SOYFOODS MAY OFFER SIGNIFICANT HEALTH BENEFITS TO MEN, SUCH AS LOWERING THE RISK OF PROSTATE CANCER, HEART DISEASE AND MORE. AS THIS FACT SHEET WILL DISCUSS, MEN NEED NOT FEAR THE RISK OF FEMINIZATION.

INTRODUCTION

Much of the research on the health effects of soyfoods has focused on postmenopausal women. In large part, this is because, among commonly consumed foods, the soybean is a uniquely rich source of isoflavones, a group of naturally-occurring plant chemicals that are classified as phytoestrogens, although they differ at both the molecular and clinical level from the hormone estrogen. Nevertheless, some men are reluctant to eat soyfoods because of the mistaken belief that isoflavones exert feminizing effects. However, not only is this concern without scientific merit, but there is a large amount of evidence suggesting adding soyfoods to the diet can benefit men by reducing the risk of prostate cancer and heart disease.

> Research has shown that soy is safe for men to consume and that they may benefit from including soyfoods in their diet.

ISOFLAVONES

The two primary isoflavones in soybeans are genistein and daidzein.[1] Average isoflavone intake among older Japanese men is about 40mg/d, which is the amount provided by about 10 to 12g of soy protein from traditional soyfoods.[2] Each serving (e.g., 1 cup soymilk or ½ cup tofu or edamame) of a minimally processed soyfood provides about 25mg of isoflavones or 3.5mg isoflavones per gram of protein. Generally, more refined soy products such as isolated soy protein (ISP) have much lower isoflavone concentrations (mg/g protein) than traditional Asian soyfoods.

Isoflavones have a chemical structure similar to the primary female reproductive hormone estrogen. (Both men and women produce estrogen; older men actually produce more estrogen than older women).[3] Consequently, isoflavones are able to bind to estrogen receptors (ER) and to exert estrogen-like effects under certain experimental conditions. For this reason, isoflavones are commonly referred to as phytoestrogens.[4] However, isoflavones and estrogen are very different molecules and, as such, they often exert different physiologic effects. The literature is replete with examples wherein isoflavones affect biological endpoints differently than estrogen.[5-25] Furthermore, isoflavones are more accurately classified as selective estrogen receptor modulators (SERMs) than as phytoestrogens.[16, 26, 27]

SERMs exert tissue-selective effects. They have estrogen-like effects in some tissues, effects opposite to those of estrogen in other tissues, and in some tissues, they exert no effects despite the presence of ERs. Since there is no "class effect" of SERMs, that is, since each SERM has different physiological properties, the effects of isoflavones can only be determined by direct experimentation.[28] Furthermore, because soybeans contain many biologically active components, soyfoods should not be equated with isoflavones.

The ability of isoflavones to exert tissue-selective effects almost certainly stems in part from their preferential binding to and transactivation of ERß in comparison with ERª. This preference is important because these two receptors have different tissue distributions within the body and when activated can have different and sometimes opposite effects. Consequently, the ERª:ERß ratio within a given cell type greatly influences the effect of estrogen and other ER-binding ligands on that cell. Furthermore, each ligand may induce ligand-ER conformations that preferentially recruit specific cofactors within the cell, thereby inducing differential responses.[29] Evidence suggests that ligands that target ERß promote breast and prostate health.[30] In fact, recent findings implicate ERß-specific agonists with having growth inhibitory effects in several cancer models.[31]

SOYFOODS AS SOURCES OF PROTEIN

Most American men meet or exceed the recommended dietary allowance (RDA) for protein, although this may not be the case for as many as 40% of older men.[32] Furthermore, some recent data suggest that the RDA may be too low and that protein intake exceeding the RDA may be advantageous.[33-35] For example, evidence suggests that consuming protein in excess of the RDA may be beneficial for weight loss,[36] reducing risk of osteoporosis,[37] enhancing the benefits of vigorous physical activity[38] and lowering blood pressure.[39, 40] Also, in older men, dietary protein intakes above the RDA may help to prevent sarcopenia or age-related loss in skeletal muscle.[41, 42] A study involving 20 older individuals found that muscle protein synthesis in response to a protein intake of 1.5g/kg body weight occurred at twice the rate it did in response to an intake of 0.8g/kg.[43] To prevent sarcopenia, researchers from the University of Texas Medical Branch recommend consuming at least 30g of protein at each of the three primary meals.[35]

Soyfoods can play important roles in helping men meet protein needs while maintaining a healthful diet as they provide ample amounts of high-quality protein but are typically low in saturated fat.[44-48] Since the protein in products such as ISP is comparable in quality to meat and milk protein, soyfoods can be recommended as protein-rich options.[45, 49] There are concerns that high-protein diets may adversely affect renal function. However, most research indicates adverse effects are only likely to occur in those whose renal function is already compromised.[50] It is worth noting that the acceptable protein intake range set by the Institute of Medicine is 10-35% of total energy intake, which means that for most people consuming as much as 1.5g/kg body weight is acceptable.

Furthermore, there is preliminary evidence that soy protein places less stress on the kidneys in comparison to other high-quality proteins, which over time could reduce the risk of developing renal disease in susceptible individuals, such as those with diabetes.[51, 52] This potential benefit may take on mounting importance as the prevalence of chronic kidney disease increased 30% during the past ten years.[53]

Soy protein may also help those with existing renal disease. A meta-analysis of clinical studies found that isoflavone-rich soy protein significantly decreased serum creatinine, serum phosphorus, C-reactive protein and proteinura in predialysis patients.[54] In individuals whose renal function is compromised, serum phosphorus levels often become abnormally high, so replacing animal protein with soy protein could be helpful. The aforementioned analysis also found that soy protein helped maintain the nutritional status of dialysis patients.[54]

Finally, soy protein supplementation leads to muscle accretion in response to resistance exercise[55] and may actually have some advantages over other high-quality proteins by reducing exercise-induced inflammation and oxidation.[56-58] Soy is lower in leucine than whey protein, which is considered to be an excellent protein for building muscle. However, once leucine requirements are met, whey and soy protein should promote muscle protein synthesis to a similar extent.[59] Importantly, one study found a blend of soy protein, casein and whey stimulated muscle protein synthesis in response to high-intensity leg resistance exercise to a greater extent than whey protein alone.[60]

CORONARY HEART DISEASE PREVENTION

Soyfoods potentially reduce risk of coronary heart disease (CHD) by several mechanisms. First, because they are generally low in saturated fat and high in polyunsaturated fat (PUFA) (linoleic acid, the essential omega-6 fatty acid comprises ~53% of the total fat content), soyfoods can help reduce blood cholesterol when they displace commonly consumed sources of protein in Western diets, which tend to be high in saturated fat.[61, 62] In 2010, Jenkins et al.[63] estimated that through displacement, soyfoods can reduce low-density-lipoprotein cholesterol (LDLC) 3 to 6 percent. Furthermore, the soybean is one of the few good plant sources of the omega-3 essential fatty acid alpha-linolenic acid (ALA).[64] ALA is thought to have independent coronary benefits.[65-67] Recently, it was shown that men with a high intake of ALA had lower levels of inflammatory biomarkers associated with risk of CHD.[67] Also, the Singapore Chinese Health Study found that even among those with high concentrations of long-chain omega-3 PUFAs, plasma ALA may still be associated with a reduced risk of acute myocardial infarction.[68]

In recent years, there has been controversy about the impact of saturated fat on CHD risk with some analyses finding no relationship.[69] However, data suggest that the impact of saturated fat is dependent upon that which replaces it. A combined analysis of the Nurses' Health Study (1980 to 2010, n=84,628) and the Health Professionals Follow-up Study (1986 to 2010, n= 42,908 men) found that replacing 5% of energy intake from saturated fat with equivalent energy intake from PUFA, monounsaturated fat, or carbohydrates from whole grains was associated with a 25%, 15%, and 9% lower risk of CHD, respectively, whereas replacing saturated fat with carbohydrates from refined starches/added sugars was not significantly associated with CHD risk.[70] Thus, full-fat soyfoods and soybean oil can help to reduce risk of developing CHD.

Not surprisingly, the recently released U.S. Dietary Guidelines recommends limiting saturated fat intake to no more than 10% of total calories. Interestingly, a new analysis concludes that worldwide, inadequate intake of PUFA contributes to three times more CHD deaths than excess intake of saturated fat.[71]

Soyfoods can help lessen blood cholesterol when they displace more traditional sources of protein in Western diets.

A second mechanism by which soyfoods reduce CHD risk is through the direct cholesterol-lowering effect of soy protein.[72] The effect of soy protein is modest compared to statins, but even the 4-6% reduction in LDLC in response to soy protein[72-75] can, in theory, reduce heart disease risk by 10% over a period of years.[76, 77] Some evidence indicates the hypocholesterolemic effects of soy protein may be greater in men than in women.[72] The combined effect of soy protein plus the improvement in the fatty acid content of the diet when soyfoods are consumed will substantially reduce LDLC and therefore, CHD.[63] When the U.S. Food and Drug Administration approved a health claim for soyfoods and CHD based on the hypocholesterolemic effects of soy protein in 1999, it established 25g/d as the threshold intake for cholesterol reduction.[78]

A third mechanism by which soy may reduce CHD risk is by lowering circulating triglyceride levels.[72-75] Although there is debate about the significance of an elevated triglyceride level as an independent predictor of CHD risk,[79] some evidence suggests that the role of triglycerides in the etiology of CHD has been underestimated.[80, 81] Furthermore, research also shows that soy protein decreases postprandial triglyceride levels, elevated levels of which are increasingly viewed as an important CHD risk.[82] Also, in contrast to some dietary interventions that lower both LDLC and high-density lipoprotein cholesterol (HDLC), soy protein intake leads to very modest increases (1-3%) in HDLC.[72-75] Each 1% or 1mg increase in HDLC lowers CHD risk by 2 to 3 percent.[83, 84] A relatively recent statistical analysis of the scientific literature found that even when LDLC is low, raising HDLC levels is beneficial.[85]

The effect of soyfoods on CHD risk factors unrelated to lipid levels is also gaining interest. For example, four meta-analyses of the clinical data found that soy protein modestly lowers blood pressure.[47-50] In the largest of these, which included 27 studies, soy lowered systolic and diastolic blood pressure by 2.21 and 1.44 mgHg, respectively.[48] Estimates are that lowering blood pressure even by this degree can reduce risk of stroke by about 10% and CHD by about five-percent.[86]

Soy protein intake has also been shown to increase LDL particle size, shifting LDL particle distribution to a less atherogenic pattern.[87] Over a period of five years, this change was estimated to result in a 5% reduction in risk of ischemic heart disease.[87] Another study found that the consumption of soy flour led to a decrease in oxidative stress markers in men, reflecting a decreased risk of CHD.[88]

Finally, a Chinese cross-sectional study supports the clinical data regarding the effects of soy on non-lipid CHD risk factors. In this study involving middle-aged adult men and women, habitual soy intake was associated with dose-dependent decreases in mean bifurcation intima-media thickness.[89] The effect was more apparent in men than women and greater than could be expected from the cholesterol-lowering effect of soy protein alone. Non-invasive assessment of intima-media thickness of the carotid arteries is widely used as an intermediate or proxy measure of generalized atherosclerosis.[90]

However, in contrast to this study, a large prospective study from Shanghai found that over the 5.4 year follow-up period, soy intake was associated with an increased risk of CHD among men.[91] Although this finding is inconsistent with a considerable amount of data (and contrasts with the effects in women) and was published as a letter to the editor, rather than as a full manuscript, the finding warrants additional investigation. It should be noted however, that in the population studies, soy protein intake may not be sufficiently high to result in a reduction in blood LDLC or blood pressure.

PROSTATE CANCER PREVENTION
EPIDEMIOLOGY

Cancer of the prostate is the most common cancer among U.S. men and the second most common cause of cancer death.[92] Evidence suggests that an overall healthful diet, as well as specific nutrients and phytochemicals, can reduce prostate cancer risk and perhaps even help treat this disease.[93-95] Since prostate cancer is typically diagnosed at an older age and prostate tumors are generally slow-growing, even modestly delaying the onset and/or slowing the growth of these tumors may dramatically reduce the number of prostate cancer deaths.[96]

Prostate cancer incidence and mortality rates vary dramatically throughout the world.[100] Epidemiological research has shown that ethnic background, age and genetics influence the risk of prostate cancer. However, only environmental factors can account for the relatively rapid changes in prostate cancer rates observed in migration studies and time trends within countries.[101, 102]

The low rates of prostate cancer among Asian countries compared to Western countries and in particular Japan, a country with a high socioeconomic status, have led to attempts to identify factors responsible for this difference, as has the relatively recent rise in prostate cancer rates that has occurred in many Asian countries. For example, the age-adjusted Japanese prostate cancer mortality rate per 100,000 men was as low as 0.5 in 1950, 3.2 in 1970 and 8.6 in 1998.[103] While there may be many factors contributing to this increase, westernization of the diet is thought to be an important one. Conversely, the consumption of soyfoods has been proposed as contributing to the low rates.

The first meta-analysis of the epidemiologic data to evaluate the relationship between soy and prostate cancer risk, which was published in 2009, found that higher intake was associated with protection against this disease. This analysis by Yan et al.[104] included 15 studies (six cohort, nine case-control) on soy consumption and nine on isoflavone intake. When all studies on soyfood intake were included in the analysis, the combined relative risk/odds ratio (RR/OR) plus 95% confidence interval (CI) was 0.74 (0.63, 0.89; P = 0.01). However, when the data were subanalyzed according to ethnicity, the combined RR/OR (95% CI) was 0.52 (0.34, 0.81; P = 0.01) for studies (n=9) with Asian populations and 0.99 (95% CI: 0.85, 1.16; P = 0.91) for studies (n=5) with Western populations. It is not surprising that protective effects were not noted in Western studies because, as was pointed out more than a decade ago, soy intake among the general population is almost certainly too low to exert biological effects.[105]

A second meta-analysis of observational studies, which included five cohort studies and eight case-control studies that was also published in 2009,[106] concurs with the findings by Yan et al.[104] The summary ORs (95% CI) comparing high versus low categories of intake were 0.69 (0.57, 0.84) and 0.75 (0.62, 0.89) for total soyfoods and nonfermented soyfoods, respectively. Isoflavone intake was also associated with protective effects.[106] On the basis of four studies, the summary OR (95% CI) for genistein and daidzein were 0.67 (0.52, 0.86; p=0.002) and 0.66 (0.51, 0.86; p=0.002), respectively. In regard to individual soyfoods, only the intake of tofu was statistically significant (OR, 0.73; 95% CI: 0.57, 0.92, p=0.009) even though the OR (95% CI) for soymilk was lower than it was for tofu (0.57; 0.19, 1.76; p=0.332). However, only two studies evaluated soymilk intake whereas five evaluated tofu.

Finally, a meta-analysis by He et al.[107] that included 11 studies (two cohort and nine case-control studies) on phytoestrogen (isoflavone and lignin) intake and eight studies on serum phytoestrogen concentrations. The findings of this analysis are generally supportive of the two previously discussed meta-analyses. For example, on the basis of eight studies, genistein and daidzein intake were both associated with protective effects as the ORs (95% CI) for these two isoflavones were 0.83 (0.72, 0.95) and 0.82 (0.70, 0.97), respectively. A limitation of this analysis is that it did not separate Asian from non-Asian studies.

The ORs (95% CI) for serum genistein and daidzein concentrations were 0.81 (0.61, 1.09) and 0.85 (0.69, 1.06). Of the four studies that comprised this analysis, the only one with an OR that exceeded 1.0 (genistein, 1.36; daidzein, 1.34) was a Scottish study.[108] The median total isoflavone intake in this study, which was approximately 1.0mg/d, is simply too small, as noted previously, to exert biological effects. It can therefore be argued that the analysis of serum isoflavone levels and prostate cancer risk underestimates the protective effects of isoflavones.

In summary, the epidemiologic data, which consists mostly of case-control rather than prospective studies, show higher soya intake (~2 servings per day) is associated with a reduced risk of prostate cancer. Protective effects are noted in studies involving Asian populations where consumption of soyfoods is higher than in Western countries.

CLINICAL RESEARCH

Not surprisingly, no primary prevention trials involving healthy men have evaluated the effects of isoflavones or soyfoods on risk of developing prostate cancer. These trials would be extremely expensive to conduct and compliance could be a problem in long-term trials intervening with soyfoods. However, as discussed below, several trials have evaluated the effects on prostate specific antigen (PSA) levels in healthy men, men at risk of developing prostate cancer and prostate cancer patients.

PSA is the most common clinical test for the detection of prostate cancer, although its use in routine screening has recently been challenged.[109-111] PSA is also a measure by which treatment efficacy can be assessed. In men with prostate tumors, serum PSA concentration is proportional to prostate tumor volume and successful treatments for prostate cancer lower PSA levels.

In an older review article, four of the eight trials involving men with prostate cancer showed that isoflavones slowed the rise in PSA levels, although no study reported an absolute decrease.[112] In support of these findings is a study published subsequent to this review which found that in men with prostate cancer, PSA levels increased 56% annually prior to study entry, but only 20% per year when men consumed about three servings of soymilk daily for 12 months.[113] More recently, a six-month pilot study by Kwan et al.[114] also found soymilk (500ml/d) tended to slow the rise in PSA levels in men with prostate cancer. Interestingly, Ide et al.[115] found that a combination of curcumin and isoflavones markedly decreased PSA levels in men with prostate cancer whose PSA levels were ≥10ng/ml. In agreement is a pilot study by Lazarevic et al[116] which found that in men with localized prostate cancer who were given 30mg/d genistein for three to six weeks there was a 7.8% decrease in PSA whereas in the placebo group it increased by 4.4 percent.

> Prostate cancer is typically diagnosed at an older age, and prostate tumors are generally slow-growing. Even modestly delaying the onset and/or slowing the growth of these tumors may dramatically reduce the number of prostate cancer deaths.

One of the more intriguing studies is a small pilot trial by Joshi et al.[117] which found soy consumption for two years resulted in favorable effects on PSA levels in men treated for prostate cancer. Nine men consumed three eight-ounce (approximately 750ml) servings of soymilk per day and a 10th consumed three servings daily of a variety of soy

> **Soyfoods protect against heart disease in the following ways:**
>
> - Displacing high saturated fat foods from the diet
> - Modestly lowering LDL-cholesterol
> - Potentially improving lip-independent risk factors

products. All men had failed conventional treatment for prostate cancer [surgery and radiation therapy (n=7) and chemical castration (n=3)] as evidenced by a continued rise in PSA levels. After soy consumption, PSA levels in four men either permanently or temporarily declined or remained stable. Among the three patients whose treatment included androgen deprivation therapy, one responded favorably to soy. Given that these patients had exhausted conventional treatment options, the effects of soy are noteworthy.

Finally, neither of the two large long-term trials that have evaluated the effects of isoflavone exposure on the progression of prostate cancer reported benefits. However, in one of these studies, men in the soy group received only approximately 24mg genistein daily.[118] That is a relatively low dose for men who had already undergone radical prostatectomy for the treatment of prostate cancer. In the other study, in addition to the treated group consuming isoflavone-rich soy protein, they were administered supplements of vitamin E and selenium.[119] There is evidence that both of these micronutrients stimulate the development of prostate cancer, although the risk associated with vitamin E is much less clear. The results of these long-term trials are not entirely surprising when the limitations of the experimental designs are considered.

In summary, there are suggestive clinical data indicating that soy consumption may prevent the development of prostate cancer and aid in the treatment of this disease by inhibiting the spread of prostate tumors and slowing prostate tumor growth.
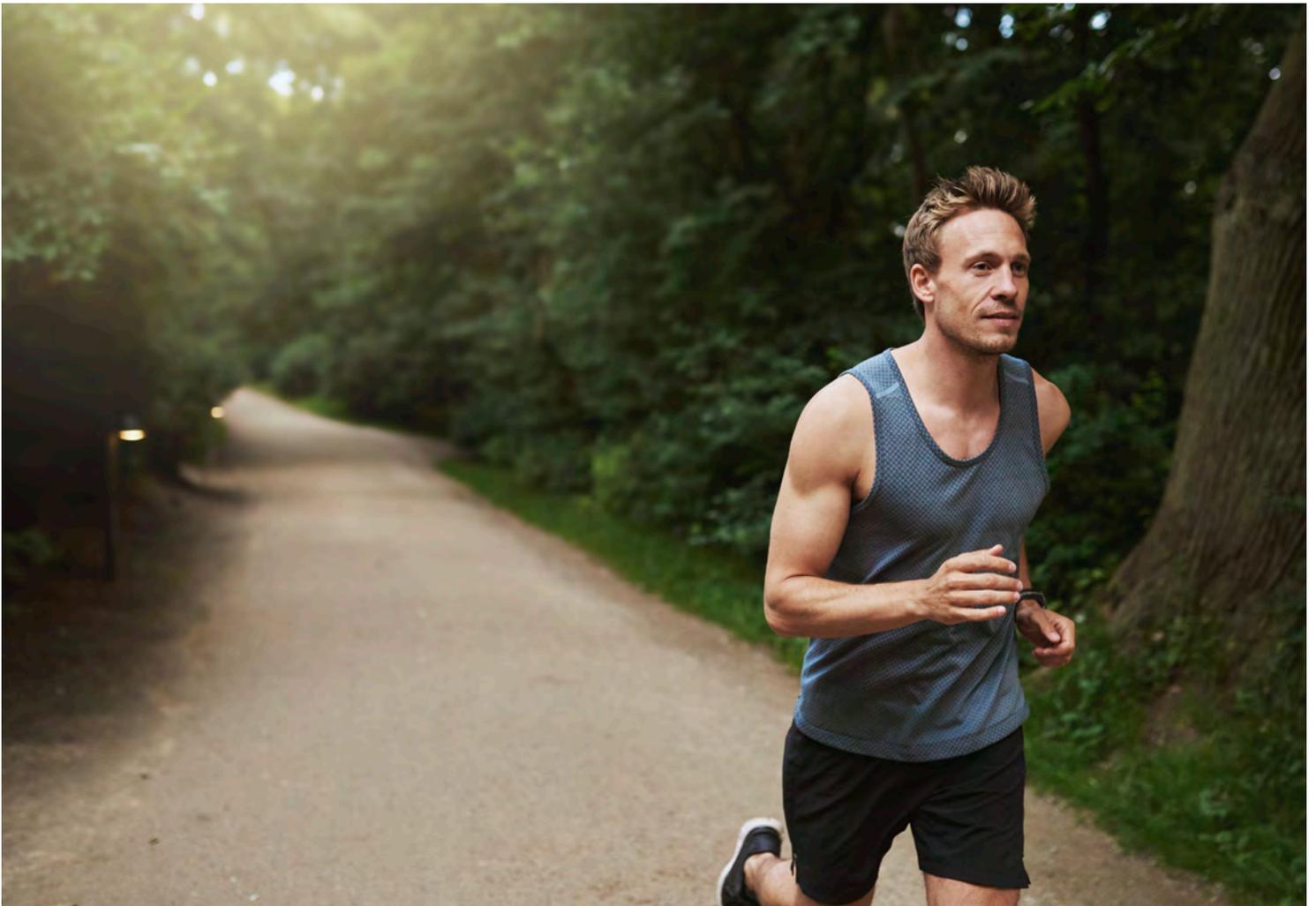
MECHANISMS

Research has provided a number of clues as to how soy/isoflavones may affect the development of prostate cancer. For example, Lazarevic et al.[120] found that genistein reduced mRNA levels of Kallikrein-related peptidase 4 (KLK4) in tumor cells. KLK4 is a serine protease that is produced by a gene whose expression is associated with prostate cancer progression.[121] Xu et al.[122] reported that levels of an enzyme that enables cells to invade tissues – matrix metalloproteinase-2 (MMP-2) – was statistically significantly reduced by 76% in the prostates of cancer patients who were given 150mg/d genistein.

More recently, this research group showed that genistein inhibited metastasis in an animal model of colorectal cancer. Furthermore, in this model, genistein downregulated MMP-2 and Fms-Related Tyrosine Kinase 4 (FLT4; vascular endothelial growth factor receptor); the latter is recognized as a marker of metastatic disease.[123] Although rodents are not a particularly good model for studying isoflavones because of the difference in isoflavone metabolism between humans and rodents, it is worth noting that adding isoflavones to the diet of mice inhibited prostate tumor metastasis to the lung – the primary site of metastasis in this animal model – by 96 percent.[124] Finally, Hamilton-Reeves et al.[125] found that isoflavone-rich soy protein decreased androgen receptor expression in the prostates of cancer patients.

Epidemiologic evidence suggests that men who eat soyfoods daily are less likely to develop prostate cancer than those who do not.

ISOFLAVONES AND FEMINIZATION

The estrogen-like effects of isoflavones have led to investigation of the effects of soyfoods on male reproductive hormones and sperm and semen parameters. Ironically, given the large populations of soyfood-consuming countries, concern has arisen that soyfoods might even impair male fertility. However, as discussed below, concerns about feminization are without scientific merit.

Two studies that evaluated reproductive hormone levels in men did find statistically significant reductions in testosterone levels in response to soy protein intake. In the first, in addition to their normal diet, 19 young men consumed three scones per day made with either soy or wheat flour for a period of six weeks.[88] Serum testosterone levels decreased from baseline values by almost 6% in the soy group. However, because the final values in the control group were not reported, it isn't known as to whether the difference between groups (the most relevant comparison) was statistically significant. Furthermore, isoflavone exposure in this study was about four times typical Japanese intake.

In the other study, there was a much larger decrease (19%) in testosterone levels, but only 12 men were enrolled in this study and the decrease resulted primarily from the change in just two participants.[126] Furthermore, this study lacked a control group. Also, in one of the two men in which the large decrease occurred, baseline testosterone levels greatly exceeded the normal range and the decrease continued for several weeks even after discontinuation of soy protein. As in the previous study, soy intake (56g soy protein/d) was about four times the typical Japanese intake.

In contrast to these two studies, a meta-analysis published in 2010 that included 32 studies (including the two noted above) and 36 treatment groups found there were no significant effects of soy protein or isoflavone intake on levels of total testosterone, sex hormone binding globulin, free testosterone or the free androgen index.[127] Studies published subsequent to this analysis are supportive of this conclusion.[128, 129]

Interest in the effects of isoflavones on sperm quality and quantity is due, in part, to reports that sperm count may have declined over the past few decades. Whether environmental estrogens may have contributed to this decrease is a matter of much debate.[130] In fact, there is also debate about whether sperm count has actually decreased.[131] More directly related to soy are the results of a small pilot case-control study conducted by Chavarro et al.[132] which found that men who were classified as soy-consumers had lower sperm concentrations than non-consumers of soy. However, there were several limitations to this study that warrant mention.

First, about half of the decreased sperm concentration resulted from an increase in ejaculate volume (total sperm count was not affected). Second, almost no other information about factors that potentially affect sperm concentration was obtained by the investigators. And finally, even in the highest intake group, soy intake averaged only about ½ serving daily, a relatively small amount compared to the amounts shown to exert effects in clinical studies. The low soy exposure raises questions about the biological plausibility of the findings.

Importantly, even if these findings by Chavarro et al.[132] are valid, they likely have no implication for fertility since sperm concentration decreased primarily among men with an above average sperm concentrations. This point is actually supported by follow-up work from the aforementioned researchers. In a cross-sectional study involving 184 men from couples undergoing infertility treatment with in vitro fertilization, male partner's intake of soyfoods and soy isoflavones was unrelated to fertilization rates, proportions of poor quality embryos, accelerated or slow embryo cleavage rate, and implantation, clinical pregnancy and live birth among couples attending an infertility clinic.[133]

> There is no meaningful clinical evidence that suggests soy protein lowers serum testosterone levels or exerts any estrogen-like or feminizing effects in men.

Definitive conclusions about the impact of soy on sperm parameters can be based only on the results from clinical (intervention) studies. Three such studies, two published in full manuscript form and one described in the proceedings from a scientific meeting, have evaluated the effects of soy or isoflavones on sperm quality or quantity. In one of the studies, healthy volunteers took a daily supplement containing 40mg isoflavones for two months. They donated blood and semen samples monthly starting two months before and ending four months after supplementation.[134] Semen samples were analyzed for ejaculate volume, sperm concentration, total sperm count, motility and morphology. In addition, testicular volume was measured. As expected, plasma isoflavone levels increased markedly following supplementation, but there was no effect on hormone measurements, testicular volume or semen parameters over the study period.

In agreement with these findings are the results of a crossover study involving 32 healthy young men who consumed diets in random order for 57 days which were supplemented with milk protein isolate or ISP containing a high or low amount of isoflavones.[135] Analysis of semen samples collected on day one and day 57 of each treatment period revealed no significant effects of diet on semen parameters, including semen volume, sperm concentration, sperm count, total motile sperm
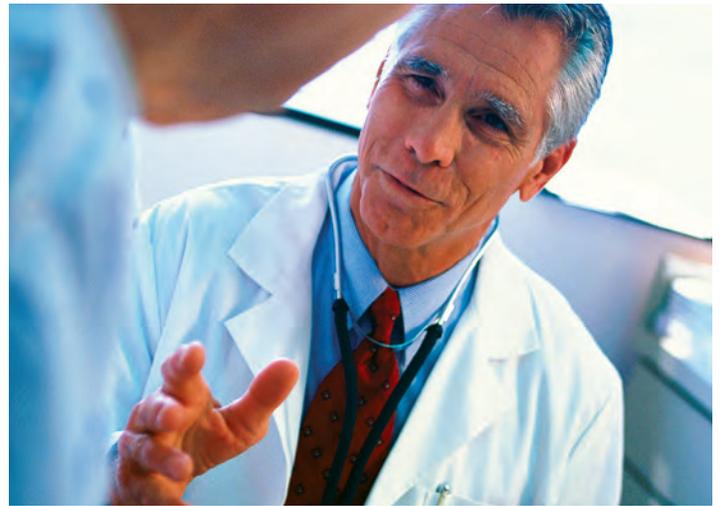
count, sperm motility or sperm morphology. In the third study, 20 volunteers were randomized to three different groups in which they were provided 60, 320 or 480mg/d isoflavones for three months.[136] When compared to baseline, there were no statistically significant differences in ejaculate volume, sperm concentration, count and motility of spermatozoa in men given isoflavones.

Interestingly, a case report described a benefit from isoflavone supplementation in a male with low sperm concentration who was unable to father a child. Daily isoflavone supplementation for six months led to normalization of sperm quality and quantity and to the birth of a healthy infant.[137] As a result, the authors of this report suggested that isoflavones may be a treatment for low sperm concentration.

Finally, there are two case reports in the literature describing feminizing effects that allegedly occurred as a result of soyfood consumption.[138] In one, a 60-year-old man developed gynecomastia likely as a result of a dramatic rise in circulating estrogen levels. These levels were ten-fold higher than the levels following discontinuation of soy consumption. In the other, a 19-year-old male vegan developed low testosterone levels, loss of libido and erectile dysfunction.[139]

If soy consumption was in fact responsible for the observed feminizing effects it is because such excessive amounts were consumed in the context of unbalanced and likely nutrient-deficient diets. Both men, coincidentally, reportedly ingested 360mg/d isoflavones, an intake about ten-fold higher than is typical for Japanese men consuming a traditional diet. In fact, in the vegan male, soy accounted for the vast majority of calories consumed. Furthermore, in contrast to the rise in estrogen levels noted in the 60-year-old man, numerous clinical studies in which men were exposed to as much as 150mg/d isoflavones, have shown that neither soyfoods nor isoflavone supplements increase levels of this hormone.[140] And as already discussed, the clinical data show that neither soy nor isoflavone supplements affect testosterone levels. These case reports simply illustrate that consuming excessive amounts of essentially any food can potentially lead to abnormalities.

HOW MUCH SOY PROTEIN DO ASIANS AND AMERICANS CONSUME?

There is some confusion about the role soy plays in the diets of Asian populations and precisely how much soy Americans consume. Soy protein is widely used by the food industry and is found in small amounts in an extensive array of foods in the United States. However, soy protein is added to foods primarily for functional purposes, i.e., to improve shelf stability and texture. Consequently, U.S. daily per capita soy protein intake is only 1 to 2g/d. That amount represents about 2% of total protein intake.[141] Obviously, because soy protein intake is so low, U.S. isoflavone intake is also very low (~2mg/day).[142] Furthermore, although each gram of protein in minimally processed or traditional soyfoods is associated with about 3.5mg isoflavones, the protein used by the food industry is often quite low in isoflavones.

In Japan, the daily intake of soy protein among those consuming a traditional diet is approximately 10g, which represents about 10% of their total protein intake.[2] Large studies from Shanghai, China, show that men consume about 12 to 13g of soy protein per day,[143] which represents about 15% of total protein intake,[144] and that women consume about 9g/d.[145] Individuals in the upper one-quarter of intake consume about 15 to 20g soy protein daily. Ten grams soy protein translates to about 1.5 servings since one serving of a traditional soyfood provides about seven grams protein although some soyfoods can provide considerably more than this amount.

Approximately half of the soy intake in Japan comes via unfermented foods, with four foods – tofu, miso, natto and fried tofu – accounting for nearly 90% of all soy consumption.[146, 147] In Shanghai, most of the soy consumed is unfermented, and soymilk, tofu and processed soy products other than tofu account for about 80% of total soy consumption.[148]

SUMMARY AND CONCLUSIONS

Soyfoods can play an important role in the diets of men. They provide high-quality protein and are generally low in saturated fat. In addition, soyfoods are heart-healthful; they have a beneficial fatty acid profile and soy protein modestly lowers cholesterol levels and possibly blood pressure. More speculative evidence indicates that soyfoods, because they contain isoflavones, help reduce risk of prostate cancer. Finally, there is no meaningful clinical evidence that suggests soy protein lowers serum testosterone levels or exerts any estrogen-like or feminizing effects in men.

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