Diabetes & Metabolic Syndrome: Clinical Research & Reviews 9 (2015) 287–291

Contents lists available at ScienceDirect

Diabetes & Metabolic Syndrome: Clinical Research & Reviews

journal homepage: www.elsevier.com/locate/dsx

Original Article

Dyslipidemia and reduced total antioxidant status in young adult Saudis with prediabetes

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ARTICLE INFO

Keywords:
Life style
Prediabetes
Dyslipidemia
Total antioxidant status
Young adults
Saudi Arabia

ABSTRACT

Aims: Lifestyle related noncommunicable health conditions are having an increasingly negative impact on the health. This study aimed to assess the lipid profile, total antioxidant capacity, and the lifestyle predictors of conversion to prediabetes in young Saudis with prediabetes.
Materials and methods: One hundred and twenty-one young Saudis with fasting plasma glucose (<125 mg/dl) enrolled in this study who further categorized into normal glucose tolerance "NGT" group (n = 86) and prediabetes group (IFG; n = 08/IGT; n = 27) based on American Association criteria. Venous blood samples were collected at fasting and 2 h postprandial from participants. Chemistry parameters and total antioxidant status (TAS) were assayed by standard procedures. Questionnaires were applied to collect information including demographic characteristics, physical activity, and family history to diabetes. Statistical analysis was performed using SPSS version 17.
Results: Compared to NGT subjects, the prediabetics characterized by marked obesity (p = .027), visceral obesity (p = .002), dyslipidemia, significantly increased HbA1c (p = .003), reduced TAS ($p < .001$), more sedentary lifestyle (p = .010). Positive correlations were documented between FPG, 2-h plasma glucose and HbA1c, BMI, WC, TC, LDL cholesterol, TG while negative correlations with HDL cholesterol, TAS.
Conclusion: The current study reported that prediabetes condition (in young adult Saudis) was associated with dyslipidemia, reduced total antioxidant status, obesity, central obesity, and physical inactivity compared to those with normoglycemia. Lifestyle modifications (through weight loss, regular physical activity, and healthy diet) should be encouraged especially among young Saudis to prevent the progression to type 2 diabetes and its complications from prediabetes state.

1. Introduction

The economic development has set the scene for the transformation of lifestyles and eating habits that having an increasingly negative impact on the health of many adults through lifestyle related noncommunicable health conditions [1]. According to the World Health Organization (WHO) 'an apparent epidemic of diabetes has occurred', that is strongly related to lifestyle and economic change [2].

Prediabetes (also referred to as impaired glucose tolerance "IGT" and/or impaired fasting glucose "IFG") is a preclinical stage in the continuum of hyperglycemia where subjects are at increased risk of developing type 2 diabetes mellitus (T2DM) in the near future [3–5]. Prediabetes is an increasingly common condition in youth and adults with a most sudden increase in the age group below 30 years of age [6,7]. The percentage of population who are prediabetic, with IFG or IGT is much greater than that of diabetic patients and is persistently increasing [8]. Worldwide, the number of people with prediabetes is estimated to be 314 million and is projected to reach 418 million in 2025 [9,10].

Progression to overt diabetes from a prediabetes state occurs gradually over a period of many years and is characterized by worsening insulin resistance and insulin secretory dysfunction and by gradual increases in fasting and postprandial plasma glucose concentrations [11–13]. In light of that, diabetics often present with diabetes-related complications at the time of their diagnosis [9]. It is urgently necessary and important to identify individuals who might develop T2DM in order to prevent and delay its development [14]. Thus screening to promote earlier diagnosis and treatment of T2DM is of significant importance, as untreated

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http://dx.doi.org/10.1016/j.dsx.2014.04.017
1871-4021/

disease leads to metabolic, microvascular, and macrovascular complications [15]. In other words, individuals with undiagnosed diabetes and prediabetes are at high risk for stroke, coronary artery disease, and peripheral vascular disease [16].

Here in this report we extended our previous study [17] to assess the lipid profile, total antioxidant capacity, and the lifestyle predictors of conversion to prediabetes (such as obesity, central adiposity, and physical inactivity) in young adult Saudis with prediabetes compared to subjects with normal glucose tolerance (NGT). The earlier detection of the prediabetes conditions might be useful to primary care physician, health care providers, and educators for earlier lifestyle intervention and education to prevent progression from prediabetes to overt T2DM and its complications and thus eventually to reduce the economic and societal consequences of the disease.

2. Subjects, materials and methods

2.1. Study design and setting

Initially we invited 124 young adult (age group 18–46) Saudi Subjects using a convenience sampling technique. The participants of both sexes were apparently healthy without a history of diabetes. Three participants were excluded based on the value of their fasting plasma glucose (FPG) of more than 125 mg/dl, while the remaining 121 participants were enrolled in this study. Participants were asked about their physical activity, smoking habits, and family history of a first-degree relative with diabetes. In addition, personal data about age, sex, education, and profession were recorded.

2.2. Definition of NGT, IFG, and IGT

Based on the American Diabetes Association (ADA) 2003 criteria [18], all the enrolled one hundred twenty-one participants were further categorized into two groups: normal glucose tolerance (NGT) group and prediabetes group (IFG or IGT). NGT was defined as fasting plasma glucose below 100 mg/dl and 2-h plasma glucose less than 140 mg/dl. IFG was defined as having fasting plasma glucose 100–125 mg/dl while IGT was defined as having 2-h plasma glucose between 140 and 199 mg/dl.

2.3. Anthropometric measurements

Body weight, height, and waist circumference were measured by trained research assistants. Weight was measured using calibrated electronic weighing scales (Proton Digital Scale, Model PHC 309 MD) and height was measured using a Portable Height Scale (Mentone Educational, Model PE087, Australia).

Waist circumference (WC) was measured using an anthropometric tape at a level midway between the lower rib margin and iliac crest with the tape all around the body in a horizontal position.

Body mass index (BMI) was calculated as body weight in kilograms divided by height in meters squared. Participants with BMI equal 25–29.9 kg/m^2 were defined as overweight while those with BMI equal to/greater than 30.0 kg/m^2 were defined as obese according to definition by WHO [19].

2.4. Analytical assay

Venous blood samples (5 ml) were collected at fasting and 2-h after breakfast (postprandial) in heparinized vacutainers from participants to prepare plasma. Glucose was measured by glucose oxidase-glucose peroxidase method; glycated hemoglobin (HbA1c) was estimated from whole blood by fast ion-exchange separation method, plasma total cholesterol (TC), high-density lipoprotein-cholesterol (HDL-C), and triglyceride (TG) levels were measured by the enzymatic colorimetric methods on Hospitex Eos Bravo clinical chemistry analyzer. Low-density lipoprotein-cholesterol (LDL-C) was calculated by Fridewald's formula [20] (LDL = TC − HDL − TG/5.0). Analyses were done using available commercially kits supplied by Human Diagnostics (Wiesbaden, Germany).

Plasma total antioxidant status (TAS) was measured colorimetrically using an antioxidant assay kit (Randox, Antrim, UK) by a method depends on the ability of serum antioxidant substances to suppress production of the radical cation ABTS$^{\bullet+}$ (stable blue-green color, measured spectrophotometrically at 600 nm) from oxidation of 2,2′-azino-di-[3-ethylbenzthiazioline sulphonate] (ABTS) by metmyoglobin and hydrogen peroxide.

2.5. Statistical analyses

Statistical analysis of the data was performed using the SPSS software version 17.0 (SPSS Inc., IL, USA) for Windows. Results were reported as the mean ± standard deviation (SD) or number (%) where appropriate. Differences between prediabetics and controls were tested for significance by a Student's *t*-test (for continuous data) or chi-square test (for categorical data). The Pearson correlation was used to examine the relation between selected variables. Crude odds ratios and 95% confidence intervals were calculated using prediabetes as the dependent variable; glycated hemoglobin, BMI, waist circumferences, lipids profile, and total antioxidant status were included as possible independent predictor factors. Findings were considered to be statistically significant at the 5% level.

2.6. Ethical consideration

The protocol of this study conformed to the provisions of the Declaration of Helsinki and verbal informed consent was obtained, following a through explanation of the goals of the study to the participants by trained field research assistants. This work was approved by institutional review committee of the authors' institute.

3. Results

3.1. Characteristics of study participants

According to ADA criteria 2003, the study participants (n = 121) were classified into two groups by their glycemic status: prediabetes group (n = 35; n = 08 for IFG and n = 27 for IGT) as the study group and NGT group (n = 86) as the control group. In both groups, there was no significant difference in the age (p = .893) and sex (p = .758) between the participants. Subjects in the prediabetic group were significantly overweight/obese (p = .027) and showed visceral obesity measured by WC (p = .002) when compared to controls. Regarding smoking habits, participants were classified as nonsmokers, past smokers, or current smokers. The majority of participants in both groups were nonsmokers. Moreover, subjects in prediabetes group had more sedentary life in that only 2.9% have ≥30 min/day physical activities compared to 20.9% of the controls (p = .010). There was no significant difference (p = .098) in the genetic predisposition to diabetes (measured by family history of diabetes) between the prediabetics and controls. The main characteristics of the prediabetics and the controls are summarized in Table 1.

3.2. Laboratory investigations of study participants

As shown in Table 2, the prediabetics presented with significant differences in all of the investigated biochemical parameters when