Future Research for the Dietary Guidelines for Americans, 2015
Evidence Review Report

The report below contains summaries of research since 2007 that are aimed at helping to address the “Needs for Future Research” addressed in the Report of the Dietary Guidelines Advisory Committee on the Dietary Guidelines for Americans, 2010. The goal of this report is to provide the Dietary Guidelines Advisory Committee current and relevant research that may help in the development of the Dietary Guidelines for Americans, 2015.

Part D. Section 1: Energy Balance

Q2: Conduct well-controlled and powered research studies testing interventions that are likely to improve energy balance in children at increased risk of childhood obesity, including dietary approaches that reduce energy density, total energy, dietary fat, and calorically sweetened beverages, and promote greater consumption of fruits and vegetables.

Relevant Research

Q6: Conduct research on the influence of snacking behavior and meal frequency on body weight and obesity. Develop better definitions for snacking as the research moves forward.

Relevant Research
Part D. Section 2: Nutrition Adequacy, Food Groups and Selected Dietary Components Under consumed

Q2: Conduct clinical trials in children and adults to critically examine the impact of adherence to the 2010 Dietary Guidelines for Americans as a total dietary approach to a healthy lifestyle on body weight change, CVD, type 2 diabetes, cancer, and osteoporosis and related clinical endpoints.

Relevant Research

  - A parallel design study of 351 hyperlipidemic participants were counseled to follow a weight-maintaining vegetarian diet for a 6-month period with foods that could be purchased in supermarkets and health food stores and that provided 0.94 g of plant sterols per 1000 kcal of diet via a plant sterol ester–enriched margarine; 9.8 g of viscous fibers per 1000 kcal of diet from oats, barley, and psyllium; 22.5 g of soy protein per 1000 kcal as soy milk, tofu, and soy meat analogues; and 22.5 g of nuts per 1000 kcal of diet.
  - This dietary pattern is not only aligned with recommendations from the dietary guidelines but also contains foods with US FDA approved heart Health Claims or Qualified Health Claims.
  - This study compared two approaches to dietary counseling that included an ‘intensive portfolio’ group (83 participants completed) who received counseling more frequently than the ‘routine portfolio’ group (94 subjects completed).
  - The control dietary advice focused on low-fat dairy and whole grain cereals together with fruit and vegetables without attention to the specific portfolio components (90 participants completed).
  - The results between the 2 portfolio dietary interventions did not differ significantly from each other, but both were significantly different for from the control group with regards to LDL-cholesterol, total cholesterol (TC), TC:HDL-cholesterol ratio and apolipoprotein B.
  - The intensive portfolio diet led to a significant reduction in diastolic blood pressure (2.1 mmHg), compared to the control diet. A reduction in the systolic BP in intensive dietary treatment group was observed, but this was not significant.

  - It is increasingly evident that diet during preadolescence and adolescence has important consequences for breast cancer during adulthood. However, only a few
epidemiologic studies have been conducted on the relationship between diet during preadolescence and adolescence, and cancer during adulthood.

- Results from the small number of epidemiologic studies are inconsistent, but evidence is emerging that specific aspects of the diet during preadolescence and adolescence are important. For example, during preadolescence and adolescence, severe calorie restriction with poor food quality, high total fat intake, and alcohol intake tend to increase risk, whereas high soy intake decreases risk.

- Research on preadolescent and adolescent diet is a paradigm shift in breast cancer investigations. This research paradigm has the potential to produce transformative knowledge to inform breast cancer prevention strategies through dietary intervention during preadolescence and adolescence, rather than later in life, as is current practice, when it is perhaps less effective.


  - The 4-week Eco-Atkins study tested high–vegetable protein diets in 47 hyperlipidemic men and women. This study demonstrates the cholesterol lowering potential of a dietary portfolio intervention that counsels free-living participants to increase consumption of cholesterol lowering foods with US FDA approved heart Health Claims or Qualified Health Claims.

  - These foods (nuts, soy, viscous fiber, and plant sterol) have also been recommended in national guidelines to enhance the effectiveness of cholesterol-lowering therapeutic diets.

  - The study represents the first randomized trial to assess the ability of an intervention that counsels for consumption of these cholesterol-lowering foods to reduce LDL-C at 6-month follow-up in real-world conditions and demonstrates the health benefits that can be incurred with adherence to dietary advice.

  - The portfolio diet has shown to be effective as a weight loss diet and is effective in reducing blood lipids.

### Part D. Section 4: Protein

**Q1: Develop standardized definitions for vegetable proteins and improve assessment methods for quantifying vegetable protein intake to help clarify outcomes in epidemiologic studies in this area.**

**Relevant Content**


  - Vegetable Protein Standards adopted by Volume 7 of the Codex Alimentations Commission

- ALTERNATE PROTEIN PRODUCT (APP) TEXTURED VEGETABLE PROTEIN: A product that can be used to satisfy all or part of the meat/meat alternate requirement of the Child Nutrition meal pattern requirements when combined with meat, poultry, or seafood. Vegetable protein products are safe and suitable edible products produced
from vegetable (plant) sources, including, but not limited to soybeans, peanuts, wheat, and corn. Also know as: Textured Vegetable Protein (TVP), VPP, SCP.

USDA Food Glossary of Terms

Q2: Develop better methods of conducting cohort studies of populations consuming plant-based diets compared to animal based diets, including defined classifications of vegetarian and “near vegetarian” eating patterns and more specific impacts of dried beans and peas on health.

Relevant Research

  - A vegetarian diet is defined as one that does not include meat (including fowl) or seafood, or products containing those foods.
  - The lacto-ovo vegetarian eating pattern is based on grains, vegetables, fruits, legumes, seeds, nuts, dairy products, and eggs.
  - The lacto-vegetarian excludes eggs as well as meat, fish, and fowl.
  - The vegan, or total vegetarian, excludes eggs, dairy, and other animal products.
  - Vegetarian diets, including total vegetarian or vegan diets, are health, nutritionally adequate, and may provide health benefits in the prevention of certain diseases. A vegetarian diet is associated with lower risk of death from ischemic heart disease and vegetarians appears to have lower LDL cholesterol, lower blood pressure, and lower rates of hypertension and type 2 diabetes than non-vegetarians. Vegetarians have overall lower rates of cancer. Additionally, vegetarians tend to have lower BMIs.
  - A vegetarian can meet all current recommendations for protein n-3 fatty acids, iron, zinc, iodine, calcium, and vitamins D and B-12.

  - Vegans consume greater amounts of legumes than omnivores which has been negatively associated with the risk of colon cancer. Legume intake is also associated with a moderate reduction in risk of prostate cancer.


  - Study compared the effects of a low-fat vegan diet and conventional diabetes diet recommendations on glycemia, weight, and plasma lipids.
  - Both diets were associated with sustained reductions in weight and plasma lipid concentrations. In an analysis controlling for medication changes, a low-fat vegan diet appeared to improve glycemia and plasma lipids more than did conventional diabetes diet recommendations. Whether the observed differences provide clinical
benefit for the macro- or micro-vascular complications of diabetes remains to be established.

  - The 4-week Eco-Atkins study tested high-vegetable protein diets in 47 hyperlipidemic men and women. This study demonstrates the cholesterol lowering potential of a dietary portfolio intervention that counsels free-living participants to increase consumption of cholesterol lowering foods with US FDA approved heart Health Claims or Qualified Health Claims.
  - These foods (nuts, soy, viscous fiber, and plant sterol) have also been recommended in national guidelines to enhance the effectiveness of cholesterol-lowering therapeutic diets.
  - The study represents the first randomized trial to assess the ability of an intervention that counsels for consumption of these cholesterol-lowering foods to reduce LDL-C at 6-month follow-up in real-world conditions and demonstrates the health benefits that can be incurred with adherence to dietary advice.
  - The portfolio diet has shown to be effective as a weight loss diet and is effective in reducing blood lipids.

  - Results show that on any given day only 7.9% of adults are consuming dry beans and peas.
  - Consuming approximately (1/2) c dry beans or peas resulted in higher intakes of fiber, protein, folate, zinc, iron, and magnesium with lower intakes of saturated fat and total fat.

  - A parallel design study of 351 hyperlipidemic participants were counseled to follow a weight-maintaining vegetarian diet for a 6-month period with foods that could be purchased in supermarkets and health food stores and that provided 0.94 g of plant sterols per 1000 kcal of diet via a plant sterol ester–enriched margarine; 9.8 g of viscous fibers per 1000 kcal of diet from oats, barley, and psyllium; 22.5 g of soy protein per 1000 kcal as soy milk, tofu, and soy meat analogues; and 22.5 g of nuts per 1000 kcal of diet.
  - This dietary pattern is not only aligned with recommendations from the dietary guidelines but also contains foods with US FDA approved heart Health Claims or Qualified Health Claims.
This study compared two approaches to dietary counseling that included an ‘intensive portfolio’ group (83 participants completed) who received counseling more frequently than the ‘routine portfolio’ group (94 subjects completed).

The control dietary advice focused on low-fat dairy and whole grain cereals together with fruit and vegetables without attention to the specific portfolio components (90 participants completed).

The results between the 2 portfolio dietary interventions did not differ significantly from each other, but both were significantly different from the control group with regards to LDL-cholesterol, total cholesterol (TC), TC:HDL-cholesterol ratio and apolipoprotein B.

The intensive portfolio diet led to a significant reduction in diastolic blood pressure (2.1 mmHg), compared to the control diet. A reduction in the systolic BP in intensive dietary treatment group was observed, but this was not significant.

  - This article presents 4 hypothetical dietary patterns (25%, 50%, 75% of baseline meat), based on MyPyramid, that vary the proportion of meat and legumes (including dry beans and peas and soy products).
  - Nutrient calculation analyses on 7-day menus found that each 5.5 oz meat replaced with an equivalent amount of legumes was associated with a 7% decrease in cholesterol and lowered saturated fat, whereas key nutrients remained within recommended levels.

  - Both vegetarian diets and prudent diets, which allow small intakes of red meat, fish and dairy products, are associated with reduced risk of diseases, particularly CHD and type 2 diabetes.
  - There is limited evidence of an association between vegetarian diets and cancer prevention.
  - Evidence linking red meat intake, particularly processed meat, and increased risk of CHD, cancer and type 2 diabetes is convincing and provides indirect support for consumption of a plant-based diet.


Q3: Conduct studies of potential limitations of plant-based diet for key nutrients, including calcium, iron, vitamin B12, and protein quality, especially in children and the elderly.
Relevant Research

  - Vegetarian diets, including total vegetarian or vegan diets, are health, nutritionally adequate, and may provide health benefits in the prevention of certain diseases. A vegetarian diet is associated with lower risk of death from ischemic heart disease and vegetarians appear to have lower LDL cholesterol, lower blood pressure, lower rates of HTN and lower rates of type 2 diabetes than non-vegetarians. Vegetarians have overall lower rates of cancer. Additionally, vegetarians tend to have lower BMIs.
  - A vegetarian can meet all current recommendations for protein n-3 fatty acids, iron, zinc, iodine, calcium, and vitamins D and B-12.
  - Studies indicate that older vegetarians have dietary intakes that are similar to non-vegetarians.
  - Average protein intakes of vegetarian children (lacto-ovo, vegan, and macrobiotic) generally meet or exceed recommendations. Vegan children may have slightly higher protein needs, but needs are generally met when diets contain adequate energy and a variety of plant foods.
  - Vegetarian diets appear to offer some nutritional advantages for adolescents. They are reported to consume more fiber, iron, folate, vitamin A, and vitamin C than non-vegetarians. They also consume more fruits and vegetables and fewer sweets, fast foods, and salty snacks compared to non-vegetarian adolescents.
  - Older adults can meet protein needs on a vegetarian diet if a variety of protein-rich plant foods, including legumes and soy products, are eaten daily.

  - Vegans tend to be thinner, have lower serum cholesterol, and lower blood pressure, reducing their risk of heart disease.
  - Vegans consume greater amounts of legumes than omnivores which has been shown to be protective against cancer. Legumes have been specifically seen to be negatively associated with the risk of colon cancer.
  - Although vegans have lower zinc intake than omnivores, they do not differ from the non-vegetarians in functional immunocompetence (as assessed by natural killer cell cytotoxic activity). It appears there may be facilitators of zinc absorption and compensatory mechanisms to help vegetarians adapt to lower intake of zinc.
  - Eliminating all animal products from the diet increases the risk of certain nutritional deficiencies. Micronutrients of special concern for the vegan include vitamins B-12 and D, calcium, and long-chain n-3 (omega-3) fatty acids.
  - Iron and zinc status of vegans may also be of concern because of the limited bioavailability of these minerals in plant-based foods.
  - Unless vegans regularly consume foods that are fortified with these nutrients, appropriate supplements should be consumed.
  o This article presents 4 hypothetical dietary patterns, based on MyPyramid, that vary the proportion of meat and legumes (including dry beans and peas and soy products).
  o Nutrient calculation analyses on 7-day menus found that each 5.5 oz meat replaced with an equivalent amount of legumes was associated with a 7% decrease in cholesterol and lowered saturated fat, whereas key nutrients remained within recommended levels.


Q4: Examine the role of dairy products in lipid profiles, especially through intervention trials in which all types of dairy products, both low and high fat, are fed. Bioactive components that alter serum lipid levels may be contained in milk fat.

Several clinical studies have investigated the effects of lean protein sources on serum lipids, such as milk and soy in comparison to carbohydrate. Two recent examples of high quality studies have been conducted since the last DG committee that investigated the ability of cow’s milk to improve blood lipids, in comparison to other protein sources.

Relevant Research

  o Soy protein (SP) and low-fat dairy product consumption have been suggested to have hypocholesterolemic effects, although the responsible mechanisms are poorly understood.
  o Subjects with hypercholesterolemia followed the Therapeutic Lifestyle Changes diet for 4 weeks, followed by a 2-week lead-in with colesvelam HCl (therapeutic cholesterol lowering agent). Individuals with LDL-C lowering of ≥5.0% with colesvelam HCl assigned to one of two groups after a 3-week washout: 1) soy protein or 2) total milk proteins.
  o Both soy protein and total milk protein reduced atherogenic lipoproteins, as indicated by changes in total cholesterol, LDL-C, non-high-density lipoprotein cholesterol, and apolipoprotein B.
These results confirm that soy protein consumption has a cholesterol lowering effect. Total milk protein consumption also lowers cholesterol but with a less pronounced response.

- Net changes in lipoproteins with soy protein consumption compared with nonsoy control diets were analyzed. Randomized parallel and crossover studies were evaluated.
- Soy protein intake was associated with net changes in serum LDL-cholesterol values of -0.23 mmol/l (95% CI, -0.28 to -0.18 mmol/l) or a 5.5% reduction in parallel studies and -0.16 mmol/l (95% CI, -0.22 to -0.11 mmol/l) or a reduction of 4.2% with crossover studies (significant p < 0.001 for parallel vs crossover). In parallel studies, net serum HDL cholesterol values were 3.2% higher (p < 0.007) with soy vs control, and fasting serum triacylglycerol values were 10.7% lower (p < 0.008) for soy vs control.
- Soy protein consumption with a median of 30 g/d was associated with a significant improvement in lipoprotein risk factors for CHD.

- A randomized, controlled trial that included 352 U.S. healthy adults assigned to 40 g/day supplementation of soy protein, milk protein or complex carbohydrate from wheat for 8 weeks in random order.
- Compared with milk protein, soy protein supplementation significantly increased HDL by 1.54mg/dl (p=0.0009), borderline significantly lowered LDL by 2.45 mg/dl (p=0.05) and also significantly reduced total/HDL cholesterol ratio.
- Soy protein supplementation significantly reduced total cholesterol by 3.97 mg/dl (p=.03), as well as the total/HDL cholesterol ratio, when compared with carbohydrate.
- This high quality randomized 3-phase crossover controlled trial indicates that, compared with carbohydrate intake, soy protein supplementation reduces total cholesterol and total/HDL cholesterol ratio among individuals without hypercholesterolemia. In addition, compared with milk protein, soy protein supplementation increased HDL and reduced total/HDL cholesterol ratio.

In response to the challenge to the U.S. FDA heart health claim on soy, this study attempted to estimate the intrinsic and extrinsic (displacement) potential of soy in reducing LDL-C to determine continued justification of claim.

The intrinsic effect of soy was derived from a meta-analysis using soy studies (20-133 g/d soy protein) included in the recent AHA Soy Advisory. The extrinsic effect of soy in displacing foods higher in saturated fat and cholesterol was estimated using predictive equations for LDL-C and NHANES III population survey data with the substitution of 13-58 g/d soy protein for animal protein foods.

The LDL-C reduction attributable to the combined intrinsic and extrinsic effects of soy protein foods ranged from 7.9 to 10.3%. Thus, soy remains one of a few food components that reduces serum cholesterol (>4%) when added to the diet.


This study ascertained the effects of soy, in the forms of textured soy protein (TSP) and soy nuts, on lipid profiles, apolipoproteins, inflammatory and prothrombotic markers, and blood pressure in 75 elderly women, ages 60-70 years, diagnosed with metabolic syndrome.

A 12-week parallel, randomized, controlled trial conducted in rural health centers of Babol, Iran. Subjects were randomized to one of the following 3 groups: i) soy nut (35g/d), ii) TSP (35g/d), and iii) control. Blood biochemical markers measured included: triglycerides (TG), cholesterol, HDL-C, LDL-C, VLDL-C, ApoB100, Apo AI, C-reactive protein, and fibrinogen.

Soy nuts significantly improved LDL-C, VLDL-C, and ApoB100 levels (P < 0.05)

Serum total cholesterol decreased significantly in the treatment groups compared with the control group (P < 0.005).

Moderate daily intake of soy may be a safe, inexpensive, and practical method to improve the risk of cardiovascular disease and reduce the need for medical treatment.


Scientific databases systematically reviewed against pre-determined criteria. Eligible RCTs evaluated the effect of 25 g (range 15-40 g) soya protein on measures of blood lipids. Results from RCTs were pooled using standard meta-analysis methods.

Thirty studies containing 42 treatment arms (n=2913), with an average soya protein intake of 26.9 g met the inclusion criteria. Soya protein inclusion led to reductions in standard difference in mean low density lipoprotein (LDL), total cholesterol and blood triglycerides.

Meta-regression analysis indicated no dose response relationship between soya protein intake in the range of 15-40 g and standard difference in LDL or HDL.
The inclusion of modest amounts soya protein (25 g) into the diet of adults with normal or mild hypercholesterolemia resulted in small, highly significant reductions in total and LDL cholesterol, equivalent to 6% LDL reduction.

Q7: Conduct randomized controlled trials to answer the question whether intake of dairy products alters blood pressure.

Relevant Research

  - We conducted a randomized, double-blind crossover trial with 3 intervention phases among 352 adults with prehypertension or stage 1 hypertension assigned to 40 g/day supplementation of soy protein, milk protein or complex carbohydrate from wheat each for 8 weeks in random order.
  - The results from this randomized, controlled trial indicate that both soy and milk protein intake reduce systolic BP compared with a high-glycemic-index refined carbohydrate among patients with prehypertension and stage 1 hypertension.
  - Diastolic BP was also reduced, but this change did not reach statistical significance.
  - There was no significant difference in the BP reductions achieved between soy or milk protein supplementation.
  - While the change in BP was relatively small, the authors state that if the average systolic blood pressure in the U.S. dropped by about two points, the annual deaths from heart disease and stroke could be expected to drop by 6% and 4%, respectively.
  - Furthermore, these findings suggest that partially replacing carbohydrate with soy or milk protein might be an important component of nutrition intervention strategies for the prevention and treatment of hypertension.


  - This study examined whether soy protein with isoflavones or isoflavones alone reduces BP and endothelial cytokines, and whether the effects differed by baseline BP level.
  - A double-blind randomized, placebo-controlled trial was conducted among 180 postmenopausal Chinese women with mild hyperglycemia. Participants were randomly assigned to one of the three arms to receive either 15 g soy protein and
100 mg isoflavones (Soy group), or 15 g milk protein and 100 mg isoflavones (Iso group), or 15 g milk protein (placebo group) on a daily basis for 6 months.

- No significant difference was observed in the change and % change of BP and endothelial cytokine levels among the three study groups. However, a subgroup analysis among 130 pre and hypertensive women suggested that soy protein and isoflavones significantly reduced SBP (p = 0.02) and the level of soluble intercellular adhesion molecule (sICAM)-1 (p = 0.02) relative to milk protein after 6-month intervention.
- Soy protein and isoflavones did have a favorable reduction on SBP, sICAM-1 and E-selectin was observed among women with initial elevated BP.

Q8: Ensure that prospective cohort studies continue to track the association between intake of dairy products and metabolic syndrome.

Metabolic syndrome is a global health problem associated with the development of cardiovascular disease and diabetes and is associated with risk factors of these and other conditions, such body weight, waist circumference, insulin resistance, high blood pressure, abnormal serum lipids. The proteins found in many plant proteins may have a beneficial effect on these risk factors.

Relevant Research


  - Overall, there is a suggestive body of evidence that soy and dietary phytoestrogens favorably alter glycemic control, improve weight and fat loss, lower triglycerides, low density lipoprotein (LDL) cholesterol and total cholesterol.
  - In animal studies, soy and phytoestrogens are effective at reducing adipose tissue and improving glucose uptake.
  - The specific soy protein components that may lead to metabolic improvements have yet to be determined. Phytoestrogens appear to have beneficial actions both on glucose and lipid metabolism but additional micro-nutriments such as saponins, phytosterols, trypsin inhibitors, as well as amino acid and protein composition, may have additive or synergistic effects.
  o Although no clinical studies have recorded a reduction in body weight, the isoflavones may help prevent obesity associated diseases by improving the plasma lipid profile.
  o The results of in vitro studies clearly suggest that isoflavones may have inhibitory effects on adipose tissue enlargement in vivo, and the experiments using rodents and humans demonstrate that some of the beneficial effects may actually apply in vivo.
  o However, in vivo, especially in humans, the actions of soy isoflavones appear to depend on a complicated interaction between many factors, such as the presence of soy protein and particular intestinal bacteria

**Part D. Section 5: Carbohydrates**

**Q3: Conduct intervention and research studies with strong designs that include sufficient sample sizes over time and specific measures of vegetable and fruit intake, including specific types of vegetables and fruits, overall dietary patterns, exercise, sex, and other confounding factors to evaluate the impact of consuming vegetables and fruits on health.**

**Relevant Research**


  o The 4-week Eco-Atkins study tested high-vegetable protein diets in 47 hyperlipidemic men and women. This study demonstrates the cholesterol lowering potential of a dietary portfolio intervention that counsels free-living participants to increase consumption of cholesterol lowering foods with US FDA approved Heart Health Claims or Qualified Health Claims.
  o These foods (nuts, soy, viscous fiber, and plant sterol) have also been recommended in national guidelines to enhance the effectiveness of cholesterol-lowering therapeutic diets.
  o The study represents the first randomized trial to assess the ability of an intervention that counsels for consumption of these cholesterol-lowering foods to reduce LDL-C at 6-month follow-up in real-world conditions and demonstrates the health benefits that can be incurred with adherence to dietary advice.
  o The portfolio diet has shown to be effective as a weight loss diet and is effective in reducing blood lipids.

- A parallel design study of 351 hyperlipidemic participants were counseled to follow a weight-maintaining vegetarian diet for a 6-month period with foods that could be purchased in supermarkets and health food stores and that provided 0.94 g of plant sterols per 1000 kcal of diet via a plant sterol ester–enriched margarine; 9.8 g of viscous fibers per 1000 kcal of diet from oats, barley, and psyllium; 22.5 g of soy protein per 1000 kcal as soy milk, tofu, and soy meat analogues; and 22.5 g of nuts per 1000 kcal of diet.

- This dietary pattern is not only aligned with recommendations from the dietary guidelines but also contains foods with US FDA approved heart Health Claims or Qualified Health Claims.

- This study compared two approaches to dietary counseling that included an ‘intensive portfolio’ group (83 participants completed) who received counseling more frequently than the ‘routine portfolio’ group (94 subjects completed).

- The control dietary advice focused on low-fat dairy and whole grain cereals together with fruit and vegetables without attention to the specific portfolio components (90 participants completed).

- The results between the 2 portfolio dietary interventions did not differ significantly from each other, but both were significantly different for from the control group with regards to LDL-cholesterol, total cholesterol (TC), TC:HDL-cholesterol ratio and apolipoprotein B.

- The intensive portfolio diet led to a significant reduction in diastolic blood pressure (2.1 mmHg), compared to the control diet. A reduction in the systolic BP in intensive dietary treatment group was observed, but this was not significant.

Q8: Determine whether the effects of vegetables and fruits in the overall dietary pattern are due to displacement of other foods in the diet or to the action of vegetables and fruits per se on specific health outcomes.

**Relevant Research**


- Jenkins et al. address two components that may be involved in soy’s cholesterol lowering effects: 1) soy protein consumption can directly lower cholesterol (the “intrinsic” effect) and 2) soy food consumption in place of foods that contain high levels of saturated fat and cholesterol can give an additional meaningful LDL-cholesterol reduction (the “extrinsic” effect).

- To evaluate the intrinsic effects of soy, 22 studies form the AHA Soy Advisory were evaluated and found 11 of these 22 studies that matched test and control diets (allowing a direct comparison of the role of soy protein’s “intrinsic” ability to lower LDL-C) showed an LDL-C reduction of 5.2%, similar to the overall results from the 22 studies in the Anderson 1995 Meta-analysis (**N Engl J Med** 333:276-28).
  o This article presents 4 hypothetical dietary patterns, based on MyPyramid, that vary the proportion of meat and legumes (including dry beans and peas and soy products).
  o Nutrient calculation analyses on 7-day menus found that each 5.5 oz meat replaced with an equivalent amount of legumes was associated with a 7% decrease in cholesterol and lowered saturated fat, whereas key nutrients remained within recommended levels.

Role of Soyfoods and Soy Components in Major Public Health Concerns

Soy Protein and Soyfoods in the Prevention of Risk Factors for Cardiovascular Disease


- Purpose of this study was to determine the effect of a daily intake of around 25 grams of soy protein on blood lipids in adults with normal or slightly high cholesterol levels.
- Systematic review of 30 randomized control trials containing 42 treatment arms (n = 2913).
- The review found that including soy protein (25 g) in the diet of adults led to reductions in low density lipoprotein (LDL), total cholesterol and blood triglycerides. There was no effect on mean difference in apolipoprotein A (ApoA), but ApoB was reduced in the soy group. There was no dose response relationship identified between soy protein intake and the standard difference in LDL or HDL.


- Jenkins et al. address two components that may be involved in soy’s cholesterol lowering effects: 1) soy protein consumption can directly lower cholesterol (the “intrinsic” effect) and 2) soy food consumption in place of foods that contain high levels of saturated fat and cholesterol can give an additional meaningful LDL-cholesterol reduction (the “extrinsic” effect).
- To evaluate the intrinsic effects of soy, 22 studies form the AHA Soy Advisory were evaluated and found 11 of these 22 studies that matched test and control diets (allowing a direct comparison of the role of soy protein’s “intrinsic” ability to lower LDL-C) showed an LDL-C reduction of 5.2%, similar to the overall results from the 22 studies in the Anderson 1995 Meta-analysis (*N Engl J Med* 333:276-28).


- Soy protein (SP) and low-fat dairy product consumption have been suggested to have hypocholesterolemic effects, although the responsible mechanisms are poorly understood.
Subjects with hypercholesterolemia followed the Therapeutic Lifestyle Changes diet for 4 weeks, followed by a 2-week lead-in with colesevelam HCl (therapeutic cholesterol lowering agent). Individuals with LDL-C lowering of ≥5.0% with colesevelam HCl assigned to one of two groups after a 3-week washout: 1) soy protein or 2) total milk proteins.

Both soy protein and total milk protein reduced atherogenic lipoproteins, as indicated by changes in total cholesterol, LDL-C, non-high-density lipoprotein cholesterol, and apolipoprotein B.

These results confirm that soy protein consumption has a cholesterol lowering effect. Total milk protein consumption also lowers cholesterol but with a less pronounced response.


The purpose of this study was to examine whether the postprandial state would be more sensitive to any favorable changes associated with consuming soy protein compared with the fasting lipid profile and whether or not the presence of isoflavones in soy would enhance this effect.

Study subjects included 30 sedentary men (aged 18-30) randomly assigned to 25g/day of milk protein (Milk), isoflavone-poor soy (Soy-), or isoflavone-rich soy (Soy+) to supplement their usual diet.

Serum triacylglycerol (TAG), total cholesterol, non-esterified fatty acids, apolipoproteins B-100 and A-I and glucose concentrations were collected before and after supplementation in a fasted state and postprandially at 30, 60, 120, 240, and 360 min after a high-fat, 1,000 kcal shake.

Results showed that fasting concentrations were not different after any protein supplementation. Postprandial TAG concentrations increased after isoflavone-poor (soy-) consumption supporting the postprandial state as a more sensitive indicator of soy ingestion effects on CVD risk factors compared with the fasting lipid profile.

Furthermore, this study suggests that the absence of isoflavones in soy protein may have deleterious consequences on supposed cardio-protective effects.


Net changes in lipoproteins with soy protein consumption compared with non-soy control diets were analyzed. Randomized parallel and crossover studies were evaluated.

Soy protein intake was associated with net changes in serum LDL-cholesterol values of -0.23 mmol/l (95% CI, -0.28 to -0.18 mmol/l) or a 5.5% reduction in parallel studies and -0.16 mmol/l (95% CI, -0.22 to -0.11 mmol/l) or a reduction of 4.2% with crossover studies (significant \( p < 0.001 \) for parallel vs crossover). In parallel studies, net serum HDL cholesterol values were 3.2% higher \( (p < 0.007) \) with soy vs control, and fasting serum triacylglycerol values were 10.7% lower \( (p < 0.008) \) for soy vs control.
- Soy protein consumption with a median of 30 g/d was associated with a significant improvement in lipoprotein risk factors for CHD.

- The purpose of this study was to determined whether isoflavone soy protein (ISP) supplementation reduces subclinical atherosclerosis.
- Double-blind, placebo-controlled trial, 350 postmenopausal women 45 to 92 years of age without diabetes and cardiovascular disease were randomized to 2 evenly divided daily doses of 25 g soy protein containing 91 mg aglycon isoflavone equivalents or placebo for 2.7 years.
- ISP supplementation had a null effect on women who were >5 years beyond menopause when randomized.
- Overall, ISP supplementation did not significantly reduce subclinical atherosclerosis progression in postmenopausal women. Subgroup analysis suggests that ISP supplementation may reduce subclinical atherosclerosis in healthy young (median age, 53 years) women at low-risk for cardiovascular disease who were <5 years postmenopausal.

- The purpose of this study was to determine the effect of soy protein with low-calorie diet on lipid profiles in the hyperlipidemic patient.
- Participants included 52 hyperlipidemic male and female patients aged 25-65 years. All of the patients received a low-calorie diet (1400 kcal, 18% protein, 24% fat and 58% carbohydrate) per day for 4 weeks. The treatment group received 30 grams per day of soy protein and control group did not receive soy protein.
- Results indicate that in both groups weight, body mass index (BMI), waist and hip circumferences were significantly reduced (p<0.05).
- The results indicate that serum low-density lipoprotein (LDL) was significantly (p<0.05) reduced in the treatment group compared to the control group while an insignificant reduction was seen in total cholesterol.

- A randomized, controlled trial that included 352 U.S. healthy adults assigned to 40 g/day supplementation of soy protein, milk protein or complex carbohydrate from wheat for 8 weeks in random order.
- Compared with milk protein, soy protein supplementation significantly increased HDL by 1.54mg/dl (p=0.0009), borderline significantly lowered LDL by 2.45 mg/dl (p=0.05) and also significantly reduced total/HDL cholesterol ratio.
- Soy protein supplementation significantly reduced total cholesterol by 3.97 mg/dl (p=.03), as well as the total/HDL cholesterol ratio, when compared with carbohydrate.
- This high quality randomized 3-phase crossover controlled trial indicates that, compared with carbohydrate intake, soy protein supplementation reduces total cholesterol and total/HDL cholesterol ratio among individuals without hypercholesterolemia. In addition, compared with milk protein, soy protein supplementation increased HDL and reduced total/HDL cholesterol ratio.


### Soy Protein and Soyfoods in the Prevention of Metabolic Syndrome


- Overall, there is a suggestive body of evidence that soy and dietary phytoestrogens favorably alter glycemic control, improve weight and fat loss, lower triglycerides, low density lipoprotein (LDL) cholesterol and total cholesterol.
- In animal studies, soy and phytoestrogens are effective at reducing adipose tissue and improving glucose uptake.
- The specific soy protein components that may lead to metabolic improvements have yet to be determined. Phytoestrogens appear to have beneficial actions both on glucose and lipid metabolism but additional micro-nutriments such as saponins, phytosterols, trypsin inhibitors, as well as amino acid and protein composition, may have additive or synergistic effects.


- Although no clinical studies have recorded a reduction in body weight, the isoflavones may help prevent obesity associated diseases by improving the plasma lipid profile.
- The results of in vitro studies clearly suggest that isoflavones may have inhibitory effects on adipose tissue enlargement in vivo, and the experiments using rodents and humans demonstrate that some of the beneficial effects may actually apply in vivo.
- However, in vivo, especially in humans, the actions of soy isoflavones appear to depend on a complicated interaction between many factors, such as the presence of soy protein and particular intestinal bacteria.

**Soy Protein and Soyfoods in Obesity Prevention and Promotion of Satiety**


- Four propositions related to soyfoods and weight loss using data from *in vitro*, animal, epidemiologic, and clinical studies were analyzed and summarized
  - Certain soyfoods will improve weight and/or fat loss when fed at iso-caloric levels. Generally supportive evidence in animal studies, but there is no compelling support in human studies.
  - Certain soyfoods will improve weight and fat loss when included as part of a diet by affecting caloric intake. Limited supportive evidence in animal and human studies.
  - Certain soyfoods will prevent/improve risk factors related to glucoregulatory function and cardiovascular health during weight loss. Some evidence supporting this proposition, but additional evidence is needed before conclusions can be made.
  - Certain soyfoods will minimize the loss of bone mass during weight loss. No data available pertinent to this proposition.
- Limitations in existing data make it difficult to reach conclusions regarding these four propositions


- This study examined the relationship between lifetime soy consumption and body mass index (BMI) among 1,418 women in Hawaii (with Caucasian, Japanese, and Native Hawaiian ancestry).
- All subjects self-reported anthropometric measures, regular diet, and soy intake throughout life.
- Results show that higher soy consumption in adulthood was related to a lower BMI (*P* = 0.02). This association was only significant for Caucasian women and for postmenopausal subjects. The women in the highest category also experienced a smaller annual weight change since age 21 (by 0.05 kg/year) than the low soy intake group (*P* = 0.02). They observed no association between early life soy intake and BMI. High vegetable consumption was significantly associated with a higher soy intake among Caucasian women. This indicates that the association may be due to other nutritional factors and behaviors common in women with high soy intake.

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Overall, there is a suggestive body of evidence that soy and dietary phytoestrogens favorably alter glycemic control, improve weight and fat loss, lower triglycerides, low density lipoprotein (LDL) cholesterol and total cholesterol.

In animal studies, soy and phytoestrogens are effective at reducing adipose tissue and improving glucose uptake.

The specific soy protein components that may lead to metabolic improvements have yet to be determined. Phytoestrogens appear to have beneficial actions both on glucose and lipid metabolism but additional micro-nutriments such as saponins, phytosterols, trypsin inhibitors, as well as amino acid and protein composition, may have additive or synergistic effects.


The 4-week Eco-Atkins study tested high –vegetable protein diets in 47 hyperlipidemic men and women. This study demonstrates the cholesterol lowering potential of a dietary portfolio intervention that counsels free-living participants to increase consumption of cholesterol lowering foods with US FDA approved heart Health Claims or Qualified Health Claims.

These foods (nuts, soy, viscous fiber, and plant sterol) have also been recommended in national guidelines to enhance the effectiveness of cholesterol-lowering therapeutic diets.

The study represents the first randomized trial to assess the ability of an intervention that counsels for consumption of these cholesterol-lowering foods to reduce LDL-C at 6-month follow-up in real-world conditions and demonstrates the health benefits that can be incurred with adherence to dietary advice.

The portfolio diet has shown to be effective as a weight loss diet and is effective in reducing blood lipids.


Research Prior to 2007 that may be useful to the 2015 Dietary Guidelines Advisory Committee

Part D. Section 1: Energy Balance. Q6

Part D. Section 4: Protein Q2

Part D. Section 4: Protein Q3

**Part D. Section 5: Carbohydrates Q3**


**Part D. Section 5: Carbohydrates Q8**