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A Prospective Interventional Study on Prevalence of Obesity and Anemia in Community Settings

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ABSTRACT

Background: Obesity and overweight are major public health problems that are associated with a higher mortality rate worldwide. BMI is a tool to estimate and screen for overweight and obesity in adults and children.

Methods: A prospective interventional study which was carried out in Narasaraopet over a period of 6 months i.e., from September 2021- March 2022. About 1200 study participants were examined for demographic details, BMI, waist circumference, hip circumference and waist to hip ratio,haemoglobin status, socioeconomic status, duration of physical activity and duration of sleep toworkout the incidence andprevalence of obesity and anemia in various age groups.

Results: Our study was carried out over a period of 6 months in a total of 1200 sample population. Not only underweight, overweight &obesity because of unhealthy lifestyle anemia is identified in around 1135 people. In a 6 months period majority of study participants were under the age group of 11 -20yrs (n=1109) with both males and females. Only 1135members showed interest to participate in follow- up sessions. After 3 counselling sessions, 254 participants got benefited from ourstudy.

Conclusions: During our study period we found that majority of people having BMI less than required (underweight)as compared to obese, overweight and anemia is the major complication present within the sample because of under nutrition. So, for reducing the obesity burden requires approaches that combine individual interventions with changes in the environment and society. Hence, we urge governments should promote the benefits of healthy lifestyle, food habits and physical activity.

Keywords: BMI, Obesity, Anemia, Waist Circumference & Hip Circumference

I. INTRODUCTION

Overweight and obesity are defined as abnormal or excessive fat accumulation that may impair health. It is a chronic disorder that is officially classified as a disease by the World Health Organization (WHO),and also by several other national and international organizations.[1]

Body mass index (BMI) is defined as a person's weight in kilograms divided by the square of his height in meters (kg/m2).[2]

The worldwide prevalence of obesity nearly tripled between 1975 and 2020. In fact, in 2020,more than 2 billion adults (39% of the adult global population) were overweight (BMI>25).Ofthese,over600 million were obese (BMI>30).[3]

In India, abdominal obesity is one of the major risk factors for cardiovascular disease (CVDs). Various studies have shown that the prevalence of obesity among women were significantly higher as compared to men. [4]

The prevalence of obesity than double among Indian adults aged20–69 years. Specifically,the prevalence of overweight and obesity reached 30.5% (27.4%-34.4%) and 9.5% (5.4%-13.3%)among men, and 27.4% (24.5%-30.6%) and13.9% (10.1%-16.9%) among women.[5][6]

➢ Pre natal maternal obesity,prenatal maternal smoking, and intrauterine growth restriction can disturb weight regulation and contribute to weight gain during childhood and later. Obesity that persists beyond early childhood makes weight loss in later life more difficult.

➢ Physical inactivity

➢ Insufficient sleep (usually considered < 6 to 8 hours/night) can result in weight gain by changing the levels of satiety hormones that promote hunger.

➢ Drugs, including corticosteroids, lithium, traditional antidepressants (tricyclics,tetracyclics, monoamine oxidase inhibitors [MAOIs]), benzodiazepines, antiseizure drugs,thiazolidinediones

(eg,rosiglitazone,pioglitazone),beta-blockers and antipsychotic drugs can cause weight gain. [7]

Body weight may therefore change depending on intake and total energy expenditure (TEE), which is equal to resting or basal energy expenditure (BEE) plusenergy expenditure during physical activity (EEA) and energy expenditure derived from thermogenesis (EET).This is defined by the energy balance equation:

$$TEE=BEE+EEA+EET$$

The efferent parasympathetic nervous system modulates hepatic metabolism,insulin secretion, and gastric emptying, thus participating in body weight control and regulation.[8]

Another biomolecule implicated in the modulation of food intake is neuropeptideY,

Whose main function is to increase food intake. NeuropeptideY is the most potent neurotransmitter with anabolic action.[9]

Other gastrointestinal peptides involved in the satiety process include the glucose-dependent insulinotropicpolypeptide(GIP),which is able to induce insulin secretion if elevated blood glucose levels occur.[11]

During development, growth and thyroid hormones work in concert to increase growth. Once in the blood, growth hormone stimulates the liver to produce another hormone, insulin-like growth factor-1 (IGF-1), which plays a key role in growth during childhood. Thyroid hormones act by increasing protein synthesis in all body tissues.[12] This affects adipose as well as non-adipose tissue, accounting for its pathophysiology in many organs, such as the liver and pancreas, and in the metabolic syndrome.[13]

The most obvious symptom of obesity is a change in the person's appearance. These weight-related health problems can cause symptoms, such as shortness of breath, difficulty breathing during activity, snoring, skin abnormalities including stretch marks, joint and back pain.[14]

Obstructive sleep apnea can result if excess fat in the neck compresses the airway during sleep. Breathing stops for moments, as often as hundreds of times a night. This disorder, often undiagnosed, can cause loud snoring and excessive day time sleepiness and increases the risk of hypertension, cardiac arrhythmias and metabolic syndrome.[15]

Anthropometric measures include waist circumference, waist-to-hip circumference ratio, body-fat determination, which is usually based on skin fold thickness or bioimpedance.[16]

BIA estimates percentage of total body water directly; percentage of body fat is derived indirectly. BIA is most reliable in healthy people and in people with only a few chronic disorders that do not change the percentage of total body water.[17]

Imaging procedures, including CT, MRI and dual-energy x-ray absorptiometry (DXA), can also estimate the percentage and distribution of body fat but are usually used only for research.[18]

Various treatment options include:

* ❖ Dietary management
* ❖ Physical activity
* ❖ Behavioral interventions
* ❖ Bariatric surgery[19]

Guidelines suggest physical activity of 150 minutes/week for health benefits and 300 to 360 minutes/week for weight loss and maintenance. Developing a more physically active lifestyle can help with weight loss and maintenance.[20,23]

Internet resources, applications for mobile devices, and other technological devices may also help with adherence to lifestyle changes and weight loss.Applications can help patients set a weight-loss goal, monitor their progress, track food consumption, and record physical activity.[22,23]

MECHANISM AND EFFICACY OF APPROVED PHARMACOTHERAPY FOR OBESITY MANAGEMENT

➢ Orlistat, a semisynthetic derivative of lipstatin.

➢ Monitor bodyweight, waist circumference and lipid profile. Patients with diabetes must adjust the dose of diabetes medicine, as weight loss can affect glycemic control.[27]

➢ Liraglutide is a daily, subcutaneously administered, human glucagon-like peptide 1(GLP-1)analog that acts centrally on the pro-opiomelanocortin (POMC) /CART neurons to improve satiation and satiety and reduce hunger, with a transient effect to decrease gastric emptying. Liraglutide was approved for chronic obesity management at a dose of 3.0mg daily,in people with or without type 2 diabetes.

➢ Monitor blood glucose levels and body weight. Body weight must be measured once in16weeks.

➢ Bupropion induces satiety centrally by enhancing production and release of α-melanocyte stimulating hormone (α-MSH) and β-endorphin from the pro-opiomelanocortin cells in the nucleus of the hypothalamus. Naltrexone disrupts the auto-inhibitory effect of β-endorphin on the pro-opiomelanocortin cells by blocking the μ-opioid receptors.

➢ The recommended titration schedule is one tablet daily for the first week,with an increase by one tablet

each week until the maintenance dose of twotabletstwice daily(totaldailydose 32mg/360mg)is reached.

SURGICALTREATMENT:
BARIATRICSURGERY:
➢ The goal of these operations is to modify the stomach and intestines to treat obesity and related diseases.
➢ These operations are extremely safe, with complication rates that are lower than common operations such as gall bladder removal, hysterectomy and hipreplacement.[29]

TYPESOFBARIATRICSURGERY:
1. SLEEVEGASTRECTOMY
2. ROUX-EN-YGASTRICBYPASS
3. ADJUSTABLEGASTRICBAND(AGB)
4. BILIOPANCREATICDIVERSIONWITHDUODENALSWITCH(BPD/DS)

PREVENTIONOF OBESITY:
1. Limit television time,screen time and other "sittime".
   4.6–12years -24hours 9–12hrs.
   13–18 years-24hours 8–10hrs
   18–60 years-7or more hrs.[32]
2. SMART goals for losing weight, or goals that are specific,measurable,achievable,realistic and time-sensitive.[31]

CAUSEOFANEMIAINOBESEINDIVIDUALS:
➢ Iron deficiency is common in over weight and obese individuals.
➢ The association between obesity and iron deficiency may be due to increased hepcidin levels mediated by chronic inflammation.
➢ Hepcidin is a small peptide hormone that functions as a negative regulator of intestinal iron absorption. This deficiency may be due to the adiposity related inflammation that increases serum hepcidin and decreases dietary iron absorption.[34]

METHODS
This is a prospective interventional study conducted in community settings for a period of six months i.e., from September to March 2022 in schools and colleges at Narasaraopeta.

Inclusioncriteria:
1. Considering the individuals from age of 10-60yrs.
2. Both males and females are included in the study.
3. Subjects who are having comorbidities were also included in the study.

Exclusioncriteria:
1. Individuals who are not willing to participate in the study were excluded from the study.
2. Physically handicapped individuals are excluded from the study.

Data collection and analysis:
➢ A data collection form was developed in which all the details of the study respondents are noted.
➢ Patients will be given adequate knowledge on Obesity- its preventive measures,complications, early screening and also on Dietary changes, lifestyle modifications have to be followed.
➢ The subjects were classified according to the body weight as underweight, overweight & obese. The patients were informed and counselled about their health status and also about the significance of weight reduction directly to them based on their level of understanding and age group. Individualized diet charts were also be provided.

Ethical Clearance:
➢ This study was approved by the Institutional Ethics Committee of Narasaraopet Institute of Pharmaceutical Sciences, Narasaraopet.
IEC Approval number: IEC-NIPS/PPP/2021-22/003

II.   RESULTS

This study was carried out over a period of 6months i.e., from 5[th]September-5[th]March among 1200 population. Study respondents will be analysed for anthropometric changes before and after counselling.

BEFORE COUNSELLING /FOLLOW-UP

TABLE1:DISTRIBUTION OF STUDY PARTICIPANTS ACCORDING TO SOCIODEMOGRAPHIC CHARACTERISTICS

S.No	Characteristics	Males	Females	Total	Percentage(%)
1.	**Ageinyrs.**				
	11-20	551	558	1109	92.4
	21-30	12	15	27.0	2.25
	31-40	12	21	33.0	2.75
	41-50	11	12	23.0	1.91
	51-60	06	02	08	0.66
2.	**Gender**	594	606	1200	100
3.	**Religion**				
	Hindu	279	204	483	40.2
	Muslims	135	190	325	27.1
	Christians	180	212	392	36.6
4.	**Literacy status**				
	Literates	555	570	1125	93.5
	Illiterates	39	36	75	6.25
5.	**Occupational status**				
	Students	547	562	1109	92.4
	Teachers	11	16	27	2.25
	Farmers	15	11	26	2.16
	Unskilled workers	13	7	20	1.66
	Business	8	5	13	1.08
	Housewife's	-	5	5	0.41
6.	**Socioeconomic status**				
	Upper class –I	24	27	51	4.25
	Upper middle class –II	53	41	94	7.83
	Lower middle class-III	198	160	358	29.8
	Upper lower class-IV	143	206	349	29.0
	Lower class-V	176	172	348	29.0
7.	**Marital status**				
	Married	47	42	89	7.41
	Unmarried	547	562	1109	92.4
	Widow	-	02	2	0.16

TABLE2:CATEGORIZATIONOFSTUDYRESPONDENTSASPERBMI

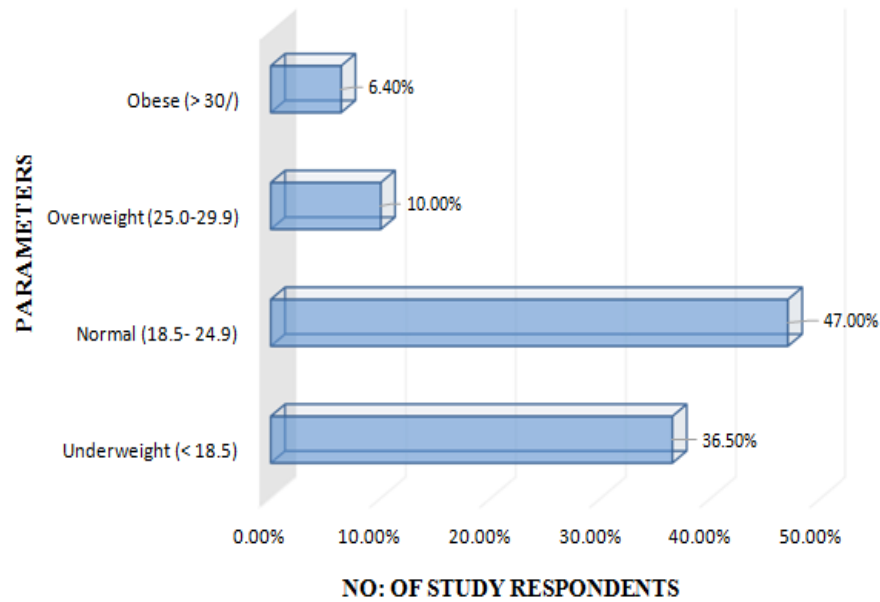| S.NO	BMI	No: of Subjects	Percentage
1.	Underweight (<18.5)	438	36.5 %
2.	Normal(18.5-24.9)	564	47.0 %
3.	Overweight(25.0-29.9)	121	10.0 %
4.	Obese(>30/)	77	6.4 %

Figure1: Categorization of study respondents as per BMI

TABLE3: RELATIONSHIP OF BMI WITH AGE & GENDER IN STUDY PARTICIPANTS

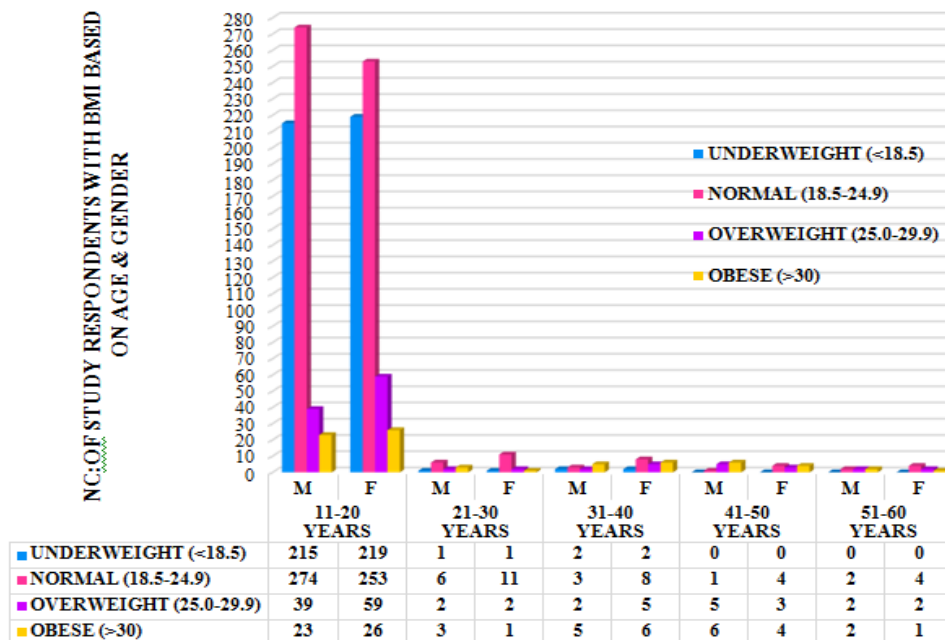| S.No	Age in yrs.	Underweight (<18.5)		Normal (18.5-24.9)		Overweight (25.0-29.9)		Obese (>30/)	
		M	F	M	F	M	F	M	F
1	11-20	215	219	274	253	39	59	23	26
2	21-30	1	1	6	11	2	2	3	1
3	31-40	2	2	3	8	2	5	5	6
4	41-50	-	-	1	4	5	3	6	4
5	51-60	-	-	2	4	2	2	2	1
Total		440(36.6%)		556(47.1%)		121(10%)		77(6.41%)	

Figure 2: Relationship of BMI with age &gender in study participants

TABLE4: DIFFERENTIATION OF OBESE PARTICIPANTS ACCORDING TO AGE &OBESE CLASSES

S.No	Age in yrs.	Obese Class-I	ObeseClass-II	ObeseClass-III
1	11-20	43	4	2
2	21-30	4	-	-
3	31-40	10	-	1
4	41-50	9	1	-
5	51-60	2	1	-
Total		68(88.3%)	6(7.7%)	3(3.8%)
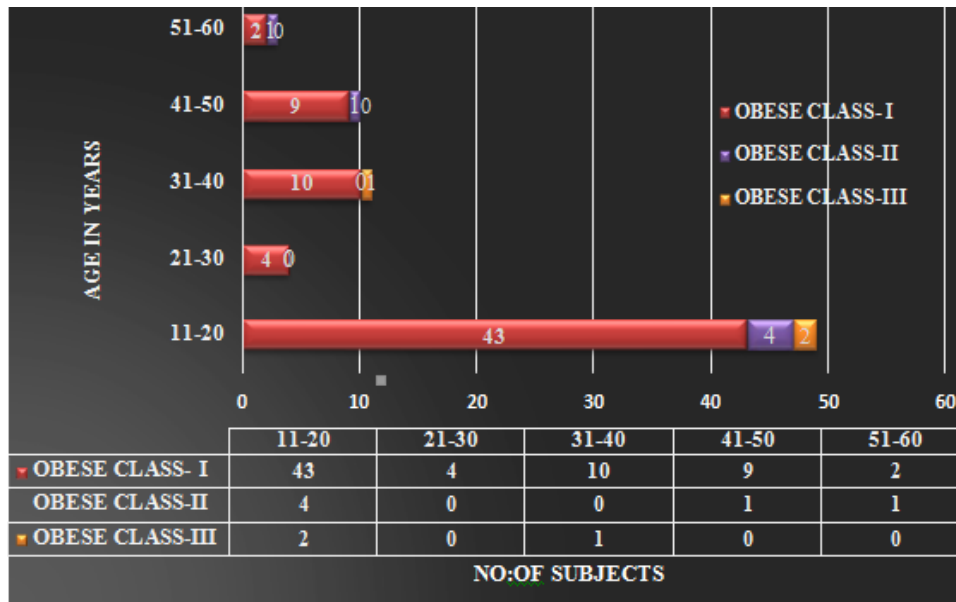
Figure 3:Differentiation of obese participants according to age & obese classes

TABLE5: PREVALENCE OF DIFFERENT CLASSES OF OBSEITY IN SAMPLE POPULATION

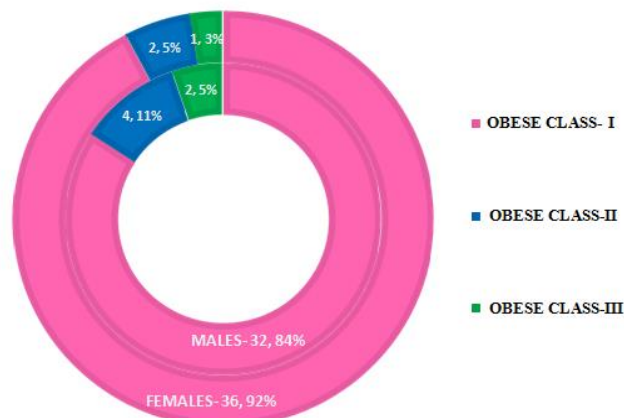| S.No	Gender	ObeseClass-I	ObeseClass-II	ObeseClass-III	Total
1	Males	32	4	2	38(49.3%)
2	Females	36	2	1	39(50.6%)

Figure 4: Prevalence of different classes of obesity in sample population

TABLE6: DISTRIBUTION OF STUDY PARTICIPANTS ACCORDING TO WAIST CIRCUMFERENCE

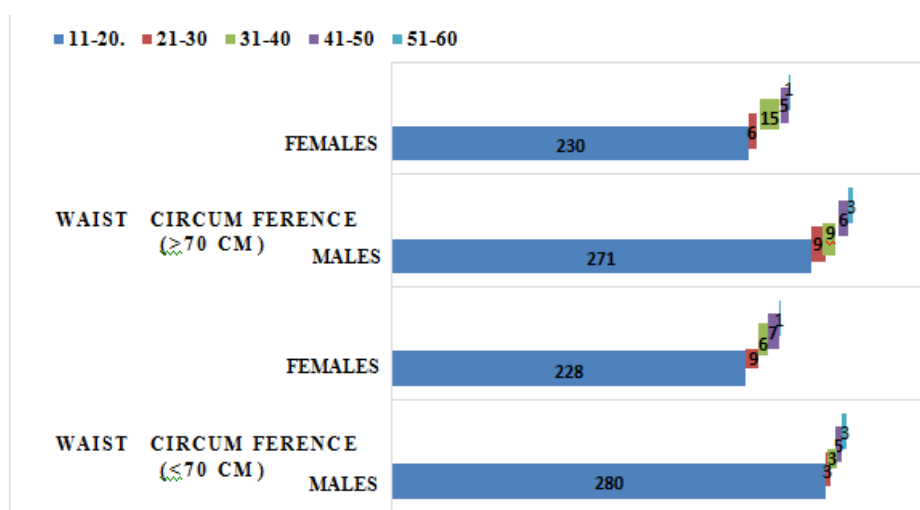| S.No	Age inyrs.	Waist Circumference (<70cm)		Waist Circumference (>70cm)		Total	Percentage
		M	F	M	F		
1.	11-20	280	228	271	230	1109	92.4
2.	21-30	3	9	9	6	27	2.25
3.	31-40	3	6	9	15	33	2.75
4.	41-50	5	7	6	5	23	1.91
5.	51-60	3	1	3	1	8	0.6

Figure 5: Distribution of study participants according to waist circumference

TABLE7:DISTRIBUTIONOFSTUDYRESPONDENTSASPERHIPCIRCUMFERENCE

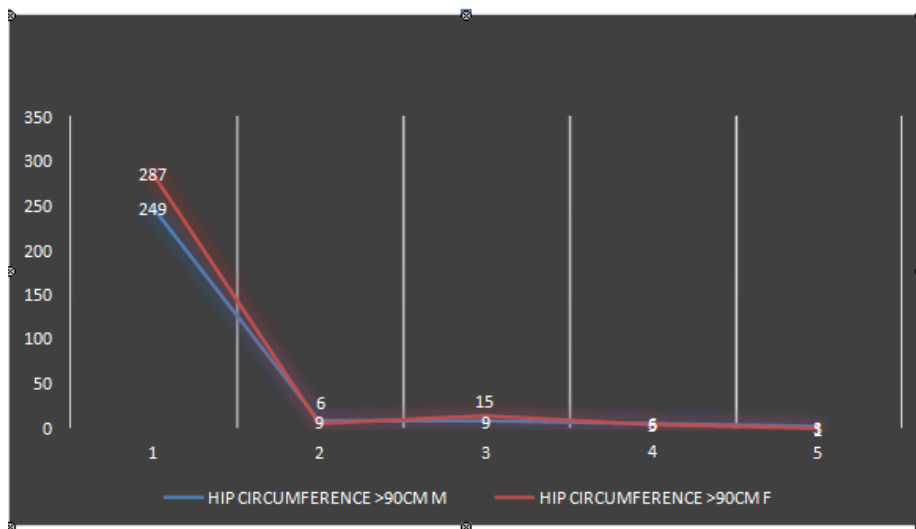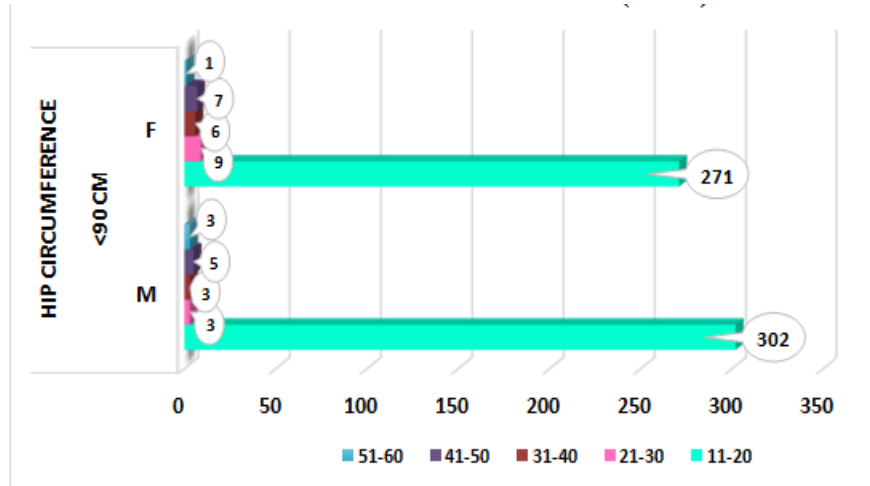| S.No	Age in yrs.	Hip Circumference				Total	Percentage
		<90cm		>90cm			
		M	F	M	F		
1	11-20	302	271	249	287	1109	92.4 %
2	21-30	03	09	09	06	27	2.25 %
3	31-40	03	06	09	15	33	2.75 %
4	41-50	05	07	06	05	23	1.91 %
5	51-60	03	01	03	01	8	0.66 %

Figure 6(a) & 6(b)): Distribution of study respondents as per Hip Circumference

TABLE 8: DISTRIBUTION OF STUDY PARTICIPANTS AS PER WAIST-HIP CIRCUMFERENCE RATIO

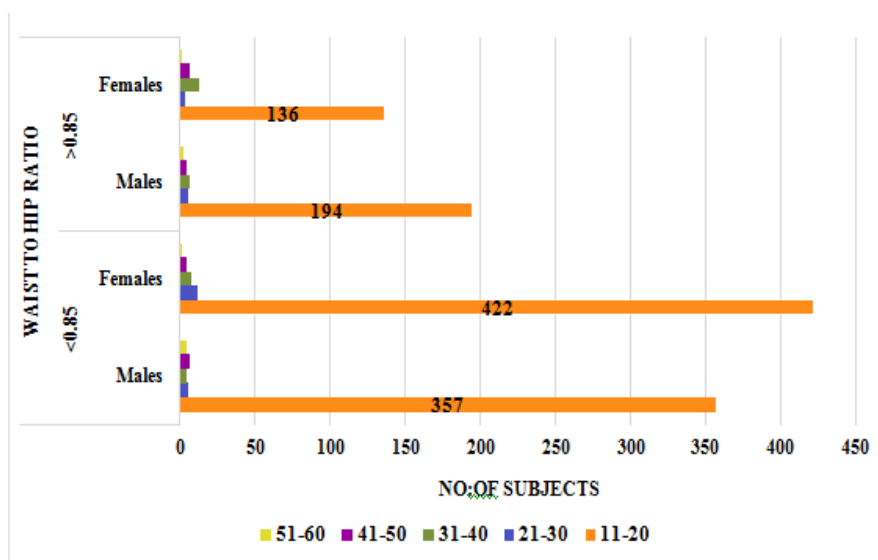| S.No	Age In yrs.	Waist to Hip Ratio				Total	Percentage
		<0.85		>0.85			
		Males	Females	Males	Females		
1	11-20	357	422	194	136	1109	92.4 %
2	21-30	06	12	06	03	27	2.25 %
3	31-40	05	08	07	13	33	2.75 %
4	41-50	07	05	04	07	23	1.91 %
5	51-60	04	01	02	01	8	0.66 %

Figure 7: Distribution of study participants as per Waist-HipCircumference Ratio

TABLE9:IDENTIFICATION OF HEMOGLOBIN STATUS IN STUDY POPULATION

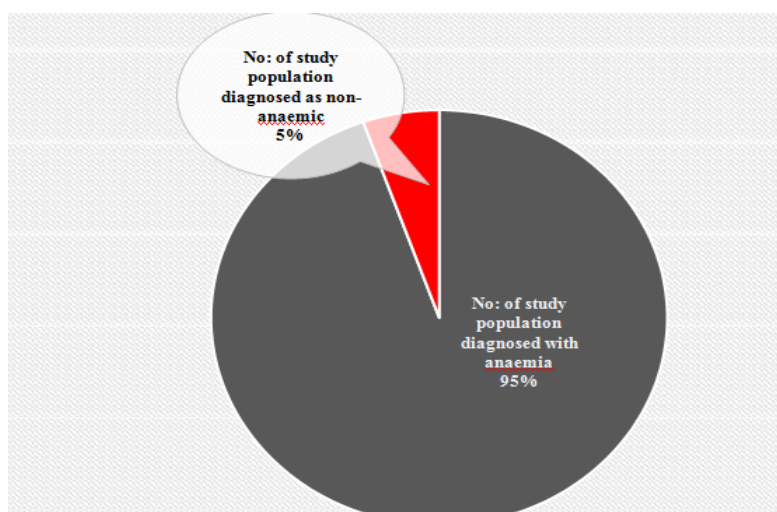| S.No	Diagnosis	No:of sample population	Percentage
1.	No: of study population diagnosed with anaemia	1135	94.5 %
2.	No: of study population diagnosed as non-anaemic	65	5.40 %

Figure 8: Identification of hemoglobin status in study population

TABLE10: INCIDENCE OF DIFFERENT GRADES OF ANEMIA AMONG THE STUDY PARTICIPANTS

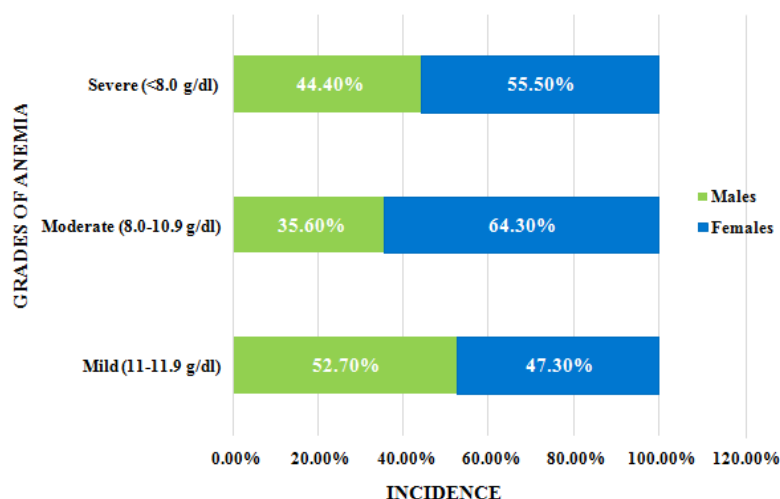| S.No	Hb Level	Males	Females	Total	Percentage
1	Mild (11-11.9g/dl)	540	485	1025	90.3%
2	Moderate (8.0-10.9g/dl)	36	65	101	8.89%
3	Severe(<8.0g/dl)	04	05	09	0.79%

Figure 9: Incidence of different grades of anemia among the study participants

TABLE11: FREQUENCY OF DIFFERENT GRADES OF ANEMIA IN DIFFERENT AGE GROUPS &GENDERS

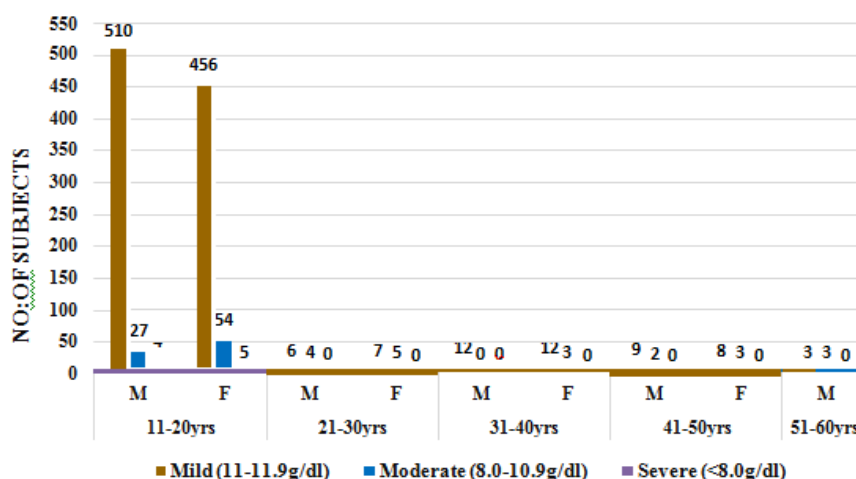| S.No	Hb Level	11-20yrs		21-30yrs		31-40yrs		41-50yrs		51-60yrs	
		M	F	M	F	M	F	M	F	M	F
1	Mild (11-11.9g/dl)	510	456	6	07	12	12	09	08	03	02
2	Moderate (8.0-10.9g/dl)	27	54	04	05	-	03	02	03	03	-
3	Severe (<8.0g/dl)	04	05	-	-	-	-	-	-	-	-
Total		1056(88%)		22(1.8%)		27(2.25%)		22(1.8%)		8(0.6%)	

Figure 10:Frequency of different grades of anemia in different Age groups & genders

TABLE12:PERCENTAGEOFNON-ANAEMICANDDIFFERENTGROUPSOFANAEMIA ACCORDINGTO THENUTRITIONAL CATEGORIES

S.No	Level of Anemia	BMI				Total
		Underweight	Normal	Overweight	Obese	
1.	Non-Anemic	16	10	33	06	65(5.4%)
2.	Mild	21	55	31	16	123(10.2%)

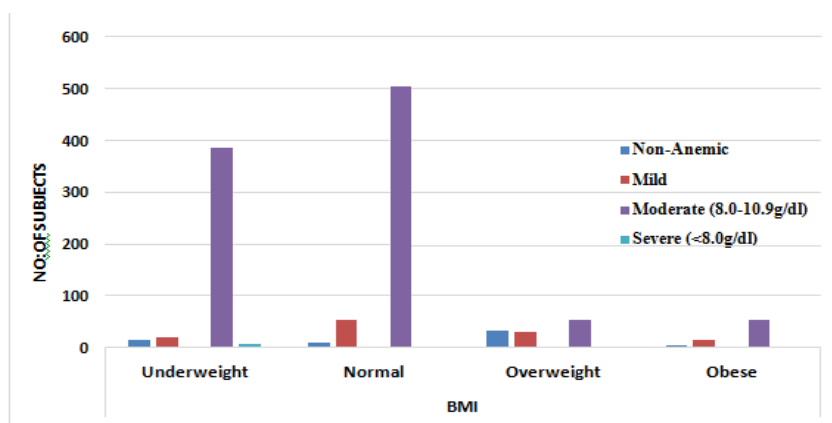|					
3.	Moderate	385	505	55	53	998(83.1%)
4.	Severe	08	02	02	02	14(1.16%)

Figure 11:Percentage of non-anemic and different groups of anemia according to the nutritional categories

TABLE13:ASSOCIATION OF TYPES OF OBESITY WITH VARIOUS FACTORS IN THE STUDY POPULATION

Risk Factors	Total	Overweight	Obese Class-I	Obese Class-II	Obese Class -III	Chi squaretest
Age 11-20yrs. 21-30yrs. 31-40yrs. 41-50yrs. 51-60yrs.	198	98 04 07 08 03	33 04 10 09 02	4 0 0 1 1	2 0 1 0 0	X^2=19 P-value=0.25
Gender Males Females	88 108	54 75	28 30	4 1	2 2	X^2=3 P- value =0.39
Family History Males Females	17 27	10 19	05 07	02 0	0 01	X^2=4 P- value =0.25
Dietarypattern Vegetarian Non-Vegetarian Mixed	21 27 150	13 17 102	07 10 40	0 0 05	01 0 03	X^2=4 P- value =0.66
Sleepduration <6hrs 7-8hrs >8hrs	130 43 25	90 17 14	30 20 7	07 06 0	03 0 04	X^2=18.9 P- value =0.44
Physical activity YES NO	83 116	55 66	25 33	3 3	0 3	X^2=2.56 P- value =0.46
Duration of Physical activity <30 min >30min <1 hr >1 hr	18 58 10 22	18 40 22 0	0 15 10 0	0 03 0 0	0 0 0 0	X^2=4.33 P- value =0.66
Co morbidities Hypertension	10	04	05	01	0	X^2=5.43

Diabetes	07	02	04	00	01	P- value
Hypothyroidism	08	05	02	01	0	=0.48

TABLE14: PATTERN OF EATING IN STUDY PARTICIPANTS

VARIABLE	CATEGORY	NO: OFSUBJECTS	PERCENTAGE
Consumption of junk food	Fastfood	232	19.3%
	Baked food	262	21.8%
	Chips	325	27.0%
	Aerateddrinks	181	15.0%
Reasons for the consumption ofjunk food	Quickservice	162	13.5%
	Lowcost	157	13.0%
	Tasty	326	27.1%
	Convenient	216	18.0%
	Others	139	11.5%
Frequency of consumption of junk food	At least once a day	376	31.3%
	At least once a week	387	32.2%
	At least once a month	237	19.7%
Preferred time for the consumption of junk food	Dinner	176	14.6%
	Snacks	620	51.6%
	Others	204	17.0%

Figure 12: Pattern of eating in study participants

AFTER COUNSELLING:

TABLE 15: IMPROEVEMENT IN ANTHROPOMETRIC MEASURES IN OVERWEIGHT&OBESITY CASES AFTER COUNSELLING

Parameters	1st Follow up	2nd Follow up	3rd Follow up
BMI	14	35	44
Waist Circumference	10	27	39
HipCircumference	7	26	34
Waist to Hip Ratio	7	25	33
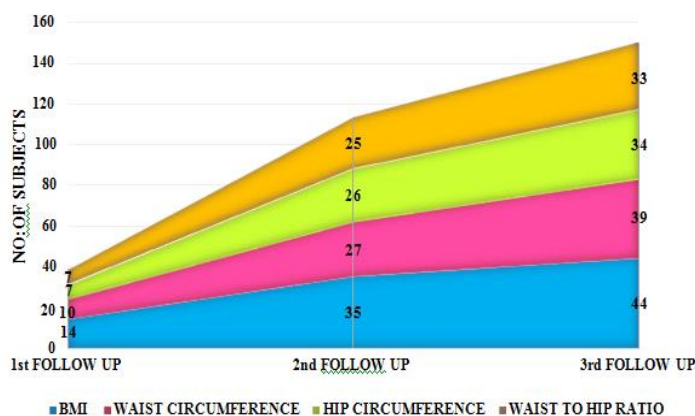
Figure 13: Improvement in anthropometric parameters in overweight & obesity participants after counselling

TABLE 16: BMI CHANGES IN DIFFERENTAGE GROUPS AND GENDER

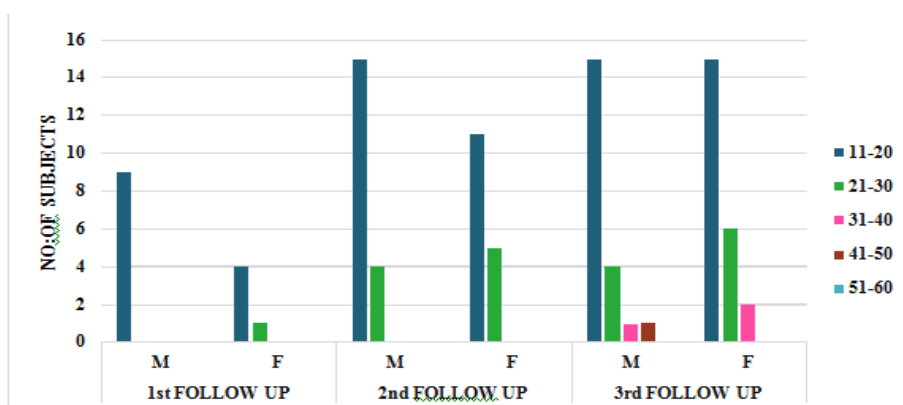| S.No	Age in Yrs.	1st Follow up		2nd Follow up		3rd Follow up	
		M	F	M	F	M	F
1	11-20	9	4	15	11	15	15
2	21-30	0	1	4	5	4	6
3	31-40	0	0	0	0	1	2
4	41-50	0	0	0	0	1	0
5	51-60	0	0	0	0	0	0
Total		14(1.16%)		35(2.9%)		44(3.6%)	

Figure 14: BMI changes in different age groups and gender

TABLE17: VARIATIONS IN WAISTCIRCUMFERENCE AMONG THE STUDY PARTICIPANTS AFTER COUNSELLING

S.No	Age inYrs.	1st Follow up		2nd Follow up		3rd Follow up	
		M	F	M	F	M	F
1	11-20	6	4	13	10	15	15
2	21-30	0	0	1	3	2	4
3	31-40	0	0	0	0	1	2
4	41-50	0	0	0	0	0	0
5	51-60	0	0	0	0	0	0
Total		10(0.83%)		27(2.25%)		39(3.25%)	
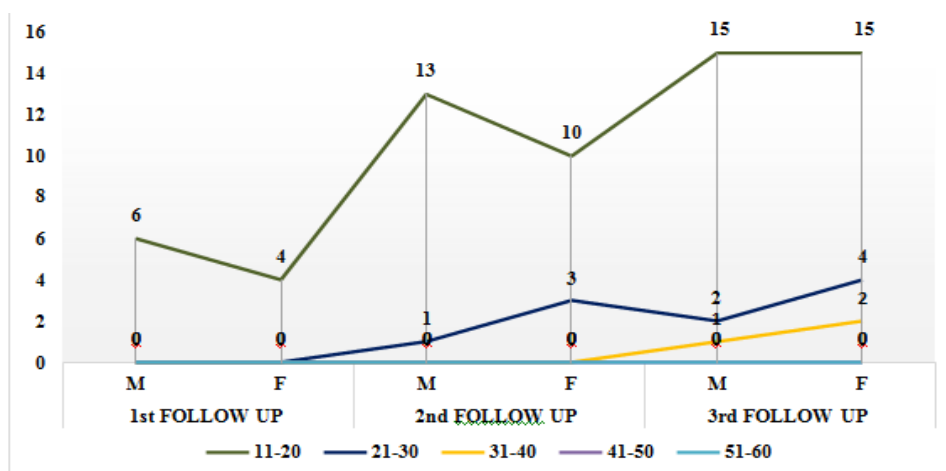
Figure 15: Variations in Waist Circumference among the study participants after counselling

TABLE 18: VARIATIONS IN HIPCIRCUMFERENCE AMONG THE STUDY PARTICIPANTS AFTER COUNSELLING

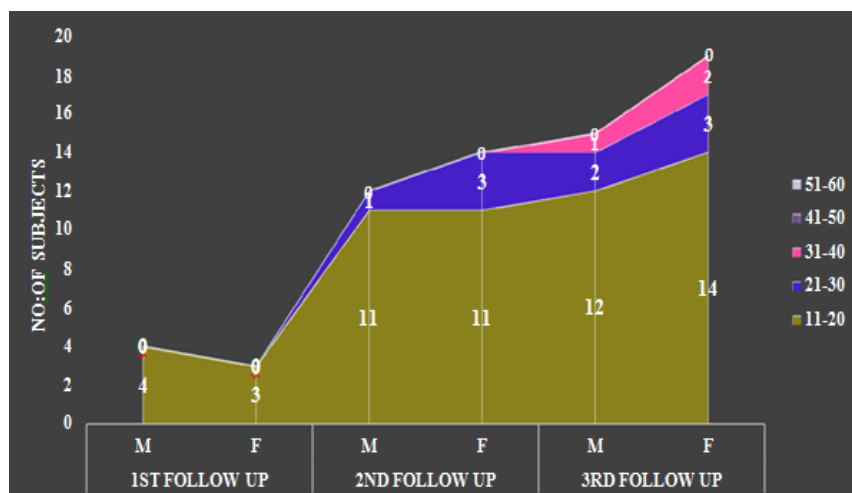| S.NO	AGE INYRS	1st FOLLOWUP		2nd FOLLOW UP		3rd FOLLOW UP	
		M	F	M	F	M	F
1	11-20	4	3	11	11	12	14
2	21-30	0	0	1	3	2	3
3	31-40	0	0	0	0	1	2
4	41-50	0	0	0	0	0	0
5	51-60	0	0	0	0	0	0
Total		7(0.5%)		26(2.16%)		34(2.8%)	

Figure 16: Variations in Hip Circumference among the study participants after counselling

TABLE19: VARIATIONS IN WAIST-HIP CIRCUMFERENCE RATIO AMONG THE STUDY PARTICIPANTS AFTER COUNSELLING

S.No	Age inYrs.	1st Follow up		2nd Follow up		3rd Follow up	
		M	F	M	F	M	F
1	11-20	4	3	10	11	12	13
2	21-30	0	0	1	3	2	3
3	31-40	0	0	0	0	1	2
4	41-50	0	0	0	0	0	0
5	51-60	0	0	0	0	0	0
TOTAL		7(0.5%)		25(2.08%)		33(2.75%)	

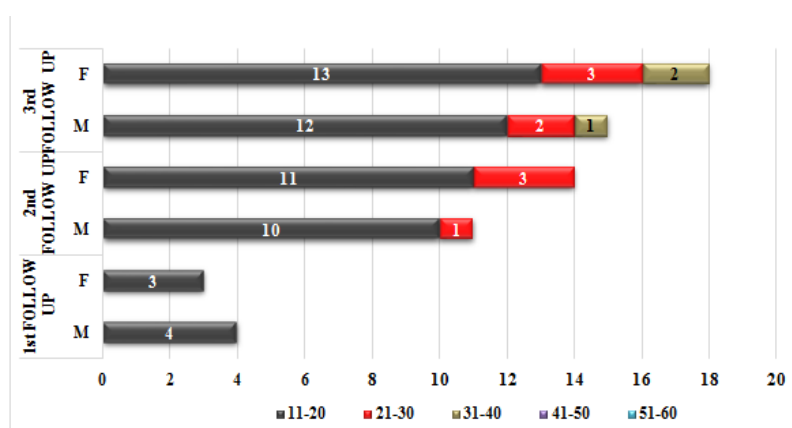**Figure 17: Variations in Waist-Hip Circumference ratio among the study participants after counselling**

TABLE20:VARIATIONSINUNDERWEIGHTSUBJECTS

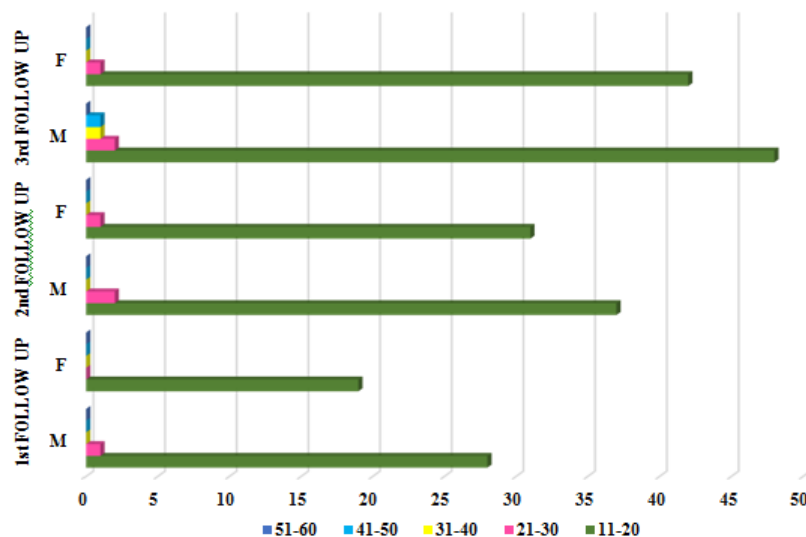| S.No	Age in Yrs	1st Follow up		2nd Follow up		3rd Follow up	
		M	F	M	F	M	F
1	11-20	28	19	37	31	48	42
2	21-30	1	0	2	1	2	1
3	31-40	0	0	0	0	1	0
4	41-50	0	0	0	0	1	0
5	51-60	0	0	0	0	0	0
Total		48(4%)		71(5.9%)		95(7.9%)	

Figure 18:Variationsinunderweightsubjects

TABLE 21: CHANGES IN HEMOGLOBIN CONCENTRATIONS AMONG THE STUDY POPULATION

S.No	Age inYrs.	1st Follow up		2nd Follow up		3rd Follow up	
		M	**F**	**M**	**F**	**M**	**F**
1	11-20	10	7	31	27	52	45
2	21-30	2	1	4	3	7	6
3	31-40	1	0	3	2	3	1
4	41-50	0	0	1	2	0	1
5	51-60	0	0	0	0	0	0
Total		21(1.75%)		73(6%)		115(9.5%)	
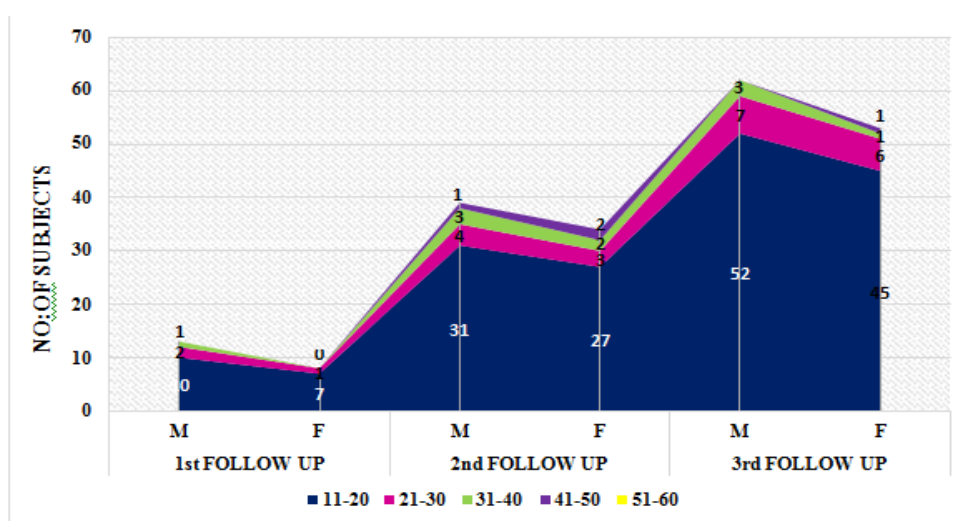
Figure 19: Changes in hemoglobin concentrations among the study population
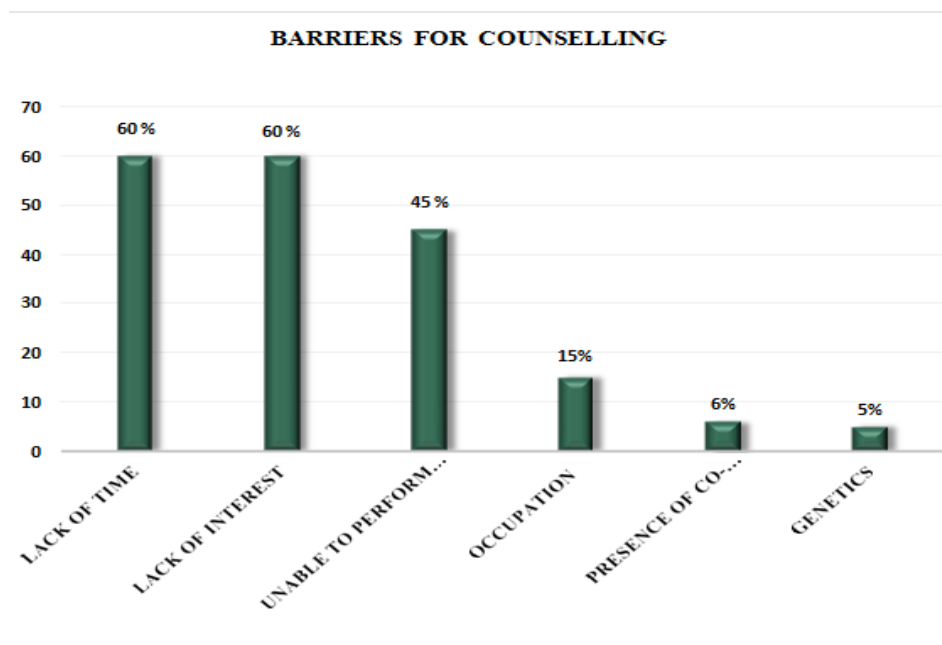
Figure 20: Barriers for counselling

III.   DISCUSSION

In our study,we educated the study participants regarding the complications of incidence and prevalence of non-Communicable diseases due to Overweight and Obesity also about the impact of childhood obesity in further stages of life with the help of information leaflets, power point presentation.

Regarding the distribution of study participants according to sociodemographic characteristics, awareness on obesity was created among the 1200population, majority of our study participants were in the age group of 11-20years(92.8%; n= 1109) and the lesser number of participants were older adults whose agegroup was in between 51-60 years (0.66%; n= 8), according to gender distribution females (50.5% n= 606) and males (49.5%; n= 594) were equally involved in this programme. Most of the participants belong to the Hindu religion(M-23.25%;n=279, F- 17%; n=204) about 1125 were literates (93.5%; M-46.25%; n=555, F-47.5%; n=570). Majority of study participants were students (92.4%;n= 1109(M-547, F- 562)), maximum number of participants from lower middle class- III (29.8%;n= 358), Upper lower class- IV (29%; n= 349)& Lower class (29%; n= 348) and1109 (92.4%) were unmarried as shown in Table 1. Our results were consistent with previous study conducted by **RAJ KAMAL R** et al**(2018).**[43]

Prevalence of underweight among ponder members was 36.5% (n= 438), 10% of respondents were having BMI in between 25.0-29.9 (i.e., Overweight) & very few members were identified as obese(6.4%;n=77) (shown in Table 2 & Fig1).In this study out of 1200 sample population, among all the ages the population fall between 11-20 yrs were mostly affected age group with Obesity (4.4%; n=49(M-23, F-26)),Overweight(8.8%; n=98 (M-39,F- 59)) and Underweight (39.1%; n= 434 (M- 215, F- 219)). Due to multiple factors girls were highly affected with Obesity (M- 46.9% , F-53.1%),Overweight(M-39.8% ,F-59.3%) and underweight (M-49.5%, F- 50.5%) compared with males (Table 3& Fig2).

Table5 shows that Out of 1200 sample, only 77 participants were identified as Obese. Among them 88.3% of subjects were fall under the category of obese class- I. Compared with all the age groups, majority of the study participants with different age groups fall under obese class- I; 43 (63%) participants belong to Obese Class- I with age group of 11-20yrs, next affected age group was 31-40yrs with prevalence of 14.7% (n=10) and the least number of people belongs to obese category-III(7.7%)(Fig 3).

Study shows that prevalence of obesity in both males and females were equal.Out of 77 obese people, 68 participants belong to obese class-I, in that 52.9% were females and 47%were males (Shown in table5& Fig 4).

From table 6 it was evident that among the total sample population,54.6% (n=655) of respondents having waist circumference >70cm which indicates that they at higher risk to develop Cardiovascular and metabolic complications, 45.4%(n=545) of people having waist circumference <70cm. out of 655 respondents with waist circumference >70cm, boys (41.3%; n=271) with age groups of 11-20yrs were having abdominal obesity than females (35.1%; n=230) and the lowest effected age group and gender with abdominal obesity was 51-60 yrs with in this age group males were dominant than females(Fig 5).

Waist circumference >70 cm determines the accumulation of abdominal fat which leads to development of cardiovascular and metabolic complications. In our study we identified males are high in number when compared tofemales in >70cm of waist circumference. Our study results were consistence with previous study conducted by **AMITSOHANI** etal. **(2015)**.[49]

Our study shows that among the total sample population, 50.8% (n=610) of people having Hip circumference <90cm & 49.1% (n=590) of respondents having Hip circumference >90cm. According to the hip circumference values boys were having healthy bodyweight than girls due to hormonal changes, body fat composition, lifestyle changes and lack of physical activity. Out of 590 respondents, girls (25.8%; n=287) with age group of 11-20yrs were having with hip circumference > 90 cm indicates that they are having more visceral fat compared to boys (22.4%; n=249) .Hip circumference >90 cm shows the visceral fat accumulation which leads to diabetes mellitus, cardiovascular diseases, stroke and some of cancers as complications. (Table 7, Fig 6(a) & 6(b).

If Waist to Hip circumference ratio is >0.85cm it indicates that an individual develops cardiovascular complications mainly Myocardial Infarction. They were categorized according to the age group and gender. In our study we identified that 68.9% (n=827) of respondents having waist to hip circumference ratio <0.85 & 31.0% (n=373) of respondent's ratio was >0.85. Out of 373 respondents, males 52.0% (n=194) with age group of 11-20yrs were at higher risk to develop complications than females (36.5%; n=136) (Table 8, Fig 7). Our study results are similar with previous study conducted by **AMIT SOHANI** et al.**(2015)**.[49]

Regarding the status of anemia in study population, during the 6 months study period 94.5% of people were diagnosed with anemia and the least number was found to be non-anemic(as shown in Table 9& Fig8). The incidence for severe anemia was found to be only 0.79% (M-4, F-5), 8.89% of subjects having moderate anemia. We observed that there is a higher incidence for mild stage of anemia in both the males (52.7%; n= 540) and females (47.3%; n= 485) i.e., about 90.3% (Table 10& Fig 9). Under this age, 80.5%(n=966) were found to be mildly anaemic(M-45.9%;n= 510, F- 38%; n=456), 7.3% (n= 81) were found be moderately anaemic (F-4.8%;n=54, M-2.4%; n= 27), 0.8% (n= 9) of people have severe anaemia (Table 11& Fig10).

Present study shows the percentage of non-anaemic and different groups of anaemia according to the nutritional categories. The incidence of anemia according to the nutritional changes among the study population. The incidence of moderate anemia (n=998, 83.1%) is higher in study respondents who are underweight,overweight and Obese. (Table 12 &Fig 11). Results were similar to the study conducted by **AMITAVA PAL** et.al. **(2014)**.[53]

Table 14 describes various risk factors associated with obesity stratified by different types of obesity in the study population. It was observed that overweight and obesity increased significantly with no physical activity & Long-term usage of smart gadgets without proper sleep which will increases the appetite, an increasing trend in all three different types of obesity was observed with increasing education status.

Table 15 signifies eating pattern of study participants. Frequency of consumption of junk food among study participants was at least once a week (n=387,32.2%).Preferred time for the consumption of junk food was snacks(n=620, 51.6%).Eating junk foods causes serious health implications like obesity, learning and memory impairment, insulin resistance and inadequate growth and development(Fig 12).Within the study period we identified around 77 were obese,121members were found to be overweight, 438 subjects having BMI <18.5(underweight) and among the 1200 sample population 1135 were anaemic along with obesity & overweight. Table 16 shows the changes in body measurements after counselling and continuous follow-up. Compared to 1st follow-up in 2nd and 3rd follow-up few more subjects were followed the diet and activities we suggested and get benefited from our study (Fig13).

Represents the BMI changes in different age groups and in different gender. After counselling and continuous follow-up, we identified that the subjects lie in the 11-20yrs of age were effectively followed the diet and lifestyle modificationsadvised during the awareness session. For each follow-up the result shows there was a significant rise in the respondents who were following the diet &life style modifications advised (Table 16 & Fig 14).

Table 17 & Fig 15 shows variations in waist circumference among the study participants after counselling. After counselling and continuous follow-up,compared to all the age groups we identified that the subjects lie in the11-20yrs of age were effectively followed the diet and lifestyle modifications advised during the awareness session.

During the study period we identified that the subjects lie in the 11-20 yrs of age were effectively reduced the hip circumference. But most of the subjects got changes in BMI & Waist circumference than hip circumference (Table 18& Fig 16). By the end of the follow-up sessions hip circumference was reduced in females than males.

Among the1200 respondents, we have identified that 435 study respondents were found to be under weight. The diet charts were provided to all thesubjects whose BMI is less than the required. After the 3 follow-

ups' with 1month duration between each follow-up, results shown that % (n= 205) of subjects increased their weight gradually from 1st follow-up to 2nd and 3rd. (Table 19 & Fig 17).

Table 20 shows changes in haemoglobin concentrations among the study population. We have identified that a total of 1135subjects were having low haemoglobin concentrations. During the awareness programme we have educated thesubjects on complication for anemia and dietary modifications to be followed. During1st follow-up only few patients (1.49%; n=17) were showed interest to follow the diet advised after the repetitive sessions by the end of the 3rd follow-up maximum number (8.54%;n=97)of study population get benefited.

A total of 1135 participants were showed interest to attend the counselling sessions and for following the diet, lifestyle modifications advised remaining 65 participants were not willing to participate because of barriers. Even after following the diet only few people got positive outcomes because of their family occupation, socioeconomical status (as shown in Table 21&Fig 19).

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