

Soy and legume seeds as sources of isoflavones: selected individual determinants of their consumption in a group of perimenopausal women

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Abstract

The aim of this study was to analyze selected individual determinants of consumption of soy products and legumes by menopausal women. The analyzed individual characteristics included the level of general self-efficacy, optimism, and satisfaction with life. The study, using a questionnaire for the assessment of food product consumption frequency, and psychological tests (GSES, LOT-R, SWLS), was conducted in a group of 320 women aged between 45 and 55 years. Spearman's coefficient of rank correlation and the Kruskal-Wallis test with the Dunn test for multiple comparisons were used for statistical analysis ($p < 0.05$).

Material and methods: The analyzed 45-55-year-old women consumed legume seeds several times a month on average, while the frequency of soy/soy product consumption was lower than once a month. Statistical analysis revealed that the frequency of soy product consumption increased with the level of self-efficacy, optimism and satisfaction with life ($p < 0.01$). Also the increased frequency of legume seed consumption was associated with higher level of optimism and satisfaction with life ($p < 0.01$).

Results: Intergroup comparisons of the average consumption frequency of these products confirmed that legume seeds were significantly more frequently chosen by women characterized by high rather than low levels of optimism (3.36 vs. 2.62, $p < 0.001$) and satisfaction with life (3.36 vs. 2.65, $p < 0.01$). Also soy products were preferred significantly more often by women with higher levels of optimism (2.00 vs. 1.38, $p < 0.05$) and satisfaction with life (2.02 vs. 1.39, $p < 0.05$).

Conclusions: The consumption of legume seeds, and especially soy products, was revealed to be very low among perimenopausal women, and varied depending on the analyzed individual traits, with a tendency to more frequent ingestion by individuals with higher levels of self-efficacy, optimism, and satisfaction with life.

Key words: women, menopause, pulse seeds, soya, phytoestrogens, psychological features.

Introduction

Phytoestrogens, a class of environmental estrogens, include lignans, stilbenes, and flavonoids [1]. Isoflavonoids, which include isoflavones, constitute one group of flavonoids. Soy and its products, and legume seeds (lentils, beans, peas) are the richest sources of isoflavones, including genistein and daidzein [2]. Moreover, small amounts of isoflavones are also contained in other plant products (cereals, potatoes, vegetables, fruits), as well as in milk, meat, and beer [1, 2].

Despite the variability of their chemical structure, phytoestrogens are structurally similar to natural and synthetic estrogens, including 17- β -estradiol. Phytoestrogens are biologically active compounds playing an important role in prevention of degenerative disorders, including neoplasms, cardiovascular conditions, and osteoporosis [1, 3-5]. Both epidemiological and clinical studies confirmed that a diet rich in soy (and phytoestrogens) decreases the incidence of breast [6] and

endometrial cancer [7]. The role of phytoestrogens in cancer prevention is, among others, related to their antiproliferative and antioxidative properties, as well as to the inhibition of angiogenesis and enhancement of apoptosis in neoplastic cells [8]. Genistein was revealed to play the most significant role in cancer prevention; its antiproliferative effect was confirmed in both estrogen-dependent and independent cells [9]. Moreover, soy phytoestrogens, including genistein, are also involved in prevention of osteoporosis. One of the crucial causes of this condition is the decrease in endogenous estrogen levels, characteristic for the menopausal period [10]. The role of isoflavones in increasing bone mineral density is associated with the inhibition of osteoclast activity, activation of osteoblasts, and elevated concentration of insulin-like growth factor I (IGF-I), which stimulates synthesis of collagen and secretion of parathormone, and increases blood concentration of calcium [6, 9, 11, 12]. Casidy *et al.* [9] revealed that daily consumption of 100 g of soy products was reflected by

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greater density and mass of bones. Although natural phytoestrogens, including soy preparations, are gaining increasing interest in gynecological practice [6], they cannot completely substitute for hormone replacement therapy (HRT) [13]. Moreover, the menopausal period is associated with increased risk of cardiovascular disorders [14, 15], and so-called functional foods, rich in phytoestrogens, play an important role in the prevention of these conditions [4, 16], due to improved lipid profile of blood, increased elasticity of blood vessels, and inhibition of thrombosis [17].

Increased risk of chronic conditions, including osteoporosis, cardiovascular disorders, and neoplasms, in menopausal women [10, 14, 15], and the documented association between personality traits and dietary choices [18], substantiated our research on the individual determinants of the consumption of soy and legume products, as foods playing an important role in the prevention of diet-dependent conditions.

The aim of this study was to analyze selected individual determinants of diet with regards to the frequency of consumption of soy products and legumes by menopausal women. The selected individual characteristics subjected to analysis included the level of general self-efficacy, optimism, and satisfaction with life.

Material and methods

The study was conducted between 2010 and 2012 in a group of 320 women aged between 45 and 55 years. All the participants were professionally active employees of various offices in the Małopolska region. They all performed intellectual work, and had secondary (70%) or higher education (30%); most of them were married (80%). Due to the principal objective of the study, a group homogeneous in terms of sociodemographic characteristics was selected.

The frequency of consumption of food products was analyzed using a 7-item scale containing the following categories: several times a day (corresponding to 7 points), once a day (6 pts), several times a week (5 pts), once a week (4 pts), several times per month (3 pts), once a month (2 pts), and rarer/never (1 pt). Body mass index (BMI) was calculated on the basis of somatic measurements of body weight and body

height. The levels of individual traits were determined with the validated tests: General Self-Efficacy Scale (GSES) by R. Schwarzer, M. Jerusalem and Z. Juczyński; Life Orientation Test (LOT-R) by M.F. Scheier, Ch.S. Carver and M.W. Bridges, adapted by R. Poprawa and Z. Juczyński; and Satisfaction with Life Scale (SWLS) by Ed Diener, R.A. Emmons, R.J. Larson and S. Griffin, adapted by Z. Juczyński. General Self-Efficacy Scale was used to determine the level of general self-efficacy, while the optimistic disposition and overall satisfaction with life were measured with LOT-R and SWLS, respectively. The examined women were classified into groups with low, moderate and high levels of self-efficacy, optimism, and satisfaction with life on the basis of relevant provisional Polish sten (standard ten) norms for adults [19].

The relationship between BMI, the levels of self-efficacy, optimism and satisfaction with life (GSES, LOT-R and SWLS scales) and the frequency of consumption of studied products was estimated on the basis of Spearman's coefficient of rank correlation. The mean frequencies of consumption of the analyzed products associated with various levels of analyzed individual traits (GSES, LOT-R and SWLS scales) were compared with the Kruskal-Wallis test with the Dunn test for multiple comparisons. Test probability was considered significant at $p < 0.05$. Statistical analysis was conducted with PQStat ver. 1.4.2.324 software.

Results

The analyzed group of women consumed legume seeds several times a month on average (3.04), and the frequency of soy/soy product consumption was lower than once a month (1.71) (Table I).

An inverse correlation was documented between the frequency of legume seed consumption and BMI ($p < 0.01$). Statistical analysis revealed that the frequency of soy/soy product consumption increased with the level of self-efficacy ($p < 0.01$), optimism ($p < 0.01$) and satisfaction with life ($p < 0.01$). Also the increased frequency of legume seed consumption was associated with higher level of optimism ($p < 0.01$) and satisfaction with life ($p < 0.01$) (Table I).

However, subsequent statistical analysis proved that the level of general self-efficacy does not influence

Table I. Spearman's coefficients of rank correlation between BMI, GSES, LOT-R, and SWLS scales and the frequency of analyzed product consumption in a group of perimenopausal women

Products	Descriptive statistics			Spearman's coefficients of rank correlation			
	X	SD	Me	BMI	GSES	LOT-R	SWLS
Legume seeds	3.04	1.44	3.00	-0.1792**	-0.0395	0.1757**	0.1558**
Soy and soy products	1.71	1.24	1.00	-0.0893	0.1606*	0.2125**	0.1949**

X – arithmetic mean; SD – standard deviation; Me – median; BMI – body mass index; GSES – General Self-Efficacy Scale; LOT-R – Life Orientation Test, SWLS – Satisfaction with Life Scale
* $p < 0.05$; ** $p < 0.01$

Table II. Frequency of analyzed product consumption depending on the level of self-efficacy (GSES), optimism (LOT-R) and satisfaction with life (SWLS) in a group of perimenopausal women

Products	Level	GSES		LOT-R		SWLS	
		Me	<i>p</i>	Me	<i>p</i>	Me	<i>p</i>
Legume seeds	H	3.0	0.0756	3.0	0.0009	3.0	0.0017
	M	3.0		3.0		3.0	
	L	3.0		2.0		2.0	
Soy and soy products	H	1.0	0.1224	1.0	0.0035	1.0	0.0035
	M	1.0		1.0		1.0	
	L	1.0		1.0		1.0	

GSES – General Self-Efficacy Scale; LOT-R – Life Orientation Test, SWLS – Satisfaction with Life Scale, H – high, M – moderate, L – low level of self-efficacy (GSES), optimism (LOT-R), satisfaction with life (SWLS), *Me* – median; *p* – significance of differences determined with the Kruskal-Wallis test

the frequency of legume and soy product consumption ($p > 0.05$) (Table II). In contrast, the level of optimism modulated the frequency of consumption of both legume seeds ($p < 0.001$) and soy products ($p < 0.01$). Intergroup comparisons revealed that women characterized by a high level of optimism consumed legume seeds significantly more often than participants with a low level of this trait ($p < 0.001$). A similar association was confirmed in the case of tofu and other soy products, significantly more frequently chosen by women with high rather than low scores of LOT-R ($p < 0.05$) (Table II). The level of satisfaction with life exerted a significant effect on the consumption frequency of legume seeds ($p < 0.01$) and tofu or other soy products ($p < 0.01$). Intergroup comparisons revealed that legume seeds were significantly more often considered in the diet of women with high rather than low satisfaction with life ($p < 0.01$). Similarly, women with high SWLS scores preferred soy products significantly more frequently than those with low values of this scale ($p < 0.05$) (Table II).

Discussion

Our study revealed that the consumption of legume seeds, and especially soy products, is very low among perimenopausal women. However, this varied depending on the analyzed individual traits, with a tendency to more frequent consumption of these products by individuals with higher levels of self-efficacy, optimism, and satisfaction with life.

In view of current dietary recommendations, the hereby presented insufficient consumption of legume seeds (several times a month on average) and sporadic consumption of soy products (less than once a month) should be considered as a qualitative nutritional mistake. Regular consumption of legume seeds is recommended according to both the new Harvard pyramid of healthy eating (2005) and the pyramid developed by the Swiss Society for Nutrition (2005) [20, 21]. These products are characterized by high nutritional value, which is deter-

mined not only by their high contents of bioactive compounds, including phytoestrogens, but also relatively complete protein, starch, dietary fiber, and vitamin B complex. Moreover, dietary and health advantages of these products are associated with their low glycemic index, vital for the prevention of some chronic conditions, such as obesity, diabetes, atherosclerosis, and some neoplasms [22]. This corresponds to the inverse correlation between the consumption of legumes and BMI ($p < 0.01$) observed in our study. In this context, insufficient consumption of legumes and soy decreases the health quality of diet.

In view of low consumption of legumes, especially soy, and abovementioned functional properties of these products, women taking part in our study should be classified as a risk group of osteoporosis, cardiovascular disorders, and some neoplasms, including breast cancer. Indeed, 2% of our participants were diagnosed with osteoporosis, and 17.1% had hyperlipidemia. Low consumption of soy and soy products (tofu, sprouts, paste, soy milk and other drinks, and fermented products) is reflected by decreased serum concentration of isoflavones. According to the literature, the average dietary supply of isoflavones is 20-100 mg/day in the Asian population, up to 200 mg/day in the Japanese, and 5 mg/day in the American one [23]. Studies of the relationship between the intake of isoflavones and breast cancer risk in Asian women showed that, consumed at 10 mg per day, these compounds reduced the risk by 12%, and consumption exceeding 20 mg/day (corresponding to about 20 g of soy protein) was associated with even 29% reduction of risk. Consumption of isoflavones by women from Western countries is generally low (< 1 mg/day), and is not associated with reduced risk of breast cancer [23, 24]. A study of Australian women aged between 40 and 80 years revealed that the consumption of soy is determined by sociodemographic characteristics, including age, educational level, and socioeconomic status; this supports consideration of these variables during the risk assessment of degenerative disorders [25]. Low consumption of food products that are a natural source of phytoestrogens, i.e., analogues of endogenous

estrogens deficient in menopausal women, may justify dietary supplementation with preparations containing natural bioactive soy compounds. Previous studies confirmed the role of such products in the attenuation of menopausal syndromes [26].

Furthermore, our study showed statistically significant associations between analyzed individual traits and dietary choices regarding consumption of soy and legumes; the more favorable choices were documented among women characterized by higher levels of general self-efficacy, optimism, and satisfaction with life. In view of the abovementioned relationships between the consumption of soy and etiology and prevention of osteoporosis and breast cancer [3, 5, 8, 10-12, 23], it can be assumed that the risk of these conditions is higher in women with low levels of self-efficacy, optimism, and satisfaction with life. The relationships documented in our study, which suggest a predictive role of the analyzed psychological traits, can be explained by their characteristics. According to the literature, the level of self-efficacy is a predictor of intentions and activities in the domain of health-related behaviors, and correlates positively with the internal locus of control, determining the self-conviction that one's choices are crucial for achieving certain objectives, including those related to health [19]. In turn, the level of optimism was revealed to correlate positively with self-assessment, satisfaction, self-efficacy, and internal locus of control, and was inversely correlated with depression and anxiety. Moreover, it correlated positively with the health-related behaviors associated with nutrition [19]. An association between low level of self-efficacy and insufficient consumption of fruits and vegetables was documented among older people from Iran [27]. Other authors also confirmed the role of self-efficacy in rationalization of nutrition [28, 29]. An American study [30] analyzing the relationship between the level of optimism/pessimism and the hemostasis system of individuals between 45 and 84 years of age revealed that more optimistic participants are characterized by lower concentration of fibrinogen and homocysteine, and thus by lower risk of cardiovascular disorders; this is consistent with more frequent consumption of soy ($p < 0.01$) and legumes ($p < 0.001$) among more optimistic women taking part in our study.

Cognitive and behavioral activities strengthening self-efficacy and optimism, and increasing the level of satisfaction with life, can be useful in the improvement of nutrition, including in menopausal women. Consequently, consideration of psychosocial variables can constitute an important aspect of rational nutrition and efficient dietary intervention, and can indirectly improve one's health potential. This issue is particularly important in the case of menopausal women, due to their increased risk of chronic disorders in the etiology of which environmental factors, including diet, play a vital role.

Conclusions

1. In view of its health consequences reported in the literature, the low frequency of soy product and legume consumption among perimenopausal women could reduce the effectiveness of the secondary prevention of osteoporosis and increase the risk of breast cancer in this population group.
2. The observed inverse correlation between BMI and consumption of legumes points to their important role in the maintenance of proper weight in perimenopausal women.
3. Statistically significant relationships were documented between the frequency of soy product and legume consumption and analyzed individual traits, suggesting that women with a high level of self-efficacy, optimism, and satisfaction with life are predisposed to more rational dietary choices.

Disclosure

Author reports no conflicts of interest.

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