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METABOLIC RISKS LINKED TO CONCURRENT OBESITY AND ANEMIA AMONG HOUSEWIVES

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Abstract

The study included 200 obese anemic subjects (100 with general obesity and 100 with abdominal obesity) of age 21-60 years. Subjects' selection was made through convenience sampling technique. The socio-demographic information was obtained by interviewing the subjects and recorded in specific questionnaire. Anthropometric measures included weight, height and waist circumference (WC). Body mass index (BMI) was calculated using the measured weight and height of subjects. Biochemical data included hemoglobin level, fasting blood glucose level and lipid profile. The clinical data included only blood pressure measurement. Hemoglobin level was used as the first screening step in selection of subjects; whereas, BMI and WC were used as second screening step. The collected data was analyzed using the statistical software SPSS and the results were presented in the form of either mean±SD or frequencies (%). Relationship of BMI and WC with the biochemical and clinical variables was determined using Pearson's correlation. The results revealed that the overall mean age of subjects was 39.9±10.1 years. Mean hemoglobin level of all subjects was 10.6±1.3mg/dl. Most of the subjects (54%) were mildly anemic. Mean weight, height, BMI and WC of all subjects were 80.7±9.8 kg, 165.0±4.9 cm, 29.7±3.6 kg/m2 and 90.1±10.1 cm, respectively. Overall, Most of the obese anemic subjects (54%) had elevated glucose levels with an overall mean fasting blood glucose level (FBG) level of 109.4±18.9 mg/dl. The abdominally obese subjects had significantly higher mean FBG level than the generally obese subjects (p<0.05). The overall mean triglycerides (Tg), total cholesterol (TC), high-density lipoprotein cholesterol

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(HDL-C) and low-density lipoprotein cholesterol (LDL-C) levels of subjects were 186.8±85.7 mg/dl, 211.9±43.8mg/dl, 47.1±11.7 mg/dl and 127.4±47.4 mg/dl, respectively. The abdominally obese subjects had significantly higher mean Tg, TC, LDL-C levels and had significantly lower HDL-C level as compared to the generally obese subjects (p<0.05). The overall mean systolic and diastolic blood pressures of subjects were 129.1±28.7 and 85.5±14.9 mm/Hg, respectively. The generally obese subjects had significantly higher mean systolic and diastolic blood pressures than the abdominally obese subjects (p<0.05). Correlation analysis indicates that, comparatively, WC had a significant positive correlation with FBG (p<0.05); Whereas, BMI had a significant positive correlation with SBP and DBP (p<0.05). The study's findings conclude that housewives with higher waist circumferences are more prone to experience metabolic issues. Intervention strategies like nutrition education should therefore be announced to cope with the problem.

1. INTRODUCTION

The double burden of malnutrition (DBM) refers to the co-occurrence of overnutrition (conditions such as overweight, obesity, or diet-related non-communicable diseases) and undernutrition (stunting, wasting, or micronutrient deficiency) (WHO, 2017). It is a serious public health issue prevailing worldwide; however, it is mainly threatening for the low- and middle-income countries (Popkin et al., 2020). DBM can occur at individual, household, community or national level. An example of malnutrition at a specific level is the combination of obesity and anaemia in the same person. Obesity and anemia are serious epidemic diseases that are affecting billions of people globally with regional variation (Aigner et al., 2014). The co-existence of obesity and anemia can result in many metabolic problems such as cardiovascular disorders, DM, high blood pressure, and several sorts of cancer (Zhao et al., 2015; Grundy et al., 2004). It also severely decreases the life expectancy by about ten years as well as poses a high economic issue in the community (Puhl and Brownell 2013).

Both types of obesity, generalized and abdominal, may cause the development of several cardio-metabolic disturbances, which include cardiovascular diseases, diabetes, hypertension, cancerous and osteoarthritis (Després and Lemieux, 2006). In abdominal obesity, the location of fat is positioned surrounding the innards and under the peritoneum, which caped the internal organs. The accumulation of fat in the abdominal part is a serious condition, as it significantly affects the physiology of nearby organs (such as the liver, pancreas, and intestine) and the cardiovascular system. The release and normal functioning of certain hormones and enzymes can also be disrupted (Saito and Shimazaki. 2007). A fat distribution pattern characterized by a central, visceral, or upper-body type (apple-shaped) has been identified as a crucial factor in metabolic syndromes, high blood pressure, and coronary artery disease, regardless of body weight (Boriani et al., 2014). Fat accumulation in the abdominal section has been identified as the most significant factor

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contributing to insulin resistance, non-alcoholic fatty liver disease, and cardiovascular problems (Silveira et al., 2013).

Among nutritional anemias, iron-deficiency anemia is considered as the most prevalent type proximate the globe. Dietary inadequacy in iron intake over a prolonged period results in a low haemoglobin concentration. Iron deficiency anemia is most commonly found in young people and women of reproductive age (Shill et al., 2014). The primary consequence of obesity is the growth of cardiovascular disease, type 2 diabetes besides an elevated risk of multiple cancer types. This condition can have a severe impact on a person's health and well-being (Myint et al., 2014). Both obesity and anemia are considered to be the cause of multiple metabolic problems. Findings are required to scrutinize the metabolic health of housewives with obese and anemic subjects. Since limited research work has been done regarding DBM in the study assortment, therefore this study is arranged for explore to the metabolic health of both types of obese housewives who are suffering from anemia as well. This study will provide insights into metabolic disorders in obese anemic housewives. Also, it will help the health authority should preventive and curative action against serious health issues.

II. MATERIAL AND METHODS

2.1. Study Design and Subjects

It was a comparative cross-sectional study conducted at the hospital. The study included 200 obese anemic housewives (100 women with generalized obesity and 100 with abdominal obesity) of age 21-60 years. Subjects were selected through a convenience sampling technique. Subjects with generalized obesity were identified as having a body mass index (BMI) of 30 kg/m^2 or higher. The abdominally obese subjects were identified as having a waist circumference of ≥88 cm (Zimmet et al., 2005). Anemia was defined as haemoglobin concentration <12 g/dl (WHO, 2011).

2.2. Data Collection

The required information of the subjects were gathered as below:

2.2.1. Socio-demographic Data

The information on socio-demographic characteristics included age of the subjects, residence area, education of subjects, husbands' education, family type, household size and household income. The information were obtained through personal interviews and recorded in a questionnaire (Appendix-A). Based on each socio-demographic characteristic, subjects were grouped to gather in-depth information.

2.2.2 Physical measurements: The subjects' Weight, Height, and waist circumference were all measured in accordance with the guidelines provided by the World Health Organization (WHO, 1995). The measuring tools had been precisely calibrated before being put to work.

i. Weight and Height

The weight of each subject was measured with a digital weighing scale to the nearest 0.01 kg. Before measurement, each subject was asked to remove heavy clothing or belongings (if any) and stand calmly and straight on the scale. The weight was recorded to the nearest 0.1 kg.

Height was measured using a wall-mounted measuring tool. Each participant was requested to remove their shoes and hat before having their Height measured (if applicable). Then, the subject

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was instructed to stand so that every part of their back touched the wall while facing it. Slowly lowering the headpiece to contact, the head was lowered. In cm, Height was measured to the nearest 0.1 cm.

ii. Calculation of Body Mass Index

Measures of Weight and Height were used to calculate body mass index (BMI) of the subjects with the following equation:

BMI = weight (kg) / Height (m^2)

Body mass index (BMI) was used to define generalized obesity as having a BMI of 30 kg/m^2 or higher (Zimmet et al., 2005; IDF, 2006).

iii. Waist circumference

The waist circumference of the subjects was measured using an ordinary, non-stretchable measuring tape. The midpoint between the iliac crest and the final rib was marked. The measurement was made while the subject was exhaling. Waist circumference was measured in centimetres to the nearest 0.01 cm. The abdominally obese subjects were identified as having a waist circumference of 88 cm or greater (Zimmet et al., 2005).

2.2.3. Biochemical tests

Blood tests of the subjects included measurements of haemoglobin concentration, blood glucose levels, and lipid profiles using standard methods.

i. Measurement of hemoglobin

The haemoglobin level of each subject was measured using the hemocue method (Hemocue, 1986; Schenck et al., 1986). Blood sample was drawn from the middle/ring finger with a prick. The blood drop was collected in the specific cuvette. The cuvette was placed in the photometer until the display of the result (15-45 seconds). The haemoglobin level was recorded in the questionnaire (Appendix-A). Anemia was defined as haemoglobin concentration <12 g/dl (WHO, 2011).

ii. Fasting blood Glucose

The blood glucose level of each subject was measured after an 8-12-hour fasting period. A blood sample was drawn from the middle/ring finger with a prick. The blood drop was collected on the surface of test strip that was already inserted in a glucometer (Accu-check blood glucometer). The displayed result was recorded in the specific questionnaire. An FBG level of ≥100 mg/dL was declared an elevated blood glucose level (IDF, 2006).

iii. Lipid profile

The serum was pipetted into the micro-centrifuge tubes. The serum was then placed in a refrigerator at 0 °C. Then, 1000 ul standard solution was taken in a test tube by pipetting. Serum (10 ul) was added to the tube. The contents were mixed by placing the tube in a water bath for 20 minutes. Concentrations were determined using Microlab 300. The LDL-C was determined by calculation using the following equation:

LDL-C = Tg/5 + HDL - Total Cholesterol

2.2.4. Clinical examination

Clinical examination of subjects included measurement of blood pressure. Each subject's blood pressure was measured in the sitting posture using an Omron digital blood pressure machine. Two systolic and two diastolic blood pressure values were taken.

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2.3. Statistical analysis

The collected data were statistically evaluated using the Statistical Package for the Social Sciences (SPSS 20).

Results

3.1. Socio-demographic characteristics of subjects

Table 4.1 shows the socio-demographic characteristics of the subjects. The mean age of all subjects was 39.9 ± 10.1 years. According to age categories, the highest number (56%) was found in the middle-aged group, followed by the younger age group (26%) and the older age group (18%), respectively. In a similar study, Herhaus and Petrowski (2021) evaluated the metabolic health of females in the same age group and found abnormalities in metabolic health.

Based on the residence area, a higher number of subjects (62.5%) was selected from urban areas. A relatively higher number of subjects (51.5%) were found as literate; hence the least number of subjects (12.5%) were highly qualified. A similar study by Cai et al. (2013) found that education ability may act as a defense against obesity, due to improved awareness of healthy food choices or the benefits of physical activity, as observed in a comparable study. Another study done by Sayin et al. (2020) showed that uneducated women had a high ratio of obesity with metabolic problems as compared to educated women. Uneducated people may be unaware of the nutritional value of foods. The husbands' education may also pose a positive effect on the health and nutritional status of women. In the current study, a high number (30%) of subjects' husbands were illiterate. Moreover, a small number (17.5%) of husbands had high qualifications i.e. graduation or above. It may be expected that husbands' education may also be a contributing factor to the ill health of women.

Results show that the overall mean family size was 6.8±2.9, which can be considered as a large family size. In a study, Xiaoyu and Lixing (2012) reported that large family size had a negative impact on the metabolic health of mothers in China. Since women have many responsibilities within family, therefore, larger family size may affect their health.

The overall mean family income was Rs. 59830 ± 27,296 per month. Higher number of subjects (45.5%) were found in the low-income group followed by middle-income group (42.5%). A smaller number of subjects (12%) had high income. Family income has been shown to have a strong link with maternal health. In contrast to these findings, Li et al. (2012) reported that family income had a non-linear effect on obesity.

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Table 1. Socio-demographic status of subjects (N=200)

Variables / Categories		Mean±SD	n (%)
Age (years)		39.9±10.1	-
	Younger (21-30 years)	-	52 (26.0)
	Middle (31-50 years)	-	112 (56.0)
	Older (51-60 years)	-	36 (18.0)
Residence Area			
	Urban	-	125 (62.5)
	Rural	-	75 (37.5)
Subjects' Education			
	Illiterate	-	97 (48.5)
	Matriculate	-	78 (39.0)
	Graduate	-	25 (12.5)
Husbands' education			
	Illiterate	-	60 (30.0)
	Matriculate	-	105 (52.5)
	Graduate	-	35 (17.5)
Family size		6.8±2.9	-
Monthly Family Income (Rupees)		59830±27296	-
	Low (< 50000)	-	91 (45.5)
	Middle (50000 – 100000)	-	85 (42.5)

3.2. Hemoglobin level of the subjects and severity of anemia

As already described, measurement of hemoglobin level was used as a screening tool for selecting anemic subjects. All the selected housewives were anemic (as per the WHO criteria of Hb < 12 g/dL), as shown in Table 4.2. Results reveal that the overall mean haemoglobin level of the anaemic subjects was 10.6 ± 1.3 g/dL.

Based on the severity of anaemia, subjects were divided into three groups: mild, moderate, and severe. It was found that most subjects (54%) had mild anemia, followed by those with moderate anemia (39%). Only 7% of the subjects were suffering from severe anaemia. Generally, a low haemoglobin level is attributed mainly to faulty eating habits and an unhealthy dietary pattern. In a similar study, Ali et al. (2020) reported that Pakistani women of childbearing age had a high prevalence of anemia and attributed it to low dietary iron intake or less consumption of meat. Besides poor dietary intake of iron, a low level of nutritional awareness may also contribute to the occurrence of anaemia.

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Table 2. Hemoglobin level of the subjects and severity of anemia (N=200)

Variables / Categories	Mean±SD	n (%)
Hemoglobin level (g/dl)	10.6±1.3	-
Severity of Anemia*		
Mild (Hb = 11.0-11.9 g/dl)	-	108 (54.0)
Moderate (Hb = 8.0-10.9 g/dl)	-	78 (39.0)

* Anemia was defined as Hemoglobin level < 12.0 g/dl.

3.3. Anthropometric status of the subjects

As previously described, measurement of haemoglobin level was used as a screening tool for identifying anaemic subjects. All the selected housewives were anemic (as per the WHO criteria of Hb < 12 g/dL), as shown in Table 4.2. Results reveal that the overall mean haemoglobin level of the anaemic subjects was 10.6 ± 1.3 g/dL.Based on the severity of anaemia, subjects were divided into three groups: mild, moderate, and severe. It was found that most subjects (54%) had mild anemia, followed by those with moderate anemia (39%). Only 7% of the subjects were suffering from severe anaemia. Generally, a low haemoglobin level is attributed mainly to faulty eating habits and an unhealthy dietary pattern. In a similar study, Ali et al. (2020) reported that Pakistani women of childbearing age had a high prevalence of anemia and attributed it to low dietary iron intake or less consumption of meat. Besides poor dietary intake of iron, a low level of nutritional awareness may also contribute to the occurrence of anaemia.

Table 3. Anthropometric status of the subjects †

Variables	All subjects (n=200)	Generally obese* (n=100)	Abdominally obese* (n=100)	p-value§
Weight (kg)	80.7±9.8	87.7±7.7	73.6±5.9	**< 0.001**
Height (cm)	165.0±4.9	163.9±5.9	166.1±3.3	**0.001**
BMI (kg/m^2)	29.7±3.6	32.6±2.1	26.7±1.7	**< 0.001**
Waist circumference (cm)	90.1±10.1	82.1±3.3	97.8±8.3	**< 0.001**

† Values are presented as **Mean±SD**

* ***Generalized obesity*** was defined as body mass index ≥ 30 kg/m^2; whereas,
Abdominal obesity was defines as waist circumference ≥ 88 cm.

§ Significant difference ($p < 0.05$) between mean values of the two groups was determined by Independent

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3.4. Biochemical status of obese anemic subjects

The selected biochemical measures and the prevalence of abnormal levels in subjects are presented in Table 4.4. The results show that the overall mean fasting blood glucose level of subjects was 109.4±18.9 mg/dl. Most of the subjects (54%) had elevated glucose levels. By comparing the groups, the abdominally obese subjects had significantly higher glucose levels than the generally obese subjects ($p < 0.05$). The prevalence of elevated glucose levels was also higher in abdominally obese subjects; however, no significant difference was found between the groups ($p > 0.05$). Studies have shown that both forms of obesity can lead to an increase in blood glucose levels. However, abdominal obesity has shown a stronger relationship with increased glucose levels. The findings of the current study align with those of Veghari et al. (2014), who also observed an increase in glucose levels with an increase in waist circumference among adult women in Iran.

The overall mean triglyceride level of subjects was 186.8±85.7 mg/dl. Majority of the subjects (59.5%) had elevated triglyceride levels. When the groups were compared, the abdominally obese subjects had significantly higher mean triglyceride level than the generally obese subjects ($p<0.05$). Prevalence of elevated triglyceride levels was also higher in abdominally obese subjects; and, a significant difference was found between the groups ($p<0.05$). Many researchers have reported an increase in triglyceride levels with both forms of obesity; however, women with abdominal obesity had higher triglyceride levels as shown by Njelekela et al. (2002).

The results reveal that the overall mean total cholesterol level of subjects was 211.9±43.8 mg/dl. Most of the subjects (58.5%) had elevated total cholesterol levels. By comparing the groups, the abdominally obese subjects had a significantly higher mean total cholesterol level than the generally obese subjects ($p < 0.05$). The prevalence of elevated total cholesterol levels was also higher in abdominally obese subjects; however, no significant difference was found between the groups ($p > 0.05$). These results are parallel to the findings of Veghari et al. (2015), who concluded that hypercholesterolemia is a major health problem among adults, especially women, in Iran and it might be due to increased prevalence of abdominal obesity.

The overall mean high-density lipoprotein cholesterol (HDL-C) level of subjects was 47.1±11.7 mg/dl. In total, a higher number of subjects (54.5%) were suffering from lower HDL-C levels. The group comparison showed that the abdominally obese subjects had a significantly lower mean HDL-C level than the generally obese subjects ($p < 0.05$). The prevalence of lower HDL-C levels was also higher in abdominally obese subjects, and a significant difference was found between the groups ($p < 0.05$). Since HDL-C is considered good cholesterol, lower values are considered abad indicator fof The current study also suggests that abdominal obesity may be a more significant risk factor for lower HDL-C levels compared to generalized obesity.

Results show that the overall mean low-density lipoprotein cholesterol (LDL-C) level of subjects was 127.4±47.4 mg/dl. Most of the subjects (71%) were suffering from higher LDL-C levels. By comparing the groups, the abdominally obese subjects had significantly higher mean LDL-C level than the generally obese subjects ($p<0.05$). Prevalence of elevated LDL-C levels was also higher in abdominally obese subjects; however, a significant difference was establish between the

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groups (p<0.05). Generally, LDL-C is considered "bad" cholesterol; therefore, higher values are not considered a good indicator of metabolic health. The findings of the current study also conclude that an increase in the LDL-C level may be more closely associated with abdominal obesity than with generalized obesity.

Numerous researchers have reported that obesity in any form can lead to adverse health outcomes. The current study reveals that abdominally obese Anaemic patients reported considerably higher rates of all metabolic abnormalities (elevated fasting blood glucose, triglycerides, total cholesterol, and LDL-C, and decreased HDL-C) than their counterparts. In another study, Kraja et al. (2011) found higher fasting blood glucose, triglycerides, total cholesterol, and LDL-C levels, but lower HDL-C levels, in adult women. It was also established that aberrant biochemical tests could lead to a variety of metabolic issues like cardiovascular disease diabetes and hypertension. Metabolic consequences of obesity are affecting people all over the world, as well as in Pakistan. Increased morbidity and death have been linked to obesity. Therefore, the relevant authorities should take measures to prevent a further rise in the frequency of generalized and abdominal obesity, as well as to reduce the risk of serious comorbidities (Goktas et al., 2019).

Table 4. Biochemical measures and prevalence of abnormal levels among subjects[†].

Variables / Categories	All subjects (n=200)	Generally obese (n=100)	Abdominally obese (n=100)	p-value[§]
Fasting blood glucose (mg/dl)	109.4±18.9	106.0±18.6	112.7±18.7	0.01
Normal (<100 mg/dl)	92 (46.0)	52 (52.0)	40 (40.0)	0.09
Elevated (≥100 mg/dl)	108 (54.0)	48 (48.0)	60 (60.0)	
Triglycerides (mg/dl)	186.8±85.7	174.2±70.3	199.4±97.5	0.04
Normal (<150 mg/dl)	81 (40.5)	49 (49.0)	32 (32.0)	0.02
Elevated (≥150 mg/dl)	119 (59.5)	51 (51.0)	68 (68.0)	
Total cholesterol (mg/dl)	211.9±43.8	204.8±40.5	219.0±46.0	0.02
Normal (<200 mg/dl)	83 (41.5)	48 (48.0)	35 (35.0)	0.09
Elevated (≥200 mg/dl)	117 (58.5)	52 (52.0)	65 (65.0)	

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High-density lipoprotein cholesterol (mg/dl)	47.1±11.7	49.4±10.8	44.8±12.1	< 0.01
Normal (≥50 mg/dl)	91 (45.5)	56 (56.0)	35 (35.0)	< 0.01
Lower (<50 mg/dl)	109 (54.5)	44 (44.0)	65 (65.0)	
Low-density lipoprotein cholesterol (mg/dl)*	127.4±47.4	120.5±44.2	134.3±49.6	0.04
Normal (<100 mg/dl)	58 (29.0)	30 (30.0)	28 (28.0)	0.87
Elevated (≥100 mg/dl)	142 (71.0)	70 (70.0)	72 (72.0)	

† Values are presented as Mean±SD or as Frequency (%)

§ Significant difference ($p < 0.05$) between means & frequencies of groups was determined by Independent sample T-test & chi-square test, respectively.

* LDL cholesterol was determined by calculation using the Friedwald formula as below:

LDL Cholesterol (mg/dl) = Total cholesterol (mg/dl) – HDL Cholesterol (mg/dl) – (Triglycerides (mg/dl) / 5).

3.5. Clinical features of obese anemic subjects

The clinical features included only blood pressure measurements of obese anaemic subjects, as well as the prevalence of abnormal blood pressure levels (Table 4.5). Results show that the overall mean systolic blood pressure (SBP) of subjects was 129.1±28.7 mm/Hg. Most of the subjects (49.5%) had either elevated or high SBP. Only few subjects (5%) had low SBP. When the two groups were compared, the generally obese subjects had significantly high SBP than the abdominally obese subjects ($p<0.05$). The prevalence of pre-hypertension (elevated SBP) and hypertension (high SBP) was significantly higher in generally obese subjects than in abdominally obese subjects ($p<0.05$). On the other side, prevalence of hypotension (low SBP) was significantly higher among abdominally obese subjects as compared to generally obese subjects ($p<0.05$).

The overall mean diastolic blood pressure (DBP) of the subjects was 85.5±14.9 mmHg. A higher number of the subjects (55%) were suffering from either elevated or high DBP. Only few subjects (4%) had low DBP. By comparing the groups, the generally obese subjects had a significantly higher mean DBP than the abdominally obese subjects ($p < 0.05$). The prevalence of pre-hypertension (elevated DBP) and hypertension (high DBP) were significantly higher in generally obese subjects as compared to the abdominally obese subjects ($p<0.05$). Whereas, prevalence of hypotension (low SBP) was significantly higher in abdominally obese subjects than the generally obese subjects ($p<0.05$).

The results of the current study indicate that both types of obesity, general and abdominal, resulted

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in an increase in blood pressure (both systolic and diastolic) in most cases. Comparatively, generalized obesity was noted to have a stronger link with an increase in blood pressure levels. One of the key contributing reasons may be excess body weight, which can increase cardiac output and blood volume, requiring the heart to work harder to pump blood throughout the body. In a study, Muluvhu et al. (2019) found that obesity can lead to hypertension and various comorbidities in adults. Khan et al. (2010) also described that hypertension in obese individuals can lead to coronary artery disease.

Table .5. Blood pressure measurements and prevalence of abnormal levels among subjects†

Variables / Categories		All subjects (n=200)	Generally obese (n=100)	Abdominally obese (n=100)	p-value§
Systolic blood pressure (mmHg)		129.1±28.7	134.8±28.6	123.4±27.7	**<0.01**
	Low (Hypotension: <90 mmHg)	10 (5.0)	02 (2.0)	08 (8.0)	**0.02**
	Normal (Ideal: 90-119 mmHg)	91 (45.5)	39 (39.0)	52 (52.0)	
	Elevated (Pre-hypertension: 120-139 mmHg)	51 (25.5)	29 (29.0)	22 (22.0)	
	High (Hypertension: ≥140 mmHg)	48 (24.0)	30 (30.0)	18 (18.0)	
Diastolic blood pressure (mmHg)		85.5±14.9	89.7±14.8	81.3±13.8	**<0.001**
	Low (Hypotension: <60 mmHg)	8 (4.0)	2 (2.0)	6 (6.0)	**<0.01**
	Normal (Ideal: 60-79 mmHg)	82 (41.0)	32 (32.0)	50 (50.0)	
	Elevated (Pre-hypertension: 80-89 mmHg)	56 (28.0)	29 (29.0)	27 (27.0)	
	High (Hypertension: ≥90 mmHg)	54 (27.0)	37 (37.0)	17 (17.0)	

3.6. Relation of body mass index and waist circumference with biochemical and Clinical variables of subjects

Table 4.6 presents a comparison of body mass index (BMI) and waist circumference (WC) with selected biochemical and clinical variables. Results reveal that the fasting blood glucose had non-significant negative correlation with BMI ($p>0.05$), but had a significant positive correlation with WC ($p<0.05$). Triglycerides and total cholesterol were non-significantly positively correlated with both BMI and WC ($p>0.05$). HDL-C had a non-significant negative correlation with both BMI and WC ($p > 0.05$). LDL-C had a non-significant negative correlation with BMI and a non-significant positive correlation with WC ($p > 0.05$). Both SBP and DBP showed a significant positive correlation with BMI ($p < 0.05$), but exhibited a non-significant negative correlation with WC ($p > 0.05$). The results indicate that abdominal obesity can be a resilient danger aspect for hyperglycemia and generalized obesity for hypertension among housewives.

Studies have shown that the metabolic abnormalities such as hyperglycemia, hyperlipidemia and hypertension can ultimately

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lead to a number morbidities. If left untreated, these abnormalities can be lethal (Myint et al., 2014). In a similar study conducted by Goktas et al. (2019), a high occurrence of general and abdominal obesity amongst Turkish women was observed and both forms of obesity were declared as key determinants for components of metabolic syndrome. In another study, directed by Saqlain et al. (2017) on Pakistani adults, it was reported that BMI and WC are strong predictors of co-morbidities associated with general and abdominal obesity.

Table 6. Comparative relationship of generalized and abdominal obesity with selected metabolic parameters of subjects.

Variables	Body Mass Index (kg/m^2)		Waist Circumference (cm)	
	Pearson correlation (r) †	p-value	Pearson correlation (r) †	p-value
Fasting blood glucose (mg/dl)	-0.049	0.63	0.206	**0.04***
Triglycerides (mg/dl)	0.106	0.29	0.016	0.87
Total Cholesterol (mg/dl)	0.020	0.85	0.053	0.60
HDL Cholesterol (mg/dl)	-0.044	0.66	-0.024	0.81
LDL Cholesterol (mg/dl)	-0.005	0.96	0.049	0.63
Systolic blood pressure (mmHg)	0.233	**0.02***	-0.056	0.58
Diastolic blood pressure (mmHg)	0.262	**0.01***	-0.078	0.44

† r = -1 to 1

* Correlation is significant at the 0.05 level (2-tailed).

** Correlation is significant at the 0.01 level (2-tailed).

V. Disscussion

The double burden of malnutrition (DBM) constitutes a significant global public health challenge, predominantly affecting low- and middle-income nations. The co-occurrence of obesity and anaemia in the same individual exemplifies DBM at the individual level. Obesity and anemia are significant epidemic disorders impacting billions of individuals worldwide, with regional disparities. The simultaneous presence of obesity and anemia can lead to several metabolic complications, including cardiovascular diseases, diabetes mellitus, hypertension, and multiple forms of cancer.

Faulty eating habits and improper dietary patterns have been shown as the primary factors responsible for the obesity and anemia co-occurrence people, notably females.

Housewives usually have less time for maintaining their own good health due to numerous household responsibilities, such as childcare, house maintenance, and fulfilling the needs of all family members. Additionally, the participation of women in social gatherings has increased recently, leading to changes in their dietary patterns. Additionally, women have increased their use of processed foods and ready-

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to-eat meals (takeaway/delivery) due to convenience. These foods are, in fact, higher in calories, fat, and sugar but lower in certain nutrients. These foods can enhance the risk of obesity among household females and their family members.

Both obesity and anemia are considered to be the cause of multiple metabolic problems. Readings are requisite to scrutinize the metabolic health of housewives with obesity and anemic. Since limited research work has been done regarding DBM in the study area, thus this study is arranged to explore the metabolic health of both types of obese housewives who are suffering from anemia as well.

The study included 200 obese anemic housewives (100 women with generalized obesity and 100 with abdominal obesity) of age 21-60 years. Subjects were selected through a convenience sampling technique. Subjects with generalized obesity were identified as having a body mass index (BMI) of 30 kg/m² or higher. The abdominally obese subjects were identified as having a waist circumference of 88 cm or greater. Anemia was defined as haemoglobin concentration <12 g/dl.

The required data included information about socio-demographic, anthropometric, biochemical and clinical parameters. The information on socio-demographic characteristics were obtained through personal interviews and recorded in a investigation. The anthropometric data included depths of Weight, Height and waist circumference of the subjects. Measures of Weight and Height were used to calculate BMI. The waist circumference of the subjects was measured using the ordinary, non-stretchable measuring tape. Blood tests of the subjects included measurements of haemoglobin concentration, blood glucose levels, and lipid profiles using standard methods. Clinical examination of subjects included measurement of blood pressure. The composed data were statistically analyzed using the Statistical Package for the Social Sciences (SPSS, version 20). Descriptive statistics, including the mean with standard deviation and frequency with percentages, were calculated for all variables. Appropriate statistical tests were used to compare the groups at a significance level of $p < 0.05$. Student's T-test and chi-square test were used for the continuous and definite variables, respectively. Pearson's correlation analysis was carried out to compare the metabolic profiles of the generalized and abdominally obese anaemic subjects.

Analysis of the socio-demographic data reveals that the mean age of all subjects was 39.9 ± 10.1 years. According to age categories, the highest subjects' number (56%) was found in the middle age group followed by younger age group (26%) and older age group (18%), respectively. Based on residence area, higher number of subjects (62.5%) was selected from urban areas. Relatively higher number of subjects (51.5%) were found as literate; but, least number of subjects (12.5%) were highly qualified. A high number (30%) of subjects' husbands were illiterate. Moreover, a small number (17.5%) of husbands had high qualification i.e. graduation or above. The overall mean family size was 6.8±2.9, which can be considered as a large family size. The overall mean family income was Rs. 59830 ± 27,296 per month. Higher number of subjects (45.5%) were found in low-income group followed by middle income group (42.5%). A smaller number of subjects (12%) had high income.

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As already described, measurement of hemoglobin level was used as screening tool for selecting anemic subjects. So all the selected housewives were anemic (as per WHO criteria of Hb < 12 g/dl). Results reveal that the total mean haemoglobin level of the anaemic subjects was 10.6 ± 1.3 g/dL. Based on the severity of anemia, subjects were divided into three groups: mild, moderate, and severe anemia. It was found that most subjects (54%) had mild anemia, followed by those with moderate anemia (39%). Only 7% of the subjects were suffering from severe anaemia.

Anthropometric measurements revealed the overall mean weights, heights, body mass indices, and waist circumferences of individuals to be 80.7 ± 9.8 kg, 165.0 ± 4.9 cm, 29.7 ± 3.6 kg/m², and 90.1 ± 10.1 cm, respectively. By comparing the groups, the mean weight of generally obese individuals was significantly higher than that of the abdominally obese individuals ($p < 0.05$). Whereas the mean Height of generally obese subjects was significantly lower than that of abdominally obese individuals ($p < 0.05$). However, as per criteria used, the typically obese subjects had significantly higher mean body mass index than the abdominally obese individuals ($p<0.05$). Similarly, as per definition used, the abdominally obese subjects had significantly higher mean waist circumference more than generally obese individuals ($p<0.05$).

The outcomes of the biochemical assessment display that the overall mean fasting blood glucose level of the subjects was 109.4±18.9 mg/dL. Most of the subjects (54%) had elevated glucose levels. By comparing the groups, the glucose levels in abdominally obese individuals were considerably higher than those in general obese subjects ($p < 0.05$). Elevated glucose levels were also more common in abdominally obese people, although no difference was identified between the groups ($p > 0.05$).

The majority of the subjects (59.5%) had elevated triglyceride levels. When the groups were compared, the abdominally obese individuals had significantly higher mean triglyceride levels than generally obese individuals ($p<0.05$). Most of the subjects (58.5%) had elevated total cholesterol levels. By comparing the groups, the abdominally obese individuals had a meaningfully higher mean total cholesterol level than the generally obese subjects ($p < 0.05$). The prevalence of elevated total cholesterol levels was also higher in abdominally obese subjects; however, no significant difference was found between the groups ($p > 0.05$). In total, a higher number of individuals (54.5%) were suffering from lower HDL-C levels. The group comparison showed that the abdominally obese subjects had a significantly lower mean HDL-C level than the generally obese subjects ($p < 0.05$). The prevalence of lower HDL-C levels was also higher in abdominally obese subjects, and a significant difference was found between the groups ($p < 0.05$). Most of the subjects (71%) were suffering from higher LDL-C levels. By comparing the groups, the abdominally obese subjects were found to have significantly higher mean LDL-C levels than the generally obese subjects ($p<0.05$). The prevalence of elevated LDL-C levels was also higher in abdominally obese subjects; however, a non-significant change was found among the groups ($p > 0.05$).

The clinical features included blood pressure measurements of obese anemic subjects and the prevalence of abnormal levels. The overall mean systolic blood pressure (SBP) of the individuals was 129.1 ± 7.7 mmHg, as reported in the

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findings. When the two sets were assessed, the participants who were generally obese had substantially higher SBP than the ones who were abdominally obese ($p < 0.05$). Pre-hypertension (elevated SBP) and hypertension (a high SBP) were considerably more prevalent in general obese patients than in abdominally obese subjects ($p<0.05$). A higher proportion of the individuals (55%) had either increased or high DBP. Pre-hypertension (elevated DBP) and hypertension (high DBP) were considerably more prevalent in generally obese patients than in abdominally obese subjects ($p<0.05$). Consequences of correlation analysis reveal that the fasting blood glucose had a significant positive correlation with WC ($p<0.05$). Both SBP and DBP had significant positive

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