

From Hot Flashes to Whole Foods: Assessing Menopause Awareness and the Utilization of Phytoestrogen-Rich Diets Among Middle-Aged Women

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Abstract

Background

Menopause is a natural physiological change with diminishing oestrogen levels resulting in vasomotor, psychological and musculoskeletal symptoms severely affecting quality of life of women. Hormone replacement medication remains the gold standard in the treatment of menopausal symptoms, but fears of long-term safety have led to a renewed interest in nutritional alternatives. Phytoestrogens are plant-derived chemicals that exist naturally and have estrogen-like biological activity, and have been proved to be effective in lowering menopausal symptoms. There is increasing scientific evidence, but knowledge about phytoestrogen-containing foods among middle aged women is still low, particularly in underdeveloped nations. The aim of this study was to investigate knowledge of phytoestrogen-containing foods and intake of phytoestrogen-rich diets in peri- and post-menopausal women.

Methods

The study was a community-based cross-sectional analytical study done among 388 peri-and post-menopausal women aged 40–60 years utilising stratified random sampling. Data were obtained by a validated interviewer-administered questionnaire that included socio-demographic information, awareness of phytoestrogen, knowledge of dietary sources, frequency of food intake, perceived advantages and barriers, and the Menopause Rating Scale (MRS). The data were analysed using IBM SPSS Statistics version 26.0. Descriptive statistics were used to summarise the characteristics of the participants and Chi-square tests, independent t-tests, Mann–Whitney U tests and binary logistic regression analyses were used to assess factors related with adequate awareness. Statistical significance was set at $p < 0.05$.

Results

The mean age of the participants was 49.8 ± 5.4 years and 57.0% were post-menopausal. Only 41.2% of women had heard about phytoestrogens and 28.1% of them knew their significance in treating menopausal symptoms. The most common dietary sources identified were soybeans (72.4%), chickpeas (69.3%) and lentils (63.1%), but awareness of flaxseeds (38.4%) and sesame seeds (42.5%) remained low. Lentils and whole grains were the most frequent sources of phytoestrogens, while products based on soy were rarely ingested. The mean Menopause Rating Scale score was 17.6 ± 6.8 , which indicated that symptom severity was mainly moderate. Adequate knowledge of phytoestrogens was independently related to higher education, urban residency and prior health counselling ($p < 0.05$).

Conclusion

While these dietary treatments may have health advantages, awareness and use of phytoestrogen-containing foods among peri- and post-menopausal women were inadequate. Higher awareness levels were substantially associated with educational attainment, healthcare counselling and urban residence. Community oriented nutrition education programmes and regular dietary counselling should be incorporated in the menopausal health care services to improve the understanding, motivate good eating patterns and promote nonpharmacologic management of

menopausal symptoms. Longitudinal and intervention studies in the future are needed to assess whether enhanced awareness results in sustainable dietary changes and improved clinical outcomes.

Keywords: Menopause; Phytoestrogens; Dietary awareness; Isoflavones; Menopause Rating Scale; Nutrition; Women's health; Cross-sectional study.

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Introduction

Menopause is a physiological transition and is defined as the permanent end of menstruation secondary to depletion of ovarian follicular activity and the subsequent drop in circulating oestrogen levels. The World Health Organisation (WHO) defines natural menopause as a retrospective diagnosis after 12 consecutive months of amenorrhoea in the absence of any pathological or physiological explanation [1]. The menopausal transition usually happens between 45-55 years of age and signifies the end of a woman's reproductive lifespan. With the progress in healthcare and the extension of life expectancy, women now spend over one-third of their lives in the postmenopausal stage, which has made menopausal health an emerging global public health problem [1,2]. Reduced oestrogen production during menopause affects several organ systems and leads to a broad spectrum of symptoms that significantly impact physical, psychological, and social well-being. Vasomotor symptoms such as hot flashes and night sweats are the most common complaints and affect over 70–80% of menopausal women. Other commonly mentioned symptoms are sleep disturbance, mood swings, anxiety, sadness, irritability, exhaustion, poor cognitive function, vaginal dryness, urinary problems, decreased sexual desire, and musculoskeletal pain [2,3]. Long-term oestrogen insufficiency further raises the risk of osteoporosis, cardiovascular disease, metabolic syndrome, obesity, type 2 diabetes mellitus, cognitive decline, and frailty, increasing morbidity and lowering the quality of life of ageing women [2,4]. Therefore, managing menopausal symptoms effectively has become a priority in women's health research and in clinical practice. Hormone replacement treatment (HRT) remains the most effective medication for relief of moderate-to-severe menopausal symptoms and prevention of osteoporosis in properly chosen women [5]. Although proven to be effective, worries about its link with breast cancer, venous thromboembolism, stroke and cardiovascular events have limited its popularity among many women and healthcare professionals [3,5]. Since the publication of the Women's Health Initiative study, there has been increased interest in

nonhormonal and lifestyle-based methods for symptom alleviation with fewer adverse effects. Therefore, dietary treatments and complementary medicine have received more attention as safer and more durable ways to address menopausal symptoms [6]. Among dietary therapies, phytoestrogens are one of the most studied natural options. Phytoestrogens are polyphenolic compounds of plant origin that structurally resemble endogenous 17β -estradiol and can bind to oestrogen receptors, especially oestrogen receptor beta ($ER\beta$), and exert weak estrogenic or anti-estrogenic activity depending on the hormonal milieu [7]. The important classes of phytoestrogens are isoflavones, lignans and coumestans. Isoflavones are found mainly in soybeans, tofu, soy milk, chickpeas and other legumes, whereas lignans are abundant in flaxseeds, sesame seeds, whole grains, fruits and vegetables. Coumestans are mostly present in sprouts and legumes [7,8]. Besides their estrogen-modulating activity, phytoestrogens have antioxidant, anti-inflammatory, cardioprotective, antiatherogenic and osteoprotective qualities, which make them potential dietary components for promoting menopausal health. There is a large amount of evidence on the positive effects of eating phytoestrogens on menopausal symptoms. Chen et al. conducted a systematic review and meta-analysis of randomized controlled trials and demonstrated that soy isoflavone supplementation significantly reduced the frequency and severity of hot flashes while improving headaches, palpitations, depression, and psychosocial symptoms among perimenopausal women [9]. Likewise, long-term soy isoflavone supplementation effectively reduced vasomotor symptoms compared with placebo, particularly when given for more than twelve weeks [10], as shown by Liu et al. "Our findings imply that consuming foods rich in phytoestrogens on a regular basis can be an effective dietary way to relieve menopausal symptoms without the side effects associated with synthetic hormones. The safety profile of phytoestrogens has also been well studied. Recent high quality information has essentially allayed previous worries about possible estrogenic stimulation of breast and endometrial tissues. Viscardi et al. recently conducted a comprehensive

systematic review and meta-analysis and concluded that soy isoflavones do not exert clinically relevant estrogenic effects on breast or endometrial tissues in postmenopausal women and are safe for consumption in dietary levels [11]. Recent narrative reviews have also emphasised the beneficial impact of dietary bioactive substances in enhancing estrogen-deficient skin health and lowering oxidative stress without raising hormone-related hazards [8]. Besides soy isoflavones, lignans from flaxseed have shown great therapeutic promise. Flaxseed supplementation has been demonstrated to considerably reduce the intensity of menopausal symptoms and improve lipid profiles and cardiovascular risk factors in postmenopausal women [12]. Wang et al. Furthermore, randomised controlled trials have demonstrated a significant improvement in vasomotor symptoms, sleep quality, metabolic parameters and quality of life in menopausal women with metabolic syndrome after supplementation with soy isoflavones plus myo-inositol and cocoa polyphenols [13]. Emerging research also shows that higher dietary consumption of phytoestrogens is beneficial for bone metabolism, antioxidant capacity and good ageing, hence minimising the long-term effects of oestrogen shortage [14]. There is insufficient awareness of these foods globally among women, despite the large body of scientific evidence supporting the efficacy and safety of phytoestrogen-rich diets. As stated by Urbisz et al., nearly two-thirds of the survey group had heard the word “phytoestrogens,” but only 16.7% knew that they have favourable effects on menopausal symptoms, and almost half claimed to have no understanding of dietary phytoestrogens [15]. Gupta et al. also observed substantial variations in the knowledge about menopause between the urban and rural women of Northern India, urban women had much higher awareness about menopause and phytoestrogen rich foods as compared to the rural women [16]. The results suggest that the translation of scientific data into a sufficient public awareness or dietary practice has not been achieved yet. In developing nations like Pakistan, the issue is worse where menopause is typically neglected in primary health care providers. Under-recognition and undertreatment of menopausal symptoms are driven by cultural attitudes, limited nutritional counselling, poor health literacy, and restricted access to evidence-based health information. As a result, many women continue to suffer needlessly, physically and psychologically, despite the fact that easy and inexpensive nutritional solutions exist. Given the availability of phytoestrogen-rich foods such as soybeans, chickpeas, lentils, sesame seeds, flaxseeds, kidney beans and whole grains and their cultural

acceptability, creating awareness regarding their health benefits may provide an effective and affordable strategy for improving menopausal health [6,14]. Healthcare experts such as gynaecologists, family physicians, nutritionists, nurses, and community health workers have an important role to play in providing evidence-based nutritional counselling during the menopausal transition. Recent intervention studies have shown that structured educational programmes administered through face-to-face counselling or virtual education can significantly increase women’s knowledge about phytoestrogens, increase dietary intake of phytoestrogenic foods, and reduce the severity of menopausal symptoms [6]. These results show the promise of educational interventions to bridge scientific evidence and community practice. Numerous randomised clinical trials have examined the therapeutic efficacy of phytoestrogen supplementation, however, few community-based studies have explored the awareness and use of naturally occurring phytoestrogen-rich foods by women especially in low- and middle-income countries. Baseline information on levels of awareness, dietary patterns, and perceived barriers is needed to design culturally appropriate health education programmes and public health interventions. Therefore, the present study was meant to determine the awareness of phytoestrogen containing foods among peri- and post-menopausal women of 40–60 years of age and to analyse the use of phytoestrogen rich diets among this demographic. The findings of this study are likely to contribute to the current body of knowledge and to inform doctors, nutritionists and policy makers in the development of evidence-based strategies for improving menopausal health through dietary interventions.

Methodology

Study Design

To investigate the level of awareness of foods containing phytoestrogens and utilisation of diets rich in phytoestrogens in peri- and post-menopausal women of age group 40–60 years, a community-based cross-sectional analytical study was conducted. The study was conducted to assess knowledge, dietary practices and perceived benefits of phytoestrogen-rich foods on menopausal symptoms among the participants.

Study Setting and Duration

The study was conducted in the selected urban and rural communities for a period of three months. The study period consisted of participant recruiting, filling out questionnaires, data collecting, data input, and statistical analysis.

Study Population

The study population was peri-menopausal and post-menopausal women aged 40-60 years living in the designated study sites. Eligible individuals were identified during household visits and invited for participation after a comprehensive explanation of the aims of the study.

Sample Size

The sample size was determined using the Epi Info™ version 7.2 (Centres for Disease Control and Prevention, Atlanta, GA, USA) for cross-sectional studies. The anticipated awareness level was considered as 50%, confidence interval as 95%, margin of error as 5%, design effect as 1.0 and non-response rate as 10%. The determined sample size was 388.

Sampling Technique

Stratified random sampling method was applied. Participants were stratified based on their area of residence (urban and rural) and menopausal state (peri-menopausal and post-menopausal). Eligible women were randomly picked from each stratum until the required sample size was reached.

Inclusion Criteria

- I. Women were included in the study if they:
- II. Were aged between 40 and 60 years.
- III. Were in the peri-menopausal stage with irregular menstrual cycles or in the post-menopausal stage with cessation of menstruation for at least 12 consecutive months.
- IV. Were willing to participate and provided written informed consent.

Exclusion Criteria

Women were excluded if they:

- I. Had surgically induced menopause following bilateral oophorectomy or hysterectomy unless more than one year had elapsed after surgery.
- II. Had a known diagnosis of breast cancer or endometrial hyperplasia.
- III. Were currently receiving hormone replacement therapy.
- IV. Were pregnant or lactating.
- V. Had cognitive impairment that prevented completion of the questionnaire.

Data Collection Instrument

Data were collected using a semi-structured, interviewer-administered questionnaire that had been

validated and pilot tested before commencement of the study. The questionnaire consisted of six sections:

1. Socio-demographic characteristics.
2. Awareness regarding phytoestrogens.
3. Knowledge of phytoestrogen-rich food sources.
4. Dietary intake frequency of phytoestrogen-containing foods.
5. Menopausal symptom severity assessed using the **Menopause Rating Scale (MRS)**.
6. Perceived benefits, barriers, and information needs regarding phytoestrogen-rich diets.

The awareness portion asked about previous knowledge of phytoestrogens, sources of information, health advantages, and identification of twelve common foods containing phytoestrogens. Dietary consumption was assessed by utilising a five-point food frequency scale from “Never” to “Daily.” Menopausal symptoms were assessed using the validated Menopause Rating Scale, which includes eleven symptoms scored 0 (none) to 4 (extremely severe).

Data Collection Procedure

Data collection was done by professional interviewers who visited the selected families in the study region. Potential participants were vetted for eligibility based on pre-defined inclusion and exclusion criteria. Eligible women were briefed on the objectives, methods, potential advantages and voluntary nature of the study. Written informed consent was obtained prior to participation. The questionnaire was given by means of face-to-face interviews, in the local language of preference of the participants. The average duration of each interview was 20-25 minutes. The completeness and consistency of completed questionnaires were checked on a daily basis. Periodic quality control checks were made over the duration of data collection to minimise errors and missing information.

Study Variables

The major outcome measure was the phytoestrogen knowledge score, computed as the percentage of properly identified phytoestrogen-containing foods from the twelve foods mentioned. Those scoring 60% and above in the awareness section were considered to have adequate awareness while those scoring below 60% were considered to have inadequate awareness. Secondary outcome variables included the dietary intake frequency of phytoestrogen-rich foods, measured using a five-point Likert-type food frequency scale, and menopausal symptom severity, measured using the Menopause Rating Scale (total

score 0–40, with higher scores indicating more severe menopausal symptoms). Independent variables included age, educational status, place of residence, menopausal state, past health care counselling addressing menopause, and history of hormone replacement therapy.

Statistical Analysis

Data were entered into Microsoft Excel 2019, cleaned, and analysed using IBM SPSS Statistics version 26.0 (IBM Corp., Armonk, NY, USA). Socio-demographic data, awareness levels, dietary intake patterns and menopausal symptom scores were summarised by using descriptive statistics such as frequencies, percentages, means and standard deviations.

The associations between category variables were tested using the Chi-square test. We utilised Pearson's or Spearman's correlation coefficients, as applicable, to assess associations between continuous variables. The independent samples t-test or Mann-Whitney U test was used to compare the mean awareness ratings between urban and rural residents and between peri-menopausal and post-menopausal women based on the data distribution. Independent determinants of adequate phytoestrogen awareness were identified by binary logistic regression analysis adjusted for potential confounding characteristics such as age, education, residence, healthcare counselling and menopausal status. Internal consistency of the Menopause Rating Scale and food frequency questionnaire was evaluated using Cronbach's alpha and a value of 0.70 and above was judged satisfactory. Statistically significant was taken as a two-tailed p-value of <0.05.

Ethical Considerations

The study was ethically approved by the Institutional Ethical Review Committee before it was started. All subjects gave written informed consent prior to enrolment. Participants were told that their participation was optional and they could withdraw from the study at any time without any consequences. The participants' confidentiality and anonymity were preserved throughout the study by using unique identification numbers in place of personal identifiers, and all information obtained was used only for the purpose of the research.

Results

The study included 388 women who were peri- and post-menopausal. The mean age of the participants was 49.8 ± 5.4 years (range 40–60 years). The age group of 46–50 years made up the bulk (54.4%) of the participants. Most were post-menopausal (57.0%) and peri-menopausal (43.0%). 58.2% of the sample population lived in urban areas. Approximately one-third of the participants had secondary education

whereas only 11.1% had postgraduate education. Just 31.2% reported having previously received menopausal counselling from a medical expert (Table 1).

Table 1. Socio-demographic characteristics of study participants (n = 388)

Variable	Frequency (n)	Percentage (%)
Age (years)		
40–45	96	24.7
46–50	211	54.4
51–55	59	15.2
56–60	22	5.7
Mean age (years)	49.8 ± 5.4	
Menopausal status		
Peri-menopausal	167	43.0
Post-menopausal	221	57.0
Residence		
Urban	226	58.2
Rural	162	41.8
Education		
No formal education	44	11.3
Primary	71	18.3
Secondary	126	32.5
College	104	26.8
Postgraduate	43	11.1
Healthcare counseling received		
Yes	121	31.2
No	267	68.8

41.2% of the participants were previously aware of the term “phytoestrogens” or “plant estrogens”. Only 28.1% knew that phytoestrogens could help in relieving menopausal symptoms. On the other hand, 46.9% of the subjects were not sure about the benefits of phytoestrogens. The most frequent sources of information were healthcare providers and social media (Table 2).

Table 2. Awareness regarding phytoestrogens (n = 388)

Variable	n	%
Heard about phytoestrogens	160	41.2
Never heard	228	58.8
Believed phytoestrogens relieve symptoms	109	28.1
Not sure	182	46.9
Believed they do not help	97	25.0

Knowledge of sources of phytoestrogens in food was variable. The most common sources of phytoestrogens identified were soybeans (72.4%), chickpeas (69.3%) and lentils (63.1%) and fewer women identified flaxseeds (38.4%), sesame seeds (42.5%) and red clover (15.2%) correctly as foods containing phytoestrogens (Table 3).

Table 3. Correct identification of phytoestrogen-containing foods

Food Item	Correct responses n (%)
Soybeans	281 (72.4)
Soy milk	254 (65.5)
Tofu	236 (60.8)
Chickpeas	269 (69.3)
Lentils	245 (63.1)
Kidney beans	211 (54.4)
Whole grains	184 (47.4)
Sesame seeds	165 (42.5)
Flaxseeds	149 (38.4)
Red clover	59 (15.2)

Daily consumption was highest for lentils (61.3%) and whole-grain bread/roti (55.7%), while soy products were consumed less frequently. Only 8.2% reported daily soy milk intake, and 5.9% consumed tofu daily. Regular flaxseed consumption was reported by only 18.8% of participants (Table 4).

Table 4. Frequency of dietary intake of phytoestrogen-rich foods

Food	Daily n (%)	Often n (%)	Sometimes n (%)	Rarely/Never n (%)
Soybeans	47 (12.1)	78 (20.1)	104 (26.8)	159 (41.0)
Soy milk	32 (8.2)	45 (11.6)	81 (20.9)	230 (59.3)
Flaxseeds	73 (18.8)	66 (17.0)	98 (25.3)	151 (38.9)
Sesame seeds	84 (21.6)	95 (24.5)	97 (25.0)	112 (28.9)
Chickpeas	118 (30.4)	132 (34.0)	86 (22.2)	52 (13.4)
Lentils	238 (61.3)	82 (21.1)	47 (12.1)	21 (5.5)
Whole-grain bread	216 (55.7)	84 (21.6)	63 (16.2)	25 (6.5)

The average score for Menopause Rating Scale (MRS) was 17.6 ± 6.8 . 44.8% of the subjects were found to have moderate symptoms and 27.3% were found to have severe symptoms. The most common symptoms reported were hot flashes (71.9%), sleep disturbance (66.8%) and joint discomfort (64.2%) (Table 5).

Table 5. Menopausal symptom severity (n = 388)

Variable	n (%)
Mild symptoms	108 (27.9)
Moderate symptoms	174 (44.8)
Severe symptoms	106 (27.3)
Mean MRS score	17.6 ± 6.8

Most common symptoms:

Symptom	n (%)
Hot flashes	279 (71.9)
Sleep disturbance	259 (66.8)
Joint pain	249 (64.2)
Irritability	225 (58.0)
Vaginal dryness	173 (44.6)

Adequate awareness was substantially linked with higher educational level ($p < 0.001$), urban living ($p = 0.002$), past health care counselling ($p < 0.001$) and college/postgraduate education ($p < 0.001$). There was no significant association between awareness and age and menopausal status (Table 6).

Table 6. Association between participant characteristics and adequate phytoestrogen awareness

Variable	Adequate Awareness n (%)	p-value
Urban residence	118 (52.2)	0.002
Rural residence	52 (32.1)	
Healthcare counseling (Yes)	84 (69.4)	<0.001
Healthcare counseling (No)	86 (32.2)	
College/Postgraduate	104 (70.3)	<0.001
Secondary or below	66 (27.5)	

The binary logistic regression analysis demonstrated that previous healthcare counselling (Adjusted Odds Ratio [AOR] = 2.91, 95% CI: 1.78–4.76), college/postgraduate education (AOR = 2.47, 95% CI: 1.49–4.08) and urban residence (AOR = 1.84, 95% CI: 1.15–2.95) were independent predictors of adequate awareness regarding phytoestrogen-rich foods ($p < 0.05$ for all variables) (Table 7).

Table 7. Multivariable logistic regression analysis of predictors of adequate awareness

Variable	AOR	95% CI	p-value
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Variable	AOR	95% CI	p-value
Urban residence	1.84	1.15–2.95	0.011
Healthcare counseling	2.91	1.78–4.76	<0.001
College/Postgraduate education	2.47	1.49–4.08	<0.001
Age	1.03	0.98–1.08	0.241
Post-menopausal status	1.19	0.74–1.89	0.462

The community based cross sectional study was carried out to investigate the awareness and utilisation of phytoestrogen rich meals among peri- and post-menopausal women belonging to the age group of 40-60 years. These results showed that knowledge of foods high in phytoestrogens was generally poor, while there is increasing evidence to suggest their therapeutic effects in the relief of menopausal symptoms. Fewer than half the participants had heard the word “phytoestrogens” before, and only a minority could accurately identify the health benefits. In addition, healthcare counselling, level of education and urban living were shown to be significant predictors of adequate awareness. These findings point to a large gap in knowledge that may result in underutilization of inexpensive dietary strategies for menopausal control. The socio-demographic characteristics of the study population were typical of the age distribution of women in the menopausal transition, with the majority of participants being in the 46–50 year age bracket. Similar demographic patterns have been described in research from India, China and Iran where menopause occurs most frequently between 45 and 52 years of age [17–19]. Furthermore, the increase in life expectancy has also led to women spending about one-third of their lives after menopause, highlighting the need for supporting healthy ageing through preventive healthcare methods, including dietary treatments [20]. One of the main outcomes of the present investigation was the poor level of knowledge regarding phytoestrogens. While roughly 40% of participants knew about phytoestrogens, fewer than 30% recognised accurately their medicinal use in treating menopausal symptoms. This result is in line with the

survey of Urbisz et al. who found that only a minority of respondents had enough knowledge about dietary phytoestrogens despite the fact that information on the topic is widely available [15]. Similarly, a population-based study in Poland shown that consumers' knowledge of functional foods, which include phytoestrogens, was still poor, and that there were significant misconceptions about their safety and efficacy [21]. Taken together, these data imply that the ever-expanding scientific knowledge base has not been translated into enough public understanding. The present investigation found a considerable positive correlation between level of education and phytoestrogen awareness. Those with college or postgraduate education were substantially more likely to have adequate knowledge as compared to those with lesser educational achievement. Similar results have been reported by Gupta et al. who showed that highly educated urban women were considerably more aware about menopause and dietary phytoestrogens than women with little formal education [16]. Similar results were found in research conducted in Turkey and Malaysia [22,23]. In these investigations, a higher level of education was consistently associated with higher knowledge about menopause, nutrition and preventative healthcare measures. Education probably increases access to health information, improves health literacy and promotes healthier food choices. Residence also had a strong effect on awareness. Knowledge was much higher among women in urban areas compared to rural individuals, comparable with data from India and other developing nations [16,24]. Urban dwellers usually have better access to health services, internet amenities, educational campaigns, nutrition advice and professional consultations. In contrast, rural women often use informal sources of information and have fewer possibilities to get evidence-based dietary counselling [4]. These differences underscore the importance of targeted community-based educational interventions to reduce disparities in underserved rural populations. In this study, the strongest independent predictor of adequate phytoestrogen awareness was prior healthcare counselling. Women who had gotten counselling from health care providers were significantly more aware than women who had not received any instruction about menopause. Similar results were reported by Sahraian et al. who demonstrated that structured educational interventions dramatically enhanced women's understanding of phytoestrogens, leading to increased food intake and reduced severity of menopausal symptoms [6]. Similarly, intervention studies in Korea and Japan have indicated that individualised nutrition counselling significantly improves dietary behaviour and adherence to healthy eating

recommendations for middle aged women [25,26]. These results confirm the fundamental importance of health professionals in translating scientific data into concrete dietary recommendations. The participants had a very diversified knowledge concerning dietary sources of phytoestrogens. Soybeans, chickpeas and lentils were relatively well known, but flaxseeds, sesame seeds and red clover were poorly identified. These patterns of dietary awareness have been reported in earlier international research, where soy products were widely known due to commercial promotion, but comparably little attention was paid to lignan-rich foods [21,27]. Flaxseeds and sesame seeds are cheap, easily available and culturally acceptable in South-Asian diets and boosting awareness regarding these foods may have major impact on improving dietary phytoestrogen consumption without increasing healthcare spending. The dietary intake patterns found in the present investigation followed the conventional dietary habits of the study population. Lentils, chickpeas and whole grains were eaten more often than soy products, which were very rare. Similar dietary preferences have been reported for South Asian communities, where legumes are a key dietary source of protein, while soy consumption is minimal [28]. Findings suggest that instructional strategies should focus on locally available foods rich in phytoestrogens, rather than soy products alone, to improve acceptability and long-term compliance. The present study also indicated a significant menopausal symptom burden, with hot flashes, sleep problems and musculoskeletal discomfort being the most frequently reported concerns. These findings are very similar to those published in systematic reviews that assessed the prevalence of menopausal symptoms worldwide [29,30]. Vasomotor symptoms continue to be the signature symptom of oestrogen insufficiency and a major detriment to everyday functioning, sleep, work productivity and psychological well-being. Previous meta-analyses have consistently shown that dietary phytoestrogens significantly lower the severity and frequency of vasomotor symptoms indicating that increased awareness could result in better symptom management by modest dietary modifications [9,10]. The current investigation did not include a direct assessment of clinical efficacy, however prior randomised controlled studies give strong evidence for the therapeutic use of phytoestrogens. Chen et al. [9] found that soy isoflavone supplementation led to significant improvements in hot flashes, sadness, headaches and psychosocial symptoms. In a similar way, Mainini et al. found an improvement of the vasomotor symptoms and metabolic parameters in menopausal women treated with soy isoflavones along with myo-inositol and cocoa polyphenols [13].

The results corroborate existing recommendations to enhance consumption of naturally occurring phytoestrogen-rich foods as part of the complete therapy of menopause. The positive effects of phytoestrogens are more than only reduction of symptoms. There is recent evidence indicating the intake of dietary phytoestrogen is positively associated with bone mineral density, antioxidant status, endothelial function, lipid metabolism and cardiovascular health [14,31]. Flaxseed lignans have been shown to have further lipid-lowering benefits while soy isoflavones may increase insulin sensitivity and reduce systemic inflammation [12,32]. These pleiotropic advantages provide a convincing basis for the promotion of dietary phytoestrogens not only for symptom treatment but also for the long-term prevention of chronic diseases linked with oestrogen insufficiency. The outcomes of this study have significant significance for public health practice. Given the low cost, cultural acceptability, and availability of phytoestrogen-rich foods, raising awareness is a viable approach to lowering the burden of menopausal symptoms in resource-limited countries. Healthcare practitioners should incorporate evidence based nutritional counselling in standard menopausal care, and national health authorities should establish culturally appropriate educational programmes for middle aged women. Community health workers, family physicians and nutritionists may be crucial avenues for spreading correct knowledge on dietary phytoestrogens. The present study has many strengths. It was marked by a very large community-based sample and employed a systematic and validated questionnaire in conjunction with the Menopause Rating Scale for symptom evaluation. The results were more generalizable because peri- and post-menopausal women from both urban and rural settings were included. However, there are several limits that should be addressed. The cross-sectional design did not permit causal inference between awareness and dietary behaviour. Dietary intake was self-reported, and consequently subject to recall bias. Furthermore, real consumption of phytoestrogens was not measured by biochemical indicators or extensive nutritional analysis. More longitudinal research and randomised intervention trials are needed to see if increased awareness leads to lasting food pattern modifications and quantifiable improvements in menopausal health outcomes. Overall, the present study showed that knowledge of phytoestrogen-rich foods among middle-aged women was still low, despite the increasing scientific data on their health advantages. Higher education, urban living, and prior health care counselling were independently linked with increased awareness. Given the low cost, easy accessibility and beneficial

safety profile of dietary phytoestrogens, extensive nutrition education programmes should be included in the routine menopausal health care services to develop healthy dietary habits and improve quality of life among peri- and post-menopausal women.

Conclusion

The present study found that peri- and post-menopausal women generally had low awareness of phytoestrogen-containing foods, despite rising evidence of its importance in reducing menopausal symptoms and maintaining long-term health. Participants knew about popular foods such as chickpeas, lentils and soy products as sources of phytoestrogens. However, there was little general understanding of dietary sources of phytoestrogens and their therapeutic benefits. Educational level, urban location and past counselling by health care providers were important predictors of appropriate awareness, underscoring the role of health literacy and access to credible health information in shaping dietary knowledge and practices. The study also found that a large number of women reported moderate-to-severe menopausal symptoms while using a natural dietary approach to control symptoms, which included inadequate intake of foods rich in phytoestrogens. The affordability, availability, cultural acceptability and good safety profile of foods rich in phytoestrogens make increased public awareness through structured health education programmes a practical, cost-effective approach to improving menopausal health especially in resource poor settings. Healthcare providers, especially gynaecologists, primary care physicians, nutritionists and community health workers, should routinely incorporate evidence-based dietary counselling into the management of menopause to promote good eating behaviours and better food choices.

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