



Soyfood consumption and risk of glycosuria in post-menopausal women

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ABSTRACT

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Menopause is a natural event to be experienced by every woman and appears to be associated with increased risk for developing type 2 diabetes mellitus. It has been postulated that a diet high in legumes may be beneficial for the prevention of glycosuria. These unique components of soy have been shown to have beneficial effects on glucose and insulin homeostasis. The objective of the present study was to examine the possibility of an association between soy food consumption and risk of glycosuria in postmenopausal women. A cross-sectional study was conducted among 94 postmenopausal women attending Mampang Prapatan Health Center, Mampang Prapatan subdistrict, South Jakarta. Anthropometric measurements were taken using standard instruments and dietary intake was assessed with a validated food-frequency questionnaire. A dipstick semiquantitative assay for urinary glucose was used to define glycosuria (positive). The results showed that 12.8% of postmenopausal women had glycosuria and mean isoflavone intake was 69.5 ± 61.4 g/d. Intake of isoflavone was inversely associated with risk of glycosuria. Compared to women in the lowest quintile of isoflavone intake (Q1), postmenopausal women in the highest quintile (Q5) had a lower risk for glycosuria of 0.30 times that of Q1, which risk was however statistically not significant (OR = 0.30; 95% CI = 0.02 – 3.14). In conclusion, isoflavone may play a role in the prevention of glycosuria (an important indicator of diabetes) among postmenopausal women.

Keywords : Isoflavone, intake, glycosuria, postmenopausal women

INTRODUCTION

Some facts about menopause are applicable to all women, since menopause is a natural event to be experienced by every woman. The common denominator is cessation of menstrual cycles. On the other hand, in relation to the symptoms and risks for osteoporosis, cardiovascular diseases, cancer

and Alzheimer disease, every woman is unique. Menopausal women suffer from deleterious effects of lowered estrogen levels, including reduction of bone mass, menopausal symptoms, and hypercholesterolemia. These effects are pronounced during early post menopause because of drastic estrogen reduction, and tend to become attenuated during late post menopause. Menopause

appears to be associated with a decrease in pancreatic insulin secretion as well as increased insulin resistance. These changes are thought to contribute to the increased risk for developing type 2 diabetes mellitus (DM) after menopause. The prevalence of type 2 DM has been increasing rapidly worldwide;⁽¹⁾ thus knowledge of risk factors and protective factors associated with type 2 DM is essential for the development of prevention strategies. Phytoestrogens can potentially alleviate hypoestrogen related deleterious effects. Soy and isoflavone dietary supplements are regularly used by millions of North Americans for symptoms associated with menopausal transition or for other purported health benefits.⁽²⁾ Phytoestrogens are naturally occurring plant compounds that are structurally and functionally similar to estradiol. There are four major classes of phytoestrogens: i) isoflavones, found in soy beans and soy products; ii) lignans, found in whole grains, cereals and oilseeds; iii) flavonoids, found in some fruits and legumes; and iv) coumestans found in bean and alfalfa sprouts.⁽³⁾ Isoflavones are phytoestrogens with the most potent estrogenic activity, comprising genistein, daidzein and glycitein found in soybeans, the latter being a major dietary source of isoflavones. Asians consume 10–100 times more isoflavones than do Westerners, and osteoporosis-related fractures are less frequent in Asian than Western communities, possibly because of the large quantities of phytoestrogen-rich soybeans and vegetables in the Asian diet.⁽⁴⁾

Soybean, a member of the legume family, is a rich source of plant protein, fiber, vitamins, minerals, and phytoestrogens (isoflavones).⁽⁵⁾ These unique components of soy have been shown to have beneficial effects on glucose and insulin homeostasis. Animal studies have demonstrated that soy protein and soy isoflavones improve glycemic control, lower insulin requirement, and increase insulin sensitivity.⁽⁶⁾ Similar benefits have also been

documented in several intervention studies with soy supplements (soy protein, soy fiber, and soy isoflavones), but results have been inconsistent.^(7,8)

One cross-sectional study examined the effect of usual dietary intake of isoflavones on glucose metabolism and observed an inverse association with insulin level.⁽⁹⁾ An animal study revealed that soy protein and isoflavone content could improve control of glycemic levels, and increase insulin sensitivity. Similar benefits were documented in several studies with soy-derived supplements, but the results were inconsistent. The main point is that soy food has a low glycemic level, which is linked to blood glucose levels.^(10,11) The present study aimed to determine the existence of an association between isoflavone intake and the risk of glycosuria in postmenopausal women in Mampang Prapatan subdistrict, South Jakarta.

METHODS

Design of the study

A cross-sectional study was conducted from 16 January 2010 to 2 February 2010 to determine the possibility of an association between soyfood intake and glycosuria in postmenopausal women at a primary health center in Mampang Prapatan sub-district, South Jakarta.

Study subjects

The subjects who participated in this study were postmenopausal women attending the primary health center at Mampang Prapatan subdistrict, South Jakarta. The inclusion criteria used in this study were: female with cessation of menstruation for one year or longer, able to communicate, and willing to participate in this study.

Data collection

Personal interviews were conducted to obtain information on demographic and

socioeconomic features, tobacco and alcohol use, physical activity, menstrual and reproductive history, lifetime occupational history, as well as medical history, including diabetes mellitus, coronary heart disease, stroke, hypertension, and other chronic diseases ever diagnosed by a physician, along with use of selected medicines, including postmenopausal hormones. Anthropometric measurements, including weight and height, were performed on all study participants according to a standard protocol. Body mass index (BMI) was calculated as weight in kilograms divided by the square of height in meters. BMI levels were categorized as normal weight ($< 23.0 \text{ kg/m}^2$), overweight or obese ($\geq 23.0 \text{ kg/m}^2$) according to the criteria established for Asian populations.⁽¹¹⁾

Dietary assessment

Data on nutrient intake were obtained by personal interview using a soy food questionnaire listing 14 soy food items responsible for the majority of soy consumption, comprising steamed tofu, dried tofu, Bandung tofu, soft tofu, steamed tempeh, *tempe bacem*, regular soy milk, *tahu kuning*, soy bean *sangria*, fried soy beans, steamed soy beans, soy sauce, *tahu bungkus*, fried tempeh.^(12,13) Study participants were asked to recall the frequency of consumption of individual food items (number of times per day, week, month, and year) and estimated portion size, using local weight units (50 g) or natural units (cup, bowl) per unit time. The USA FDA Food Composition Table⁽¹³⁾ was used to estimate the intake levels of isoflavone for study participants.

Urinary glucose test

A dipstick semi-quantitative assay for random urinary glucose was performed on study participants who gave a spot urine sample. A cutoff point of greater than trace for urinary glucose was used to define glycosuria (positive) in this study.

Sample size

The number of subjects required for this study was calculated on the basis of the formula for sample size for surveys with a prevalence of glycosuria of 0.1, alpha level of 0.05 and acceptable margin of error for proportion being estimated of 0.05.⁽¹⁴⁾

The sample was taken by consecutive non-random sampling, where persons attending the health center and meeting the inclusion criteria were designated as respondents until the required sample size was obtained.

Statistical analysis

Study participants were divided into five categories according to quintile distribution of total soy protein intake (an equivalence of total soy food intake) among the study participants. The lowest quintile was treated as the reference group. Logistic regression analysis was used to obtain maximum likelihood estimates of the odds ratios (ORs) and their 95% confidence intervals (CIs) to measure the association between soy food consumption and glycosuria. Variables adjusted for multiple regression models included age, education, regular physical activity during the past 5 years, and BMI. All statistical tests were based on two-sided probability using SPSS, version 15.0.

RESULTS

The study participants were 94 postmenopausal women with mean age of 58.7 ± 7.7 years (range 43-89 years). Around half of the women (59.6%) was married, 85.1% was unemployed, 68.1% had a low level of education and 97.9% did not smoke (Table 1).

For most respondents (40.4%) the duration of menopause was more than 10 years, normal and underweight BMI (≤ 22.9) accounted for 50% of respondents, and 56.4% of respondents performed moderate activity (Table 2).

Glycosuria was present in 12.8% of respondents, while mean isoflavone intake was $69.5 \pm 61.4 \text{ g/d}$ (Table 3).

Table 1. Distribution of demographic characteristics of postmenopausal women (n=94)

Demographic	n (%)
Age (years)*	58.7 ± 7.7
Level of education **	
Low	64 (68.1)
Medium	19 (20.2)
High	11 (11.7)
Employment	
Unemployed	85.1
Employed	14.9
Marital status	
Married	59.1
Widowed	39.4
Single	1.1

*Mean ± SD; **Low: No education, primary school; Medium: junior high school; High: Senior high school and academy/university

Table 2. Distributions of duration of menopause, BMI dan activity of respondents (n=94)

Factors	n (%)
Duration of menopause (years)	
1 – 5	29 (30.9)
5 – 10	27 (28.7)
> 10	38 (40.4)
Body mass index	
≤ 22.9	47 (50)
= 23.0	47 (50)
Activity	
Inactive	34 (36.2)
Moderate	53 (56.4)
High	7 (7.4)

Table 3. Glycosuria prevalence and isoflavone intake in postmenopausal women (n=94)

Factors	n (%)
Glycosuria	
Positive	12 (12.8)
Negative	82 (87.2)
Isoflavone intake (g/d) *	69.5 ± 61.4
Quintile 1	16.9 ± 5.8
Quintile 2	31.2 ± 4.9
Quintile 3	50.2 ± 8.6
Quintile 4	87.1 ± 13.1
Quintile 5	159.2 ± 75.0

* Mean ± S.D.

Table 4 shows that compared to women in the lowest quintile of isoflavone intake (Q1), postmenopausal women in the highest quintile of isoflavone (Q5) had a 0.30 times lower risk for glycosuria, but the difference was not statistically significant (OR = 0.30;95% CI = 0.02 – 3.14).

DISCUSSION

In the present study, the prevalence of glycosuria in postmenopausal women with mean age of 58.7 ± 7.7 years was 12.8%, differing from that of a large cross-sectional study of Chinese women, where the prevalence was 8.2%.⁽¹¹⁾ In our study, postmenopausal women with higher isoflavone intakes had a lower risk of glycosuria, although the association was not statistically significant. However, in the abovementioned Chinese cross-sectional study there was a significant inverse association between soy intake and glycosuria among postmenopausal women.⁽¹⁶⁾ Our study found a mean isoflavone intake of 69.5 ± 61.4 g/d. In traditional Asian diets, soy intake is usually high, with a mean level of 100 g/d, which corresponds to an approximate soy protein intake of 10 g/d.⁽¹⁵⁾ There are few studies on the relationship between isoflavone intake and glycosuria in postmenopausal women in Indonesia. Glycosuria is a strong predictor of diabetes, and our results suggest a potential role for soy foods in the prevention of diabetes. Although no previous study has evaluated regular consumption of soy foods in relation to the risk of diabetes, our findings are supported by the existing evidence from animal and human studies showing that several major components of soy foods have beneficial effects on glucose and insulin homeostasis. Animal studies have revealed that feeding soy protein results in elevated glucose disposal rates, decreased pancreatic insulin release, and increased hepatic insulin removal.⁽¹⁶⁾ Although glycosuria is a powerful predictor of diabetes, its value in diagnosis of diabetes has been

Table 4. Odds Ratio (OR) and 95% confidence interval (CI) for glycosuria associated with isoflavone intake among postmenopausal women

Isoflavone intake (g/d)	n	OR (95% CI)
Quintile 1	18	1.00 (reference group)
Quintile 2	19	1.01 (0.24 – 6.13)
Quintile 3	19	1.00 (0.23 - 5.72)
Quintile 4	19	0.63 (0.16 – 4.38)
Quintile 5	19	0.30 (0.02 – 3.14)

questioned. In a large prospective, population-based study of middle-aged Chinese women, a higher intake of legumes, soybeans in particular, was associated with a reduced risk of type 2 DM.⁽¹⁷⁾ Soy intake is generally low in Western populations, which limits the ability of epidemiologic studies to determine associations between soy intake and type 2 DM in these populations.

Phytoestrogens have a molecular structure similar to that of estrogens and are weakly estrogenic in conditions of endogenous estrogen depletion.⁽¹⁸⁾ Among postmenopausal women, previous studies have found an association between intakes of dietary isoflavone and isoflavone supplements on the one hand and improved insulin resistance on the other.^(8,19) In addition, there is evidence that soy consumption in postmenopausal women also increases sex hormone-binding globulin level,⁽²⁰⁾ the latter being inversely associated with impaired glucose tolerance. In a double-blind, randomized, placebo-controlled trial involving 203 postmenopausal Chinese women aged 48 to 62 years, the investigators found that soy isoflavone supplementation for a period of one year presumably could decrease fasting glucose levels.⁽²¹⁾ In contrast, a 6-mo randomized controlled trial could not convincingly demonstrate that soy protein with or without isoflavone supplementation had favorable effects on glycemic control and insulin sensitivity among postmenopausal Hong Kong Chinese women with prediabetes or early untreated diabetes.⁽²²⁾

Soy isoflavones, as a major category of

phytoestrogen, can bind to the estrogen receptors α and β , although more strongly to the latter.⁽²³⁾ Existing evidence has shown that isoflavones could act as estrogen agonists or antagonists, depending on the target tissues,⁽²⁴⁾ doses and types of isoflavones,⁽²⁵⁾ and endogenous circulating sex hormone profile.⁽²⁰⁾ A previous cross-sectional study in Shanghai reported that soy intake was associated differently with glycosuria between premenopausal and postmenopausal women, indicating that menopausal status and endogenous estrogen levels may modify the phytoestrogen activity of soy.⁽¹¹⁾ Legumes have been indirectly linked to a protective role in the development of type 2 DM as components of a prudent diet, which is associated with a lower risk of type 2 DM.^(27,28) Conversely, in another study, high consumption of legumes was linked to a dietary pattern associated with an increased risk of type 2 DM.⁽²⁹⁾

Nevertheless, our study has several limitations. The primary concern of this study is the accuracy of the method used to detect urinary glucose. A published study, however, has demonstrated that the dipstick assay for urinary glucose is quite accurate, showing a very good agreement with the quantitative estimation (k coefficient = 0.8).⁽³⁰⁾ The possibility of other sources of bias is minimized because of the use of validated FFQ. Owing to the inherent limitations of a cross-sectional study design, the temporal sequence of soyfood intake and development of glycosuria cannot be firmly established in this study.

CONCLUSIONS

Regular isoflavone intake was inversely associated with the risk of glycosuria among postmenopausal women, suggesting a potential protective effect of soy foods in the prevention of diabetes.

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