Dietary Intake of Fruits and Vegetables and the Risk of Metabolic Syndrome

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Introduction

It is estimated that approximately 34 percent of adults 20 years of age or older in the United States have a clustering of risk factors (i.e., insulin resistance (with or without glucose disturbance), increased abdominal fat, dyslipidemia, and hypertension) known as the metabolic syndrome. According to the National Health and Nutrition Examination Survey (NHANES), 2003–2006, the prevalence increases with age and with increasing body mass index (BMI). Individuals with the metabolic syndrome have an increased risk of morbidity and mortality due to diabetes and cardiovascular disease.

The Adult Treatment Panel III (ATP III) recommends that individuals with the metabolic syndrome improve the quality of their diet by lowering their intake of saturated fat, trans fats, cholesterol and simple sugars, and increasing their intake of fruits, vegetables, and whole grains. Dietary patterns characterized by high fruit and vegetable intake are associated with a lower risk of hypertension, obesity, type 2 diabetes and a lower incidence of cardiovascular disease. Data from the NHANES Epidemiologic Follow-up Study on 9,609 adults aged 25 to 74 years free of cardiovascular disease at their baseline survey observed over an average of 19 years a dose-response relationship, the higher the intake of fruits and vegetables, the lower the cardiovascular disease risk. Data evaluating the relationship between fruit and vegetable consumption and the metabolic syndrome is limited. The purpose of this study was to determine the association between fruit and vegetable intake and the prevalence of the metabolic syndrome among adults living in New Ulm, Minnesota. It was hypothesized that the individuals who report eating 5 or more fruit/vegetable servings daily would be less likely to have prevalent metabolic syndrome relative to those who eat fewer fruits/vegetables.

Methods

Sample: 1917 adults were screened through the Heart of New Ulm project, a 10-year demonstration project to reduce incident myocardial infarctions in New Ulm, MN.

Measures and procedures: Data was collected at 30-minute, heart-health screenings by trained health professionals. The ability of fruit/vegetable consumption to predict prevalence of metabolic syndrome was assessed; covariates included perceived stress, tobacco use, physical activity, and demographics (age, sex, education).

◆ Fruit/Vegetable Consumption: Measured via a one-item screener question defining a standard serving.

◆ Metabolic Syndrome: Defined as presence of ≥3 of the following:

1) Blood Pressure: Systolic blood pressure ≥130 mm/Hg, or diastolic blood pressure ≥85 mm/Hg, or current high blood pressure prescription medication.

2) Anthropometrics: Waist circumference ≥40 inches if male, or waist circumference ≥30 inches if female, or if waist circumference was unavailable, body mass index ≥30 kg/m^2.

3) Low HDL Cholesterol: HDL cholesterol <40 mg/dL if male, and <50 mg/dL if female.

4) Triglycerides: Triglycerides ≥150 mg/dL.

5) Glucose: Fasting blood glucose ≥100 mg/dL or current glucose control prescription medication.

◆ Perceived Stress: Measured via a shortened four-question Perceived Stress Scale converted to an index between 0 and 16.

◆ Cigarette use: Measured via a single question asking if participant was a current, former, or never smoker.

◆ Physical Activity: Evaluated via the CDC's 2001 Behavioral Risk Factor Surveillance System, measuring weekly amount of moderate and vigorous physical activity.

◆ Demographics: Assessed via self-reported age, gender, and highest education level.

◆ Statistical Analysis: SAS Version 9.1 was used. Confounders were covariates that changed the initial logistic regression (PROC LOGISTIC) by more than 10%, and independent predictors were covariates with p-value <.05; both were retained in final model.

Results

Descriptive characteristics of the sample are outlined in Table 1. Based on the definition of the metabolic syndrome, the overall prevalence of the study sample was 30%. Unadjusted analyses revealed that participants who reported eating less than 5 fruits/vegetables per day had 88% higher odds of having the metabolic syndrome relative to participants who reported eating 5 or more fruits/vegetables per day (see Table 2). The final multivariate regression model revealed that, after adjusting for the confounding variables of age (OR=1.02[1.02, 1.03], X^2=40.35, p<0.001) and physical activity level (OR=1.61[1.31, 1.98], X^2=20.12, p<0.001), participants who reported eating less than 5 fruits/vegetables per day had two times higher odds of having the metabolic syndrome relative to participants who reported eating 5 or more fruits/vegetables per day (OR=2.03[1.49, 2.75], X^2=20.50, p<0.001). The intercept for this model was β±se=-2.83±0.26.

Table 1:
Descriptive characteristics of the sample

Values are SD ± for age, perceived stress, physical activity and fruit/vegetable consumption. Remaining values are frequency (percent of sample).

	N = 1,917
Age (years)	51.2 ±14.6
Sex (female)	1,178 (61%)
Education (college or graduate degree)	660 (34%)
Perceived stress (score 0–16)	3.9 ±2.8
Tobacco use (current)	184 (10%)
Physical activity ≥150 minutes/week minutes/week	376.4 ±411.9 1,270 (66%)
Fruit/vegetable consumption ≥5 servings/day servings/day	2.9 ±1.7 314 (16%)
High blood pressure (systolic blood pressure ≥130 mm/Hg, or diastolic blood pressure ≥85 mm/Hg, or current high blood pressure prescription medication)	939 (49%)
Abdominal obesity (≥40 inches if male, or ≥30 inches if female, or body mass index ≥30 kg/m^2 [if waist circumference unavailable])	999 (52%)
Low HDL cholesterol (<40 mg/dL if male, or <50 mg/dL if female)	535 (28%)
High triglycerides (≥150 mg/dL)	552 (29%)
High glucose (≥100 mg/dL or current glucose prescription medication)	460 (24%)
Metabolic syndrome (present)	569 (30%)

Table 2:
Unadjusted association between low fruit/vegetable consumption and prevalent metabolic syndrome in non-diseased adults (N=1,917)

	Metabolic syndrome	No metabolic syndrome
< 5 servings per day	507 (26%)	1096 (57%)
≥ 5 servings per day	62 (3%)	252 (13%)

Conclusion

This study demonstrated that higher intakes of fruit and vegetables were associated with a lower prevalence of the metabolic syndrome. These findings support current recommendations to increase intakes of fruits and vegetables as a measure to prevent cardiovascular disease. In choosing a therapeutic diet for individuals diagnosed with the metabolic syndrome, fruit and vegetable intake should be considered and encouraged as part of the broader nutrition therapy strategies to treat all of the abnormalities of the metabolic syndrome. Future studies, such as a clinical trial, may be helpful to determine if fruit and vegetable consumption does improve incident metabolic syndrome.

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