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Original Research Article

Obesity as Risk Factor in Type-2 Diabetes Mellitus in Middle Aged Women: A Case Control Study

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Abstract

Aim: The aim of the present study was to evaluate the obesity as risk factor in type-2 diabetes mellitus in middle aged women.

Methods: The study was conducted at Department of physiology, Nalanda Medical College, Patna, Bihar, India for the period of 10 months. 100 volunteer women of age 35 to 55 years were selected as subjects.

Results: Within group I, the mean values of FBS, HDL, TG & VLDL were higher with more significance ($p<0.01$). Within group II, the mean values of W/H RATIO, FBS, HDL,TG & VLDL are higher with more significance ($p<0.01$). Within group III, the mean values of W/H RATIO, FBS, HDL,TG and VLDL are higher with more significance ($p<0.01$). The mean values of TC and LDL are higher with less significance ($p<0.05$). Within group IV, the mean values of BMI,W/H RATIO, FBS, HDL,TG and VLDL are higher with more significance ($p<0.01$). The mean values of TC and LDL are higher with less significance ($p<0.05$).

Conclusion: The role of genes, lifestyle and other factors contributing to rapid increase in the incidence of type 2 diabetes. The core aims are to bring forward the new therapy strategies and cost-effective intervention trials of type 2 diabetes. The present study revealed that the mean values of waist hip ratio of obese women of group I, II. III and IV showed statistically highly significant increase in values respectively. The mean values of fasting blood sugar of obese women of group I, II, III and IV showed statistically highly significant increase in values respectively.

Keywords: Obesity, Type-2 Diabetes Mellitus, Middle Aged Women.

Introduction

Diabetes mellitus (DM) is a major public-health problem, with a global prevalence of 9.3% (463 million people) in 2019 that is expected to reach 10.2% (578 million people) in 2030. [1] Obesity, the most prominent risk factor of DM and that leads to the development of insulin resistance, is more common in women than men. [2-6] Women gain about 0.7 kg/year on average, independent of race [7,8] and more women are overweight or obese after age 45 years, whether more males tend to be overweight at younger age. [9] Overweight, defined as body mass index (BMI) between 25 and 29.99 kg/m2, and obesity, defined as BMI ≥30 kg/m2, [10] are known risk factors of

type 2 DM. [11] Both obesity and type 2 DM are well-known cardio metabolic risk factors for vascular complications, such as coronary heart disease and peripheral vascular disease.

On the other hand, menopause is a potential risk factor for the development of DM, likely due to a reduction in circulating estrogens. [12] The Study of Women's Health Across the Nation (SWAN) suggested that lower E2 concentrations resulted in a 47% higher risk of type 2 DM during the menopausal transition. [13] The European Prospective Investigation into Cancer (EPIC)-Interact study suggested that menopause before the age of 40 years was associated with a 32% greater risk of type 2 DM. [14] A previous meta-analysis reported that levels of fasting glucose (weighted mean difference [WMD] 4.64, 95% confidence interval [CI] 3.94–5.33) and fasting insulin (WMD 20.88, 95% CI 2.12–39.65) were both increased after menopause. [15]

Randolph et al. reported that obese women had lower pre-menopausal estradiol level, which is sampled on day 2–5 of a spontaneous menstrual cycle, but higher postmenopausal estradiol level compared to non-obese women. [16] However, the association between obesity and DM according to menopausal status remains unclear. One US study combining the Health Professionals Follow-up Study and the Nurses' Health Study found the association between body mass index (BMI) and risk of DM to be significantly stronger among younger women (age < 60 years) compared to older women (age 60–69 years and age ≥70 years, p trend < 0.001). [17] Adult humans have limited and variable numbers of brown fat cell [18], which play a role in thermogenesis and potentially influence energy expenditure and obesity susceptibility. [19] Of greater concern is that cardiovascular complications of obesity are on the increase, including the incidence of stroke, end-stage renal disease and heart failure. [20]

The aim of the present study was to evaluate the obesity as risk factor in type-2 diabetes mellitus in middle aged women.

Materials and Methods

The study was conducted at Department of physiology, Nalanda Medical College, Patna, Bihar, India for the period of 10 months. 100 volunteer women of age 35 to 55 years were selected as subjects.

Inclusion Criteria

1. Only female subjects are selected of BMI 25 Kg/m2
2. Subjects with no family history of diabetes.
3. Subjects with no history of cardiovascular diseases.

Exclusion Criteria

1. Male subjects were excluded.
2. Subjects with past history of smoking and alcohol intake.
3. Subjects with family history of diabetes and hypertension.

Materials

1. Measuring tape and Krups weighing machine to record height and weight.
2. Graduated measuring tape to measure waist and hip circumference.
3. Sphygmomanometer to record blood pressure.
4. Glucometer to record fasting blood sugar.
5. Lipid profile study.

Method

1. Body Mass Index calculation:

Standing height was recorded without shoes and with light clothes on a wall mounted measuring to the nearest of the centimeter (<5mm & 5mm).

Weight was recorded without shoes and with light clothes on a Krups weighing machine with a least count of 100 gm7.

BMI was calculated by the formula:

BMI = weight (kg) / height (mt2)

2. Waist – Hip circumference ratio estimation:

Waist circumference was measured by using a graduated tape when subjects were in a standing position. Waist circumference were obtained at the level midway between the lower rib margin8

Waist hip ratio was calculated by dividing waist circumference by Hip circumference.

3. Sphygmomanometer:

Conventional mercury sphygmomanometer (DIAMOND) to record indirect BP is used. Resting BP was recorded by auscultatory methods in sitting position. The mean of three measurements was used in the analysis.

4. Easy Gluco Glucometer

It is a medical device for determining the approximate concentration of glucose in the blood. A small drop of blood obtained by pricking the skin with a lancet, is placed on a disposable test strip that the meter reads and used to calculate the blood glucose level Each strip is used once and then discarded.

Volume of blood sample: it varies from 0.3 to 1ul.

Testing time: range from 3 to 60 sec.

Display: glucose value in mg/dl or mmol/l. is displayed

5. Study of Lipid profile:

Mispa Excel Chemistry Analyser

The analyzer used is Mispa Excel Company. It is designed to be powerful and reliable but easy to use biochemistry analyzer. It simplifies the end users task by offering the possibility of printing test results patient as well as by parameters. It's touch sensitive screen and software driven menu lead the user through the simple operation procedures. [21]

Collection of blood sample:

After overnight fasting for 12 hrs, from each subject 3 ml of blood was obtained from cubital vein in a clean dry bottles containing EDTA. After 1 hr the serum was separated by centrifugation11. From the serum the following parameters were estimated:

i. serum cholesterol.

ii. serum triglyceride.

iii. serum HDL cholesterol.

From these values of parameters other parameter values of lipid profile are calculated13,14.

VLDL cholesterol = It is calculated by

Total cholesterol

LDL cholesterol = it is calculated by

Total cholesterol – (HDL cholesterol + VLDL cholesterol)

In present study 100 volunteer women of age 35-55 years were selected as subjects. Depending upon body mass index, these subjects were divided into following groups.

Control – (BMI < 25 kg / m2) Group I (BMI 25-29.9 kg / m2) Group II (BMI 30-34.9 kg / m2) Group III (BMI 35-39.9 kg / m2) Group IV (BMI > 40 kg / m2)

The above groups were made on the basis of WHO classification of obesity. Depending upon these, four observation tables have been derived. Each table consists of mean values, 't' test, 'p' values of various parameters along with interpretation. [22,23]

Results

Table 1: Comparison of mean values of various parameters in controls and group I

Parameters	Controls Mean ± SD	GRI Mean ± SD	P- value
PULSE RATE	74.46 ± 6.84	75.35 ± 4.16	> 0.1
SBP	112.18 ± 7.33	122.38± 13.07	> 0.1
DBP	73.43 ± 5.45	76.34 ± 7.42	> 0.1
W/H RATIO	0.76 ± 0.025	0.77 ± 0.02	> 0.1
FBS	94.36 ± 12.44	150 ± 40.80	<0.001
TC	152.38 ± 42.38	176.34 ± 36.44	> 0.1
HDL	46.34 ± 6.44	45.35 ± 10.42	0.01
TG	112.88 ± 28.22	160.40 ± 102.32	<0.01
LDL	92.38 ± 36.04	96.04 ± 20.14	> 0.1
VLDL	23.7 ± 6.30	26.74 ± 21.19	< 0.01

Within group I, the mean values of FBS, HDL,TG & VLDL were higher with more significance ($p<0.01$).

Table 2: Comparison of mean predicated values of various parameters in controls and group II

Parameters	Controls Mean ± SD	GRI Mean ± SD	P- value
PULSE RATE	74.64 ± 7.47	75.05 ± 5.55	> 0.1
SBP	112.18 ± 6.84	122.8± 15.75	> 0.1
DBP	75.25 ± 5.65	78.22 ± 9.21	> 0.1
W/H RATIO	0.765 ± 0.025	0.82 ± 0.03	< 0.001
FBS	92.48 ± 12.64	160.53 ± 44.62	< 0.001
TC	152.48 ± 42.24	178.42 ± 40.04	> 0.1
HDL	46.54 ± 7.40	42.68 ± 10.40	0.1
TG	110.92 ± 26.40	168.02 ± 104.65	< 0.001
LDL	92.48 ± 36.04	98.02 ± 25.84	> 0.1
VLDL	23.7 ± 6.24	32.34± 20.32	< 0.01

Within group II, the mean values of W/H RATIO, FBS, HDL,TG & VLDL are higher with more significance ($p<0.01$).

Table 3: Comparison of mean values of various parameters in controls and group III

Parameters	Controls Mean ± SD	GRI Mean ± SD	P- value
PULSE RATE	74.66 ± 7.73	76.44 ± 5.15	> 0.1
SBP	111.19 ± 7.65	123.57± 11.23	> 0.1
DBP	73.27 ± 5.55	81.39 ± 9.41	> 0.1
W/H RATIO	0.776 ± 0.025	0.85 ± 0.04	< 0.001
FBS	93.77 ± 13.47	196.94 ± 56.34	< 0.001
TC	154.36 ± 46.24	180.40 ± 32.28	0.05
HDL	44.46 ± 7.33	40.52 ± 10.55	0.01
TG	114.85 ± 28.12	176.24 ± 46.44	< 0.001
LDL	92.88 ± 36.04	100.07 ± 23.87	> 0.05
VLDL	24.6 ± 6.24	34.36 ± 8.79	0.01

Within group III, the mean values of W/H RATIO, FBS, HDL,TG and VLDL are higher with more significance ($p<0.01$). The mean values of TC and LDL are higher with less significance ($p<0.05$).

Table 4: Comparison of mean values of various parameters in controls and group IV

Parameters	Controls Mean ± SD	GRI Mean ± SD	P- value
PULSE RATE	76.54 ± 7.84	77.86 ± 4.53	> 0.1
SBP	114.34 ± 7.43	140.22 ± 10.24	< 0.001
DBP	76.24 ± 5.65	82 ± 5.42	< 0.001
W/H RATIO	0.77 ± 0.025	0.88 ± 0.01	< 0.001
FBS	94.36 ± 12.68	200.55 ± 35.75	< 0.001
TC	154.56 ± 42.26	183.8 ± 36.24	> 0.1
HDL	46.44 ± 7.32	38.18 ± 6.34	0.01
TG	115.55 ± 28.22	204.36 ±28.42	< 0.001
LDL	96.34 ± 35.04	142.46 ± 9.87	< 0.01
VLDL	22.6 ± 6.27	39.23 ± 6.06	< 0.001

Within group IV, the mean values of BMI,W/H RATIO, FBS, HDL,TG and VLDL are higher with more significance ($p<0.01$). The mean values of TC and LDL are higher with less significance ($p<0.05$).

Discussion

Morbidity and prevalence of type 2 diabetes mellitus (DM) are increasing in obese middle aged women. Obesity is a major health problem throughout the world because of its high prevalence and its association with increased risk of cardiovascular disease. [24] Type 2 diabetes is a serious and common chronic disease resulting from a complex inheritance-environment interaction along with other risk factors such as obesity and sedentary lifestyle. Type 2 diabetes and its complications constitute a major worldwide public health problem, affecting almost all populations in both developed and developing countries like India with high rates of diabetes-related morbidity and mortality. A growing number of variables are being identified in population cross-sectional studies or laboratory studies that are related to mechanisms involved in obesity control. [25]

Within group I, the mean values of FBS, HDL, TG & VLDL were higher with more significance ($p<0.01$). Within group II, the mean values of W/H RATIO, FBS, HDL,TG & VLDL are higher with more significance ($p<0.01$). Within group III, the mean values of W/H RATIO, FBS, HDL,TG and VLDL are higher with more significance ($p<0.01$). The mean values of TC and LDL are higher with less significance ($p<0.05$). Within group IV, the mean values of BMI,W/H RATIO, FBS, HDL,TG and VLDL are higher with more significance ($p<0.01$). The mean values of TC and LDL are higher with less significance ($p<0.05$). The increased risk of developing DM after menopause is due to a decrease in estrogen. Weight gain tends to accompany aging in a woman's life cycle and has been suggested to be a result of decreasing estrogen level after menopause, as estrogen facilitates adipose tissue function and deposition. [26] Thus, menopause is followed by adipose tissue redistribution to visceral depots, which is associated with insulin resistance, while greater subcutaneous gluteal-femoral fat is associated with protection from metabolic syndrome. [27] On the other hand, the impact of body weight on DM risk differs in obese women depending on menopausal status. In premenopausal women, obesity has a direct inhibitory effect on estradiol production from the ovaries [28,29] while estrogens are synthesized in adipose tissue by aromatization of androgens after menopause. [30]

The different tendencies of association between obesity and DM by menopausal status can be explained by the change of body composition during the menopause transition. During pre-menopause, fat mass

tends to increase, while the proportion of lean mass decreases over time. However, in Chinese women, decreasing fat mass and increasing proportional lean mass were found after menopausal transition. [31] Therefore, high BMI might reflect excess fat mass, which contributes to the association between obesity and DM, in premenopausal women rather than postmenopausal women. Indeed, estradiol level is lower in obese women than non-obese women at premenopausal age but is higher in obese women of post-menopausal age. [16] It seems that obesity before menopause increases the risk of DM by lowering the estrogen level in the body in addition to an increase in insulin resistance caused by obesity itself. On the contrary, obesity after menopause can increase the estrogen level in the body, providing a protective effect against DM.

Conclusion

The role of genes, lifestyle and other factors contributing to rapid increase in the incidence of type 2 diabetes. The core aims are to bring forward the new therapy strategies and cost-effective intervention trials of type 2 diabetes. The present study revealed that the mean values of waist hip ratio of obese women of group I, II. III and IV showed statistically highly significant increase in values respectively. The mean values of fasting blood sugar of obese women of group I, II, III and IV showed statistically highly significant increase in values respectively.

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