Master of Science in Public Health

Assessment of Metabolic Syndrome and its Knowledge among Adults Visiting Fitness and Rehab Centers, Rawalpindi

By

Bushra Kanwal

Al-Shifa School of Public Health, PIO,

Al Shifa Trust Eye Hospital

Quaid-i-Azam University

Islamabad, Pakistan

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Assessment of Metabolic Syndrome and its Knowledge among Adults Visiting Fitness and Rehab centers, Rawalpindi

BUSHRA KANWAL

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This dissertation is the result of an independent investigation. Where my work is indebted to others, I have made acknowledgments.

I declare that this work has not been accepted in substance for any other degree, nor is it currently being submitted in candidature for any other degree.

_____ _____

(Ms. Hina Sharif)

Al-Shifa School of Public Health,
PIO, Al Shifa Trust Eye Hospital

Date: 08-04-2022

(Bushra Kanwal)
362827-PIO/MSPH-2020
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LIST OF ABBREVIATIONS

CVDs - Cardio vascular diseases

HDL – High density lipoproteins

IDF - International Diabetes Federation

LDL – Low intensity lipoprotein

METS – Metabolic Syndrome

METS-KS - Metabolic syndrome knowledge scale

NCDs - Non-communicable diseases

NCEP ATP-III - National Cholesterol Education Program Adult Treatment Panel – III

ABSTRACT

Background:

The metabolic syndrome is the name of a cluster of threat factors that, when they appear together, dramatically raise the risk of heart complaint, heart failure, stroke and diabetes, as well as other non-cardiovascular conditions. Prevalence of MetS is high, which is an alarming situation. Significant public awareness has to be created to eliminate the epidemic of the metabolic syndrome, which is creating substantial challenges.

Objectives:

The main aim of the study is to evaluate metabolic syndrome and its knowledge among adults visiting fitness and rehab centers of Rawalpindi.

Methodology:

This cross sectional study included 334 eligible adults visiting the fitness and rehab centers of Rawalpindi. Data was collected using a structured questionnaire and NCEP ATP III criteria was used to assess the level of metabolic syndrome. Metabolic Syndrome Knowledge Level Scale (MetS-KS) was used to measure the knowledge level of MetS. Pearson chi square was employed to determine any association between sociodemographic factors and metabolic syndrome. Data was analysed using SPSS version 25 and for statistical significance, $P < 0.05$ was accepted.

Results:

Total 334 adults visiting fitness and rehab centers participated in this study out of which 41.0% (n=137) were females and 59% (n=197) were males. The overall prevalence of metabolic syndrome in the study was 30.2% (101), out of which 36 (35.6%) were females and 65 (64.3%) were males. Factors significantly associated with Mets were educational levels, BMI, employment status, age, diabetes, hypertension, work demanding physical activity, family history of diabetes and physical activity level. Knowledge about the Metabolic syndrome (MetS) is high 54.5% (n=182) in the participants. A significant association between educational level and knowledge of METs. Out of 334 participants, 53.9% (n=180) said that patients of MetS have a higher risk of

myocardial infarction, while 51.2% (n=171) participants reported that the thickness of the waist circumference is a crucial factor of MetS.

Conclusion:

Metabolic syndrome is quite prevalent in the population i.e. 33% and lifestyle-related risk factors are associated with the metabolic syndrome. The overall knowledge of adults regarding metabolic syndrome was good. Adopting a healthier lifestyle can have a positive impact.

Keywords:

Cardiovascular disorder, hypertension, knowledge, metabolic syndrome, obesity, type 2 diabetes

CHAPTER I: INTRODUCTION

1.1 Definition and background

As the world have successfully overcome many infectious diseases, Non-communicable diseases (NCDs) have increased the morbidity and mortality rate in the developing world as well as developed world. Metabolic syndrome (MetS) is the real plague in this world among all NCDs (Saklayen, 2018).

Metabolic syndrome is a cluster of determinants having metabolic origin. They are associated with different cardiovascular diseases and Type II diabetes mellitus. Insulin resistance can result in clustering of risk factors and contribute towards unexpected outcomes associated with metabolic syndrome. Atherogenic dyslipidemia, pro-thrombotic state and pro-inflammatory states are the associated clinical risk factors. Elevated blood pressure and plasma glucose levels, low High-Density Lipoprotein (HDL) and high triglycerides level are symptoms of Atherogenic dyslipidemia. Truncal obesity, hyperinsulinemia and low glucose tolerance are also characteristics of metabolic syndrome. Studies of intermittent claudication have also reported lipid profile abnormalities, such as reduced HDL levels and high triglyceride level. Strong association between HDL Levels and claudication severity have also been reported (Daynene Vykoukal, 2011).
Syndrome, described by Gerald M. Raevan (1980s), have number of definitions as well as criteria for diagnostic. The National Cholesterol Education Program Adult Treatment Panel – III (NCEP ATP-III) and International Diabetes Federation (IDF), defined MetS as group of interlinked metabolic abnormalities. These abnormalities included hypercholesterolemia and dyslipidemia as well as diabetes mellitus, obesity and elevated blood pressure. Mortality rate in cardiovascular diseases and type-II diabetes mellitus increases due to MetS. Associations between MetS and pro-thrombotic as well as pro-inflammatory states have also been reported. MetS is also associated with reproductive diseases and non-alcoholic steatohepatitis (P. Ranasinghe, 2017).

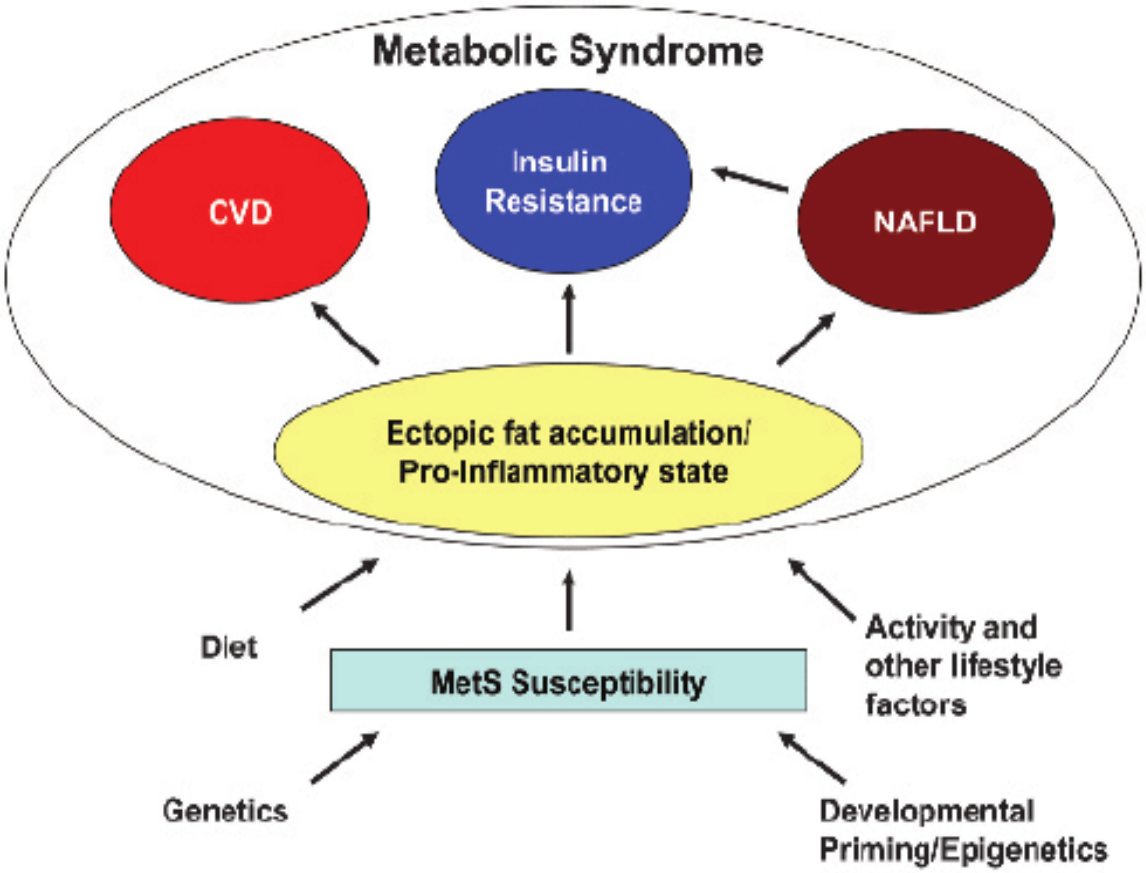


Figure 1: Schematic diagram of the metabolic syndrome (MetS) with suggested mechanisms linking the MetS components.

MetS patients have two-fold susceptibility to cardiovascular diseases and five-fold to Type-II diabetes mellitus as compared to normal persons. (Grundy, 2008). Microvascular damage, caused by Insulin resistance, makes patient liable to endothelial damage and hypertension. Endothelial damage lead to hypertension and atherosclerosis. Hypertension can cause vascular damage including ventricular hypertrophy and cardiomyopathy. It also leads to renal impairment (Swarup, Goyal, Grigorova, & Zeltser., 2022).

1.2 The Global Picture of METS

20-30% of adults in most countries suffer from metabolic syndrome. This puts huge health, social and economic burden on those countries. In developing countries, prevalence is low as compared

to developed countries due to higher population of young adults. Increase in average age of population, increases the prevalence (Grundy, 2008).

American Heart Association estimates that 47 million, 1 out of 6, Americans suffer from metabolic syndrome. The syndrome is inheritable. Hispanic, Asian, Native American, and African-American are more liable to MetS.

Asian countries have reported nearly equal liability in men and women to metabolic syndrome and its associated risk factors including hypertension and dyslipidemia while in European Countries, men are more susceptible. MetS prevalence is age dependent. Increase in age also increases the prevalence. Young adults of South Asia develop cardiovascular risk factors early (Niloufer Sultan Ali A. K.-u.-R., 2012).

India and other South Asian countries are reporting surge in prevalence of metabolic syndrome as well as obesity. Parts of India reported 11-41% prevalence. An increase in mortality as well as morbidity rate due to cardiovascular diseases and Type II diabetes mellitus have been observed because of increase in prevalence of MetS. $1/3^{rd}$ of South Asian living in urban areas show symptoms of MetS. In Asia, 30% children suffer from Insulin resistance. Most of them show symptoms of MetS (D. S. Prasad, 2012).

According to different definitions of prevalence, Asian countries have reported 10-40% prevalence of metabolic syndrome. Urban areas of Karachi, have reported 12-20% prevalence according to an epidemiological survey while according to definitions of WHO, ATP III, and IDF, 12%, 20% and 27% prevalence were reported respectively. In another epidemiological study conducted in Chennai, 23%, 18%, and 26% prevalence was reported when check in accordance with definitions of WHO, ATP III, and IDF, respectively. A tertiary cardiology unit in Pakistan conducted a study of 400 subjects, in accordance with ATP III, and reported 44% prevalence. $2/3^{rd}$ patients of diabetes and $1/4^{th}$ general population of Pakistan are suffering from MetS. Another study conducted in Karachi, in accordance with WHO definition, 46% patients of Type II diabetes mellitus also suffered from MetS (Abdul Basit, 2008).

Metabolic syndrome prevalence was lower in men as compared to women. The major contributor in women were Hyperglycemia and increased waist circumference while hypertension and

elevated triglycerides contributed largely in men. In women, elevated BMI and low HDL cholesterol also contributed significantly. Men and women showed difference in contribution of several metabolic components in MetS. The relative risk of metabolic complications have gender specific differences because of this factor (Jain, 2012).

1.3 Heredity

Difference in rate of inheritance was reported. Insulin resistance, blood pressure, plasma glucose and insulin, and waist circumference had lowest rate of inheritance while lipoprotein and plasma lipid show highest. Genetic as well as environmental factors influenced both waist circumference and plasma glucose. This suggested that in addition to insulin resistance, there is a variety of other influencers that influences plasma glucose and waist circumference (Sonya J.Elder, 2009).

Abdominal obesity and insulin resistance appear to be the principal risk factors behind MetS. Aging, lack of physical activity and imbalance of hormones are also associated with MetS. A diet that is rich in fats can also increase the probability of developing cardiovascular diseases in patients of MetS. Atherogenic diet is not a risk factor for MetS.

Individuals with MetS are generally advised to improve lifestyle by avoiding drugs and tobacco, eating healthy food and increasing their physical activity to control risk factors (Jeffrey J. VanWormer, 2017). Initial strategies for prevention and treatment of metabolic syndrome include changing lifestyle. MetS can be delayed or prevented by adopting a healthy lifestyle.

A healthy lifestyle can also prevent cardiovascular diseases as well as Type 2 diabetes mellitus in patients suffering from MetS. In obese persons, preventing MetS requires weight loss which can be achieved by restricting calorie intake and increasing physical activity. These weight loss steps must be characterized based on physical fitness level and disease a person suffer (Pablo Pérez-Martínez, 2017).

Apart from controlling weight and reducing calorie intake, diet should have low amount of saturated fats, and simple sugars. Quantity of Trans fats, cholesterol and sodium should also be low. Sufficient amount of fruit, vegetables and whole grain should also be present in diet. Mercury content of some fishes should be kept in mind while eating fishes which is encouraged in

preventing MetS. Dyslipidemia is worsen when diet contains very high amount of carbohydrate. As recommended by ATP III, 25-35% of total calories of diet should be compromised of fats for individuals managing their cholesterol levels. A diet with more 35% fats causes difficulty in maintaining low level of LDL because of low intake of saturated fats (Scott M. Grundy, 2005).

An interdisciplinary team compromising of dietician, pharmacist, doctor of internal medicine, cardiologist bariatric surgeon, neurologist, nurse practitioner, social worker, physical therapist and endocrinologist, can provide best management of MetS. Preventing and educating patient serves as the key to this disorder. The patient must be educated regarding changes in lifestyle and weight loss and their importance in preventing MetS. Patient should also be educated about diet of Mediterranean people and exercise by a dietician. Refraining from cigarette smoke and alcohol should be encouraged. Patient compliance towards the medicine should be ensured by pharmacist. Exercise is the most important intervention. Exercise lowers cholesterol blood pressure, blood glucose and body weight simultaneously. The last but not least step is educating patients with a good sleep routine (Lawson, 2018).

Prevalence of MetS is high, which is an alarming situation. The effects on health of people are important. Screening of MetS from general population is required and screening measures should be economical and non-invasive. It should be simple yet it should give reliable results. These measures are specially needed in developing countries (Tania Naveel Sabiha Gul, 2022).

1.4 Criteria for diagnosis

For diagnosis of metabolic syndrome, different types of clinical criteria were developed by different expert groups. None of those criteria got complete acceptance. In 1998, WHO presented the first proposal followed by EGIR. NCEP and ATP III defined MetS in 2001.
In 2005, American Heart Association and NCEP updated the definition. In the same year, IDF, published a new set of criteria diagnosis of MetS. Organizations published a Joint Interim Statement (JIS) in 2009. The statement proposed that the same components should be measured. However, there was a difference in cut-off and combinations of these organizations, which is why prevalence of MetS is not same for every organization in the same sample/population (Rebuma Belete, 2021)

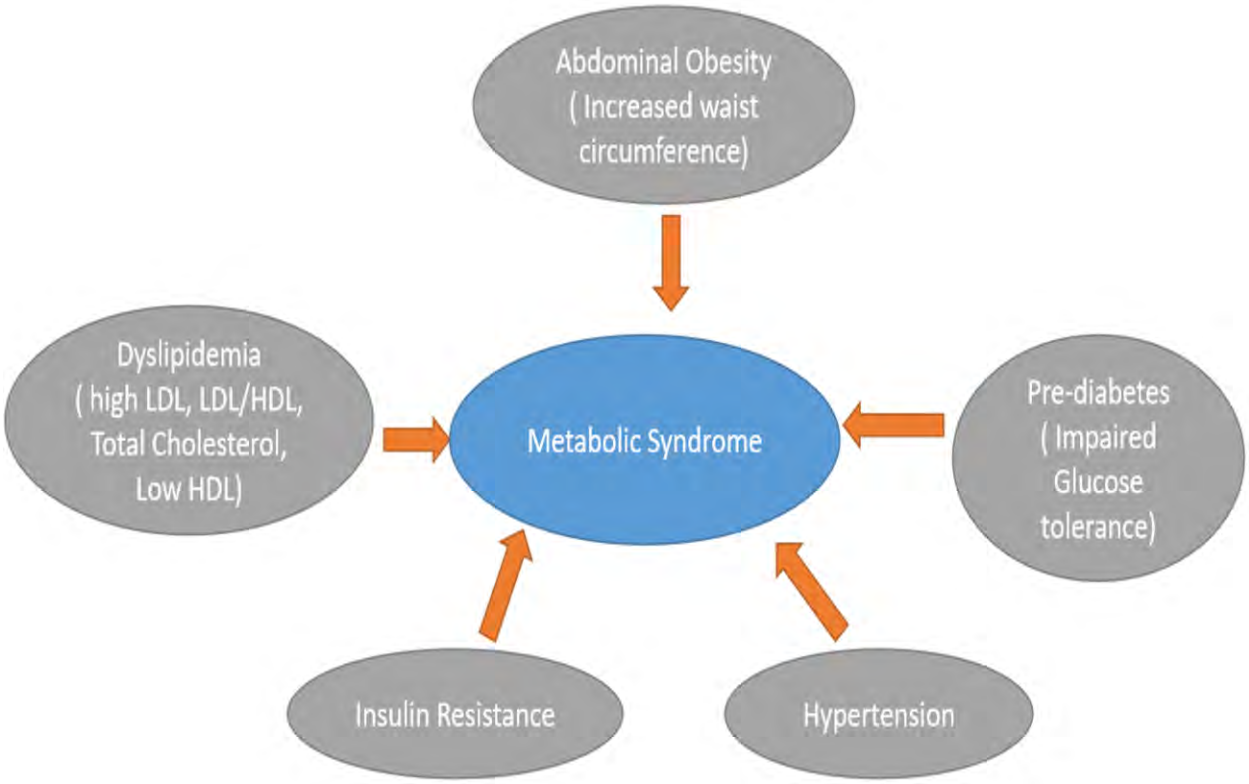


Figure 2: criteria for diagnosis

The following table summarizes definitions of metabolic syndrome;

	WHO (1998)	**NCEP ATP III (2005)**	**IDF (2005)**
Criteria	Insulin Resistance >6.1nmol/L (110 mg/dl)	Presence of either of • Obesity • Dyslipidemia • Hypertension	Waist Circumference • Men≥94cm • Women≥80 cm Along with two of; • Obesity • Dyslipidemia • Hypertension
Obesity	Waist/hip ratio • Men> 0.9 Women> 0.85 BMI> 30 kg/m2	Waist Circumference • Men>40 inches • Women>35 Inches	Central obesity
Dyslipidemia	TG≥150 mg/dl HDL • Men<0.9 mmol/L (35 mg/dl)	TG≥150 mg/dl	TG≥150 mg/dl

	• Women<1.0 mmol/L (40mg/dl)		
Hypertension	≥140mmHg	Systolic>130mmHg Diastolic>85mmHG	

Table 1: Definition of Metabolic Syndrome (Huang, 2009)

1.5 Rationale for the study

A more up to date understanding of MetS is required because of the socio-economic changes that have occurred during last decade in Pakistan. Therefore this study is an effort to determine the burden of metabolic syndrome and to evaluate its association with sociodemographic factors. Moreover it also analyzes the knowledge of Pakistani adults about the risk factors of metabolic syndrome using metabolic syndrome knowledge level scale (METS-KS). This will provide insights of the frequency of metabolic syndrome in this section of the population and will also help determine that which socio demographic factors contribute to it. The findings may serve to be beneficial for future management and will help to develop interventional strategy at community and governmental levels. It can also be used to design schemes that promote healthcare especially for improving awareness and knowledge related to MetS.

1.6 OBJECTIVE(S)

1. To assess metabolic syndrome among adults visiting fitness and rehab centers.

2. To assess their knowledge regarding risk factors for metabolic syndrome.

3. To study the association between socio-demographic factors and metabolic syndrome.

1.7 Operational Definition

1. **Metabolic syndrome (METs):**

The NCEP ATP III panel defined metabolic syndrome as the presence of three or more of the following determinants: 1) increased waistline (>102 cm [>40 in] for men, >88 cm [>35 in] for women); 2) elevated triglycerides (≥150 mg/dl); 3) low HDL cholesterol (<40 mg/dl in men, <50 mg/dl in women); 4) hypertension (≥130/≥85 mmHg); and 5) impaired fasting glucose (≥110 mg/dl)

2. **Cardiovascular disease (CVDs):**

CVDs are heart diseases that point out to a group of diseases that affect the heart and blood vessels of your body.

3. **Metabolic syndrome knowledge level scale (METS-KS):**

A validated scale comprising of 25 questions regarding METS which is used to assess level of knowledge about METs in individuals.

4. **Waist circumference:**

The measurement was taken around the abdomen at the level of the umbilicus (belly button), it is commonly used to screen patients for possible weight-related health problems.

CHAPTER II: LITERATURE REVIEW

Over the years, there have been various studies conducted on metabolic syndrome in which researchers have focused on the prevalence of the syndrome and its associated determinants. Additionally, knowledge of metabolic syndrome have also been studied extensively in various sections of the population. There are definitely some factors that cause metabolic syndrome. They cannot be replaced but many are malleable for alteration and reduction. This section discusses past research and its findings on topics relevant to the current study and focuses on understanding the current problem in light of previous results and conclusions.

2.1 Universal problem

Spread of Western lifestyle all around the world has caused metabolic syndrome to become a universal problem. The metabolic started from West and spread east and Far East. The prevalence of this disease is lower in urban areas of West as compared to East. Diet which is rich in high calorie and low in cellulose or starch is one of the major reason for spread of this ailment while the other is luxurious lifestyle which has decreased physical activity. This ailment also increases the prevalence of other related disease such as coronary diseases, stroke, type 2 diabetes and others (Saklayen, 2018).

2.2 Mets in America

Central American Diabetes Initiative (CAMDI) started a study to evaluate prevalence of MetS. Five Major Central American populations were taken into accounts in this study, they were; Nicaragua (Managua), Honduras (Tegucigalpa), Belize (national), Guatemala (Guatemala City), and Costa Rica (San José). NCEP-ATP III criteria of MetS was used to find prevalence. 30.3% was the overall prevalence reported. Differences in gender and working conditions provided variability in prevalence. Unpaid workers and females reported more prevalence (Roy A. Wong-McClure, 2015).

An intervention study conducted in city of Picos, Brazil reported that if students are provided support and awareness, than it resulted in an increased knowledge about MetS and its risk factors.

It also caused a change in attitude among young adults towards risk factors of MetS (Ramiro Marx Alves Cortez, 2018).

A study was conducted in Central Michigan University. Objective of the study was to assess the level of perception as well as knowledge about MetS present in young adults. It was found that 80% of students were able to identify risk factors of heart as arteriosclerosis, diabetes, hypertension and stroke. 39% of female falsely believed than diabetic patient is allowed only certain sweets while in male the number was 58%. Liposuction was falsely identified by more than 50% of students as best treatment of adiposity (Najat Yahia, 2014).

2.3 Mets in African Countries

A study was conducted in Ghana, reporting, Type II Diabetes susceptibility increases 5 times if patient suffers from metabolic syndrome. The same study reported a 90.6% of prevalence with female being affected more than male. The main risk factors reported by the author were high waist circumference and high levels of triglycerides (Francis Agyemang-Yeboah, 2019).

A study was conducted at Ho Municipal Hospital, Ghana. The study was aimed to estimate the frequency of metabolic syndrome as well as its associated determinants. The study sample were the Type 2 diabetes patients attending the hospital. It was reported that the prevalence in accordance of NCEP-ATP III was 43.83%, according to WHO criteria it was 63.58% and according to IDF definition, it was 69.14%. Abdominal obesity was determined as most common risk factor by IDF (69.14%) while high blood pressure suggested as most important risk factor by NCEP-ATP III (66.67%) and WHO (62.96%). High blood pressure was more prevalent in male than female while in female abdominal obesity was common (James Osei-Yeboah, 2017).

2.4 Mets Trends in Asia

A study took place in Qatar with the objective of assessing the frequency of MetS as well as it determinants and to decide what should be optimum range for abdominal obesity. The best way to measure obesity was waist circumference. It was found nearly 1/4th of all adults in Qatar are within range of criteria of MetS. With the increase in age or physical activity of a person, the chances of MetS were lower (Mohamed Hamad Al-Thani, 2016).

A study was conducted in Syria. The study was aimed to determine frequency of MetS as well as its components in adults. It was reported that MetS was found in 39.6% participants. Hypertension was found in 56.6% participants, it was most common component. Central obesity was reported in 51.4% participants. If obesity and diabetes was found in family history, it caused an increase in the risk of MetS. Adult Syrians are prone to CVDs and its cause is the high frequency of MetS and its components (H. Ramadan, 2016).

A study was conducted in China. Its aim was to evaluate how much knowledge Chinese adults have regarding MetS. This study reported than 50% of participants had MetS. Most of the participants were obese. 44.9 was the mean knowledge score. Participants scoring below 50% were more than 61%. This showed that there is poor knowledge of MetS among Chinese. The lowest score were from unemployed participants or participants having lower level of education (Sally Wai Size Lo, 2015).

Another study in China evaluated knowledge level of MetS in patients that are hospitalized and that present one of the cardiometabolic risk factors. Majority of patients previously had no history of cardiometabolic risk factors such as hypotension, dyslipidemia or diabetes. MetS was present in 56% of participants. Media score of MetS Knowledge Scale was very low. This implied that education of MetS should be provided immediately. Participants having higher MetS knowledge also had higher education level, history of dyslipidemia and normal level of HDLs. The study concluded that adults already suffering from cardiomaetabolic risk and having low knowledge of MetS, can develop MetS (by Qun Wang, 2019).

A study took place in Northern Taiwan to find the relation between MetS and health behaviors and education. Higher the education level, lower are the chances of MetS. Persons who keep check and balance in waist circumference and blood pressure had lower chances of MetS. MetS risk was lower in participants having more knowledge about health. Knowledge about hypertension reduced MetS by chances by &% while diabetes knowledge reduced it by 8% (Tsou, 2017).

A study was conducted in Western Turkey with aim of evaluating the likely factors that are common between level of knowledge regarding MetS and literacy level of health of adult population. There no direction connection between Health literacy level and MetS knowledge. However, there was association between MetS Knowledge as well as Health literacy level, with

higher educational and socioeconomic levels and positive health behaviors of young adults (G Ozturk Emiral, 2021).

A study in Sri Lanka evaluated knowledge as well as attitudes and practice of Sri Lankan adults towards MetS as well as CVDs and risk factors of both. A questionnaire was made. The scale was set as high, moderate and low. The study reported that adults had moderate practice and knowledge score regarding CVDs as well as its risk factors while attitude score was high. If a participant had high knowledge score, waits circumference was low. They also had reduced levels of fasting glucose. Participant having high practicing score, showed lower BMI as well as waist circumference. Participants having moderate knowledge score had high attitude score. This study proves that higher knowledge and pratise decreases CVDs and MetS risk factors (Priyanwada Amarasekara, 2016).

Another similar study was conducted in Tehran Province, Iran to assess KAP (Knowledge, Attitude and Practice) score associated with CVDs and its risk factors. A questionnaire was made. The scale was from 0-100. For knowledge related to CVDs, the median score was 91.7. 80% of participants showed highly satisfactory awareness level. Hypertension was identified as most common risk factor of CVDs. Obesity was 2nd most risk factor. 89 was the median score for attitude. 70% of participant's attitudes was highly satisfactory towards CVDs. In behaviors, the study concluded that behaviors of majority was not satisfactory (Khalili, 2020).

2.5 Mets Trend in Pakistan

To access the prevalence of MetS in Karachi, an epidemiological study was conducted in Urban Karachi. According to criteria of IDF, the prevalence was 54.9% while NCEP putted it at 55.4%. High level of triglycerides and diabetes and other diseases related to glucose impairment caused the highest prevalence of MetS in people age from 45 to 54 years old. People above the age of 55 years, reported hypertension commonly while young people, below the age 34, had low level of HDLs common in them. The prevalence was found to be same in both genders, however, there were differences reported between some components of different genders. Man showed lower prevalence in terms of fasting glucose impairment, high levels of HDLs and obesity (Asma Ahmed, 2020).

A survey was conducted by Aga Khan University Hospital, Karachi. The study was aimed to compare clinical risk determinants related to metabolic syndrome between males and females and also to determine its prevalence. 35.2% adults presented 3 or more risk factors of metabolic syndrome. In 36.4% of sample, the glucose level during fasting was elevated. BMI of above 25 was reported in 78.8% sample. Male were more susceptibility to MetS as compared to females. Prevalence was similar to previous studies in developing countries. Higher lower of glucose during fasting and obesity were reported in most of patients with MetS. Females had lower levels of triglycerides and higher level of HDLs as compared to make while blood pressure was almost same for both (Firdous Jahan, 2007).

A study in Pakistan reported that 46-68% of Pakistani population is obese if their waist circumference is measured. There was a strong association between insulin resistance and fatty arms. In terms of dyslipidemia, low levels of HDLs was found in 68-81% while 27-54% of population have high levels of triglycerides. Half of the population of Pakistan, is at a high risk of hypertension as well as MetS. Prevalence of MetS, in accordance with varies definitions, ranges from 18% to 46%. This is because of high prevalence of risk factors. MetS needed to be considered as prime target when using preventive medicine. Lifestyle can also be a risk factor associated with MetS and diabetes. Preventive programs are needed in order to prevent the disease before majority of cases starts developing complications (Abdul Basit, 2008).

Agha Khan University Hospital conducted another study with aim to calculate the persistence of MetS, along with its components and all other components associated with MetS. This study reported 63.7% prevalence of MetS. BMI over 25 was found to be present in 70.3% of sample. It was the most common risk factor of MetS. Male gender encounter this ailment more frequently than females. There was also association between, MetS and diabetes in parents (Niloufer Sultan Ali A. K.-u.-R., 2012).

Another study took place in Bahawalpur, Pakistan aimed of checking frequency of MetS as well as the level of awareness that is present in the medical community (healthcare workers). 14.95% of participants were diagnosed with MetS. Gender difference did not played any significant report in prevalence in this study. 18.56% of participants were able to identify three criteria of MetS and physicians showed higher levels of awareness. 22.68% of participants suffered from abdominal

obesity. Female had lower prevalence (14.74%) as compared to males (29.29%) (Mazhar Faiz Alam, 2011).

2.6 Risk for CVDs

Risk of cardiovascular diseases (CVDs) is higher when a person is suffering from metabolic syndrome (MetS) compared to normal person. In order to check association between varying definitions of MetS published by various organizations, a meta-analysis compromising of cohort studies and RCT post-hoc analysis was performed. This meta-analysis also evaluated risk of death in every patient from MetS as well as from MetS in combination with CVDs. This analysis showed that MetS increases death in every case. Low level of HDLPs also increased risk of death in normal as well as CVDs. Low level of glucose (less than 100 mg/dl), also increased risk of death (Xiao Li, 2021).

MetS can increase the CVDs probability by almost 2 times. It also increases general mortality by 1.5 times. This findings were reported in systematic review which was also a meta-analysis (Salvatore Mottillo, 2010).

2.7 Mets Prevalence in Young Adults

A statistical analysis technique, known as pooled analysis, was used in order to determine frequency of MetS as well as its risk determinants in young adults, from previous literature. It was found that 4.8-7% of young adult exhibited MetS. 26.9-41.2% young adult had low level of HDLs, proving it to be most prevalent component. Fasting glucose levels (2.8-15.4%) was also higher than normal. 6.8%-23.6% young adults reported abdominal obesity. Higher blood pressure was found in 8.6-15.6% young adults. It was concluded that MetS is quite frequently present in young adults (Paul B.Nolan, 2017).

CHAPTER III: METHODOLOGY

3.1 Study Design

A cross-sectional study was designed, focused on assessing prevalence of metabolic syndrome and its knowledge in the study group.

3.2 Study Setting

This study took place in the fitness and rehabilitation centers of Rawalpindi. Multistage cluster sampling was used and clusters were made of different areas in Rawalpindi. An area was selected randomly. Two fitness and rehab centers were selected via convenience sampling.

3.3 Study Duration

The study was continued over a span of 6 months i.e. from March 2022 to August 2022.

3.4 Study Population

All adults of age more than 20 years and less than 65 years were a part of the study.

3.5 Inclusion Criteria

- Both genders were included in the study.
- All clients of age >20yrs and <65 yrs. visiting the fitness and rehab centers.
- Adults who consented to participate in the study.

3.6 Exclusion Criteria

- Pregnant and lactating women.
- Those clients who were long-term members of the fitness and rehab center.

3.7 Sampling

- **Sampling frame:** All clients of age >20yrs and <65 yrs. visiting the fitness and rehab centers.
- **Sampling unit:** A client of age >20yrs and <65 yrs. visiting the fitness and rehab centers.

- **Sample size:** Following formula was used to calculate sample size

$$\mathbf{N = z^2 \times P \times Q \div E^2}$$

Where,

P= estimated prevalence in previous studies

Z= confidence interval at 95% (standard value of 1.96)

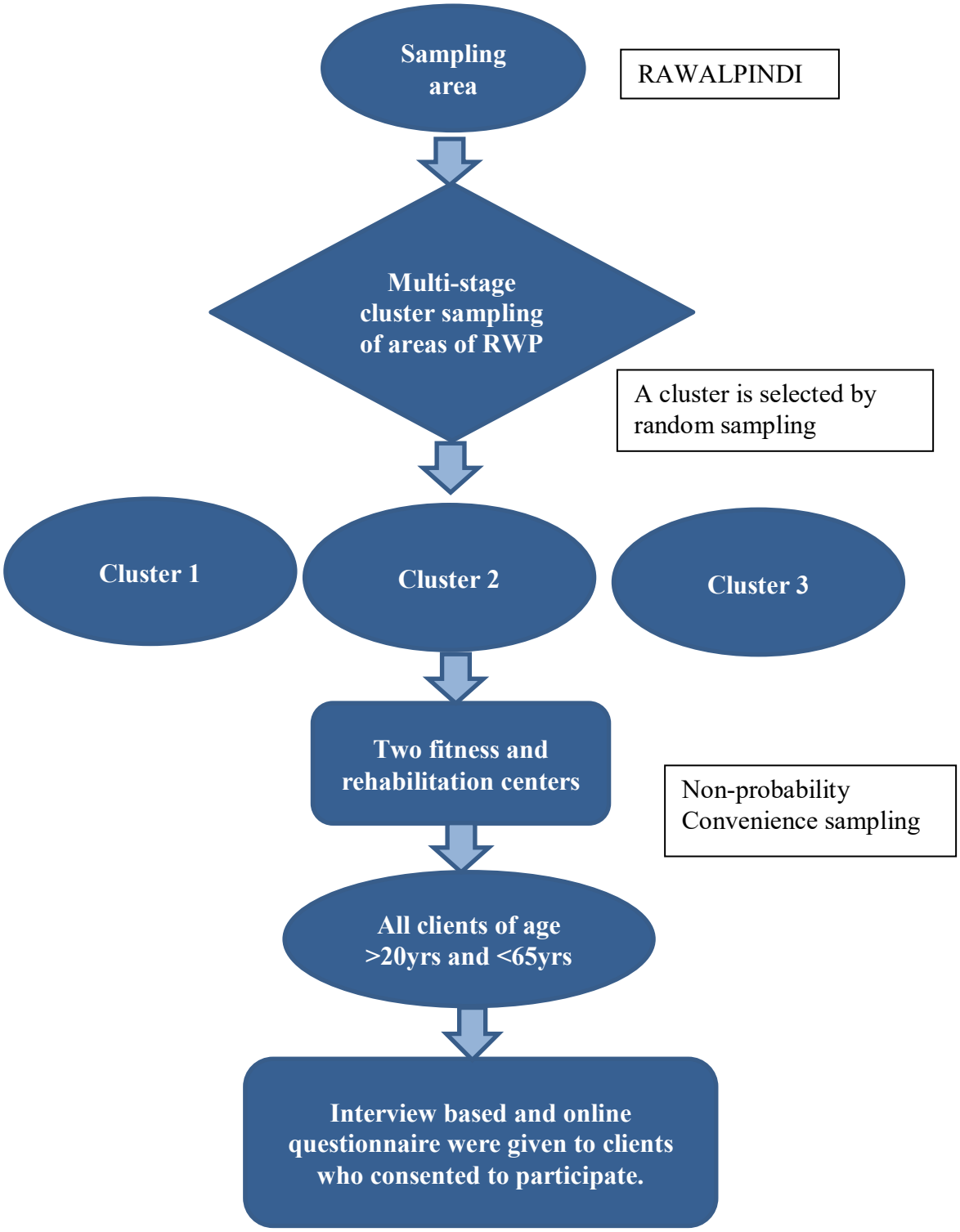
Q= 1-P

E= margin of error

Prevalence of metabolic syndrome in Pakistan is 32% (Basit and Shera). Which when put in Cochran's formula gives a total sample of 334 participants, with confidence interval 95% and margin of error 5%.

3.8 Sampling Technique

Multistage random sampling was done in following steps.



3.9 Data Collection Procedure

Data for this research was collected using structured questionnaire form which has 3 parts. Section-A for demographic details, section-B for the diagnosis of metabolic syndrome using NCEP ATP III criteria and section C for Knowledge assessment using Mets knowledge scale (METS-KS). This knowledge scale comprises 25 propositions about MetS with three possible responses as follows: “True”, “Wrong” or “I do not know”. Scoring of the scale is as follows: Each correct answer was awarded 1 point, the ”wrong” and ”I do not know” answers were given 0 points. Higher scores indicate, higher knowledge level about MetS. The scale's minimum score is 0, and the maximum score is 25. Data was also collected by interviews following same section pattern and questionnaire form was also distributed online. Interview based questionnaires were distributed to the clients that visited the rehab centers and complete guidance was given to them for better understanding. Online questionnaires were sent to the clients that met the inclusion criteria via google form. Pilot testing was done on 10% of the sample size in a similar setting before proceeding further.

3.9 Data Analysis

SPSS version 25 was used for data analysis. A P-value of less than 0.05 was considered as significant with 95% confidence interval.

3.10 Descriptive Statistics

- **Categorical/qualitative variables:** is presented in form of frequency, percentages, and bar charts.

3.11 Inferential Statistics

- Pearson Chi square test

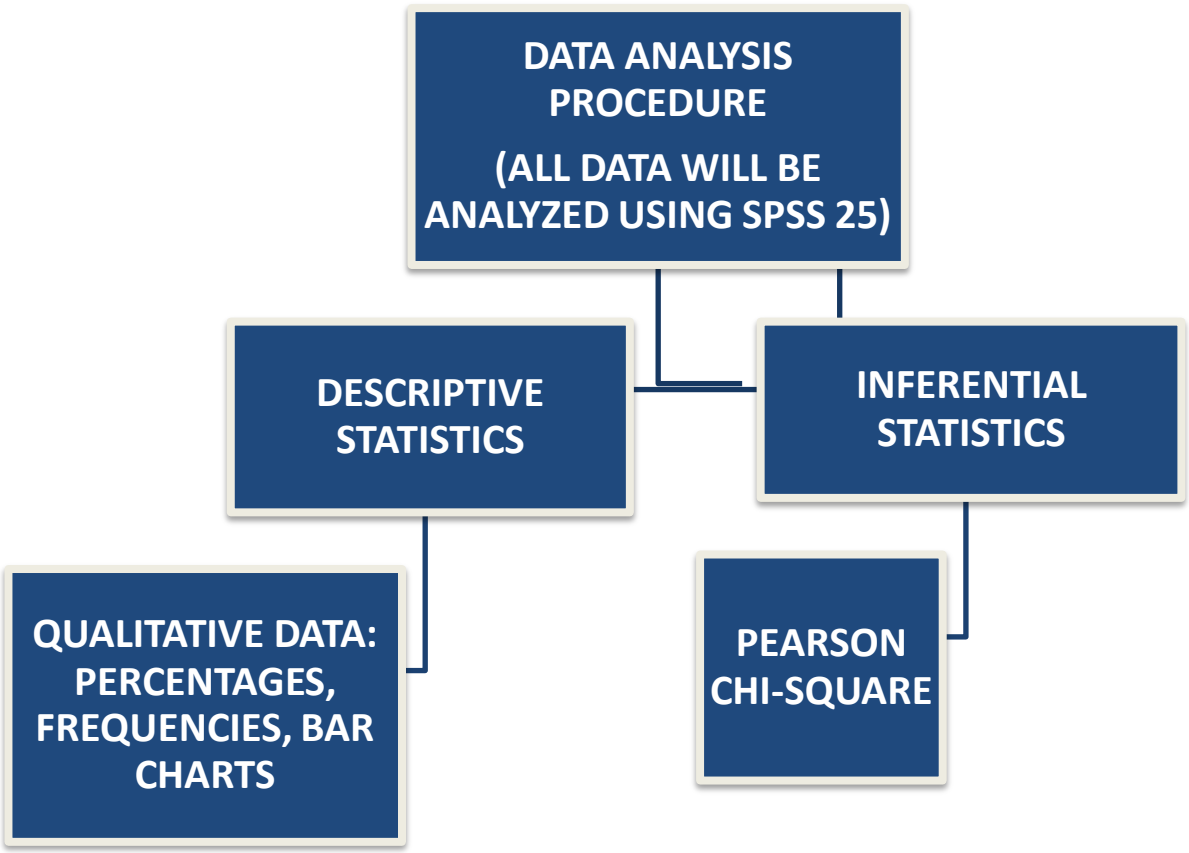


Figure 3: Data Analysis Plan

3.12 Ethical Considerations

i. A formal permission letter from the Al Shifa Review Board to carry out the study was obtained.

ii. A permission letter from each fitness and rehab center before study conduction was obtained.

iii. Clients were given a brief introduction about the study and its purpose according to their understanding level.

iv. The anonymity of each participant was ensured.

v. Privacy and confidentiality of data were thoroughly maintained.

CHAPTER IV: RESULTS

4.1 Descriptive Results

4.1.1 Socio-demographic Frequencies

A total of 334 adults visiting fitness and rehab centers participated in this study (table 1), out of which 41.0% (n=137) were females and 59% (n=197) resided in different cities of Pakistan. The age-wise distribution of the participants included 74.5% (n=249) in the age group of 20-39 years, 19.2% (n=64) in the age group 40-59 years, and 6.3% (n=21) were aged 60 years and above. The frequency of participants having BMI 18-24.9 (normal) was seen to be 47.6% (n=159), 5.7% (n= 19) were having BMI <18 (underweight), while 20.1% (n=67) were classified as overweight having BMI 25-29.9 and 20.1% (n=67) were classified as obese with having BMI >30.

Table 2: Frequencies of Socio-demographic Variables

Variables	Categories	N (%)
Age	20 – 39 years	249 (74)
	40 – 65 years	85 (26)
Gender	Male	197 (59.0)
	Female	137 (41.0)
Educational level	No Formal education	37 (11.1)
	Intermediate	105 (31.4)
	Higher education	192 (57.5)
Marital status	Married	174 (51.8)
	Unmarried	160 (47.9)
Employment status	Employed	192 (57.5)
	Unemployed	94 (28.1)
	Housewife	48 (14.4)
BMI	< 18 (underweight)	19 (5.7)
	18-24.9 (normal)	159 (47.6)
	25-29.9 (over-weight)	89 (26.6)

	>30 (obese)	67 (20.1)
House-hold Income	<50k	124 (37.1)
	50k-1lac	120 (35.9)
	>1 lac	90 (26.9)
Height (inches)	Under 5 ft.	5 (1.5)
	5 ft. – 6 ft.	317 (95)
	More than 6 ft.	12 (3.5)
Weight	< 40 kg	4 (1.5)
	41-65 kg	121 (36.5)
	66-90 kg	153 (45.8)
	> 90 kg	54 (16.2)

4.1.2 Level of Metabolic syndrome Frequencies

Of the 334 participants, table 2 shows that 85.3% (n=285) reported to have never experienced diabetes disease ever, while 14.7% (n=49) complained that they have diabetes. Having issue blood pressure was reported by 22.5% (n=75) of the participants and 77.5% (n=259) said that they don't have any issue of Blood pressure. Waist measurement of 80-90 cm (31.5 -35.4 inches) was found in 46.4% (n=155) of the participants, 91-100 cm (35.5 - 35.5 inches) waist was found in 27.8% (n=93) of the participants, while >100 cm (35.5 inches) waist was found in 15.0% (n=50) of the participants. Out of 334 participants 74.3% (n=248) were reported that they have <150 mg/dl triglyceride level while 25.7% (n=86) were reported that they have ≥150 mg/dl triglyceride level. HDL of <40 mg/dl was reported in 33.2% (n=111) of the participants, while HDL of 40-49 mg/dl was reported in 39.5% (n=132) of the participants. Fasting glucose level of <100mg/dl was reported in 78.1% (n=261) of the participants, while 21.9% (n=73) reported ≥100 mg/dl fasting glucose level. 18.6% (n=62) reported that they are smoker, 3.6% (n=12) reported they are former smokers, while 77.8% (n=260) non-smokers were reported in the study sample. Out of 334 participants only 18.0% (n=60) showed active (1hr workout daily) physical activity in their daily routine and 47.6% (n=159) showed moderate (30min workout daily) physical activity in their daily routine, while 34.4% (n=115) reported Sedentary (no workout at all) physical activity. 60.2% (n=201) reported that they

eat junk food, while 39.8% (n=133) said they don't eat junk food. A total of 30.2% (n=101) participants have MetS, while 60.8% (n=233) don't have MetS as diagnosed by NCEP ATP III criteria (figure. 1). Out of 101 individuals who were diagnosed with Mets 36 (35.6%) were females and 65 (64.3%) were males.

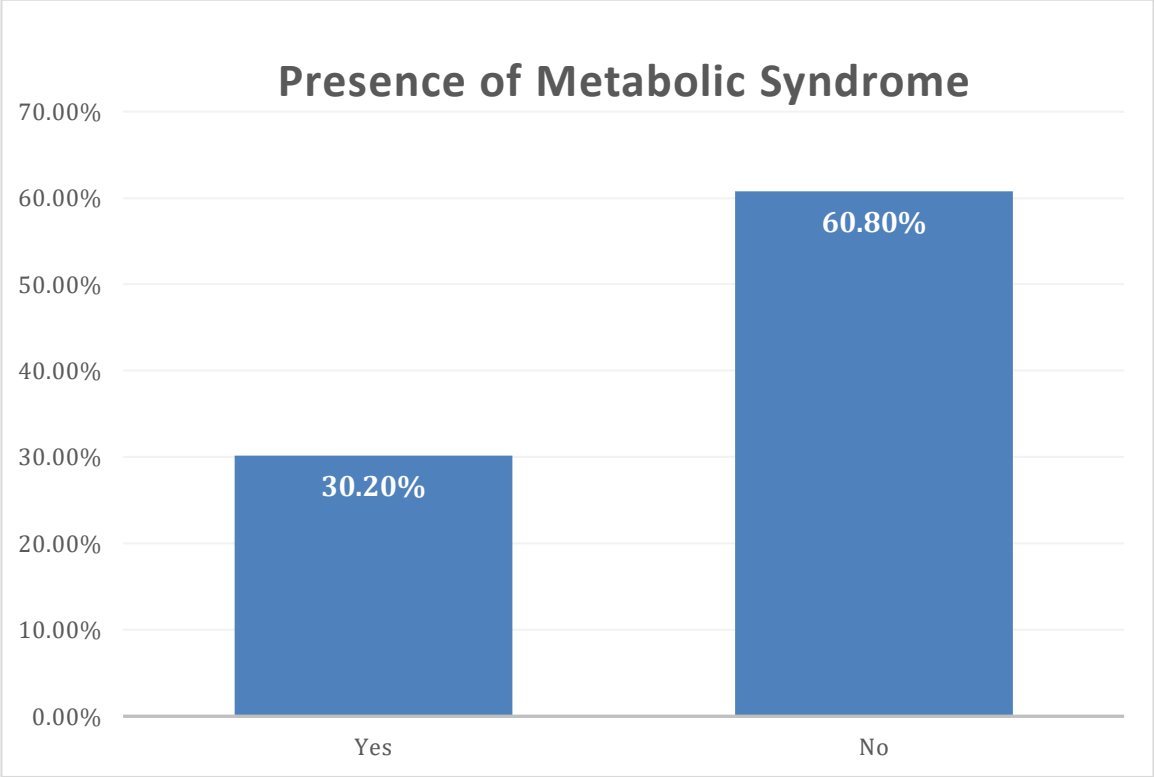


Figure 4: Presence of MetS in participants

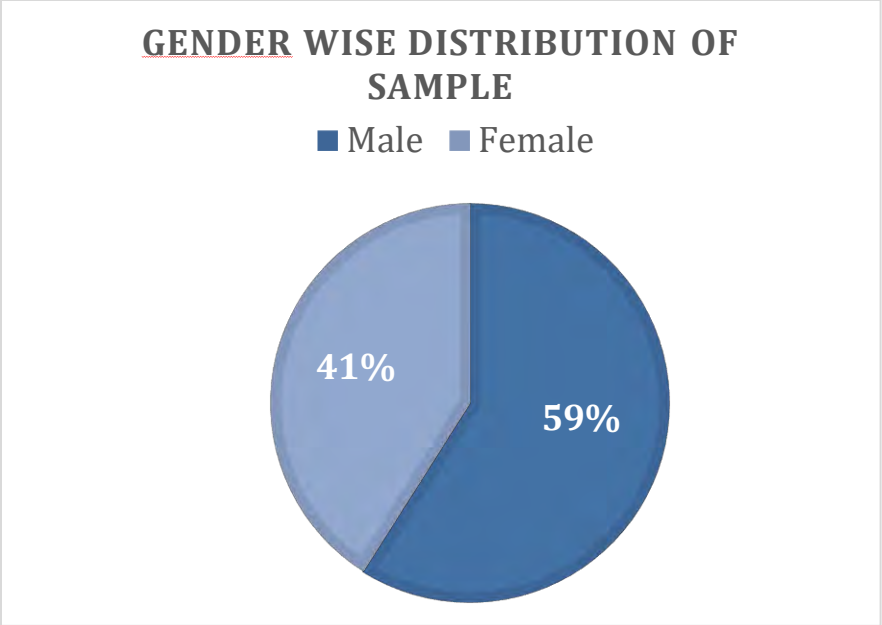


Figure 5: Gender wise distribution of METs

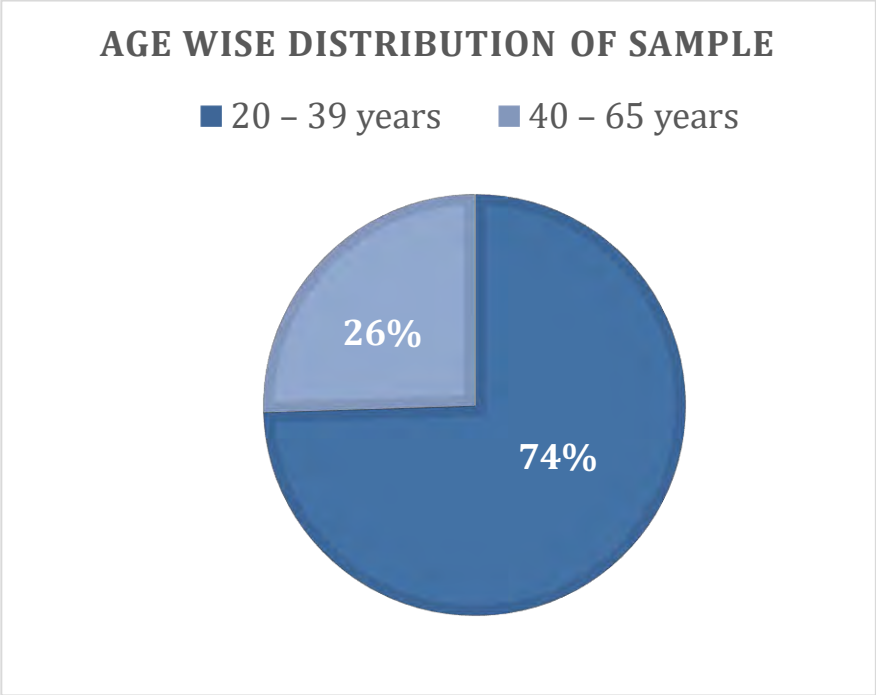


Figure 6: Age wise distribution of METs

Table 3: Frequencies of metabolic syndrome

Variables	Categories	N (%)
FH of diabetes	Yes	191 (57.2)
	No	143 (42.8)
FH of hypertension	Yes	172 (51.5)
	No	162 (48.5)
FH of cardio-disease	Yes	132 (39.5)
	No	202 (60.5)
Hypertension drugs	Yes	53 (15.9)
	No	281 (84.1)
Smoking	Yes	62 (18.6)
	No	260 (77.8)
	Former smoker	12 (3.6)
Physical activity	Sedentary (no workout at all)	115 (34.4)
	Moderate (30min workout daily)	159 (47.6)
	Active (1hr workout daily)	60 (18.0)
Work demand PA	Yes	155 (46.4)
	No	179 (53.6)
Junk food	Yes	201 (60.2)
	No	133 (39.8)
Considering of food	Yes	143 (42.8)
	No	191 (57.2)
Regular health checkup	Yes	67 (20.1)
	No	267 (79.9)
Blood pressure	Yes	75 (22.5)
	No	259 (77.5)
Diabetes	Yes	49 (14.7)
	No	285 (85.3)

Waist	<80cm (31.5 inches)	36 (10.8)
	80-90 cm (31.5 -35.4 inches)	155 (46.4)
	91-100 cm (35.5 - 35.5 inches)	93 (27.8)
	>100 cm (35.5 inches)	50 (15.0)
Triglycerides	<150 mg/dl	248 (74.3)
	≥150 mg/dl	86 (25.7)
HDL	<40 mg/dl	111 (33.2)
	40-49 mg/dl	132 (39.5)
	≥50 mg/dl	91 (27.2)
Fasting glucose	<100 mg/dl	261 (78.1)
	≥100 mg/dl	73 (21.9)
BP	≤120/80 mmHg	248 (74.3)
	≥130/85mmHg	86 (25.7)
Presence of Mets	Yes	101 (30.2)
	No	233 (60.8)

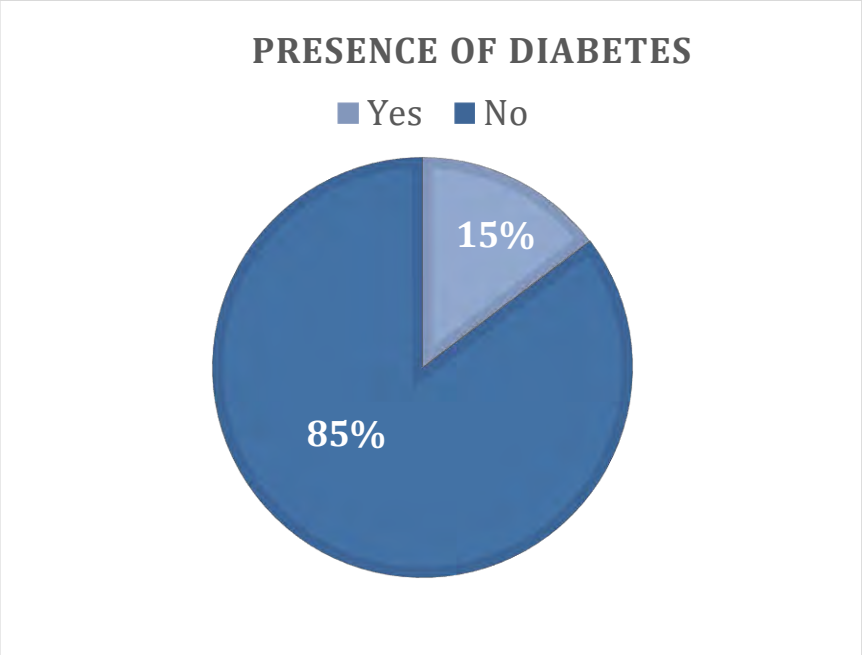


Figure 7: Presence of diabetes

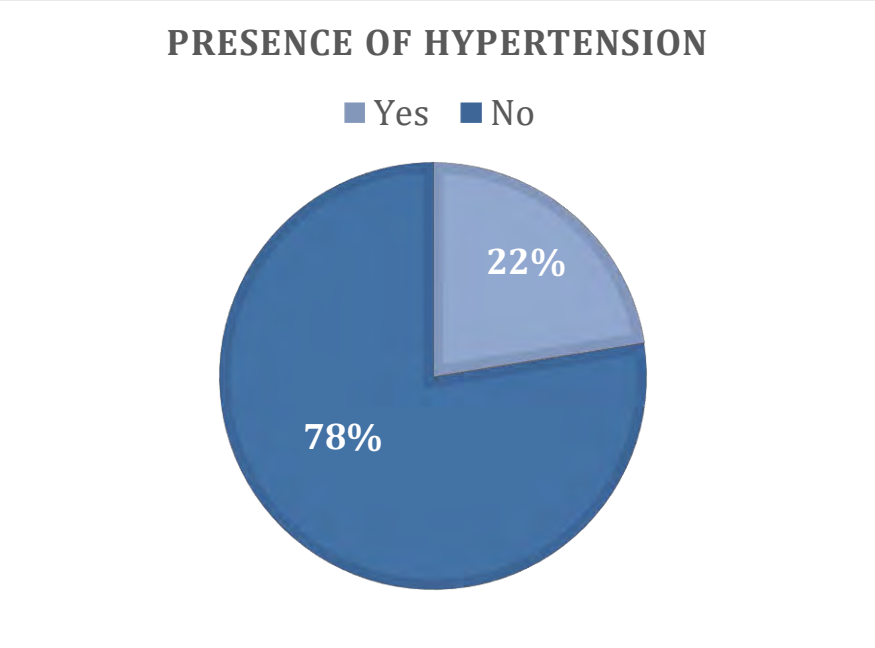


Figure 8: Presence of hypertension

4.1.3 Assessment of knowledge about METs:

It can be seen from collected data that the knowledge about the Metabolic syndrome (MetS) is high 54.5% (n=182) in the participants (table 3). Out of 334 respondents, majority 50.3% (n=168) said that MetS is a common clinical condition, more 54.2 % (n=181) reported that MetS prevalence increases as age increases, and more than half 53.6% (n=179) responded that they knew the waist circumference was different in males and females in case of MetS. Many of respondents 42.8% (n=143) reported that MetS is more common in females. 48.2% (n=161) responded that the diet rich in saturated fatty acids increases the risk of MetS.

Out of 334 participants, 53.9% (n=180) said that patients of MetS have a higher risk of having a myocardial infarction, while 51.2% (n=171) participants reported that the increase in of the waist line is an important component of MetS. Half of the participants 50.3 % (n=168) reported that high calorie nutrition is associated with MetS, while only 42.2% (n=141) said that MetS is more common in smokers while 11.4% (n=38) responded that there is no association between the alcohol consumption and MetS. Out of 334 participants, 55.6% (n=186) reported that individuals with MetS are at increased risk of developing diabetes. Only 16.5% (n=55) reported that MetS is less common in overweight individuals.56.0% (n=187) reported MetS is a treatable clinical condition while 56.3% (n=188) said that MetS is preventable.

Table 4: frequencies of metabolic syndrome knowledge scale (METS-KS)

Variables	Categories	N (%)
Metabolic syndrome (MetS) is a clinical condition with high blood pressure, impaired blood lipids, increased waist circumference, and elevated blood glucose levels.	Right	182 (54.5)
	Wrong	7 (2.1)
	Don't know	145 (43.4)
MetS is a common clinical condition.	Right	168 (50.3)
	Wrong	27 (8.1)
	Don't know	139 (41.6)
MetS prevalence increases as age increases.	Right	181 (54.2)
	Wrong	14 (4.2)
	Don't know	139 (41.6)

MetS is present in all Age groups	Right	125 (37.4)
	Wrong	79 (20.7)
	Don't know	140 (41.9)
Prevalence of cardiovascular disease reduces risk of MetS	Right	34 (10.2)
	Wrong	140 (41.9)
	Don't know	160 (47.9)
The waist circumference is different in males and females patients of MetS	Right	179 (53.6)
	Wrong	11 (3.3)
	Don't know	144 (43.3)
MetS is more common in females	Right	143 (42.8)
	Wrong	32 (9.6)
	Don't know	159 (47.6)
A diet rich in saturated fatty increases probability of **MetS.**	Right	161 (48.2)
	Wrong	17 (5.1)
	Don't know	156 (46.7)
Patients with MetS have a higher probability of having a heart attack.	Right	180 (53.9)
	Wrong	14 (4.2)
	Don't know	140 (41.9)
The waist line is important component of MetS	Right	171 (51.2)
	Wrong	9 (2.7)
	Don't know	154 (46.1)
MetS probability increases because of high calorie diet	Right	168 (50.3)
	Wrong	14 (4.2)
	Don't know	152 (45.5)
There is no need to measure blood fat in MetS.	Right	34 (10.2)
	Wrong	146 (43.7)
	Don't know	154 (46.1)
MetS is more common in smokers.	Right	141 (42.2)
	Wrong	42 (12.6)

	Don’t know	151 (45.2)
High Blood Pressure is one of the components of MetS.	Right	179 (53.6)
	Wrong	12 (3.6)
	Don’t know	143 (42.8)
There is no association between alcohol consumption and MetS	Right	38 (11.4)
	Wrong	126 (37.7)
	Don’t know	170 (50.9)
Individuals with MetS are at increased risk of having diabetes.	Right	186 (55.6)
	Wrong	8 (2.4)
	Don’t know	140 (41.9)
Physical inactivity (sedentary life) facilitates the formation of MetS.	Right	185 (55.4)
	Wrong	15 (4.5)
	Don’t know	134 (40.1)
MetS is a treatable clinical condition.	Right	187 (56.0)
	Wrong	7 (2.1)
	Don’t know	140 (41.9)
MetS is preventable.	Right	188 (56.3)
	Wrong	10 (3.0)
	Don’t know	136 (40.7)
Changes in lifestyle play an important role in protecting MetS.	Right	199 (59.6)
	Wrong	8 (2.4)
	Don’t know	127 (38.0)
Individuals with MetS have lower probability of having cancer.	Right	65 (19.5)
	Wrong	96 (28.7)
	Don’t know	173 (51.8)
If lifestyle changes are insufficient in MetS, drug treatment can be applied.	Right	169 (50.6)
	Wrong	17 (5.1)
	Don’t know	148 (44.3)
	Right	187 (56.2)

MetS is less common in individuals who are fed adequately and balanced.	Wrong	10 (3.0)
	Don't know	136 (40.8)
Individuals with MetS have a higher chance of stroke	Right	167 (50.2)
	Wrong	13 (3.9)
	Don't know	153 (45.9)
MetS is less common in overweight individuals.	Right	55 (16.5)
	Wrong	130 (38.9)
	Don't know	148 (44.3)

4.2 Inferential Results

4.2.1 Metabolic syndrome association with sociodemographic factors

Out of 101 individuals who were diagnosed with Mets 36 (35.6%) were females and 65 (64.3%) were males. Pearson chi-square test of association showed that there was no significant association between gender or patient and presence of metabolic syndrome (x^2 (1) = 1.72, p-value = 0.189). Those who don't have any formal education, made up 13.8% (n=14) of the total diagnosed MetS cases, while 44.5% (n=45) of the diagnosed cases were found in those who have higher education. There is a statistically significant relationship between age of an individual and presence of metabolic syndrome (x^2 (2) = 23.39, p-value = 0.000). A significant association between both education levels and presence of metabolic syndrome (x^2 (2) = 9.966, p-value = 0.007) was also found, as evidenced by the Pearson chi-square test of association. Body mass index (BMI) was also significantly related with MetS (x^2 (3) = 77.41, p-value = 0.0001). Physical activity level of the participants had significantly association with the presence of metabolic syndrome (x^2 (2) = 7.169, p-value = 0.028) as well. Diabetes, hypertension, work demanding physical activity and presence of diabetes in family were also statistically significantly associated with presence of metabolic syndrome (x^2 (2) = 12.436, p-value = 0.02). All other factors of sociodemographic showed non-significant association with the metabolic syndrome.

Table 5: Association and sociodemographic factors and MetS

Variables	Categories	MetS N (%)		Chi-Square (df)	p-value
		Diagnosed	Not Diagnosed		
Age	20 – 39 years	102 (30.3)	147 (44.0)	23.39 (3)	0.0001*
	40 – 65 years	36 (11)	49 (14.7)		
Gender	Male	65 (19.4)	132 (39.6)	1.72 (1)	0.189
	Female	36 (10.8)	101 (30.2)		
Educational level	No Formal education	12 (3.6)	25 (7.5)	9.966 (2)	0.007*
	Intermediate	34 (10.2)	71 (21.3)		
	Higher education	91 (27.2)	101 (30.2)		
Marital status	Married	69 (20.7)	104 (31.1)	0.933 (2)	0.627
	Unmarried	68 (20.4)	92 (27.5)		
Employment status	Employed	84 (25.1)	108 (32.3)	4.235 (2)	0.120
	Unemployed	38 (11.4)	56 (16.8)		
	Housewife	15 (4.5)	33 (9.9)		
BMI	< 18 (underweight)	10 (3.0)	9 (2.7)	77.41 (3)	0.0001*
	18-24.9 (normal)	73 (21.9)	86 (25.7)		
	25-29.9 (over-weight)	35 (10.5)	54 (16.2)		
	>30 (obese)	19 (5.7)	48 (14.4)		
House-hold Income	<50k	52 (15.6)	72 (21.6)	0.032 (2)	0.984
	50k-1lac	46 (13.8)	74 (22.2)		
	>1 lac	39 (11.7)	51 (15.3)		

Height (inches)	Under 5.5	61 (18.3)	65 (19.2)	6.533 (4)	0.163
	5.6-5.9	59 (17.7)	94 (28.1)		
	5.9-6.3	14 (4.2)	31 (9.3)		
	6.3 and higher	3 (0.9)	7 (2.1)		
Weight	Under 40	1 (0.3)	2 (0.9)	6.926 (5)	0.226
	41-65	60 (18.1)	61 (18.4)		
	66-90	59 (17.8)	94 (28.3)		
	91-115	14 (4.2)	29 (8.7)		
	116 and above	3 (0.9)	8 (2.1)		
Diabetes	Yes	29 (8.7)	20 (5.9)	22.805 (1)	0.001*
	No	72 (21.5)	213 (63.7)		
	Total	101 (30.2)	233 (70.6)		
Blood Pressure	Yes	50 (14.9)	24 (7.1)	65.373 (1)	0.001*
	No	51 (15.3)	209 (62.5)		
	Total	101 (30.2)	233 (70.6)		
Consider Nut Off Mood	Yes	40 (11.9)	103 (30.8)	0.609 (1)	0.435
	No	6 (1.8)	130 (30.9)		
	Total	101 (30.2)	233 (70.6)		
Regular Health Checkup	Yes	20 (5.6)	47 (14.1)	0.006 (1)	0.938
	No	81 (24.2)	186 (55.7)		
	Total	101 (30.2)	233 (70.6)		
Junk Food	Yes	68 (20.3)	133 (39.8)	3.086 (1)	0.079
	No	33 ()	100 ()		
	Total	101 (30.2)	233 (70.6)		
Work Demand PA	Yes	36 (9.8)	119 (35.6)	6.744 (1)	0.009*
	No	65 (19.4)	114 (34.1)		
	Total	101 (30.2)	233 (70.6)		

Physical Activity	Sedentary (No workout at all)	45 (13.5)	70 (20.9)	7.169 (2)	0.028*
	Moderate (30 min workout)	43 (12.8)	116 (34.7)		
	Active (1 hour workout daily)	13 (3.9)	47 (14.1)		
Smoking	Yes	28 (8.3)	36 (10.7)	5.134 (2)	0.077
	No	71 (24.2)	186 (55.6)		
	Former Smoker	4 (1.2)	8 (2.3)		
FH of Diabetes	Yes	72 (21.5)	118 (35.3)	12.436 (2)	0.002*
	No	29 (8.6)	114 (34.1)		
	3.00	0	1		
FH of Cardio-diseases	Yes	47 (14.1)	85 (25.4)	2.980 (1)	0.084
	No	54 (16.1)	148 (44.3)		
	Total	101 (30.2)	233 (70.6)		
FH of Hypertension	Yes	60 (17.9)	112 (33.5)	3.626 (1)	0.057
	No	41 (12.2)	121 (36.2)		
	Total	101 (30.2)	233 (70.6)		
Household Income	<50,000 Rs	37 (11.1)	87 (26)	0.032 (2)	0.984
	50,000-100,000 Rs	37 (11.1)	83 (24.8)		
	>100,000 Rs	27 (8.1)	63 (18.9)		

All p-values marked with a * indicate a statistically significant association between the variables. In addition to the mentioned associated we were able to fine additional associations of various categories with the MetS

4.2.2 Sociodemographic factors association with knowledge

Out of 334 participants, 34.5% of male respondents (n=115) had enough knowledge about risk factors of metabolic syndrome, while 22.5% (n=75) of the females had enough knowledge about risk factors of metabolic syndrome (table 5). Pearson chi-square test of association showed that gender and knowledge of MetS were not significantly associated (x^2 (1) = 508, p-value = 0.476). Those who don't have any formal education, made up 4.8% (n=16) of the total participants that had enough knowledge about risk factors of metabolic syndrome, while 36.3% (n=121) of the participants had good knowledge were found in those who have higher education. Educational level and knowledge of METs were significantly related (x^2 (2) = 7.825, p-value = 0.020), as evidenced by the Pearson chi-square test of association. All other factors of sociodemographic showed non-significant association with the knowledge about risk determinants of metabolic syndrome.

The overall knowledge of the participants regarding the risk factors of Mets was good 57.06% while the pie-chart showed that 42.94% of the participants have poor knowledge regarding the risk factors of Mets (figure 4).

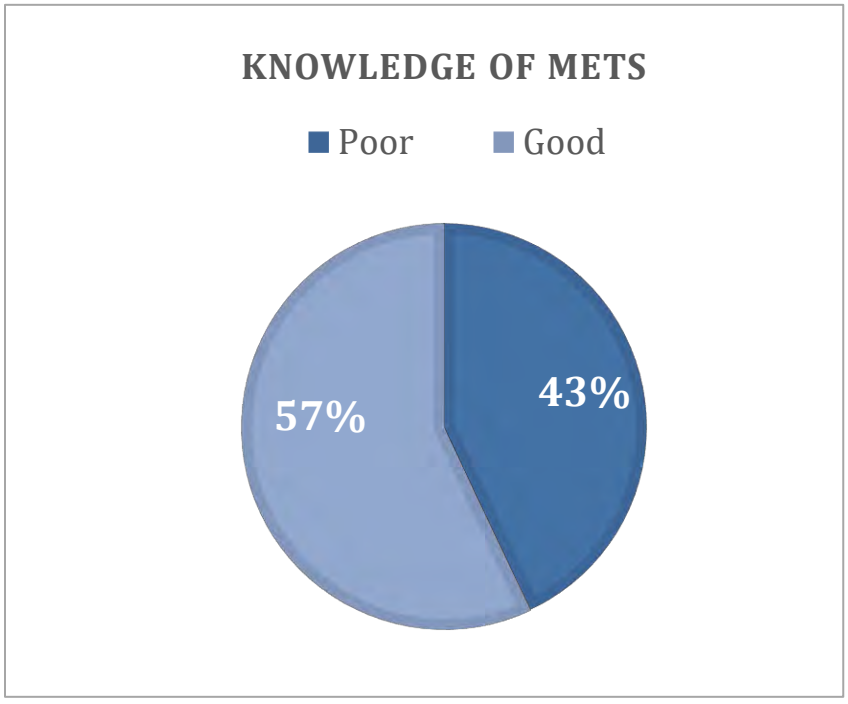


Figure 9: The overall percentage of Knowledge of participants regarding MetS

Table 6: Sociodemographic factors association with knowledge

Variables	Categories	Knowledge Poor N (%)	Knowledge Good N (%)	Chi-Square (df)	p-value
Age	20 – 39 years	101 (30.3)	147 (44.1)	3.489 (3)	0.322
	40 – 59 years	31 (9.3)	33(9.9)		
	60 years and above	11 (3.3)	10 (3.0)		
Gender	Male	81 (24.3)	115 (34.5)	0.508 (1)	0.476
	Female	62 (18.6)	75 (22.5)		
Educational level	No Formal education	21 (6.3)	16 (4.8)	7.825 (2)	0.020*
	Intermediate	52 (15.6)	53 (15.9)		
	Higher education	70 (21.0)	121 (36.3)		
Marital status	Married	80 (24.0)	93 (27.6)	2.478 (2)	0.290
	unmarried	63 (18.9)	27 (19.1)		
Employment status	Employed	73 (21.9)	118 (35.4)	5.509 (2)	0.064
	Unemployed	43 (12.9)	51 (15.3)		
	Housewife	27 (8.1)	21 (6.3)		
BMI	< 18 (underweight)	11 (3.3)	8 (2.4)	8.149 (3)	0.043*
	18-24.9 (normal)	56 (16.8)	103 (30.9)		
	25-29.9 (over-weight)	45 (13.5)	44 (13.2)		
	>30 (obese)	31 (9.3)	71 (10.5)		
	<50k	53 (15.9)	66 (21.3)	0.435 (2)	0.804
	50k-1lac	54 (16.2)	53 (19.8)		

House-hold Income	>1 lac	36 (10.8)	51 (15.9)		
Height (inches)	Under 5.5	54 (16.2)	72 (21.6)	7.260 (4)	0.123
	5.6-6.5	59 (17.7)	94 (28.2)		
	6.6-7.5	26 (7.8)	18 (5.4)		
	7.6 and higher	3 (1.2)	6 (1.8)		
Weight	Under 40	2 (0.6)	2 (0.6)	8.186 (5)	0.117
	41-65	51 (15.4)	70 (21.1)		
	66-90	59 (17.8)	94 (28.4)		
	91-115	26 (7.9)	16 (4.8)		
	116-140	4 (1.2)	6 (1.8)		
	141 and above	1 (0.3)	0		
All p-values marked with a * indicate a statistically significant association between the variables.					

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CHAPTER V: DISCUSSION

Metabolic syndrome (MetS) has been defined by IDF and NCEP ATP-III as a group of abnormalities related to metabolism which are inter-connected. They including glucose diabetes mellitus, hypercholesterolemia, dyslipidemia, elevated blood pressure and abdominal obesity (Emiral, 2021). Atherogenic dyslipidemia can be defined by the presence of low levels of HDLPs, high triglycerides levels, elevated blood pressure and glucose level in plasma. Its symptoms also include pro-thrombotic state, and pro-inflammatory state (Ramadan, 2016).

Our study results showed that a total of 30.2% (n=101) participants have MetS, while 60.8% (n=233) don't have MetS as diagnosed by NCEP ATP III criteria. While the knowledge of the participants regarding the risk factors of Mets was good that counts (57.06%). A cross-sectional study that took place in China evaluated the metabolic syndrome's prevalence and its related determinants among individuals showed that the overall prevalence of metabolic syndrome was 24.2% among Chinese adults (Li Y *et al.*, 2018). In our study it have been found that 57.2% (n=192) of the total participants have higher education, 31.2% (n=105) have education to the intermediate level while 11.1% (n=37) had no formal education. There is a significant association between both variables (x^2 (2) = 7.593, p-value = 0.022). A same type of analysis was conducted in Northern Taiwan to find the association between MetS and health behaviors and education. MetS risk was lower in participants having more knowledge about health. Knowledge about hypertension reduced MetS by chances by &% while diabetes knowledge reduced it by 8% (Tsou, 2017). In another study conducted in Central Michigan University, It was found that 80% of students were able to identify risk factors of heart as arteriosclerosis, diabetes, hypertension and stroke (Najat Yahia, 2014).

Our results shows that out of 334 participants 74.3% (n=248) were have <150 mg/dl triglyceride level while 25.7% (n=86) have ≥150 mg/dl triglyceride level. 14.7% (n=49) complained that they have diabetes, while22.5% (n=75) of the participants have issue of blood pressure. A study was conducted in Ghana, reporting, Type II Diabetes susceptibility increases 5 times if patient suffers from metabolic syndrome. Same study reported a 90.6% of prevalence. The main risk factors reported were high levels of triglycerides (Francis Agyemang-Yeboah, 2019).

It can be seen from our studies that out of 334 participants 74.3% (n=248) have <150 mg/dl triglyceride level while 25.7% (n=86) have ≥150 mg/dl triglyceride level. 14.7% (n=49) complained that they have diabetes, while22.5% (n=75) of the participants have issue of blood pressure. A previous study have reported on young adults reported prevalence of MetS at 4.8-7%. Low HDLPs was the most common MetS component (26.9–41.2%), seconded by elevated blood pressure (16.6–26.6%), followed by abdominal obesity (6.8–23.6%), raised triglycerides (8.6–15.6%), and raised fasting glucose (2.8–15.4%) (Nolan, et al., 2017). Another study showed that lipid metabolism disorders are present in 27-54% of the population, whereas 68-81% have low levels of HDLPs (Basit and Shera, 2008).

Our study concluded that frequency of participants having BMI 18-24.9 (normal) was seen to be 47.6% (n=159), 5.7% (n= 19) were having BMI <18 (underweight), while 20.1% (n=67) were classified as overweight having BMI 25-29.9 and 20.1% (n=67) were classified as obese with having BMI >30. Body mass index (BMI) was also significantly related with MetS (x^2 (3) = 7.177, p-value = 0.066). A similar cross-sectional study that took place in hospital had 405 diabetic individuals. The study reported that diabetic females were more susceptible to abdominal obesity and reduced levels of HDLPs than diabetic males (Francis Agyemang *et al.,* 2019). Another study in Pakistan showed that abdominal obesity is present in 46-68% of the Pakistani population. There is a significant association between arm fat and insulin insensitivity (Grundy, 2008). In our study, only 18.0% (n=60) showed active (1hr workout daily) physical activity in their daily routine and 47.6% (n=159) showed moderate (30min workout daily) physical activity in their daily routine, while 34.4% (n=115) reported Sedentary (no workout at all) physical activity. Similar cross-sectional study that took place in the city of Bauru, Brazil showed high rate of hypertension, diabetes and hypercholesterolemia, abdominal obesity and MetS and these were also associated with lower level of physical activity. They found 76.8% of participants had AH, 28.5 % had diabetes, and 32.7% had hypercholesterolemia (Grundy, 2008). Another study reported that less physical activity in free-time is associated with higher prevalence of diabetes, hypercholesterolemia and MetS (Bruna C Turi *et al.,* 2016). A study reported that results showed that despite having knowledge about importance of physical activity, 63% participants had never tried 30mins of regular exercise, though they had MetS (Amarasekara *et al*., 2016).

It can be observed from our study that the knowledge about the Metabolic syndrome (MetS) is high 54.5% (n=182) in the participants. Majority 50.3% (n=168) said that MetS is a common clinical condition, more 54.2%(n=181) reported that MetS prevalence increases as age increases, and more than half 53.6% (n=179) responded knew the waistline different in males and females patients of MetS(Grundy, 2018). In a study conducted in urban area of Karachi, High level of triglycerides and diabetes caused the highest prevalence of MetS in people of age from 45 to 54 years old. People above the age of 55 years, reported hypertension commonly while young people below the age 34 had low level of HDLs common in them (Asma Ahmed, 2020).

In our study, 48.2% (n=161) responded that the diet rich in saturated fatty acids, increases the probability of MetS. 53.9% (n=180) said that MetS patients have a higher probability of having a myocardial infarction, while 51.2% (n=171) participants reported that abdominal obesity is an important determinant of MetS. A previous study reported that MetS have been reported to increase the CVDs probability by almost 2 times. It also increases general mortality by 1.5 times. This findings were reported in systematic review which was also a meta-analysis (Salvatore Mottillo, 2010). Our Half of the participants 50.3% (n=168) reported that one risk factor for MetS is a high calorie diet, while only 42.2% (n=141) said that MetS is more common in smokers while 11.4% (n=38) responded that there is no significant association between the alcohol consummation and MetS development. 55.6% (n=186) reported that MetS patients have higher probability developing diabetes (Lawson, 2018).

Only 16.5% (n=55) reported that MetS is less common in overweight individuals.56.0% (n=187) reported MetS is a treatable clinical condition while 56.3% (n=188) said that MetS is preventable. Nutrition clinic located at the National Hospital of Sri Lanka, conducted a similar study. They reported that the 1/3rd of participants had a moderate mean knowledge score while only 3% had awareness regarding range of healthy BMI (Niloufer, 2012).

CHAPTER VI: CONCLUSIONS AND WAY FORWARD

The present study focused on adults visiting the fitness and rehab centers. The objective of the study was to evaluate the prevalence of metabolic syndrome, and their level of knowledge. It also aimed determine if any association exists between the sociodemographic factors and MetS. Metabolic syndrome is quite prevalent in the population i.e. 33% and lifestyle-related risk factors are associated with the metabolic syndrome. The overall knowledge of adults regarding metabolic syndrome was good and enlightening people about life style factors which are healthy. The findings may also prove to be beneficial when making theoretical and practical implications for adults vesting fitness and rehab centers.

Limitations of the Study

- Being a cross-sectional study, it may not allow cause-effect findings.
- Imbalance in male to the female ratio which have caused some bias in the study.
- Questionnaire was lengthy and seemed to be exhaustive.
- Use of google form for self-reporting also have possibility of introducing bias.
- Smoking was self-reported measure in the study, the findings could be attributed to social-desirability bias.

Recommendations

As discussed earlier the existence of MetS is a multifaceted issue that requires several recommendations to achieve the goal of halting the disease as best as possible.

Targeting the young generation to prevent MetS before its occurrence is a better strategy than attempting to cure it after it has occurred. While a dedicated group of health policy makers can develop a complete plan for a given society or community, the following are some ideas:

- Lifestyle modifications should be made such as adopting a healthy eating patterns and engage in physical activity.
- Labelling of fat and sugar content on food labels should be made mandatory.
- Developing strategies for increasing physical activity as well as reducing weight

- Students in high school and college should be taught how to cook. The priority on fast food cannot be reduced unless people learn to cook healthy but enjoyable meals. Because adapting a healthy lifestyle starts at younger age.
- To ensure significant and additional health benefits and weight loss, our study recommends 60 minutes of moderate-intensity PA per day, plus at least two sessions per week of resistance training. As a result, evidence suggests that improving metabolic control can be achieved by promoting energy balance, changing the distribution of body fat, and increasing muscle mass.
- MetS awareness in educational institutions and sports activities should be made mandatory.
- Community health programs should be aimed at educating the collective community regarding the awareness of MetS issues, their symptoms, associated factors, and what management measures can be taken to reduce their impact.
- Local and international organizations should be pushed to develop community-based campaigns to sensitize the community members about MetS and its management.
- MetS epidemic can be linked to capitalistic economics model. Adopting a more human friendly economic system main reduce the risk of this disease

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Appendix A – Consent Form

TITLE OF THE RESEARCH

ASSESSMENT OF METABOLIC SYNDROME AND ITS KNOWLEDGE AMONG ADULTS VISITING FITNESS AND REHAB CENTERS, RAWALPINDI

RESEARCHER

Bushra Kanwal

Al-Shifa School of Public Health

CONTACT INFORMATION

Email id: bkanwal1996@gmail.com

Contact Number: 03145331160

PURPOSE OF THE STUDY

This study is an effort to determine the level of metabolic syndrome and to evaluate its association with sociodemographic factors. Moreover it also analyzes the knowledge of Pakistani adults about the risk factors for metabolic syndrome.

STUDY PROCEDURE

The study will involve collecting data from adults visiting the fitness and rehabilitation centers. Consent will be taken from the fitness centers and the clients as well after which only the consented adults will be asked to fill in the questionnaire. The study will take place from March 2022 to August 2022 in Rawalpindi.

RISK

There is no foreseeable risk posed by the study as it does not involve any invasive procedures. All the participants will have free will to participate and those refusing to take part in the study will suffer no consequences.

BENEFITS

This will help develop a clear picture of the burden of metabolic syndrome in this section of the population and will also help determine that which socio demographic factors contribute to it. The findings may serve to be beneficial for future management. The finding may also be used to design schemes that promote healthcare especially for improving awareness related to metabolic syndrome.

CONFIDENTIALITY

All data collected will be kept confidential and no data sharing with anyone other than the research team will be done. The identities of all participants will be kept anonymous and their privacy will be strictly maintained.

VOLUNTARY PARTICIPATION

Participation in this study will be completely voluntary and of free will. The participants can refuse to participate at any point in the study with no harm or consequences.

CONSENT CERTIFICATE

I have read the foregoing information or it has been read to me. I have been given sufficient opportunity to ask questions and all my ambiguities have been answered to my satisfaction. I voluntarily consent to participate in this study as a participant/to allow my child/student to participate in this study.

Participant/ Teacher/ Guardian Signature: Date:

_____

Researcher's Signature: Date:

_____

Appendix B – Questionnaire

SECTION A - SOCIO-DEMOGRAPHIC FACTORS

1. Height (ft.): _____

2. Weight (Kgs): _____

3. BMI:

- <18 (underweight)
- 18-24.9 (normal)
- 25-29.9 (over-weight)
- >30 (obese)

4. What is your gender?

- Male
- Female

5. What is your age?

- 20-39 years
- 40-59 years
- ≥ 60 years

6. Marital status:

- Married
- Unmarried

7. What is your education level?

- No formal education
- Intermediate
- Higher education

8. Employment status:

- Employed
- Unemployed
- Housewife

9. What is your household income per month?

- Less than 50,000 Rs
- 50,000 to 100,000 Rs
- More than 100,000 Rs

10. Family history of diabetes:

- Yes
- No

11. Family history of hypertension:

- Yes
- No

12. Family history of cardiovascular diseases:

- Yes
- No

13. Are you taking any anti-hypertensive drugs?

- Yes
- No

14. Do you smoke?

- Yes
- No
- Former smoker

15. What is your physical activity level?

- Sedentary (no workout at all)
- Moderate (30 min workout daily)
- Active (1 hour workout daily)

16. Does your work demand physical activity?

- Yes
- No

17. Do you eat junk food?

- Yes
- No

18. Do you consider nutrients of your food while eating?

- Yes
- No

19. Do you get regular health checkup every 6 months?

- Yes
- No

SECTION B- ASSESSMENT OF METABOLIC SYNDROME

1. Waist circumference:

- < 80 cm
- 80-90 cm
- 90-100 cm
- >100 cm

2. Triglycerides level:

- <150 mg/dl
- ≥150 mg/dl

3. HDL levels:

- <40 mg/dl
- 40-49 mg/dl
- ≥50 mg/dl

4. Fasting glucose levels:

- <100 mg/dl
- ≥100 mg/dl

5. Blood pressure:

- ≤120/80 mmHg
- ≥130/85 mmHg

6. Presence of Metabolic syndrome

- Yes
- No

SECTION C - ASSESSMENT OF KNOWLEDGE

1. **Metabolic syndrome (MetS) is a clinical condition with high blood pressure, impaired blood lipids, increased waist circumference, and elevated blood glucose levels.**
    - Correct
    - Wrong
    - Don't know
2. **MetS is a common clinical condition.**
    - Right
    - Wrong
    - Don't know
3. **MetS prevalence increases as age increases.**
    - Right
    - Wrong
    - Don't know
4. **MetS can be seen in all age groups.**
    - Right
    - Wrong
    - Don't know
5. **When family members have heart disease, the risk of MetS is reduced.**
    - Right
    - Wrong
    - Don't know
6. **The waist circumference for MetS is different in males and females.**
    - Right
    - Wrong
    - Don't know
7. **MetS is more common in females**
    - Right
    - Wrong
    - Don't know

8. A diet rich in saturated fatty acids such as margarine increases the risk of MetS.

- Right
- Wrong
- Don't know

9. **Individuals with MetS have a high risk of having a heart attack**.

- Right
- Wrong
- Don't know

10. The thickness of the waist circumference is an important component of MetS.

- Right
- Wrong
- Don't know

11. High calorie nutrition is one of the risk factors for MetS.

- Right
- Wrong
- Don't know

12. There is no need to measure blood fat in MetS.

- Right
- Wrong
- Don't know

13. MetS is more common in smokers.

- Right
- Wrong
- Don't know

14. Blood pressure is higher than 130/85 mmHg, one of the components of MetS.

- Right
- Wrong
- Don't know

15. There is no relationship between the amount of alcohol consumed and MetS formation.

- Right
- Wrong

- Don’t know

16. Individuals with MetS are at increased risk of having diabetes.

- Right
- Wrong
- Don’t know

17. Physical inactivity (sedentary life) facilitates the formation of MetS.

- Right
- Wrong
- Don’t know

18. MetS is a treatable clinical condition.

- Right
- Wrong
- Don’t know

19. MetS is preventable.

- Right
- Wrong
- Don’t know

20. Changes in lifestyle play an important role in protecting MetS.

- Right
- Wrong
- Don’t know

21. Individuals with MetS are less likely to have cancer.

- Right
- Wrong
- Don’t know

22. If lifestyle changes are insufficient in MetS, drug treatment can be applied.

- Right
- Wrong
- Don’t know

23. MetS is less common in individulas who are fed adequately and balanced.

- Right

- Wrong
- Don’t know

24. Individuals with MetS have a high risk of stroke.

- Right
- Wrong
- Don’t know

25. MetS is less common in overweight individuals.

- Right
- Wrong
- Don’t know

Appendix C – Gantt chart

Research Activities	February 2022	March 2022	April 2022	May 2022	June 2022	July 2022	August 2022	September 2022
Literature review								
Proposal submission								
Proposal defense/IRB								
Pilot study								
Data collection								
Data analysis								
Thesis writing								
Thesis draft submission								
Research article submission								
Thesis defense								
Final thesis defense								

Appendix D – Budget

Sr No	Items	Resource	Unit	Cost/unit	Total amount
01	Literature search	- Internet - Library - Supervisor discussions	01 01	1000/- 500/-	1500/-
02	IRB	Transport	01	800/-	800/-
03	Field visit	Transport	15 visits	1000/-	15000/-
04	Pilot study	- Questionnaire printing - Transport	20 2 visits	20/- 1000/-	400/- 2000/-
05	Data collection	- Questionnaire printing - Transport	300 8 visits	30/- 1000/-	9000/- 8000/-
06	Data analysis	Internet		1500/-	1500/-
07	Thesis printing	Paper	3 copies	2000/-	6000/-
08	Thesis binding	Hardcover	3 copies	2500/-	7500/-
09	Miscellaneous	- Food expenses - Stationary	-	5000/-	5000/-
10	Total amount		-		56,700/-

Appendix E – Official Permission Letters

Copies of letters obtained from Al-Shifa and fitness and rehabilitation centers included in the study are attached ahead.