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## Original research

# The relation of Dietary diversity score and food insecurity to metabolic syndrome features and glucose level among pre-diabetes subjects

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## ABSTRACT

**Introduction:** Prediabetes is considered as an increased risk factor for cardiovascular disease and overt diabetes and is the precursor stage of diabetes. Dietary Diversity Score (DDS) is recognized as an essential factor of a high-quality diet. However, diets with more varieties of food items might increase calorie intake and body weight. Therefore, this study was carried out to determine the association of DDS with metabolic syndrome features in adults with prediabetes.

**Methods:** Three hundred subjects were randomly selected from participants who were undergone diabetes test screening program. Dietary intake was assessed by using a validated semi-quantitative food frequency questionnaire. DDS was calculated by scoring food intake as nine food groups. The 18-items USDA household food securities and International Physical Activity (IPAQ) were also measured. The metabolic syndrome was defined according to the Adult Treatment Panel III.

**Results:** DDS mean for cases and controls were 4.43 and 4.9, respectively ( $p < 0.005$ ). The prevalence of food insecurity was 67/3% in cases and 55/4% in controls group. The decrease in metabolic syndrome probability was compatible with quartiles of DDS (the quartiles odds

Abbreviations: BMI, Body mass index; WC, Waist circumference; DDS, Diet diversity score.

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ratios: 0.6, 0.5, 0.4, 0.19,  $P=0.05$ ). A higher DDS was associated with lower level of fasting blood glucose, HDL-cholesterol, TG and Waist circumference.

**Conclusion:** Lower DDS was associated with high probability of metabolic syndrome and with some features of it, like high fasting blood glucose. Therefore, it seems that increase in dietary diversity scores could prevent the pre diabetes development to overt diabetes.

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## 1. Introduction

At present, diabetes is a major public concern [1] and its prevalence among US population is on the increase and is predicted to rise from 14% in 2010 to 21% by 2050 [2]. According to a national study, there was a 35.1% increase in DM prevalence over 6 years (from 2005 to 2011) among Iranian population [3]. Additionally, it seems that a person with pre-diabetes is 20 times more susceptible to be diabetic. Studies with pre-diabetic individuals have shown that lifestyle and diet modification can reduce the chance of having type 2 diabetes up to 58% [4,5]

Furthermore, different dietary patterns and factors such as consumption of different nutrients, food groups and also calorie restriction have been reported to be related to this health problem [6–9]. To the best of our knowledge, there is little research about the effect of overall quality of diet on diabetes in the literatures [10] and dietary diversity score (DDS) can be regarded as an indicator of overall quality of diet evaluation [11,12]. Moreover, a diverse diet is associated with higher levels of micronutrients intake such as fibre, vitamin C and calcium, all which are protective factors against metabolic syndrome, cancers, cardiovascular disease and also diabetes [13,14]. Dietary pattern could also be considered as the main factor in the link between DDS and risk of type 2 diabetes [6,15]. Nonetheless, the role of DDS in preventing development of prediabetes to overt diabetes mellitus has been neglected.

Food and Agriculture organization (FAO) defined food insecurity refers to going hungry or being at risk for going hungry because of the inability to afford food [16]. Previous studies showed food-insecure people were unable to achieve a hemoglobin A1c (HbA1c) goal of 7% or less [17,18]. Food insecurity may act as a risk factor for diabetes. Among subject with food insecurity, increased consumption of foods that are high in fat, salt and sugars which are often calorically dense and nutritionally poor, may play a role in this regard [19,20]. However, the association between food insecurity and glycemic control has not been assessed in previous studies, and mechanisms for a relationship between food insecurity and glycemic control in prediabetic subject remain unclear.

Food and Agriculture organization (FAO) has defined food insecurity as a state of hungry or being at risk for becoming hungry due to the inability of affording adequate food. Previous studies showed that food insecure people were unable to achieve the hemoglobin A1C goal level of 7% and food insecurity may act as a risk factor for diabetes. Increased consumption of foods that are high in fat, salt, sugars and are also calorically dense and nutritionally poor may play a role in diabetes development among people with insecurity

[17,20]. However, the association between food insecurity and glycemic control has not been assessed in previous studies.

In addition, although there are few studies about the role of diet in the etiology of metabolic syndrome [14,21], there is no report about the association of DDS and prediabetes. Therefore, evaluation of the association of DDS and prediabetes, which has not been reported earlier, seems to be interesting. According to a previous study, which revealed that DDS is a noble indicator of nutritional adequacy, the current study evaluated the relation between DDS and prediabetes with other features of the metabolic syndrome in Tehranian adults. The association of DDS and food insecurity in prediabetes patients were also assessed.

## 2. Materials and methods

### 2.1. Subjects

This cross-sectional study was carried out at Tehran University of Medical Sciences Tehran, Iran. Among the clinics where diabetes screening program is running, four clinics were randomly selected and all the patients in those clinics were considered for further tests. Fasting blood glucose/sugar (FBS) test was done according to World Health Organization recommendations. From each clinic, patients were chosen randomly from the list of diabetes screening program records. A total of 300 patients participated in the current study whose necessary information was available and, subjects were selected as follows. The healthy patients were selected from an outpatient research clinic as the control groups through convenience sampling method. The healthy patients have no pre/diabetes but maybe having hypertension and hyperlipidemia. Patients with FBS between 110 mg/dl to 126 mg/dl is classified as prediabetes subjects. Healthy individuals were selected from an outpatient research clinic as control groups through convenience sampling method. Patients with FBS between 110 mg/dl to 126 mg/dl were classified as prediabetes subjects. A written informed consent was obtained from each participant. Inclusion criteria was prediabetes individuals aged between 20 to 60 years whose diabetes were diagnosed no more than 4 months ago and exclusion criteria were a history of heart disease or heart attacks, cancer, diabetes, smoking, medications affecting blood pressure, blood lipids and blood glucose, dieting. The study was approved by the research council of the School of Nutrition and Diet Therapy, Tehran University of Medical Sciences (Ethics Number: TUMS. 9123468011-143806).

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