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ASSOCIATION OF CARDIO METABOLIC AND ANTHROPOMETRIC RISK FACTORS AMONG IMPAIRED FASTING GLUCOSE SUBJECTS IN RURAL PONDICHERRY POPULATION.

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ABSTRACT

Screening for Impaired fasting glucose (IFG) in the early stage of Diabetes mellitus can avert the long term complications. Cross-sectional study was conducted in 500 study subjects in order to assess the IFG status and to find relationship between plasma triglyceride level (TAG) and anthropometric risk factors of rural Pondicherry population. Study groups were divided into two groups; above and below 40 years of age. Subjects with IFG in the study population was 21.3%. When compared to normo glycemic, there was a significant increase in Insulin resistance, TAG and HDL in IFG population in the study groups. In subjects with above 40 years of age, a significant difference was noted with WHR (p=0.03). Insulin resistance was assessed by HOMA IR, which had a significant association with WHR in subjects with above 40 years age (r=0.9; p=0.03) but not with BMI (r=0.4; p=0.57). In subjects with below 40 years of age, HOMA IR showed a significant correlation with BMI (r=0.8; p=0.004) and WHR (r=0.7; p=0.5). TAG and HDL significantly associated with BMI in both groups. HOMA-IR can be of additional value in screening IFG in both above and below 40 years of age.

KEYWORDS: **Impaired fasting glucose (IFG), Diabetes mellitus (DM), Triglyceride (TAG), High density lipoprotein (HDLc), Body mass index (BMI), waist-hip ratio (WHR), fasting plasma insulin (FPI)**

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INTRODUCTION

Diabetes mellitus remains one of the major health challenges in developed and developing nations of the world .In India it is estimated that 11.6% of the urban population and 2.4% of the rural population are Diabetics and the numbers are increasing till date. It has been estimated that by the year 2030 the number of diabetic patients in India may be around 80 million [1]. As per the Chennai Urban Rural Epidemiology Study (CURES) the prevalence of undiagnosed diabetes was 9.1% [2]. Studies have documented an increased prevalence of undiagnosed diabetes in the rural community. With limited reports on French influenced Pondicherry rural population, it is necessary to detect the large pool of undiagnosed prediabetics [3]. Impaired Fasting Glucose (IFG) is a state where fasting plasma glucose level ranges between 100 to 125 mg/dl, which is a great risk factor for type II diabetes mellitus . Timely detection and lifestyle modifications can prevent the progression of IFG into full blown diabetes. IFG is associated with obesity and related complications like coronary heart disease and stroke etc. A study has documented that Indians have a greater risk for Diabetes even at a low BMI when compared to European race. A strong association between IFG and anthropometric indices [BMI, Waist circumference (WC)] has been documented [4]. With changing life style and rapid urbanization among rural population it's time to reassess and evaluate undiagnosed cases of diabetes by assessing Impaired Fasting Glucose status, anthropometric risk factors and insulin resistance which we aimed to study.

MATERIALS AND METHODS

This study was conducted in Mahatma Gandhi Medical College & Research Institute, Pondicherry after getting the approval of the Institutional Ethics Committee. Randomly 500 study subjects were chosen between the 30 to 50 years of age and were subdivided into two groups [Above 40 years of age and Below 40 years of age]. Patients on treatment for acute or chronic medical illness, newly diagnosed cases of Diabetes mellitus and other Endocrine disorders were excluded from the study. The procedure was explained and informed consent was obtained from each participant. 2ml of Fasting venous blood sample was withdrawn and separated plasma was used for estimation of glucose concentration by Glucose Oxidase (GOD) Peroxidase (POD) method to assess the status of IFG [5]. Triglycerides were estimated by Glycerokinase method in Hitachi-902 fully automated analyzer at the clinical chemistry laboratory. Insulin resistance was calculated by HOMA-IR formula using Fasting glucose (Hitachi-902) and fasting plasma insulin (FPI) levels in blood in Elecys1010 chemiluminesence analyzer adapted to Roche diagnostic Germany [6]. Anthropometric variables such as height, weight, waist and hip circumferences were measured to assess general and central obesity.

General obesity

Height was measured to the nearest 0.1 cm, while the subject was standing in erect position with bare feet on flat floor against a vertical scale and with heels touching the wall and head straight at the outpatient department [7]. Body Weight was measured using Bathroom weighing scale, while the subject was minimally clothed and without shoes, standing motionless and it was recorded nearest to 0.1 kg. Body-Mass Index (BMI) was calculated using weight (kg) / height (m^2). The cut off value for normal BMI for men was 23 kg / m^2 [8].

CENTRAL OBESITY

Waist-Hip Ratio (WHR) was calculated to assess central obesity. Waist circumference (in cm) was measured at a point mid-way between the lower rib and iliac crest with the measuring tape centrally positioned at the level of the umbilicus. Waist circumference is the average of two measurements one taken after inspiration and the other taken after expiration in standing position. Hip circumference was measured (in cm) over light clothing at the trochanter

major of the head of femur[9]. WHR was calculated using the following formula to assess central obesity [Waist (cm)/Hip (cm)]. Normal cut off value is 0.88 in men [8].

STATISTICAL ANALYSIS

Statistical analysis was done using SPSS version 17. All the data were presented as Mean ± SD. To compare the mean Student "t" test was performed. The blood and anthropometrical parameters correlation assessed by using two- tailed Pearson's correlation. *P Value* < 0.05 was considered statistically significant.

RESULTS

The percentage of individual with IFG in the study population was 21.3 %. The incidence was higher in the age group above 40 years (25.3%) when compared to below 40 years age group (12.8%). As depicted in Table 1 & Table 2, $HOMA_{IR}$, TAG, HDL, was higher in subjects with IFG in both age groups ($p<0.05$). Anthropometric measurements BMI and WHR showed significant difference between normoglycemic and IFG in subject with below 40 years of age. ($p=0.004$; $p=0.025$) respectively. Wherein, subjects with above 40 years of age significant difference were noted only with reference with WHR. ($p=0.031$)

Table 1

Comparison of Study Parameters in between Normoglycemic and impaired fasting glucose in Study groups with age < 40 years.

Parameters	< 40 years		'p' value
	Normoglycemic (n = 218)	Impaired fasting glucose (n = 32)	
Age (yrs)	23.7±2.1	24± 2.6	0.46
BMI (Kg/m2)	22± 1.6	23± 2.1*	0.004
WHR cm/cm)	0.81±0.12	0.87±0.24	0.025
FBS (mg %)	93±6	118±9**	<0.001
FPI (µIU/ml)	10±2	29±3**	<0.001
HOMA IR	1.7±0.2	2.8±0.4**	<0.001
TGL (mg %)	128±9	138±12**	<0.001
HDL (mg %)	39±4	42±6*	0.003

Values are expressed in Mean and SD. * indicate P value < 0.05; ** indicate P value <0.001 considered significant in comparison with normoglycemic control.

As depicted in table 3 $HOMA_{IR}$ showed good correlation between anthropometric risk factors BMI and WHR in IFG subject below 40 years of age. In subjects above 40 years of age there was significant correlation between $HOMA_{IR}$ and WHR ($r=0.9$; $p=0.03$) but not with BMI($r=0.4$; $p= 0.57$). Correlation between HDL with BMI were significant in both age group ($p<0.05$), but no significant correlation was seen between TAG and BMI ($r =0.5$; $p=0.6$).

Table 3

Correlation between HOMA IR and other anthropometric risk factors in study group

Parameter	Impaired Fasting Glucose			
	< 40 Years		> 40 Years	
	'r'	'p'	'r'	'p'
BMI	0.8	0.004	0.7	0.54
WHR	0.7	0.5	0.9	0.03

P value <0.05 was considered significant.

DISCUSSION

Present study gives the insight in the percentage of IFG in rural population of union territory (Pondicherry) of Indian as 21.3%.The incidence was comparatively higher in the age group above 40 years (25.3%) than age group below 40 years (12.8%).This can be compared with other studies (table 4).

Table 4
Prevalence of IFG studies

Chennai (South India)	8.7%.	Ramachandran et al
Jaipur(North India)	12.8%	Gupta A et al[10]
Kolkata (East India)	6.2%	S Kumar et al[11]
China	21.6%	Yun Qian, Yudi Lin, Tiemei Zhang et al
US	23.5%	Thorpe L E et al

From this it is clear that the prevalence of IFG is highly variable worldwide [10,11]. This is in accordance with other studies conducted in US (32.4%) China (21.6%). When compared to other reports from India, our study showed higher prevalence of IFG in both above and below 40 years of age. This high prevalence of IFG in this population may be due to changing food habits and sedentary life style. This could be due to the socio - economic status, physical activity and epigenetic factors. The mean age in IFG was found to be 24±2.6 and 53±3.4 (<40 and >40 years of age) respectively. There was an increase in the number of IFG cases in >40 years of age. This implies that the prevalence rate of IFG showed a n increasing trend with age [12-15]. With Government welfare schemes on free television and decreased agricultural activities have increased couch potatoes in both the age groups even in the villages of India. This could explain the variation in the prevalence of IFG between the two age groups. But few studies did not show an increasing trend with age [8,16-19] . Studies have also documented that occurrence of diabetes in India is around 35 – 40 years of age. This is much earlier the western population. Major limitation of our study is that we have not included women because of limited volunteers and variation on menstrual age which we like to study in future.

IFG AND ANTHROPOMETRIC INDICES

In this present study, we have found that all the subjects with IFG were obese (BMI >22 .9). This is in accordance with other studies [4,8,14,15,20,21]. There was a significant correlation of anthropometric measurements with other cardio metabolic risk factors but not with TAG in <40 years of age. Studies have documented BMI as a measure of sedentary life and remain vague in estimating exact adiposity because measurement of BMI depends only on height and weight. But other factors like muscle mass, hormonal status etc., were not taken into account. Moreover studies have shown poor sensitivity especially in thin individual who is thin outside but fat inside. Our study has shown a high WHR in IFG subjects similar to other studies [22,23] and significant correlation with other cardiovascular risk markers especially in >40 years of age. But comparatively less in <40 years of age, Waist circumference and WHR are used to somatotype the body into android or gynoid type. Subjects with WHR 1cm and above the normal are at greater risk of cardiovascular disease. Recent study by Price GM et al documented WHR a better predictor of death in older individual than younger individual [24]. Studies have also showed that despite having lower BMI; Indians with low income have a normal WHR comparable to high income group. Studies by Lim JS et al 2007 showed development of type 2 DM only in obese individuals with altered liver metabolism [25,26]. Insulin resistance is a state where hormone losses its biological function due to increased fasting plasma glucose and altered insulin sensitivity. IR can be best measured by glycemic clamp technique.

Current study showed an increased level of IR associated with other cardiovascular risk factors. This could be due to high TGL with dyslipidemia along with altered liver functions, which could play a critical role in glucose insulin metabolism [27,29]. A crosstalk between dyslipidemia, IR and altered liver functions could be a reason for inconsistent association between WHR and BMI in above and below 40 years of age study group. However both the age groups correlated well with IR, guiding us to conclude that along with WHR and BMI, HOMA IR could be an additional marker in screening IFG.

CONCLUSION

Anthropometric measurements like BMI and WHR along with cardiometabolic risk factors like HDL,TGL and HOMA IR can be used as predictor variables of IFG . Our study also showed a slightly increased incidence in IFG in Pondicherry. The cause for which has to be elucidated though lifestyle and genetic factors may play a major role. A further study on life style status and genetic polymorphism can provide an insight of exact cause for the increased incidence of IFG in Pondicherry population.

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