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Brief Telephone Intervention Increases Soy Intake in Peri- and Postmenopausal US Women: the Herbal Alternatives (HALT) Trial

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Abstract

Background—Effective dietary intervention strategies that can be widely disseminated and have the potential for sustainable dietary modifications are needed.

Objective—To describe and evaluate the effectiveness of a telephone-based soy intervention.

Design—A randomized controlled trial comparing self-reported and serum measures of soy intake during a 1-year dietary soy (Soy) to fruit and vegetable (Placebo) intervention conducted in two of five arms from the Herbal Alternatives Trial between May 2001–September 2004.

Subjects/setting—163 peri- and postmenopausal women (mean age 52 y) consuming self-selected diets; Pacific Northwest, US.

Intervention—Five telephone contacts with a dietitian during a 12-month intervention with the goal to increase soy food consumption to two servings daily.

Main outcome measures—Change from baseline in self-reported soy servings and serum isoflavone (daidzein and genistein) concentrations were estimated using analysis of variance and generalized estimating equations. Proportion of participants achieving the intervention goal was compared using Chi-squared tests.

Results—Ninety-four percent (n=74) of participants in the Soy arm and 89% (n=75) in the Placebo arm completed the trial, and just over 1/3 (n=27) received 5 phone contacts. Mean(±SD) intake of

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soy was similar for the Soy and Placebo arms at baseline (0.6 ± 1.0 versus 0.4 ± 0.8 servings/day, $P > 0.05$). At the 12-month follow-up visit, mean $\pm$ SD servings of soy per day were 1.6 ± 1.4 for the Soy intervention compared to 0.5 ± 0.9 within the Placebo arm ($P < 0.001$). There were concomitant increases in serum isoflavones at 3 and 6 months from baseline in the Soy arm only, with approximately 2-fold increases in both daidzein (mean 66.4 nmol/L, 95% CI 39.0 to 93.9) and genistein (mean 100.4 nmol/L, 95% CI 60.9 to 139.9) concentrations. Mean weight changed by less than 1 kg over the 12-month period in each group and physical activity remained stable, suggesting participants incorporated soy foods into their diet by substituting for non-soy foods rather than adding them to their diet.

Conclusions—A brief telephone-based intervention having a focused message delivered by a dietitian is a feasible approach for encouraging targeted dietary changes such as an increase in soy intake among peri- and postmenopausal women.

Keywords

dietary intervention; soy; telephone; randomized controlled trial

Introduction

In the past decade, soy foods have been investigated for their potential role in the prevention of breast (1,2) and prostate cancers (3), cardiovascular disease (4), diabetes (5), osteoporosis (6), and relief of menopausal symptoms (7). In order to study the effects of soy foods, several dietary interventions have been designed; however, their design and delivery may not be feasible for population-based dietary interventions aimed at increasing soy intake. Many of the soy interventions required multiple in-person counseling visits (8,9) and/or group meetings (9,10) and were delivered by providing either some or all soy foods to study participants (1, 3,7). Although the majority of these trials achieved the intervention goal to increase soy intake, the resources required to conduct these interventions are typically not available for wide dissemination.

Dietary intervention approaches that are effective at achieving significant and sustainable dietary change and can be translated into clinical practice are needed (11). Counseling interventions delivered via telephone rather than in-person may have numerous advantages including relatively low cost, less burden to the participant, and proactive outreach to at-risk individuals not necessarily seeking treatment or coaching. Telephone-based interventions have been successful for the delivery of behavior change interventions such as smoking cessation (12), reducing alcohol consumption (13), treating depression (14), and encouraging multiple dietary changes (15,16). However, diet-related interventions are complex and data about telephone-based dietary interventions are limited.

The Herbal Alternatives Trial (HALT) was designed to compare multiple strategies for alleviating menopausal symptoms, including increasing soy intake. The rationale, safety, and effectiveness of the study interventions are described elsewhere (17), but they were developed from the evidence base and pilot data about the naturopathic approach to managing menopausal symptoms. The purpose of this report is to describe and evaluate the effectiveness of one of these approaches: a brief, tailored telephone-administered dietary intervention designed to increase soy food consumption among peri- and post-menopausal women who entirely self-selected their diets.

Methods

Participants

Participants in this study consisted of women in two of the five arms of the HALT trial, a randomized, placebo-controlled, double-masked intervention trial comparing strategies (soy foods, herbal regimens and hormone therapy) to placebo for relief of vasomotor symptoms. Women were recruited from May 2001 through August 2003 via mail and were eligible if they were peri- or post-menopausal (age 45 to 55), averaged at least 2 vasomotor symptoms per day over 2 weeks with at least 6 moderate to severe symptoms, had no contraindications to hormone therapy, had not used hormone therapy or oral contraceptives within 3 months of the trial, had not used herbal supplements for menopausal symptoms within 1 month of the trial, had no history of breast cancer, and were adherent during the run-in period (>80% of capsules taken).

HALT Study Design

Study design and procedures for HALT are described in detail elsewhere(17,18). Briefly, 351 participants were randomized to one of five study arms a) soy + multi-botanical, receiving both an intervention and a daily supplement to increase intake of soy-based foods; b) multi-botanical supplement only, receiving a daily supplement; c) black cohosh (160 mg/day); d) hormone therapy; or e) placebo. The multi-botanical contained 200 mg black cohosh, 400 mg alfalfa, 4 mg boron, 200 mg chaste tree, 400 mg dong quai, 200 mg false unicorn, 400 mg oats, 400 mg pomegranate, and 400 mg Siberian ginseng.

This report compares the 163 participants randomized to either the soy + multi-botanical (Soy, n=79), receiving both a telephone-based intervention to increase intake of soy-based foods and a daily multi-botanical supplement, or placebo (Placebo=84), receiving phone contacts to encourage intake of fruits and vegetables and a daily placebo pill. No exclusions were made based on baseline soy intake. However, soy intake in women in the Pacific Northwest is generally low (19). The Group Health Institutional Review Board approved study procedures, and all participants provided written, informed consent. To facilitate masking, the consent form indicated participants would be contacted multiple times by a dietitian but did not describe the topic of the intervention (i.e. soy or fruit and vegetable consumption).

Soy Arm

The goal of this intervention was to encourage participants to consume 2 servings of soy daily throughout the 12-month study period. The focus of the intervention was to increase soy intake through foods rather than supplements.

At study entry, participants randomized to the soy intervention arm were sent a letter introducing a 34-page dietary intervention booklet titled "Soy Foods: a guide to eating soy", which was modeled after "Take Five," a study intervention designed to promote vegetable and fruit intake (20). The soy booklet consisted of a brief description of the study goals as well as detailed information on various soy foods including serving size information, recipes, and tips for incorporating soy into the diet. After the intervention booklet was mailed, the study dietitian contacted participants to initiate the intervention.

Telephone Counseling Intervention

The telephone counseling intervention was delivered to all study participants by one dietitian who was trained in Motivational Interviewing Techniques (21). Participants randomized to the soy arm received 5 telephone contacts from the same study dietitian during the 12-month study period. The dietitian maintained documentation of attempted contacts with study participants. These calls were conducted more frequently during the initiation of the intervention, once a month for the first two phone contacts, after which they were reduced to once every two months.

The duration of calls varied depending on the participant's familiarity with soy foods, but typically lasted between 30 and 45 minutes for the first two phone contacts, and gradually decreased in duration over time. The phone contacts were structured to enable and encourage participants to incorporate soy foods into their diet.

During each soy intervention call, the dietitian asked participants to estimate soy intake using the Soy Foods Booklet as a guide. This information was used to tailor the call to the participant's current intake. A serving of soy was defined as containing 6.25 g of soy protein. This was communicated to participants in the Soy Foods Booklet as 1 cup of soymilk, 3 oz tofu, ½ cup cooked soybeans (24). Participants were instructed not to count foods containing highly variable amounts of isoflavones (i.e. soy bars, soy pills), or foods containing minimal amounts of isoflavones (i.e. soy sauce, soybean oil), since estimation of the soy and isoflavone content of such foods is subject to substantial measurement error.

During the first call, the dietitian established rapport, described the intervention, reviewed the soy booklet, and assessed current soy consumption by having the participant describe her typical dietary intake. Participants were also asked to rate their perceived importance and confidence for achieving 2 servings of soy per day, using a 10-point Likert Scale. The dietitian used these responses to assess readiness for change (pre-contemplation, contemplation, preparation, action, or maintenance), apply stage-specific motivational interviewing strategies to bolster motivation and self-efficacy for diet change (21,22) and provide tailored recommendations to help the participant incorporate soy into her diet. The dietitian helped each participant problem-solve barriers and set goals.

During follow-up calls lasting 15-30 minutes, the dietitian re-assessed current soy consumption, assessed progress with goals set in the previous phone contact, assessed readiness to change soy intake, and set goals to increase soy consumption. After each call, the dietitian sent a follow-up letter that summarized the items discussed during the call, re-stated the goals established during the call, confirmed the next phone appointment, and provided recipes and coupons to help the participant incorporate soy into her diet.

Placebo Arm

All participants randomized to the placebo arm (n=84) were sent a "5-A-Day" booklet aimed at increasing servings of fruits and vegetables in the diet and instructed to take four capsules daily. The color of the lactose placebo capsules was matched to other study medications to facilitate masking. Participants in the placebo arm were contacted by the dietitian once during the 12-month study period. A small (4%) percentage of participants in the placebo arm also received follow-up calls from the dietitian to help mask the interventions. This phone contact was structured in a similar manner to the first phone contact for the soy arm, although the focus was on increasing fruit and vegetable intake to 5 servings per day. Similar to the soy arm, these participants were sent a follow-up letter after the phone contact.

Diet, Anthropometric, and Lifestyle Measures

Soy intake was estimated at each study visit (baseline, 3 months, 6 months, 12 months) using the validated soy foods questionnaire (23). Pearson correlations between isoflavone intake assessed via the soy foods questionnaire and plasma isoflavone concentrations ranged from 0.35 to 0.47. The soy foods questionnaire queried the frequency and amount of intake of 19 soy foods and supplements, as well as two line items for "other" soy foods (reported items included soy cereal, soy crackers, soy butter, soy creamer), in the past three months. The size of a medium serving was specified, and participants indicated whether their usual serving was small, medium, or large. The frequency of intake was multiplied by the usual portion size (0.5 for small, 1.0 for medium, and 1.5 for large) to obtain servings/week for each of the line items

on the FFQ. The milligrams of daidzein and genistein per medium serving were multiplied by servings per week for each item. A dietitian tabulated the total number of soy servings by summing the amount estimated from the 19 foods on the soy FFQ with the amount reported as “other” foods, and these values were reviewed by another dietitian for accuracy. Isoflavone values for each of the FFQ items were obtained using Nutrition Data System for Research software (Version 5.35, 2004, University of Minnesota, Minneapolis, MN).

Diet (as measured by daily energy, macronutrient, and fruit and vegetable intake) was assessed at baseline using a 122 item self-administered semi-quantitative Food Frequency Questionnaire (FFQ) (25). Energy adjusted correlation coefficients comparing the FFQ with four 24-hour recalls and 4-day food records ranged from 0.2 to 0.7 with a mean of 0.5. Weight was measured to 0.1 kilogram(kg) precision using a standard balance beam scale and height was measured in duplicate to 1 millimeter (mm) precision using a stadiometer by trained nurses at each study visit and body mass index was calculated (weight in kg/height in m squared). If the height measurements differed by >4mm, a third measurement was taken.

Demographic and lifestyle characteristics were assessed at baseline via self-administered questionnaire. Physical activity was assessed using the Women’s Health Initiative Physical Activity Questionnaire (26), querying the frequency and duration of walking as well as other mild, moderate, and strenuous exercise. The total number of days per week a woman engaged in at least 20 minutes of moderate or strenuous physical activity was summed and categorized.

Serum Isoflavones

Blood samples were collected in the morning following an overnight fast at baseline, 3, and 6 month study visits. Serum daidzein and genistein concentrations were measured using time-resolved fluoroimmunoassay kits (Labmaster, Turku, Finland) (27,28). Fluorescence was measured with the use of the Victor 2 model 1420 spectrofluorimeter (Wallac, Turku, Finland). Data were analyzed by using GRAPHPAD PRISM software (GraphPad Software Inc, San Diego, CA). Serum samples were run in duplicate and reported as the mean of the two measures. Samples with %CV >15% were rerun. Limit of quantification (LOQ) for daidzein and genistein was 2.5 and 5 nmol/L, respectively. Concentrations below the LOQ were reported as the half-way value between 0 and the LOQ. The interassay coefficients of variation for daidzein and genistein were 13% and 12%, respectively.

Quality Control

Soy intervention calls were monitored for protocol adherence and quality control. All study staff other than the dietitian were masked as to which patients were participating in the soy arm (n=79) in order to prevent bias in the ascertainment of outcomes. Pill counts were conducted by study staff at each follow-up visit to monitor adherence. Food frequency questionnaire data were checked for completeness and were processed using a scanner at the Fred Hutchinson Cancer Research Center. All other data were entered in duplicate and checked for consistency.

Data Analyses

Descriptive statistics were used to characterize the study sample in the soy intervention versus placebo arm, and the distribution of soy consumption and isoflavone concentrations were plotted to check the normality assumption. Intervention effects for soy intake were evaluated at 3, 6, and 12 months as measured by the soy FFQ and for serum isoflavone concentrations (at 3 and 6 months only). Change from baseline was estimated using unadjusted models and linear regression models controlling for baseline values of the dependent variable, BMI and baseline energy intake as measured by the FFQ (all energy intake was within 500 and 5000

kcal/d). Results from unadjusted and adjusted models were similar; therefore, unadjusted models are presented.

Percent reporting any soy consumption and percent achieving the dietary intervention goals were compared by randomization assignment using chi-squared tests. For analyses comparing groups based on average change from baseline to all three follow-up visits combined, generalized estimating equations (GEE) linear regression was used to account for within-person correlation due to the repeated measures (independent working correlation with empirical variance estimated)(29). Associations between estimates of isoflavone intake from the soy food frequency questionnaire and serum concentrations were estimated using Spearman correlations stratified by treatment assignment and time point. All analyses were conducted in SAS (Version 9.1.3, SAS Institute, 2003, Cary, NC). $P < 0.05$ was considered statistically significant.

Results

Baseline Characteristics

Randomization provided balance on baseline characteristics (Table 1). Participants were approximately evenly divided between normal weight, overweight, and obese as classified by National Heart, Lung, and Blood Institute's weight classification system(30). Participants were primarily White, physically active at least one day a week, non-smokers, married, currently employed, and almost all had greater than a high school education. Approximately two-thirds of participants reported soy consumption at baseline (71% Soy, 66% Placebo), though on average participants consumed less than half of a serving of soy daily (Mean =0.6 and 0.4 servings for Soy and Placebo, respectively).

Process Measures

Retention at each follow-up visit was high for both groups: of 79 participants assigned to the Soy arm, 95% (n=75) completed the soy FFQ at 3 months and 94% (n=74) completed the questionnaire at both the 6 and 12 month visits. Of 84 participants assigned to the Placebo arm, 92% (n=77), 90% (n=76), and 89% (n=75) of women also completed the soy FFQ at each follow-up visit (3, 6, and 12 months, respectively). Serum isoflavones were available for most women in both groups at each visit (96% (n=76), 92 % (n=73), 95 % (n=75) for Soy and 98 % (n=82), 87% (n=73), 85% (n=71) for Placebo at baseline, 3 months, and 6 months, respectively). Compliance was similar between groups, with 87% of women randomized to the Soy arm and 82% of women assigned to Placebo remaining in the study and taking at least 80% of pills at the 12 month follow-up.

Ninety percent (n=72) of participants assigned to the Soy arm received at least one call from the study dietitian. Eighty five percent (n=71) of women in the Placebo arm received at least one call from the dietitian encouraging increased fruit and vegetable intake. Among Soy participants receiving at least one call, 72% (n=52) received more than three calls and 38% (n=27) had five contacts with the study dietitian. At baseline, there was heterogeneity in readiness to consume soy: the dietitian assessed 39% (n=28) were in pre-contemplation or contemplation, 32% (n=23) were in the preparation phase, while 28% (n=20) were either in action or maintenance phases.

For both Soy and Placebo arms, self-reported measures of soy intake were moderately correlated with serum measures. Spearman correlations ranged from 0.4-0.6 for both daidzein and genistein at each timepoint (baseline, 3 months, 6 months).

Intervention Effects

Mean $\pm$ SD intake of soy was similar between groups at baseline (0.6 ± 1.0 versus 0.4 ± 0.8 servings per day in Soy and Placebo arms, respectively, $P>0.05$). Participants in the Soy intervention arm increased soy consumption by approximately one serving of soy per day over the 12-month intervention period compared to the Placebo arm (Table 2). At the 12-month follow-up visit, mean $\pm$ SD servings of soy per day were 1.6 ± 1.4 for the Soy intervention compared to 0.5 ± 0.9 within the Placebo arm ($P<0.001$). Increases from baseline were largest at 6 months for self-reported measures and 3 months for serum measures, but the intervention effects were not appreciably attenuated at the 12-month follow-up visit. On average, at the one-year follow-up, women who received 4-5 telephone contacts consumed 0.5 more servings of soy daily ($n=52$ due to missing data for two participants) compared to women who received 1-3 contacts ($n=20$) (data not shown).

Serum isoflavone concentrations increased only among those participants in the Soy arm (Table 2). Weight remained stable throughout the intervention period for both groups (Table 2), and there were no pair-wise differences in weight change over the intervention period (mean between group differences -0.5 kg, 95% CI -1.4 to 0.4), suggesting participants incorporated soy foods into their diet by substituting for non-soy foods, rather than adding them to their diet. The distribution of number of days women engaged in at least 20 minutes of moderate or strenuous physical activity in both the Soy and Placebo arms also remained unchanged throughout the trial.

At each intervention time point, a greater proportion of participants in the Soy intervention arm reported consuming soy (Figure 1). The proportion of participants achieving the intervention goal of consuming two servings of soy per day increased at each time point (Figure 2). Fewer than 10% in the Placebo arm reported consuming 2 servings of soy daily at any time point. There were concomitant increases in serum isoflavones at 3 and 6 months from baseline in the soy arm only, with approximately 2-fold increases in both daidzein (mean 66.4 nmol/L, 95% CI 39.0 to 93.9) and genistein (mean 100.4 nmol/L, 95% CI 60.9 to 139.9) concentrations.

Of the soy foods listed on the soy FFQ, a greater proportion of women reported consuming tofu (35%) and soy milk (33%) while few women consumed soy yogurt (3%) or tempeh (3%). Propensity for consuming soy from soy milk, tofu, energy bars, and veggie burgers tracked over the 12-month follow-up period. At 12 months, 45% of women reported consuming soy milk and 41% reported consuming tofu.

Sensitivity analyses

The HALT intervention also included a multibotanical only arm ($N=76$); participants were randomized to receive 4 multi-botanical capsules daily without the soy foods intervention. In order to test whether the multi-botanical supplement had any effect on self-reported or serum measures of soy intake, women were compared in the multi-botanical only arm to the soy and placebo arms for all measures noted in Tables 1 and 2. There were no significant differences between the multibotanical only arm and placebo for any outcome measure (all comparisons $P>0.05$, data not shown).

Discussion

Results of this study suggest that a tailored, brief intervention delivered entirely by telephone and printed materials with no in-person counseling sessions can elicit increases in soy intake among peri- and post-menopausal women who entirely self-select their diets. The rationale for intervening to increase soy intake was that isoflavones in soy may alleviate menopausal symptoms by acting as weak estrogens (31). More than 90% of women in the soy intervention

group reported consuming soy foods at 6 (n=70) and 12 (n=68) months, and approximately 40% (n=41) of women receiving the soy intervention achieved the goal of consuming two servings of soy daily at one year. Furthermore, the self-reported increases in soy consumption were supported by concomitant and proportional increases in serum daidzein and genistein concentrations.

Several key components likely contributed to the effectiveness of this dietary intervention. The Soy Foods booklet, which provided an introduction to the study and detailed description of different soy foods including preparation and storage methods, serving sizes, recipes and tips to incorporate soy foods into the diet, helped familiarize participants with different soy foods and served as an important reference guide throughout the study. The use of telephone contacts as opposed to office visits enabled the dietitian to deliver the intervention while minimizing participant burden in terms of time and travel expenses. The dietitian also individualized the intervention by tailoring recommendations to increase soy intake according to each participant's lifestyle and typical dietary habits. Furthermore, the use of personalized messages, which were mailed to participants, served as a reminder of the dietitians' recommendations and the participant goals set during telephone contacts.

There are two important differences between the soy intervention described here and the many other successful soy intervention programs described in the published literature. First, this intervention did not provide soy foods to participants, and instead required participants to select and purchase their own soy foods. The majority of interventions previously designed to increase soy consumption have provided some or all soy foods to participants (1,3,7). Many provided a single food such as soy milk (10) or provided a specially formulated isoflavone-enriched food (32), while others provided a regular supply of several soy foods (4). In these studies providing soy supplements equivalent to 2-3 servings of soy per day, compliance to the intervention was high, ranging from 94-100%. (4,10,32).

This intervention suggests that it may not be necessary to provide soy foods to achieve substantial increases in soy consumption. Secondly, this intervention was delivered primarily by telephone with no in-person contacts, whereas the majority of other soy interventions involved at least one in-person contact, and some required multiple in-person counseling contacts (8,9) and/or group sessions (9,10).

Similar to studies implementing multi-component strategies and/or providing soy foods, serum isoflavone concentrations increased among intervention participants at follow-up compared to no significant change in control participants (9,10). Serum levels doubled from baseline to 6 months in HALT. Urinary isoflavones were 6 times higher after a 12-month multi-component intervention providing soy foods (9) and plasma isoflavones were 7 times higher after a 2-year intervention providing isoflavone-rich soymilk (10). Given the different intervention approaches and clinical endpoints, the studies can not be directly compared, but they provide support for the value of innovative intervention approaches.

There is substantial evidence demonstrating the efficacy of telephone-delivered interventions for dietary behavior change (11), most of which have targeted dietary goals such as increasing intakes of vegetables, fruits, and fiber and decreasing fat intake. Results from this study provide evidence that a soy intervention delivered by a dietitian via telephone and printed materials, rather than in person, can be effective yet presumably require fewer resources. These findings are consistent with other telephone counseling interventions designed to increase vegetable and fruit consumption (33) or make multiple changes (i.e. increase vegetable and fruits and decrease fat) to dietary patterns (15,16). Newman and colleagues reported over a two-thirds increase in vegetable and fruit servings per day, a 40% increase in whole-grain and bean servings per day, and a significant increase in plasma carotenoids after a 3-month telephone

counseling intervention designed to promote a dietary pattern rich in fruits, vegetables, and whole-grains through eight telephone calls (15). Pierce and colleagues provided evidence that sustainable dietary changes are possible in a motivated group of breast cancer survivors (n=3088) through a telephone-based intervention, as significant increases in vegetable, fruit, fiber, legume, and whole grain were maintained in the intervention compared to the control group after 4-years in the Women's Health Eating and Living Study (16).

Although this intervention effectively increased soy consumption in 90% of participants, approximately 60% did not achieve the overall goal of 2 servings of soy per day. This intervention involved only 5 phone contacts throughout the 12 month study period, with only 38% (n=27) of participants receiving five intervention calls. Women who received more phone calls in our study consumed more soy products compared to those receiving fewer calls. A recent review of telephone-based dietary interventions found that intervention effectiveness increases with the number of telephone contacts (11); therefore, it is possible our intervention effectiveness could have been improved by increasing the number of telephone contacts. However, in this intervention it is also possible that the participants who achieved the study goal of 2 servings of soy per day were more motivated or interested in increasing soy consumption, and thus completed more telephone contacts.

One of the major challenges in administering the intervention was reaching participants by phone, as fewer than 40% of the soy intervention participants received all 5 intervention calls despite numerous attempts by the dietitian. Most (85%) women in the soy intervention were employed, and their availability by phone was somewhat limited. Despite receiving fewer intervention contacts, the intervention effectively increased soy consumption, though not to the goal of two servings per day for most participants. The inability to view nonverbal cues through a telephone-based intervention may have been another challenge, but there was no comparison group receiving in-person counseling sessions to provide data to support this. Another study limitation was that serum measures were analyzed through 6, but not 12 months. The increases from baseline were largest at 3 months for the serum isoflavones, but the increases from baseline were largest at 6 months based on the soy FFQ. A possible explanation for the difference between self-reported measures and serum measures is that women in the soy intervention continued to report higher levels of soy intake at 6 months, but serum levels would suggest they were not maintaining soy intake. However, the 12-month soy FFQ data suggested participants continued to maintain higher intake of soy, and since the soy FFQ and serum isoflavones were moderately correlated at 3 and 6 months (Spearman r , 0.4-0.5), it may be likely that the 12-month FFQ data reflect a sustained increase in soy. Given the sample was comprised of predominantly Caucasian, post-menopausal women, generalizability of these findings with respect to race/ethnicity, age, and gender is limited.

A unique strength of this study is that the women were not specifically recruited to participate in a dietary intervention study and were not specifically motivated to change their dietary habits. Thus, even though women had varying levels of motivation to incorporate soy into their diet, the intervention was able to achieve substantial increases in soy intake. Another major strength of this study is the availability of objective measures of soy intake. Biomarkers of dietary intake are valuable, given the measurement error in self-reported diet assessment (34) and concerns that self-reported diet can be biased by an intervention (35). Additional strengths include high retention over the 12-month intervention period and an experienced dietitian delivering the intervention. Having a single dietitian trained in motivational interviewing making all calls provided the ability to insure consistency of the message provided to participants and the opportunity to establish rapport.

Conclusions

In conclusion, a tailored, brief intervention delivered via telephone and written materials increased soy consumption by approximately one serving per day. The intervention goal was not achieved by most participants; strategies for improving the effectiveness of the intervention could include increasing the level of contact with participants or complementing telephone counseling with other intervention approaches, such as interactive websites or structured newsletters. Future directions could also include incorporating interactive voice technology to automate delivery, text messaging, email or internet, which would provide the ability to disseminate the intervention more widely. However, it would be important to have oversight by a dietitian to address individual questions or concerns.

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*** $P < 0.001$ at each timepoint per Fisher's Exact Test.

Figure 1.

Participants (%) Reporting Any Soy Consumption by Timepoint and Treatment for Peri- and Post-Menopausal Women in the Herbal Alternatives Trial (HALT) as reported on the Soy Food Frequency Questionnaire²³.

Sample size at baseline, 3 months, 6 months, and 12 months was 79,75,74, and 74 for Soy and 84,77, 76, and 75 for Placebo.

Figure 2.

Participants (%) Achieving Intervention Goal to Consume Two Servings of Soy Daily by Timepoint and Treatment for Peri- and Post-Menopausal Women in the Herbal Alternatives Trial (HALT) as reported on the Soy Food Frequency Questionnaire²³.

Sample size at baseline, 3 months, 6 months, and 12 months was 79,75, 74, and 74 for Soy and 84,77, 76, and 75 for Placebo.

Table 1

Baseline Demographic and Lifestyle Characteristics by Treatment Assignment for Peri- and Post-Menopausal Women in the Herbal Alternatives Trial (HALT)

	Mean $\pm$ SD or n (%)		<i>p</i> ^a
	Soy n=79	Placebo n=84	
Age	52.4 $\pm$ 2.5	52.0 $\pm$ 2.5	0.57
Race			
White	74 (94%)	76 (90%)	
Black	4 (5%)	2 (2%)	
Asian/Pacific Islander	0 (0%)	4 (5%)	
Hispanic	1 (1%)	1 (1%)	
Other	0 (0%)	1 (1%)	0.13
Body Mass Index, kg/m²	28.4 $\pm$ 5.7	29.2 $\pm$ 6.4	0.61
Normal, 18.5-24.9	28 (35%)	24 (29%)	
Overweight, 25-29.9	26 (32%)	29 (35%)	
Obese, $\geq$ 30	25 (32%)	30 (36%)	0.91
Physical Activity, days/week^b			
None	5 (6%)	8 (10%)	
1-2	33 (42%)	30 (36%)	
3-4	14 (18%)	13 (15%)	
5-7	27 (34%)	33 (39%)	0.79
Smoking			
Never	49 (62%)	54 (64%)	
Former	26 (33%)	25 (30%)	
Current	4 (5%)	5 (6%)	0.33
Employed	66 (85%)	72 (87%)	0.48
Education beyond high school	75 (94%)	79 (94%)	0.61
Living as Married	58 (73%)	58 (69%)	0.63
Food Frequency Questionnaire (FFQ)			
Energy, kcal/d	1667 $\pm$ 698	1651 $\pm$ 802	0.95
Total Fat, % kcal	35.4 $\pm$ 8.1	37.7 $\pm$ 7.7	0.20
Carbohydrate, % kcal	45.2 $\pm$ 8.6	44.0 $\pm$ 10.3	0.60
Protein, % kcal	17.2 $\pm$ 3.1	17.7 $\pm$ 3.8	0.57
Vegetable, servings/d	2.3 $\pm$ 1.2	2.2 $\pm$ 1.4	0.88
Fruit, servings/d	1.7 $\pm$ 1.1	1.6 $\pm$ 1.1	0.72
Soy consumers ^c	56 (71%)	55 (66%)	0.76

^aEstimated using ANOVA for continuous variables and chi-squared or Fisher's Exact Test for categorical variables.

^bCategorized as number of days per week engaging in moderate or strenuous physical activity for at least 20 minutes.

^cReported consuming any soy products at least once in the previous 3 months on the Soy FFQ.

Table 2

Between-Group Differences in Change in Soy Intake Measures by Timepoint for Peri- and Post- Menopausal Women in the Herbal Alternatives Trial (HALT)

	Mean (95% CI)		Difference in Mean Change from Baseline (95% CI) ^a
	Soy, n= 79	Placebo, n = 84	Soy vs. Placebo
Soy (servings/d) ^b			
Baseline	0.6 (0.4 to 0.8)	0.4 (0.2 to 0.6)	NA ^c
3 month change	0.7 (0.6 to 0.9)	0.1 (−0.1 to 0.3)	0.6 (0.4 to 0.9)
6 month change	1.2 (1.0 to 1.4)	0.1 (−0.1 to 0.3)	1.1 (0.8 to 1.4)
12 month change	1.0 (0.8 to 1.3)	0.2 (−0.1 to 0.4)	0.9 (0.6 to 1.2)
All follow-up time ^d	1.0 (0.7 to 1.2)	0.1 (0 to 0.2)	0.9 (0.6 to 1.1)
FFQ Daidzein (mg/d)			
Baseline	4.7 (2.9 to 6.6)	4.3 (2.4 to 6.2)	NA ^c
3 month change	6.4 (4.6 to 8.1)	0.6 (−1.2 to 2.3)	5.8 (3.3 to 8.2)
6 month change	10.2 (8.2 to 12.3)	0.4 (−1.6 to 2.4)	9.8 (7.0 to 12.7)
12 month change	8.7 (6.6 to 10.8)	0.8 (−1.3 to 2.9)	7.9 (4.9 to 10.8)
All follow-up time ^d	8.4 (6.4 to 10.5)	0.6 (−1.0 to 2.2)	7.8 (5.2 to 10.4)
FFQ Genistein (mg/d)			
Baseline	5.8 (3.5 to 8.0)	6.0 (3.0 to 9.0)	NA ^c
3 month change	7.3 (4.6 to 10.1)	0.3 (−2.4 to 3.0)	7.0 (3.2 to 10.9)
6 month change	11.7 (8.8 to 14.7)	−0.1 (−3.0 to 2.8)	11.8 (7.7 to 16.0)
12 month change	10.3 (7.1 to 13.6)	0.7 (−2.5 to 4.0)	9.6 (5.0 to 14.1)
All follow-up time ^d	9.8 (7.2 to 12.4)	0.3 (−2.8 to 3.4)	9.5 (5.5 to 13.5)
Serum Daidzein (nmol/L)			
Baseline	32.1 (19.3 to 44.9)	22.2 (13.3 to 31.0)	NA ^c
3 month change	74.8 (49.6 to 100.1)	−4.3 (−29.2 to 20.7)	79.1 (43.6 to 114.6)
6 month change	57.4 (35.8 to 79.0)	3.4 (−18.5 to 25.3)	54.0 (23.2 to 84.7)
All follow-up time ^d	66.0 (40.6 to 91.3)	−0.5 (−10.9 to 10.0)	66.4 (39.0 to 93.9)
Serum Genistein (nmol/L)			
Baseline	51.1 (32.2 to 69.9)	42.7 (26.3 to 59.1)	NA ^c
3 month change	108.2 (71.1 to 145.4)	−11.0 (−47.6 to 25.7)	119.2 (67.1 to 171.4)
6 month change	77.7 (42.2 to 113.3)	−4.0 (−40.1 to 32.00)	81.8 (31.1 to 132.4)
All follow-up time ^d	92.8 (56.3 to 129.3)	−7.6 (−22.6 to 7.4)	100.4 (60.9 to 139.9)
Weight, kg			
Baseline	76.1 (72.5 to 79.7)	77.2 (73.6 to 80.9)	NA ^c
3 month change	0 (−0.6 to 0.5)	−0.2 (−0.7 to 0.4)	0.2 (−0.6 to 0.9)
6 month change	−0.1 (−0.9 to 0.7)	0.05 (−0.8 to 0.7)	0 (−1.2 to 1.0)
12 month change	−0.8 (−1.7 to 0.1)	−0.3 (−1.2 to 0.6)	−0.4 (−1.7 to 0.8)

	Mean (95% CI)		Difference in Mean Change from Baseline (95% CI) ^a
	Soy, n= 79	Placebo, n = 84	Soy vs. Placebo
All follow-up time ^d	-0.3 (-0.9 to 0.3)	-0.2 (-0.7 to 0.3)	-0.5 (-1.4 to 0.4)

^a P<0.001 for all pair-wise comparisons except for weight (P>0.05 for all comparisons).

^b Estimated using the Soy Food Frequency Questionnaire.

^c NA=Not applicable

^d Difference in mean change from baseline between intervention and comparison group using all time-points of follow-up using GEE with an unstructured covariance matrix.