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Metabolic Syndrome Prevalence among Prediabetic and Normoglucotolerant Women

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Abstract

Prediabetes is a known risk factor for type 2 diabetes and lead to long term complications such as cardiovascular diseases. In Cameroon, they are limited data dealing with prediabetes prevalence among Cameroonians. Our study objective was to estimate the prevalence of metabolic syndrome among prediabetic women and normoglyceamic women.

Methods: A total of 200 women (100 prediabetic women and 100 normoglyceamic) participated in the study, they were aged between 20-55 years. For their studied data, they were referred to the Andre Fouda Medical Fundation in Yaounde. Metabolic syndrome was diagnosed using Adult Treatment Panel-III [ATP-III] 2001 guidelines and prediabetes was defined as impaired fasting plasma glucose ranged between 6.1-6.9 mmol/l.

Results: The frequency of various cardiovascular risk factors was not different among the two group of study; only fasting blood glucose was significantly high among prediabetics compared to normoglyceamics women. The mean age in prediabetic women was 34.34 ± 8.96 years and 35.48 ± 9.88 years among normoglyceamic women. Among the prediabetic population, a total 61% of patients had hyperglyceamia, 59% had hypertension, 58% had increased waist circumference and 56% were diagnosed with metabolic syndrome. The most common abnormalities in normoglyceamic women was hypertension (58%), increased waist circumference (53%) and low HDL (52%). Metabolic syndrome was diagnosed in 23% of normoglyceamic women. Prediabetics women had a relative high risk of metabolic syndrome 2.43 compared to normoglyceamics women.

Conclusion: This study shows that prediabetes is associated with increased prevalence of metabolic syndrome among Cameroonian women. Lifestyle interventions and medication should be instituted to avoid complications among prediabetes.

Keywords: Metabolic syndrome; Prediabetes; Normoglyceamic; Women; Cameroon

Introduction

Prediabetes is a condition where blood glucose concentration is higher than normal but, not enough to be call type 2 diabetes, it is the borderline of type 2 diabetes [1]. Sometimes, people who develop type 2 diabetes develops firstly prediabetes, but not everyone who has prediabetes ends up with diabetes [2]. In fact, changing lifestyle can significantly delay or even prevent type 2 diabetes [3,4], however for American Diabetes Association (ADA), it is a clear need for most people to check their blood sugar [glucose] levels regularly and avoid complications. Prediabetes has no signs and symptoms, people with prediabetes have a greater risk of developing type 2 diabetes and/or associated complications [5-8]. Prediabetes generally aggregates with other cardiovascular risk factors and make up metabolic syndrome. Metabolic syndrome is an assemblage of risk factors that increases the risk of cardiovascular disease and type 2 diabetes. These factors include dysglycemia, high blood pressure, elevated triglyceride levels, low high-density lipoprotein cholesterol levels [HDL-C], and obesity [9,10]. With high rate of nutritional transition in developing countries, metabolic syndrome [11] and diabetes [12,13] prevalence is increasingly common and both diseases are important public health problem. Glucose abnormality can be present [14] or not in metabolic syndrome [15,16]. In Cameroon, there are limited published data dealing with glucose abnormalities and metabolic syndrome. This study compared the frequency and risk of metabolic syndrome between prediabetic and normoglucotolerant women.

Materials and Methods

Ethics

The cross sectional study was approved by the Education Planning Commission of Fouda Medical Foundation. Women were recruited through free multiple chronic diseases campaign from March 2014 to March 2016. Admission to the study was based solely on voluntary participation of women. The study volunteers were therefore referred at the Medical Foundation Andre Marie Fouda, Yaounde Cameroon. Exclusion from the study occur if women were not taking any medications that can affect blood glucose or having history of endocrine disorder like diabetes or thyroid diseases. At the time of recruitment all the participants were explained and provided a detail information leaflet about study objectives, procedures and the risk and benefits involved. All the participants were instructed to maintain fast

of at least 12 hours till blood collection. The participants were reassured about the confidentiality of data. Females were excluded from the study if they were pregnant or lactating. All participants in the study provided verbal informed consent. All measurements and questionnaire were in accordance with the Helsinki Declaration (1983 version).

Subjects

The data collection comprised healthcare questionnaire, anthropometric measurement of weight, Height, and abdominal circumference, health examination and laboratory test in fasting state for lipids and fasting blood glyceamia.

Height, weight, and waist circumference were all measured using standardized techniques and calibrated equipment. BMI was calculated by dividing weight by height squared [kg/m^2] classified according to WHO rules ≥ 30 [17].

A well trained nurse drew 10 ml of fasting morning blood samples from the examinees arm. Two ml was dispensed into fluoride oxalate tubes and the rest into vacutainer plain for separation of plasma and serum respectively. Standardized techniques were used to obtain the blood pressure measurements after at least 10 min of rest.

Waist circumference was taken with the subject in a standing position, to the nearest millimetre, using a non-stretchable tape measure at the mid-point between the lowest rib and the iliac crest in expiration. The height was measured in standing position using tape meter while the shoulder was in a normal position to the nearest millimetre [Siber Hegner, Zurich, Switzerland]. Body weight and body fat were determined in 12 h fasted participants [with very light clothing on and without shoes] using a Tanita™ scale. Glucose was assay in the plasma by the glucose oxidase peroxidase colorimetric enzymatic method while serum was used for lipid profile. Total cholesterol and triglycerides in plasma were measured using previously described standard methods [18,19]. High Density Lipoprotein cholesterol was determined using a heparin manganese precipitation of Apo B-containing lipoproteins [20].

Definition of Metabolic Syndrome

Workers were considered to have Metabolic Syndrome if they had three or more of the five following criteria, according to the ATPIII definition [21].

1. Abdominal obesity, defined as a waist circumference in women ≥ 88 cm [35 inches], in men ≥ 102 cm [40 inches].

2. Hypertriglycerideamia ≥ 150 mg/dL [1.7mmol/L] or drug treatment for elevated triglycerides.

3. HDL cholesterol level <50 mg/dL [1.3 mmol/L] in women, <40 mg/dL [1mmol/L] in men or drug treatment for low HDL-C.

4. Blood pressure ≥ 130/85 mmHg or drug treatment for elevated blood pressure

5. Fasting plasma glucose [FPG] ≥ 110 mg/dL [6.1mmol/L] or drug treatment for elevated blood glucose [22].

Definition of Prediabetes

The diagnostic of prediabetes was made with IFG [Impaired fasting Glucose levels belonging to the range of 100 to 125mg/dL after an overnight fast [1].

Statistical analysis

All data were analyzed by STATA® 8.2. Continuous variables are reported as means ± standard deviations [SD] and categorical variables are presented as percentages or numbers. A p value less than 0.05 was considered statistically significant. Quantitative and qualitative variables were tested using Student's t-test and the chi-square test respectively. P value <0.05 was considered statistically significant.

Results

Of a total of 603 women screened through fasting plasma glucose during the campaign, based on the results of above test, women were classified according to ADA, the first 100 prediabetics and fisrt100 normoglyceamic were selected for our study. The mean age was 35.48 ± 9.88 for normoglyceamic women and 34.34 ± 8.96 for prediabetic women respectively. The prevalence of individuals components of metabolic syndrome among prediabetic were shown to be: high fasting glucose levels 61%, high waist circumference 59%, high blood pressure 58%, low high density lipoprotein-cholesterol 56% and triglyceride levels 10 %. Among normoglyceamic high blood pressure was reported among 58%, high waist circumference among 53%, low high density lipoprotein-cholesterol among 52% and triglyceride levels 14%.

Prediabetic women with metabolic syndrome represented 48% with 3 abnormalities 6 with abnormalities and 2 with five metabolic abnormalities. Among normoglyceamic individuals, with metabolic syndrome represented 22% with 3 abnormalities, 1 with abnormalities, and nobody with five metabolic abnormalities.

Prevalence rates of metabolic syndrome varied according to hyperglycaemia status, 56% of prediabetic women had metabolic syndrome while 23% of normoglyceamic women had metabolic syndrome. Prediabetic women had a relative risk of 2.43 (Tables 1-4).

Discussion

Worldwide, the World Health Organization estimates that 346 million have type 2 diabetes mellitus [23]. Diabetes is the four leading cause of mortality among developing countries. In Cameroon there is an urban rural discrepancy among diabetes prevalence and 60% of diabetes cases are undiagnosed. The major and long term complications of diabetes are cardiovascular diseases that lead to many complications. It is important to identify individuals at early stages of type 2 diabetes for efficient [24]. Prediabetes is the intermediary state between normal glycaemia and diabetes, at this stage this condition is reversible if early detected and appropriate measure taken [25]. The conversion rate of hyperglycemia to metabolic abnormalities depends on degree of initial glycaemia, ethnic background, and environmental influence. The higher the glucose values, greater the risk of progression to diabetes and others complications of prediabetes [19].

Ciccone et al. [26] study show that Prediabetic condition is a further expression of incipient atherosclerosis lesions development through synergism between systemic inflammatory condition and the presence of high blood glucose concentrations. The enhanced oxidative stress generated, the increased circulating free fatty acids and the altered lipids metabolism induce heart structure damages that can lead to diabetic cardiomyopathy.

Parameters	Total	Normo glyceamic Women	Prediabetic Women	P value
All women, No. [%]	200	100	100	-
Age [years]	34.86 ± 9.40	35.48 ± 9.88	34.34 ± 8.96	0.582
BMI, kg/m²	30.80 ± 5.98	30.42 ± 4.99	31.17 ± 6.39	0.317
WC, cm	102.02 ± 12.21	101.08 ± 11.42	102.98 ± 12.21	0.39
SBP, mmHg	129.15 ± 23.78	127.66 ± 20.53	130.68 ± 26.81	0.481
DBP, mmHg	86.21 ± 14.50	85.47 ± 14.72	87.00 ± 14.35	0.562
FBS, mg/dl	95.96 ± 19.22	79.42 ± 11.17	112.50 ± 8.02	0.000*
TG, mg/dl	86.74 ± 53.16	80.80 ± 45.17	92.68 ± 59.91	0.226
T-Chol, mg/dl	146.84 ± 53.64	151.77 ± 56.63	142.18 ± 50.73	0.353
HDL-Chol, mg/dl	57.66 ± 40.73	57.04 ± 42.33	58.25 ± 39.49	0.871
*Significant difference between subject with prediabetic and normoglycemic women BMI: Body Mass Index; WC: Waist Circumference; SBP: Systolic Blood Pressure; DBP: Diastolic Blood Pressure; FBS: Fasting Blood Glucose; TG: Triglyceride; T-CHOL: Total Cholesterol and HDL-CHOL: HDL-cholesterol *P value less than 0.05 was considered significant.				

Table 1: Demographic and clinical characteristics of Total, Prediabetics and normoglycemic Women.

Individual components	Normo glyceamic Women	Prediabetic Women	P-Value
Hyperglyceamia	0	61	0
Low HDL	52	56	0.821
High Triglycerides	14	10	0.342
Abdominal obesity	53	58	0.353
Hypertension	58	59	0.746
*P<0.05 considered significant			

Table 2: Prevalence of Metabolic Syndrome individual components.

Parameters	Normo glyceamic Women	Prediabetic Women	P-Value
3 criteria n (%]	22	48	0.000
4 criteria n [%]	1	6	0.000
5 criteria n [%]	0	2	0.154

Table 3: Metabolic Syndrome Items.

There are scarce studies dealing with comparison of metabolic syndrome among prediabetics and normoglyceamics individuals in Cameroon, this is the first report on metabolic syndrome and prediabetes. Based on NCEP definition, the overall prevalence of metabolic syndrome among prediabetic women was 56% and 23% among normoglyceamic women. The prevalence of metabolic syndrome of our study is higher than the one reported among prediabetics Pakistan report [27]. The difference between the two studies can be explained by the size of study population (100 for our study verse 40 for the Pakistan study), the methods of prediabetes diagnosis (impaired fasting glucose for our study and for the Pakistan study two method oral glucose tolerance test and impaired fasting glucose) and the nutritional status of our population [our study population was obese while the Pakistan study population was only overweight.

Glyceamia	MetS positive	MetS negative
Normo glyceamic Women	23	77
Prediabetic Women	56	44
Total	79	121

Table 4: Distribution of Metabolic Syndrome in Normo glyceamic and Prediabetic women.

Prediabetic women had a relative risk of metabolic syndrome of 2.43, this risk is higher than the relative risk of 1.27 to develop cardiovascular diseases recorded from Levitan et al. in the meta-analysis where pre-diabetic condition increases the cardiovascular risk profile of individuals [28]. The conversion of hyperglyceamia to it associated complications is enhanced with risk factors such as obesity, being overweight or obese is the main modifiable risk factor for type 2 diabetes, as body mass index increases, so does the risk of type 2 diabetes. In addition, duration of obesity has also been found to increase risk of developing type 2 diabetes, with greater risk among people who have been obese for longer periods of time [14]. In our study, while comparing individual metabolic syndrome risk factor, only a significant difference of altered fasting plasma glucose was found among prediabetic and normoglyceamic women, this is not in agreement with Pakistan study [27] where a higher frequency of all individual components of cardiovascular risk factors was found.

Among prediabetic obese youth, Shah et al. [29] study show has that demonstrated that there is an increased common carotid intima-media thickness (an important marker of atherosclerosis) comparatively to

obese youth with normal glyceamic control. Also it is noted that prediabetes altered the performance of coronary vessels which increases the overall cardiovascular risk of individuals.

It is well known that most of people suffering from prediabetes often reveal insulin-resistance and the resulting chronic hyperglycemia further at lesser extend advances pancreatic β-cell dysfunction [30,31]. Glucose toxicity occurs through several mechanisms that begin when hyperglycemia leads to an increase in the intracellular glucose level. The damaging effects of elevated intracellular glucose levels may stem from alterations in a number of pathways [32-38]: oxidative stress and reactive oxygen species creation.

Hyperglycemia, in fact is able to activate protein kinase C which is able to enhance nicotinamide adenine dinucleotide phosphate [NADP] oxidase action, thus promoting the genesis of reactive oxygen species [ROS] and consequentially, oxidative stress [18,19]. The same happens after the production of the advanced glycation end [AGE] products which are compound able to increase NADP oxidase activity, ROS generation and enhance coagulation processes. Moreover hyperglycemia is able to increase the flux through the hexosamine pathway and to induce the polyol pathway, all conditions related to a further ROS generation and finally to induce over-expression of growth factors and inflammatory cytokines [16,17].

Furthermore, beyond oxidative stress, hyperglycemia is able to impair and uncouple endothelial nitric oxide [eNOS] activity [16]. Such an impairment is dangerous because predisposes to endothelial dysfunction, which is a well know early marker of atherosclerosis and increased cardiovascular risk [20,21]. Strengths of our study are the use of standardized data collection of protocol as well as a relatively large size of prediabetics women. Although metabolic syndrome studies in Cameroon are arising, this study is the first study evaluating metabolic syndrome among prediabetics women.

The main limitations of this study were it cross sectional nature and Prediabetes was not diagnostic through oral glucose tolerance or glycated hemoglobin test.

Conclusion

This study shows that metabolic syndrome prevalence is higher among prediabetic women comparatively to normoglyceamic ones. Although costly, it important to organized early screening for prediabetes among women for reducing the prevalence of type 2 diabetes. Prediabetes risk factors should be studied among our population for prevention and treatment of prediabetic patients.

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