019). Prevalence of risk factors of non-communicable diseases in Kerala, India: Results of a cross-sectional study. BMJ Open, 9(11), e027880. https://doi.org/10.1136/bmjopen-2018-027880

3. Mahipala, P., Dorji, G., Tisocki, K., & Rani, M. (2019). A critical review of addressing cardiovascular and other non-communicable diseases through a primary health care approach in the South-East Asia Region. Cardiovascular Diagnosis and Therapy, 9(2), 150–157. https://doi.org/10.21037/cdt.2018.09.03

4. Soodejani, M. T. (2024). Non-communicable diseases in the world over the past century: A secondary data analysis. Frontiers in Public Health, 12, 1436236. https://doi.org/10.3389/fpubh.2024.1436236

5. Grosso, G. (2019). Impact of nutritional risk factors on chronic non-communicable diseases. The European Journal of Public Health, 29(Supplement_4), ckz185.197. https://doi.org/10.1093/eurpub/ckz185.197

6. World Health Organization. (2024, December 23). Noncommunicable diseases. https://www.who.int/news-room/fact-sheets/detail/noncommunicable-diseases

7. Mohan, V., Unnikrishnan, R., Shobana, S., Malavika, M., Anjana, R. M., & Sudha, V. (2018). Are excess carbohydrates the main link to diabetes & its complications in Asians? The Indian Journal of Medical Research, 148(5), 531–538. https://doi.org/10.4103/ijmr.IJMR_1698_18

8. Reynolds, A., Mann, J., Cummings, J., Winter, N., Mete, E., & Te Morenga, L. (2019). Carbohydrate quality and human health: A series of systematic reviews and meta-analyses. The Lancet, 393(10170), 434–445. https://doi.org/10.1016/S0140-6736(18)31809-9

9. Lunghar, J., & Banu, A. T. (2021). Dietary approaches in management of noncommunicable diseases: A review. International Journal of Noncommunicable Diseases, 6(4), 159–165. https://doi.org/10.4103/jncd.jncd_63_2

10. Mounsey, S., Waqa, G., McKenzie, B., Reeve, E., Webster, J., Bell, C., & Thow, A. M. (2022). Strengthening implementation of diet-related non-communicable disease prevention strategies in Fiji: A qualitative policy landscape analysis. Globalization and Health, 18, 79. https://doi.org/10.1186/s12992-022-00859-9

11. Bhandari, G. P., Angdembe, M. R., Dhimal, M., Neupane, S., & Bhusal, C. (2014). State of non-communicable diseases in Nepal. BMC Public Health, 14, 23. https://doi.org/10.1186/1471-2458-14-23

12. Daar, A. S., Singer, P. A., Persad, D. L., Pramming, S. K., Matthews, D. R., Beaglehole, R., Bernstein, A., Borysiewicz, L. K., Colagiuri, S., Ganguly, N., Glass, R. I., Finegood, D. T., Koplan, J., Nabel, E. G., Sarna, G., Sarrafzadegan, N., Smith, R., Yach, D., & Bell, J. (2007). Grand challenges in chronic non-communicable diseases. Nature, 450(7169), 494–496. https://doi.org/10.1038/450494a

13. Nethan, S., Sinha, D., & Mehrotra, R. (2017). Non-communicable disease risk factors and their trends in India. Asian Pacific Journal of Cancer Prevention, 18(7), 2005–2010. https://doi.org/10.22034/APJCP.2017.18.7.20

14. Pan American Health Organization. (n.d.). Noncommunicable diseases. https://www.paho.org/en/topics/noncommunicable-diseases

APPENDIX

Metabolic Syndrome Questionnaire

1. Name :

2. Age :

3. Sex :

   Male

   Female

4. Religion :

   Christian

   Hindu

   Muslim

   Others

5. Employment nature of the respondent :

   Full time

   Part time

   Retired

   Homemaker

   Unemployed

Assessment of Body Composition Measures

6. Height :

7. Weight :

8. BMI :

9. Waist circumference :

10. Hip circumference :

11. Waist hip ratio :

Assessment of NCEP ATP III guidelines and IDF criteria

12. Fasting blood glucose :

13. Serum Triglycerides :

14. Total cholesterol :

15. LDL Cholesterol :

16. HDL Cholesterol :

17. Blood pressure :

Assessment of environmental risk factors

18. Do you currently smoke?

Yes

No

i. If Yes, How often?

Daily

Twice a week

Weekly

Rarely

ii. How many cigarettes do you smoke per day?

iii. How long have you been a regular smoker?

iv. How often does anyone smoke inside your home?

Daily

Weekly

Monthly

Never

19. Currently, Do you take alcoholic drink?

Yes

No

i. How often do you have a drink containing alcohol?

Daily

Twice a week

Weekly

Monthly

ii. If Yes, How many drinks do you have on a typical day when you drink (peg)?

1 to 5

5 to 10

10 to 15

>15

iii. How often do you have six or more drink on one occasion?

Daily

Twice a week

Weekly

Monthly

iv. How long have you been an alcoholic?

< 1 year

1 to 5 year

5 to 10 year

>10 years

Other habits

20. How many cups of tea/ coffee do you drink daily:

Nil

1-3 cups

>3cups

21. How many hours do you sleep daily?

8 Hours

More than 8 Hours

Less than 8 Hours

Physical activity

22. Do you exercise regularly?

Yes

No

i. If Yes, how often?

Daily

Alternate days

3 days/week

5 days/week

ii. If No, please mention the reason

No time to do exercise

Not interested

Feeling lazy

Health problem

Dietary Assessment

23. Type of diet following:

Vegetarian

Lacto vegetarian

Ovo- lacto vegetarian

Non vegetarian

24. Do you have the habit to take food at regular time?

Yes

No

25. Do you skip meals?

Yes

No

26. If Yes, Which meal?

Breakfast

Lunch

Dinner

27. How do you compensate for the skipped meal?

Tea

Coffee

Fried snacks

Cakes/ Pastry

Biscuits

Vegetable salads

Sandwiches

Fruits/ Fruits juices

Any other foods

28. Do you have good appetite?

Yes

No

29. Do you eat food from outside?

Yes

No

30. How often you take the following foods

Fast Foods ---------- times per week / times per month / times per year / Never

Carbonated drinks---------- times per week / times per month / times per year / Never

Fried foods ---------- times per week / times per month / times per year / Never

Sweets ---------- times per week / times per month / times per year / Never

31. What type of cooking methods regularly followed your family?

Boiling

Steaming

Frying

Roasting

Combination

24 Hours Recall Method

Working Day 1

Breakfast :

Midmorning :

Lunch :

Evening time :

Dinner :

Bed time :

Any other time :

Working Day 2

Breakfast :

Midmorning :

Lunch :

Evening time :

Dinner :

Bed time :

Any other time :

Holiday (Nonworking day)

Breakfast :

Midmorning :

Lunch :

Evening time :

Dinner :

Bed time :

Any other time :

Food Frequency Table

Cereals

Rice – Daily / Weekly / Monthly / Occasionally

Wheat – Daily / Weekly / Monthly / Occasionally

Ragi – Daily / Weekly / Monthly / Occasionally

Oats – Daily / Weekly / Monthly / Occasionally

Pulses and Legumes

Red gram – Daily / Weekly / Monthly / Occasionally

Black gram – Daily / Weekly / Monthly / Occasionally

Green gram – Daily / Weekly / Monthly / Occasionally

Red gram dhal – Daily / Weekly / Monthly / Occasionally

Black gram dhal – Daily / Weekly / Monthly / Occasionally

Green gram dhal – Daily / Weekly / Monthly / Occasionally

Horse gram – Daily / Weekly / Monthly / Occasionally

Chickpea (Channa) – Daily / Weekly / Monthly / Occasionally

Rajma – Daily / Weekly / Monthly / Occasionally

Milk and meat products

Milk – Daily / Weekly / Monthly / Occasionally

Curds – Daily / Weekly / Monthly / Occasionally

Buttermilk – Daily / Weekly / Monthly / Occasionally

Milk powder – Daily / Weekly / Monthly / Occasionally

Cheese – Daily / Weekly / Monthly / Occasionally

Chicken – Daily / Weekly / Monthly / Occasionally

Beef – Daily / Weekly / Monthly / Occasionally

Pork – Daily / Weekly / Monthly / Occasionally

Mutton – Daily / Weekly / Monthly / Occasionally

Egg – Daily / Weekly / Monthly / Occasionally

Fish – Daily / Weekly / Monthly / Occasionally

Vegetables and Fruits

Amaranth (Red cheera) – Daily / Weekly / Monthly / Occasionally

Spinach (Green cheera) – Daily / Weekly / Monthly / Occasionally

Chekkurmanis – Daily / Weekly / Monthly / Occasionally

Drumstick leaves – Daily / Weekly / Monthly / Occasionally

Cabbage – Daily / Weekly / Monthly / Occasionally

Lettuce – Daily / Weekly / Monthly / Occasionally

Ash gourd – Daily / Weekly / Monthly / Occasionally

Beans – Daily / Weekly / Monthly / Occasionally

Bitter gourd – Daily / Weekly / Monthly / Occasionally

Brinjal – Daily / Weekly / Monthly / Occasionally

Cauliflower – Daily / Weekly / Monthly / Occasionally

Cucumber – Daily / Weekly / Monthly / Occasionally

Ivy gourd (Kovai) – Daily / Weekly / Monthly / Occasionally

Ladies finger – Daily / Weekly / Monthly / Occasionally

Papaya – Daily / Weekly / Monthly / Occasionally

Plantain – Daily / Weekly / Monthly / Occasionally

Pumpkin – Daily / Weekly / Monthly / Occasionally

Bottle gourd – Daily / Weekly / Monthly / Occasionally

Snake gourd – Daily / Weekly / Monthly / Occasionally

Tomato green – Daily / Weekly / Monthly / Occasionally

Jackfruit raw – Daily / Weekly / Monthly / Occasionally

Breadfruit (Kadachakka) – Daily / Weekly / Monthly / Occasionally

Beetroot – Daily / Weekly / Monthly / Occasionally

Carrot – Daily / Weekly / Monthly / Occasionally

Onion – Daily / Weekly / Monthly / Occasionally

Potato – Daily / Weekly / Monthly / Occasionally

Tapioca – Daily / Weekly / Monthly / Occasionally

Yam – Daily / Weekly / Monthly / Occasionally

Colocasia – Daily / Weekly / Monthly / Occasionally

Apple – Daily / Weekly / Monthly / Occasionally

Amala – Daily / Weekly / Monthly / Occasionally

Banana – Daily / Weekly / Monthly / Occasionally

Dates – Daily / Weekly / Monthly / Occasionally

Grapes – Daily / Weekly / Monthly / Occasionally

Guava – Daily / Weekly / Monthly / Occasionally

Jackfruit – Daily / Weekly / Monthly / Occasionally

Litchi – Daily / Weekly / Monthly / Occasionally

Mosambi – Daily / Weekly / Monthly / Occasionally

Watermelon – Daily / Weekly / Monthly / Occasionally

Orange – Daily / Weekly / Monthly / Occasionally

Papaya – Daily / Weekly / Monthly / Occasionally

Passion fruit – Daily / Weekly / Monthly / Occasionally

Pears – Daily / Weekly / Monthly / Occasionally

Pineapple – Daily / Weekly / Monthly / Occasionally

Pomegranate – Daily / Weekly / Monthly / Occasionally

Sapota – Daily / Weekly / Monthly / Occasionally

Tomato ripe – Daily / Weekly / Monthly / Occasionally

Oils and Sugar

Butter – Daily / Weekly / Monthly / Occasionally

Ghee – Daily / Weekly / Monthly / Occasionally

Vanaspathi – Daily / Weekly / Monthly / Occasionally

Cooking oil – Daily / Weekly / Monthly / Occasionally

Sugar – Daily / Weekly / Monthly / Occasionally

Honey – Daily / Weekly / Monthly / Occasionally

Jaggery – Daily / Weekly / Monthly / Occasionally