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Original article

A visceral adiposity index-related dietary pattern and the cardiometabolic profiles in women with polycystic ovary syndrome

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SUMMARY

Background & aims: Visceral adiposity index (VAI), an indicator of visceral adiposity, has been found to be associated with cardiometabolic disturbances in women with polycystic ovary syndrome (PCOS). The association of dietary intakes with VAI, and subsequently cardiometabolic variables is still unclear. The aims of this study were to identify a dietary pattern associated with VAI and to investigate whether this pattern is associated with cardiometabolic variables in PCOS women.

Methods: The study was conducted on 53 PCOS women, aged 18–45 years, diagnosed according to National Institutes of Health (NIH) criteria, and 167 age-matched normo-ovulatory women who were recruited from the Tehran Lipid and Glucose Study. Reduced rank regression was applied to determine a dietary pattern that explains the maximum variation of the VAI. Associations between the dietary pattern and cardiometabolic profiles were investigated using linear and logistic regression, adjusted for age and BMI.

Results: A VAI dietary pattern was identified characterized by high consumption of fried vegetables, vegetable oils (except olive oil), salty snacks, legumes, eggs, fast foods and low consumption of traditional sweets, high and low fat dairy, cruciferous vegetables, sugars and honey. A one standard deviation (SD) increase in dietary pattern score was significantly associated with higher triglycerides (TGs) (βcontrol = 0.22, p = 0.003; βcase = 0.48, p = 0.001) and TGs/HDL-C ratio (βcontrol = 0.23, p = 0.002; βcase = 0.52, p = 0.001) in both groups. After adjusting for age and BMI, a 1-SD increase in dietary pattern score was associated with increased risk of VAD in PCOS (OR 2.77; 95% CI 1.15, 6.66) and control groups (OR 2.41; 95% CI 1.41–4.12). In the control group, the risk of hypercholesterolemia, hypertriglyceridemia, high LDL-C, low HDL-C, hyperglycemia and IGT + IFG increased significantly per 1-SD increase in dietary pattern score, which all remained significant after adjusting for age and BMI, except for the risk of high LDL-C. Among the cardiometabolic abnormalities, only the risk of hypertriglyceridemia was significantly associated with dietary pattern score in women with PCOS, which lost its significance after adjusting for age and BMI.

Conclusion: The VAI dietary pattern affects most cardiometabolic variables in controls, but to a lesser extent in PCOS women. Our study suggests that relationships between diet and cardiometabolic risk profiles may be modified by PCOS status.

1. Introduction

Polycystic ovary syndrome (PCOS), the main etiology for anovulatory infertility, is an endocrinology disorder commonly seen in reproductive age women [1]. The prevalence of PCOS estimated to be 14.7% in Iranian women [1]. In addition to endocrine

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abnormalities and gynecological manifestations, cardiometabolic abnormalities, including increased central and visceral adiposity, insulin resistance and impaired glucose tolerance, dyslipidemia, metabolic syndrome, and hypertension are also common features of women with PCOS [2–4]. Because of an increased risk for type 2 diabetes, and possibly cardiovascular disease (CVD) in women with PCOS, this syndrome has become a public health concern [2,4]. The increased visceral adiposity, observed in PCOS women plays an important role in the pathophysiology of this syndrome and its associated metabolic disorders [3]. It has been suggested that assessment of visceral adiposity may be better if performed independent of overall obesity to predict CVD morbidity and determine treatment protocols for PCOS [5]. Visceral Adiposity Index (VAI) is simply determined [6], and is considered a useful substitute for the visceral CT scan [5]. VAI can predict insulin sensitivity in PCOS women [5], and hence be a useful clinical tool in detecting metabolically unhealthy women with PCOS and assessing the cardiometabolic risk associated with it [7].

Diet interventions are among the first-line treatment for PCOS because nutritional factors may have important effects on metabolic and hormonal features of the PCOS [8]. Associations of diet with cardiometabolic risk factors have been reported in non-PCOS populations [9,10]; however, the association in PCOS women is still not clear. Although most studies of PCOS women show that macronutrient intake is not associated with indices of glycemic status [11–13], findings of one study demonstrate that dietary glycemic index is associated with a less favorable metabolic profile in this population [14]. HDL-C has been reported to be positively correlated with protein intake (as % of energy intake) and inversely correlated with carbohydrate in the women with the PCOS [15]; however, these associations were contrary to those observed in the control group without PCOS. Since all the aforementioned studies of dietary intakes in women with PCOS used single nutrients or food groups, investigating the association between dietary patterns may add additional information about diet and cardiometabolic profiles in the PCOS populations.

The aim of this study was therefore to identify a dietary pattern associated with VAI, using reduced rank regression (RRR), and subsequently, to investigate the association between the dietary pattern and cardiometabolic risk factors in women with PCOS and their age-matched controls.

2. Materials and methods

2.1. Study population

This study was carried out within the framework of the Tehran Lipid and Glucose study (TLGS), a prospective population based study of district 13 of Tehran, the capital of Iran. The aims of TLGS were to determine the prevalence of non-communicable diseases and their risk factors and to develop healthy life styles to ameliorate them. The objectives, design, and methods of collecting data for the TLGS were previously explained in details [16]. This study was initiated between 1999 and 2001 with 15,005 participants, whose demographic, lifestyle, medical and dietary information and biochemical measurements have been updated every three years since. Of 4290 women aged 18–45 years, who participated at baseline, 1002 participants were randomly selected using a systematic random sampling method for comprehensive assessment of PCOS status [17]. Of the 1002 women, there were 85 women with PCOS using National Institutes of Health (NIH) criteria and 718 women without any hirsutism or clinical menstrual dysfunction based on their history and physical examination were considered as normal eumenorrheic non-hirsute women. After excluding those women lacking dietary information, there were 53 PCOS and 670 controls that constituted our study pools; data of those 53 women with the PCOS along with 167 randomly selected age-matched controls were analyses for the current study. According to NIH criteria, women with menstrual dysfunction and clinical hyperandrogenism and/or hyperandrogenemia (HA), without evidence of having hyperprolactinemia, thyroid dysfunction, non-classic 21-hydroxylase deficiency (NCCAH) and Cushing's syndrome [17] were diagnosed as PCOS.

This study was approved by the ethics committee of the Research Institute for Endocrine Sciences of Shahid Beheshti, and written informed consent was obtained from all participants.

2.2. Data collection

Data on clinical and anthropometric assessments, and dietary intakes collected during the fourth follow-up examinations of the TLGS study (2009–2011) used in the current study.

2.3. Clinical assessments

A comprehensive questionnaire including demographic, reproductive and past medical history was completed for each study participant. Anthropometric variables including weight, height, waist circumference (WC) were measured according to standard protocols to the nearest 100 g for weight, 0.5 cm for height, and 0.1 cm for WC [16]. BMI (kg/m^2) was calculated as weight (kg) divided by height in meters squared (m^2). As described by Amato et al., VAI was computed using the formula $[WC/(36.58 + (1.89 \times BMI))] \times (TGs/0.81) \times (1.52/HDL\text{-}C)$, where the TGs and HDL-C concentrations are expressed in mmol/l [6].

Blood pressure (BP) was measured after a 15-min rest in the sitting position, using a standardized mercury sphygmomanometer. Two measurements of blood pressure were taken on the right arm, and the mean of the two measurements was considered as the participant's blood pressure.

Hirsutism was assessed using the modified Ferriman-Gallwey (mFG) scoring method by a general practitioner, who had been trained in a one-month observer course at the PCOS clinic under supervision of a single endocrinologist.

2.4. Dietary assessment

Validated food frequency questionnaire (FFQ) of 168 food items was used to assess dietary intakes [18]. The portion size for each food item was defined in the FFQ. Participants reported the frequency consumption of each food item with the number of portion sizes consumed on daily, weekly, monthly, or yearly over the past year. The consumption of each food item was then converted to grams per day. In this study, food items were aggregated into 23 food groups, based on resemblance in nutrients and their methods of preparation.

2.5. Biochemical assessment

All participants gave blood samples after 12–14 h overnight fasting. The enzymatic colorimetric method using Pars Azmun kits (Pars Azmun Inc., Tehran, Iran) was applied to assess fasting plasma glucose (FPG), the 2-h post challenge plasma glucose (2h-PG), total cholesterol (TC), TGs, and HDL-C. FPG and 2h-PG were assessed with the glucose oxidase technique, TC with cholesterol esterase and cholesterol oxidase, TGs with glycerol phosphate oxidase, and HDL-C with phosphotungistic acid after precipitation of the apolipoprotein β-containing lipoprotein. Inter- and intra-assay coefficients of variation (CVs) were both 2.2% for FPG, 0.6 and 1.6% for TGs, and 0.5 and 2% for TC and HDL-C, respectively. The Friedewald

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