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Metabolic Syndrome Among Diabetic Pre- And Postmenopausal Women

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ABSTRACT:

The risk of having metabolic syndrome is closely linked to overweight and obesity and lack of physical activity. It increases the chances of type 2 diabetes. The situation gets worsened in postmenopausal women. For the present cross-sectional study 595 women were recruited. 330 were premenopausal and 265 were postmenopausal. The anthropometric measurements like height, weight, waist circumference and skin folds like biceps, triceps, supra iliac and sub scapular were taken on each subject using standard methodology. Blood pressure was measured with mercury sphygmomanometer. Body mass index, waist hip ratio, weight height ratio, body fat, percent body fat was calculated. Fasting blood samples were taken for biochemical analysis. A person was considered to be having diabetes if she was already diagnosed case of diabetes and /or was on treatment or current fasting blood glucose was ≥126 mg/dl.

Lipid profile of diabetic subjects was assessed. Total serum Cholesterol (TC), triglycerides (TG) and lipoproteins; heavy density lipoproteins (HDL-C) and low density lipoproteins (LDL-C) were estimated. Statistically significant differences were observed in the mean values of most of the anthropometric and physiological variables between normal and diabetic pre- and postmenopausal women. Values were on higher side in postmenopausal women as compared to their premenopausal counterparts although statistically higher values were observed in case of biceps, percent body fat, fat mass and pulse pressure only. Similar was the status of lipid profile. Statistically higher values of TC, TG, LDL-C and lower value of HDL-C was observed among diabetic postmenopausal women as compared to premenopausal women. Lower levels of estradiol and higher age among postmenopausal women could be among the various risk factors. Balanced diet and regular exercise is recommended for a healthy life style.

Key Words: Metabolic Syndrome, Premenopausal, Postmenopausal, Diabetes

INTRODUCTION

The term "metabolic" refers to the biochemical processes involved in the body's normal functioning. Metabolic syndrome is the name for a group of risk factors that raises your risk for heart disease and other health problems, such as diabetes and stroke. A large waistline, also called as abdominal obesity, a high triglyceride level, a low HDL cholesterol level, high blood pressure or high fasting blood sugar are among the high risk factors which lead to metabolic syndromes and consequently the occurrence of type 2 diabetes mellitus and stroke (NCEP-III, 2001). More are the risk factors; more are the chances of the occurrence of metabolic disorders. The risk of having metabolic syndrome is closely linked to overweight and obesity and lack of physical activity. Other than this age, gender, unhealthy diet, macrosomia, hypertension, cardiovascular diseases, micropolycystic ovary syndrome, high blood glucose on previous testing, impaired glucose tolerance and glycated hemoglobin ≥5.7% lead to type 2 diabetes (American Diabetes Association, 2013).

Diabetes describes a group of metabolic diseases where a patient has high blood sugar due to problems related to processing or producing insulin. Diabetes can affect anyone, regardless of age, race, gender, or lifestyle. Approximately 90% of all cases of diabetes worldwide are type 2 where the body does not produce enough insulin for proper function, or the cells in the body do not react to insulin. Changes in human behavior and lifestyle associated with globalization have resulted in a dramatic increase in its prevalence and incidence worldwide (Zimmet et al., 2011, Whiting et al., 2011). People with a lot of visceral fat, also known as central obesity, belly fat, or abdominal obesity, are especially at risk.

Men develop type 2 diabetes at a lower BMI than women of a similar age (Logue et al., 2011). The reason may be that males tend to store fat around their organs rather than under the skin as women do. In the general population, women live longer than men, largely because of their lower rates of heart disease. Yet, when women get diabetes, something happens that strips them of this advantage (http://www.diabetesforecast.org/2011/oct/how-diabetes-differs-for-men-and-women.html?referrer=https://www.google.co.in/, retrieved on January 9th, 2017).Among women their menopausal status becomes another limiting factor.

The prevalence of the metabolic syndrome increases with age and after the onset of menopause, and may explain in part the apparent acceleration of cardiovascular disease in postmenopausal women. After menopause, changes in hormone levels can trigger fluctuations the blood sugar level. Some women gain weight during the menopausal transition or after menopause. This weight gain can sometimes leads to the onset of diabetes. And if diabetes predisposition is already there, it can worsen the situation. This can increase the need for insulin or oral diabetes medication. It can also bring increased resistance to insulin. Risk is women increases as they age, especially in women over 50, and in those who have gained weight, or in those women who do not stay active. Weight gain is further related to worsening of lipid profile which ultimately leads to many metabolic disorders. In our previous study we observed statistically higher rate of diabetes among postmenopausal women as compare to their premenopausal counterparts (Khokhar et al., 2012). In continuity to that the present study was conducted to study the metabolic risk factors among pre- and postmenopausal women and further compare them with respect to various anthropometric, physiological and biochemical factors.

MATERIALS AND METHODS

595 (330-pre- and 265-postmenopausal) women, working in various educational institutes and hospitals were personally interviewed for the study. A questionnaire was framed to get the desired information. The study was approved by the Ethical Review Committee of Guru Nanak Dev University, Amritsar. The anthropometric measurements like; height, weight, waist circumference (WC), hip circumference (HC) skin folds like, biceps, triceps, supra iliac and subscapular were taken on each subject using standard methodology (Weiner and Lourie, 1981). Blood pressure (BP) was measured with mercury sphygmomanometer (Diamond Deluxe BP Apparatus, Pune, India) and stethoscope as per recommendations of Rose and Blackburn (1968). Random Blood Glucose level (RBG) of all the subjects was checked at the time of the interview using a standardized digital glucometer (Accua Chek Active Glucometer, Roch Diagnostics, Switzerland). Body mass index (BMI), Waist- Hip Ratio (WHR), Waist Height Ratio (WHtR), Percent Body Fat (PBF), Fat Mass (FM) was calculated. From blood pressure values, Pulse pressure (PP) and Mean Arterial pressure (MAP) was calculated. 5 ml of fasting blood samples were taken for biochemical analysis. Lipid profile was assessed by kit manufactured by Crest Biosystems, Goa, (India). Total serum Cholesterol (TC), Triglycerides (TG) and lipoproteins; Heavy Density Lipoproteins (HDL-C) and Low Density Lipoproteins (LDL-C) were estimated. The absorbance in each case was measured with semi-autoanalyser RA-50 (Bayer India Limited). A person was considered to be having diabetes if she was already diagnosed case of diabetes and /or was on treatment or current fasting blood glucose was ≥126 mg/dl (WHO, 2006).

The diabetic subjects were further divided in two groups; non-obese and overweight/ obese as per World Health Organization (WHO, 2000) guidelines. Status of hypertension was assessed as reported by Chobanian et al., (2003) and the Type 2 diabetes was evaluated as per guidelines given by WHO (2006). Body fat was assessed by Durnin, and Womersley Method (1974). For statistical analysis Chi square test and Student's t-test was applied.

Out of the 330 premenopausal women 51 were hypertensive. Similarly out of 265 postmenopausal women, 76 were hypertensive and these were excluded from the study. Out of remaining 279 premenopausal women, 28 were diabetic and out of 189 postmenopausal women, 39 were diabetic.

RESULTS

The results can be presented under two headings;

1. Anthropometric and physiological variables
2. Lipid Profile

1. Anthropometric and physiological variables

a. Non-diabetic and Diabetic Premenopausal Women

The comparative account of all the variables in non-diabetic and diabetic premenopausal and postmenopausal women is depicted in **Table 1**. It is evident from table that mean age of the diabetic women was slightly more than the non-diabetic subjects. The former were significantly heavier (69.61±1.03 kg; $p<0.02$) than the latter (64.67±11.45kg). Both the groups were matching for height but diabetic women were having significantly more WC (95.19±13.08 cm; $p<0.001$) than non-diabetic women (87.89±10.92 cm). The HC in non-diabetic women was observed as 100.75±10.50 cm and in diabetic women, it was observed as 103.28±7.15 cm. Although it was observed higher in diabetic women but the difference between the groups was non-significant. Both the groups were matching for biceps whereas significant increase in the mean values of triceps, suprailiac and subscapular was observed in diabetic women. The mean value of triceps in non-diabetic and diabetic women was observed as 24.31±8.48 and 27.66±6.58 mm, respectively and the difference was statistically significant ($p<0.05$). The mean value of suprailiac was 24.22±7.96 mm in non-diabetic women and 28.19±5.42 mm in diabetic women with statistically significant difference ($p<0.01$) between them. Similarly, the value of subscapular significantly increased from 22.69± 7.95 mm in non-diabetic women to 26.97±4.40 ($p<0.01$) mm in diabetic women. BMI, WHR and WHtR also showed increment in their mean values in case of diabetic premenopausal subjects. The mean value of BMI in non-diabetic and diabetic premenopausal women was observed as 26.41 ±4.37 and 28.69± 4.73 kg/m^2, respectively. The difference between the groups was statistically significant ($p<0.01$). WHR was observed statistically higher in diabetic women being, 0.92±0.09 in diabetic women ($p<0.01$) whereas in non-diabetic women, its mean value was noticed as 0.86±0.07. Similarly, WHtR increased from 0.56±0.08 in non-diabetic women to 0.61±0.05 in diabetic women with statistically significant difference ($p<0.01$).

Table 1: Comparison of mean values of Anthropometric and Physiological parameters of Non-Diabetic and Diabetic Premenopausal and Postmenopausal Women

Variables	Premenopausal Women		Postmenopausal Women	
	Non-Diabetic	Diabetic	Non-Diabetic	Diabetic
Age (Yrs.)	41.16±8.00	42.56±5.72	50.58±4.70[d’’]	53.97±3.05[d’,d’’’]
Weight (kg)	64.67±11.45	69.61±10.03[b]	59.59±12.31[a’’]	69.85±9.07[d’]
Height (cm)	156.83±5.67	156.49±4.99	155.17±5.84	154.18±6.00
WC(cm)	87.89±10.92	95.19±13.08[d]	86.94±11.54	97.89±8.92[d’]
HC (cm)	100.75±10.50	103.28±7.15	97.50±9.89	104.70±11.18[d’]
Biceps (mm)	20.02±7.21	20.44±5.83	15.28±4.83	23.42±6.26[d’,a’’’]
Triceps (mm)	24.31±8.48	27.66±6.58[a]	24.02±10.88	25.86±7.58
Supra iliac (mm)	24.22±7.96	28.19±5.42[c]	19.77±5.39[a’’]	23.88±5.08[d’]
Sub scapular (mm)	22.69±7.95	26.97±4.40[c]	22.13±9.50	27.09±8.27[d’]
BMI (kg/m^2)	26.41±4.37	28.69±4.73[c]	24.90±4.79	29.53±3.32[d’]
WHR	0.86±0.07	0.92±0.09[d]	0.88±0.60[b’’]	0.92±0.07[d’]
WHtR	0.56±0.08	0.61±0.05[c]	0.59±0.07[c’’]	0.62±0.08[a’]
PBF	38.66±4.73	39.95±3.60	35.80±5.02[a’’]	44.08±2.74[d’,d’’’]
FM (kg)	25.35±6.77	27.98±6.11[a]	22.16±6.08[a’’]	31.05±5.37[d’,c’’’]
SBP (mm/Hg)	120.76±17.52	128.03±13.81[a]	126.40±16.64[a’’]	131.92±20.18[a’]
DBP (mm/Hg)	80.11±12.18	84.78±10.32[a]	80.12±14.45	83.90±12.97[a’]
PP (mm/Hg)	41.10±9.80	45.22±10.07[a]	46.42±11.64[c’’]	49.92±11.70[a’,c’’’]
MAP (mm/Hg)	93.30±12.87	99.84±12.68	95.54±11.72	99.37±14.26[a’]

The differences between non-diabetic and diabetic premenopausal is presented as a,b,c and d; non-diabetic and diabetic postmenopausal women as b’, d’, non-diabetic pre- and post as a’’, b’’,c’’, d’’ and diabetic pre- and postmenopausal women as a’’’, c’’’ and d’’’ where *a-p<0.05, b-p<0.02, c-p<0.01, d-p<0.001*

PBF of non-diabetic and diabetic premenopausal subjects did not show much change, whereas FM increased with statistically significant difference ($p<0.05$) in diabetic women (27.98±6.11 kg) as compared to non-diabetic (25.35±6.77 kg) women. Significant increase was observed in the mean values of SBP, DBP and PP of diabetic women ($p<0.05$) as compared to non-diabetic women. SBP observed in non-diabetic women was 120.76±17.52 mm/Hg which increased to 128.03±13.81 mm/Hg in diabetic women. Similarly, DBP in non-diabetic and diabetic premenopausal women was observed as 80.11±12.18 and 84.78±10.32 mm/Hg, respectively. PP also increased from 41.10±9.80 mm/Hg in non-diabetic women to 45.22±10.07 mm/Hg in diabetic women. Similar status was observed in the mean value of MAP of diabetic women (99.84±12.68 mm/Hg; $p<0.01$) as compared to non-diabetic women (93.30±12.87 mm/Hg).

b. Non-diabetic and Diabetic Postmenopausal Women

The **Table 1** also reflects the comparative account of anthropometric and physiological variables of non-diabetic and diabetic postmenopausal women. Both the groups vary significantly with respect to age, weight, WC, skin folds, BMI, etc. from each other.

The mean age in non-diabetic women was observed as 50.58±4.70 years whereas in diabetic subjects, it was observed as 53.97±3.05 years, with statistically significant difference ($p<0.001$). The mean weight in diabetic postmenopausal subjects was observed as 69.85±9.07 kg which was much higher ($p<0.001$) than the weight of non-diabetic women (59.59±12.31 kg). The height in both the groups was matching. The mean value of WC in non-diabetic subjects was 86.94±11.54 cm and in diabetic subjects, it was observed as 97.89±8.92 cm. A significant difference ($p<0.001$) was observed in the WC of both the groups. Similarly, the mean values of HC in pre- and postmenopausal women were observed as 97.50±9.89 and 104.70±11.18 cm, respectively. The difference between the mean values of HC in two groups was significant ($p<0.001$). On comparing the mean values of skin folds, significant differences were observed in the mean values of skin folds between both the groups. The mean value of biceps in non-diabetic postmenopausal women was 15.28±4.83 mm whereas its value in diabetic postmenopausal women was significantly higher (23.42±6.26 mm; $p<0.001$). The mean values of suprailiac and subscapular in non-diabetic postmenopausal women were observed as 19.77±5.39 and 22.13±9.50 mm, respectively and in diabetic postmenopausal women as 23.88±5.08 and 27.09±8.27 mm, respectively with significant differences between the groups ($p<0.001$). Non-significant increase in the mean value of triceps was observed in diabetic postmenopausal women as compared to non-diabetic postmenopausal women. BMI of diabetic postmenopausal women was also observed as significantly higher (29.53±3.32 kg/m2; $p<0.001$) than non-diabetic women (24.90±4.79 kg/m2). WHR also increased from 0.88±0.60 in non-diabetic women to 0.92±0.07 in diabetic postmenopausal women and the difference between the groups was statistically significant ($p<0.001$). WHtR was also statistically higher in diabetic women (0.62±0.08; $p<0.001$) as compared to non-diabetic (0.59±0.07). Among non-diabetic women, the PBF was observed as 35.80±5.02 whereas its value in diabetic women was noticed as 44.08±2.74 and the difference was significant ($p<0.001$). FM was seen having significantly higher mean value in diabetic postmenopausal women (31.05±5.37 kg; $p<0.001$) than non-diabetic postmenopausal women (22.16±6.08 kg).

Blood pressure was also found statistically higher in diabetic postmenopausal women as compared to non-diabetic women. The mean values of SBP in non-diabetic and diabetic postmenopausal women were observed as 126.40±16.64 and 131.92±20.18 mm/Hg, respectively. Similarly, the mean value of DBP was seen 80.12±14.45 mm/Hg in non-diabetic women which increased to 83.90±12.97 mm/Hg in postmenopausal women ($p<0.05$). Similar was the status of PP and MAP. The mean values of PP were observed as 46.42±11.64 and 49.92±11.70 mm/Hg in pre- and postmenopausal women, respectively. The mean value of MAP also increased from 95.54±11.72 mm/Hg in premenopausal women to 99.37±14.26 mm/Hg in postmenopausal women ($p<0.05$).

Comparison between Pre- and Postmenopausal Women

On comparison between non-diabetic pre- and postmenopausal women, as expected postmenopausal women were significantly of higher age ($p<0.001$). Non-diabetic postmenopausal women were significantly heavier ($p<0.05$) than non-diabetic premenopausal women. Significantly higher mean values of suprailiac ($p<0.05$), SBP ($p<0.05$), PP ($p<0.01$), WHR ($p<0.02$), WHtR ($p<0.01$), PBF ($p<0.05$) and FM ($p<0.05$) were observed in non-diabetic postmenopausal women as compared to their premenopausal counterparts.

When compared the mean values of different variables between diabetic pre- and postmenopausal women, age as expected was significantly higher ($p<0.001$) among postmenopausal women. Other than this, significantly higher mean values of biceps ($p<0.05$), PP ($p<0.01$), PBF ($p<0.001$) and FM ($p<0.01$) were observed among diabetic postmenopausal women as compared to their premenopausal counterparts.

2. **Lipid Profile**

a. Non-diabetic Pre- and Postmenopausal Women

Table 2 depicts the lipid profile of non-diabetic non-obese and obese pre- and postmenopausal women. In non-diabetic subjects, the mean value of TC was found to be significantly higher in obese ($p< 0.001$) as compared to non-obese premenopausal women. Similarly, the level of TG was also observed significantly higher in obese premenopausal subjects as compared to non-obese ones and the difference between the groups was significant ($p<0.05$). LDL-C level was also found to be significantly higher in obese premenopausal women ($p<0.001$) as compared to non-obese premenopausal women. On the other hand mean value of HDL-C declined in obese premenopausal subjects ($p<0.02$) as compared to their obese counterparts.

Similar trend of changes in lipid profile was observed on comparing non-diabetic non-obese and obese postmenopausal women.

Table 2: Lipid Profile in Non-diabetic Non-Obese and Obese Premenopausal and Postmenopausal Women

Component	Premenopausal Women		Postmenopausal Women	
	Non-Obese (10)	Obese (11)	Non-Obese (10)	Obese (11)
TC (mg/dl)	152.59±20.76 (133.00-195.00)	201.57±30.28^{d} (170.00-258.60)	168.21±17.50$^{a''}$ (146.00-197.00)	205.70±33.88$^{b'}$ (171.10-282.30)
TG (mg/dl)	90.12±17.98 (65.03-125.30)	131.20±49.70^{a} (74.94-214.50)	107.09±29.26 (74.29-156.00)	142.67±18.20$^{b'}$ (116.78-170.00)
LDL-C (mg/dl)	73.17±12.13 (55.00-89.00)	135.89±25.54^{d} (83.63-168.00)	104.82±20.69$^{c''}$ (69.40-132.00)	146.71±32.75$^{b'}$ (92.65-218.20)
HDL-C (mg/dl)	62.03±13.44 (32.39-74.33)	43.15±9.71^{b} (33.78-61.49)	46.37±5.02 $^{d''}$ (41.43-54.66)	40.48±10.62 (29.87-61.00)

The values are Mean± SD. a, b, d represents the comparison between non-obese and obese premenopausal women; b' stands for comparison between non-obese and obese postmenopausal women; a'', c'', d'' compares the mean values of non-obese pre- and postmenopausal women where a-p<0.05, b-p<0.02, c-p<0.01, d-p<0.001

Comparison between non-diabetic Pre- and Postmenopausal Women

On comparison between pre- and postmenopausal subjects, it was observed that the levels of TC, and LDL-C were higher in both non-obese and obese postmenopausal women as compared to non-obese and obese premenopausal subjects with statistically significant increase in non-obese group ($p<0.05$ in TC, $p<0.0.1$ in LDL-C). On the other hand, HDL-C content showed decline in both non-obese and obese postmenopausal subjects as compared to non-obese premenopausal women with statistically significant difference in non-obese group ($p<0.001$).

b. Diabetic Pre- and Postmenopausal Women

Table 3 presents the mean values of different components of lipid profile among diabetic non-obese and obese pre- and postmenopausal women. In case of diabetic subjects, higher levels of TC, TG, LDL-C and lower level of HDL-C were observed on comparing non-obese and obese subjects of both premenopausal as well as postmenopausal groups. In obese premenopausal subjects, the mean values of TC, TG and LDL-C were significantly higher than their non-obese counterparts (p<0.0.05, 0.02 and 0.01 rspectively). Mean HDL-C was lower in obese as compared to non-obese premenopausal subjects but the difference was not statistically significant. Similarly, in case of diabetic postmenopausal subjects the mean TC, TG and LDL-C were higher in obese subjects as compared to their non-obese counterparts but the difference was not statistically significant. On the other hand, the mean values of HDL-C in both, non-obese and obese diabetic postmenopausal women were matching.

Comparison between diabetic Pre- and Postmenopausal Women

On comparing diabetic non-obese pre- and postmenopausal women, significantly higher mean value of TC ($p<0.05$), TG ($p<0.05$) and LDL-C ($p<0.01$) were observed in non-obese postmenopausal women as compared to their non-obese premenopausal counterparts. Whereas the mean value of HDL-C was observed as significantly lower in diabetic non-obese postmenopausal women ($p< 0.01$) as compared to their premenopausal counterparts. Similar was the status when the diabetic obese pre- and postmenopausal women were compared but the significant difference was observed only in the mean value of HDL-C only ($p<0.05$).

Table 3: Lipid Profile in Diabetic Non-Obese and Obese Premenopausal and Postmenopausal Women

Component	Premenopausal Women		Postmenopausal Women	
	Non-Obese (10)	Obese (11)	Non-Obese (10)	Obese (11)
TC (mg/dl)	178.82±15.18 (154.78-196.27)	201.03±20.65[a] (178.00-245.00)	203.06±24.82[a’’] (179.56-256.00)	215.63±60.62 (165.00-375.20)
TG (mg/dl)	114.60±19.53 (86.00-140.00)	148.54±30.32[b] (101.20-200.30)	132.93±23.74[a’’] (94.46-149.00)	156.17±48.64 (81.60-223.00)
LDL-C(mg/dl)	76.90±16.76 (56.00-119.00)	129.70±26.46[c] (88.00-167.00)	142.56±17.69[c’’] (121.00-171.00)	149.40±28.75 (116.00-200.00)
HDL-C (mg/dl)	45.02±8.61 (39.00-59.98)	40.38±7.47 (31.00-53.00)	32.60±4.99[c’’] (26.00-41.81)	33.76±6.14[a’’’] (27.00-45.00)

Values are Mean ±SD. a, b, c stands for comparison between non-obese and obese premenopausal women; a’’, c’’ compares the mean values of non-obese pre- and postmenopausal women and a’’’ compares the mean values of obese pre- and postmenopausal women where a-p<0.05, b-p<0.02, c-p<0.01

DISCUSSION

It has been observed that the mean values of most of the anthropometric and physiological variables are higher in diabetic premenopausal as well as postmenopausal and are still higher among postmenopausal women as compared to their premenopausal counterparts. Similar is the status of the lipid profile. In our previous study, we observed higher percentage of obesity (Khokhar et al.,2010 a), hypertension (Khokhar et al., 2009), Type 2 diabetes mellitus (Khokhar et al., 2012) and worsened lipid profile and lower levels of estradiol among hypertensive postmenopausal women (Khokhar et al., 2010 b) as compared to premenopausal women.

Increased values of obesity related body parameters like WC, HC, BMI, WHR, WHtR, PBF, FM, etc. have been observed among diabetic patients. Being overweight or obese increases the chances of developing the common type of diabetes i.e. Type 2 diabetes. Obesity is believed to account for 80-85% of the risk of developing Type 2 diabetes. Research suggests that obese people are up to 80 times more likely to develop type 2 diabetes than those with a BMI of less than 22. The influence of obesity on type 2 diabetes risk is determined not only by the degree of obesity but also by where fat accumulates. Increased upper body fat including visceral adiposity, as reflected in increased abdominal girth or waist-to-hip ratio, is associated with the metabolic syndrome, type 2 diabetes, and cardiovascular disease although underlying mechanisms remain uncertain. (Björntorp, 1991).

Meta-analysis of studies of association of obesity and diabetes showed higher relative risk with BMI as well as waist circumference in both men and women (Guh et al., 2009). Not all subjects with type 2 diabetes are obese and many obese subjects do not have diabetes, but most of the subjects with type 2 diabetes are overweight or obese. More than generalized obesity, the risk of central obesity increases with increase in WC, WHR, visceral adiposity, or abdominal obesity (Cassano et al., 1992;Snijder et al., 2003). Studies show that in lean subjects the prime determinant of insulin resistance is BMI, that is, subcutaneous fat, whilst in overweight and obese subjects, it is WC and visceral adiposity. It has also been shown that the metabolic syndrome suddenly increases in prevalence at high levels of insulin resistance and it is suggested that this is due to the diversion of lipids from the subcutaneous to the visceral depot (Ali et al., 2011).

In this disease, the body makes enough insulin but the cells in the body have become resistant to the salutary action of insulin. The passage from obesity to diabetes is made by a progressive defect in insulin secretion coupled with a progressive rise in insulin resistance. An increase in overall fatness, preferentially of visceral as well as ectopic fat depots, is specifically associated with insulin resistance. The accumulation of intramyocellular lipids may be due to reduced lipid oxidation capacity (Golay and Ybarra, 2005).

Overeating stresses the membranous network inside of cells called endoplasmic reticulum (ER). When the ER has more nutrients to process than it can handle, it sends out an alarm signal telling the cell to dampen down the insulin receptors on the cell surface. This translates to insulin resistance and to persistently high concentrations of the sugar glucose in the blood, one of the sure signs of diabetes. Mitochondrial dysfunction could be one of many important underlying defects linking obesity to diabetes, both by decreasing insulin sensitivity and by compromising β-cell function (Bournat and Brown, 2010)

Present study showed widespread lipid abnormalities in the course of diabetes triggered dyslipidemia as hypercholesterolemia, hypertriglyceridemia, elevated LDL and decreased HDL. The lipid abnormalities are prevalent in diabetes mellitus because insulin resistance or deficiency affects key enzymes and pathways in lipid metabolism (Teskinen, 2002). In diabetes many factors may affect blood lipid levels, because of interrelationship between carbohydrates and lipid metabolism. Therefore, any disorder in carbohydrate metabolism leads to disorder in lipid metabolism and vice versa. The possible mechanism responsible for hypertriglyceridaemia may be due to increased hepatic secretion of very low density lipoprotein (VLDL) and delayed clearance of triglyceride rich lipoproteins, which is predominantly due to increased levels of substrates for triglyceride production, free fatty acids and glucose (Goldberg, 1996).

The reason for severity in metabolic syndromes in postmenopausal women could be the fall in estradiol level. The menopause, and the years leading up to it, is when women's bodies gradually produce less estrogen and progesterone. Prevalence of metabolic syndromes increases with age especially while transition occurs from pre to post menopausal state (Wu et al., 2001; Teede et al., 2010). These hormonal changes can affect blood sugar levels differently for each individual. Higher blood pressure values have been observed among obese, diabetic and postmenopausal women as compared to their non obese, non diabetic and premenopausal counterparts. It is widely assumed that obesity, a high-fat, high-sodium diet, and inactivity have led to a rise in both conditions.

Does Menopause Increase Diabetes? This question is difficult to answer, but it does look like estrogen and progesterone may have something to do with it. Also, of course, our age, weight and lifestyle plays an important part. As women start to go into menopause, changes in hormone levels can lead to swings in blood glucose levels. A healthy life style with healthy diet and regular work out is recommended not only in postmenopausal women but in women of all ages.

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