OBESITY AND FOOD HABITS OF ISLAMIC UNIVERSITY STUDENTS: A CROSS-SECTIONAL STUDY

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A Project Submitted in Partial Fulfillment of the Requirements for the Degree of Bachelor of Science in Statistics

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January 21, 2024

Declaration of Authorship

I, Md Abu Saeed declare that:

This statistical project entitled "OBESITY AND FOOD HABITS OF ISLAMIC UNIVERSITY STUDENTS: A CROSS-SECTIONAL STUDY" has not been presented for any academic degree or examination in any other university. It exclusively relies on original data, figures, charts, graphs, tables, and information. No content, whether textual, graphical, or analytical, has been directly copied and pasted from the internet without explicit acknowledgment and detailed sourcing provided within the statistical project and the reference section.

Signed: Date:
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Signed: Date:
Professor Dr Mahabub

Acknowledgement

First and foremost, I extend my utmost gratitude and heartfelt appreciation to the Almighty, whose immense power, mercy, and kindness have been instrumental in the success of this endeavor.

I express my wholehearted diligence, devotion, and gratitude to my project supervisor, **Dr. Md. Mahabubur Rahman** for his precious guidance, scholarly direction, and unconditional support during my tenure in conducting the research. I have learned a great deal from him. His counseling makes me more sincere and gratified.

I extend my gratitude to **Sumon Biswas** (Lecturer) along with the faculty members of the Department of Statistics, Islamic University (IU), for their crucial academic assistance and logistical support throughout my studies.

I am also thankful to all students of department of Statistics, IU for being friendly with me during the period of data collection and for their moral and psychological support, which inspired me to going towards. I sincerely thank all of the respondent students of my study.

Finally, I am immensely thankful to my loving parents and supportive sisters for their unwavering guidance and support throughout my life's journey, especially during the completion of my project.

Author
Md Abu Saeed

Abstract

The prevalence of obesity in Bangladesh among young adults is high. Eating habits display general trends over time, reflecting sociocultural trends in food availability and nutritional knowledge and goals; lifestyle changes toward unhealthy dietary patterns such as high fast food consumption are becoming trendy among young adults. The purpose of this study was to assess the prevalence of overweight and obesity in a sample of students from the Islamic University Kushtia-7003, Bangladesh (IU) and to examine their eating habits. A cross-sectional survey of 811 university students (males and females) aged 18-26 years, who were chosen randomly from Islamic University campus. Students were asked to fill out a self-reported questionnaire that included questions on their eating, drinking and smoking habits, their weight, and height. Body mass index (BMI) was used to assess students' weight status.

The results showed that 11.6% of the students were overweight, 4.1 % were obese, while (66.2%) were of normal weight and 18.1% were underweight. Eating habits of the students showed that the (41.6%) was taking meals irregularly. Almost half of students (45.7%) reported eating two meals per day. About 53.6% of students reported eating breakfast daily. Two third of the student were taking snacks daily or three to four times per week. Male students tend to eat more fruits daily as compared to females. Smoking was not common among students. The study concluded that obesity and overweight were prevalent among IU students, irregular and infrequent meals together with low vegetables intake and frequent snacking were the most common unhealthy eating habits of the participants. In terms of eating patterns, significant differences were observed between the two genders with respect to frequent snacking by males.

Keywords: IU students, Obesity, Overweight, Food habits, Sex, Age, Height, Weight, BMI, Descriptive analysis, Association, Regression, Factor analysis, Discriminant, Neural Network.

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Chapter – 1

Introduction

The terms "obesity" refer to body weights that exceed what is deemed normal and healthy for a particular height. In addition to excess body fat, overweight can also result from an excess of muscle, bone, or fluid. Adiposity and excessive body fat are associated with obesity. (Naji, Kashoo, and Kashoo 2013).In adults, Obesity and overweight is classified by the BMI. To calculate BMI we need weight and height for every individual. It is calculated by individual's weight in kilograms (kg) divided by his/her height in meter square (kg/m2) (WHO, 16 February 2018). Obesity is preventable. The fundamental cause of obesity and overweight is an energy imbalance between calories consumed and calories expended. Globally, there has been an increased intake of energy-dense foods that are high in fats and sugars; and an increase in physical inactivity due to the increasingly sedentary nature of many forms of work, changing modes of transportation, and increasing urbanization. Changes in dietary and physical activity patterns are often the result of environmental and societal changes associated with development and lack of supportive policies in sectors such as health, agriculture, transport, urban planning, environment, food processing, distribution, marketing, and education.(Amruth and Kumar 2019)

1.1 Worldwide Obesity and Overweight:

The prevalence of obesity is increasing day by day in the all income class countries in the world. USA, Australia and some other countries of Europe the rate of obesity and overweight is increasing and it is growing as a major health problem. According to WHO, the rate of overweight among adults, 18 years and older were 1.9 billion (WHO, 16 February 2018). The most dangerous search is the obesity among youth, young, young adults of developing and middle income countries like Brazil, china and Indonesia are three times increasing(Yahia et al. 2008)

1.2 Overweight and Obesity in Bangladesh:

The prevalence of general obesity was 18.2% and abdominal obesity was 41.9% in Bangladesh. About 95 of the participants were underweight and 39% were overweight. Both general and abdominal obesity prevalence was higher in females (25.2 and 56.1%, respectively) than the males (12.2 and 29%, respectively). This rate is very alarming.(Sultana et al. 2022)

1.3 Complications of Obesity and Overweight:

A mass range of health complexity such as hypertension, diabetes type-ii, heart disease, stroke, osteoarthritis, digestive problem, sleep apnea, fatty liver disease and different types of cancers morbidity in adulthood of later life in connected with obesity and overweight in children (0-12 years) and adolescent (13-19 years) (Malnick and Knobler 2006)and 20+.

1.4 Factors behind Overweight and Obesity:

There are many factors behind overweight and obesity given below:

- Breakfast skipping
- Lower level of physical Activity
- Food behavior
- Sweet eating habit
- Drink and beverage habit
- Others

1.5 BMI of every Individuals:

BMI according to WHO is Underweight is
Underweight is <18.5
Normal weight is 18.5-24.5
Overweight is 25-29.9
Obese is >30

1.6 Significance of this study:

In a present days, Obesity and overweight became a global epidemiology. Various research found the raising tendency of overweight and obesity at different parts of the world. Bangladesh also has a risk of being obese in among most of the people. Young people of university going students are at the risk of being overweight and obese. In this study I tried to find out the amount of students in the risk of overweight and obesity due to some different identified factors. This study also tried to find out the nutritional lacking, food behavior, lacking of physical activity etc. which is directly or indirectly related to obesity and overweight

1.7: Objective of the study:

- To find out the frequency of overweight or obese among the university going students of IU which represent the small portion of Bangladesh.
- To find out the food habit and physical activity of selected students.
- Determine the causal relationship of eating habits, smoking, alcohol drinking and sleeping in overweight and obese
- Investigate the risk factors and status of fast-food consumption among students.
- Obtain the risk factor of obesity and overweight.
- Find accuracy in prediction using different model.

CHAPTER-2

Literature Review

Early Observations (17th-18th Centuries):
Giovanni Lancisi (1646-1720): An Italian physician who observed and documented the link between excessive food intake and obesity-related health problems, particularly gout.
Bernard Mandeville (1670-1733): An English philosopher and economist who satirized the overindulgent eating habits of the wealthy and their connection to health issues.
Emerging Research (19th Century):
Jean Anthelme Brillat-Savarin (1772-1826): A French gastronome and writer who emphasized the importance of moderation and balance in dietary habits for overall health and well-being.
William Banting (1796-1878): An English undertaker who published the first known diet book ("Letter on Corpulence") based on his personal experience reversing his obesity through dietary restrictions.

Scientific Foundations (20th Century):
Ancel Keys (1904-2004): An American physiologist who conducted the Seven Countries Study, one of the first large-scale studies to link dietary fat and cholesterol intake to heart disease and obesity rates.
Jean Mayer (1920-1989): An American physician and nutrition scientist who emphasized the role of environmental factors and societal changes in shaping food habits and contributing to the rise of obesity in the 20th century.

Modern Research and Advocacy (21st Century):
Gary Taubes (born 1952): An American science writer whose book "Why We Get Fat" challenged the prevailing "low-fat" dietary recommendations and highlighted the role of sugar and processed carbohydrates in obesity.Kelly D.
Brownell (born 1956): An American psychologist and public health researcher who advocates for comprehensive approaches to obesity prevention, including policy changes, community interventions, and individual behavior modification.
It's important to remember that knowledge about food and health has been continuously evolving throughout history, with each figure contributing to our understanding in their own way. Attributing a singular "first" presentation is challenging, but these individuals and events represent key milestones in our understanding of the connection between food habits and obesity

Rising Rates of Obesity:
Doubled in past 15 years: Bangladesh has seen a dramatic increase in obesity prevalence, particularly among urban women and children.

Higher than regional average: According to WHO, Bangladesh's adult obesity rate (11.2%) is higher than the South Asian average (9.6%).

Dietary Factors:

Shifting preferences: Traditional, fiber-rich diets are giving way to increased consumption of processed foods, sugary drinks, and fast food.

Hidden sugars: Sugar content in processed foods and beverages is often underestimated, contributing to calorie intake.

Portion distortion: Large serving sizes, even in street food and home-cooked meals, can lead to unintentional overeating.

Limited access to fruits and vegetables: Affordability and availability of fresh produce can be a challenge, especially in rural areas.

Socioeconomic Influences:

Urbanization and lifestyle changes: Increased sedentary lifestyles and decreased physical activity contribute to weight gain.

Poverty and food insecurity: Limited access to nutritious food and reliance on calorie-dense staples can lead to malnutrition and obesity.

Lack of awareness: Understanding of healthy eating practices and the dangers of obesity may be limited, particularly in underserved communities.

Initiatives and Challenges:

Government programs: National Nutrition Strategy promotes breastfeeding, healthy food choices, and physical activity.

School food interventions: Efforts to improve school meals and introduce nutrition education are underway.

Community-based initiatives: NGOs and civil society organizations are promoting healthy eating habits through awareness campaigns and behavior change programs.

Challenges: Implementation of interventions faces obstacles like limited resources, inadequate infrastructure, and social norms regarding food and body image

Multi-pronged approach: Addressing obesity requires a comprehensive strategy that targets dietary patterns, physical activity, and awareness creation.

Empowering individuals: Providing access to knowledge, resources, and affordable healthy food choices is crucial for sustainable change.

Collaboration: Government, NGOs, private sector, and communities need to work together to create a supportive environment for healthy eating and active lifestyles.

Remember, these are just starting points. You can customize the bullet points to fit your specific focus, add data points, and tailor them to your presentation style.

Powerful learning capabilities: Can handle complex, nonlinear relationships and high-dimensional data.

Adaptability: Can learn and adapt to new data without explicit reprogramming.

Generalization: Can generalize to unseen data, making predictions for new cases

CHAPTER-3

Research Methodology And Data Collection

This chapter is continued to indicate a brief description to the selection problem, source of data field work and data processing and background characteristics, analytical methodology have discussed in this chapter.

3.1: Data Collection:

The researcher should have cleared idea about population, sample, sampling method, data collection method etc. Related data are being collected from 35 departments of all faculty of IU.

In this study I used primary data and simple random sampling method have been used. Related data like age, height, weight, BMI, family income, physical activity, food habit etc. are measured with usual range. All of the information is filling up by the personal interview procedure.

3.2: Study Period:

Actually the whole period of B.Sc. final year is the study period for conducting the project work. It formally announced in august 2023. The total duration of project is 6 months. And I have spent 1 months for my project work.

3.3: Study Area:

My target population was the current students of all faculty of IU. There were 8 Faculty and 35 departments. Information have been collected by me with my heart and soul and also hard working with the help of the students of all faculty.

3.4: Preparation of Questionnaire:

The most important portion of sample survey is the construction of questionnaire. It require skill, special technique as well as familiarity with the subject matter under study. A questionnaire is an important element for collecting data in my project work. To make a good sufficient questionnaire we need enough skill and experience. A questionnaire must be allowed understood to the respondents, brief and not offending. My project topic was “OBESITY AND FOOD HABITS OF ISLAMIC UNIVERSITY STUDENTS: A CROSS-SECTIONAL STUDY”. For project the questionnaire was prepared on the basis of the information according to the title of my project work. Before doing statistical analysis, first, I have to define my study area.

3.10: Problem in collecting data:

During the period of the project, I have faced some problems. The problems that I faced are as follows-

- Many respondents hesitated to give answer of some belonging to the questionnaire for their personal information.
- Since most of the respondents did not say their correct height, weight, smoking status, alcohol consumptions information etc.

3.5: Sampling Design and Sampling Unit:

Sampling Frame There are 8 faculty and corresponding 35 department. The sampling frame used for the study where enrolment of each faculty and corresponding department provided by IU. A total of 811 samples from IU were randomly selected during this study period.

3.6 Data editing:

After collecting the necessary data at first, I edited those data orderly as it can be easily analyzed in computer for getting expected result of the study. Such as classification tabulation, coding, variable selection etc.

3.7: Selection of computer program and data entry:

The analysis is an important part of any research project and field studies. At first, I had to code the entire questionnaire according to the predetermined code plan and enter the data into the computer program. So I had to select a suitable computer program for data entry and analyze. I had selected SPSS for windows version 26 program, the most convenient program for data analysis for social science and R programming, a powerful tool for data analysis and visualization.

3.8: Analysis of data:

The analysis is an important part of any research project and field studies. At first, I had to code the entire questionnaire according to the predetermined code plan and enter the data into the computer. Then I had to make different types of table, bar chart, pie chart, histogram, frequency distribution table, association, correlation among variables. I had also prepared some graphs to make a decision.

3.9: Data processing:

The whole procedure of data processing consists of editing, coding and tabulation has been examined by the researcher. The analysis has done with the help of computer. A brief description about data processing is as follows:

1. Coding: After editing the collected data I coded the possible answer on questionnaire. Coding refers to the process of assigning numbers or symbols to answer so that responses can be put into a limited number of categories or classes. It makes the process easier and faster. The coded data are checked with the original data.
2. Tabulation: Tabulation is a process of summarizing row data.

3.11: Limitation of this project:

I have faced some limitations during this work. Some are given below-

- Proper care should be taken in the planning and execution of the survey, otherwise the result obtained might be incorrect and misdealing. I gave my best effort, hence there may present some error.
- b. Survey requires the service of trained and qualified personal and sophisticated equipment for its planning, execution and analysis. In the absence of these, the results of the survey will not trustworthy.
- c. Many respondents gave the unrelated and erroneous information.

Beside these, I needed enough time, money and adequate skilled personal to conduct a survey.
As I am a student of department of Statistics, Islamic University, to give enough time and money is hard for me. Also, I am not as skilled as required.

Chapter-4

Data Analysis

Analysis of data:

The analysis of collected data is presented in this chapter. Different calculation is expressed in percentages. The frequency and percentage distribution table, pie charts, bar diagram were constructed for the analysis. Regression analysis, model fit, factor analysis with PCA, discriminant analysis, neural network and ROC curve also done. Data were managed and analyzed using IBM SPSS and R programming. Descriptive data were presented as frequency and percentages.

4.1: Graphical representation and Frequency table

Graphical representation is more effective than tabular representation because it is easily understandable. We can show the result at a glance by graphically. We consider below some important types of graphical representation, which are necessary for our analysis.

- ❖ Bar diagram
- ❖ Pie chart

Table 4.1.1: Percentage distribution of respondent's department

Deartment	Frequency	Percent	Valid Percent	Cumulative Percent
Accounting and Information Systems	20	2.5	2.5	2.5
Al Hadith And Islamic Studies	11	1.4	1.4	3.8
Al-Fiqh and Legal Studies	11	1.4	1.4	5.2
Al-Quran and Islamic Studies	24	3	3	8.1
Applied Chemistry and Chemical Engineering	26	3.2	3.2	11.3
Applied Nutrition and Food Technology	27	3.3	3.3	14.7
Arabic Language and Literature	24	3	3	17.6
Bangla	18	2.2	2.2	19.9
Biomedical Engineering	18	2.2	2.2	22.1
Biotechnology and Genetic Engineering	18	2.2	2.2	24.3
Communication and Multimedia Journalism	17	2.1	2.1	26.4

Computer Science and Engineering	26	3.2	3.2	29.6
Da'wah and Islami studies	31	3.8	3.8	33.4
Development Studies	19	2.3	2.3	35.8
Economics	22	2.7	2.7	38.5
Electrical and Electronic Engineering	18	2.2	2.2	40.7
English	27	3.3	3.3	44
Finance and Banking	14	1.7	1.7	45.7
Fine Arts	15	1.8	1.8	47.6
Folklore Studies	21	2.6	2.6	50.2
Geography and Environment	27	3.3	3.3	53.5
Human Resource Management	18	2.2	2.2	55.7
Information and Communication Technology	27	3.3	3.3	59.1
Islamic History And Culture	19	2.3	2.3	61.4
Law	29	3.6	3.6	65
Law and Land Management	19	2.3	2.3	67.3
Management	33	4.1	4.1	71.4
Marketing	20	2.5	2.5	73.9
Mathematics	25	3.1	3.1	76.9
Pharmacy	30	3.7	3.7	80.6
Political Science	32	3.9	3.9	84.6
Public Administration	20	2.5	2.5	87.1
Social Welfare	28	3.5	3.5	90.5
Statistics	46	5.7	5.7	96.2
Tourism and Hospitality Management	31	3.8	3.8	100
Total	811	100	100	

From the above frequency table we can see that 2.5% students from Accounting and Information Systems, 1.4% from Al Hadith And Islamic Studies, 1.4% students from Al-Fiqh and Legal Studies, 3% students from Al-Quran and Islamic Studies, 3.2% students from Applied Chemistry and Chemical Engineering, 3.3% students from Applied Nutrition and Food Technology, 3% students from Arabic Language and Literature, 2.2% students from Bangla, 2.2% students from Biomedical Engineering, 2.2% students from Biotechnology and Genetic Engineering, 2.1% students from Communication and Multimedia Journalism, 3.2% stdents from Computer Science Engineering, 3.8% students from Da'wah and Islamic studies, 2.3% students from Development Studies, 2.7% students from economics, 2.2% students from Electrical and Electronic engineering, 3.3% Students from English, 1.7% students from Finance and Banking, 1.8% students from Fine Arts, 2.6% students from Folklore Studies, 3.3% students from Geography and Environment, 2.2% students from Human Resource

Management, 3.3% students from Information and Communication Technology, 2.3% students from Islamic History and Culture, 3.6% students from LAW, 2.3% students from Law and Land Management, 4.1% students from Management, 2.5% students from Marketing, 3.1% students from Mathematics, 3.7% students from Pharmacy, 3.9% students from Political Science, 2.5% students from Public Administration, 3.5% students from Social Welfare, 5.7% students from Statistics and 3.8% students from Tourism and Hospitality Management.

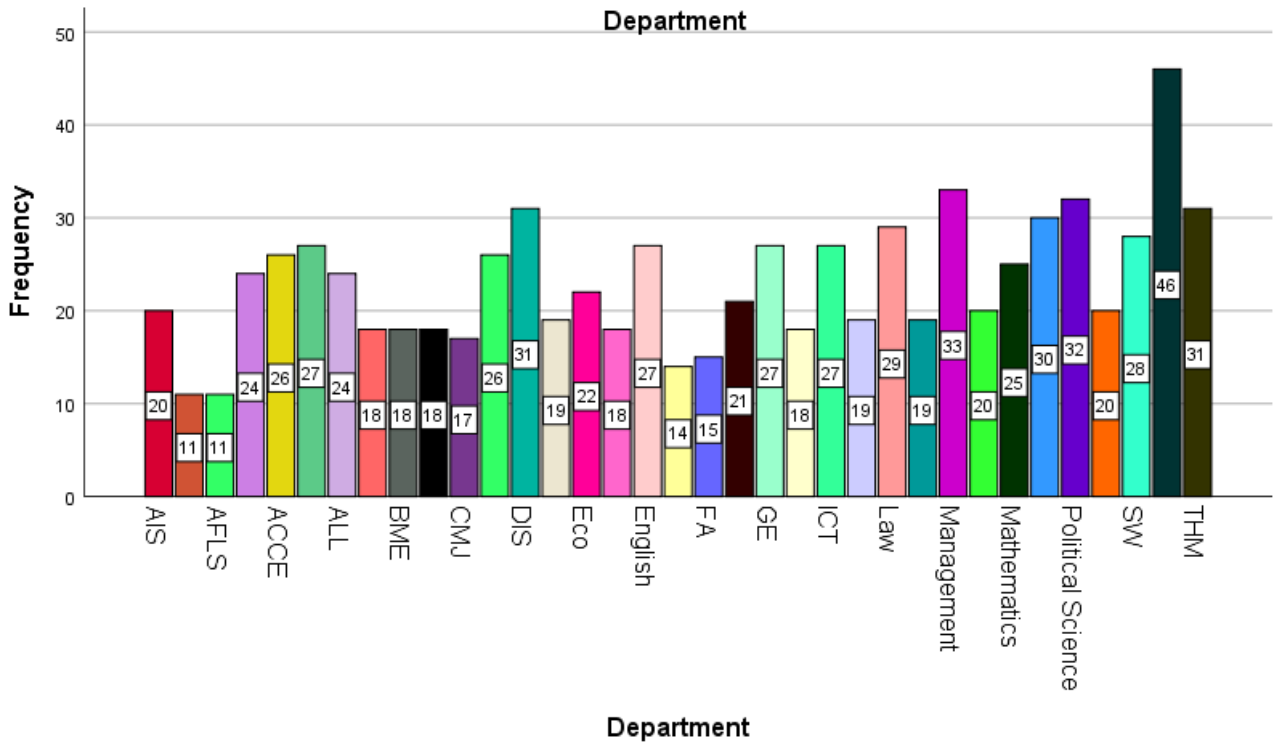

Figure 4.1.1: Bar diagram of respondent's Department.

Table 4.1.2: Percentage distribution of respondent's gender.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Female	296	36.5	36.5	36.5
	Male	515	63.5	63.5	100
	Total	811	100	100	

From this frequency distribution table we can see that 63.50% respondents are Male and 36.50% respondents are female.

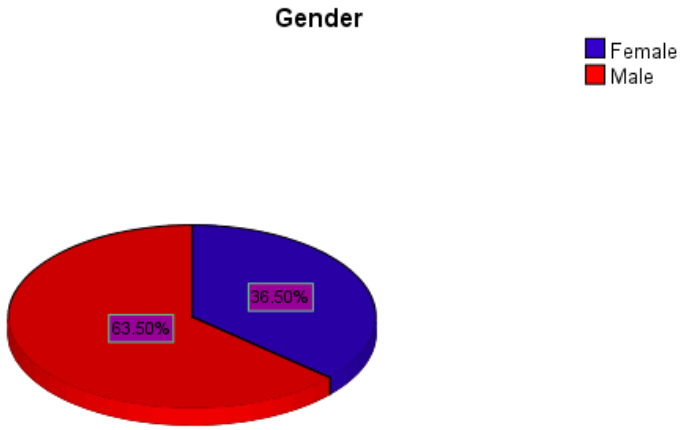

Figure 4.1.2: Pie Chart of respondent's Gender.

Table 4.1.3: Percentage distribution of respondent's age.

Height	Frequency	Percent	Valid Percent	Cumulative Percent
18	29	3.6	3.6	3.6
19	154	19.0	19.0	22.6
20	246	30.3	30.3	52.9
21	156	19.2	19.2	72.1

22	74	9.1	9.1	81.3
23	57	7.0	7.0	88.3
24	43	5.3	5.3	93.6
25	32	3.9	3.9	97.5
26	20	2.5	2.5	100.0
Total	811	100.0	100.0	

From this table we can see that 3.6% respondent's age are 18, 19.0 % respondent's age are 19, 30.3% respondent's age are 20, 19.2 % respondent's age are 21, 9.1% respondent's age are 22, 7.0 % respondent's age are 23, 5.3% respondent's age are 24, 3.9 respondent's age are 25, 2.5% respondent's age are 26.

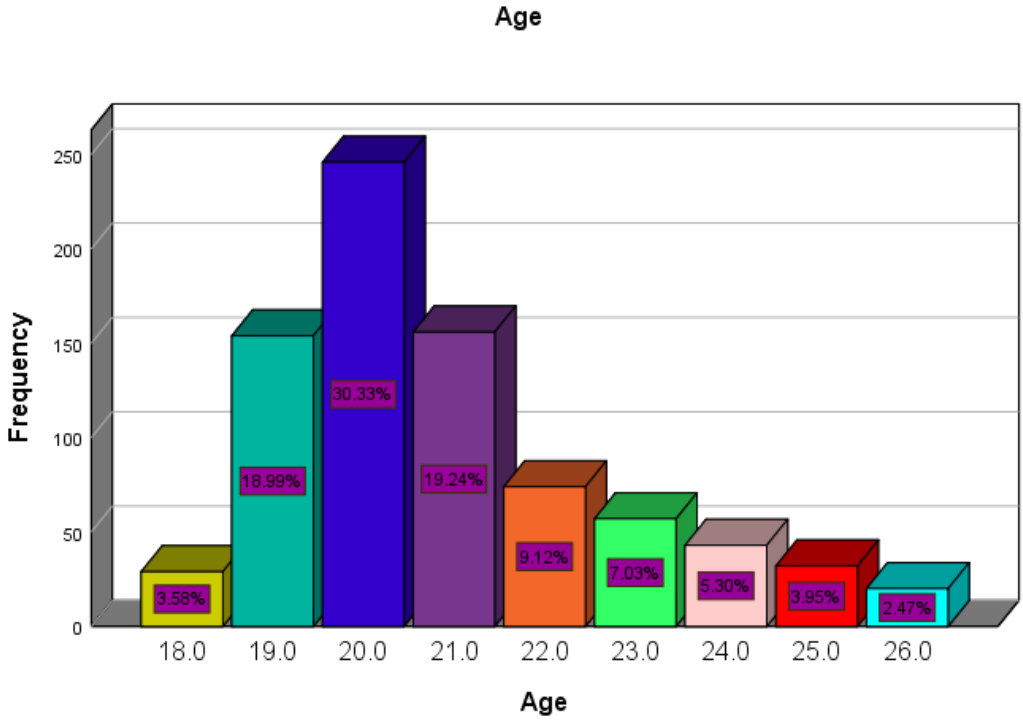

Figure 4.1.3: Bar diagram of respondent's Age

Table 4.1.4 Percentage distribution of respondent's height

Height	Frequency	Percent	Valid Percent	Cumulative Percent
Under 5.00 Feet	76	9.4	9.4	9.4
5.01-5.30 Feet	239	29.5	29.5	38.8

5.31-5.59 Feet	186	22.9	22.9	61.8
5.60-5.89 Feet	242	29.8	29.8	91.6
Above 5.90 Feet	68	8.4	8.4	100.0
Total	811	100.0	100.0	

From this above table we can see that 9.4%respondents height are Under 5 feet, 29.5% respondents are 5.01 feet to 5.30 feet, 22.9 % respondents are 5.31 feet to 5.59 feet, 29.8% respondents are 5.60 feet to 5.89 feet and 8.4% respondents are above 5.90 feet.

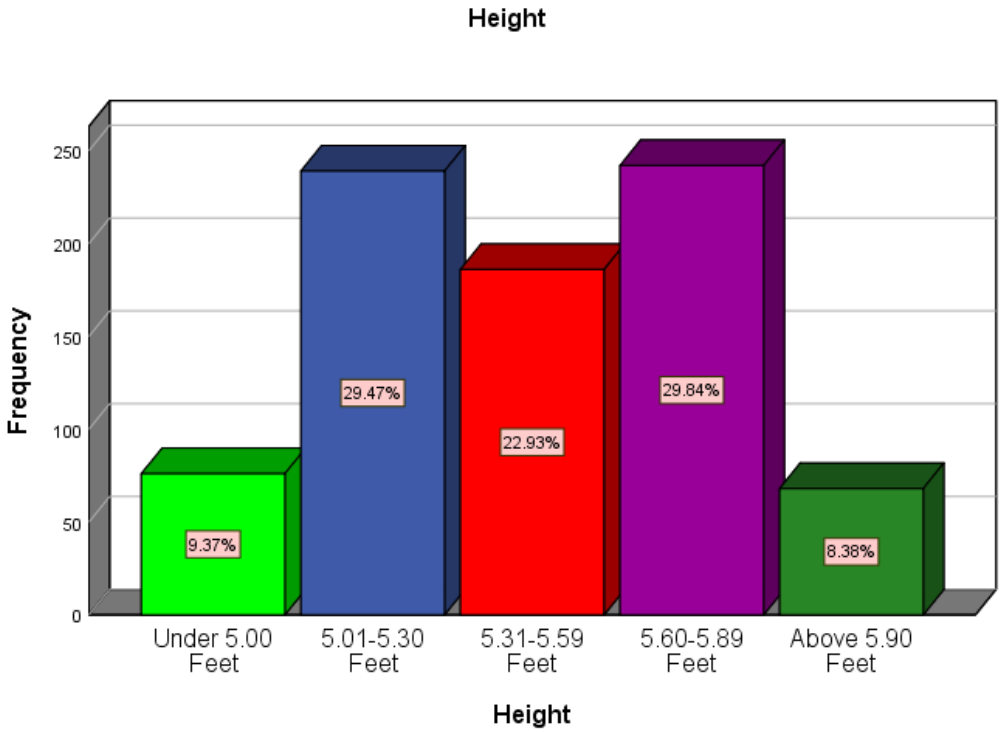

Figure 4.1.4: Bar diagram of respondent's Height.

Table 4.1.5: Percentage distribution of respondent's weight

Weight	Frequency	Percent	Valid Percent	Cumulative Percent
Under 45 KG	71	8.8	8.8	8.8
46-55 KG	238	29.3	29.3	38.1
56-65 KG	295	36.4	36.4	74.5
66-75 KG	137	16.9	16.9	91.4
Above 76 KG	70	8.6	8.6	100.0
Total	811	100.0	100.0	

From this Table we can see that 8.8% respondent's weight are Under 45 kg, 29.3% respondent's weight are 46 to 55 kg, 36.4% respondent's weight are 56 to 65 kg, 16.9 % respondent's weight are 66 to 75 kg, 8.6% respondent's weight are above 76 kg.

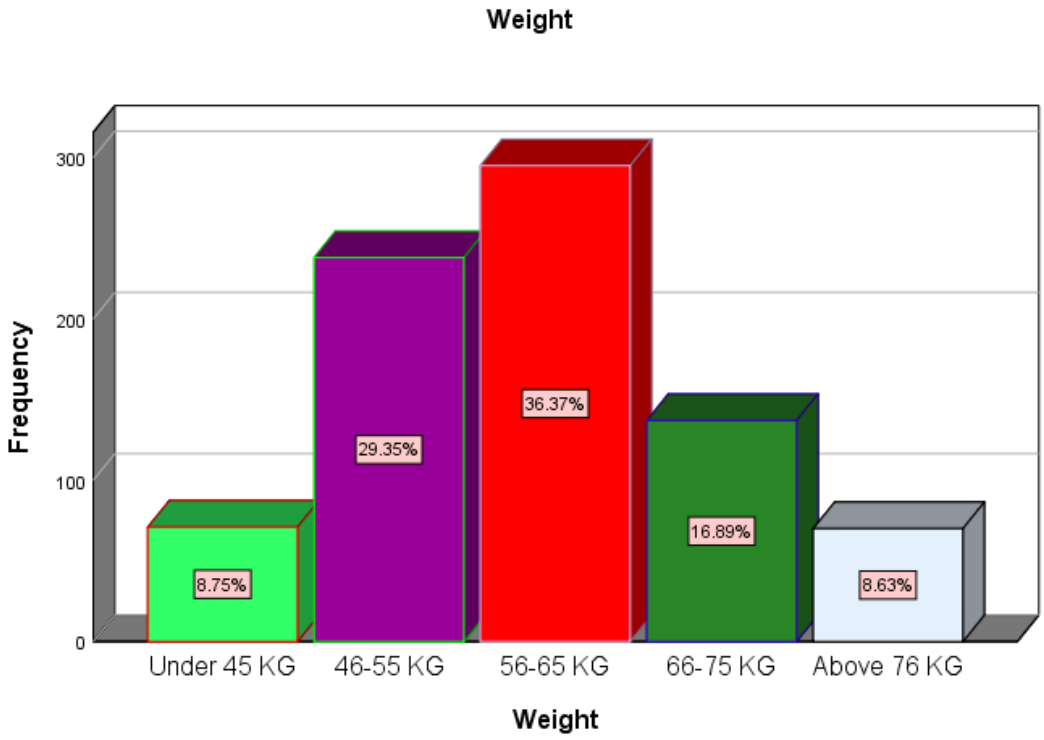

Figure 4.1.5: Bar diagram of respondent's Weight

Table 4.1.6: Percentage distribution of respondent's BMI Status

BMI	Frequency	Percent	Valid Percent	Cumulative Percent
Under Weight	147	18.1	18.1	18.1
Normal Weight	537	66.2	66.2	84.3
Over Weight	94	11.6	11.6	95.9
Obese	33	4.1	4.1	100.0
Total	811	100.0	100.0	

From this frequency table we can see that 18.1% students are underweight, 66.2% students are Normal weight, 11.6% students are Overweight and 4.1% are obese students according to BMI.

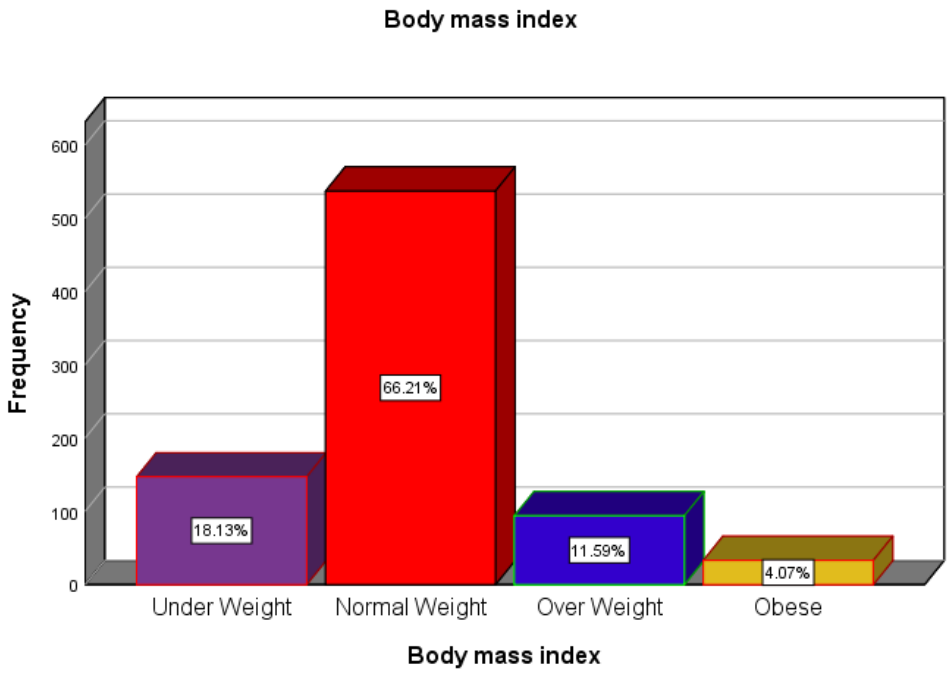

Figure 4.1.6: Bar diagram of respondent's BMI Status

Table 4.1.7: Percentage distribution of respondent's total family income

Total Family Income	Frequency	Percent	Valid Percent	Cumulative Percent
10,000-20,000	423	52.2	52.2	52.2
21,000-30,000	173	21.3	21.3	73.5
31,000-40,000	78	9.6	9.6	83.1
41,000-50,000	50	6.2	6.2	89.3
50,000+	87	10.7	10.7	100.0
Total	811	100.0	100.0	

From this above frequency table we can see that 52.2% respondent's total family income 10000-20000 taka, 21.3% respondent's total family income 21000-30000 taka, 9.6% respondent's total family income 31000- 40000 taka, 6.2% respondent's total family income 41000-50000 taka, 10.2% respondent's total family income 50000+ taka.

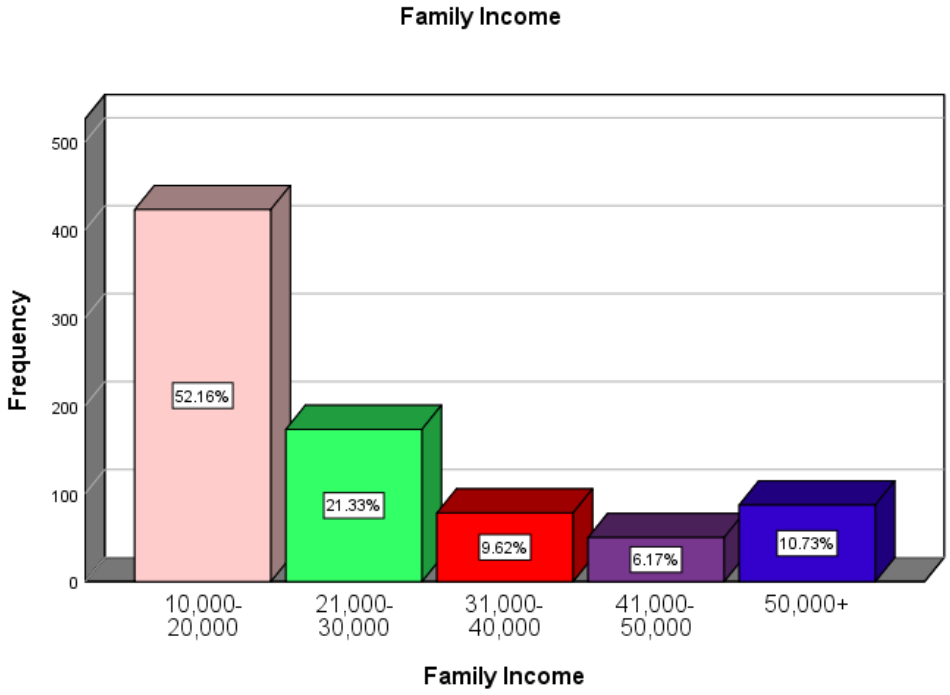

Figure 4.1.7: Bar diagram of respondent's total family income

Table 4.1.8: Percentage distribution of respondent's Resident

Residential Status	Frequency	Percent	Valid Percent	Cumulative Percent
Govt. house	12	1.5	1.5	1.5
Hostel	104	12.8	12.8	14.3
Mess	480	59.2	59.2	73.5
Others	32	3.9	3.9	77.4
Own home	117	14.4	14.4	91.9
Rent house	66	8.1	8.1	100.0
Total	811	100.0	100.0	

From this table we can see that 1.5% students live in govt. house, 12.8% students live in hostel, 59.2% students live in mess, 3.9 % students live in others, 14.4% students live in own home, and 8.1% students live in rent house.

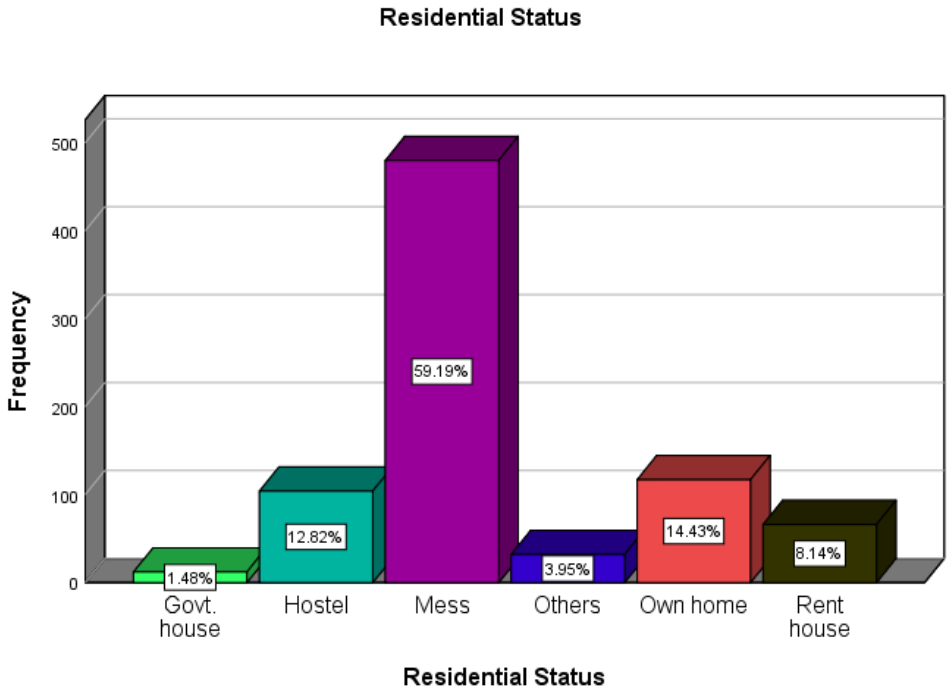

Figure 4.1.8: Pie chart of respondent's Resident.

Table 4.1.9: Percentage distribution of Smoking Status

	Frequency	Percent	Valid Percent	Cumulative Percent
Irregularly	38	4.7	4.7	4.7
Never	726	89.5	89.5	94.2
Regularly	47	5.8	5.8	100.0
Total	811	100.0	100.0	

From this above table we can see 4.7%students smokes irregularly, 89.5% respondents smoke regularly, 5.8% respondents smoke regularly.

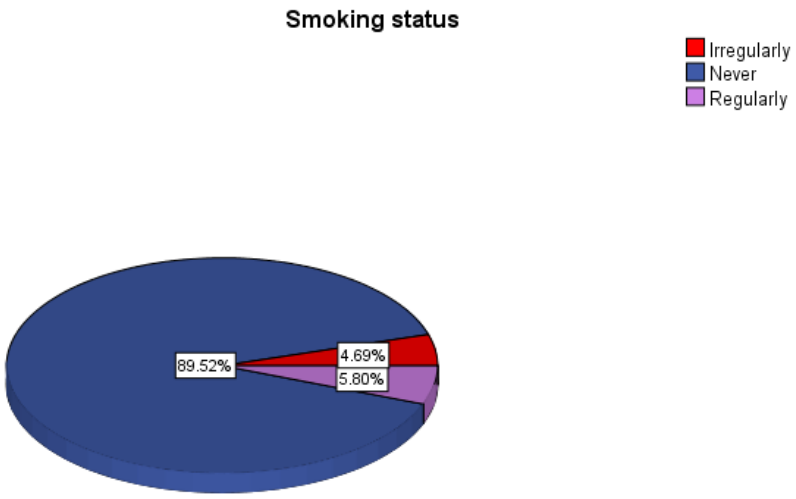

Figure 4.1.9: Pie chart of Smoking Status.

Table 4.1.10: Percentage distribution of respondent's physical activity and exercise

	Frequency	Percent	Valid Percent	Cumulative Percent
Every Day	78	9.6	9.6	9.6
In specific day	52	6.4	6.4	16.0
Never	169	20.8	20.8	36.9
Sometimes	512	63.1	63.1	100.0
Total	811	100.0	100.0	

From this table we can see that 9.6% respondents exercise every day, 6.4% respondents exercise in a specific day, 63.1% respondents exercise sometimes and 20.8%respondents never exercise.

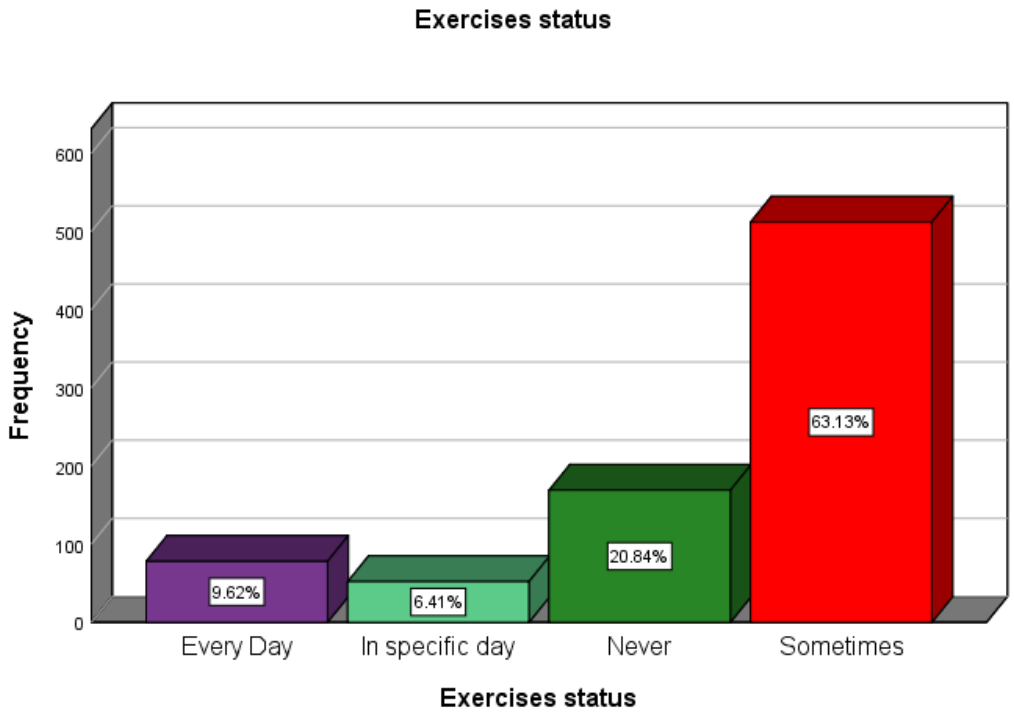

Figure 4.1.10: Bar diagram of respondent's Physical activity and exercise

Table 4.1.11: Percentage distribution of respondent's meal regularity

Taking Meal	Frequency	Percent	Valid Percent	Cumulative Percent
Always regular	474	58.4	58.4	58.4
Irregular	337	41.6	41.6	100.0
Total	811	100.0	100.0	

In this above table we can see that 58.4% respondents take meal regular, 41.6% respondents take meal irregular.

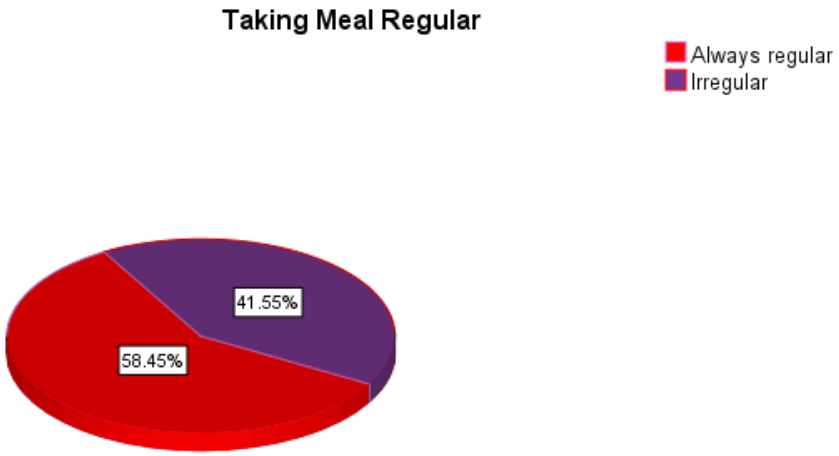

Figure 4.1.11: Pie chart of respondent's meal regularity.

Table 4.1.12: Percentage distribution of respondent breakfast count

Taking Breakfast	Frequency	Percent	Valid Percent	Cumulative Percent
Daily	437	53.9	53.9	53.9
Once or twice per week	91	11.2	11.2	65.1
Rarely	126	15.5	15.5	80.6
Three or four times per week	157	19.4	19.4	100.0
Total	811	100.0	100.0	

In this above table we can see that 53.9% respondents take breakfast daily, 11.2% respondents take breakfast once or twice per week, 15.5% take breakfast rarely, 19.4% respondents take breakfast three or four times per week.

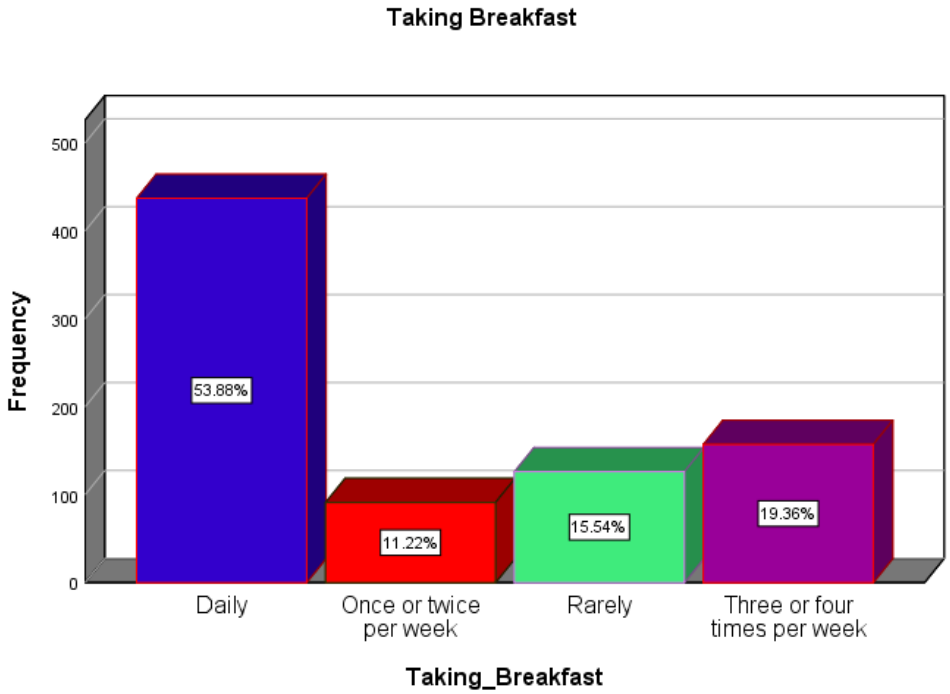

Figure 4.1.12: Bar diagram of respondent's breakfast count

Table 4.1.13: Percentage distribution of respondent Eating Excepts Snacks.

Eating Except Snacks	Frequency	Percent	Valid Percent	Cumulative Percent
Four Times	17	2.1	2.1	2.1
One time	167	20.6	20.6	22.7
Three times	374	46.1	46.1	68.8
Two times	253	31.2	31.2	100.0
Total	811	100.0	100.0	

In this above table we can see that 2.1% respondents eating except snacks four times, 20.6% respondents eating except snacks One times, 46.1 respondents eating except snacks three times, 31.2% respondents eating except snacks two times.

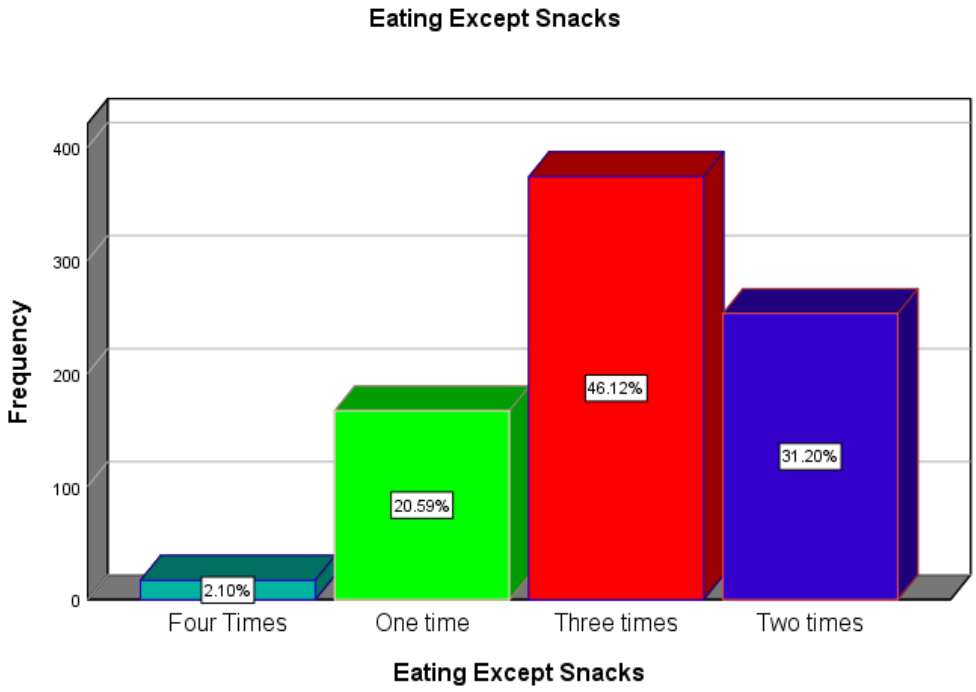

Figure 4.1.13: Bar diagram of respondent's Eating Excepts Snacks.

Table 4.1.14: Percentage distribution of respondent Taking Snacks Apart From Regular Meal.

Taking snacks apart regular meal	Frequency	Percent	Valid Percent	Cumulative Percent
Daily	198	24.4	24.4	24.4
Once or twice per week	197	24.3	24.3	48.7
Rarely	215	26.5	26.5	75.2
Three or four times per week	201	24.8	24.8	100.0
Total	811	100.0	100.0	

From this above table we can see that 24.4% respondents take snacks daily, 24.8% take snacks three or four times per week, 24.3% respondents take snacks once or twice per week, 26.5% respondents take snacks rarely.

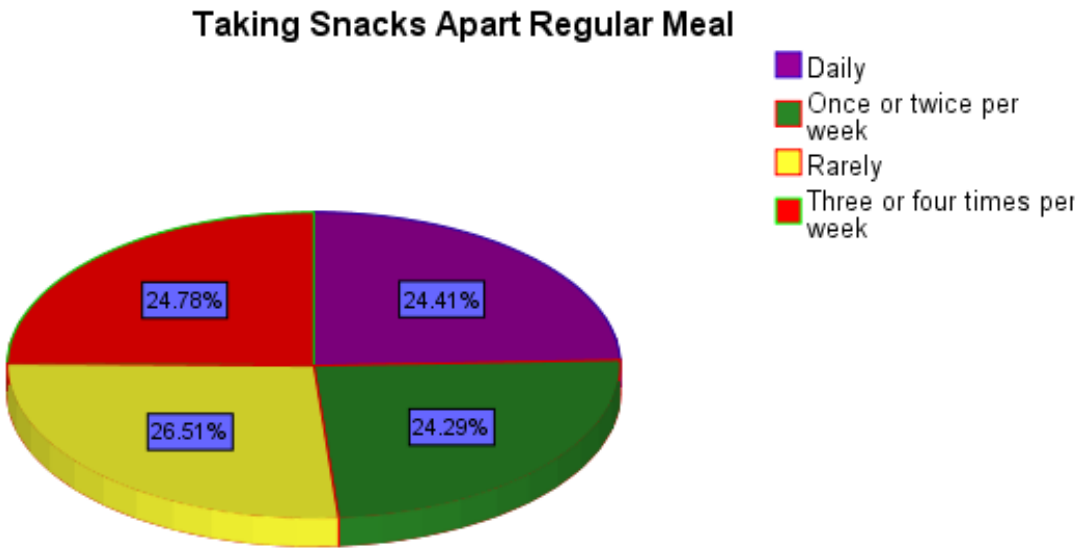

Figure 4.1.14: Pie chart of respondent's Taking Snacks Apart From Regular Meal.

Table 4.1.15: Percentage distribution of respondent's eating count of green, red colored vegetables.

Eat Vegetables	Frequency	Percent	Valid Percent	Cumulative Percent
Daily	249	30.7	30.7	30.7
Once or twice per week	161	19.9	19.9	50.6
Rarely	97	12.0	12.0	62.5
Three or four times per week	304	37.5	37.5	100.0
Total	811	100.0	100.0	

rom this above table we can see that 30.7% eat daily, 37.5% eat three or four times per week, 19.9% eat once or twice per week and 12.0% eat rarely green, red, yellow colored vegetables.

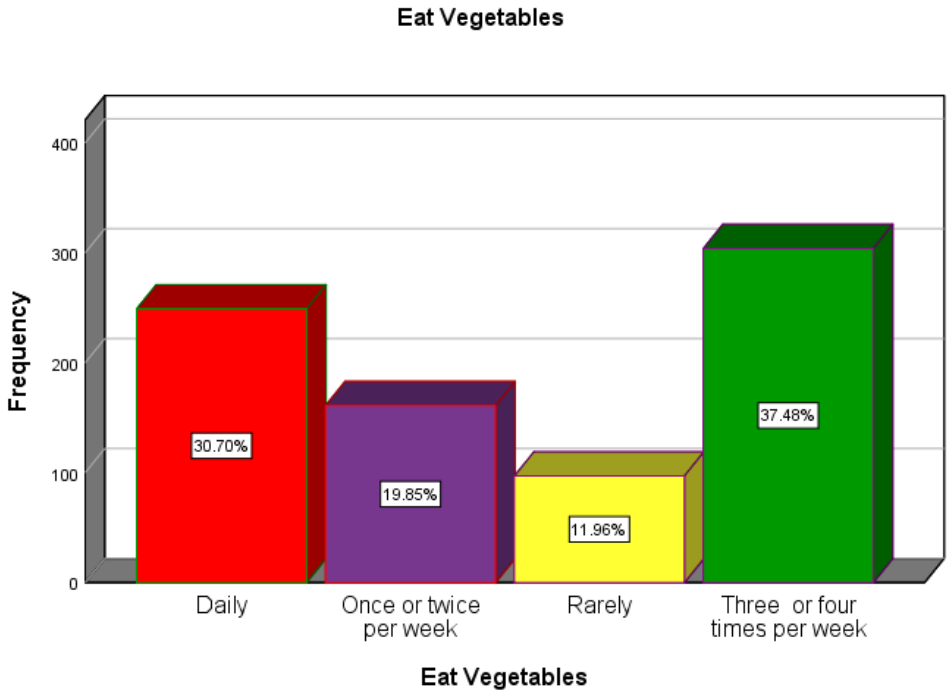

Figure 4.1.15: Bar diagram of respondent's eating count of green, red colored vegetables.

Table 4.1.16: Percentage distribution of respondent's fruit eating count

Eat Fruit	Frequency	Percent	Valid Percent	Cumulative Percent
Daily	105	12.9	12.9	12.9
Once or twice per week	234	28.9	28.9	41.8
Rarely	323	39.8	39.8	81.6
Three or four times per week	149	18.4	18.4	100.0
Total	811	100.0	100.0	

From this above table we can see that 12.9% eat fruit daily, 18.4% eat fruit three or four times per week, 28.9% eat fruit once or twice per week and 39.8% eat fruit rarely.

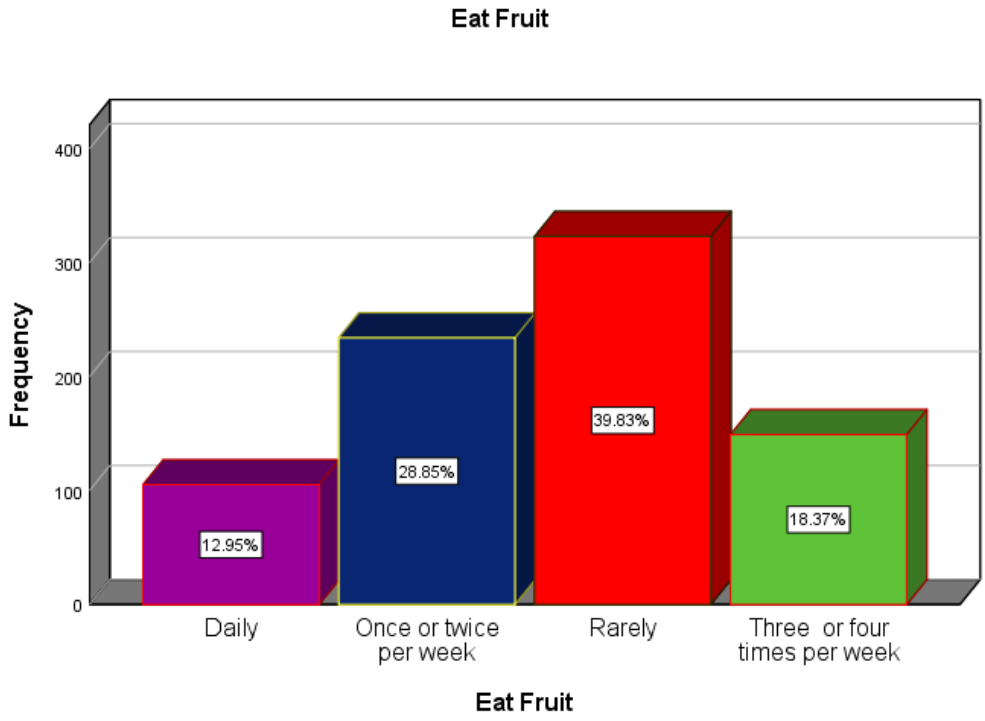

Figure 4.1.16: Bar diagram of respondent's fruit eating count.

Table 4.1.17: Percentage distribution of respondent's fried food eating count

Eat Fried Food	Frequency	Percent	Valid Percent	Cumulative Percent
Daily	75	9.2	9.2	9.2
Once or twice per week	239	29.5	29.5	38.7
Rarely	295	36.4	36.4	75.1
Three or four times per week	202	24.9	24.9	100.0
Total	811	100.0	100.0	

From this above table we can see that 9.2% eat fried food daily, 24.9% eat fried food three or four times per week, 29.5% eat fried food once or twice per week and 36.4% eat fried food rarely.

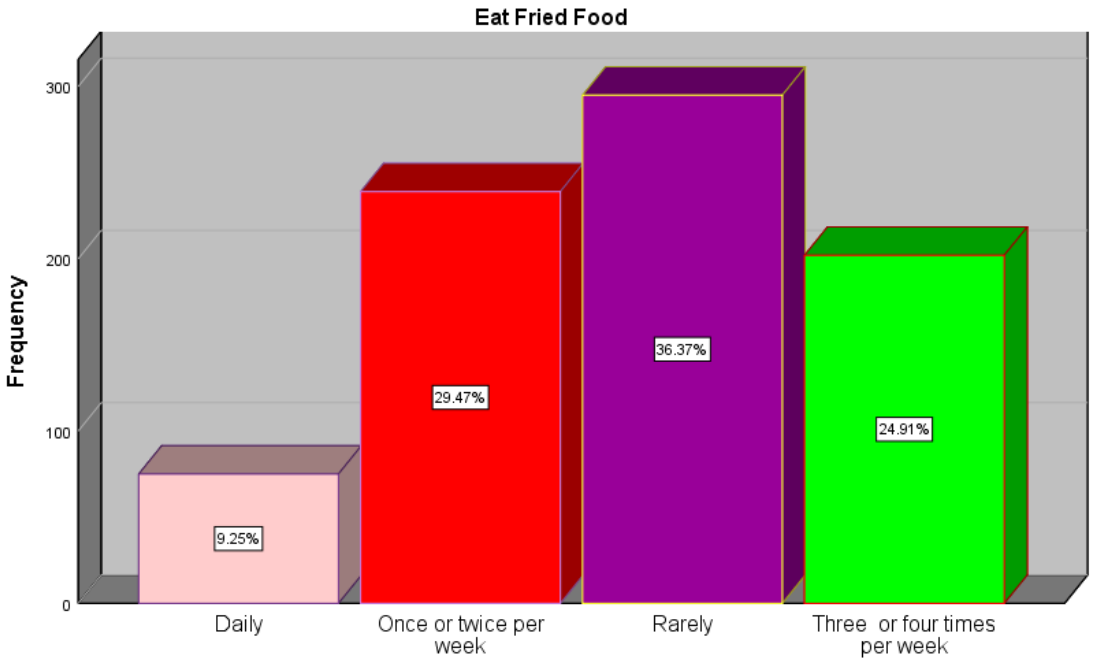

Figure 4.1.17: Bar diagram of respondent's fried food eating count.

Table 4.1.18: Percentage distribution of respondent's eating with family and friends count

Eating with Family & Friends	Frequency	Percent	Valid Percent	Cumulative Percent
Daily	215	26.5	26.5	26.5
Once or twice per week	177	21.8	21.8	48.3
Rarely	301	37.1	37.1	85.5
Three or four times per week	118	14.5	14.5	100.0
Total	811	100.0	100.0	

From this above table we can see that 26.5% respondents eat daily, 14.5% eat three or four times per week, 21.8% eat once or twice per week and 37.1% eat rarely with family and friends.

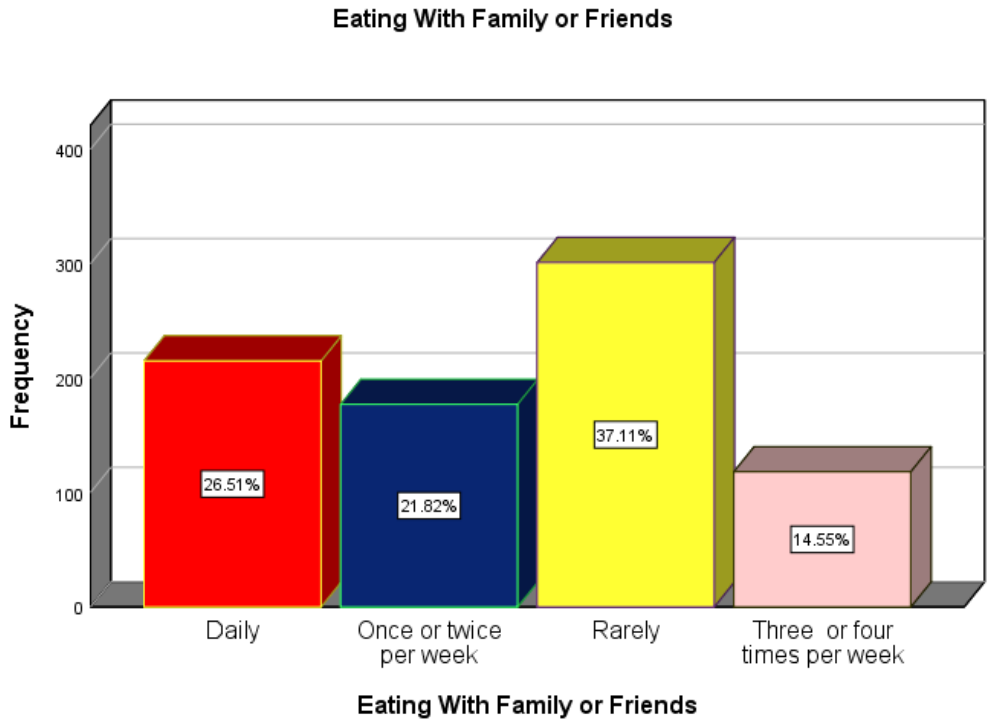

Figure 4.1.18: Bar diagram of respondent's eating with family and friends count.

Table 4.1.19: Percentage distribution of respondent's eat to have balance count.

Eat to have Balance	Frequency	Percent	Valid Percent	Cumulative Percent
Both	556	68.6	68.6	68.6
Mainly meat	76	9.4	9.4	77.9
Mainly vegetables	179	22.1	22.1	100.0
Total	811	100.0	100.0	

From this above table we can see that 68.6% respondents eat to balance meat and vegetables, 9.4% eat to balance mainly meat and 22.1% eat to balance mainly vegetables.

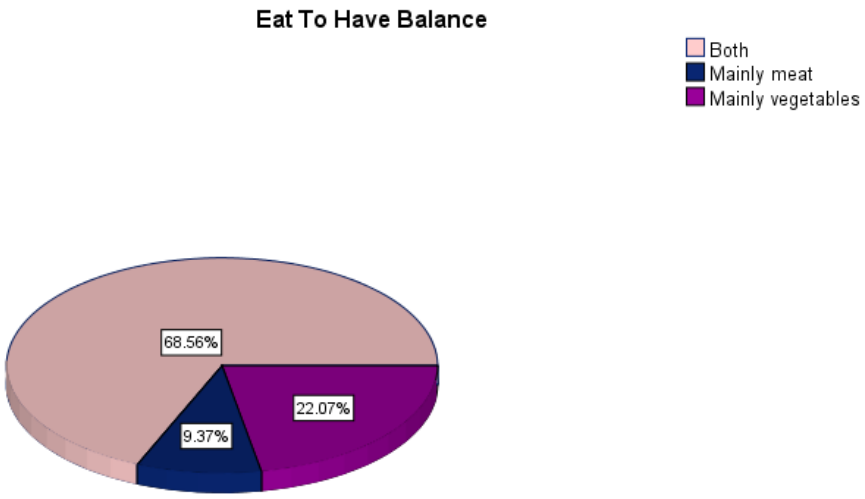

Figure 4.1.19: Pie chart of respondent's eat to have balance count.

Table 4.1.20: Percentage distribution of respondent's drink alcohol count.

Drink Alcohol	Frequency	Percent	Valid Percent	Cumulative Percent
Never	707	87.2	87.2	87.2
Rarely	89	11.0	11.0	98.2
Regularly	4	0.5	0.5	98.6
Two or three times per week	11	1.4	1.4	100.0
Total	811	100.0	100.0	

From this above table we can see that 87.2% respondents never drink alcohol, 11.0% rarely drink alcohol and 1.4% two or three times per week drink alcohol and 0.5% respondents regularly drinks alcohol.

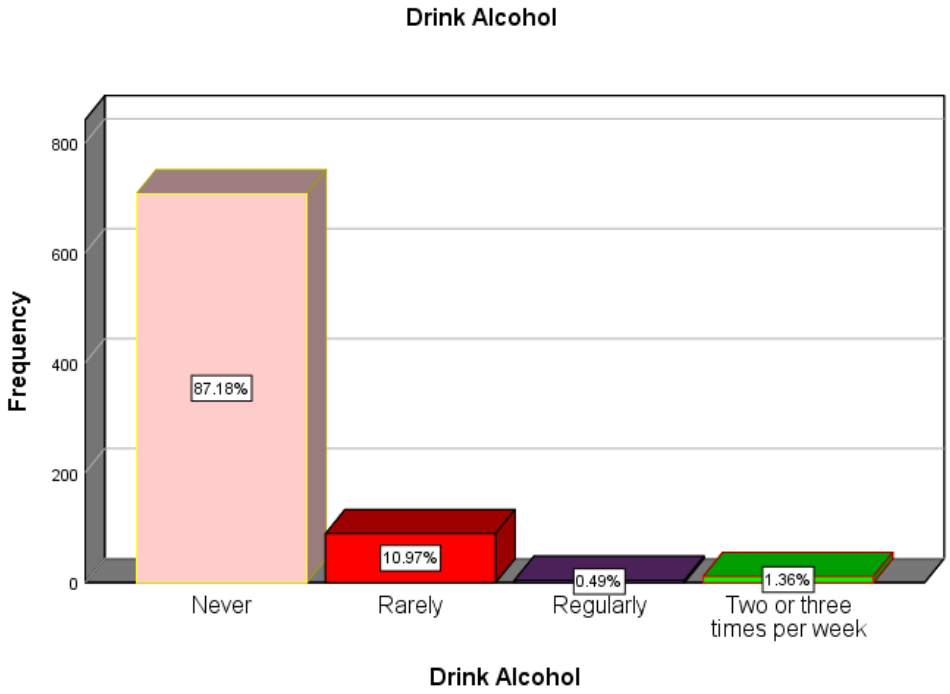

Figure 4.1.20: Bar diagram of respondent's drink alcohol count.

Table 4.1.21: Percentage distribution of respondent's prefer to enjoy meal.

Prefer to Enjoy Meal	Frequency	Percent	Valid Percent	Cumulative Percent
Fast food	125	15.4	15.4	15.4
Home-cooked meals	545	67.2	67.2	82.6
Other	47	5.8	5.8	88.4
Restaurant food	94	11.6	11.6	100.0
Total	811	100.0	100.0	

From this above table we can see that 15% respondents prefer to enjoy mea fast food, 67.2% respondents home cooked meals, 5.8% respondents other and 11.6% respondents prefer to enjoy meal restaurant food.

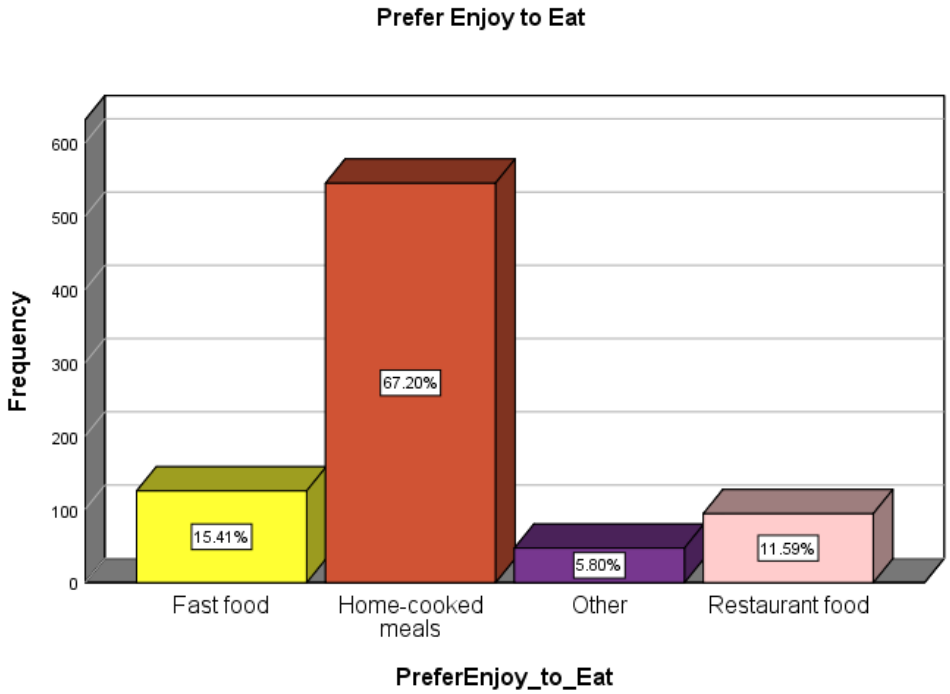

Figure 4.1.21: Bar diagram of respondent's prefer to enjoy meal.

Table 4.1.22: Percentage distribution of respondent's like to eat sweet.

Eat sweet	Frequency	Percent	Valid Percent	Cumulative Percent
Like Sometimes	289	35.6	35.6	35.6
No	78	9.6	9.6	45.3
Yes	444	54.7	54.7	100.0
Total	811	100.0	100.0	

From this above table we can see that 54.7% respondents like to eat sweets, 9.6% respondents do not like to eat sweets and 35.6% respondents like sweet sometimes.

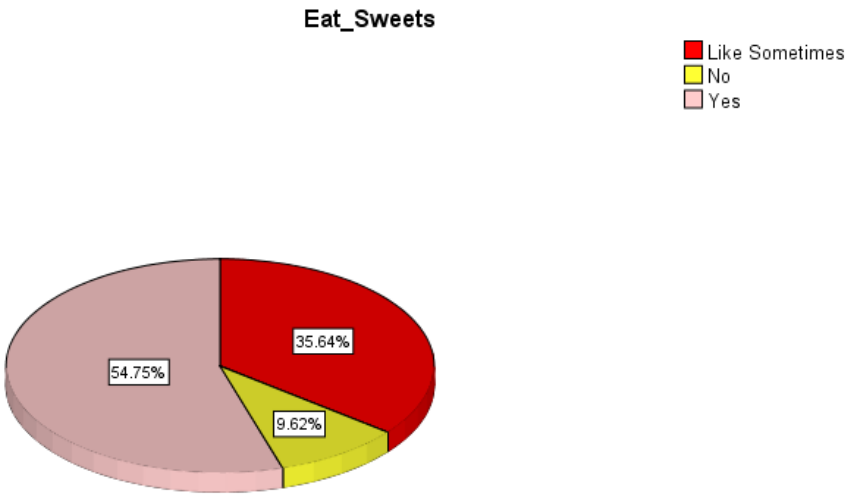

Figure 4.1.22: Pie chart of respondent's like to eat sweet.

Table 4.1.23: Percentage distribution of respondent's beverage and juice choice

Like beverage and juice	Frequency	Percent	Valid Percent	Cumulative Percent
Both	308	38.0	38.0	38.0
Fresh juice	233	28.7	28.7	66.7
Other	68	8.4	8.4	75.1
Soft Drinks	202	24.9	24.9	100.0
Total	811	100.0	100.0	

From this table we can see that 24.9% respondents like soft drinks, 28.7% respondents like fresh juice and 38.0% respondents like both and 8.4% respondents like others.

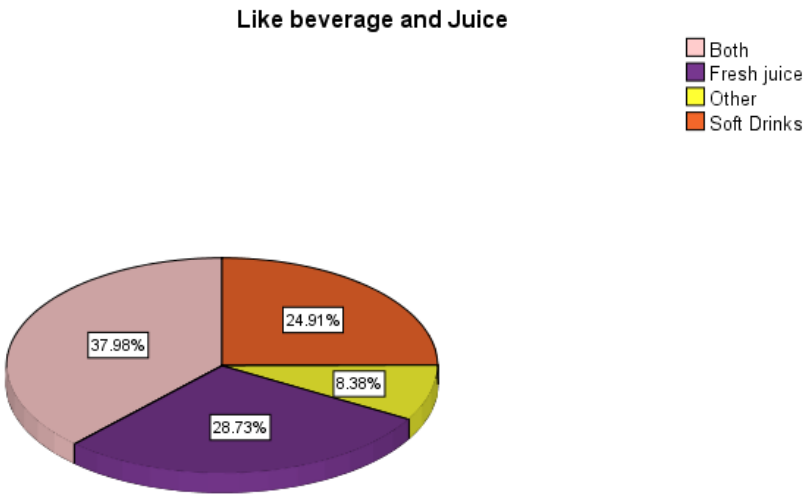

Figure 4.1.23: Pie chart of respondent's beverage and juice choice

Table 4.1.24: Percentage distribution of respondent's idea about obesity relates with food habit

Think obesity relates with food habit	Frequency	Percent	Valid Percent	Cumulative Percent
No	158	19.5	19.5	19.5
Yes	653	80.5	80.5	100.0
Total	811	100.0	100.0	

From this above table we can see that 80.5% respondents said yes for obesity relates with food habit and 19.5% said no.

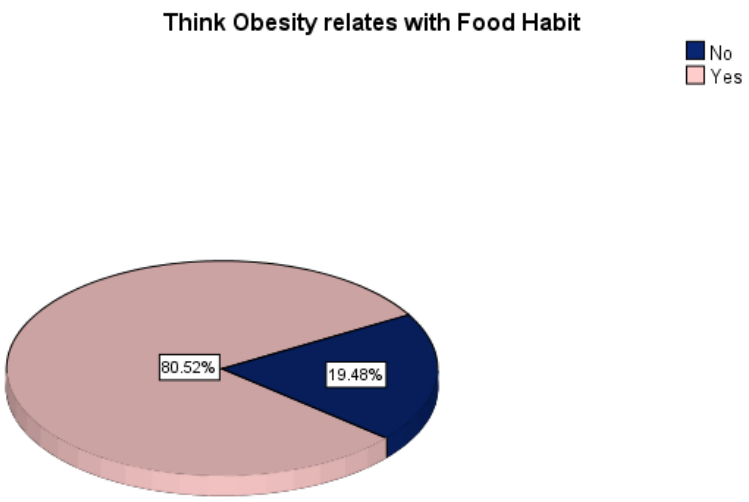

Figure 4.1.24: Pie chart of respondent's idea about obesity relates with food habit

Table 4.1.25: Percentage distribution of respondent's disease related with obesity and overweight

Suffer any disease related with obesity	Frequency	Percent	Valid Percent	Cumulative Percent
No	677	83.5	83.5	83.5
Yes	134	16.5	16.5	100.0
Total	811	100.0	100.0	

From this above table we can see that 16.5% respondents suffer disease related with obesity and overweight and 83.5% respondents are not

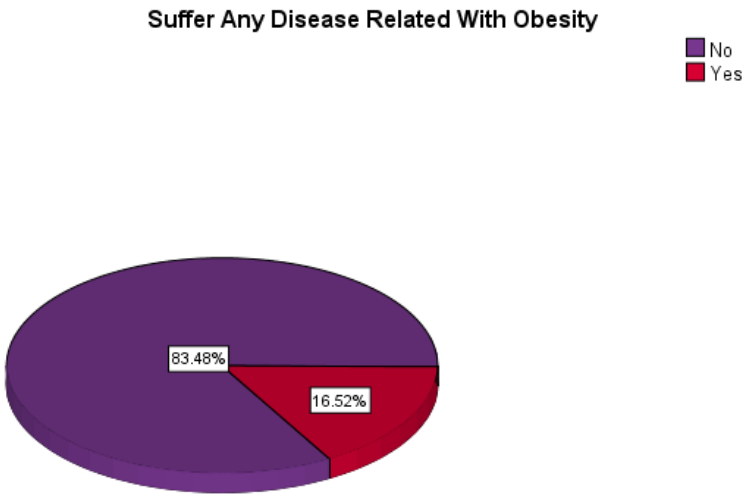

Figure 4.1.25: Pie chart of respondent's disease related with obesity and overweight

4.2 Comparative Analysis, Statistical Analysis and findings, Hypothesis:

A chi square test is a statistical test commonly used for testing independence and goodness of fit. Testing independence determines whether two or more observations across two populations are independent on each other. In both cases the question to calculate the chi square statistic.

$$\chi^2 = \frac{\sum_{i=1}^{n}(O_i - E_i)^2}{E_i}$$

Where, O_i = the observed frequency E_i= the expected frequency and n = the no of cells.

Cross table 4.2.1: Body mass index and Gender cross tabulation

		Gender1		Total
		Female	Male	
Body mass index	Under Weight	73	74	147
	Normal Weight	191	346	537
	Over Weight	25	69	94
	Obese	7	26	33
Total		296	515	811

Hypothesis:

H_0 = There is no association between BMI status and Gender.

H_1 = There is significant association between BMI status and Gender.

Chi-square test

	Value	df	P Value
Pearson Chi-Square	18.492	3	0.00

Comment: Since p-value is less than 0.05 with 3 DF, we reject the null hypothesis. So at 5% level of significance we can say that there is significant association between BMI status and Gender.

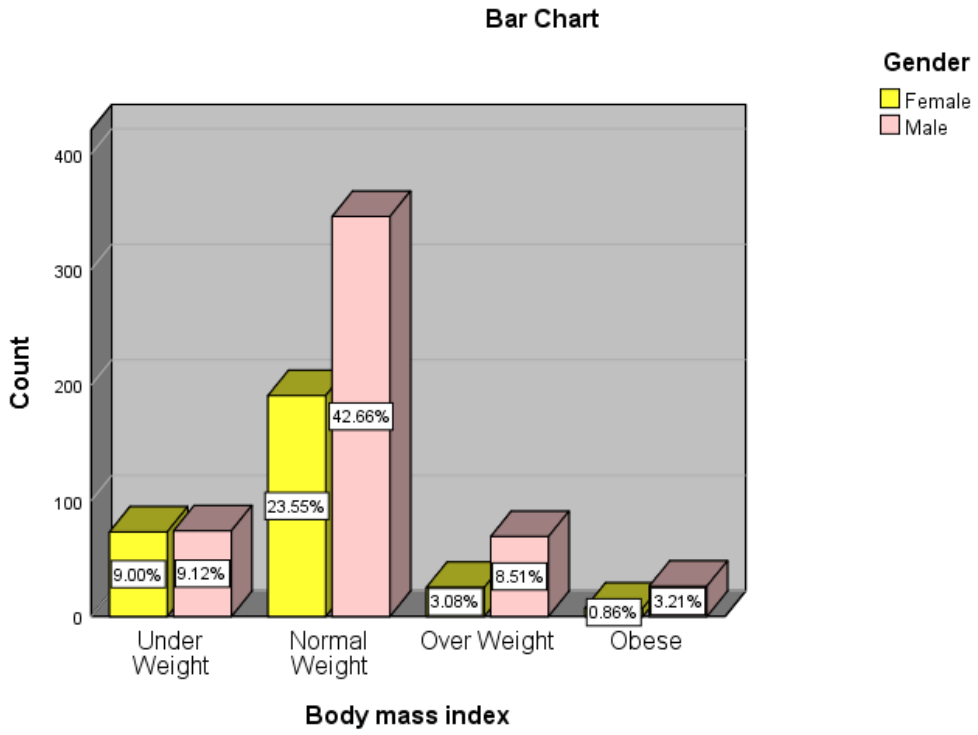

Figure 4.2.1: Cluster bar diagram of BMI status and Gender

Cross table 4.2.2: Body mass index status and exercise status or Physical activities make your body fit status cross tabulations.

		Exercises Status				Total
		Every Day	In specific day	Never	Sometimes	
Body mass index	Under Weight	13	3	40	91	147
	Normal Weight	61	36	103	337	537
	Over Weight	3	11	18	62	94
	Obese	1	2	8	22	33
Total		78	52	169	512	811

Hypothesis:

H_0= There is no association between BMI status and physical activity and exercise.

H_1 = There is significant association between BMI status and physical activity and exercise.

Chi-square test

	Value	df	P-value
Pearson Chi-Square	19.988	9	0.018

Comment: Since p-value is less than 0.05 with 9 DF, we reject the null hypothesis. So at 5% level of significance we can say that there is significant association between BMI status and physical activity and exercise.

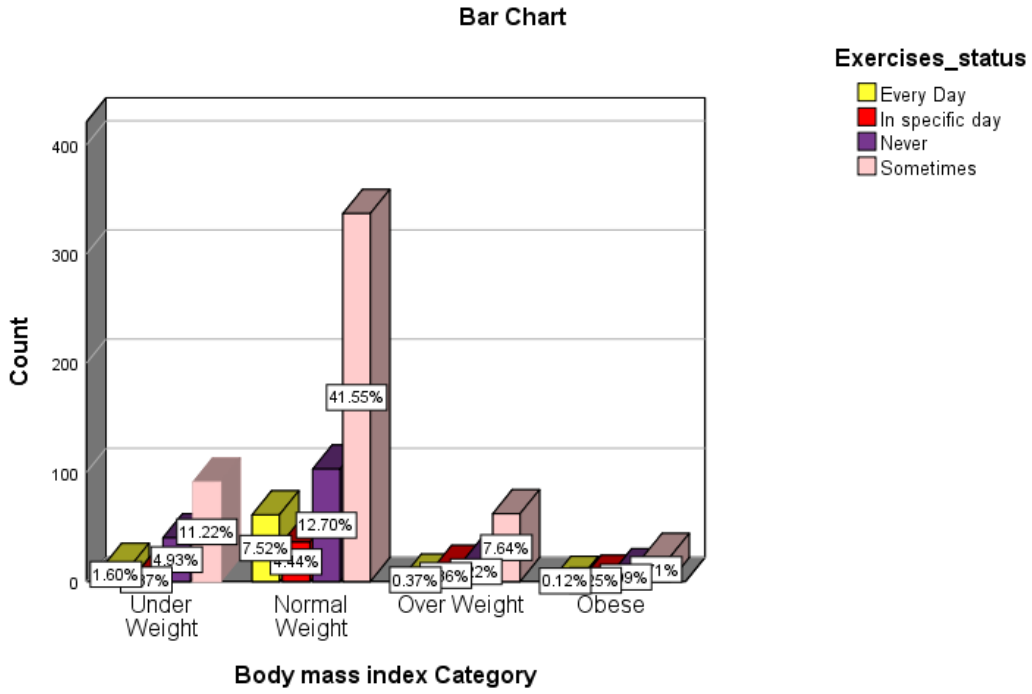

Figure 4.2.2: Cluster Bar diagram for Body mass index status and physical activity or exercise.

Table 4.2.3: Body mass index status and taking meal regularly cross tabulations.

		Taking meal Regular		
		Always regular	Irregular	Total
Body mass index	Under Weight	71	76	147
	Normal Weight	314	223	537
	Over Weight	63	31	94
	Obese	26	7	33
Total		474	337	811

Hypothesis:

H_0=There is no association between Body mass index status and taking meal regularly.

H_1= There is significant association between Body mass index status and taking meal regularly.

Chi-square test

	Value	df	P-value
Pearson Chi-Square	14.700	3	0.002

Comment: Since p-value is less than 0.05 with 3 DF, we reject the null hypothesis. So at 5% level of significance we can say that there is significant strong association between Body mass index status and taking meal regularly.

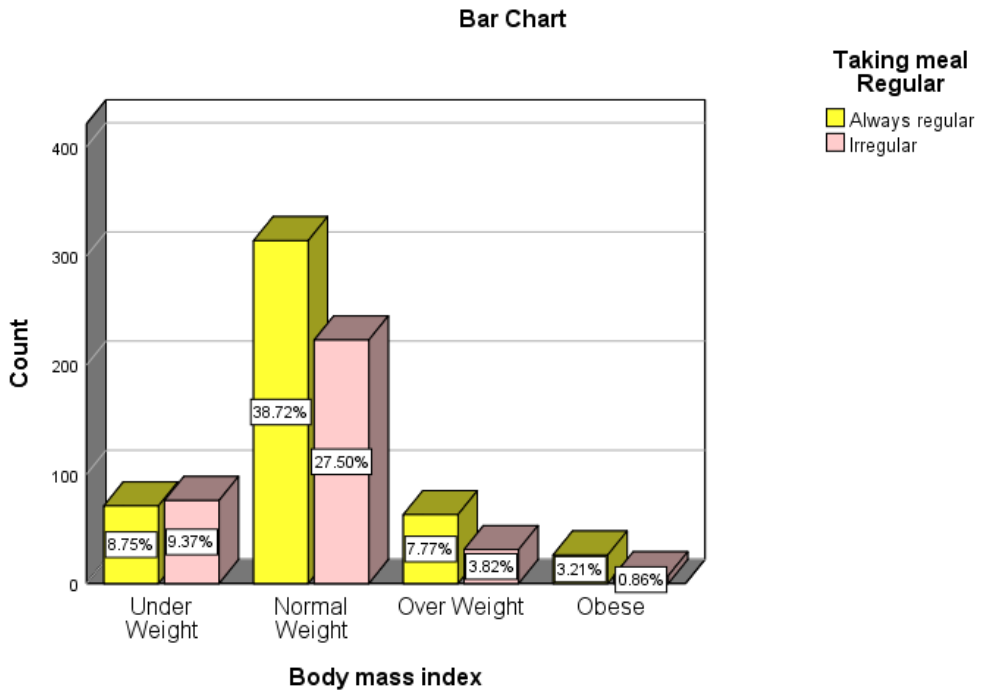

Figure 4.2.3: Cluster bar diagram for Body mass index status and taking meal regularly.

Cross table 4.2.4: Body mass index status and taking breakfast.

		Taking Breakfast				Total
		Daily	Once or twice per week	Rarely	Three or four times per week	
Body mass index	Under Weight	72	16	27	32	147
	Normal Weight	287	57	87	106	537
	Over Weight	51	14	10	19	94
	Obese	27	4	2	0	33
Total		437	91	126	157	811

Hypothesis:

H_0=There is no association between Body mass index status and taking breakfast.

H_1 = There is significant association between Body mass index status and taking breakfast.

Chi-square test

	Value	df	P-vaiue
Pearson Chi-Square	17.976	9	0.035

Comment: Since p-value is less than 0.05 with 9 DF, we reject the null hypothesis. So at 5% level of significance we can say that there is significant strong association between Body mass index status and taking breakfast.

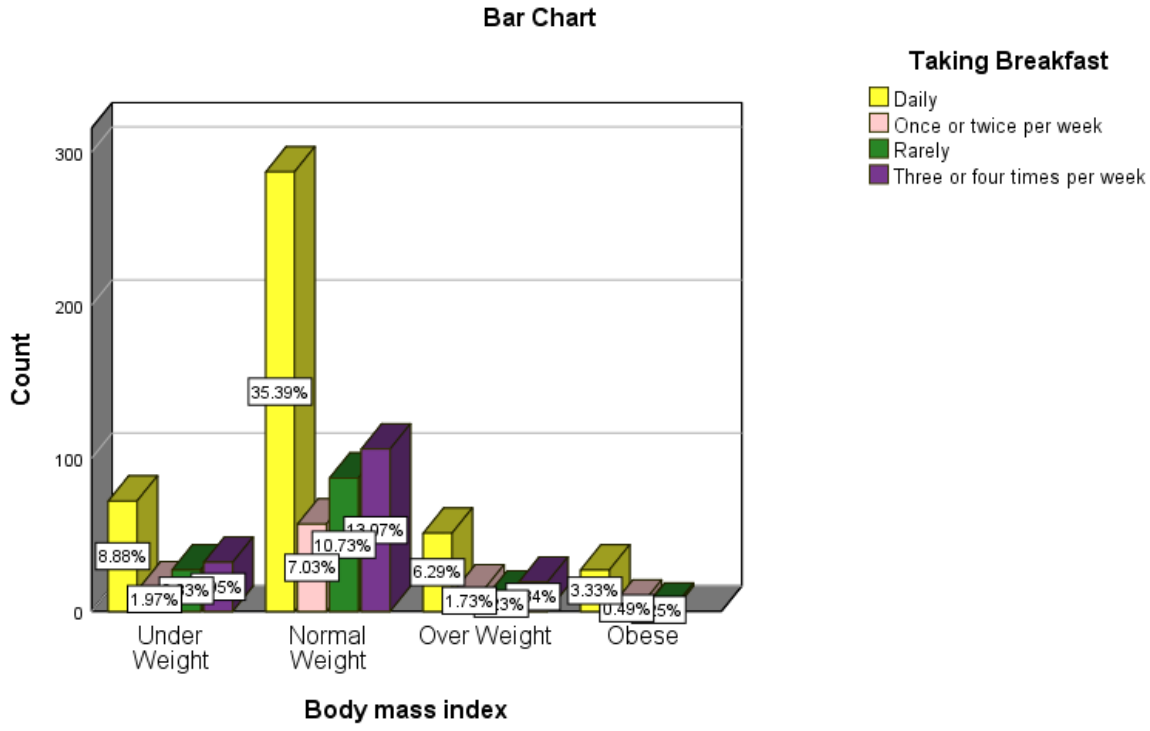

Figure 4.2.4: Cluster bar diagram of Body mass index status and taking breakfast.

Cross table 4.2.5: Body mass index status and eating meals except snack

		Eating except Snacks				Total
		Four Times	One time	Three times	Two times	
	Under Weight	2	36	66	43	147

Body mass index	Normal Weight	6	112	254	165	537
	Over Weight	1	18	37	38	94
	Obese	8	1	17	7	33
Total		17	167	374	253	811

Hypothesis:

H_0= There is no association between Body mass index status and eating meals except snacks.

H_1= There is significant association between Body mass index status and eating meals except snacks.

Chi-square test

	Value	df	P-value
Pearson Chi-Square	91.851	9	0.000

Comment: Since p-value is less than 0.05 with 9 DF, we reject the null hypothesis. So at 5% level of significance we can say that there is significant association between Body mass index status and eating meals except snacks.

Figure 4.2.6: Cluster bar diagram for Body mass index status and eating meals except snacks.

Cross table 4.2.6: Body mass index status and taking snacks apart from regular meal.

		Taking Snacks Apart From Regular Meal				Total
		Daily	Once or twice per week	Rarely	Three or four times per week	
Body mass index	Under Weight	30	34	42	41	147
	Normal Weight	120	135	147	135	537
	Over Weight	32	22	21	19	94
	Obese	16	6	5	6	33
Total		198	197	215	201	811

Hypothesis:
H_0= There is no association between Body mass index status and taking snacks apart from regular meal.
H_1= There is significant association between Body mass index status and taking snacks apart from regular meal.

Chi-square test

	Value	df	P-value
Pearson Chi-Square	18.668	9	0.028

Comment: Since p-value is less than 0.05 with 9 DF, we reject the null hypothesis. So at 5% level of significance we can say that there is significant strong association Body mass index status and taking snacks apart from regular meal.

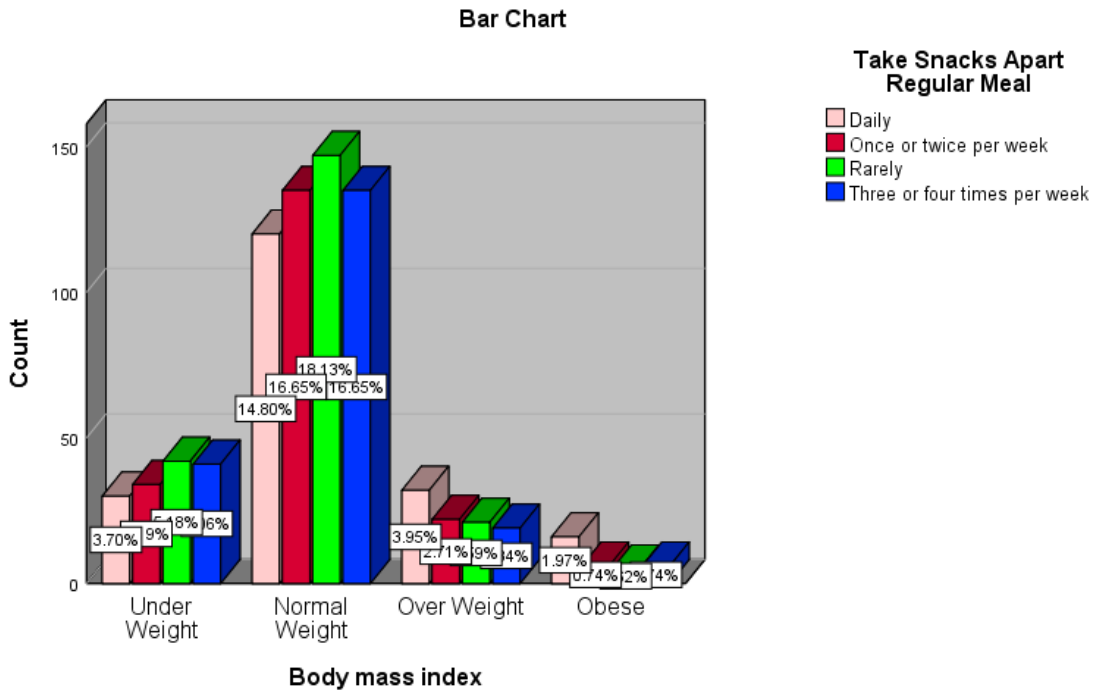

Figure 4.2.6: Cluster bar diagram Body mass index status and taking snacks apart from regular meal.

Cross table 4.2.7: Body mass index status and eating fried food.

		Eat Fried Food				Total
		Daily	Once or twice per week	Rarely	Three or four times per week	
Body mass index	Under Weight	14	44	58	31	147
	Normal Weight	51	165	205	116	537
	Over Weight	6	23	28	37	94
	Obese	4	7	4	18	33
Total		75	239	295	202	811

Hypothesis:

H_0=There is no association between Body mass index status and eating fried food.

H_1= There is significant association between Body mass index status and eating fried food.

Chi-square test

	Value	df	P-value
Pearson Chi-Square	33.097	9	0.000

Comment: Since p-value is less than 0.05 with 9 DF, we reject the null hypothesis. So at 5% level of significance we can say that there is significant association between Body mass index status and eating fried food.

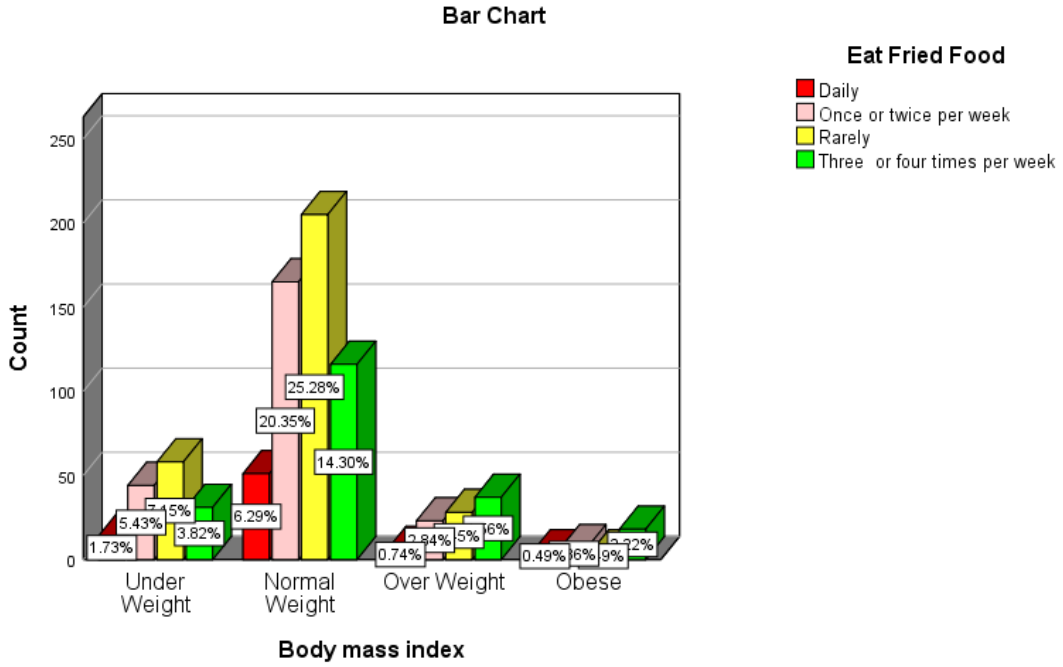

Figure 4.2.7: Cluster bar diagram for Body mass index status and eating fried food.

Cross table 4.2.8: Body mass index status and eat with family or friends.

		Eat With Family or Friends				Total
		Daily	Once or twice per week	Rarely	Three or four times per week	
Body mass index	Under Weight	37	27	64	19	147
	Normal Weight	151	118	201	67	537
	Over Weight	21	22	28	23	94
	Obese	6	10	8	9	33
Total		215	177	301	118	811

Hypothesis:

H_0=There is no association between Body mass index status and eat with family or friends.

H_1= There is significant association between Body mass index status and eat with family or friends.

Chi-square test

	Value	df	P-value
Pearson Chi-Square	20.470	9	0.015

Comment: Since p-value is less than 0.05 with 9 DF, we reject the null hypothesis. So at 5% level of significance we can say that there is significant association between Body mass index status and eat with family or friends.

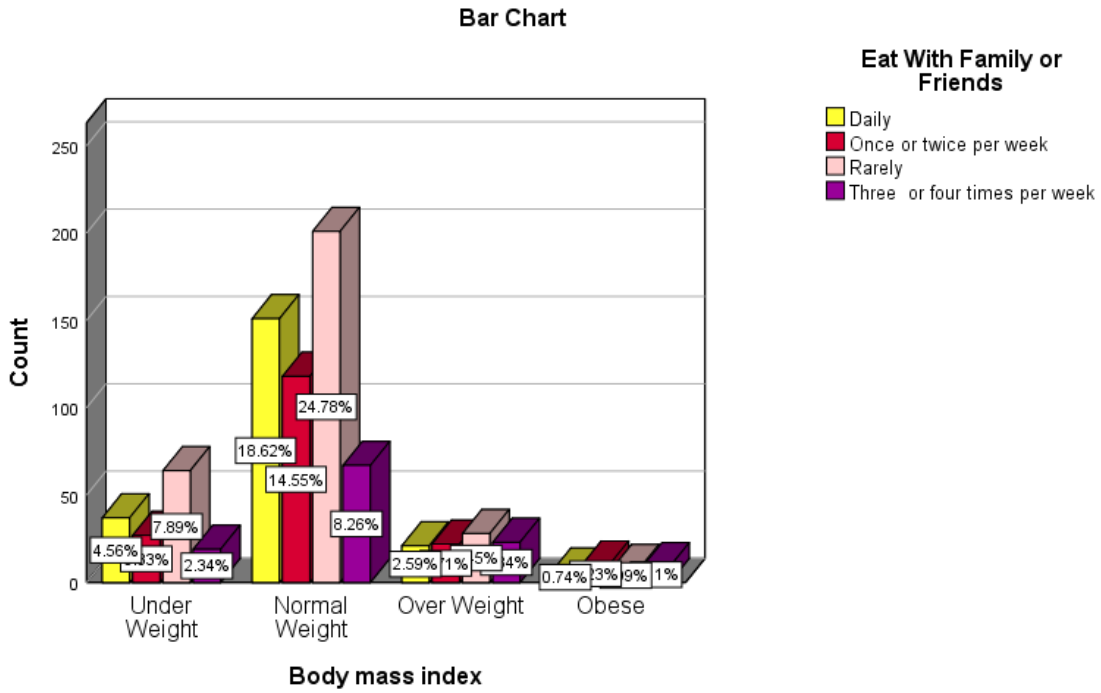

Figure 4.2.8: Cluster bar diagram for Body mass index status and eat with family or friends.

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Cross table 4.2.9: Body mass index status and Eat Sweets.

		Eat Sweets			
		Like Sometimes	No	Yes	Total
Body mass index	Under Weight	60	24	63	147
	Normal Weight	187	48	302	537
	Over Weight	34	5	55	94
	Obese	8	1	24	33
Total		289	78	444	811

Hypothesis:

H_0=There is no association between Body mass index status and eat sweets.

H_1= There is significant association between Body mass index status and eat sweets.

Chi-square test

	Value	df	P-value
Pearson Chi-Square	19.054	6	0.004

Comment: Since p-value is less than 0.05 with 6 DF, we reject the null hypothesis. So at 5% level of significance we can say that there is significant association between Body mass index status and eat sweets.

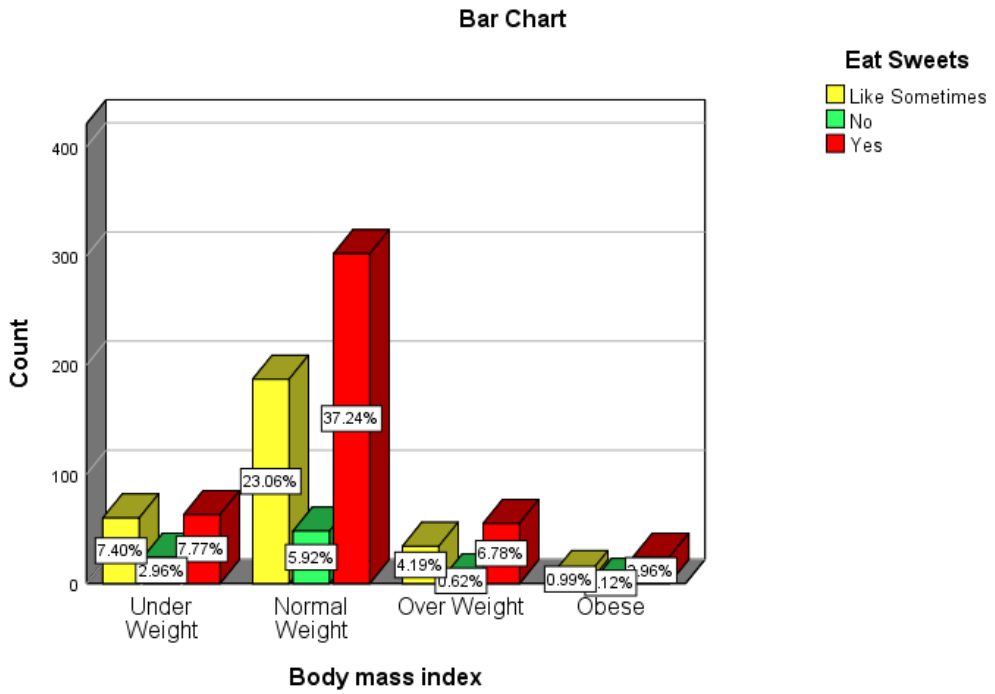

Figure 4.2.9: Cluster bar diagram for Body mass index status and eat sweets.

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Cross table 4.2.10: Body mass index status and like beverage or juice.

		Like beverage Juice				Total
		Both	Fresh juice	Other	Soft Drinks	
Body mass index	Under Weight	67	39	6	35	147
	Normal Weight	183	163	56	135	537
	Over Weight	41	22	4	27	94
	Obese	17	9	2	5	33
Total		308	233	68	202	811

Hypothesis:

H_0=There is no association between Body mass index status and like beverage or juice.

H_1= There is significant association between Body mass index status and like beverage or juice.

Chi-square test

	Value	df	P-value
Pearson Chi-Square	18.397	9	0.031

Comment: Since p-value is less than 0.05 with 9 DF, we reject the null hypothesis. So at 5% level of significance we can say that there is significant association between Body mass index status and and like beverage or juice.

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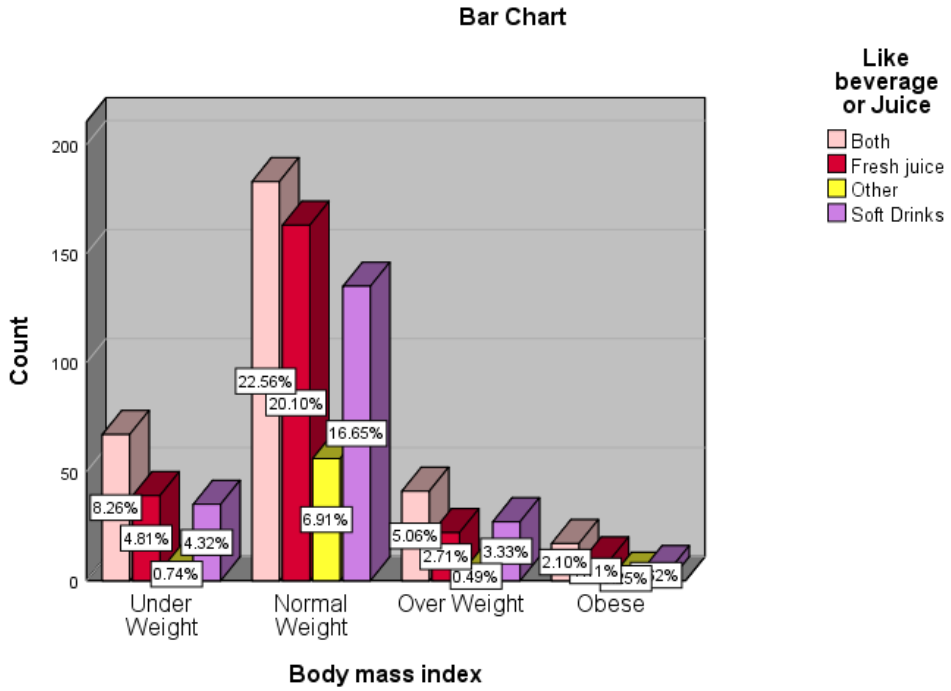

Figure 4.2.10: Cluster bar diagram for Body mass index status and like beverage or juice.

Table 4.2.11: Body mass index status and Smoking status.

		Smoking status			
		Irregularly	Never	Regularly	Total
Body mass index	Under Weight	4	133	10	147
	Normal Weight	21	491	25	537
	Over Weight	10	76	8	94
	Obese	3	26	4	33
Total		38	726	47	811

Hypothesis:

H_0=There is no association between Body mass index status and Smoking status.

H_1= There is significant association between Body mass index status and Smoking status.

Chi-square test

	Value	df	P-value
Pearson Chi-Square	16.759	6	0.010

Comment: Since p-value is less than 0.05 with 6 DF, we reject the null hypothesis. So at 5% level of significance we can say that there is significant association between Body mass index status and Smoking status.

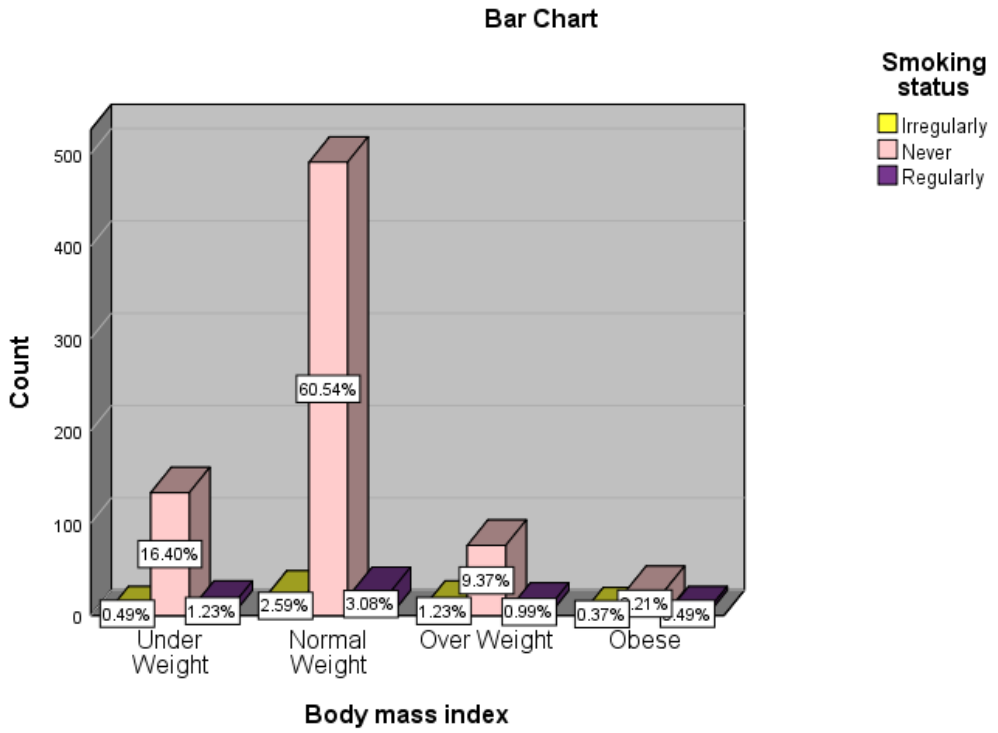

Figure 4.2.11: Cluster bar diagram for Body mass index status and Smoking status.

4.3: Regression analysis and model fit:

For this project as dependent variable BMI status has four category so I use multinomial logistic regression for regression analysis.

Table 4.3.1:Case Processing Summary

		N	Marginal Percentage
Body mass index Category	Under Weight	147	18.1%
	Normal Weight	537	66.2%
	Over Weight	94	11.6%
	Obese	33	4.1%
Gender	Female	296	36.5%
	Male	515	63.5%
Smoking Status	Irregularly	38	4.7%
	Never	726	89.5%
	Regularly	47	5.8%
Exercises Status	Every Day	78	9.6%
	In specific day	52	6.4%
	Never	169	20.8%
	Sometimes	512	63.1%
Taking Meal Regular	Always regular	474	58.4%
	Irregular	337	41.6%
Taking Breakfast	Daily	437	53.9%
	Once or twice per week	91	11.2%
	Rarely	126	15.5%
	Three or four times per week	157	19.4%
Eating except Snacks	Four Times	17	2.1%
	One time	167	20.6%
	Three times	374	46.1%
	Two times	253	31.2%
Take Snacks Apart Regulae meal	Daily	198	24.4%
	Once or twice per week	197	24.3%
	Rarely	215	26.5%
	Three or four times per week	201	24.8%

Eat Vegetables	Daily	249	30.7%
	Once or twice per week	161	19.9%
	Rarely	97	12.0%
	Three or four times per week	304	37.5%
Eat fruit	Daily	105	12.9%
	Once or twice per week	234	28.9%
	Rarely	323	39.8%
	Three or four times per week	149	18.4%
Eat Fried Food	Daily	75	9.2%
	Once or twice per week	239	29.5%
	Rarely	295	36.4%
	Three or four times per week	202	24.9%
Drink alcohol	Never	707	87.2%
	Rarely	89	11.0%
	Regularly	4	0.5%
	Two or three times per week	11	1.4%
Prefer Enjoy to Eat	Fast food	125	15.4%
	Home-cooked meals	545	67.2%
	Other	47	5.8%
	Restaurant food	94	11.6%
Eat Sweets	Like Sometimes	289	35.6%
	No	78	9.6%
	Yes	444	54.7%
Like beverage Juice	Both	308	38.0%
	Fresh juice	233	28.7%
	Other	68	8.4%
	Soft Drinks	202	24.9%
Valid		811	100.0%
Missing		0	
Total		811	

Model fitting information

Hypothesis:
H_0=There is no association between Body mass index status and selected independent variables.
H_1= There is significant association between Body mass index status and selected independent variables.

Table4.3.2: Model Fitting Information

Model	Model Fitting Criteria			Likelihood Ratio Tests		
	AIC	BIC	-2 Log Likelihood	Chi-Square	df	Sig.
Intercept Only	1567.333	1581.428	1561.333			
Final	1528.942	1768.554	1426.942	134.390	48	0.000

Comment: Since p-value of model is less than 0.05 with 48 DF, we reject the null hypothesis. So at 5% level of significance we can say that there is significant strong association between Body mass index status and selected independent variables.

Goodness of fit test

Hypothesis:

H_0= The data fit model perfectly.
H_1= The data doesn't fit the model perfectly

Table4.3.3: Goodness-of-Fit

	Chi-Square	df	Sig.
Pearson	0.004	512	1.000
Deviance	0.008	512	1.000

Comment: Since p-value is greater than 0.05 with 512 DF, we may accept the null hypothesis. So at 5% level of significance we can say that the data fit the model perfectly.

Likelihood Ratio Test

Hypothesis:

H_0 = There is no association between dependent variable and independent variables.

H_1 = There is significant association between dependent and independent variables.

Here,

Dependent variable = BMI status

Independent variable = Gender, Smoking Status, Exercises Status, Taking Meal Regular, Taking Breakfast, Eating Except Snacks, Take Snacks Apart Regular Meal, Eat Vegetables, Eat Fruit, Eat Fried Food, Drink Alcohol, Prefer Enjoy to Eat, Eat Sweets, Like Beverage Juice.

Table 4.3.4: Likelihood Ratio Tests

Effect	-2 Log Likelihood of Reduced Model	Likelihood Ratio Tests	df	Sig.
Intercept	1641.437	0.000	0	
Gender	1654.647	13.209	3	0.004
Smoking Status	1682.704	41.267	6	0.000
Exercises Status	1668.856	27.418	9	0.001
Taking Meal Regular	1660.112	18.675	3	0.000
Taking Breakfast	1650.792	9.355	9	0.405
Eating Except Snacks	1318.609		9	
Take Snacks Apart Regular Meal	1632.763		9	
Eat Vegetables	1768.873	127.436	9	0.000
Eat Fruit	1773.370	131.932	9	0.000
Eat Fried Food	1622.730		9	
Drink Alcohol	1737.707	96.269	9	0.000
Prefer Enjoy to Eat	1818.190	176.753	9	0.000
Eat Sweets	1655.955	14.518	6	0.024
Like Beverage Juice	1932.870	291.433	9	0.000

Comment: Since p-value of Gender, Smoking Status, Exercises Status, Taking Meal Regular, Eat Vegetables, Eat Fruit, Drink Alcohol, Prefer Enjoy to Eat, Eat Sweets and Like Beverage Juice are 0.004, 0.000, 0.001, 0.000, 0.000, 0.000, 0.000, 0.000, 0.024, 0.000 respectively which is less than 0.05 So, we reject the null hypothesis and accept the alternative hypothesis. We can say that there is significant association between Dependent and independent variables and the rest are not.

4.4: Factor Analysis Using Principal Component Analysis

Factor Analysis: Factor analysis is a statistical technique that reduces a set of variables by extracting all their commonalities into a smaller number of factors. It can also be called data reduction.
There are two types of factor analysis such as

- Exploratory
- Confirmatory

Principal Component Analysis: Principal component analysis, or PCA, is a statistical procedure that allows you to summarize the information content in large data tables by means of a smaller set of "summary indices" that can be more easily visualized and analyzed.

Correlation matrix: A correlation matrix is simply a rectangular array of numbers that gives the correlation coefficients between a single variable and every other variable in the investigation. The correlation coefficient between a variable and itself is always 1, hence the principal diagonal of the correlation matrix contains 1s. The correlation coefficients above and below the principal diagonal are the same. The determinant of the correlation matrix is shown at the foot of the table below.

With respect to the correlation matrix if any pair of variables has a value less than 0.5, consider dropping one of them from the analysis. For this factor, analysis needs to be reperformed with the exclusion of pair of variables with less than 0.5 value. The off-diagonal elements (The values on the left and right sides of the diagonal in the table below) should all be very small (close to zero) in a good model.

Table 4.4.1: Correlation Matrix

		Gender1	Smoking_status	Exercises_status	Taking_meal_Regular	Taking_Breakfast	Eating_except_Snacks	TakeSnacks_apartRegulae_meal	Eat_FriedFood	EatWith_FamilyorFriends	EatTo_haveBalance	Drink_alcohol	PreferEnjoy_to_Eat	Eat_Sweets	Like_beverage_Juice
	Gender1	1.000	0.034	-0.027	-0.088	0.068	-0.007	0.025	-0.017	0.016	0.063	0.078	0.057	0.197	0.109
	Smoking_status	0.034	1.000	0.038	-0.013	0.079	-0.032	-0.002	0.029	0.046	0.051	0.037	-0.043	0.058	0.097
	Exercises_status	-0.027	0.038	1.000	0.043	0.048	0.016	0.035	0.028	0.015	-0.030	-0.007	0.029	0.001	-0.072
	Taking_meal_Regular	-0.088	-0.013	0.043	1.000	0.200	0.034	0.072	-0.020	-0.024	-0.001	-0.016	0.026	-0.023	-0.026
	Taking_Breakfast	0.068	0.079	0.048	0.200	1.000	0.117	0.108	-0.066	0.048	0.043	0.031	-0.003	-0.031	0.013
	Eating_except_Snacks	-0.007	-0.032	0.016	0.034	0.117	1.000	-0.006	0.027	0.019	-0.025	-0.011	-0.008	-0.020	-0.036

Correlation	TakeSnacks_apartRegulae_meal	0.025	-0.002	0.035	0.072	0.108	-0.006	1.000	0.034	-0.005	-0.011	-0.021	-0.060	-0.004	0.054
	Eat_FriedFood	-0.017	0.029	0.028	-0.020	-0.066	0.027	0.034	1.000	0.045	-0.021	-0.022	0.017	0.005	-0.025
	EatWith_FamilyorFriends	0.016	0.046	0.015	-0.024	0.048	0.019	-0.005	0.045	1.000	0.027	0.003	0.009	0.030	-0.017
	EatTo_haveBalance	0.063	0.051	-0.030	-0.001	0.043	-0.025	-0.011	-0.021	0.027	1.000	0.064	0.059	0.000	0.070
	Drink_alcohol	0.078	0.037	-0.007	-0.016	0.031	-0.011	-0.021	-0.022	0.003	0.064	1.000	0.126	0.014	-0.020
	PreferEnjoy_to_Eat	0.057	-0.043	0.029	0.026	-0.003	-0.008	-0.060	0.017	0.009	0.059	0.126	1.000	-0.005	-0.056
	Eat_Sweets	0.197	0.058	0.001	-0.023	-0.031	-0.020	-0.004	0.005	0.030	0.000	0.014	-0.005	1.000	0.037
	Like_beverage_Juice	0.109	0.097	-0.072	-0.026	0.013	-0.036	0.054	-0.025	-0.017	0.070	-0.020	-0.056	0.037	1.000
Sig. (1-tailed)	Gender1		0.167	0.225	0.006	0.027	0.425	0.237	0.312	0.322	0.037	0.013	0.051	0.000	0.001
	Smoking_status	0.167		0.141	0.351	0.013	0.178	0.475	0.204	0.095	0.072	0.149	0.109	0.048	0.003
	Exercises_status	0.225	0.141		0.110	0.085	0.328	0.157	0.217	0.333	0.196	0.418	0.201	0.486	0.020
	Taking_meal_Regular	0.006	0.351	0.110		0.000	0.169	0.020	0.288	0.249	0.488	0.326	0.233	0.260	0.234
	Taking_Breakfast	0.027	0.013	0.085	0.000		0.000	0.001	0.030	0.085	0.109	0.188	0.466	0.187	0.354
	Eating_except_Snacks	0.425	0.178	0.328	0.169	0.000		0.437	0.217	0.293	0.242	0.375	0.410	0.280	0.156
	TakeSnacks_apartRegulae_meal	0.237	0.475	0.157	0.020	0.001	0.437		0.165	0.447	0.377	0.271	0.044	0.458	0.061
	Eat_FriedFood	0.312	0.204	0.217	0.288	0.030	0.217	0.165		0.098	0.278	0.262	0.314	0.440	0.241
	EatWith_FamilyorFriends	0.322	0.095	0.333	0.249	0.085	0.293	0.447	0.098		0.222	0.460	0.395	0.196	0.312
	EatTo_haveBalance	0.037	0.072	0.196	0.488	0.109	0.242	0.377	0.278	0.222		0.035	0.047	0.499	0.023
	Drink_alcohol	0.013	0.149	0.418	0.326	0.188	0.375	0.271	0.262	0.460	0.035		0.000	0.342	0.283
	PreferEnjoy_to_Eat	0.051	0.109	0.201	0.233	0.466	0.410	0.044	0.314	0.395	0.047	0.000		0.444	0.054
	Eat_Sweets	0.000	0.048	0.486	0.260	0.187	0.280	0.458	0.440	0.196	0.499	0.342	0.444		0.144
	Like_beverage_Juice	0.001	0.003	0.020	0.234	0.354	0.156	0.061	0.241	0.312	0.023	0.283	0.054	0.144	

Kaiser Meyer Olkin (KMO) and Bartlett's Test (measures the strength of relationship among the variables):

The KMO measures the sampling adequacy (which determines if the responses given with the sample are adequate or not) which should be close to 0.5 for satisfactory factor analysis to proceed. Kaiser (1974) recommends 0.5 (value for KMO) as a minimum (barely accepted), values between 0.7-0.8 are acceptable, and values above 0.9 are superb. Looking at the table below, the KMO measure is 0.673, which is close to 0.7 and therefore it is accepted.

There is no significant answer to the question "How many cases respondents do I need to factor analysis?", and methodologies differ. A common rule is to suggest that a researcher has

at least 10-15 participants per variable. Fiedel (2005) says that in general over 300 Respondents for sampling analysis is probably adequate.

Bartlett's test is another indication of the strength of the relationship among variables. This tests the null hypothesis that the correlation matrix is an identity matrix. An identity matrix is a matrix in which all of the diagonal elements are 1 (See Table 1) and all off-diagonal elements (term explained above) are close to 0. I want to reject this null hypothesis. From the table, we can see that Bartlett's Test of Sphericity is significant (0.00). That is, the significance is less than 0.05 i.e. the significance level is small enough to reject the null hypothesis. This means that the correlation matrix is not an identity matrix.

Hypothesis:

H_0= the correlation matrix is an identity matrix

H_1= the correlation matrix is not an identity matrix

Table 4.4.2: KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0.673
Bartlett's Test of Sphericity	Approx. Chi-Square	207.546
	df	91
	Sig.	0.000

Communalities:

The table 4.4.2 of commonalities which shows how much of the variance (i.e. the communality value which should be more than 0.5 to be considered for further analysis. Else these variables are to be removed from further steps of factor analysis) in the variables has been accounted for by the extracted factors.

Table 4.4.2: Communalities

	Initial	Extraction
Gender	1.000	0.615
Smoking status	1.000	0.504

Exercise Status	1.000	0.505
Taking Meal Regular	1.000	0.472
Taking Breakfast	1.000	0.613
Eating Except Snacks	1.000	0.647
Take Snacks Apart Regular Meal	1.000	0.400
Eat Fried Food	1.000	0.404
Eat With Family or Friends	1.000	0.497
Eat To have Balance	1.000	0.449
Drink alcohol	1.000	0.418
Prefer Enjoy to Eat	1.000	0.523
Eat Sweets	1.000	0.566
Like beverage Juice	1.000	0.477

Total variance explained

For analysis and interpretation purposes we are concerned only with Initial Eigenvalues and Extracted Sums of Squared Loadings. The requirement for identifying the number of components or factors stated by selected variables is the presence of eigenvalues of more than 1. Table 4.4.3 here in shows that for 1^{st} component the value is 1.368 > 1, 2^{nd} component is 1.325 > 1, 3^{rd} component is 1.201 > 1, 4^{th} component is 1.116 >1, 5^{th} component is 1.055, 6^{th} component is 1.024. Thus, the stated set of 14 variables with 811 observations represents six components. Further, the extracted sum of squared holding % of variance depicts that the first factor accounts for 9.796% of the variance features from the stated observations, the second 9.466%, the third 8.58%, the fourth 7.971%, the fifth7.536% and sixth 7.312. Thus, 6 components are effective enough in representing all the characteristics or components highlighted by the stated 14 variables.

1: Component: 10 components as like shown in communalities table.
2: Initial Eigenvalues Total: Total variance.
3: Initial Eigenvalues % of the variance: The percent of variance attributable to each factor.
4: Initial Eigenvalues Cumulative %: Cumulative variance of the factor when added to the previous factors.
5: Extraction sums of Squared Loadings Total: Total variance after extraction.
6: Extraction Sums of Squared Loadings % of the variance: The percent of variance attributable to each factor after extraction. This value is of significance to us and therefore we determine in this step that they are four factors which effect food habits.

7: Extraction Sums of Squared Cumulative %: Cumulative variance of the factor when added to the previous factors after extraction.
8: Rotation of Sums of Squared Loadings Totals: Total variance after rotation.
9: Rotation of Sums of Squared Loadings % of the variance: The percent of variance attributable to each factor after rotation.
10: Rotation of Sums of Squared Loadings Cumulative %: Cumulative variance of the factor when added to the previous factors

Table 4.4.3: Total Variance Explained

	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
Component	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	1.368	9.769	9.769	1.368	9.769	9.769	1.292	9.227	9.227
2	1.325	9.466	19.235	1.325	9.466	19.235	1.227	8.762	17.989
3	1.201	8.580	27.814	1.201	8.580	27.814	1.207	8.619	26.608
4	1.116	7.971	35.785	1.116	7.971	35.785	1.188	8.487	35.095
5	1.055	7.536	43.321	1.055	7.536	43.321	1.108	7.913	43.007
6	1.024	7.312	50.633	1.024	7.312	50.633	1.068	7.626	50.633
7	0.993	7.093	57.726						
8	0.949	6.778	64.504						
9	0.922	6.584	71.089						
10	0.914	6.528	77.616						
11	0.864	6.172	83.788						
12	0.807	5.766	89.554						
13	0.784	5.603	95.158						
14	0.678	4.842	100.000						

Scree Plot

The scree plot is a graph of the eigenvalues against all the factors. The graph is useful for determining how many factors to retain. The point of interest is where the curve starts to flatten. It can be seen that the curve begins to flatten between factors 6 and 7. Note also that factor 7 onwards has an eigenvalue of less than 1, so only six factors have been retained.

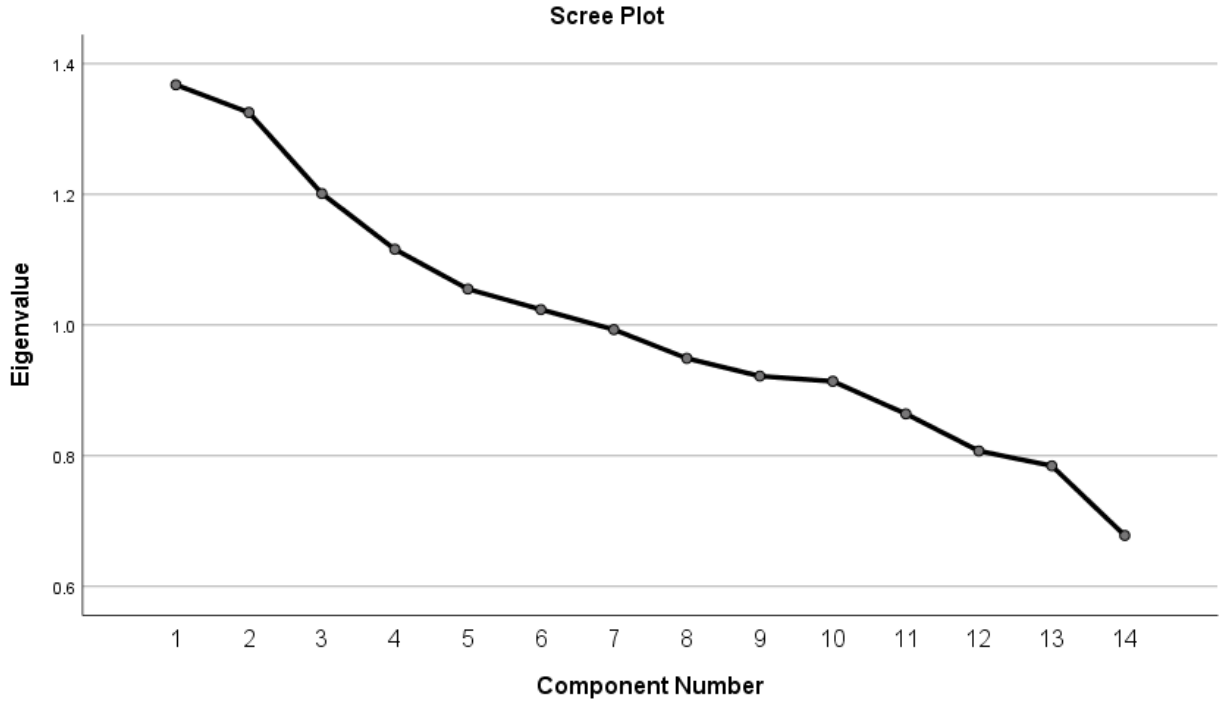

Figure 4.4.1: Scree Plot

Component Matrix

Table 4.4.4 below shows the loadings (extracted values of each item under 6 variables) of the variables on the factors extracted. The higher the absolute value of the loading, the more the factor contributes to the variable. We have extracted variables wherein the 14 items are divided into 6 variables according to the most important items which are similar responses in component 1 and simultaneously in components 2, 3, 4, 5 and 6. The gap (empty spaces) on the table represents loadings that are less than 0.3, this makes reading the table easier. We suppressed all loadings less than 0.3. As the requirement of having precise computation of each factor component, Table 4.4.4 depicts that there is the presence of cross loading i.e. one factor measuring more than one component. For this, the solution is to redistribute the factor loading

by having rotation, and the hence rotated component matrix is examined for the identification of components.

Table 4.4.4: Component Matrix

	Component					
	1	2	3	4	5	6
Gender	0.666				-0.403	
Eat Sweets	0.491			0.314	-0.449	
Taking Breakfast		0.759				
Taking meal Regular		0.600				
Take Snacks Apart Regulae Meal		0.398	-0.328			0.344
Prefer Enjoy to Eat			0.696			
Drink alcohol	0.307		0.541			
Like beverage Juice	0.437		-0.441			
Eat Fried Food				0.589		
Eat With Family or Friends				0.465		-0.398
Smoking status	0.359				0.502	
Eat To have Balance	0.366				0.431	
Eating Except Snacks		0.312				-0.643
Exercises Status				0.434		0.463

Rotated Component Matrix

Here table 4.4.5 show that one variable measuring one component.

Table 4.4.5: Rotated Component Matrix

	Component					
	1	2	3	4	5	6
Taking Breakfast	0.674					0.337
Taking meal Regular	0.655					
Take Snacks Apart Regular Meal	0.493					
Gender		0.747				
Eat Sweets		0.739				
Prefer Enjoy to Eat			0.708			

Drink alcohol			0.627			
Smoking Status				0.648		
Eat To Have Balance			0.337	0.529		
Like beverage Juice				0.509	-0.302	
Exercises Status					0.603	
Eat Fried Food					0.592	
Eating Except Snacks						0.750
Eat With Famil yor Friends					0.332	0.527

Component Transformation Matrix

Table 4.4.6: Component Transformation Matrix

Component	1	2	3	4	5	6
1	-0.096	0.727	0.264	0.606	-0.156	-0.027
2	0.932	-0.018	0.037	0.181	0.053	0.307
3	-0.052	-0.114	0.941	-0.253	0.077	0.173
4	-0.137	0.275	-0.122	-0.057	0.883	0.328
5	-0.154	-0.612	0.101	0.727	0.246	-0.050
6	0.277	0.087	0.139	-0.068	0.356	-0.875

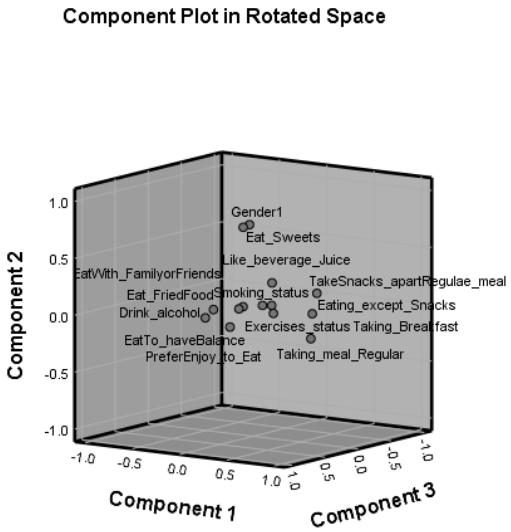

Figure 4.4.2: Component Plot in Rotated Space.

4.5: Discriminant Analysis

It builds a predictive model for group membership. The model is composed of a discriminant function based on linear combinations of predictor variables. Those predictor variables provide the best discrimination between groups.

Table 4.5.1: Analysis Case Processing Summary

Unweighted Cases		N	Percent
Valid		811	100.0
Excluded	Missing or out-of-range group codes	0	0.0
	At least one missing discriminating variable	0	0.0
	Both missing or out-of-range group codes and at least one missing discriminating variable	0	0.0
	Total	0	0.0
Total		811	100.0

Analysis Case Processing Summary – This table summarizes the analysis dataset in terms of valid and excluded cases. Here all of the observations in the dataset are valid.

Table 4.5.2: Group Statistics

Body mass index Category		Valid N (listwise)	
		Unweighted	Weighted
Under Weight	Gender	147	147.000
	Smoking status	147	147.000
	Exercises status	147	147.000
	Taking Meal Regular	147	147.000
	Taking Breakfast	147	147.000
	Eating except Snacks	147	147.000
	Take Snacks apart Regular meal	147	147.000
	Eat Fried Food	147	147.000
	Eat With Family or Friends	147	147.000
	Eat To have Balance	147	147.000
	Drink Alcohol	147	147.000
	Eat Sweets	147	147.000
	Like Beverage Juice	147	147.000
Normal Weight	Gender	537	537.000
	Smoking status	537	537.000

	Exercises status	537	537.000
	Taking Meal Regular	537	537.000
	Taking Breakfast	537	537.000
	Eating except Snacks	537	537.000
	Take Snacks apart Regular meal	537	537.000
	Eat Fried Food	537	537.000
	Eat With Family or Friends	537	537.000
	Eat To have Balance	537	537.000
	Drink Alcohol	537	537.000
	Eat Sweets	537	537.000
	Like Beverage Juice	537	537.000
Over Weight	Gender	94	94.000
	Smoking status	94	94.000
	Exercises status	94	94.000
	Taking Meal Regular	94	94.000
	Taking Breakfast	94	94.000
	Eating except Snacks	94	94.000
	Take Snacks apart Regular meal	94	94.000
	Eat Fried Food	94	94.000
	Eat With Family or Friends	94	94.000
	Eat To have Balance	94	94.000
	Drink Alcohol	94	94.000
	Eat Sweets	94	94.000
	Like Beverage Juice	94	94.000
Obese	Gender	33	33.000
	Smoking status	33	33.000
	Exercises status	33	33.000
	Taking Meal Regular	33	33.000
	Taking Breakfast	33	33.000
	Eating except Snacks	33	33.000
	Take Snacks apart Regular meal	33	33.000
	Eat Fried Food	33	33.000
	Eat With Family or Friends	33	33.000
	Eat To have Balance	33	33.000
	Drink Alcohol	33	33.000
	Eat Sweets	33	33.000
	Like Beverage Juice	33	33.000

Total	Gender	811	811.000
	Smoking status	811	811.000
	Exercises status	811	811.000
	Taking Meal Regular	811	811.000
	Taking Breakfast	811	811.000
	Eating except Snacks	811	811.000
	Take Snacks apart Regular meal	811	811.000
	Eat Fried Food	811	811.000
	Eat With Family or Friends	811	811.000
	Eat To have Balance	811	811.000
	Drink Alcohol	811	811.000
	Eat Sweets	811	811.000
	Like Beverage Juice	811	811.000

Group Statistics – This table presents the distribution of observations into the four groups within BMI.

Summary of Canonical Discriminant Functions

In table 4.5.3 the first canonical discriminant function explained 66.0%, second function explained 23.5% and third function explained 10.5% of total variance in the dependent variable. Dependent variable has four categories, so there are three discriminant function. The canonical correlation is the measure of association between the discriminant function and the dependent variable. Here canonical correlation of 1st function is 0.310, 2nd function is 0.191, 3rd function is 0.129. So the 1st function is better.

Table 4.5.3: Eigenvalues

Function	Eigenvalue	% of Variance	Cumulative %	Canonical Correlation
1	.106[a]	66.0	66.0	0.310
2	.038[a]	23.5	89.5	0.191
3	.017[a]	10.5	100.0	0.129

Wilks' lambda

Wilks' lambda is a measure of how well each function separates cases into groups. Nearly all of the variance explained by the model is due to the first two discriminant functions. We can ignore the third function. In this model Wilks lamda of function 1 is 0.856 indicating the model is good (low value closer to 0 reflects better discriminating power of the model). For each set of functions, this tests the hypothesis that the means of the functions listed are equal across groups. The test of function 3 has a p value of 0.267, so this function contributes little to the model. Here the 1st and 2nd has a p value 0.000 and 0.010 which is significant and we can say that each function separates cases into groups.

Table 4.5.4: Wilks' Lambda

Test of Function(s)	Wilks' Lambda	Chi-square	df	Sig.
1 through 3	0.856	124.223	39	0.000
2 through 3	0.948	43.170	24	0.010
3	0.983	13.420	11	0.267

Standardized Canonical Discriminant Function Coefficients

Standardized Canonical Discriminant Function Coefficients (table 4.5.5) indicate the relative importance of the independent variables in predicting the dependent. They allow us to compare variables measured on different scales. Coefficients with large absolute values correspond to variables with greater discriminating ability.

Table 4.5.5: Standardized Canonical Discriminant Function Coefficients

	Function		
	1	2	3
Gender	0.338	0.455	-0.115
Smoking status	-0.086	-0.313	-0.025
Exercises Status	0.189	-0.058	0.302
Taking Meal Regular	-0.267	-0.288	0.089
Taking Breakfast	-0.349	0.166	0.247
Eating Except Snacks	-0.150	0.467	0.243
Take Snacks Apart Regular Meal	-0.357	-0.172	-0.200

Eat Fried Food	0.358	0.139	0.448
Eat With Family or Friends	0.166	-0.077	0.433
Eat To have Balance	0.261	-0.194	0.097
Drink Alcohol	0.411	-0.378	-0.209
Eat Sweets	0.180	0.129	-0.382
Like Beverage Juice	-0.161	0.357	-0.216

Structure Matrix

The structure matrix table shows the correlations of each variable with each discriminant function.

Table 4.5.6: Structure Matrix

	Function		
	1	2	3
Drink Alcohol	.406	0.406	-0.368
Taking Breakfast	-.395	-0.123	0.347
Taking Meal Regular	-.386	0.305	0.093
Take Snacks Apart Regular meal	-.382	0.082	-0.173
Eat To Have Balance	.249	0.233	-0.013
Gender	0.374	-.534	-0.111
Like Beverage Juice	-0.130	-.443	-0.179
Smoking Status	-0.050	.289	-0.102
Eat Fried Food	0.345	-0.029	.493
Eat With Family or Friends	0.177	0.154	.442
Eat Sweets	0.253	-0.251	-.381
Exercises Status	0.133	0.171	.316

Canonical Discriminant Function Coefficients

This table (4.5.7) contains the unstandardized discriminant function coefficients. These would be used like unstandardized b (regression) coefficients in multiple regression -- that is, they are used to construct the actual prediction equation which can be used to classify new cases.

Table 4.5.7: Canonical Discriminant Function Coefficients

	Function		
	1	2	3
X_1 = Gender	0.747	-1.006	-0.003
X_2 = Smoking Status	-0.287	1.076	-0.407
X_3 =Exercises status	0.195	0.127	0.293
X_4 =Taking Meal Regular	-0.572	0.608	0.048
X_5 Taking Breakfast	-0.299	-0.195	0.313
X_6 =Take Snacks Apart Regulae Meal	-0.330	0.121	-0.221
X_7 =Eat Fried Food	0.395	-0.073	0.536
X_8 =Eat With Famil yor Friends	0.161	0.154	0.404
X_9 =Eat To have Balance	0.312	0.317	0.016
X_{10} =Drink Alcohol	0.849	0.901	-0.770
X_{11} =Eat Sweets	0.199	-0.190	-0.398
X_{12} =Like beverage Juice	-0.124	-0.356	-0.095
(Constant)	-2.171	-2.225	-0.808

Here the discriminant model are

D_i=-2.171+0.747X_0-0.287X_1+0.195X_2-0.572X_3-0.299X_4-
0.330X_5+0.395X_6+0.161X_7+0.312X_8+0.849X_9+0.199X_{10}-0.124X_{11}

D_i=-0.356-1.006X_0+1.076X_1+0.127X_2+0.608X_3-0.195X_4+0.121X_5-
0.073X_6+0.154X_7+0.317X_8+0.901X_9-0.190X_{10}

D_i = -0.808-0.003X_0-0.407X_1+0.293X_2+0.048X_3+0.313X_4-
0.221X_5+0.536X_6+0.404X_7+0.016X_8-0.770X_9-0.398X_{10}-0.095X_{11}

Functions at Group Centroids

Centroids are the mean discriminant scores for each group. This table 4.5.9 is used to establish the cutting point for classifying cases.

Table 4.5.8: Functions at Group Centroids

Body mass index Category	Function		
	1	2	3
Under Weight	-0.249	-0.314	0.149
Normal Weight	-0.076	0.058	-0.078
Over Weight	0.342	0.302	0.263
Obese	1.378	-0.413	-0.137

Unstandardized canonical discriminant functions evaluated at group means

Classification Statistics

Table 4.5.9: Classification Processing Summary

Processed		811
Excluded	Missing or out-of-range group codes	0
	At least one missing discriminating variable	0
Used in Output		811

Prior Probabilities for Groups

Here prior probabilities for (table 4.5.10) each group is of the same size, so we specify equal prior probabilities for all groups.

Table 4.5.10: Prior Probabilities for Groups

Body mass index	Prior	Cases Used in Analysis	
		Unweighted	Weighted
Under Weight	0.25	147	147
Normal Weight	0.25	537	537
Over Weight	0.25	94	94
Obese	0.25	33	33
Total	1	811	811

Classification Results

This table 4.5.11 is used to assess how well the discriminant function works, and if it works equally well for each group of the dependent variable.

Table 4.5.11: Classification Results

Body mass index Category			Predicted Group Membership				Total
			Under Weight	Normal Weight	Over Weight	Obese	
Original	Count	Under Weight	76	27	31	13	147
		Normal Weight	174	155	137	71	537
		Over Weight	21	12	46	15	94
		Obese	2	4	4	23	33
	%	Under Weight	51.7	18.4	21.1	8.8	100
		Normal Weight	32.4	28.9	25.5	13.2	100
		Over Weight	22.3	12.8	48.9	16	100
		Obese	6.1	12.1	12.1	69.7	100
Cross-validatedb	Count	Under Weight	64	34	35	14	147
		Normal Weight	178	145	143	71	537
		Over Weight	24	17	33	20	94
		Obese	3	4	7	19	33
	%	Under Weight	43.5	23.1	23.8	9.5	100
		Normal Weight	33.1	27	26.6	13.2	100
		Over Weight	25.5	18.1	35.1	21.3	100
		Obese	9.1	12.1	21.2	57.6	100

4.6 Neural Network

Artificial neural networks, usually simply called neural networks or neural nets, are computing systems inspired by the biological neural networks that constitute animal brains. An ANN is based on a collection of connected units or nodes called artificial neurons, which loosely model the neurons in a biological brain.

Case Processing Summary

In table 4.6.1 I split the training and test sample. I take 73.5 % or 596 training sample and 26.5 % or 215 test sample.

Table 4.6.1: Case Processing Summary

		N	Percent
Sample	Training	596	73.5%
	Testing	215	26.5%
Valid		811	100.0%
Excluded		0	
Total		811	

Network Information

In table 4.6.2 represents in input layer 13 no of units, standardized rescaling method for covariates, 1 number of hidden layer. In hidden layer 4 number of units in hidden layer 1a, activation function hyperbolic tangent, 1 dependent variable (Body Mass Index), 4 number of units. In output layer activation function softmax and error function cross entropy.

Table 4.6.2: Network Information

Input Layer	Covariates	1	Gender1
		2	Smoking Status
		3	Exercises Status
		4	Taking Meal Regular
		5	Taking Breakfast
		6	Eating Except Snacks

		7	Take Snacks Apart Regular meal
		8	Eat Fried Food
		9	Eat With Family or Friends
		10	Eat To have Balance
		11	Drink Alcohol
		12	Eat Sweets
		13	Like beverage Juice
	Number of Units[a]		13
	Rescaling Method for Covariates		Standardized
Hidden Layer(s)	Number of Hidden Layers		1
	Number of Units in Hidden Layer 1[a]		4
	Activation Function		Hyperbolic tangent
Output Layer	Dependent Variables		Body mass index
	Number of Units		4
	Activation Function		Softmax
	Error Function		Cross-entropy

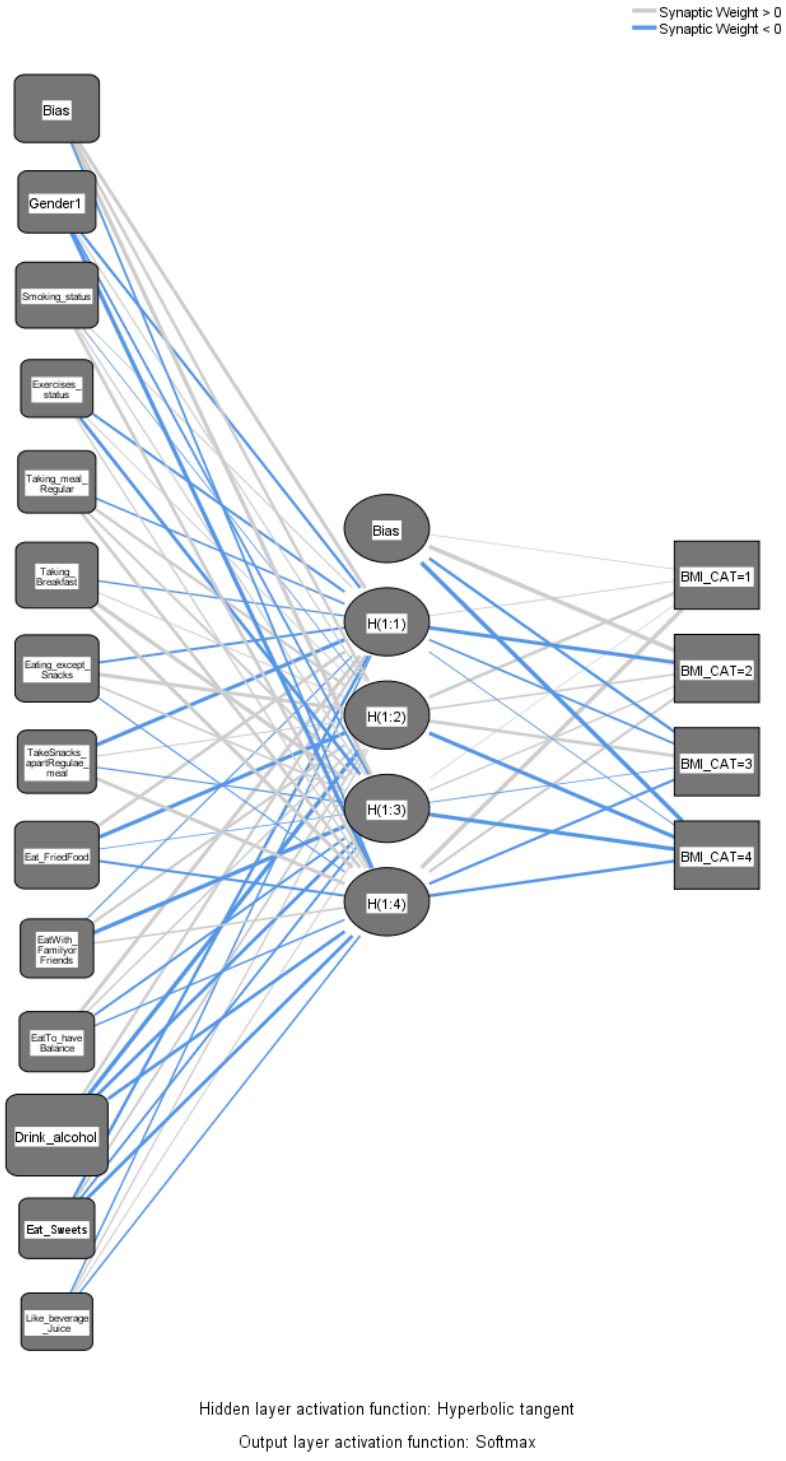

Figure 4.6.1: Neural network model (Multiple perceptions)

Model Summary

In table 4.6.3 shows that cross entropy error 544.262, percent incorrect predictions 35.4%, training cross entropy error 188.572, testing incorrect predictions 29.3% that's mean the model predict 70.70% correctly.

Table 4.6.3: Model Summary

Training	Cross Entropy Error	544.262
	Percent Incorrect Predictions	35.4%
	Stopping Rule Used	1 consecutive step(s) with no decrease in error
	Training Time	0:00:00.23
Testing	Cross Entropy Error	188.572
	Percent Incorrect Predictions	29.3%

Table 4.6.4: Classification

Sample	Observed	Predicted				
		Under Weight	Normal Weight	Over Weight	Obese	Percent Correct
Training	Under Weight	0	117	0	0	0.00%
	Normal Weight	0	385	0	0	100.00%
	Over Weight	0	73	0	0	0.00%
	Obese	0	21	0	0	0.00%
	Overall Percent	0.00%	100.00%	0.00%	0.00%	64.60%
Testing	Under Weight	0	30	0	0	0.00%
	Normal Weight	0	152	0	0	100.00%
	Over Weight	0	21	0	0	0.00%
	Obese	0	12	0	0	0.00%
	Overall Percent	0.00%	100.00%	0.00%	0.00%	70.70%

Accuracy: Accuracy is the probability that the model prediction is correct. Here accuracy 70.70% that means the model prediction is 71% correct.

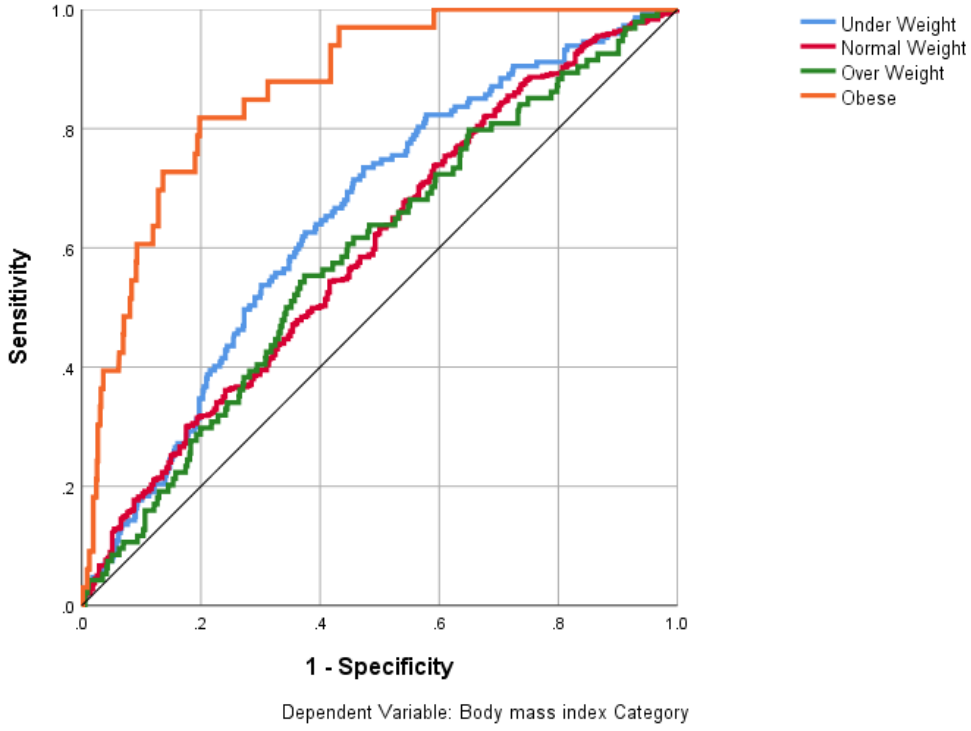

Figure 4.6.2: ROC curve

In this ROC curve we can see that the Orrange line that is Obese give the best accuracy in predictions because it is close to the left corner (0, 1) of the ROC space.

AUC table indicates the area of under weight is 0.651, normal weight is 0.597, Overweight is 0.588, obese is 0.867. They give good accuracy in predictions. Among them Obese give best accuracy in predictions.

Table 4.6.5: Area Under the Curve

		Area
Body mass index	Under Weight	0.651
	Normal Weight	0.597
	Over Weight	0.588
	Obese	0.867

Chapter-5

Conclusions and Recommendations

In this study, I explored the relationship between certain eating habits and the risk of obesity and overweight among the students of IU. Finally, from the chi-square table we can conclude that BMI status has significant association with gender, physical activity and exercise, meal regularity, breakfast habit, snacks habit, fried food, suffer obesity and overweight related disease, sweet, beverage and juice preference. The data also fit model perfectly. From the likelihood ratio test we can conclude that there is significant association between Dependent and independent variables (Gender, Age, Height, Weight, meal, Snacks, Fried food). The model correctly classifies 100% of cases overall a percentage accuracy in classification. In factor analysis the sample adequacy is 6.645 in KMO test and the matrix is not an identity matrix in Bartlett's test. I get four principal component and four factors in factor analysis using PCA. Here the 1st principal component explain 26.097% of total variance. Cumulative percentage is 64.582. Scree plot gives 4 component. In discriminant analysis wilks lamda test is significant (0.00). In this model Wilks lamda of function 1 is 0.346 indicating the model is good. Such that each function separates cases into groups well. Discriminant analysis gives 54.4% accuracy in prediction. In Neural Network analysis we get neural network model and here accuracy in prediction is 70.70%. Obese give best AUC in ROC Curve. Among this model multinomial logistic regression model is good for accuracy in prediction.

In this study, we evaluated the association between specific eating behaviors and the likelihood of obesity and overweight in IU students. My result explained that low level of physical exercise, eating meal more, eating snacks, low eating of fruit and vegetables, eating fried food habit, sweet eating habit and drinking beverage and soft drinks may have caused obesity and overweight.

So, I suggested that sufficient meal habit, eating vegetables and fruits, enough exercise, avoid excessive fried food and snacks and reduce drinking beverage and soft drinks may have potential benefits for reducing obesity and overweight among students of IU.

In addition to lowering the incidence of obesity-related disorders, my research offers some helpful information for interventions aimed at preventing the onset of obesity and overweight, which would benefit both the individual and their family.

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Questionnaire

1. Name.
Ans:

2. Department.
Ans:

3. Faculty.
● Theology and Islamic Studies ● Faculty of Arts ● Faculty of Social Science Faculty of Law● Faculty of Business Administration ● Faculty of Sciences ● Faculty Of Engineering & Technology ● Faculty Of Biological Science

4. Session.
Ans:

5. Gender.
● Male ● Female

6.Age.
Ans:

7. Height.
Ans-

8. Weight.
Ans:

9. BMI.
Ans:

10. Educational Qualification of father.
● Under S. S. C● S. S. C ● H. S. C ● Honors ● Masters ● Others

11. Educational Qualification of father.
● Under S. S. C ● S. S. C ● H. S. C ● Honors ● Masters ● Others

12. Occupation of Father.
● Government ● Non-Government ● Businessman ● Farmer ● Worker ● Others

13. Occupation of Mother.
● Government ● Non-Government ● Businessman ● Housewife ● Others

14. Total Family income.
● 10,000 – 20,000 ● 21,000 – 30,000 ● 31,000 – 40,000 ● 41,000 – 50,000 ● 50,000+
● Others

15. Where do you live in?
● Own home ● Rent house ● Govt. house ● Hostel ● Mess ●Others

16. Do you Smoke?
● Never ● Regularly ● Irregularly

17. Do you exercise, or Physical activities make your body fit?
● Every day ● In specific day ● Sometimes ● Never

18. Do you take your meal regularly?
● Always regular ● Irregular

19. Do you take breakfast?
● Daily ● Three of four times per week ● Once or twice per week ●Rarely.

20. How many times do you eat meals except snacks?
● One time ● Two times ● Three times ● Four times

21. How often do you take snacks apart from regular meals?
● Daily ● Three or four times per week ●Once or twice per week ● Rarely

22. How often do you eat green, red or yellow colored vegetables?
● Daily ● Three or four times per week ●Once or twice per week ● Rarely

23. How often do you eat fruit?
● Daily ● Three or four times per week ●Once or twice per week ● Rarely

24. How often do you eat fried food?
● Daily ● Three or four times per week ●Once or twice per week ● Rarely
25. How often do you eat with family and friends?
● Daily ● Three or four times per week ●Once or twice per week ● Rarely

26. What type of food do you think you should eat to have a balanced nutrition?
● Mainly meat ● Mainly vegetables ● Others

27. How often do you drink alcohol?
● Regularly ● Two or three times per week ● Rarely ● Never

28. Do you think obesity relates with rood habit?
● Yes ● No

29. Do you suffer any disease related with obesity? (Who is obese)
● Yes ● No

30. If 29 (yes) which disease?
● Diabetes type 2 ● Hypertension ● Sleep apnea ● Osteoarthritis ● Digestive problem
● heart disease ● Stroke ● Others

31. Do you like eat sweets?
● Yes ● No ● some times

32. What kind of beverage or juice do you like?
● Soft drink ● Fresh juice ● Both