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Effect of whole wheat bread and white bread consumption on pre-diabetes patient

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ABSTRACT

Background and Objective: Soluble dietary fibers reduce postprandial glucose, total and LDL cholesterol level. Finding about the efficacy of whole grain on chronic disease such as diabetes and ischemic heart disease (IHD) and mortality is controversial. Bread is the most important source of carbohydrate diet and investigation the effect of bread on glycemic response is important. The aim of this study was to compare the effect of whole wheat bread and white wheat bread on risk factors of pre-diabetes patients.

Methodology :Nine hundred forty six **(**946) men and women 35 to 55 year of age were included in the study. Dietary intake was assessed with 3 days record. Whole breads involve sangak and barbary (are a kind of Iranian breads) that were considered 270 and 250 grams for each one, respectively. White breads involve bagets, lavash and taftoon (are a kind of Iranian breads) that were considered 90, 88 and 120 grams for each one, respectively. Biochemical assessments and anthropometric indices were determined according to the standard protocol.

Results: About 23% of participant was men and 77% were women**.** Significant positive correlation between white bread consumption and WC, BS 120, HbA1C, TG and SBP were found. We didn't find any significant correlation between white bread and other variables. After controlling some confounding factors such as age, sex and total energy intake, we found a positive association between white bread consumption and BS120, HbA1C and TG.

Conclusions: According to our finding white breads have an inverse effect of healthy status and whole wheat bread didn't have any significant effect of risk factors of diabetes.

KEY WORDS: Whole bread, White bread, Pre-diabetes.

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INTRODUCTION

Diabetes patients are increasing by population growth, aging, urbanization, increasing prevalence of obesity and physical inactivity.[1] Lipid profile abnormality, increasing blood glucose and glaciated hemoglobin (HbA1c) and obesity are the most risk factors for diabetes and lead to complications of this disease.[2]

Important factor to control and manage diabetes is dietary habits and nutrition. A novel approach in dietary habits is glysemic index (GI) and glycemic load (GL). Different interventions were made to lower the glycemic response. Studies showed soluble and non-soluble fiber and low GL diet can control glycemic response. Refined carbohydrate

and grains without bran have higher GL and GI than whole grains and have adverse effect on health.[3] According to findings soluble dietary fibers reduce postprandial glucose, total and LDL cholesterol levels.[4] Finding about the efficacy of whole grain on chronic disease such as diabetes and ischemic heart disease (IHD) and mortality is controversial.[5] Studies showed high intake of carbohydrates increase TG levels by enhancing hepatic synthesis of very low-density lipoprotein (VLDL) and decrease activity of lipoprotein lipase.[6] Large portion of energy be obtained from carbohydrates.[7]

Bread is the most important source of carbohydrate diet. Since bread is low cost and is the most part of Iranian diet and approximately more people consume it in all days of week, investigation about the effect of bread on glycemic response is important. Findings about whole and refined grains in recent studies are inconsistent so the aim of this study was to compare the effect of whole wheat bread and white wheat bread on risk factors of pre-diabetes patients.

METHODOLOGY

Participant: This cross sectional research was performed in Isfahan Endocrine and Metabolism Research Center (IEMRC). We choose participants from a cohort study that was conducted from 2003 until now with 3454 member in this center. Aims of this cohort study were prevention of type 2 diabetes by changing in life style or by medical intervention among high risk people. Inclusion criteria were men and female 35 to 55 years who were first relative history of type 2 diabetes. Exclusion criteria were those who used medication that has effect on glucose tolerance test and lipid profiles. One thousand three hundred fifteen subjects were pre-diabetes and 1050 of them had food record. Nine hundred forty six participants reported that they consume white or whole bread. According to ADA criteria[8] three hundred sixty eight subjects were impaired fasting glucose (IFG), those with 100-125 mg/dl of fasting blood glucose. In IFG group, 117 subjects consumed whole bread and 251 subjects consumed white bread. Three hundred three subjects were Impaired Glucose Tolerance (IGT), those with 140-199 mg/dl of blood glucose 120 minute after intake 75gr oral glucose. In IGT group, 133 subjects consumed whole bread and 170 subjects consumed white bread. Two hundred seventy five subjects were combined pre-diabetes (IFG +IGT) that 87 subjects consumed whole bread and 188 subjects consumed white bread. The Isfahan Endocrine and Metabolism Research Center (IEMRC) Medical Ethics Committee approved this study and each participant gave written informed consent.

Assessment of anthropometric indices: Weight was measured by Seca scales (Germany) to the nearest 100g with minimal clothing and without shoes. Height was measured in a standing position, without shoes while the shoulders were in a normal position to the nearest 0.5 cm. Waist circumference (WC) was measured using un-stretchable tape in a standing position without applying any pressure to the body's surface, and was recorded to the nearest 0.1 cm. WC was measured in the middle of the lowest gear and the top of the iliac crest (the most narrow waist circumference) Body mass index was estimated as weight (kg) divided by height (m) squared. WC was considered as abdominal obesity index and BMI was considered as general obesity index.

Biochemical assessment: Blood samples were taken from 7:30 to 9:30 AM, after 12 hours overnight fasting to determine serum lipids and whole blood glucose levels. Blood glucose, serum triglyceride (TG), total cholesterol and high density lipoprotein cholesterol (HDL-C) levels were determined by using an enzymatic method. Oral Glucose Tolerance Test (OGTT) was done after 10-12 hours of overnight fasting, a 75gr oral glucose was administered and plasma glucose concentrations were measured at fasting and 120 minutes after glucose taking (BS120). The analysis of sample was performed with an auto analyzer (BT 3000, Rome, Italy) using commercial kits (Chem Enzyme, Tehran Iran). Serum total cholesterol and triglycerides levels were measured by enzymatic reagents (Chem. Enzyme, Tehran Iran) adapted to Selecta auto analyzer.

HDL-C levels were measured by using available commercial kits (Pars Azmun, Tehran Iran). Low density lipoprotein cholesterol levels (LDL-C) were calculated from the values of serum triglyceride (TG), total cholesterol and HDL cholesterol according to the Fried Wald formula in triglyceride <400 mg/dl[9]: LDL-C=Total cholesterol –HDL-C-TG/5.

HbA1c were assessed with DS5 analyzer uses low pressure cat ion exchange chromatography in conjunction with gradient elution to separate human hemoglobin subtypes and variants from hemolyse whole blood.[10,11]

Inter assay coefficients of variations were 1.25 for triglycerides, 1.2 for cholesterol and 1.25 for glucose. The corresponding intra-assay coefficients of variations were 1.97, 1.6 and 2.2, respectively.

Table-I: Clinical and biochemical variables of participants.

Variables	*mean±SD**
Age	44.25±6.82
Waist circumference	90.78±9.42
Hip circumference	108.4±9.26
BMI	29.59±4.25
FBS	105.7±10.84
Bs120	143.51±38.39
HbA1C	5.22±0.82
TG	174.95±107.57
TC	202.35±40.45
HDL-C	45.63±12.33
LDL-C	109.03±24.73
SBP	11.7±1.67
DBP	7.6±1.22

*Mean ± Standard Deviation
BMI=body mass index, FBS=fasting blood sugar, BS 120=blood sugar 120, HbA1C= glycosylated hemoglobin, TG=triglycerides, TC=total cholesterol, HDL-C= high-density lipoprotein cholesterol, LDL-C= low-density lipoprotein cholesterol, SBP= systolic blood pressure, DBP= diastolic blood pressure.

Assessment of dietary intake: Dietary intake was assessed by three days record and trained dietitian adjusted it. These records had eleven columns that included cereals group, legumes, dairy, meat, fat, nuts, fruit, vegetable, sweet and sugar free and drinks. Dietitians educated the groups in classes how to prepare records. Then dietitians changed record's contents to gram.[12] According to the kind of breads consumption in their record we divided subjects in two groups (white bread consumer and whole bread consumer). Whole breads involve sangak and barbary (are a kind of Iranian breads) that were considered 270 and 250 grams for each one, respectively. White breads involve bagets, lavash and taftoon (are a kind of Iranian breads) that were considered 90, 88 and 120 grams for each one, respectively.

Statistic Analysis: SPSS (version 13) was used for statistical analysis. Continuous variables presented as mean ± standard deviation. Correlation between dependent variables (glucose and lipid parameters, anthropometric indices and blood pressure) and independent variables (whole and white bread) was evaluated by Pearson correlation. The relationships between dependent variable with bread consumption were examined using multiple linear regression analysis, after controlling for potential confounders (adjusted with age, sex, energy intake). $P<0.05$ was considered statistically significant.

RESULTS

About 23% of participant were men and 77% were women. Clinical and characteristics of the study participant are shown in Table-I.

Significant positive correlation between white bread consumption and WC, BS 120, HbA1C, TG and SBP were found. We didn't find any significant correlation between white bread and other variables. Any significant correlation between whole bread and variables was not observed.

After controlling some confounding factors such as age, sex and total energy intake, we found a positive association between white bread consumption and BS120, HbA1C and TG. Increasing the amount of white bread consumption lead to enhance BS120, HbA1C and TG levels. Any significant association was not observed between whole bread consumption and variables.

DISCUSSION

In this study we observed a positive association between white bread consumption and BS120, HbA1C and TG levels with and without adjusting of confounding factor. There were positive correlation between white bread consumption and WC and SBP without adjusting. High intake of whole grains is related to a reduced risk of type 2 diabetes and consumed regularly, may reduce body weight, improving insulin sensitivity, blood pressure and lipid metabolism;[13,14] however we didn't observe any significant association between whole wheat bread and risk factors of pre-diabetes. Similarly our findings; studies showed whole grains have no significant effect on metabolic syndrome variables such as TG, LDL-C, HDL-C, SBP, DBP, FBS and BMI.[15] A cross sectional study did not show any association between whole grain consumption and HDL-C, HbA1c and TG.[16] An interventional study

Table-II: Correlation coefficient of risk factors of pre-diabetes and type of bread consumption.

	Waist circumference	*BMI*	*FBS*	*BS120*	*HbA1C*	*TG*	*TC*	*HDL*	*LDL*	*SBP*	*DBP*
White bread	0.14*(0.001)	0.04(0.32)	0.03(0.52)	0.16(0.001)	0.01(0.04)	0.1(0.01)	-0.01(0.92)	-0.02(0.54)	0.13(0.48)	0.11(0.007)	0.05(0.2)
Whole bread	0.07(0.18)	0.02(0.62)	-0.04(0.48)	-0.03(0.63)	0.67(0.23)	0.06(0.21)	-0.01(0.86)	-0.02(0.7)	0.23(0.41)	-0.02(0.61)	0.024(0.65)

* Correlation coefficient (p-value), Abbreviations as in Table-I

Table-III: Multiple regression analysis on the association between type of bread consumption and risk factors of pre-diabetes.

	White bread		*Whole bread*	
	B±SE	*P*	*B±SE*	*P*
Model 1: Bs0	0.002±0.001	0.14	0.002±0.002	0.32
Model 2: Bs120	0.011±0.003	0.001	0.004±0.004	0.24
Model 3: HbA1c	0.01±0.001	0.04	0.01±0.001	0.26
Model 4: TG	0.12±0.013	0.035	0.005±0.14	0.73
Model 5: TC	0.05±0.005	0.99	0.001±0.006	0.95
Model 6: HDL	0.01±0.002	0.69	0.01±0.003	0.82
Model 7: LDL	0.013±0.43	0.51	0.001±0.43	0.97
Model 8:WC	0.01±0.001	0.38	0.001±0.001	0.57
Model 9:BMI	0.01±0.001	0.73	0.01±0.001	0.32

*Data are B-coefficient ± Standard Error. Values are corrected for various confounders such as total energy, sex and age. Independent variable is type of bread consumption. Abbreviations as in Table-I

showed three month consumption of wheat bran didn't change FBS and HbA1c in diabetes patients.[17] However some findings indicated that whole grain may have beneficial affect on glucose and lipid metabolism. Epidemiological studies showed an inverse effect of whole grain on risk factors of diabetes and beneficial effect to prevention of type 2 diabetes but findings are inconsistent.[2] Exact biological mechanisms related to the beneficial effects of whole grains are unknown.[15]

Whole grains are a rich source of fiber, minerals, vitamins, phenolic compounds, phytoestrogens and antioxidants and these components are related to beneficial effects of whole grains on healthy and improve insulin sensitivity. High fiber of whole grains leads to slower absorption of macronutrient, decrease blood glucose and insulin secretion. Soluble fiber can decrease cholesterol concentrations. However whole wheat (whole bread) contain little soluble fiber and cannot be responsible for reduce cholesterol levels.[5] Lack of association between whole wheat bread and risk factors of diabetes in our study and other studies may be due to little amount of soluble fiber in whole wheat bread. In addition to whole breads that subjects consumed may not have enough bran to effect of glucose and lipid parameters.

In contrast to our finding, some studies showed whole grains were associated with less weight gain.[18] Results of cohort prospective studies have reported whole grain foods decrease BMI and improve the metabolic abnormalities that related to diabetes progression.[19] Whole grains effect on satiety and decrease energy intake.[4] However, other studies reported no significant effects.[20,21]

Our study showed white bread may increase BS120, HbA1C and TG levels. White bread and refined carbohydrates have high GI and rapidly absorb from intestine and lead to increase blood glucose and insulin secretion. The Nurses' Health Study showed high dietary GL and low grain fiber and bran intake was associated with higher risk of type 2 diabetes mellitus.[22] High intake of carbohydrates induces hypertriglyceridemia.[23,24] Among healthy people, high refined-carbohydrate consumption reduces levels of HDL.[25] Many metabolic studies have shown that high carbohydrate diets increase levels of fasting triglycerides and increase in plasma remnant lipoprotein cholesterol and remnant lipoprotein triglycerides.[26] Studies have also showed refined grains increase dietary glycemic load, insulin demand and glysemic responce that may enhance the risk of type 2 diabetes and coronary heart disease.[6] Despite the contradictory findings, whole grains because of high content of fiber and many enzymatic inhibitors are digested and absorbed more slowly than refined grains and associated with small postprandial glucose responses and little insulin demand.[27]

CONCLUSION

According to our finding white breads have an inverse effect of health status and whole wheat bread didn't have any significant effect of risk factors of diabetes. Efficacy of whole wheat breads because of low content of soluble fiber must be further investigated to assess beneficial effect of them on healthy status.

REFERENCES

1. Wild S, Roglic G, Green A, Sicree R, King H. Global Prevalence of Diabetes Estimates for the year 2000 and projections for 2030. Diabetes Care. 2004;27:1047–1053.
2. Montonen J, Knekt P, Järvinen R, Aromaa A, Reunanen A. Whole-grain and fiber intake and the incidence of type 2 diabetes 1, 2. Am J Clin Nutr. 2003;77:622–629.
3. Ziaee A, Afaghi A, Sarreshtehdari M. Effect of Low Glycemic Load Diet on Glycated Hemoglobin (HbA1c) in Poorly-Controlled Diabetes Patients. Global J Health Sci. 2012;4(1).
4. Weickert M, Pfeiffer A. Metabolic Effects of Dietary Fiber Consumption and Prevention of Diabetes. J Nutr. 2008;138:439–442.
5. Jensen MK, Koh-Banerjee P, Franz M, Sampson L, Gronbaek M, Rimmam E. Whole grains, bran, and germ in relation to homocysteine and markers of glycemic control, lipids, and inflammation. J Clin Nutr. 2006;83:275-283.
6. Liu S. Intake of Refined Carbohydrates and Whole Grain Foods in Relation to Risk of Type 2 Diabetes Mellitus and Coronary Heart Disease. Am Coll Nutr. 2002;21(4):298–306.

7. Association AD. Nutrition recommendations and principles for people with diabetes mellitus. Diabetes Care. 2000;23(Suppl 1):S43–S6.
8. Seino M, Nanjo K, Tajima N, Kadowaki T, Kashiwagi A, Araki E, et al. Report of the Committee on the Classification and Diagnostic Criteria of Diabetes Mellitus. J Diabet Invest. 2010;1(5):212-228.
9. Becarevic M, Andrejevic S, Miljic P, Bonaci-Nikolic B, Majkic-Singh N. Serum lipids and anti-oxidized LDL antibodies in primary antiphospholipid syndrome. Clin Exp Rheumatol. 2007;25:361–366.
10. Frank E, Moulton L, Little R, Wiedmeyer H, Rohlfing C, Roberts W. Effects of hemoglobin C and S traits on seven glycohemoglobin methods. Clin Chem. 2000;46:864–867.
11. Roberts W, De B, Brown D, Hanbury C, Hoyer J, John W, et al. Effects of hemoglobin C and S traits on eight glycohemoglobin methods. Clin Chem. 2002;48:383–385.
12. Ghafarpoor M, Hoshiarrad A, Kianfar H. Guide to Home-scale, conversion coefficients and percentage of edible food. 1, editor.: Agricultural Sciences; 1999.
13. Harris K, Kris-Etherton P. Effects of whole grains on coronary heart disease risk. Curr Atheroscler Rep. 2010;12:368-376.
14. Jacobs D, Marquart L, Slavin J, Kushi L. Whole-grain intake and cancer: an expanded review and meta-analysis. Nutr Cancer. 1998;30(2):85–96.
15. Andersson A, Tengblad S, Karlstrom B, Kamal-Eldin A, Landberg R, Basu S, et al. Whole-Grain Foods Do Not Affect Insulin Sensitivity or Markers of Lipid Peroxidation and Inflammation in Healthy, Moderately Overweight Subjects. J Nutr. 2007;137(6):1401-1407.
16. Montonen J, Boeing H, Fritsche A, Schleicher E, Joost H, Schulze M, et al. Consumption of red meat and whole-grain bread in relation to biomarkers of obesity, inflammation, glucose metabolism and oxidative stress. Eur J Nutr. 2012. [Epub ahead of print]
17. Jenkins D, Kendall C, Augustin L, Martini M, Axelsen M, Faulkner D, et al. Effect of wheat bran on glycemic control and risk factors for cardiovascular disease in type 2 diabetes. Diabetes Care. 2002;25:1522–1528.
18. Koh-Banerjee P, Franz M, Sampson L. Changes in whole-grain, bran, and cereal fiber consumption in relation to 8-y weight gain among men. Am J Clin Nutr. 2004;80:1237–1245.
19. Giacco R, Della Pepa G, Luongo D, Riccardi G. Whole grain intake in relation to body weight: From epidemiological evidence to clinical trials. Nutr Metab Cardiovasc Dis. 2011;21(12):901-908.
20. Weickert M, Spranger J, Holst J, Otto B, Koebnick C, Mohlig M, et al. Wheat-fibre-induced changes of postprandial peptide YY and ghrelin responses are not associated with acute alterations of satiety. Br J Nutr. 2006;96:795–798.
21. Howarth N, Saltzman E, McCrory M, Greenberg A, Dwyer J, Ausman L, et al. Fermentable and nonfermentable fiber supplements did not alter hunger, satiety or body weight in a pilot study of men and women consuming self-selected diets. J Nutr. 2003;133:3141–3144.
22. Salmeron J, Manson J, Stampfer M, Colditz G, Wing A, Willett W. Dietary fiber, glycemic load, and risk of non-insulindependent diabetes mellitus in women. JAMA. 1997;277:472–477.
23. Liu S, Manson J, Stampfer M, Holmes M, Hu F, Hankinson S, et al. Dietary glycemic load assessed by food frequency questionnaire in relation to plasma high-density lipoprotein cholesterol and fasting triglycerides among postmenopausal women. Am J Clin Nutr. 2001;73:560–566.
24. Nestel P, Carroll K, Havenstein N. Plasma triglyceride response to carbohydrates, fats and caloric intake. Metabolism. 1970;19:1–18.
25. Mensink R, Katan M. Effect of monounsaturated fatty acids versus complex carbohydrates on high-density lipoprotein in healthy men and women. Lancet. 1987;1:122–125.
26. Abbasi F, McLaughlin T, Lamendola C, Kim H, Tanaka A, Nakajima K, et al. High-carbohydrate diets, triglyceride rich lipoproteins, and coronary heart disease risk. Am J Cardiol. 2000;85:45–48.
27. Jenkins D, Wesson V, Wolever T, Jenkins A, Kalmusky J, Guidici S, et al. Whole meal versus wholegrain breads: proportion of whole or cracked grain and the glycaemic response. BMJ. 1988;297:958–960.