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ANNEXURE I- INSTITUTIONAL HUMAN ETHICS COMMITTEE

INSTITUTIONAL HUMAN ETHICS COMMITTEE

Avinashilingam
Institute for Home Science and Higher Education for Women
University
(Estd. u/s 3 of UGC Act 1956)

10th September 2018

To
Ms. Challagundla Reddy Jyothsna
Department of Food Science and Nutrition
Avinashilingam Institute for Home Science and
Higher Education for Women
Coimbatore–641 043

Dear Challagundla Reddy Jyothsna,

Ref: Your proposal No. IHEC/17-18/FSN/50'Metabolic Syndrome in relation to Body Composition and Lifestyle Adaptation among Adults of Bengaluru' submitted for approval of the IHEC on 14th December.

The Institutional Human Ethics Committee of our University hereby grants approval to your research proposal No. IHEC/17-18/FSN/50 'Metabolic Syndrome in relation to Body Composition and Lifestyle Adaptation among Adults of Bengaluru' submitted by you. The Approval number for the same is AUW/ IHEC/ FSN -17-18/XPD/50.

We wish you all the best in your research endeavours.

Regards,

V. Uma Mageshwari
Dr.S.Uma Mageshwari
Member Secretary

Institutional Human Ethics Committee

ANNEXURE II- INSTITUTIONAL ETHICS COMMITTEE

SAKRA
WORLD HOSPITAL
JV by SECOM & TOYOTA TSUSHO, JAPAN

26/06/2019

From

Dr. Theanmozhi Yatish
Member Secretary
Institutional Scientific and Research Committee (ISRC)
Sakra World Hospital
Bangalore- 560103

To

Ms. Challagundla Reddy Jyothsna,
Principal Investigator,
Clinical Nutrition Department
Sakra World Hospital
Bangalore- 560103

Subject: Institutional Scientific and Research committee approval

Dear Ms. Jyothsna,

Thanks for the submission of your research proposal titled "METABOLIC SYNDROME IN RELATION TO BODY COMPOSITION AND LIFESTYLE ADAPTATION AMONG ADULTS OF BENGALURU" to the Institutional Scientific and Research committee conducted on 26/06/2019.

The study has been scrutinized and approved from Institutional Scientific and Research Committee.

Thanking you

Dr. Theanmozhi Yatish
ISRC Member Secretary

C. Ramachandra
Dr. Ramachandra
ISRC Chairperson

Sakra World Hospital (A unit of Takshasila Hospitals Operating Private Limited)
Sy No. 52/2 & 52/3, Devarabeesanahalli, Varthur Hobli, Bangalore - 560103. Landmark: Opposite Intel, Outer Ring Road, Marathahalli
E: info@sakraworldhospital.com T: +91 80 4969 4969. W: sakraworldhospital.com

ANNEXURE III- CTRI REGISTRATION

Clinical Trial Details (PDF Generation Date :- Thu, 29 Jul 2021 14:25:49 GMT)

CTRI Number	CTRI/2021/07/035254 [Registered on: 29/07/2021] - **Trial Registered Prospectively**
Last Modified On	28/07/2021
Post Graduate Thesis	Yes
Type of Trial	Observational
Type of Study	Case Control Study
Study Design	Single Arm Trial
Public Title of Study	Clinical trial on obesity and risk factors
Scientific Title of Study	Metabolic Syndrome In Relation To Body Composition And Lifestyle Adaptation Among Adults Of Bengaluru

Secondary IDs if Any

Secondary ID	Identifier
NIL	NIL

Details of Principal Investigator or overall Trial Coordinator (multi-center study)

Details of Principal Investigator	
Name	Challagundla Reddy Jyothsna
Designation	Chief Clinical Nutritionist
Affiliation	Sakra World Hospital,
Address	Sakra World Hospital, 1st Floor Devarabeesanahalli, Varthur Hobli Bengaluru, KarnatakaBengaluru India Bangalore KARNATAKA 560103 India
Phone	
Fax	
Email	jyothsnard@gmail.com

Details Contact Person (Scientific Query)

Details Contact Person (Scientific Query)	
Name	DR MRS S KOWSALYA
Designation	Registrar
Affiliation	Avinashilingam Institute for Homescience and Higher Education
Address	Avinashilingam Institute for Homescience and Higher Education for Women Coimbatore – 641043, India Coimbatore TAMIL NADU 641043, India
Phone	
Fax	
Email	kowsiskk@gmail.com

Details Contact Person (Public Query)

Details Contact Person (Public Query)	
Name	DR MRS S KOWSALYA
Designation	Registrar
Affiliation	Avinashilingam Institute for Homescience and Higher Education
Address	Avinashilingam Institute for Homescience and Higher Education for Women Coimbatore – 641043, India Coimbatore TAMIL NADU 641043, India
Phone	

Fax	
Email	kowsiskk@gmail.com

Source of Monetary or Material Support

Source of Monetary or Material Support
> Challagundla Reddy Jyothsna Sakra World Hospital, Bengaluru- 560103, India

Primary Sponsor

Primary Sponsor Details	
Name	Sakra World Hospital
Address	Bengaluru- 560103, India
Type of Sponsor	Private hospital/clinic

Details of Secondary Sponsor

Name	Address
NIL	NIL

Countries of Recruitment

List of Countries
India

Sites of Study

Name of Principal Investigator	Name of Site	Site Address	Phone/Fax/Email
Challagundla Reddy Jyothsna	Sakra World Hospital	1 st floor Devarabeesanahalli, Varthur Hobli Opp Intel, Outer Ring Rd, Marathahalli, Bengaluru, Karnataka Bangalore KARNATAKA	9986733459 jyothsnard@gmail.com

Details of Ethics Committee

Name of Committee	Approval Status	Date of Approval	Is Independent Ethics Committee?
Ethics commitee-INSTITUTIONAL HUMAN ETHICS COMMITTEE	Approved	10/09/2018	No

Regulatory Clearance Status from DCGI

Status	Date
Not Applicable	No Date Specified

Health Condition / Problems Studied

Health Type	Condition
Patients	Other specified metabolic disorders

Intervention / Comparator Agent

Type	Name	Details
Intervention	NIL	NIL
Comparator Agent	NIL	NIL

Inclusion Criteria

Inclusion Criteria	
Age From	20.00 Year(s)
Age To	50.00 Year(s)
Gender	Both
Details	1. Adults visiting Clinical Nutrition Department after undergoing Health Check in Sakra World Hospital, Bengaluru 2. Young & Middle aged adults- 20-50 year living in Bengaluru 3. Adults having Metabolic Syndrome as defined by NCEP ATP III (2005 revision) 4. Willing to participate in the study and given written consent

Exclusion Criteria

Exclusion Criteria	
Details	1. Pregnant and Lactating women 2. Type 1 diabetes mellitus adults 3. Adults who have implants 4. Adults physically challenged who are

Method of Generating Random Sequence	Not Applicable
Method of Concealment	Not Applicable
Blinding/Masking	Not Applicable

Primary Outcome

Outcome	Timepoints
To look at the significance/ relation between metabolic syndrome, body composition and lifestyle adaptations	Day 0 to Week 16

Secondary Outcome

Outcome	Timepoints
1. Prevalence of metabolic syndrome in adults of Bengaluru 2. To establish the means by which we can prevent the metabolic syndrome.	Day 0 to Week 16

Target Sample Size	**Total Sample Size**=125 **Sample Size from India**=125 **Final Enrollment numbers achieved (Total)**=Applicable only for Completed/Terminated trials **Final Enrollment numbers achieved (India)**=Applicable only for Completed/Terminated trials
Phase of Trial	N/A
Date of First Enrollment (India)	30/07/2021
Date of First Enrollment (Global)	No Date Specified
Estimated Duration of Trial	**Years**=1 **Months**=0 **Days**=0
Recruitment Status of Trial (Global)	Not Applicable
Recruitment Status of Trial (India)	Not Yet Recruiting
Publication Details	NIL
Brief Summary	[redacted]

ANNEXURE IV- CONSENT FORM

CONSENT FORM

NAME: **RESEARCH PROJECT ID.**

RESEARCH PROJECT TITLE: Metabolic Syndrome in relation to body composition and lifestyle adaptation among adults of Bengaluru

RESEARCH PARTICIPANTS STATEMENT

I voluntarily accept to participate in the project titled "Metabolic Syndrome in relation to body composition and lifestyle adaptation among adults of Bengaluru". The manner in which the project will be conducted and the requirements expected from me as a research participant are clearly explained to me. I understand that I can withdraw from the study at any time. I confirm that I have crossed my 18th birthday (My Date of Birth is) and I have the required age as a major to participate in an adult research project and to provide an independent consent.

I consent to the release of scientific data resulting from my participation in this project to the Principal Investigator for the use of her scientific purpose. The Principal Investigator assures me my anonymity. I understand that the record of this project will be a part of Sakra World Hospital, Bangalore and Avinashilingam University, Coimbatore and is a protected confidential document with them.

I also understand that the duration of the study is for four months from the day of my enrolment. I do understand there is no compensation or monetary benefit for me by participating in the project. The Principal Investigator will give me a date in fourth month from the date of my enrolment for my revisit to her. I have to visit my Principal Investigator and then get Blood Pressure (BP), WC (Waist Circumference) checked in Sakra World Hospital, Bengaluru. Six ml blood will be drawn to examine fasting blood sugar (FBS), triglyceride (TG), HDL cholesterol. Principal Investigator will twice do Body Fat Analysis using the Bio Electrical Impedance Technique. Once on the enrolment day and second time on my review date (as given by Principal Investigator). I understand that the Life style counselling given to me will be benefiting me and I'm willing to participate in the Project on my own consent. Principal Investigator has clearly explained me about the project. I also understand that by participating in the project, I'm not waiving off any of my legal rights.

RESEARCH PARTICIPANT:

I'M CLEARLY EXPLAINED ABOUT THE RESEARCH PROJECT.

I HAVE READ CLEARLY THE PATIENT INFORMATION SHEET, CONFIDENTIALITY STATEMENT AND THE CONSENT FORM.

I'M WILLING TO BE A RESEARCH PARTICIPANT IN THE PROJECT.

Name: **Signature:** **Date:**

PRINCIPAL INVESTIGATOR:

I HAVE CLEARLY EXPLAINED ABOUT THE RESEARCH PROJECT.

Name: Challagundla Reddy Jyothsna **Signature:** **Date:**

ANNEXURE V- RESEARCH PARTICIPANT INFORMATION SHEET

RESEARCH PARTICIPANT INFORMATION SHEET

For the welfare of the community especially young & middle aged adults; as a Research Scholar; I'm carrying out research at Sakra World Hospital, Bengaluru under the guidance of Avinashilingam University, Coimbatore.

The Research project is titled "Metabolic Syndrome in relation to body composition and lifestyle adaptation among adults of Bengaluru".

The information about demographic details, life style pattern and family and personal health history will be collected by filling the questionnaire. Anthropometric measures of height, weight, waist circumference will be measured and body composition analysis will be done. The blood pressure, biochemical analysis reports of the blood glucose, triglycerides, HDL cholesterol will be noted.

METABOLIC SYNDROME CRITERIA AS PER NCEP ATP III 2005 REVISION

ABSOLUTELY REQUIRED	NONE
CRITERIA	IF ANY THREE OF THE BELOW FIVE CRITERIA ARE PRESENT THEN THE PERSON IS SAID TO HAVE METABOLIC SYNDROME
1. CENTRAL OBESITY	WAIST CIRCUMFERENCE >90cm MALE; >80cm FEMALE
2. HYPERGLYCEMIA	FASTING GLUCOSE >= 100 mg/dl or Rx
3. DYSLIPEDEMIA	TRIGLYCERIDES >= 150 mg/dl or Rx
4. DYSLIPEDEMIA (SECOND SEPARATE CRITERIA)	HDL <40 mg/dl MALE or <50 mg/dl FEMALE or Rx
5. HYPERTENSION	>130 mm Hg SYSTOLIC or >85 mm Hg DIASTOLIC or Rx

The participant will be given necessary counselling and the review will be carried out in the fourth month. Anthropometric Measures of weight, waist circumference will be measured and body composition analysis will be done. Six ml blood will be collected to check triglycerides, HDL cholesterol, blood pressure will be redone.

All the information collected will be kept confidential.

Participants need not pay extra fee to take part in the study. Nor any remuneration will be given to the participants.

If participant has any discomfort in the study, they have all the right to discontinue from the study at any time.

The study will help to know the Metabolic Syndrome in relation to body composition of the individuals, and get to its relation to life style adaptations of young and middle age adults.

Contact persons

Challagundla Reddy Jyothsna, Principal Investigator, 9986733459

Dr. Chanda Kulkarni, IEC member secretary, 9886116151

ANNEXURE VI- QUESTIONNAIRE

RESEARCH QUESTIONNAIRE

1. INITIAL SCREENING OF PARTICIPANTS-

i.	UNDERGOING PREVENTIVE HEALTH CHECK	YES	NO
ii.	AGE GROUP OF 20-50 YEAR	YES	NO
iii.	RESIDING IN BENGALURU	YES	NO

2. SOCIO-ECONOMIC PROFILE

i. Age (year) _____

ii Gender Male/ Female

iii. Education (of self) _____

Are you the head of the family Yes/ No

If 'NO' Education of the head of the family _____

iv. Occupation _____

v Income of the family _____

vi. Family Structure Single/ Nuclear/ Joint/ Extended

vii. Size of the Family _____ members

viii. Marital Status Unmarried/ Married/ Divorcee or Separated/ Widow

Anthropometric measure

Height _____

Weight _____ BMI _____

Waist Circumference _____

Hip Circumference _____ Waist Hip Ratio _____

Biochemical parameters

Fasting blood sugar _____ Haemoglobin _____

Postpronial blood sugar _____

HBA1C _____ Blood pressure _____

Total cholesterol _____

Triglycerides _____ Exercise _____

HDL _____ type _____

LDL _____ duration _____

RESEARCH PARTICIPANT HEALTH HISTORY- _____

FAMILY HEALTH HISTORY MOTHER _____ FATHER _____

SMOKING/ TOBACCO _____

ALCOHOL _____

DIET PREFERENCE PURE VEG LACTO VEG LACTO-OVO-VEG VEG-NON VEG NON-VEG-VEG JAIN

APPETITE IS NORMAL IF ABNORMAL SPECIFY INCREASED OR DECREASED SINCE:

FOOD ALLERGY / SENSITIVITY NO IF YES SPECIFY:

DIET SUGGESTED-

DIET REVIEWED-

CRITERIA OF METABOLIC SYNDROME AS STATED BY NCEP ATP

IF YES (SCORE 1); IF NO (SCORE 0)

	SCORE
a. HIGH WAIST CIRCUMFERENCE	
b. HIGH FBS	
c. HIGH TRIGLYCERIDES	
d. LOW HDL CHOLESTEROL	
e. HIGH BLOOD PRESSURE	
TOTAL	

METABOLIC SYNDROME

PRESENT _____

ABSENT _____

IF METABOLIC SYDROME IS PRESENT & CONSENT OBTAINED TO PROCEED FURTHER IN THE STUDY

PERFORM BODY COMPOSITION ANALYSIS

Body Composition Analysis Parameters	Value
Total Body Water (kg)	
Protein (kg)	
Minerals (kg)	
Body Fat Mass (kg)	
Weight (kg)	
Skeletal Muscle Mass (kg)	
Body fat %	
Extracellular water Ratio (ECW)	
Inbody Score	
Visceral Fat Area (cm2)	
Target Weight (kg)	
Weight To Control(kg)	
Fat To Control(kg)	
Muscle To Control, Median (IQR)	
Basal Metabolic Rate (BMR)	
Obesity Degree	
Whole Body Phase Angle (WBPA)	

ANNEXURE VII- FOOD FREQUENCY QUESTIONNAIRE

FOOD FREQUENCY QUESTIONNAIRE- DURING PHASE II								
		HOW OFTEN THE FOOD IS CONSUMED				HOW MUCH IS CONSUMED		
FOOD GROUP	TYPE	NEVER	DAILY	WEEKLY	MONTHLY	Quantity of Medium Serve=		No. of Serves
						Raw	Cooked	
CEREAL	Rice					30g	1/2 cup	
	Wheat					25g	1 no.	
	Millets					30g	1/2 cup	
PULSES	Whole					30g	1/2 cup	
	Split					30g	1/2 cup	
	Sprouts					20g	1/4 cup	
MILK	Low Fat					200ml	1 cup	
	Regular					200ml	1 cup	
MILK PRODUCT	Curd					100ml	1/2 cup	
	Paneer					30g	1/4 cup	
	Cheese					20g	1 slice	
VEGETABLES	Other					100g	1/2 cup	
	Green					100g	1/2 cup	
	Root					100g	1/2 cup	
FRUIT	Regular					200g	1 cup	
	Seasonal					200g	2 cup	
MEAT-POULTRY	Egg Whole					1 no.	1/2 cup	
	Egg White					2 no.	1/2 cup	
	Chicken					85 g	3-4 med. pieces	
	Fish					85 g	2 med. pieces	
	Red Meat					85 g	3-4 med. pieces	
BEVERAGES	Water					1 litre		
	Tea/Coffee					100ml	1/2 cup	
	Juices					200ml	1 cup	
	Alcohol					30ml	1 peg	
	Colas					200ml		
FAT&OILS	Veg Oil					5ml		
	Ghee/Butter					5ml		
SUGARS	Sugar					10g		
	Honey/Jaggery					10ml		
	Artificial					2 sachets/ 2 pellets		
FOOD PREFERENCES AND LIFESTYLE								
EATING OUTSIDE								
FRIED FOOD								
DESSERT/SWEETS/CHOCOLATES								
NUTRITIONAL SUPPLEMENTS								
FAVORITE FOODS								
COOKING METHODS								
POINTS TO NOTES:								

ANNEXURE VIII- 24 HOUR DIET RECALL

24 HOUR DIET RECALL

Recall Day & Date (mention if any special occasion/ holiday):

MEAL TIME	FOOD / BEVERAGE CONSUMED	INGREDIENTS	QUANTITY (G/ML)
EARLY MORNING			
BREAKFAST			
MID- MORNING			
LUNCH			
EVENING			
DINNER			
BED TIME			

ANNEXURE IX- KAP QUESTIONNAIRE

NAME: **AGE:** **GENDER:** **UHID:**

KNOWLEDGE, ATTITUDE AND PRACTICE ON LIFESTYLE MODIFICATION AND BODY COMPOSITION ANALYSIS AMONG METABOLIC SYNDROME PEOPLE

Explain to the participant: I will ask you few questions about lifestyle modification, body composition Metabolic syndrome, and Body Composition. We are asking these questions to various people in the community who were selected independently and willing to participate in the study. Please let me know if you need me to clarify any of the questions. Feel free to ask any questions you may have.

I. KNOWLEDGE QUESTIONS 1. Score on knowledge about healthy diet/ general nutrition

i. Nutritious substances that people eat/ drink to maintain life and growth
   a. Food b. Nutrient c. Rice d. Vegetables

ii. What are macronutrients
   a. Carbohydrates b. Proteins c. Only a & b d. Fats along with a & b

iii. Vitamins and minerals are
   a. Essential b. Non essential

iv. Name 3 food groups----------
   a. Could name b. Couldn't name

v. Breakfast should be
   a. Consumed b. Skipped

vi. Food Pyramid guides us to
   a. Choose as per desire b. As per requirement

vii. Factors influencing Human nutrition are
   a. Modifiable b. Non-modifiable c. Both a & b

viii. Portioning sizes per meal are better given in
   a. Food Pyramid b. My Plate

ix. Individuals' meal per day should be as per
   a. Age b. Gender c. Occupation d. RDA

x. We can alter our foods one with another through
   a. Food Exchange List b. Availability c. Affordability

xi. Water and Fiber are also essential for health
   a. Only water b. Only Fiber c. Yes

xii. Fruits should be consumed daily

a. Yes b. No need

2. Score on knowledge about Exercise

i. Exercise should be done only when weight is high

a. Yes b. No

ii. In the exercise pyramid what is on the top side

a. Watching TV/ Being sedentary b. Playing games/ Being Active

iii. Exercise should be done

a. Daily if possible b. Weekly is enough c. Monthly is enough

iv. FITT means

a. Frequency Intensity Time and Type of exercise
b. Fully Individualised / Tailor made Training plan of exercise

v. Warm up and cool down are important for

a. Elderly b. Adults c. Adolescents d. All age groups vi. Overweight/ obesity is due to

a. Eating habits b. Physical Inactivity c. Unknown d. Both a & b

3. Score on knowledge about Body Composition

i. Body Mass Index (BMI) is calculated with

a. Age and Height b. Age and Weight c. Height and weight

ii. BMI and Body Composition are same

a. Yes b. More or less c. No

iii. Key for weight management is

a. Energy Balance b. Energy Intake- Energy Expenditure c. Both a& b

iv. Weight comprises of

a. Total body water & Body Fat mass c. Both a and b
b. Protein and Minerals d. Fat mass& Fat Free mass d. Both c& d

v. Visceral Fat area should be

a. Less than 100cm^2 b. More than 100cm^2

vi. Central obesity in males and females is defined as

a. BMI <30 c. Both a& b
b. Waist Circumference >90 or >80cm d. BMI <22

4. Score on knowledge about Metabolic syndrome and diet to be followed

i. Health problems that can occur when a person is overweight or obese

a. DM, HTN b. DM, CVD, Metabolic syndrome c. HTN

ii. Metabolic syndrome is

a. High Waist circumference, DM, High triglycerides, HTN, Low HDL cholesterol b. Any two factors from a c. Any three factors from a iii. What does a healthy lifestyle include

a. Eating habits b. Physical activity c. Only a & b

d. Social habits of Alcohol, Smoking & Stress Management e. a, b & c

iv. Lifestyle diseases comprise of

a. DM b. HTN c. Cancers d. CVD e. Metabolic Syndrome f. All the above

v. Risk factors leading to Metabolic syndrome

a. High HDL cholesterol b. Low Blood pressure c. Both d. None of the above

vi. Metabolic syndrome occurs in

a. Elderly b. Adults c. Adolescents d. All age groups

II. ATTITUDE QUESTIONS

i. Do you believe lifestyle adaptations can help prevent Metabolic syndrome

a. Yes b. No c. May be d. Not known

ii. How important is it to follow a healthy lifestyle pattern a. Not important b. Not sure c. Important

If Not Important: Can you tell me the reasons why it is not important?

- iii. How confident do you feel in following a healthy lifestyle a. Not confident b. Ok/so-so c. Confident

If Not confident: Can you tell me the reasons why you do not feel confident?

---

iv. Overweight/ Obesity/ DM+/ HTN+/ De-ranged Lipid values are due to a. Family History/ Gene

b. Lifestyle habits of Diet pattern/ Physical activity/ Alcohol/ Smoking

c. Both d. Not Known

v. Do you feel Lifestyle counseling is necessary from an Expert?

a. Yes b. No If No Reason- I'm aware of everything/ I'll search on google/ My family/ friends/colleagues will help me/ I have the expert advice already

vi. To what extent you can follow each of them and what is the challenge for not following ----------

a. When need comes I'll follow b. I can surely follow

III. PRACTICE QUESTIONS

i. Intake of Fruits is daily a. Yes b. No

ii. Cooking methods Daily ---------- Weekly---------- Fortnight ----------

iii. Exercise is followed 30 minutes minimum 5 days/ week Activity

a. Yes b. No

iv. Diet varies due to ----------

How frequently? ---------days/ months/ ½ year/ Years

How long it'll take to fall back into healthy routine again? ---------days/ months/ ½ year/ Years

v. Physical Activity varies due to ----------

How frequently? ---------days/ months/ ½ year/ Years

How long it'll take to fall back into healthy routine again? ---------days/ months/ ½ year/ Years

vi. Social habits vary due to

How frequently? ---------days/ months/ ½ year/ Years

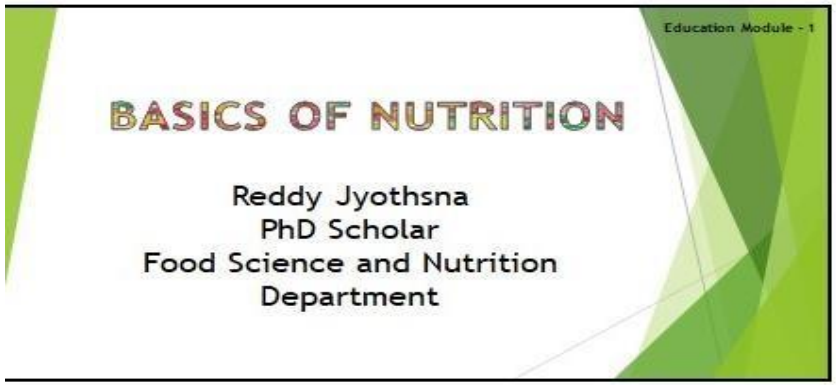
How long it'll take to fall back into healthy routine again? ---------days/ months/ ½ year/ Years

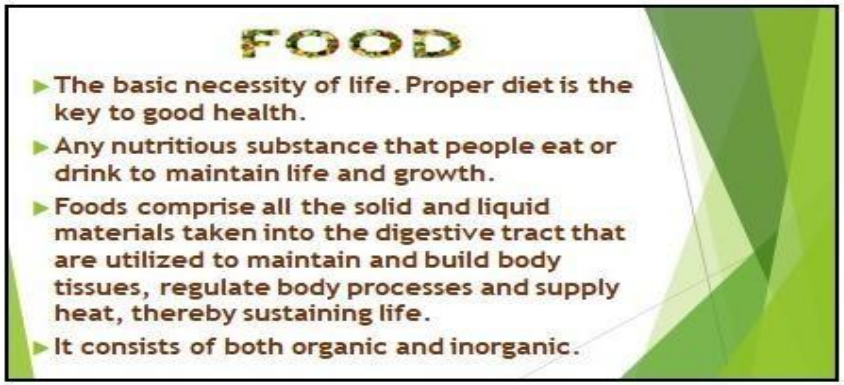
	SCORE	REMARK
I. KNOWLEDGE REGARDING		
1. Healthy diet/ general nutrition	**/12**	
2. Benefits of Exercise	**/6**	
3. Body composition	**/6**	
4. Metabolic syndrome	**/6**	
II. ATTITUDE	**/6**	
III. PRACTICE	**/6**	

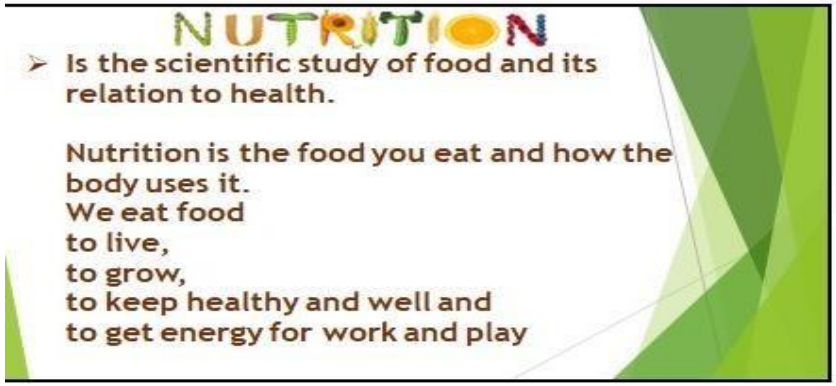
VARIABLE
I. KNOWLEDGE SCORING SCALE
Score on knowledge about healthy diet/ general nutrition
0–5 (Poor knowledge)
6–9 (Average knowledge)
10–12 (Good knowledge)
Score on knowledge about benefits of exercise and weight loss
0-2 (Poor knowledge)
3-4 (Average knowledge)
5–6 (Good knowledge)
Knowledge Regarding Body composition
0-2 (Poor knowledge)
3-4 (Average knowledge)
5–6 (Good knowledge)
Knowledge Regarding Metabolic syndrome and diet to be followed
0-2 (Poor knowledge)
3-4 (Average knowledge)
5–6 (Good knowledge)
II. ATTITUDE SCORING SCALE
0 (Strongly negative)
1 (Negative)
2 (Neutral)
3 (Positive)
4-6 (Strongly positive)
III. PRACTICE SCORING SCALE
0 (Very poor practice)
1 (Poor practice)
2 (Neutral)
3 (Good practice)
4-6 (Very good practice)

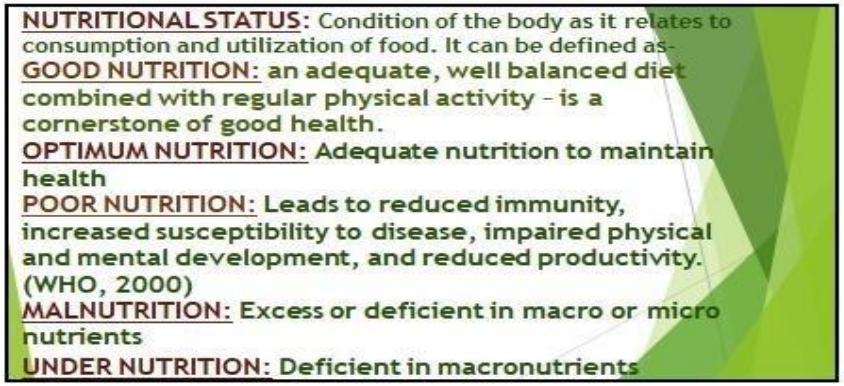
ANNEXURE – X

EDUCATION MODULE

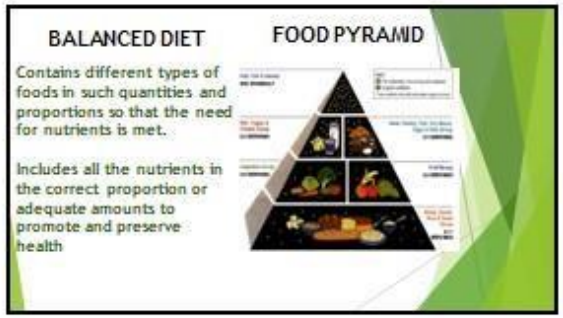




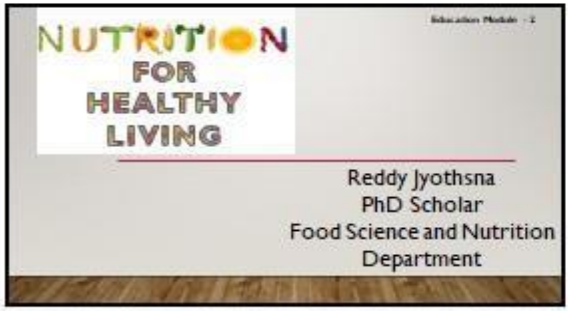


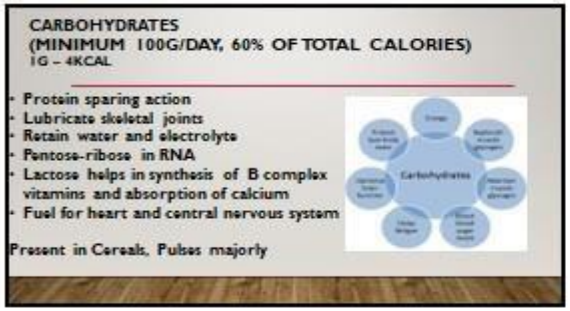


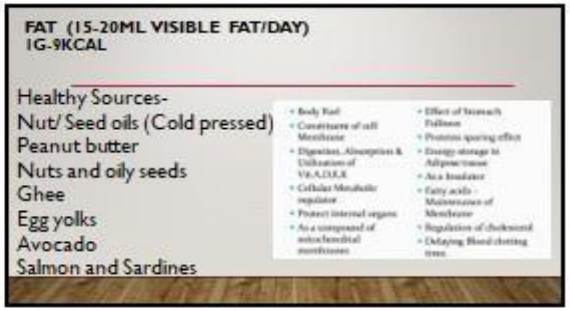
EDUCATION MODULE 1: BASICS OF NUTRITION



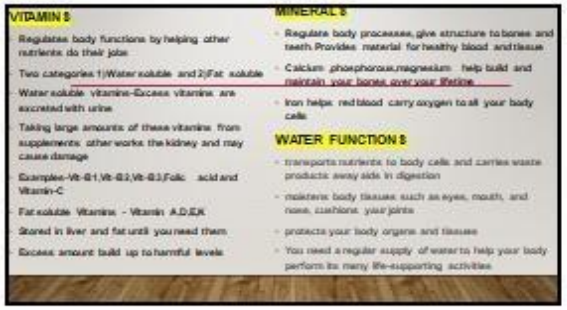
EDUCATION MODULE 1: BASICS OF NUTRITION (CONTINUED)

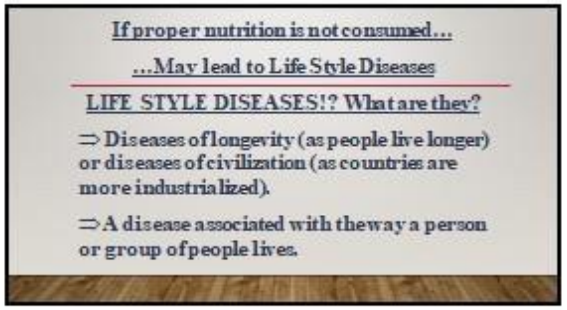


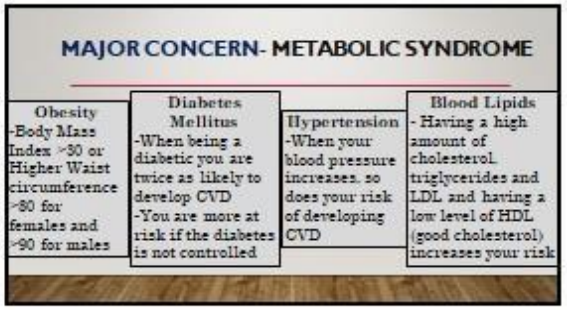


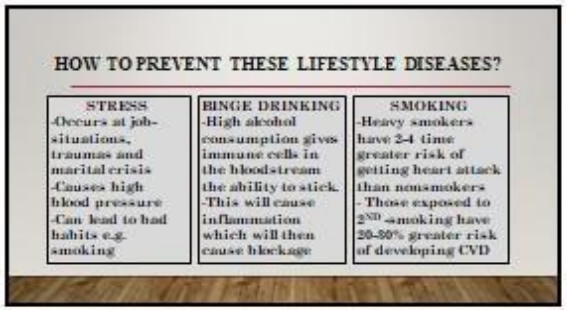


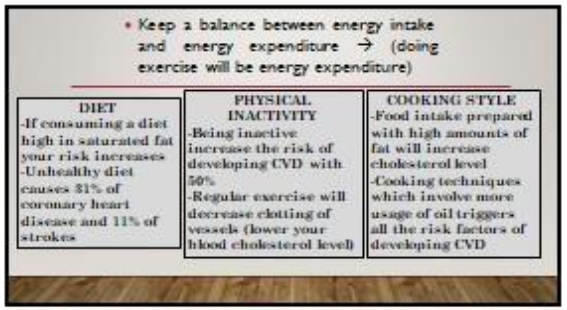
EDUCATION MODULE 2: NUTRITION FOR HEALTHY LIVING

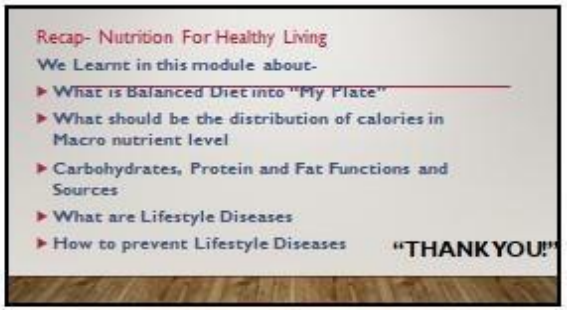




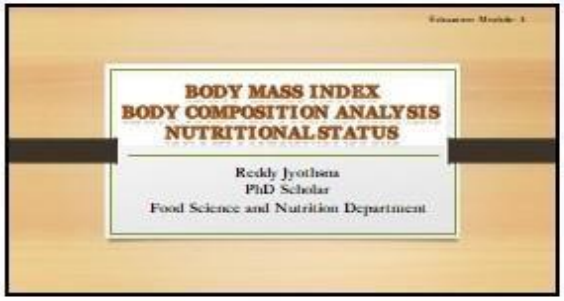


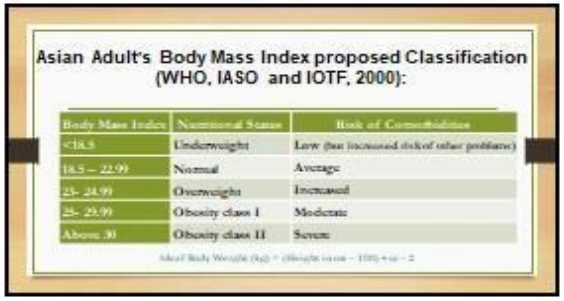


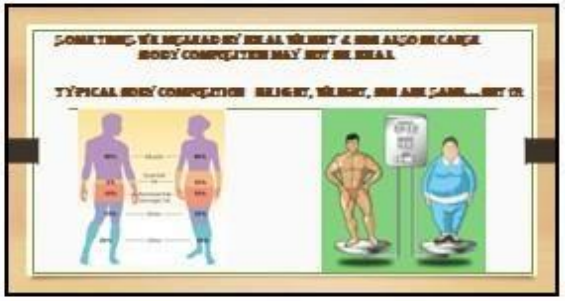


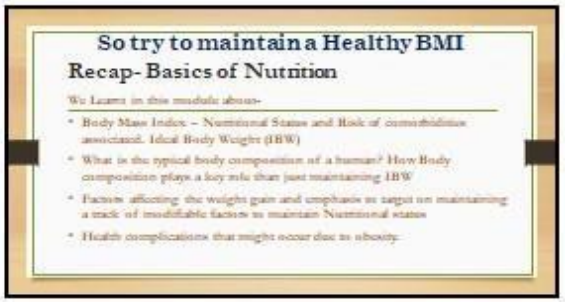


EDUCATION MODULE 2: NUTRITION FOR HEALTHY LIVING (CONTINUED)

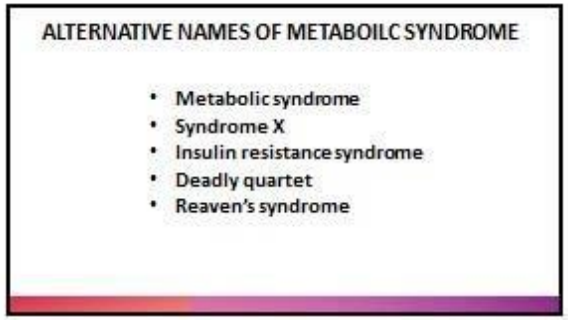


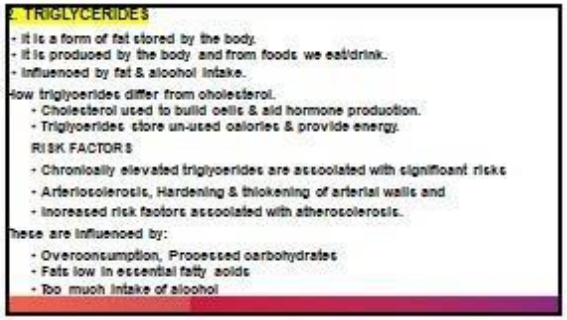


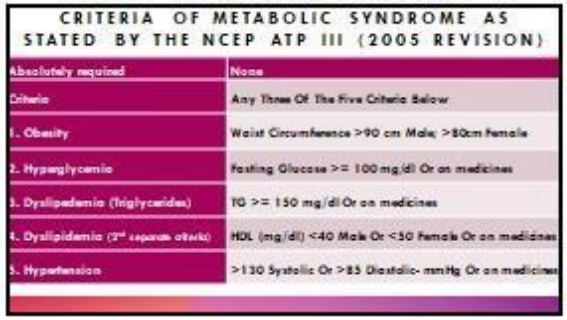


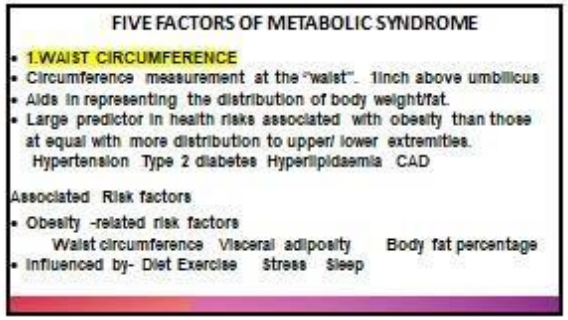


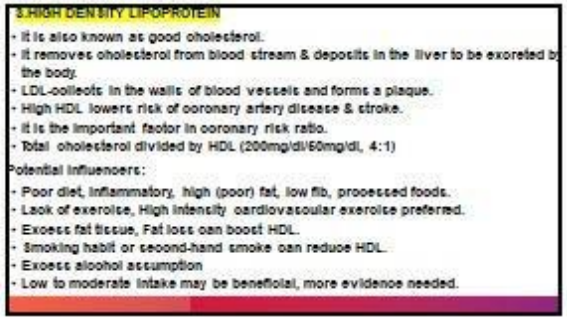
EDUCATION MODULE 3: BODY MASS INDEX, BODY COMPOSITION ANALYSIS NUTRITIONAL STATUS



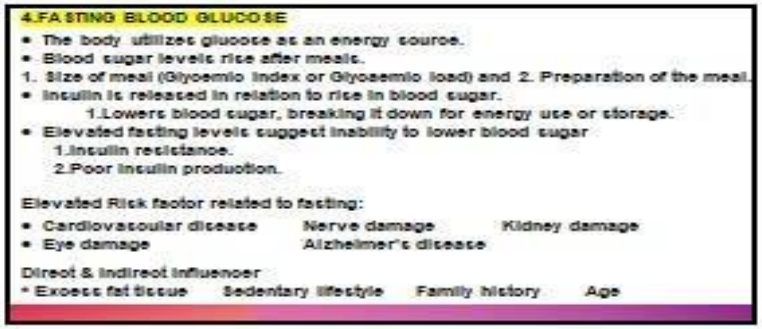


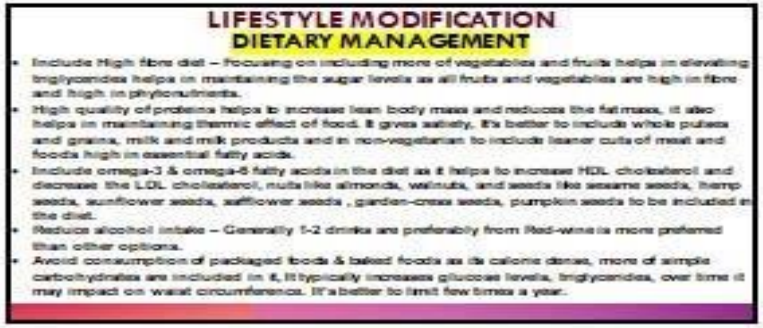


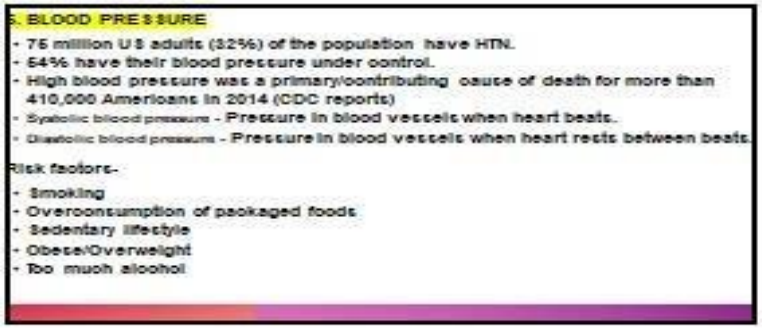


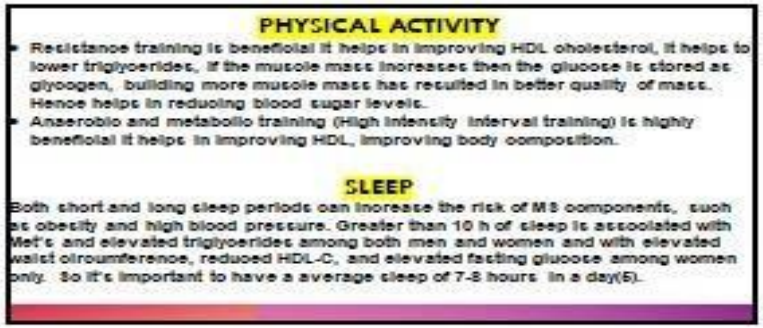


EDUCATION MODULE 4: LIFESTYLE TO BE FOLLOWED IN METABOLIC SYNDROME

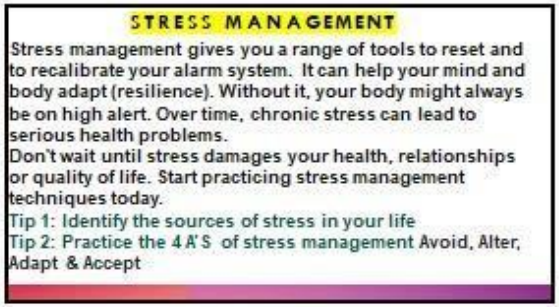


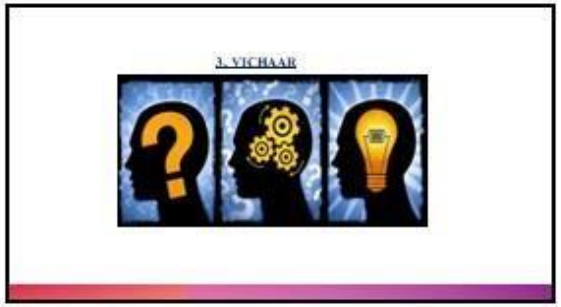






EDUCATION MODULE 4: LIFESTYLE TO BE FOLLOWED IN METABOLIC SYNDROME (CONTINUED)





EDUCATION MODULE 4: LIFESTYLE TO BE FOLLOWED IN METABOLIC SYNDROME (CONTINUED)

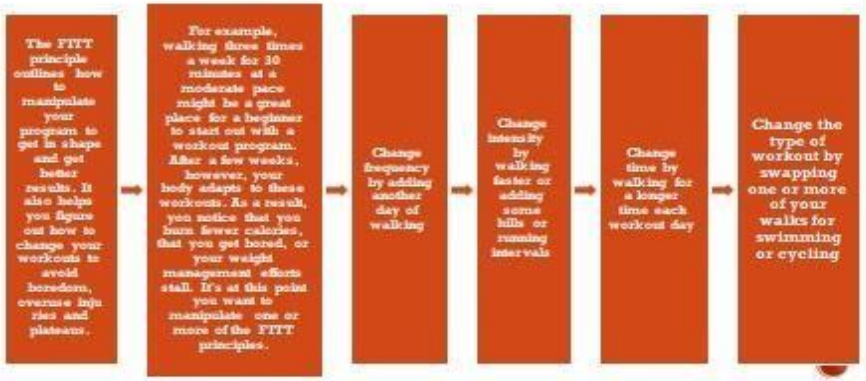
Education Module - 5

Exercise
As A Part of Healthy Lifestyle

Reddy Jyothsna
PhD Scholar
Food Science and
Nutrition Department

EXERCISE PRESCRIPTION INVOLVES THE MANIPULATION OF FREQUENCY, INTENSITY, TIME AND TYPE OF EXERCISE [FITT]

HOW TO USE FITT



LIFESTYLE PHYSICAL ACTIVITY

Principles of exercise training

- **Warm up and cool down-** Moderate and vigorous exercise is best preceded by a warm-up and followed by a cool-down period. A warm-up usually involves doing the planned exercise at a lower intensity and speed and allows the body to prepare for more vigorous activity. A cool-down is done to aid recovery and, following vigorous exercise, can prevent exercise-associated postural hypotension and its manifestations
- **Walking prescription-** Brisk walking at an individual's preferred pace is the most reported and recommended physical activity as it meets the minimum intensity to achieve a cardiorespiratory benefit and decrease adiposity in the unfit
- **Aerobic exercise-** The word aerobic means "with oxygen," meaning that your breathing determines the amount of oxygen that gets to your muscles. Oxygen in your muscles is what helps them to move, giving you the strength to exercise. Your body creates this energy by using stored carbohydrates and fats in combination with oxygen

EDUCATION MODULE 5: EXERCISE AS A PART OF HEALTHY LIFESTYLE

Principles of exercise training (continues...)

- **Resistance exercise training-** It is any activity that causes muscles to contract against external force. Since the goal of resistance training is to progressively overload the musculoskeletal system, weight machines, dumbbells, and barbells are usually used as resistance

- **Respiratory muscle training-** Impaired breathing may hamper your ability to be physically active and may make walking, climbing stairs, and even sleeping difficult. Speech and swallowing can also be affected. Respiratory muscle training strengthens your respiratory muscles and improves your ability to perform these activities.

Principles of exercise training (continues...)

- **Balance and flexibility -** Flexibility exercises are stretching motions that help maintain inherent muscle flexibility and smooth mobility and avoid deterioration stemming from factors like increasing age, sports injuries, or physical overexertion. These exercises enhance muscle length, elasticity, and power and promote a broader range of motion. Overall, muscular resilience to physiological wear and tear, as well as injuries, increases. Balance movements strengthen the inner muscles responsible for maintaining muscular coordination and equilibrium, thereby improving body posture and stability and enhancing hand-eye coordination to avert the risk of injuries.

- **WHO Guidelines and American college of sports medicine recommends on Physical Activity and Sedentary Behavior 2020 Age-Appropriate Fitness Protocols and Guidelines for age 18-64 years**
- **1. Adults should do at least 150 minutes to 300 minutes of moderate intensity aerobic physical activity, or do at least 75 to 150 minutes of vigorous-intensity aerobic physical activity, or an equivalent combination of moderate and vigorous-intensity activity throughout the week for substantial health benefits;**
- **2. Adults should also do muscle-strengthening activities at moderate or greater intensity that involve all major muscle groups on 2 or more days a week, as these provide additional health benefits.**

Energy expenditure on various physical activities(Kcal/hour)

ACTIVITY	KCAL/ HR
SHUTTLE	300
TABLE TENNIS	245
TENNIS	392
VOLLEYBALL	180
DANCING	372
FISHING	222
SHOPPING	204

ACTIVITY	KCAL/ HR
SLEEPING	57
STANDING	132
SITTING	86
RUNNING	
12 KM/HR	750
10KM/HR	655
8KM/HR	522
6KM/HR	353
4KM/HR	160
WALKING 4KM/HR	160
CYCLING 15KM/HR	360

* Approx. energy expenditure for 60 Kg reference man. Individuals with higher body weight will be spending more calories than those with lower body weight. Reference woman (50 kg) will be spending 9% less calories.
(DIETARY GUIDELINES FOR INDIANS - NIN MANUAL 2011)

EXERCISE AND PHYSICAL ACTIVITY IN INDIAN SCENARIO

- Adults >20 yr should undertake a minimum of 30-45 minutes of physical activity of moderate intensity (such as brisk walking 6-8 km/hr) 6-8 days of the week.
- Greater health benefits can be obtained by engaging in physical activity of longer duration or more vigorous intensity such as jogging, running, cycling and swimming. Sedentary people embarking on a physical activity programme should undertake a moderate intensity activity of short duration to start with and gradually increase the duration or intensity.
- Other day-to-day activities like walking, housework, gardening, will be beneficial not only in weight reduction but also for lowering of blood pressure and serum triglycerides. It also elevates HDL (good) cholesterol in blood. Simple modification in lifestyle like deliberately climbing up the stairs instead of using the lift and walking for short distance instead of using a vehicle could also immensely help in increasing our physical activity.
- Exercise program should include 'warm up' and 'cool down' periods each lasting for 5 minutes.
- During exercise, the intensity of exercise should ensure 60-70% increase in heart rate.

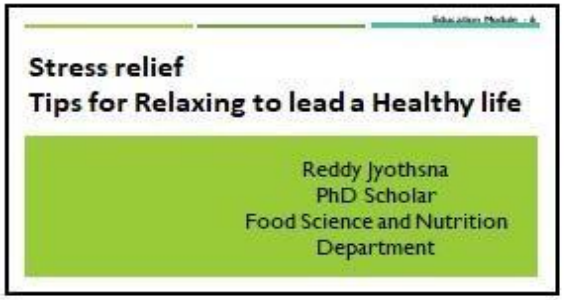
RECAP- EXERCISE AS A PART OF A HEALTHY LIFESTYLE

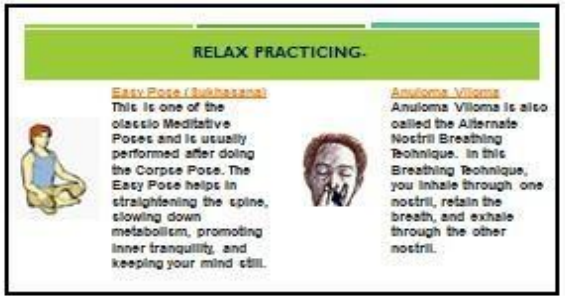
We Learnt in this module about-

- Exercise pill- take one daily
- Exercise Prescription
- FITT (Frequency Intensity Time and Type of Exercise)
- Principles of Exercise Training
- WHO guidelines
- Energy Expenditure on various physical activities
- Indian specific exercises

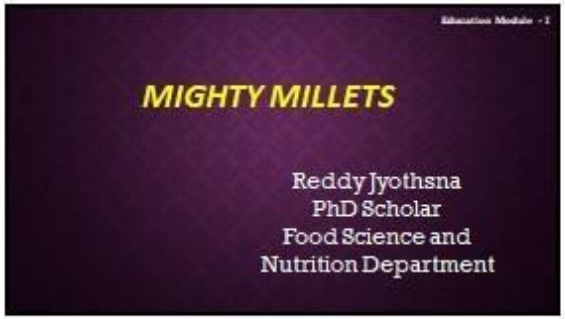
"THANK YOU!"

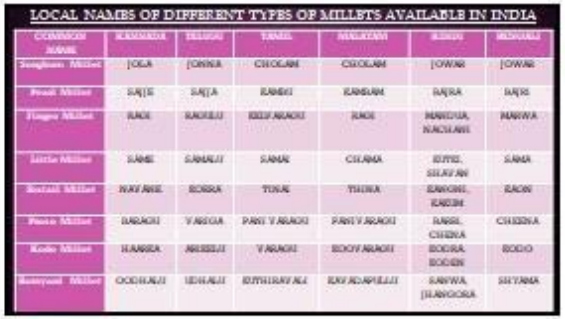
EDUCATION MODULE 5: EXERCISE AS A PART OF HEALTHY LIFESTYLE (CONTINUED)

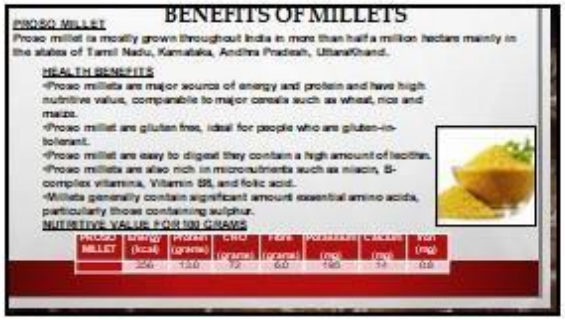




EDUCATION MODULE 6: STRESS RELIEF TIPS FOR RELAXING TO LEAD A HEALTHY LIFE







EDUCATION MODULE 7: MIGHTY MILLETS

FINGER MILLET

HEALTH BENEFITS

-Improves skin health due to its antioxidant and anti-inflammatory properties, prevents hyperpigmentation and skin- aging

-Prevents obesity due to its Tryptophan, amino acid content

-Aids healthy pregnancy, aids in milk production, relieves anxiety and stress , and prevents insomnia

-Rich in calcium, improves bone and teeth health , prevents bone weakness caused by osteoporosis. Controls diabetes

-Reduces cholesterol due to its dietary fibre having cholesterol- lowering properties

-Prevents iron-deficiency anaemia in adolescents due to its natural iron, high protein content and high mineral content

-Rich in dietary fibre, improves digestion, prevents constipation

-Prevents malnutrition due to its high protein content and essential amino acids

-Good source of protein for vegetarians. Good replacement diet for people with gluten intolerance as it is gluten free

-Ragi is the healthy first food for babies due to its rich calcium, iron and fibre content.

NUTRITIVE VALUE FOR 100 GRAMS

Finger Millet	Energy (kcal)	Protein (grams)	CHO (grams)	Fibre (grams)	Potassium (mg)	Calcium (mg)	Iron (mg)
	328	7.3	72.0	11.5	408	344.0	3.9

BARNYARD MILLET

HEALTH BENEFITS

Good for Diabetes due to its high dietary fibre and protein content

Rich in antioxidants and phytochemicals, protects from heart diseases , cancer

Helps to lower blood cholesterol levels

Helps to lose weight and boosts metabolism

Helps in digestion and relieve constipation due to its decent amount of soluble and insoluble fibre content

Strengthens immune system due to its reasonable amount of iron and zinc

Good for celiac disease as it is gluten- free

Reduces anaemia in lactating mother and good for milk production in them. Good for pancreas, helps to cure thyroid problem

Relieves fatigue, weakness and sleepiness

Beneficial for cleansing of liver / kidney / gall bladder

Gives quick relief from Jaundice

Reduces cancer of the ovaries and uterus

Protects from ulcer formation in the small intestine and cancer of the liver and spleen of the large intestine

NUTRITIVE VALUE FOR 100 GRAMS

Barnyard millet	Energy (kcal)	Protein (grams)	CHO (grams)	Fibre (grams)	Potassium (mg)	Calcium (mg)	Iron (mg)
	300	11.0	55.0	13.6	97.5	19.6	22.9

FOXTAIL MILLET

Foxtail millet has also been grown in India since antiquity and it was consumed as the staple food until three to four decades ago. Currently, it is widely grown in Andhra Pradesh, Karnataka, Tamilnadu, Maharashtra, Uttar Pradesh and Bihar states. Helps in good digestion

HEALTH BENEFITS

•Aids in Weight loss. Improves immunity.

•Foxtail millet which is rich in natural iron which helps reduce muscular spasms and ease out restless syndrome.

•Protects bone health and Muscle health, Regulates blood sugar level.

•Cures muscle weakness. Good for cardiac health.

•Foxtail millet is rich in VITAMIN B12 which is essential for maintaining a healthy heart & smooth functioning of nervous system.

•A diet including foxtail millet improve glycaemic control and reduce insulin and fasting glucose in type2 diabetes mellitus.

•Slowes the development of Alzheimer's disease, Enhance the concentration and memory power.

•Maintenance of hair and Skin health.

NUTRITIVE VALUE FOR 100 GRAMS

Foxtail Millet	Energy (kcal)	Protein (grams)	CHO (grams)	Fibre (grams)	Potassium (mg)	Calcium (mg)	Iron (mg)
	55.17	10.15	2.63	11.24	108	3.17	0.47

LITTLE MILLET

HEALTH BENEFITS

•Rich in potent antioxidants and phytochemicals help to fight against diabetes, cardiovascular diseases, cataract, cancer, inflammation , gastrointestinal problems and delay ageing

•Helps treat Diabetes as it is low in glycaemic index and high in dietary fibre

•Rich in magnesium and niacin, helps lower cholesterol, improve heart health

•Contains phosphorus, great for weight loss, tissue repair and energy production after strenuous workout

•Helps in weight loss due to its high water-soluble fibre content, provide satiety, prolonged gastric emptying

•Good for celiac disease as it is gluten free

NUTRITIVE VALUE FOR 100 GRAMS

Little Millet	Energy (kcal)	Protein (grams)	CHO (grams)	Fibre (grams)	Calcium (mg)	Potassium (mg)	Iron (mg)
	341	67	7.7	2.53	17	129	9.3

KODO MILLET

It is grown in India from Kerala and Tamil Nadu in the south, to Rajasthan and Uttar Pradesh in the north, and West Bengal in the east, as a food grain..

HEALTH BENEFITS:

•Low glycaemic index – Which means that Kodo millets release glucose/energy slowly, over a longer period of time and thus helps in sugar control. This makes it a great substitute for polished white rice

•Gluten-free – Great for people with gluten intolerance or celiac disease. Easy to digest

•Rich in antioxidants like polyphenols and dietary fibre.

•Good source of vitamins – Vitamin B6, Niacin, folic acid and minerals such as calcium, iron, magnesium and zinc

•Regular consumption of Kodo millet is very beneficial for postmenopausal women suffering from signs of cardiovascular diseases like high blood pressure and high-cholesterol levels

NUTRITIVE VALUE FOR 100 GRAMS

Kodo Millet	Energy (kcal)	Protein (grams)	CHO (grams)	Fibre (grams)	Calcium (mg)	Potassium (mg)	Iron (mg)
	309	65.9	6.3	2.47	27	144	0.5

Namaskaram!

Scan the QR-Code to Download the soft copy of Mighty Millets Booklet which contains-

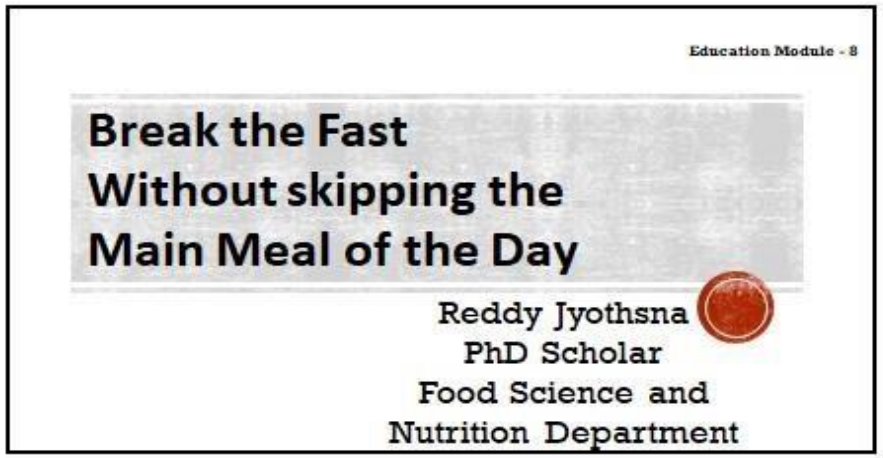
Brochure,
Know your Millets
Nutritive values & benefits
Millet Recipes- Enjoy the delicacies and drop us a feedback later

RECAP- MIGHTY MILLETS

WE LEARNT IN THIS MODULE ABOUT-

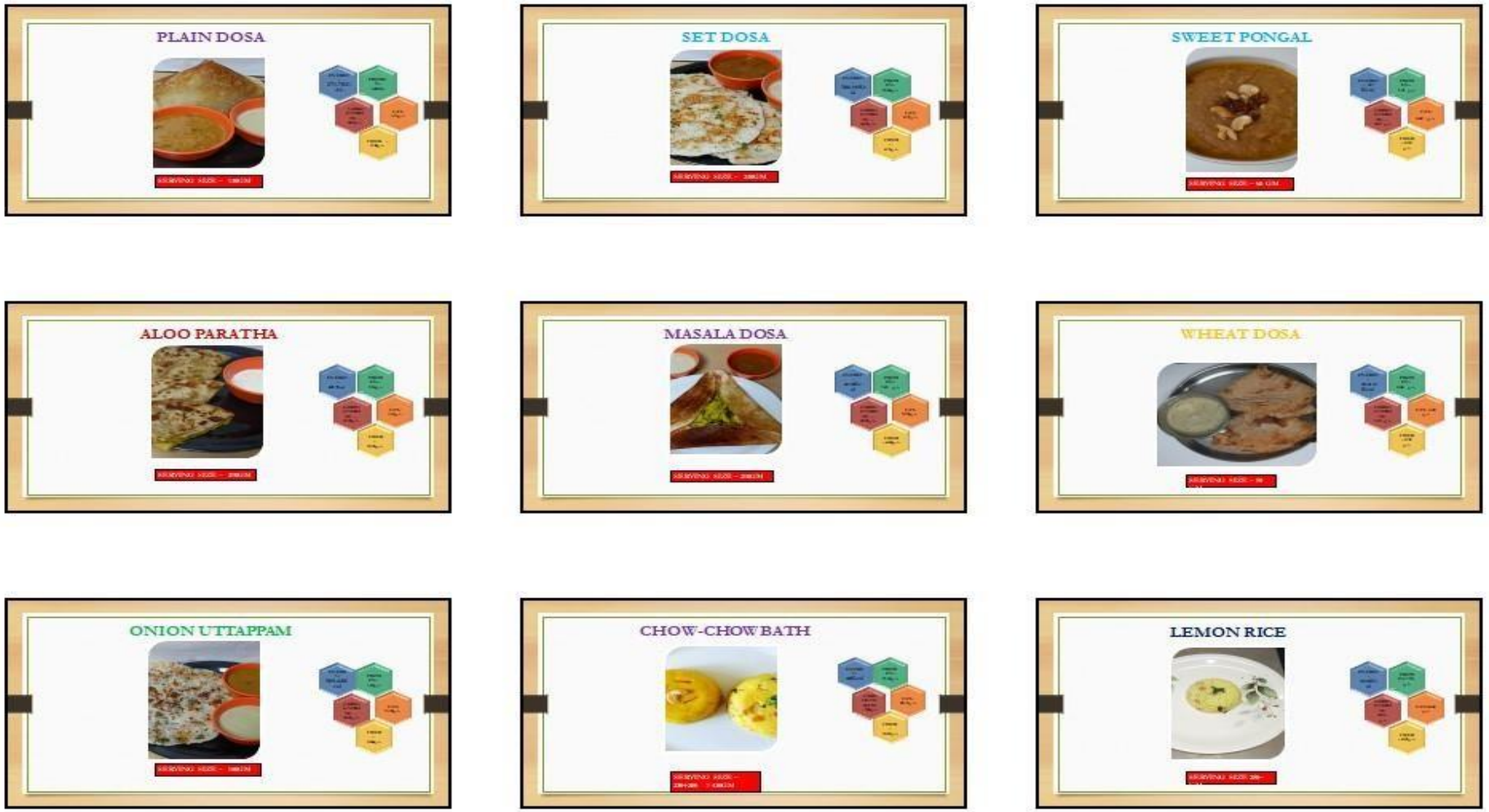
* KNOWS YOUR MILLETS
* LOCAL NAMES OF MILLETS
* HEALTH BENEFITS AND NUTRITIVE VALUES OF MILLETS
* MILLET RECIPES QR CODE

EDUCATION MODULE 7: MIGHTY MILLETS (CONTINUED)



EDUCATION MODULE 8: BREAK THE FAST WITHOUT SKIPPING THE MAIN MEAL OF THE DAY

EDUCATION MODULE 8: BREAK THE FAST WITHOUT SKIPPING THE MAIN MEAL OF THE DAY (CONTINUED)



EDUCATION MODULE 8: BREAK THE FAST WITHOUT SKIPPING THE MAIN MEAL OF THE DAY (CONTINUED)

CURD RICE

BISIBELEBATH

APPAM & CHICKEN CURRY

JEERA RICE & DHAL FRY

POORI AND ALOO SABZI

VEG RICE

RAGI DOSA

MUSELI & MILK

Recap- Break the Fast without skipping the Main Meal of the Day

We Learnt in this module about-

- Why we shouldn't skip breakfast
- Benefits of Healthy Breakfast
- General Indian Breakfast options with their nutritive values

EDUCATION MODULE 8: BREAK THE FAST WITHOUT SKIPPING THE MAIN MEAL OF THE DAY (CONTINUED)

Education Module - 9

FRESH FRUITS IN OUR DAY TO DAY CONSUMPTION

Reddy Jyothsna
PhD Scholar
Food Science and Nutrition Department

- ✓ Fruit is packed with vitamins, minerals, fiber, and plant compounds called phytonutrients. As such, it's one of the healthiest foods you can eat.
- ✓ Some fruits are even considered "superfoods" due to their numerous benefits. Even though there's no exact definition of what constitutes a superfood, they're often rich in health-boosting compounds with antioxidant and anti-inflammatory properties.
- ✓ Many fruits have been studied for their health effects. Although it's clear that total fresh fruit intake is an important factor in disease prevention, certain fruits stand out due to their robust nutrient content and associated benefits

ORANGE

HEALTH BENEFITS

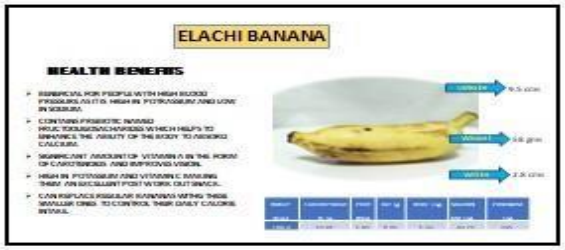
- KEEPS YOUR BONES AND TEETH STRONG AND HELPS FIGHT AGAINST VIRAL INFECTIONS
- ITS ACTS AS CHOLAGOGUE
- RICH IN VITAMIN C
- MOISTURIZE & NOURISH SKIN
- HELPS REGULATE HIGH BLOOD PRESSURE
- GOOD FOR YOUR KIDNEYS AND HEART
- PREVENTS ARTHRITIS
- HELP FIGHT CANCER
- GOOD FOR PREGNANT WOMEN AND NURSING MOTHERS
- IMPROVES BLOOD CIRCULATION AND ALSO ELIMINATES BAD BREATHE

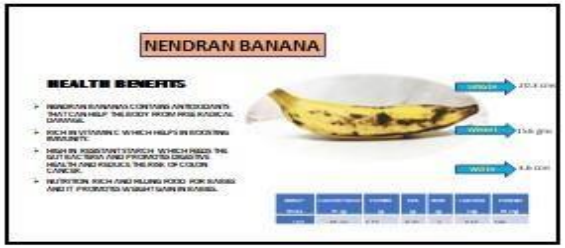
PINE APPLE

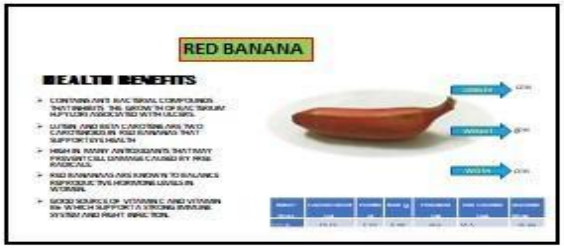
HEALTH BENEFITS:

- SUPPORTS THE IMMUNE SYSTEM
- IMPROVES VISION AND EYE HEALTH
- HAVE ANTI INFLAMATORY BENEFITS
- HELPS WITH SINUS AND COMMON COLD
- HELP FOR BONE STRENGTH
- AIDS IN DIGESTION
- REDUCES BLOOD CLOTS
- PREVENTS CANCER
- BENEFICIAL FOR ORAL HEALTH

EDUCATION MODULE 9: FRESH FRUITS IN OUR DAY TO DAY CONSUMPTION







EDUCATION MODULE 9: FRESH FRUITS IN OUR DAY TO DAY CONSUMPTION (CONTINUED)

MANGOSTEEN

HEALTH BENEFITS

- RICH IN ANTIOXIDANTS
- MANGOSTEENS ARE LOW IN CALORIES AND RICH IN DIETARY FIBER
- SUPPORTS IN BLOOD SUGAR CONTROL
- POSSESS ANTI-INFLAMMATORY PROPERTIES
- HELPS IN MAINTAINS HEALTHY SKIN
- HELPS IN REDUCE THE CHOLESTEROL IN BODY
- EFFECTIVE IN TREATING ALZHEIMER'S DISEASE
- IT CONTAINS LOW CALORIES WHICH PROMOTES IN WEIGHT LOSS
- BE RICH IN ANTIOXIDANTS PROMOTES HEALTHY IMMUNE SYSTEM.

Weight	Calories	Carbohydrate	Fat	Protein	Fiber
100g	73	15.6 g	1.46 g	0.41 g	1.8 g

RAMBUTAN

HEALTH BENEFITS

- PREVENTS ANEMIA.
- IT HELPS IN ABSORPTION OF MICRO NUTRIENTS
- HELPS IN GENERATION OF WHITE AND RED BLOOD CELLS.
- IT IS HAVING ANTI SEPTIC PROPERTIES
- PREVENTS DEHYDRATION
- HELPS IN PROMOTING BONE AND MUSCLE STRENGTH

Weight	Calories	Carbohydrate	Fat	Protein	Fiber
100g	82	20.87 g	0.21 g	0.65 g	0.9 g

STAR FRUIT

HEALTH BENEFITS

- STAR FRUITS HAVING ANTI INFLAMMATORY PROPERTIES
- IT REGULATES BLOOD PRESSURE
- IMPROVES METABOLISM AND DIGESTION
- HELPS IN IMPROVING RESPIRATORY HEALTH
- IT HELPS IN REGULATING CHOLESTROL LEVELS AND MAINTAINS HEARTH HEALTH.
- IT DETOXIFY'S THE BODY
- IT IS HAVING ANTI ULCER PROPERTIES.

Weight	Calories	Carbohydrate	Fat	Protein	Fiber
100g	31	6.73 g	0.33 g	1.04 g	2.8 g

RED APPLE

HEALTH BENEFITS

- Great source of Vitamin C
- Contains soluble and insoluble fiber
- Anti-inflammatory
- Increases bone fit
- Improves bone density
- Improves metabolism by increasing calorie burn

Weight	Calories	Carbohydrate	Fat	Protein	Fiber
100g	52	13.81 g	0.17 g	0.26 g	2.4 g

SHIMLA APPLE

HEALTH BENEFITS

- Shimla apples will vary in nutritional content, depending on the variety.
- A source of fibre to regulate the digestive tract.
- Vitamin C to strengthen the immune system while reducing inflammation.
- High in potassium which balances fluid levels within the body.
- The iron also promotes oxygen to produce red blood cells, vitamin K to assist in faster wound healing.
- Calcium to build strong bones and teeth.
- Dark red apples have anthocyanin's, which are pigmented components that have antioxidant like properties to protect cells against the damage caused by free radicals.
- Proven source for the all the micro nutrients.

Weight	Calories	Carbohydrate	Fat	Protein	Fiber
100g	52	13.81 g	0.17 g	0.26 g	2.4 g

GREEN APPLE

HEALTH BENEFITS

- Promotes Healthy Digestion.
- Reduces The Risk Of Chronic Diseases.
- Improves Heart Health.
- Boosts Immune System.
- Promotes Healthy Skin.
- Supports Healthy Weight Management.
- Promotes Hair Growth.
- Prevents Hair Loss.

Weight	Calories	Carbohydrate	Fat	Protein	Fiber
100g	52	13.81 g	0.17 g	0.26 g	2.4 g

WATER MELON

HEALTH BENEFITS

- CONTROL HIGH BLOOD PRESSURE
- REDUCE BODY FAT
- HYDRATE THE BODY
- IMPROVES EYE HEALTH
- KEEPS KIDNEY HEALTH
- GOOD FOR CARDIAC PATIENTS
- COMBATS CANCER
- RICH IN ANTIOXIDANTS
- BOOST ENERGY LEVEL

Weight	Calories	Carbohydrate	Fat	Protein	Fiber
100g	30	7.55 g	0.15 g	0.61 g	0.4 g

MUSK MELON

HEALTH BENEFITS

- MUSK MELON IS HIGH IN WATER CONTENT KEEPS BODY HYDRATE.
- IT IS A GOOD SOURCE OF VITAMIN A, ITS BENEFICIAL FOR EYE HEALTH.
- IT HELPS IMPROVES EYESIGHT AND PREVENTS CATARACTS.
- HIGH IN FIBER WHICH HELPS IN GOOD GUT HEALTH.
- KIDNEY CELLS GET ORGANIZATION'S DAMAGED CAN BE PREVENTED BY MUSKMELON EXTRACT KNOWN AS GLUTATHIONE.
- RICH IN BIOTIN HELPS FOR HAIR GROWTH AND HELPS IN ABSORPTION OF VITAMIN D.
- RICH IN ANTIOXIDANTS AND MINERALS, RICH IN VIT C .

Weight	Calories	Carbohydrate	Fat	Protein	Fiber
100g	34	8.16 g	0.2 g	0.84 g	0.9 g

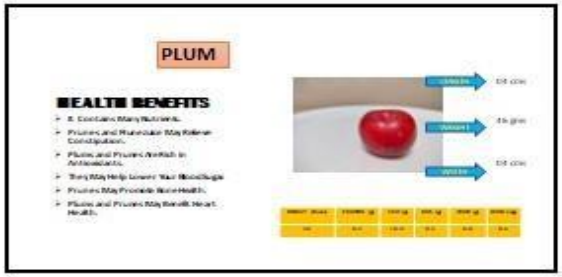
CHERRY

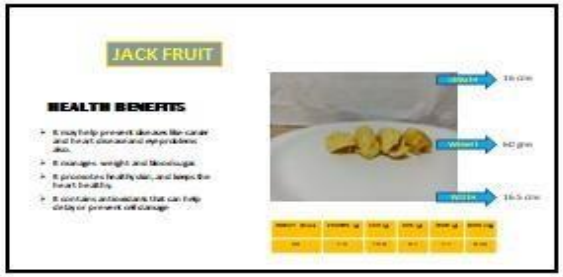
HEALTH BENEFITS

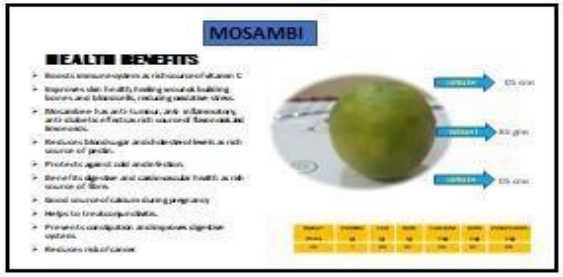
- Rich in antioxidants and anti-inflammatory compounds.
- Improve symptoms of arthritis and gout.
- Improve sleep quality.

Weight	Calories	Carbohydrate	Fat	Protein	Fiber
100g	63	16 g	0.2 g	1.06 g	2.1 g

EDUCATION MODULE 9: FRESH FRUITS IN OUR DAY TO DAY CONSUMPTION (CONTINUED)







Education Module - 10

ANTIOXIDANTS

Reddy Jyothsna
PhD Scholar
Food Science and Nutrition
Department

What is Free Radicals?

- Free radicals are volatile molecules that seek to bond to other molecules to increase their stability. Free Radicals are derived from Oxidation.
- Oxidation is a chemical reaction that transfers electrons from a substance to an oxidizing agent.
- Radicals can start chain reactions. When chain reactions happen in a cell it will cause damage or death of the cell.

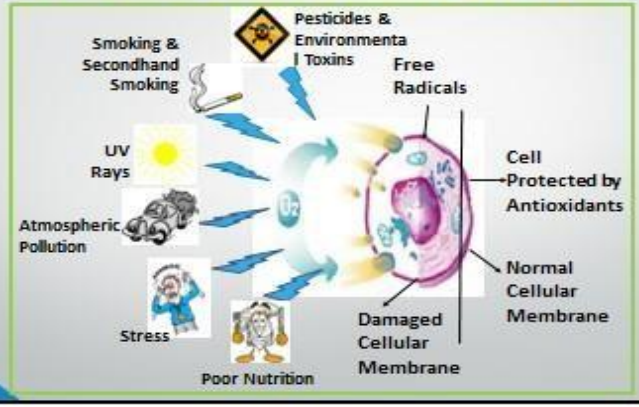
What Harm can Free Radicals Do?

- Oxidative stress (which creates free radicals) is an important factor in human diseases
  - Contributes development of Alzheimer's disease, Parkinson's disease, rheumatoid arthritis, neuro degeneration in motor neuron disease, CVD and cancer.

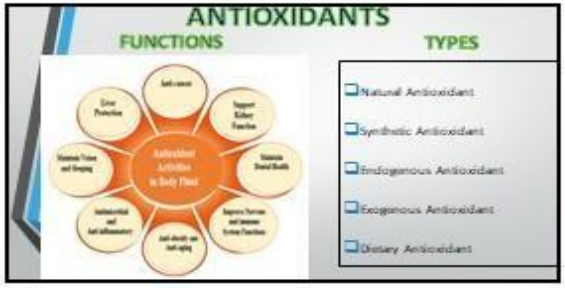
How Does Antioxidants Work?

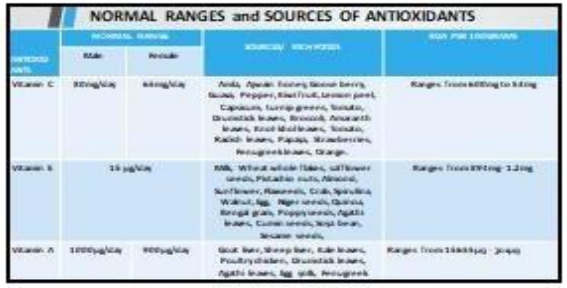
- Antioxidants terminate the chain reactions (caused by free radicals), remove free radicals intermediates and inhibit other oxidation reactions.

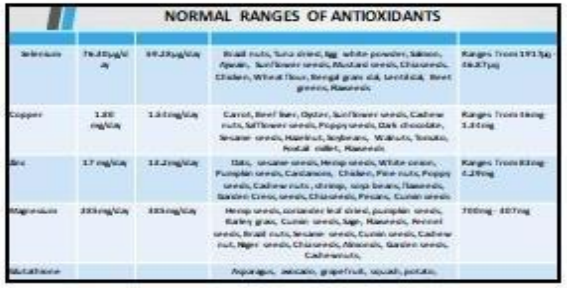
CAUSE FOR FREE RADICAL FORMATION

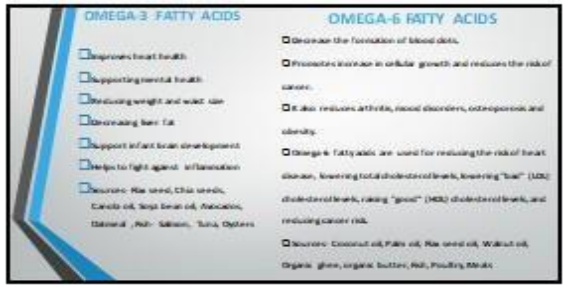


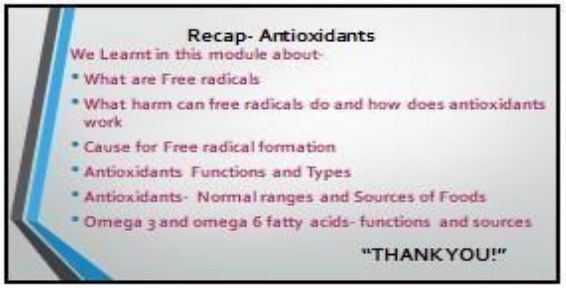
EDUCATION MODULE 10: ANTIOXIDANTS (CONTINUED)











EDUCATION MODULE 10: ANTIOXIDANTS (CONTINUED)

Avinashilingam Institute for Home Science and Higher Education for Women
(Deemed to be University Estd. u/s 3 of UGC Act 1956, Category A by MHRD
Re-accredited with A++ Grade by NAAC. CGPA 3.65/4, Category I by UGC
Coimbatore - 641 043, Tamil Nadu, India

(Item No. 5 of Check List)

Details of Research Publications

S. No.	Article Title	Journal	Other Details Vol. / No. / Page No. / Year	Published in UGC-CARE / Scopus / Web of Science
1	INFLUENCE OF LIFESTYLE FACTORS ON METABOLIC SYNDROME CRITERIA	THE INDIAN JOURNAL OF NUTRITION AND DIETETICS	Vol-58, No-1, Pages: 1-9, Year: 2021	UGC-CARE-I
2	PREVALENCE OF METABOLIC SYNDROME CRITERIA AMONG ADULTS POST-COVID PANDEMIC SITUATION AND STEPS TOWARDS PREVENTION	THE INDIAN JOURNAL OF NUTRITION AND DIETETICS	Vol-60, No-1, Pages: 94-111 Year: 2023	UGC-CARE-I

*Proof of list of Journals from Internet to be attached along with copies of reprints.

Research Scholar: Reddy Jyothsna

Supervisor: 20/12/23

Checked By: HoD / Dean of respective school 20/12/23

The scholar Miss. C. Reddy Jyothsna (16PHFNP003) has published her article in the following journal: "The Indian Journal of Nutrition and Dietetics" - is indexed and active in UGC Care List Group I from January 2021 to present.

This may be considered.

20.12.2023

The Indian Journal of Nutrition and Dietetics
ISSN: 0022-3174; eISSN: 2348-621X
www.ijndonline.org

DOI:10.21048/IJND.2021.58.S1.27532

Influence of Lifestyle Factors on Metabolic Syndrome Criteria

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Abstract

In Urban India especially among the young and middle aged adults the Metabolic Syndrome (MetS) is increasing day by day. Lifestyle influences the individual parameters of MetS. The MetS criteria are adversely affecting the health and performance of an individual. During this Covid-19 pandemic situation, the lifestyle of individuals altered to a great extent and equally influenced MetS. To study the influence of lifestyle factors on MetS criteria, a prospective observational study was performed in the Clinical Nutrition department. A total of 465 subjects were screened initially. Both males and females with age 25-54 years were included in the study. Subjects who recovered from Covid-19, pregnant and lactating women were excluded. Using a questionnaire the subjects' previous and current data of anthropometric measures of Waist Circumference (WC), weight and height were noted. The Body Mass Index (BMI) was computed. Serum values of Triglycerides, HDL cholesterol, Fasting Blood Sugar (FBS), Glycosylated Haemoglobin were noted along with the Blood Pressure (BP) measurement. Food Frequency Questionnaire (FFQ) and three days diet recall was written down. The daily calorie uptake was calculated. Their habits pertaining to smoke, alcohol and Physical Activity (PA) patterns were gathered. The NCEP-ATP-III criteria were used to categorize under MetS. The obtained data in the study was analysed by SPSS 20. Females-100 and Males-182 were included in the study and assessed further. The percentage of overweight individuals did not increase significantly. But there was a significant increase by about 10% in obesity. 3% of non-diabetics became diabetic. The FBS were higher at 75% subjects compared to 62% earlier. High-Triglycerides (TG) was observed in 75% individuals compared to 66% subjects earlier. There was no significant increase in individuals with low HDL and high BP. Lack of PA was seen in 63% subjects compared to 42% earlier. Also it is observed that the intensity and consistency of PA activity dropped. Calories consumption per day >2000 kcal was observed in 68%

subjects compared to 47% earlier. Alcohol habit was observed in 52%. Smoking habit was observed in 43% individuals. Though there was no significant increase in smoking or alcohol consuming individuals, the frequency and quantity of consumption of smoke and alcohol increased significantly. Three criteria of MetS were observed in 46% subjects when compared to 33% previously. The altered lipid values and high BMI had a significant correlation with lack of PA and high calorie diet consumed. High WC and high BMI had a significant correlation. Elevated TG had significant correlation with alcohol consumption. Moderate correlation was observed between the factors of increased calorie consumption and raised blood sugars/ high WC. The people who had lack of PA, high intake of calories on a day to day basis and alcohol consumption had MetS significantly. From the present study it was found that MetS is at the raise in the current pandemic situation. Identifying lifestyle and interventions necessary in means of education to correct lifestyle of the young adults emphasizing to choose healthy food ingredients, cooking methods and alternative PA is very important to raise MetS in the community.

Keywords: *Metabolic syndrome, MetS, lifestyle, Covid-19, MetS criteria, pandemic, physical activity*

Introduction

Metabolic Syndrome (MetS) is an emerging disorder which might be causing cardio-metabolic risk among people with central obesity, altered serum lipid values, insulin resistance or glucose intolerance and elevated blood pressure. Worldwide it is observed that the prevalence of MetS is increasing rapidly as a result of the obesity epidemic and it is observed that there is a considerable impact on the Global incidence of Type 2 diabetes mellitus and cardiovascular disease. Central obesity, triglycerides (TG), High Density Lipoprotein (HDL) cholesterol, blood sugars and blood pressure were the five criteria of MetS. Using these criteria MetS is defined variedly by many researchers.

According to World Health Organisation (WHO, 1998) a person is said to have MetS if the insulin resistance or type 2 diabetes for sure and two out of five other criteria (i) obesity-body mass index > 30 kg/ m^2 or waist/hip ratio males > 0.9 or females >0.85 (ii) TG $\geq$ 177 mg/ dl (iii) HDL < 39 mg/dl (iv) blood pressure $\geq$ 140/90 mm Hg (v) microalbuminuria.

In 1999 European Group for the study of Insulin Resistance (EGIR) came up defining MetS when a person has hyper- insulinemia and two out of four criteria- (i) waist circumference (WC) males

≥ 94 cm, females ≥ 80 cm (ii) triglycerides ≥ 177 mg/dl (iii) HDL cholesterol < 39 mg/dl (iv) blood pressure ≥ 140/90 mm Hg or if taking medicines to treat hypertension.

International Diabetes Federation (IDF, 2005) stated that people are said to have MetS if one has central obesity (WC females ≥ 80 cm, males ≥ 94 cm) and two out of four other criteria (i) fasting blood sugars ≥ 100 mg/dl (ii) TG ≥ 150 mg/dl (iii) HDL cholesterol males < 40 mg/dl, females < 50 mg/dl or on anti-statin medications (iv) taking medicines to control blood pressure or systolic > 130 mm Hg or diastolic > 85 mm Hg.

The National Cholesterol Education Program Adult Treatment Panel III (NCEP ATP III, 2005) revision stated in simple terms that if a person is having any three out of the five criteria (i) WC (males > 40 inches and females > 35 inches) (ii) fasting blood sugars (FBS) ≥ 100 mg/dl (iii) TG ≥ 150 mg/ dl (iv) HDL cholesterol (males <40 mg/dl or females < 50 mg/dl) (v) blood pressure systolic > 130 mm Hg or diastolic > 85 mm Hg or if on medications to treat either elevated blood sugar or blood pressure or altered lipid.

Though each definition has some common and varying components, the measurement of Insulin Resistance (IR) is required by WHO and EGIR classifications. But it is majorly used in research. The NCEP ATP III defines criteria that can be used in the outpatient clinic and became the backbone for upcoming classifications given in the IDF diagnostic criterion.

Covid-19 pandemic changed the living pattern of the entire population and a new normal was created based on the economic status, accessibility and availability to the commodities, their prior and current health condition. The lack of caution and awareness put them at altered

TABLE I

Metabolic Syndrome Criteria (as per NCEP ATP III 2005 Revision)

Absolutely required	None
Criteria	Any three of the five criteria below
Central obesity	* Waist circumference > 90cm male; > 80cm female
Hyperglycemia	Fasting glucose ≥ 100 mg/dl or Rx
Dyslipidemia	Triglycerides ≥ 150 mg/dl or Rx
Dyslipidemia (2nd separate criteria)	HDL < 40 mg/dl Male or < 50 mg/dl Female or Rx
Hypertension	> 130 mm Hg systolic or > 85 mm Hg diastolic or Rx

* Criteria for Central Obesity are specific for Asian- Indian Population[3]

nutritional and health status. During this covid-19 pandemic the people varied in their lifestyle habits pertaining to intake of food and beverage, day to day habits of physical activity, smoking and alcohol consumption. Both the nutrition security and food Security of the population diversified a lot. The altered lifestyle of individuals equally influenced MetS. The most widely used MetS criteria particularly in OPD clinics as per NCEP ATP III 2005 (revision) is being used in the present study (Table I).

Materials and Methods

A prospective observational study was performed in the Clinical Nutrition department. A total of 465 subjects were screened.

Subjects and measurements

Both males and females with age 25-54 years were included into the study. Subjects who are having Covid-19 or recovered from Covid-19, pregnant and lactating women were excluded. Using a standardized nutritional assessment questionnaire the subjects were interviewed. The prior data of the subjects before February 2020 was noted and current data during the pandemic situation was again noted down.

The anthropometric measurements of Waist Circumference (WC), weight and height were measured. Body Mass Index (BMI) was computed. Fasting Blood Sugar (FBS), Glycosylated Hemoglobin (HbA1C), Triglyceride (TG) and HDL (High Density Lipoprotein) cholesterol, Blood Pressure (BP) were noted down.

The details of the food security and nutrition security were captured using Food Frequency Questionnaire (FFQ) of both before and during the pandemic situation. A three day diet recall method was used to capture the day to day items they were consuming. Later the per day consumed calories was calculated. The day to day habits pertaining to their Physical Activity (PA), smoking and alcohol consumption pattern were jotted down. NCEP ATP III (revision 2005) criteria were used to categorize under MetS.

All the patients were given nutrition education with proper handouts with meal plan and Medical Nutrition Therapy, emphasis was given to include feasible physical activity and sustain in doing it. The importance and means of stress relieving practices were also discussed as the pandemic situation created a lot of changes in the thought process impacting the eating, sleeping and physical activity of an individual. Also counselled and encouraged the cessation of smoking and alcohol habits. The data was analyzed using SPSS 20.

Results and Discussion

A total of 465 people were screened in the Clinical Nutrition Department. Later both males and females of age 25 to 54 years

were included excluding the pregnant/ lactating women and males/ females who recovered from Covid-19 pandemic. The study included 100 females and 182 males and were assessed further. The study included 66 subjects in the age group of 25-34 years; 107 subjects of 35-44 years and 109 subjects of 45-54 years (Figure 1).

The body mass index was calculated and WHO classification was used to categorise into various grades and are observed as shown in Figure 2. The percentage of overweight individuals did not increase significantly. But there was a significant increase by about 10% in obesity.

A 3% of the non-diabetics became diabetic. The FBS were higher at 75% compared to 62% of earlier. Figure 3 shows the FBS observed in the subjects included in the study. Most of the subjects indulged in consuming sweets/ desserts on a more regular basis during the pandemic than before the pandemic situation. In the interview they even mentioned that the quantity and frequency of consumption increased with regard to fruits, fruit juices, sweetened dishes and rice consumption particularly. In few subjects, the consumption of dry fruits was also observed on a daily basis compared to weekly consumption earlier to pandemic. One more reason what the diabetics were mentioning was as regular lab monitoring of blood sugars was not there they were little lenient on Direct sugar / jaggery consumption. In few subjects due to high sugar values, they lost weight drastically and they ignored the loss of weight thinking they are not proper on food consumption and they started eating more quantity as and when they were feeling hungry and few were happy as they were losing weight and ignored the actual fact finding for their weight loss. This put them into risk of diabetes and pre-diabetes.

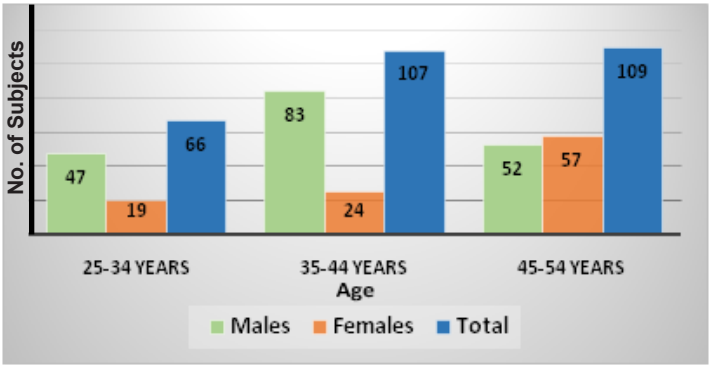

Figure 1
Number of subjects included from each age group

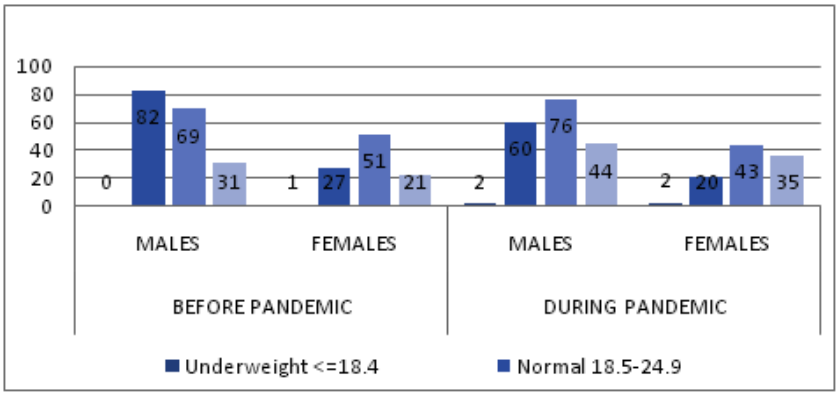

Figure 2
Body Mass Index as per WHO classification

High Triglycerides (TG) was observed in 75% compared to 66% earlier. There was no significant increase in individuals with Low HDL and High BP. The major nutrient from which the calories were consumed had a great influence on increased TG and lack of physical activity seen in 63% compared to 42% earlier also contributed to altered lipids. Also it is observed that the intensity and consistency of PA activity dropped. Calories consumption per day >2000 kcal was observed in 68% subjects compared to 47% earlier. Alcohol habit was observed in 52%. Smoking habit was observed

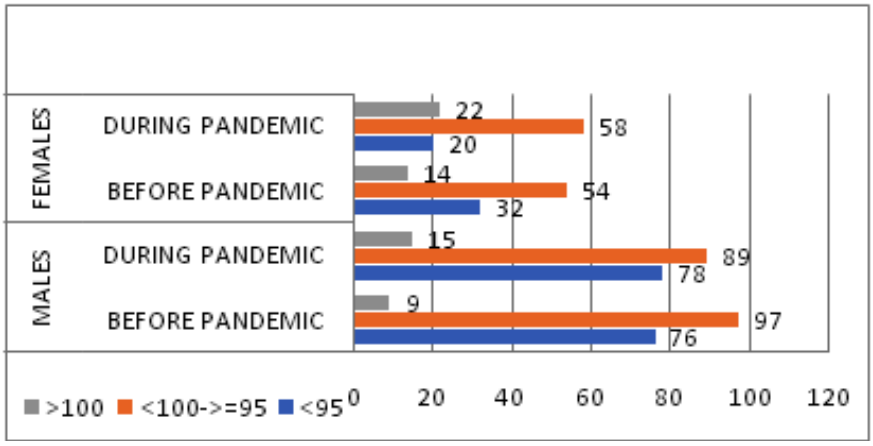

Figure 3
Fasting blood sugars of the subjects before and during pandemic situation

in 43% individuals. Figure 4 shows the details of smoking, alcohol and >2000 kcal/ day consumption. Though there was no significant increase in smoking or alcohol consuming individuals, the frequency and quantity of consumption of smoke and alcohol increased significantly.

Even the subjects who had healthy weight were observed to have MetS. Three criteria of MetS were observed in 46% when compared to 33% previously. Figure 5 shows MetS criteria observed in the subjects included in the study. The altered serum lipid values and high BMI were due to physical inactivity and high consumption of calories on a day-to-day basis. High WC and high BMI correlated significantly. The elevated TG was observed in those with an alcohol habit and had significant

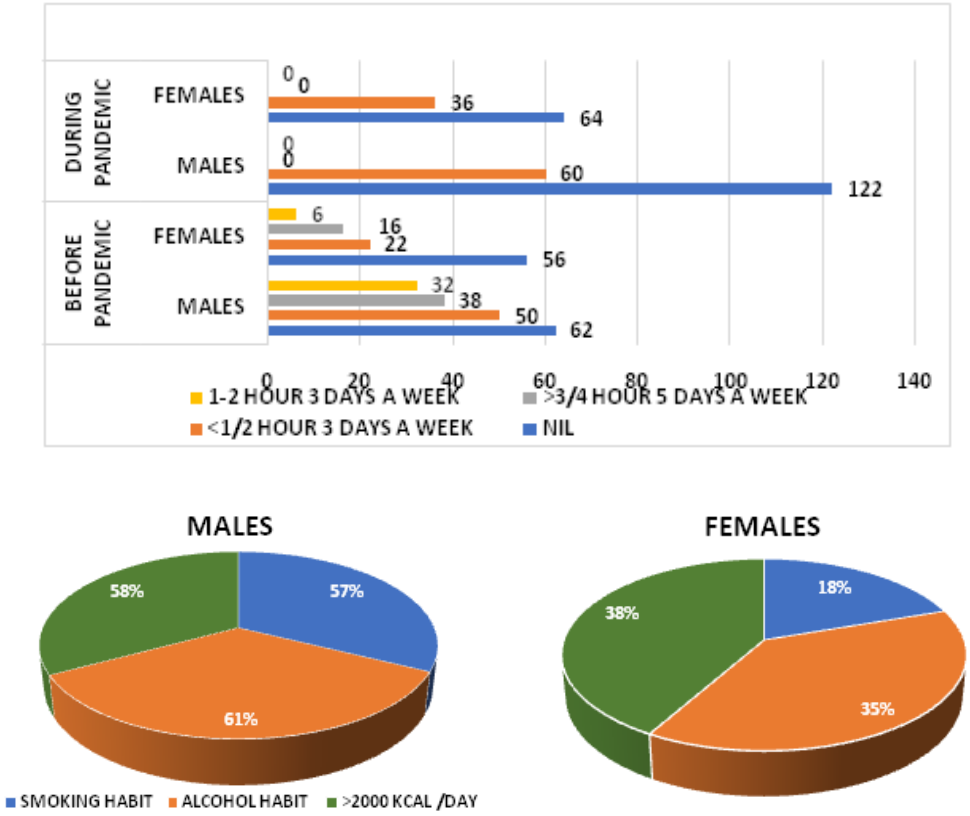

Figure 4
Physical activity, smoking habit, alcohol habit and >2000kcal/day consumption

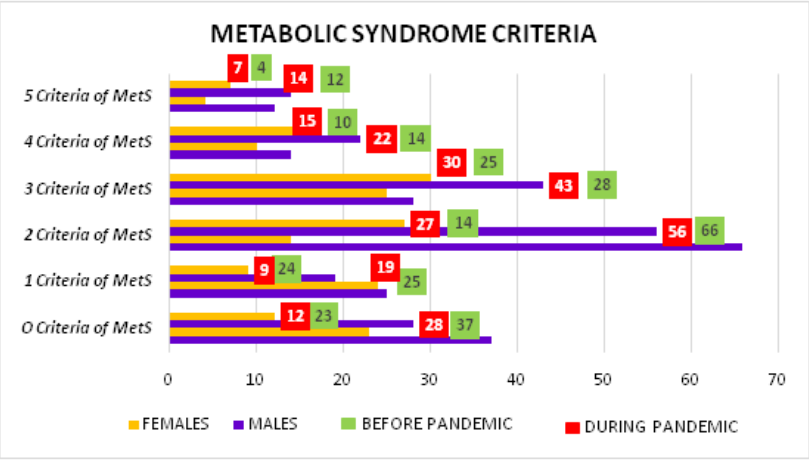

Figure 5
Metabolic syndrome criteria

correlation. Blood sugars had a moderate correlation with high WC and raised serum sugar levels. The physically inactive people with high calorie / alcohol consumption had a significant MetS criteria observed in them. On the whole the MetS risk increased in the observed population.

Conclusion

Findings suggest that MetS is on the rise in the present pandemic situation. Though the population studied is not a representative sample of the community on the whole, are should not ignore the findings observed and studies should be conducted on larger groups to derive conclusive evidence. But with the current study it can be recommended to Identifying lifestyle and interventions / education to correct lifestyle of the young adults emphasizing to choose healthy food ingredients, cooking methods and alternative PA is very important to contain raising MetS in the community. Living a healthy lifestyle is one of the best preventive steps to be away from MetS or its individual criteria.

Acknowledgement

The paper is an in-house study outcome without financial support.

Conflict of interest

No conflict of interest as per authors.

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Prevalence of Metabolic Syndrome Criteria among Adults Post Covid Pandemic Situation and Steps towards Prevention

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(Received 18th April, 2022)

Abstract

Metabolic Syndrome (MetS) is one among the Non-Communicable Diseases (NCDs) which might occur due to genetic, environmental, physiological and behavioural factors. MetS is increasing alarmingly in the population. Addressing the modifiable factors to reduce the risk is of prime importance. The current study is intended to observe the prevalence of Metabolic Syndrome criteria with respect to its relation to lifestyle factors among subjects post pandemic situation and the MetS incidence to understand how the disease can be prevented and the means to improve the public health. Random sampling method was used to enrol 20–50 year old (male and female) urban adults of Bengaluru into the study. Type-I-diabetics, lactating and pregnant women, post-cardiac surgery/ pre-post-transplant/ covid-19 recovered patients were excluded. Height, weight, Waist-Circumference (WC) and hip-circumference were measured. BMI and Waist–Hip Ratio (WHR) were calculated. Fasting Blood Glucose (FBS), Triglycerides (TG), HDL, Blood Pressure (BP) values were analysed and recorded. Diet recall was captured and calories consumed per day was estimated. The habits of exercise routine, smoking, tobacco chewing and alcohol were observed. IDF (International Diabetes Federation, 2006) criteria was used to categorise MetS. The data was analysed using relevant statistical tools. A total of 1211 adults (females 486 and males 725) were assessed. High WC indicating central obesity was observed in 55%. High FBS was observed in 29%. Hyper-triglyceridemia was more in males (36%) than females (19%). Low HDL was observed in 65% females against 43% males. High BP was observed among 10% in males and 8% in females. Lack of exercise was observed among 81% of the adults. Due to pandemic situation 10.7% stopped doing exercise. Moderate activity in 5.6% and vigorous activity in 2.8% was recorded; 68% of the subjects were

consuming >2000 calories/day on an average; 18.6% were alcoholic. MetS was observed in 10.6% and MetS-2 criteria in 33.4% and MetS-1criteria in 24.5% before pandemic situation and post pandemic there was an increase. MetS was observed in 12.2% and MetS-2criteria in 49.7% and MetS-1criteria in 27.9% post pandemic*. The lack of exercise and high-calorie consumption had a significant correlation with altered lipid values and central obesity. High WC had significant relation to High BMI. WHR had very significant correlation with high FBS and TG. Women had significantly high WC compared to men. The alcohol habit had a significant correlation with hypertriglyceridemia in males. Increased calorie consumption had a moderate correlation with raised FBS and WHR. MetS was significantly observed in those who had lack of exercise, high calorie consumption and alcohol habit. Findings suggest that MetS is in rise in 31-50 year age group. Central obesity, dyslipidemia and high FBS were predominant in 31-40 year group. High BP was observed in 45-50 years age group. Identifying and educating the young adults to correct their life style is the need of the hour to reduce increase of MetS in community.*

Keywords: *Metabolic syndrome, central obesity, lifestyle, NCD's, covid-19, pandemic*

Introduction

Non-Communicable Diseases (NCDs) are contributing to great extent to morbidity and mortality across the globe due to swift demographic transition and changes in the lifestyle of the individuals. As per International Diabetes Federation (IDF, 2021)[1], by 2045, 700 million adults will have diabetes. According to the CDC 2021, currently 463 million adults have diabetes, worldwide. In India the prevalence of diabetes is 11.2% in the 15-49 year age group that the study evaluated; in Karnataka the prevalence rate is 4.6%. World Health Organisation reports that India is the third most obese country in the world. Prevalence of obesity in India is 40.3%. The south Indian urban women are found to be more obese than their other counter parts. National Health Portal of India, (2019) observes that in India approximately 25-30% of urban are suffering from dyslipidaemia. Although, Metabolic Syndrome (MetS) is more common among males, but it affects both the genders[2]. As per research studies 25% Indians have Metabolic syndrome[3-5]. There are various definitions used to evaluate the Metabolic syndrome[5-8]. As per IDF, 2006 definition[1] to categorise under MetS central obesity is a definite criterion along with two other criteria out of increased fasting blood sugars, high triglyceride values, low level of HDL cholesterol and high blood pressure. Due to diet and lifestyle changes in developing countries the prevalence

rate of Metabolic syndrome is gradually increasing[9-11]. As the individual criteria listed under MetS definition are increasing; the prevalence is proportionately increasing[12-14]. The COVID pandemic situation has highly influenced the lifestyle and MetS of the population, worldwide. The Metabolic syndrome is defined to be the group of metabolic abnormalities which includes central obesity any two out of four defined factors which include diabetes mellitus that is due to insulin resistance, high blood pressure, dyslipidemic state of a person which can be hyper-triglyceridemia or low levels of high-density lipoproteins. All the individual criteria that might result in metabolic syndrome have direct or indirect impact based on life style[15]. In the pandemic situation the individual criteria of metabolic syndrome are altered to a great extent putting more individuals at risk of metabolic syndrome. The objective of the study is to evaluate the dynamic criteria behind the increase in the incidence of metabolic syndrome rise during the pandemic situation and the ways and means by which it can be prevented.

Materials and Methods

The individuals were randomly selected and enrolled for the study from those visiting the Health Check Department of Sakra World Hospital, Bengaluru. Inclusion and exclusion criteria were defined for enrolling the subjects into the research study. Men and women in the age group of 20-50 years undergoing health check-up currently with pre-pandemic health records were included. People with Type I diabetes, post-surgical or pre / post-transplant patients, those who recovered from Covid 19, lactating and pregnant women; those who undergone health checks in pre pandemic period were excluded. As per the previous research studies, the incidence of metabolic syndrome is found to be around 19% in South Indian Population. Using the statistical formula considering 90% confidence level the worked-out sample size is 150 with total screening population N- 1500.

$$n = \frac{c^2 Np(1-p)}{(A^2 N) + (c^2 p[1-p])}$$

n - Sample Size N - Total population
c - To be 90% sure of the result the constant c = 1.645
p - The average proportion of records expected to meet the various criteria

A pre tested questionnaire was used to collect the information. The age in years, gender (male or female), education (illiterate, primary schooling, secondary schooling, technical diploma certificate courses, graduate, professional or honours), occupation (un-employed, semi-routine and routine occupations, lower supervisory and technical occupations, small employers and own account workers, intermediate occupations, higher

managerial, administrative and professional occupations).

Socioeconomic class (upper, upper middle, lower middle, upper lower and lower) was determined by using modified Kuppuswamy socio-economic scale updated for the year 2021[16,17]. To derive at socioeconomic class- the scores were marked after collecting total monthly income of the family, occupation and education of the head of the family. Socioeconomic class was marked basing on score; if score is 26-29 Upper, score 16-25 Upper Middle, score 11-15 Lower Middle, score 5-10 Upper Lower and score <5 Lower.

Religion (Jainism, Hinduism, Christianity and Islam), family structure (single member, nuclear family, joint family and extended family) and marital status (unmarried, married, divorcee and widowed) of the participants was collected.

Exercise routine was collected from the subjects under four headings- Never (0)- Not attempted any exercise routine, Former (1)- stopped exercise routine for >1year and if any exercise is performed; then duration of activity and frequency of activity was obtained and classified under moderate activity (2) (3-6 metabolic equivalents- 3.5 to 7 kcal/min) and vigorous activity (3) (greater than 6 metabolic equivalents- more than 7 kcal/min)[18,19]. Smoking habit, tobacco chewing and alcohol consumption were obtained under three major headings- never (0), former (1) (if the habit is left since >1yr) and current (2).

Diet pattern / history / recall and food frequency questionnaire

The dietary pattern (vegetarian-1 those who consume no milk and milk products, vegetarian-2 those who consume milk and milk products, ova-vegetarian those who consume milk and egg, predominantly vegetarian and at times non vegetarian, predominantly non- vegetarian and at times vegetarian. More detailed Diet history was obtained using FFQ (Food Frequency Questionnaire) which gave diversity of food groups included by the subject and 24-hour dietary recall of two days (the day before of the interview and a typical weekend) was obtained. For better communication and quantification of recall, standardized cups, spoons and measures were used. The daily caloric consumption was calculated using IFCT[20].

Anthropometric measurements

Anthropometric measures of height, weight, waist circumference and hip circumference were measured[21]. All the equipment used for measuring were calibrated periodically. In-body stadiometer was used to measure the height in cm to the nearest 0.1 cm. Weight measurement was done in fasting state using Tanita weighing scale in kg to precision of g. The measurement was taken thrice to attain consistent reading of the participant.

The waist and hip circumference were measured using a measuring tape in cm to the nearest 0.1 cm. All men with waist circumference >90 cm and women with >80 cm was categorised under abdominal obese central obesity category.

Body Mass Index (BMI)

BMI is calculated by taking weight in kilogram and dividing by the square of the person's height in metre (kg/m^2). Altered BMI can caution the risk of comorbidities and the individual can take the primary precautionary steps to attain normal BMI. BMI is the primary index to determine the nutritional status of a person. World Health Organisation (WHO), International Association for the Study of Obesity (IASO) and International Obesity Task Force (IOTF) in 2000- in a publication[22]. The Asia-Pacific Perspective: Redefining Obesity and its Treatment proposed the revision of cut off values as stated in the Table I to prevent the risk of developing health issues.

Waist-Hip Ratio (WHR) was calculated by dividing waist circumference by the hip circumference. WHR of ≥ 0.90 for men and ≥ 0.85 women were classified as obese category[7].

Basal metabolic rate and total energy expenditure

The basal metabolic rate BMR was calculated using Harris-Benedict equation[23]. In men, BMR=66.4730 + 13.7516 x weight in kg + 5.0033 x height in cm – 6.7550 x age in year. In women, BMR=655.0955 + 9.5634 x weight in kg + 1.8496 x height in cm – 4.6756 x age in year. The total energy expenditure (TEE) was estimated by multiplying physical activity level (PAL) factor with BMR. PAL factor [24,25] considered for Sedentary (little or no exercise) 1.2, Lightly active (light exercise/sports 1-3 days/week) 1.375, Moderately active (moderate exercise/sports 3-5 days/week) 1.55, Very active (hard exercise/sports 6-7 days a week) 1.725 and if vigorous activity (very hard exercise/sports and a physical job) 1.9.

TABLE I

Asian Adult's BMI proposed Classification (WHO, IASO and IOTF, 2000)

BMI	Nutritional Status	Risk of comorbidities
<18.5	Underweight	Low (but increased risk of other problems)
18.5 - 22.99	Normal	Average
23 - 24.99	Overweight	Increased
25 - 29.99	Obesity class I	Moderate
30 - 35.99	Obesity class II	Severe

Blood Pressure

Blood pressure (BP) is measured in units of milli-meter of mercury (mmHg). The readings are upper (systolic) value and lower (diastolic) value. The blood pressure levels were recorded by using a manual sphygmomanometer. Measurements were recorded two times, and the average was taken as recorded measurement. Digital Automatic BP monitor (HEM- 8712 Model, Omron Health Care Manufacturing Vietnam Co. Ltd., Singapore) was also used to cross-check the measurement.

All the measurements were taken using standard techniques as defined by Centers for Disease Control and Prevention (CDC), National Health And Nutrition Examination Survey[21].

Blood sample

Trained and certified lab professionals drew the blood samples to analyse the fasting blood glucose, triglycerides and high density lipo-protein levels. Prior information was given to the participant that 6ml blood will be drawn for analysis. First morning blood sample required for analysing Fasting Blood Sugar (FBS) and Lipid profile was drawn. VITROS XT 7600 equipment was used for testing FBS and lipid profile. The reference values were specified in reagent kit inserts given by manufacturer Ortho clinical diagnostics of VITROS XT 7600. Calibration was done once in six months or whenever reagent lot was changed or if any Quality Control (QC) variations were observed. The test results were run in Biored unity software for QC purpose and LJ- Levey-Jennings graphs were observed. West guard rules (six rules) were observed for QC check. Co-efficient of variation used was ± 2SD (Table II).

Metabolic syndrome classification

The new IDF, 2006 definition[6,7] was used for classifying metabolic syndrome

TABLE II

Method of Analysis for the Blood parameters and Biological Reference Interval

Blood/ Serum	Method	Biological reference interval
FBS	Glucose Oxidase peroxidase	Hypoglycemia: < 70 mg/dL Normal: 70 - 99 mg/dL Pre-diabetes: 100 - 125 mg/dL Diabetes: ≥ 126 mg/dL
Triglycerides	Enzymatic procedure	Normal: <150 mg/dL Borderline high: 150-199 mg/dL High: 200-500 mg/dL Very high: >500 mg/dL
HDL	Non-HDL precipitation	40 - 60 mg/dL

subjects. According to the definition, a subject has the MetS if central obesity- Waist Circumference >90 cm men and >80 cm women is present along with two or more criteria Hypertriglyceridemia: ≥150 mg/dl or on medication, Low HDL-C: <40 mg/dl in men and <50 mg/dl in women or on medication, High blood pressure (BP): >130/85 mmHg or on medication, High fasting glucose: ≥100 mg/dl or on medication.

Ethical committee approval

IHEC (Institutional Human Ethics Committee) of Avinashilingam Institute for Home Science and Higher Education for Women, Coimbatore first approved (IHEC17-18/FSN/50) the present research study. Later the research study was proposed and clearance was obtained from Sakra World Hospital IEC (Institutional Ethics committee) (IEC/ SWH/CN/26619). The study was enrolled in Clinical Trials Registry India (CTRI) (CTRI/2021/07/035254). The research subject information sheet and consent form were available in English and Kannada.

Statistical analysis

Appropriate, standard statistical tools and measures were used to analyse the data. Continuous variables were expressed as mean values ± Standard Deviation (SD). All statistical tests were two-tailed. The statistical significance was set at $p<0.05$ and $p<0.001$.

Results and Discussion

A total of 1211 adults were enrolled in the study from a total health check-up subject of 1850. From total study subjects enrolled 1211; 486 were females (40.1%) and 725 were males (59.9%).

The mean age (year) of the participants was 37.8±7. The mean height (cm) and weight (kg) were males- 171.7± 6.4, 77.9 ± 12.97 and females- 158.4±6.1, 67.35 ± 13.18.

Professional or honours degree was held by 12.88% of participants in the study group. 54.42% were graduates; 24.61% had technical diploma or have undergone certificate courses sufficient to take up a job; 7.6% had secondary schooling and 0.25% had primary schooling.0.25% were illiterate. Occupation wise 54.17% of them were placed into intermediate jobs and 27% were self-employed. 1.32% were in managerial jobs. 8.67% were in lower supervisory technical jobs and 8.75% were unemployed.

Majority of subjects (85.96%) were from upper- middle income group; 8.09% of were from high- income group and 5.95% of the subjects were of lower middle income group. 90.75% of the subjects were Hindus, 5.12% were Christians, 3.14% were Islam, and <1% were Jains. Nuclear family set up was observed in 84.56% of the subjects with only 4.13% in joint extended family system; 11.81% of the subjects were living alone

single members. Married individuals were 66.14% and 32.2% were unmarried. 1.07% were divorce and 0.58% were widowed.

Smoking habit was observed among 4.79% and alcohol consumption in 18.58% among the subjects. None of the participants had tobacco chewing habit. Vigorous activity level was observed among 2.81% and moderate exercise level was observed in 5.45%. Nearly 12.97% males and 7.2% females discontinued the exercise routine due to covid 19 pandemic situation and 81.09% of the subjects had no exercise routine. Predominantly non-veg and occasional non veg group were 84.72%. 9.58% of the subjects used non veg more than vegetarian food. Around 1.98% were ovo-vegetarian and 2.56% were lacto vegetarians; 1.16% were vegans- who included only vegetarian food and no animal products.

This lifestyle habit had a significant relation to central obesity or dyslipedemic state among the enrolled subjects. Table III presents the socio- economic state and life style habits of the subjects.

TABLE III

Characteristics of the Research Participants (N=1211)

Measured Parameter	Research subjects (N)	Males n ± S.D	Females n ± S.D
Total number of subjects	N-1211 (100)	725 (59.9)	486 (40.1)
Mean age (year)	37.8 ± 7.0	38.4 ± 6.7	36.9 ± 7.3
Mean height (cm)	166.32 ± 9.05	171.7 ± 6.4	158.4 ± 6.1
Mean weight (kg)	73.67 ± 14.0	77.9 ± 12.97	67.35 ± 13.18
Education level N (%)			
Illiterate	3 (0.25)	1 (0.14)	2 (0.41)
Primary schooling	3 (0.25)	0 (0)	3 (0.62)
Secondary schooling	92 (7.60)	48 (6.62)	44 (9.05)
Technical / diploma certificate courses	298 (24.61)	225 (31.03)	73 (15.02)
Graduate	659 (54.42)	362 (49.93)	297 (61.11)
Professional or Honours	156 (12.88)	89 (12.28)	67 (13.79)
Occupation N (%)			
Unemployed	106 (8.75)	0 (0)	106 (21.81)
Semi-routine and routine occupations	0 (0)	0 (0)	0 (0)
Lower supervisory and technical occupations	105 (8.67)	22 (3.03)	83 (17.08)
Small employers and own account workers	328 (27.09)	283 (39.03)	45 (9.26)

Intermediate occupations	656 (54.17)	408 (56.28)	248 (51.03)
Higher managerial, administrative and professional occupations	16 (1.32)	12 (1.66)	4 (0.82)
Socioeconomic class N (%)			
Lower (Score <5)	0 (0)	0 (0)	0 (0)
Upper Lower (Score 5-10)	0 (0)	0 (0)	0 (0)
Lower- middle (Score 11-15)	72 (5.95)	43 (5.93)	29 (5.97)
Upper- middle (Score 16-15)	1041 (85.96)	598 (82.48)	443 (91.15)
Upper (Score 26-29)	98 (8.09)	84 (11.59)	14 (2.88)
Religion N (%)			
Jainism	12 (0.99)	7 (0.97)	5 (1.03)
Hinduism	1099 (90.75)	655 (90.34)	444 (91.36)
Christianity	62 (5.12)	39 (5.38)	23 (4.73)
Islam	38 (3.14)	24 (3.31)	14 (2.88)
Family structure N (%)			
Single member	143 (11.81)	128 (17.66)	15 (3.09)
Nuclear family	1018 (84.06)	567 (78.21)	451 (92.80)
Joint family	35 (2.89)	22 (3.03)	13 (2.67)
Extended family	15 (1.24)	8 (1.1)	7 (1.44)
Marital status N (%)			
Unmarried	390 (32.20)	223 (30.768)	167 (34.36)
Married	801 (66.14)	494 (68.14)	307 (63.17)
Divorcee	13 (1.07)	7 (0.97)	6 (1.23)
Widowed	7 (0.58)	1 (0.14)	6 (1.23)
Consumption of alcohol N (%)			
Never	983 (81.17)	564 (77.79)	419 (86.21)
Former	3 (0.25)	3 (0.41)	0 (0)
Current	225 (18.58)	158 (21.79)	67 (13.79)
Smoking habit N (%)			
Never	1142 (94.30)	664 (91.59)	478 (98.35)
Former	11 (0.91)	11 (1.52)	0 (0)
Current	58 (4.79)	50 (6.90)	8 (1.65)
Exercise pattern N (%)			
Never	982 (81.09)	567 (78.21)	415 (85.39)
Former	129 (10.65)	94 (12.97)	35 (7.20)
Moderate	66 (5.45)	41 (5.66)	25 (5.14)
Vigorous	34 (2.81)	23 (3.17)	11 (2.26)

Dietary pattern N (%)			
Vegetarian-1 (No milk and milk products)	14 (1.16)	8 (1.10)	6 (1.24)
Vegetarian-2 (Includes milk and milk products)	31 (2.56)	19 (2.62)	12 (2.47)
Ovo- vegetarian (Includes milk and egg)	24 (1.98)	15 (2.07)	9 (1.85)
Predominantly veg and at times non-veg	1026 (84.72)	597 (82.34)	429 (88.27)
Predominantly non-veg and at times veg	116 (9.58)	86 (11.86)	30 (6.17)

In the study the IDF definition for metabolic syndrome was taken into consideration. The covid pandemic situation has put most of the study subjects at risk of having one to two metabolic syndrome criteria.

Age wise distribution

The mean age was 37.8±7. The age group 31-40 years had 536 subjects (44.3%) - 319 males (44%) and 217 females (44.7%) and 41-50 years age range for 474 subjects (42.8%) - 310 males (42.8%) and 164 females (33.7%) and rest of them - 201 subjects (16.6%) were of 21-30 years - 96 males (13.2%) and 105 females (21.6%). Age wise distribution of the selected subjects is highlighted in Figure 1.

The study subjects were classified based on the IDF metabolic syndrome. The enrolled subjects (1211) pre covid health records were checked and the MetS criteria were recorded. Figure 2 shows the pre covid period and post covid period data of the MetS criteria of the enrolled subjects. Pre and post covid pandemic period MetS criteria were observed in 148 (12.2%) against 128 (10.6%) and MetS-2 criteria in 602 (49.7%) against 404 (33.4%) and MetS-1 criteria in 338 (27.9) against 297 (24.5%). Pre pandemic period 381 subjects

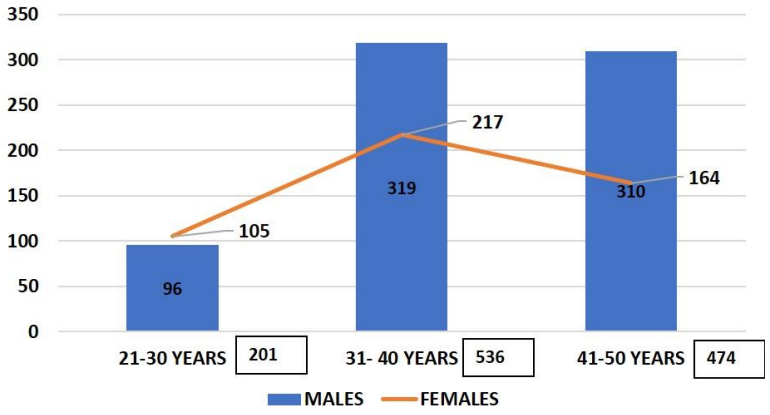

Figure 1
Age group of research participants

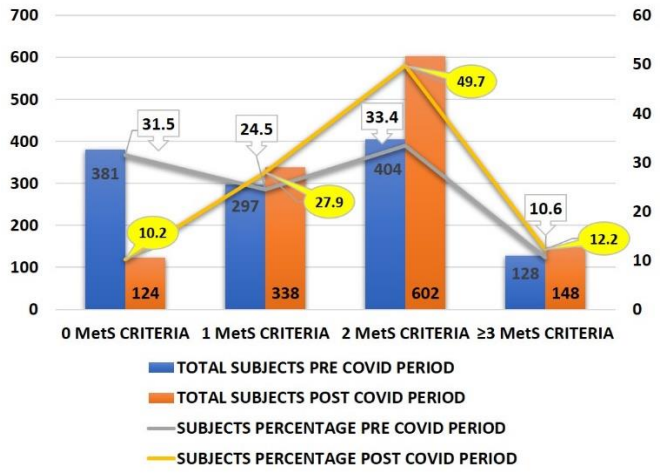

Figure 2

Metabolic Syndrome (MetS) criteria among the participants in pre and post COVID period

had zero MetS criteria which decreased to 124 subjects with zero MetS criteria.

Further in the current data of enrolled subjects of males (725) and females (486) - zero metabolic syndrome criteria is observed in 10.2% (123 subjects- 90 males and 33 females) of the study subjects. The subjects having one to two criteria are at risk of developing Metabolic syndrome- 77.6% (one criteria - 27.9% and two criteria- 49.7%). 4.2% of them had three MetS criteria; 5.8% had four MetS criteria and five MetS criteria was observed in 2.2%. A total of 12.2% - 148 subjects - 100 males and 48 females of the study subjects had metabolic syndrome having 3-5 criteria and is depicted in Figure 3.

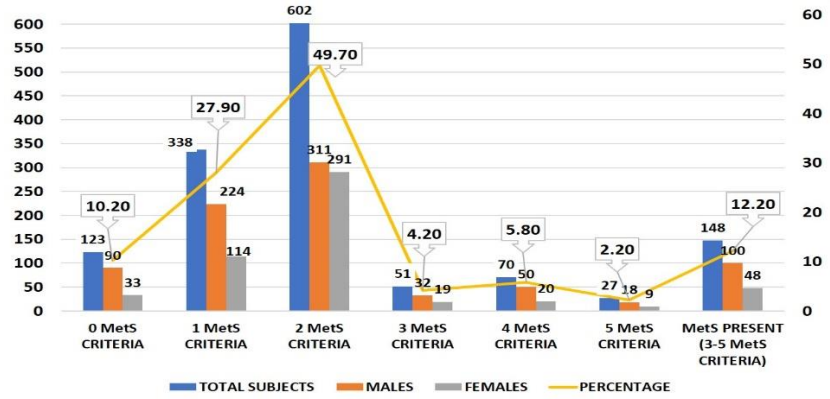

Figure 3

Metabolic syndrome (MetS) criteria among the research participants

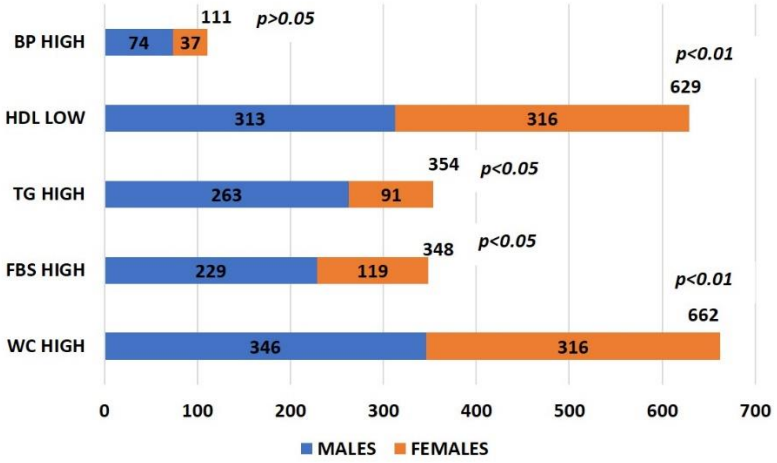

Figure 4
MetS individual criteria among the men and women

Age had statistically significant correlation with central obesity and hyper triglyceridemia with p<0.01. Age to BMI and Age to low level of HDL were statistically not significant. In the research study the central obesity and low level of HDL has contributed to high prevalence of MetS 662 and 629 subjects respectively. High FBS and hypertriglyceridemia levels was observed in 348 and 354 subjects. Around 111 subjects had elevated BP. Among males and females, the p value was <0.01 for low HDL levels and high waist circumference. The p value was <0.05 among males and females for hyper triglycerides and high FBS. The BP had no significance among males and females. These are represented in the Figure 4.

Table IV shows the Correlation Coefficient between MetS criteria Waist Circumference (WC), Fasting Blood Sugar (FBS), Triglycerides (TG), High Density Lipoproteins (HDL); anthropometric measures - Body Mass Index (BMI), Waist- Hip Ratio (WHR) and lifestyle habits pertaining to exercise, alcohol, smoking, tobacco chewing and high calorie intake of the research subjects (N=1211). High WC had significant correlation with FBS, TG, BMI, HDL, High calorie intake and lack of exercise. The p value was <0.01. BMI and waist to hip ratio were statistically significant p < 0.001. FBS had statistically significant correlation with high triglycerides, low HDL. Exercise had significant correlation with WC, BMI, WHR, FBS, TG, HDL and BP. Alcohol habit had significant correlation with triglycerides and HDL. In the present study,

TABLE IV

Correlation Coefficient between Mets Criteria, Anthropometric Measures and Lifestyle of the Research Subjects (N=1211)

	WC	BMI	WHR	FBS	TG	HDL	Exercise	Alcohol	Smoking	BMR	TEE
WC	-	.001***	.001***	.001***	.001***	.001***	.001***	.001***	.001***	.001***	.001***
BMI		-	.001***	0.59	0.32	.001***	0.76	0.11	0.66	.001***	.001***
WHR			-	.001***	.001***	.001***	.001***	.001***	.001***	.001***	.001***
FBS				-	.001***	0.48	.001***	.001***	.01**	0.29	0.73
TG					-	.001***	.001***	.001***	.01**	0.03	0.29
HDL						-	0.64	.01**	.01**	.001***	.001***
Exercise							-	.001***	.01**	0.14	0.001
Alcohol								-	.001***	0.01	0.01
Smoking									-	0.03	0.09
BMR										-	0
TEE											-

* Correlation is significant at the 0.05 level (2-tailed); ** Correlation is significant at the 0.01 level (2-tailed); *** Correlation is significant at the 0.001 level (2-tailed)

smoking had no significant correlation with any of the tested parameter.

High calorie consumption compared to their BMR had significant correlation with WC, BMI, WHR, FBS and TG. During the pandemic years high caloric intake was observed coming through high fatty foods, simple carbohydrate foods and lack of exercise has put the individuals at risk of MetS.

The BMR calculated using Harris-Benedict for the group was 1654.28±203.78 and Total energy Expenditure calculated using the Physical Activity Level was 2024.11±287.15. The BMR and TEE of Males were 1889.15±293.18 and 2266.98±351.81 and of females were 1554.82±218.84 and 1865.79±262.61. Equally the intake of fresh fruits, reduction in consuming restaurant foods / salt preserved / fast foods, comparatively less salt used in the diet along with reduction in travel stress had contributed to a great extent for normal blood pressure values. According to the data consumption of high fatty or sugary foods leading to high caloric intake and low or no exercise is one of the main aetiologies for metabolic syndrome. The level of significance is stated in the Table IV as three categories with p values <0.05, <0.01 and <0.001.

The Metabolic syndrome criteria observed in the research subjects (N=1211)

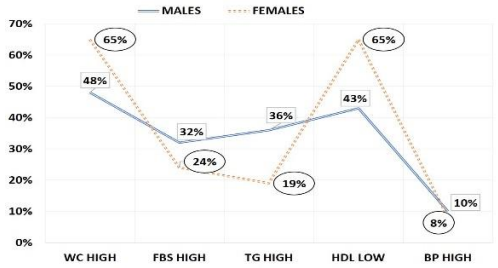

Figure 5

MetS criteria among the men and women

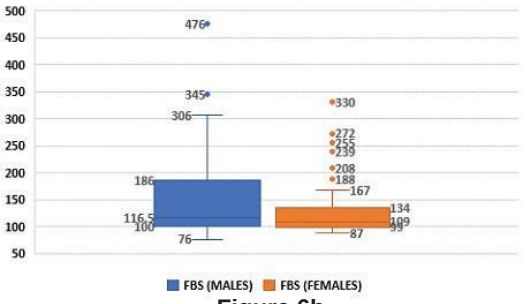

Figure 6b

Fasting blood sugar of the MetS subjects

is graphically represented in Figure 5. Among the studied research subjects, the dynamic criteria contributing to metabolic syndrome were high WC and low HDL in both males and females. High WC and low HDL levels were 45 and 46% in female subjects and 63% each in male subjects. The high FBS and high TG were in 32 and 33% of males respectively. In females 22% of them had high FBS and 9% had high TG. In the current enrolled research subjects 6% females and 8% males had elevated BP.

The individual Metabolic Syndrome criteria of the subjects using box and whisker plots is shown in the Figure 6 (a to e).

As represented in Figure 6a- Waist circumference (in cm) of males ranged from 85 to 124.5 with 99.9 as median and 139 and 144 as outliers. In females, the waist circumference ranged from 79 to 119.4 with 98.5 as median and 124.5 as outlier.

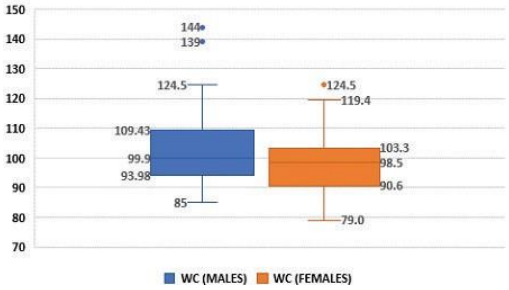

Figure 6a

Waist circumference of the MetS subjects

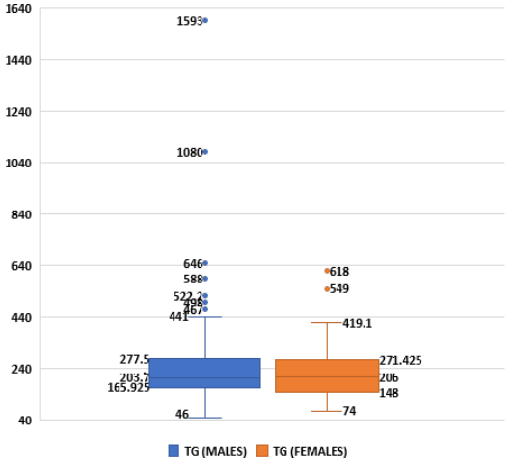

Figure 6c

Triglycerides of the MetS subjects

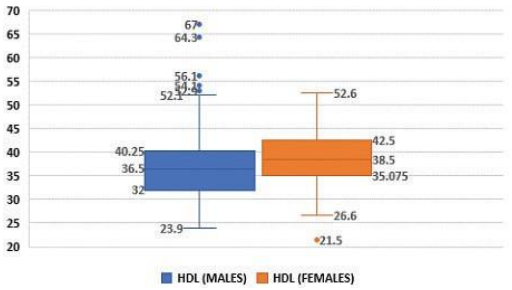

Figure 6d

High density lipo-proteins of the MetS subjects

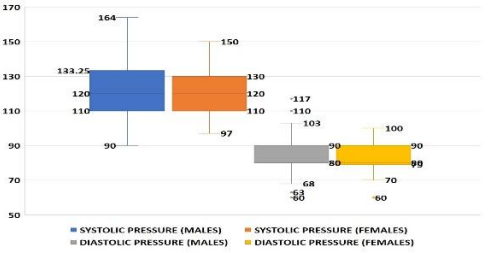

Figure 6e

Systolic and diastolic blood pressure of the MetS subjects

As plotted in Figure 6b- fasting sugars (in mg/dl) of males was in lower range of 76 to 306 (median 116.5) and outliers of 345 and 476 in comparison to that of females ranging between 87 to 167 (median 109) and 188, 208, 239, 255, 272 and 330 as outliers. Triglycerides of the MetS subjects is shown in Figure 6c. Males TG levels (mg/dl) were in slightly on higher range 46- 441 (median 203.7) that compared to females 74-419.1 (median 206) with 549 and 618 as outliers.

High Density Lipo-protein (HDL) values (mg/dl) are as plotted in Figure 6d. In males, the HDL median was 36.5 mg/dl with range of values between 23.9 and 52.1. Whereas in females the HDL values median was 38.5 and ranged between 26.6 to 52.6 with an outlier 21.5. Figure 6e shows the systolic and diastolic blood pressure values (mmHg) in males and females. In males, it ranged between 90-164 and 68-103 with median 120 and 80 for systolic and diastolic pressure. In females, systolic and diastolic pressure ranged as 197-150 and 60-100 with median values of 120 and 80 for systolic and diastolic. Diastolic blood pressure had 60 as outlier in both males and females and 63 in males.

Conclusion

The current study shows the prevalence of metabolic syndrome among the study group at the age of 31-40 years and the risk of developing MetS is high as one - two criteria are present in a more than one third (77%) in the study group. The results suggest apart from abdominal obesity or central obesity which is a compulsory MetS criteria as defined by IDF; low HDL levels was another major criteria of Metabolic syndrome observed in the study group. The study population showed both men and women are equally at risk of developing metabolic syndrome. Hypertriglyceridemia is more among men compared to women which might be due to high calorie consumption, alcohol consumption and stopping of exercise routine due to pandemic situation.

The research findings also call attention to the need for comprehensive planning for evidence-based prevention, diagnosis, and management of metabolic syndrome and its associated factors by conducting the research in larger group.

The individual factors criteria should also be addressed as primary prevention from the onset of metabolic syndrome and addressing the cluster criteria together might be the secondary prevention aspect. As soon as one-two criteria of MetS criteria are prevalent in an individual the corrective steps have be to taken to normalise them and reduce the risk of MetS. The research should further continue by intervening with diet and life style tailor made to the individual needs and review over a defined time frame interval, systematically.

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Conflict of interest

There are no conflicts of interest in the current study.

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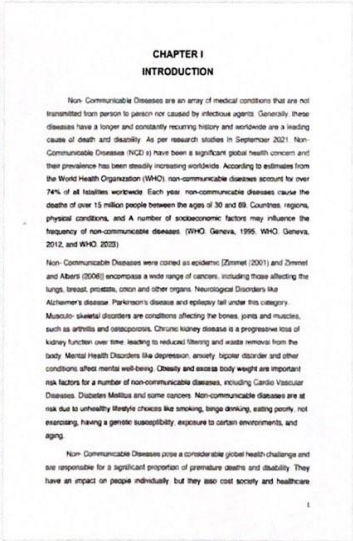

CHAPTER I
INTRODUCTION

Non- Communicable Diseases are an array of medical conditions that are not transmitted from person to person nor caused by infectious agents. Generally, these diseases have a longer and constantly recurring history and worldwide are a leading cause of death and disability. As per research studies in September 2021. Non-Communicable Diseases (NCD s) have been a significant global health concern and their prevalence has been steadily increasing worldwide. According to estimates from the World Health Organization (WHO), non-communicable diseases account for over 74% of all fatalities worldwide. Each year, non-communicable diseases cause the deaths of over 15 million people between the ages of 30 and 69. Countries, regions, physical conditions, and A number of socioeconomic factors may influence the frequency of non-communicable diseases. (WHO. Geneva, 1999. WHO. Geneva, 2012, and WHO. 2023)

Non- Communicable Diseases were coined as epidemic [Zimmet (2001) and Zimmet and Alberti (2006)] encompass a wide range of cancers, including those affecting the lungs, breast, prostate, colon and other organs. Neurological Disorders like Alzheimer's disease, Parkinson's disease and epilepsy fall under this category. Musculo- skeletal disorders are conditions affecting the bones, joints and muscles, such as arthritis and osteoporosis. Chronic kidney disease is a progressive loss of kidney function over time, leading to reduced filtering and waste removal from the body. Mental Health Disorders like depression, anxiety, bipolar disorder and other conditions affect mental well-being. Obesity and excess body weight are important risk factors for a number of non-communicable diseases, including Cardio Vascular Diseases, Diabetes Mellitus and some cancers. Non-communicable diseases are at risk due to unhealthy lifestyle choices like smoking, binge drinking, eating poorly, not exercising, having a genetic susceptibility, exposure to certain environments, and aging.

Non- Communicable Diseases pose a considerable global health challenge and are responsible for a significant proportion of premature deaths and disability. They have an impact on people individually, but they also cost society and healthcare