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In addition to summarizing articles from scientific peer-reviewed journals, **Bean Briefs** highlights news and research about beans and health.

Dietary protein sources in early adulthood and breast cancer incidence: prospective cohort study

Farvid MS, Cho E, Chen WY, et al *British Medical Journal* 2014; 348: g3437.

The influence of protein on breast cancer has been frequently studied over the years; a high protein intake can increase insulin-like growth factor, which may affect breast cancer risk. Evidence for this, however, has been equivocal, even for red meat. This research team realized that most studies have looked only at women in mid-life or older, while studies that have included younger women suggest a stronger connection. Therefore they sought to discern the difference between pre- and postmenopausal women and protein intake, as well as to separate out the effects of different sources of protein.



The study gleaned data from nearly 89,000 premenopausal women in the Nurses' Health Study II who answered a food-frequency questionnaire five times over the course of the study. After 20 years, 3% of the participants had been diagnosed with breast cancer. Overall, a higher red meat intake was associated with a higher risk of the disease, while legumes (and other non-meat protein sources) were not associated with risk. Furthermore, the researchers determined that substituting one serving a day of legumes for red meat lowered the risk of breast cancer by 15% for all women, and a remarkable 19% for premenopausal women.



TAKE-HOME BEAN MESSAGE:

Red meat intake, specifically, seems to increase the risk of breast cancer, while beans reduce the risk, especially if substituted for red meat. All women can benefit, but women in young adulthood appear to benefit the most if they start eating a daily serving of beans instead of red meat. This presents an opportunity to introduce younger women to beans and their health benefits.



Fruit and vegetable intake and the risk of colorectal cancer: results from the Shanghai Men's Health Study

Vogtmann E, Xiang YB, Li HL, et al *Cancer Causes & Control* 2013; 24: 1935-45. Colorectal cancer is among the leading causes of death in the US and globally, including countries such as mainland China. Researchers continue to actively examine diet as both a contributing factor to the disease and an important aspect of primary prevention. So far, the relationship between colorectal cancer and diet in general, and fruits and vegetables in particular, is suggestive but not conclusive. The large-scale Shanghai Men's Health Study (SMHS) offers the opportunity to evaluate the effects of dietary fruits and vegetables on the risk of colorectal cancer.

The SMHS is a prospective, population-based cohort study of more than 60,000 men between the ages of 40 and 74 without a history of cancer. They were evaluated every two to three years for colorectal cancer and other chronic diseases. Diet assessments at each visit utilized a food frequency questionnaire (FFQ) listing eight commonly consumed fruits and 38 commonly consumed vegetables. The research team used the FFQ to quantify intake of total fruit, total vegetables, and total fruit and vegetables combined, along with five vegetable subgroups (cruciferous, allium, green leafy, legumes, and other), citrus fruit, and watermelon. For analysis purposes, participants were divided into either tertiles or quintiles, depending on the fruit or vegetable parameter being considered. Follow-up averaged approximately six years.

After adjusting for age, overall and individual fruit and vegetable consumption was similar in those who developed colorectal cancer and those who did not. Both groups had relatively high intakes. However, the quintiles with the highest intake of fruits (but not vegetables) and fruits and vegetables combined had significantly lower cancer risk than the lowest quintiles. Legumes were the only vegetable subgroup that reduced risk.

TAKE-HOME BEAN MESSAGE:

The high intake of fruits and vegetables among Chinese men in this study likely overshadowed the effects of individual items. Still, beans stand out as part of the only subgroup that conferred additional benefit. This reinforces the importance of eating plenty of fruits and vegetables and choosing beans often.

The effects of legumes on metabolic features, insulin resistance and hepatic function tests in women with central obesity: a randomized controlled trial

Alizadeh M, Gharaaghaji R, Gargari BP International Journal of Preventive Medicine 2014; 5(6): 710-20. Researchers sought to determine the metabolic effects of a legume-rich, low-calorie diet on women in Iran, where the prevalence of central obesity is over 50%. Unique to this study was a high pre-study intake of legumes—three servings a week—with very little from soybeans. Thus a high bar for demonstrating that bean intake improved measurements compared to the baseline period existed. The researchers divided 42 premenopausal women into two groups: (1) a low-calorie diet without legumes, and (2) a low-calorie diet enriched with one cup of non-soy legumes a day, including chickpeas, cowpeas, wax beans, lentils and split peas.

After six weeks of follow-up, the high-legume group saw significant improvements in many measures, including systolic blood pressure (8% drop), triglycerides (12% drop), and liver function tests (up to 24% drop). Researchers saw a marked difference in the results at the end of six weeks compared to the halfway mark of three weeks, suggesting that these measures can improve over time. Limitations of the study include the fact that the non-legume group was instructed to stop eating legumes and substitute meat instead (1-2 servings/day. Even though the percent of calories from total fat was the same on both diets, presumably the saturated fat intake on the non-legume diet was increased compared to the legume-enriched diet due to the increased intake of red meat. This likely contributed to the poorer results for the legume-free group. However, the low-calorie diet without legumes resembles a low-calorie Western diet, so it offers a particularly pertinent comparison for Americans.



TAKE-HOME BEAN MESSAGE:

The more beans, the better. Beans were found to improve several measures of health, including triglycerides, blood pressure, and liver function, even among young women who were already eating a large amount of beans, particularly as compared to a typical American diet. It stands to reason that people who rarely eat beans would definitely benefit from regularly adding beans to their diet.

Effect of dietary pulse intake on established therapeutic lipid targets for cardiovascular risk reduction: a systematic review and meta-analysis of randomized controlled trials

Ha V, Sievenpiper JL, de Souza RJ, et al *Canadian Medical Association Journal* 2014; 186(8): E252-62.

Dietary total and insoluble fiber intakes are inversely associated with prostate cancer risk

Deschasaux M, Pouchieu C, His M, et al *The Journal of Nutrition* 2014; 144: 504-10. Eating more beans is suggested as a way to lower cholesterol levels, but Canadian researchers aimed to quantify the benefit in order to encourage the inclusion of bean recommendations in heart health guidelines. This meta-analysis of prospective studies, which combined the data from 26 randomized controlled trials, sought to determine the effect that pulses (beans and legumes other than soy and peanuts) can have on reducing the risk of heart disease. Collectively, the trials included 1,037 middle-age men and women, many with elevated lipid levels, but also some with normal profiles. Beans were the most common pulses in the diets of

study participants.

After pooling the study results, statistical analyses demonstrated a significant 5% reduction in LDL-cholesterol in participants who ate three-quarters of a cup of beans a day on average. Based on previous research by others, this suggests that eating beans regularly could reduce vascular events like heart attack and stroke by 5-6%. This is likely on top of a 5-10% reduction expected from a heart-healthy diet alone.



TAKE-HOME BEAN MESSAGE:

Even for people who already follow a heart-healthy diet, eating a generous serving of beans each day may significantly lower the risk of heart attack

and stroke by reducing LDL-cholesterol levels an additional 5%. The daily serving of beans needed to achieve this—3/4 cup—may be daunting for Americans, but is a worthwhile goal.

Previous research suggests that dietary fiber has the potential to protect against prostate cancer, but very few prospective studies have been conducted. Those that do exist show inconsistent results. This prospective study by French researchers analyzed the diets of 3,313 men in an attempt to clarify the conflicting data. It looked at fiber from different sources and separated soluble fiber from insoluble, which other studies have not done, finding that insoluble fiber and legume fiber were independently protective.

Participants provided at least three 24-hour dietary recall records in the first two years of the study and were followed for almost 13 years in total. Fiber intake was divided into quartiles; average intake was 21 grams per day for these French participants. This is significantly more than the amount of fiber eaten by Americans, whose average daily intake is about 15 grams.

The researchers accounted for other potentially causative factors that might confuse the results, including body mass index, alcohol intake, insulin resistance measures, and circulating hormone levels. Still, they found that total fiber intake was linked to prostate cancer risk. Specifically, insoluble fiber and legume fiber were protective, but not soluble fiber or fiber from fruits, vegetables, or cereals. In the past, researchers have not separated intake of soy fiber from other legumes, making it unclear which was more responsible for results. In this study, soy intake was very low because it's not a regular food for French people, so there was no worry it might skew the data. That means that non-soy legumes, like beans, were indeed protective.

The researchers believe that fiber's mechanisms of action may include its ability to reduce inflammation via short-chain fatty acids that are created when fiber ferments in the colon, as well as fiber's beneficial effect on glucose tolerance.



TAKE-HOME BEAN MESSAGE:

The fiber in beans protects against prostate cancer, according to this 13-year prospective study, the first to separate fiber sources by type. Bean fiber has been shown to reduce inflammation and lower blood glucose levels, both of which protect the prostate. Americans should aim to up their fiber intake to 25 grams daily, in part by eating more beans. With up to 9 grams of fiber per 1/2 cup cooked, beans are among the foods highest in fiber.



Snacking pattern, diet quality, and cardiovascular risk factors in adults

Nicklas TA, O'Neil CE, Fulgoni VL *BMC Public Health* 2014; 14:388. Because snacking has become ubiquitous in American culture, researchers from the Baylor College of Medicine in Houston sought to determine the effect of snacks on risk factors for cardiovascular disease. Previous study results have been conflicting, with some showing that snacks affect body weight, while others show no effect on weight or body fat. Perhaps this is because the foods that constitute a snack vary tremendously from person to person.

The researchers compiled data from NHANES (2001-2008), a government survey of food intake, for nearly 19,000 ethnically diverse adults over age 18. Diet information was obtained via a 24-hour dietary recall interview. "Snacks" were self-defined by participants as any foods or beverages not eaten with a meal, then coded into one of 21 snack groupings. Diet quality was evaluated using the Healthy Eating Index 2005, scores were adjusted for caloric intake, physical activity was determined by questionnaire, and anthropometry measures were obtained from NHANES. Cluster analysis identified 12 distinct snacking patterns, one of which was vegetable/legumes; another was no snacks, which became the reference group for comparison to all other groups when evaluating cardiovascular risk factors. These factors included weight; body fat; blood pressure; and blood levels of glucose, triglycerides, and LDL- and HDL-cholesterol.

Not surprisingly, most of the snack patterns resulted in more total calories compared to the no-snack pattern. However, total intake of beneficial nutrients was higher in the snacking groups, and the diets of snackers were slightly more nutrient dense. Notably, participants who followed a legumes/vegetables snack pattern ate diets that scored statistically higher in fiber, magnesium, and potassium, with less saturated fat and sodium. The most surprising finding of the study was the lack of association between body weight and snacking, despite a higher calorie intake. The authors suggest improved satiety and increased activity as possible explanations. In addition, none of the snack patterns resulted in higher cardiovascular risk factors than eating no snacks at all.

TAKE-HOME BEAN MESSAGE:

Beans make smart snacking and this study shows that people who snack on legumes and vegetables can improve their nutrient density, scoring well in healthy eating parameters. Most of the snackers in this study were less likely to be overweight or obese compared to non-snackers, even with a higher calorie intake. Moreover, most snackers, including bean eaters, saw no negative relationship between their snacking and cardiovascular risk factors. People may not think of beans as a snack food, but finding easy, portable bean options for today's mobile, hurried lifestyle will improve snack quality and overall nutrition.

Consumption of nuts and legumes and risk of incident ischemic heart disease, stroke, and diabetes: a systematic review and meta-analysis

Afshin A, Micha R, Khatibzadeh S, Mozaffarian D *American Journal of Clinical Nutrition* 2014; 100: 278–88. Bean and nut consumption have been shown to lower heart disease risk, but their effects on specific heart health parameters are inconsistent. This meta-analysis, a combined analysis of randomized controlled trials (RCTs), prospective cohort reports, and case-control studies, looked for associations between intakes of nuts and legumes (beans, peas, lentils, and tofu, but not soy, soy milk, or soybean oil) and the incidence of fatal and nonfatal heart attacks, ischemic and hemorrhagic strokes, and diabetes. Studies under consideration were scored based on types of foods included and excluded; assessment of exposure to nuts and legumes; assessment of disease outcomes; control of confounding factors such as age, sex, tobacco use, and intake of fats, fiber, fruits and vegetables; and any bias in the study.

The meta-analysis combined 27 studies (2 RCTs, 23 prospective cohort reports, and 2 retrospective case-control studies) totaling more than 500,000 participants. Their average weekly legume intake ranged from 0 to 938 grams (more than five cups). In evaluating risk, the research team controlled for varying intakes by standardizing consumption to 100 grams (a generous one-half cup) four times a week and then employing several different analytical models.

Five of the studies explored the relationship between eating legumes and the incidence of heart attack, finding 14% less risk in legume-eaters among nearly 200,000 participants. In the six studies on stroke that totaled more than 250,000 participants, legumes did not affect stroke risk. Initially, when results were combined for the only two qualifying studies on legumes and diabetes, they showed no relationship between intake and incidence. However, additional statistical analysis did

suggest that legumes help protect against diabetes. Nut consumption was inversely associated with fatal and nonfatal heart attacks and diabetes, but not stroke.



TAKE-HOME BEAN MESSAGE:

Numerous bioactive compounds in beans, including fiber and phytochemicals, may partially explain the positive effect of beans on heart health and blood lipids summarized in this study. Beans also have been shown to improve blood glucose, although few studies have been conducted to date on the relationship between beans and diabetes risk.

Food-insecure dietary patterns are associated with poor longitudinal glycemic control in diabetes: results from the Boston Puerto Rican Health Study

Berkowitz SA, Gao X, Tucker KL *Diabetes Care* 2014; 37(9): 2587-92.

At-risk populations, including those who are at a lower socioeconomic status (low SES), have been shown to be more likely to develop diabetes. Additionally, control of diabetes tends to be worse among low SES individuals who are food insecure, that is, they have limited or inconsistent access to foods that are nutritionally adequate and safe. Berkowitz and colleagues questioned whether people at a low SES who have both diabetes and food insecurity might be selecting a diet that is inexpensive, calorie-dense, low in nutrients, and lower in costly fruits and vegetables, and whether this type of diet



compromises control of their diabetes.

A total of 516 participants in the Boston Puerto Rican Health Study who had diabetes (70.4% women, 87% with less than a college education, 26% food insecure) completed both baseline and two-year follow-up exams. Their diet was evaluated at the start of the study and after two years using the Healthy Eating Index 2005 (HEI); the HEI score is derived from intakes of healthful and less healthful foods, namely, total fruit, whole fruit, total vegetables, dark green and orange vegetables and legumes, total grains, whole grains, milk, meat and beans, oils, saturated fats, sodium, and energy from SoFAAS (solid fats, alcoholic beverages, and added sugars).

Younger participants, men, current cigarette smokers and those with food insecurity had the lowest HEI scores. Specifically, food-insecure participants ate fewer total fruits, whole fruits, total vegetables, dark green and orange vegetables, and legumes. While hemoglobin A1c, a measure of long-term blood glucose levels, did not differ significantly between the food-secure and food-insecure groups, it was lower in participants who had higher scores for HEI, total vegetables, dark green and orange vegetables.



TAKE-HOME BEAN MESSAGE:

The low bean intake in food-insecure study participants provides an opportunity to make a real nutrition difference for relatively little money. In fact, Adam Drewnowski, PhD, at the University of Washington, has shown that of all vegetables, including potatoes, beans provide the most nutrients per penny (see Bean Briefs, Fall 2013). Nutrition professionals who work with low SES clients with diabetes can encourage them to incorporate beans into their meals as an affordable, versatile, filling, and nutritious ingredient that also may help control their diabetes.



Relationship between legumes consumption and metabolic syndrome: Findings of the Isfahan Healthy Heart Program

Sajjadi F, Gharipour M, Mohammadifard N, et al ARYA Atherosclerosis 2014; 10: 18-24. The metabolic syndrome (MetS) is defined by at least three abnormal measures from the following: waist circumference, high density lipoprotein (HDL) cholesterol, triglycerides, systolic or diastolic blood pressure, and/or fasting blood glucose, or current treatment for blood lipid abnormalities, hypertension or diabetes. On the rise around the world, MetS is thought to increase the risk of subsequently developing heart disease and diabetes. A healthful diet with high amounts of fruits, vegetables, and legumes has been shown to improve factors associated with MetS, including waist circumference, blood pressure, triglycerides, and HDL-C levels. This study examines the impact of legume consumption on MetS in a group of adults in Isfahan, Iran.

Researchers randomly selected 2,027 participants in the Isfahan Healthy Heart Program—982 with MetS and 1,045 without. A food-frequency questionnaire was employed to gather dietary intake information from the previous year, with foods categorized under 12 headings: fruits, vegetables, legumes, nuts, grains, dairy products, non-hydrogenated vegetable oils, white meat, hydrogenated vegetable oils, red meat, processed meat, and sweets and pizza. The research team divided participants into quintiles according to their intake of each type of food and awarded one point each to those in the top two quintiles for the healthful food items, namely, fruits, vegetables, non-hydrogenated vegetable oils, legumes, nuts, dairy products, and white meat.

The results revealed that participants with MetS ate legumes significantly less often than those without. In women, a higher legume intake was linked to a lower risk of MetS. However, when adjusted for age, differences between those who ate and didn't eat legumes were not significant.

TAKE-HOME BEAN MESSAGE:

Although age appears to be the strongest influence on the development of MetS, beans improved the MetS factors that also are related to long-term health, reducing the risk of other chronic diseases. To take advantage of these benefits, incorporate beans into meals several times per week, along with other healthful foods, such as fruits and vegetables, nuts, dairy products, lean meats, and non-hydrogenated oils.



<mark>Emerging Resear</mark>ch from the Lab



Building Better Beans Through Marker-Assisted Breeding

The large *Phaseolus* bean (common bean) family encompasses numerous widely consumed varieties, including navy, black, great northern, small red, pinto, red kidney, yellow, cranberry, and green beans. In order to achieve commercial success and consumer satisfaction, growers need to cultivate bean plants that have a high and dependable yield, resist disease, tolerate environmental stresses such as cold weather or drought, provide an attractive nutrition profile, and look and taste good. Development of new bean cultivars using conventional methods requires up to a decade of crossbreeding, cultivation, testing, and additional hybridization. The introduction and evolution of marker-assisted breeding speeds up and improves the process for creating new strains that have desirable characteristics.

Much of the recent movement in marker-assisted breeding falls under the USDAsupported Common Bean Coordinated Agricultural Project (BeanCAP), which focuses on the genetics and genomics of beans. Specifically, the project aims to identify genetic markers for nutrition and other desirable traits and contribute to the growing repository of genotype information on factors that control those traits in beans. BeanCAP collaborators include Colorado State University; Michigan State University; North Dakota State University; Oregon State University; University of California, Davis; University of Nebraska, Lincoln; USDA Children's Nutrition Research Center, Houston, TX; USDA Soybean Genomics and Improvement Lab, Beltsville, MD; USDA Sugarbeet and Bean Research Unit, East Lansing, MI; USDA Tropical Agriculture Research Station, Mayaguez, PR; and USDA Vegetable and

Forage Crops Research Lab, Prosser, WA.

Bean genome map becoming a reality

Bean breeders have long utilized marker technology to map genes that control desirable features, such as disease resistance, and transfer those genes through conventional bean breeding. Today's more sophisticated information and tools—soon also to include a full map of the genome of common bean—speed up the hybridization process using marker-assisted breeding. This also enables the incorporation of more than one trait during a single breeding cycle.

Wild relatives help pinpoint desired traits

One of the major bean research labs in the country, the Grain Legume Genetics and Physiology Research Unit at Washington State University, works to develop improved bean varieties that resist common diseases, tolerate environmental stress, and have a desirable nutrition profile. Using wild relatives and multi-generational gene pools from peas, lentils, and chickpeas, the research team identifies genetic markers and creates gene maps that pinpoint specific sections of the gene that control desired traits. This information is used for targeted crossbreeding that creates new plant varieties with higher concentrations of minerals in their seeds, better yields, and improved resistance to bean diseases such as *Aphanomyces* root rot, *Sclerotinia* wilt, and *Ascochyta* blight.

We have seen the future...and it demands better beans (and more of them)

The popularity of hummus, a Middle Eastern chickpea dip, has dramatically increased the market for chickpeas. Marker-assisted breeding of chickpeas can increase supply by developing strains that can be cultivated in other regions of the country outside of the Pacific Northwest. The Agricultural Act of 2014, also known as the Farm Bill, may boost demand for beans by supporting research on the nutrition and health benefits of beans. Positive results from this research are expected to boost demand, increasing the need for a reliable bean harvest year after year.



The United States Dry Bean Council (USDBC) is a private trade association in the United States that represents growers, shippers and end users of U.S. edible dry beans. The USDBC promotes the use, consumption, and marketing of edible dry beans worldwide.



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