The Relationship Between Oral Health, Nutritional Status, and Food Intake in Older Adults
Tina White, MS, RD; Suzanne Neubauer, PhD, RD, CNSC

LEARNING OBJECTIVES
At the completion of this self-study article, the learner will be able to:
• Describe the relationship between Mini-Nutrition Assessment (MNA) scores and oral health.
• Describe the negative impact of poor oral health on nutritional status as it relates to an MNA score and BMI.
• Distinguish between the effects of food avoidance and food modification on nutritional status.
• Identify two oral-health interventions used to improve or maintain nutritional status.

Introduction
Mastication is the first step toward proper digestion and absorption of nutrients. Maintaining an adequate number of healthy teeth is the best guarantee to support adequate chewing ability and preserve optimal nutritional status. A majority of adults over age 60 suffer from poor oral health, including tooth loss, denture-related issues, cavities, and periodontal disease. A substantial number of older individuals cannot chew properly because they have few or no natural teeth; therefore, they select foods they can chew easily. Limited nutritional intakes may be related to food choices, as well as the mechanical effects of impaired chewing. As a result of an impaired chewing ability and subsequent altered food choices, older individuals may be at risk of malnutrition.

The Academy’s position is that oral health and nutrition have a multifaceted relationship. Nutrition can affect the integrity of the oral cavity as well as the progression of oral diseases. Moreover, poor oral health can impact functional ability to eat as well as nutritional status. The purpose of this literature review is to explore the association between oral health, nutritional status, and food intake. These possible associations could provide valuable information for implementing oral-health intervention programs that improve oral health, thus improving nutritional status both in the community and in institutions caring for older adults. Appendix 1 summarizes the articles used in this literature review.

ORAL HEALTH AND NUTRITION STATUS
Oral Health and Malnutrition
Several studies examining the relationship between oral health and nutritional status utilized the Nestle® Nutrition Institute Mini-Nutrition Assessment (MNA®) tool to identify individuals 65 years of age and older who are malnourished or at risk for malnutrition. The questionnaire consists of 18 questions based on anthropometric measurements, general health status, a dietary questionnaire, and a subjective assessment (self-perception) of health and nutrition. Each question is assigned a weighted number, and the maximum score is 30 points. A score of ≥24 indicates good nutritional status, 17–23.5 indicates a risk of malnutrition, and <17 indicates malnutrition.

In this issue ...
Oral Health
continued from page 1

Lopez-Jornet et al.6 studied the relationship between oral health and the risk of malnutrition in 465 institutionalized and non-institutionalized adults aged ≥65 years to determine which group was at greater risk of malnutrition. Institutionalized participants had poorer oral health than non-institutionalized participants, and their risk of malnutrition was five times greater (OR=5.12, 95% CI 3.08–8.49). There were no differences in terms of malnutrition or risk of malnutrition between the participants with or without dentures, or between the dentate and edentulous participants. Because of the cross-sectional design of this study, the results cannot confirm a causal relationship between oral health and malnutrition.

Looking at institutionalized individuals alone, Soini et al.7 examined the association between oral status and nutritional status among individuals in either nursing homes (n=2,036, mean age 83 years) or long-term care wards (n=1,052, mean age 81). Nutritional status was significantly associated with oral status and with a number of oral-health problems. Those with mixed dentition or complete dentures had a significantly better nutritional status (MNA≥23.5) than those totally edentulous without prosthesis (MNA≤17). Malnutrition increased significantly and consistently with the increasing number of oral-health problems (including chewing problems, swallowing difficulties, pain in the mouth, and xerostomia) for individuals in both nursing homes and long-term care wards. Similarly, Dion et al.8 found that the risk of malnutrition increased significantly (OR 1.15, 95% CI 1.06–1.25) when chewing ability decreased by 10 points, which was equivalent to the loss of two molars, in 1,094 institutionalized individuals aged ≥60 years.

Also evaluating the relationship between oral health and nutrition status in institutionalized individuals, Lamy et al.9 investigated whether poor oral status contributed to the development of malnutrition in 120 adults, mean age 81 years. An oral examination and evaluation of chewing ability were performed, and participants were classified into three groups according to oral status: edentulous without dentures or with only one complete denture (poor oral-health status), edentulous with two complete dentures, or dentate with or without partial dentures. Subjects with a poor oral-health status had significantly lower MNA scores than did edentulous subjects with two complete dentures. Subjects with two complete dentures had similar MNA scores as dentate subjects with few remaining teeth (10.4 ±7.8 teeth).

The aforementioned studies looked at the relationship between oral health and nutrition status in institutionalized elderly people; however, non-institutionalized individuals with poor oral health were also found to have a compromised nutrition status.10–12 Marchi et al.10 conducted a study to examine the association between oral-health status and risk of malnutrition in 471 community-dwelling adults aged ≥61 years. Subjects who were malnourished or at risk for malnutrition had significantly fewer teeth than did well-nourished subjects. Interestingly, having one to eight natural teeth was protective against the risk of malnutrition (OR 0.53, 95% CI, 0.29–0.98) even after adjusting for self-rated gingival health, oral status, and gender, all of which were variables independently associated with the MNA.

Similarly, Samnieng et al.11 found that the number of teeth present in malnourished individuals was significantly lower than in individuals with normal nutrition or those at risk of malnutrition in 612 community-dwelling individuals with a mean age of 67 years. Functional tooth units (FTUs) were defined as pairs of upper and lower opposing natural teeth and artificial teeth on fixed or removable prostheses, whereas the presence of cavities and teeth with extensive damage to the crown and tooth loss was regarded as non-functional. Individuals with 13.2 teeth, 10.3 FTUs, and only 1.1 decaying teeth had a normal nutritional status, while malnourished individuals had 8.7 teeth, 8.3 FTUs, and 1.6 decaying teeth. Malnourished individuals had fewer FTUs than did subjects with normal nutrition, and a lessened chewing ability than those who were at risk of malnourishment and those with normal nutrition (p<0.05). They also had significantly more decaying teeth than those who were at risk of malnutrition and those with normal nutrition.

El Osta et al.12 evaluated the associations between nutritional deficits and measures of oral health in 201 community-dwelling individuals aged ≥65 years. Individuals were categorized based on MNA nutritional status, which included individuals who were malnourished or at risk for malnutrition (n=85) and individuals with normal nutritional status (n=116). Compared with individuals with normal nutritional status, individuals at risk of malnutrition or who were malnourished had fewer than 21 residual teeth without dentures, or were edentulous without dentures. Additionally, the number of FTUs was significantly associated with nutrition; participants who had four FTUs or fewer were three times more likely to be malnourished.
Oral Health
continued from page 2

ished than participants with more than four FTUs.

Summary: With the exception of Lopez-Jornet et al., these studies found a relationship between oral health and nutritional status in both non-institutionalized and institutionalized older individuals. Malnourished older persons were found to have significantly fewer teeth, significantly more decaying teeth, and fewer FTUs than individuals at risk or malnutrition or those with normal nutritional status according to the MNA. Institutionalized older adults were found to have poorer oral health and were at a significantly greater risk of malnutrition than non-institutionalized older adults. Additionally, malnutrition increased consistently with increasing number of oral-health problems.

Oral Health and Body Mass Index

While the MNA generates a score that reflects the nutritional status of older individuals, researchers have found that oral-health status is also associated with body mass index (BMI). BMI can be used as a screening tool to identify possible weight problems for adults. Institutionalized individuals are provided with food from their respective facilities; however, when oral-health care is not consistent, this can lead to fluctuations in food intake and subsequent shifts in BMI. Conversely, because community-dwelling individuals have more control over food selection and caloric intake, they may therefore experience increased BMIs irrespective of oral health.

Majon et al. evaluated the relationship between oral-health status and nutritional deficiency among 324 institutionalized adults, mean age 85 years. The Barthel index was used to categorize subjects as dependent or semi-dependent based on oral-health status and ability to perform activities of daily living, including self-feeding and self-grooming. When adjusted for age, the presence of a compromised oral function was more common in dependent subjects than in semi-dependent subjects, and BMI was significantly lower in subjects with a compromised oral functional status. This suggests that the ability to perform activities of daily living was protective against declines in oral health, and was thereby protective against adverse changes in BMI.

Looking at non-institutionalized individuals, Nascimento et al. evaluated whether poor oral status was associated with underweight or overweight regardless of confounding variables in 875 adults, mean age 72 years. Having 20 or more teeth in the mouth is associated with normal BMI values; thus, participants were categorized into the following groups: edentulous without dentures or wearing one complete denture, edentulous wearing complete dentures, <20 teeth without prosthesis, <20 teeth with prosthesis, ≥20 teeth without prosthesis, and ≥20 teeth with prosthesis. After adjusting for confounders, edentulous subjects wearing one or no dentures were three times more likely to be underweight (OR 3.94, 95% CI, 1.14–13.64) or two times more likely to be overweight/obese (OR 2.88, 95% CI, 1.12–7.40) compared with all other groups.

While the previous study found a relationship between BMI and either the number of teeth or the use of a prosthetic, Sahyoun et al. examined the relationship between total number of posterior FTUs and BMI in 5,958 non-institutionalized adults aged >50 years, participating in the National Health and Nutrition Examination Survey (NHANES). Subjects were categorized into the following groups based on number of posterior pairs of teeth: zero posterior pairs, full dentures, one to four posterior pairs, and five to eight posterior pairs (reference group). Individuals with one to four posterior pairs of teeth had higher BMIs compared with the reference group (p=0.009), but no association was found between edentulous individuals or individuals wearing dentures and BMI.

Also evaluating non-institutionalized individuals, Ritchie et al. assessed the nutritional status of 49 adults aged ≥65 years to identify factors associated with poor nutritional status. Subjects were asked a series of questions to assess their oral health; self-reported difficulty in chewing and being bothered by one’s teeth were significantly associated with a lower BMI after controlling for age, education level, functional status, and gender. This study suggests that individuals are aware of their oral-health issues, but are perhaps unable to solve the problem and are unaware of the effects on their nutritional status.

Summary: These studies suggest a link between oral health and BMI in both non-institutionalized and institutionalized older adults. Interestingly, self-reported oral-health problems were associated with lower BMIs, which indicates that simple measures such as incorporating soft foods can be taken to prevent declines in nutritional status regardless of living situation. Because cross-sectional studies cannot conclude cause-and-effect relationships, and because most of the above studies did not collect information on food intake, additional evaluation of the effects of oral health on nutritional status in relation to food intake is needed.

continued on page 4
ORAL HEALTH AND FOOD INTAKE
The associations between oral health and nutritional status in the studies listed above suggest that elderly individuals who have impaired oral health may change their dietary habits; for example, they may avoid foods that are difficult to chew or modify the way foods are prepared or eaten. Modifications in food selection practices may result in high-calorie diets or in the elimination of calories, leading to weight changes regardless of living situation. The relationship between oral health and nutrition can be better understood by examining food intake.

Chewing Ability
Taking into consideration oral functional status and food intake, Ikebe et al. found that chewing ability was significantly associated with the number of teeth when examining 1,288 individuals ages 60 to 84 years. Looking at the long-term effects of impaired chewing ability, Lee et al. examined chewing ability in conjunction with food intake and energy status in 1,410 individuals aged ≥65 years with metabolic syndrome. By the end of the eight-year study, 368 subjects had died; there was a significantly lower intake of fruit and unsatisfactory chewing ability had significantly lower HEI scores, including inadequate intake of essential micronutrients compared to baseline, whereas HEI scores for the group with no persistent oral-health problems (n=125) did not change from baseline.

Food Avoidance and Modification
To better understand the reasons for differences in diet quality, researchers have evaluated food avoidance and food-modification behaviors in relation to oral health. Hildebrandt et al. compared the number and types of functional tooth units with complaints about oral function and food-avoidance practices in a convenience sample of 602 adults, mean age 70 years. Chewing ability was assessed by the number of opposing natural or prosthetic FTUs; those who did not avoid a food texture were considered the control group. Individuals avoiding stringy foods had significantly fewer natural FTUs and more prosthetic FTUs compared with the control group. Additionally, individuals avoiding crunchy foods had significantly fewer natural FTUs and more non-functional FTUs compared with the control group. Furthermore, individuals avoiding dry solid foods had significantly fewer total and natural FTUs and more non-functional FTUs compared with the control group. These data suggest that individuals unable to modify their own food are more likely to avoid difficult-to-chew, nutrient-dense foods and instead may consume foods higher in calories and fat. For instance, individuals avoiding three to 14 foods consumed more saturated fat and energy and more added sugar than those avoiding fewer than three foods and those who modified four to five foods.

continued on page 5
ORAL HEALTH
continued from page 4

Summary: These studies suggest that persistent oral-health problems are associated with compensatory food behaviors. Dietary quality was compromised for older adults who shift their food choices toward foods that are soft and easy to chew and swallow, and away from those that are dry, crunchy, and stringy. Elderly individuals avoid a large number of foods due to oral-health problems, and individuals who avoid one food are more likely to avoid others, which may impact nutritional status. In contrast, modifying foods in response to oral-health problems was associated with better dietary quality, and may contribute to better nutritional status.

INTERVENTION PROGRAMS
Due to the numerous studies that found associations between oral health, nutritional status, and food intake, researchers have examined the impact of oral-health intervention programs on nutritional status in older individuals. In a prospective 60-day pilot study, Paturu et al. analyzed the change in eating pattern and nutritional status of two groups of edentulous individuals: those fitted with complete dentures for the first time, and those who after wearing the same complete dentures for 5 to 10 years were fitted with new dentures. Individuals who wore dentures for the first time showed no difference in BMI after dental treatment compared to baseline; note that these individuals may have needed time to adjust to their new dentures. In contrast, BMIs of second-time denture wearers were significantly greater than before the intervention, and food-intake data revealed an improved intake of fruits, vegetables, and protein.

While not all intervention programs will improve nutrition status, they may help prevent declines in nutritional status. For example, Sumi et al. conducted a one-year longitudinal, controlled study finding that individuals who received oral care three times per week, including the use of a powerful electric toothbrush and an antibacterial agent, had no significant declines in body weight or BMI compared to baseline; the control group had significant declines in both measures. Similarly, Worstmann et al. found that six months after dentures were restored or replaced in 47 older individuals, markers of nutritional status, including MNA scores, remained unchanged.

Further emphasizing the need for oral-healthcare intervention, Jung and Shin found that half the 268 participants (mean age 72 years) taking part in a quality-of-life study related to oral health thought they were in need of oral-healthcare services. Likewise, McGrath and Bede found that disparities in quality of life related to oral health were seen among individuals who experienced tooth loss and did not seek oral-health care for dentures (p<0.001), and Marino et al. found that older adults whose self-reported quality of life was “average/bad” were more likely to be edentulous compared with those who self-reported a “good/excellent” quality of life (OR 1.5, 95% CI, 1.10–2.00). These studies suggest that older adults are aware of their oral-health status, yet their needs are not being met.

CONCLUSION AND IMPLICATIONS FOR PRACTICE
This review of the studies evaluating the relationship between oral health, nutritional status, and food intake provides recommendations for improving oral-health status.

For More Information
  The systematic review conducted by Yoshida et al. found a general consensus among studies that tooth loss leads to reduced fruit and vegetable consumption, and that tooth loss could lead to nutritional diseases such as obesity and low body weight.
  This article by Putten et al. examines the effect of aging and age-related diseases on oral-health status in non-institutionalized individuals, including the adverse effects of polypharmacy, frailty, disability, care dependency, and limited access to oral healthcare. The article also provides recommendations for improving oral-health status.
  The Seattle Care Pathway is an evidence-based, standardized healthcare program designed to prevent oral-health issues in older adults. This article describes the development of the program and provides guidance for its application through various clinical scenarios.
  This website describes the efforts proposed to maintain oral health in adults, including providing access to preventative services, oral-health interventions, monitoring and surveillance systems, and modifications in the public health infrastructure.
indicates that poor oral health is associated with modifications in food-selection behaviors, and subsequently with poor nutritional status in both institutionalized and non-institutionalized older adults. Based on the studies reviewed, institutionalized individuals with compromised oral functionality tend to have lower BMIs than their independent counterparts, suggesting that older adults with impaired ability to perform activities of daily living are at greater risk of declining nutritional status. Individuals who are at risk of malnutrition or who are malnourished tend to have fewer teeth and FTUs compared with individuals with normal nutritional status. When considering food-selection behaviors, individuals tend to avoid or modify foods due to poor oral health. These findings are important for institutionalized individuals who are unable to prepare foods; therefore, caretakers must be aware of the current oral-health status, food preferences, and appropriate food modifications required for each patient. Moreover, individuals living in the community who avoid foods may lose weight or consume soft, easy-to-chew foods that are less nutrient dense and higher in calories, which could lead to weight gain. Prevention programs focused on oral-health care and coordinated nutrition education may help maintain the nutritional status of older adults. One such program is the Louisiana Smiles for Life Program, which focuses on independent older adults and includes lesson plans for nutrition, a handout promoting healthy food choices based on the food pyramid, denture care, and overall oral health and hygiene. Likewise, independent older adults may benefit from handouts with tips on healthy eating and oral health awareness. For example, the Aging Resources of Central Iowa’s handout “Are You Having Trouble Swallowing?” provides tips for healthy eating, food-modification strategies for addressing chewing and swallowing difficulties, and a self-administered dental checklist used to identify oral-health problems.

Dietetics practitioners should advocate for appropriate, affordable dental care for the older population to promote oral health and thus prevent declines in food intake. Preventative measures and simple dental procedures, either by a visiting dental hygienist or a trained nurse, are an important part of the routine care in institutions. Additionally, practitioners should monitor patients with compromised oral-health status using validated assessment tools such as BMI and MNA to assess changes in nutritional status. Community pilot programs focused on dietary education for the elderly inclusive of oral health and food-intake strategies should be explored.

About the Authors
Tina White, MS, RD, received her bachelor’s degree in May 2007 from the University of Vermont, Burlington, VT. She completed the Coordinated Program in Dietetics and received her master’s degree from Framingham State University in May 2014. Tina is interested in nutrition throughout the life cycle; she is currently writing a literature review on the efficacy of cornstarch to treat glycogen storage disease (GSD). Tina plans to pursue a career in clinical nutrition.

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References
Click here to see the references for this article.
Chair’s Message

Maria Mahar, MA, RD, CDN

The HA Executive Committee has a full agenda this fall. The team continues to make progress on our program of work and strategic plan, which handles the operating budget for the Healthy Aging DPG. Amy Sheeley, treasurer, continues to make positive strides toward achieving a balance between recurring revenues and ongoing expenses. The executive committee is effectively focusing its energy into coordinating and aligning efforts in meeting the tactics of the strategic plan. One of the strategies of engaging members is our newly released video, “I Am Healthy Aging,” which lets you watch HA DPG members as they give inspiring (and sometimes funny) explanations about why they’ve joined our DPG—you might even know one of the interviewees.

Our nominating committee is busily processing the incoming slate of officers for the 2015–2016 leadership year. If you or someone you know is interested in volunteering in a leadership position for the 2016–2017 year, look for our eblasts sometime in the fall of 2015. You can also recommend a qualified HA DPG member for a position. We encourage self-nominations.

Healthy Aging held a spotlight session at the 2014 FNCE® in Atlanta, “RD/DTRs and Local Farming Communities Together: Partnering to Improve the Health and Well-Being of Older Adults.” Dr. Nancy Cohen of the University of Massachusetts in Amherst co-presented with Ben Vitale, farmer and executive director of the Central New York Regional Farmers Market. I can’t wait to write about the exciting ideas that these two people have shared at FNCE.

The professional chair and membership chair continue to create professional-development webinars on topics requested by our members, such as nutrition and Alzheimer’s disease. Our communications team continues its ongoing efforts to keep our members connected and current about Academy and DPG resources through Facebook and Twitter.

I am very grateful to be a member of this astute and resourceful group. My peers continuously provide me with new ideas about how to lead the Healthy Aging DPG. Speaking of new ideas to share, I would like to share about a program I manage at work that many RDNs and DTRs have asked about: Men Can Cook.

Jack Smith of Syracuse, New York didn’t realize just how ill-prepared he was for life without his wife until he opened his freezer and found it empty; he had consumed all the frozen meals she had prepared for him before she died. “My wife and I were married 50 years and she would never let me in the kitchen,” the 80-year-old widower explained. “So when she passed away five years ago, all I could make was a cup of coffee. I was handicapped.” Jack decided to enroll in the four-week cooking class Men Can Cook.

Men Can Cook is a nutrition cooking class offered through the Onondaga County Department of Aging’s nutrition and caregiver programs. The program is funded by the Older Americans Act. Men Can Cook began in 2009, with par-

continued on page 8

Call for Information: Conferences and Events

The Healthy Aging DPG calendar contains events of interest to RDNs, RDs, and DTRs who work with older adults. If you would like to suggest a conference or event for our calendar, please email Robin Dahm (dahmRD@gmail.com) with your information. The event must focus on the nutritional and physical health of older adults.
Chair’s Message
continued from page 7

Participants meeting three hours every Wednesday for four weeks. The class is offered to men 60 years of age and older. Originally the target audience was men who were caregivers or widowers, but the audience was expanded to include men whose wives were concerned about what would happen if their husbands had to fend for themselves. In addition to learning how to prepare and cook tasty, healthy meals, the participants also learn about food safety, shopping on a budget, and cooking meals for one or two people.

As a registered dietitian, I led the men’s cooking group, which is held in a church’s commercial kitchen. Together we prepared healthy dishes such as chicken cacciatore, grilled herbed salmon, and quinoa salad. I also taught them how to prepare desserts such as chocolate chip and oatmeal cookies. Each participant became increasingly confident about finding his way around a kitchen. Everyone increased their cooking activities at home, developed healthy cooking skills, and improved their ability to cook a variety of cuisines. To date, over 40 men have completed the course. I have received a number of calls from federal, state, and local agencies from across the country, hoping to start similar classes.

For many men of Jack’s generation, cooking is the purview of women. But when they outlive their wives or become their caretakers, that culinary ignorance can mean more than the loss of some of life’s simple pleasures; it can lead to poor diets that exacerbate or cause serious health problems. A growing recognition that kitchen confidence can be critical to the health of older men has medical and social-service agencies around the country offering classes to help them cooking. As many as a third of American men over the age of 80—more than a million people—face nutrition-related health concerns because of an inability to cook for themselves. We dietetics practitioners know that men who can’t cook are more likely to rely on fast or frozen foods or even skip meals, which can lead to chronic health problems.

When surveyed about the reasons they were attending the program, the men also noted that they enjoyed having lunch with “the guys” and meeting new friends. It’s more than a matter of taste; it’s also good medicine. Older men who can cook tend to be healthier because they eat better, and sharing an activity is a sociable endeavor. Classes generally are small (eight to ten people) to make sure everyone gets time at the stove. Since many older men are intimidated by female classmates, most of the men are happy to learn that the only woman in the class will be the instructor.

After completing two semesters of cooking classes, Jack has mastered several dishes, even the classic French dish chicken cordon bleu. He proudly boasts, “Now it’s so easy.”

Regardless of age, people can and want to learn new life skills. As a healthy-aging specialist, I continually ask myself if there are additional ways or programs I can use to teach people about nutrition. Is the program working? How can I attract different types of seniors to attend my nutrition programs? How can I make it fun so the information they learn is used to make healthy, nutritious choices? I find that questioning is the best way to gain deeper insights and develop new, innovative solutions. Out of this strategy, the concept Men Can Cook evolved. Innovators understand client needs by asking questions. It is the simplest and most effective way of learning.

The Healthy Aging DPG has many resources and members who can help with questions about how to develop creative ways to teach or help clients. Just as Jack reached out to our Men Can Cook office, you can reach out to the Healthy Aging DPG. Join our Healthy Aging electronic mailing list (EML) and ask questions. To join the EML, click on Member Benefits, then click on the EML title and follow the directions. Our members are eager to help and share ideas with you.

The Healthy Aging DPG Community Based Applied Research/Best Practice Award encourages applied research projects that improve the nutritional status, well-being, and independence of community-residing older adults. Ideally, the $4,000 award will be used to solve and identify problems pertaining to dietetic practice, program administration, service/care coordination, and/or behavioral practices of older adults. The award is administered by the Academy of Nutrition and Dietetics Foundation.
THE FALL 2014 MEGA ISSUE QUESTION: How can all Academy members utilize, expand, and sustain business and management skills to take advantage of current and emerging professional opportunities? The House Leadership Team (HLT) developed this question based on the combined recommendations coming from five dietetic practice groups that have a management component. The HLT used these recommendations to develop the HOD fact sheet and backgrounder, providing history, urgency and current evidence justifying the pursuit of the question. Below are some of the reasons why business and management skills are critical to the profession of dietetics:

- These skills span all areas of dietetics and help elevate the profession of nutrition and dietetics.
- Expertise in business and management advances practitioners beyond entry-level positions.
- The current work environment is changing. An RDN’s and DTR’s knowledge, experience, and skills must evolve to meet future practice needs.
- Employers identify lack of management skills as a weakness for entry-level practitioners.¹

With a thorough investigation of this Mega Issue, the HLT and the HOD will work to:

- Create a plan with strategies and resources so that all members at all practice levels and areas can enhance their business and management skills and advance their careers to higher administrative levels.
- Focus attention on the breadth of business and management positions in all practice areas.
- Identify compelling reasons for RDNs and DTRs to consider academic coursework, including continuing education, in business and management as a priority in advancing their career paths.
- Address key dissatisfactions identified by Academy members, such as low salaries and limited recognition by other fields.

The HOD Delegate report in our next issue (winter 2015) will feature the results of these activities.

What is available now for the dietetics practitioner to develop business and management skills? The Academy offers opportunities to volunteer for positions at the district, state, or national level as well as volunteer positions in dietetic practice groups. Working with peers—for example, holding a volunteer position with the Healthy Aging DPG—is a great way to develop and exercise management and leadership skills. The professional development portfolio offers self-evaluation and needs-assessment tools for planning goals related to business management. Consider taking one of the two online Certificate of Training programs offered by the Academy’s Center for Professional Development (Developing Your Role as Leader, Advancing Your Role as Leader). Or you could start by reading the supplement “Management is a Multifaceted Component Essential to the Skill Set of Successful Dietetics Practitioners,”² published in the May 2012 Journal of the Academy of Nutrition and Dietetics.

It is my privilege to serve as your HA Delegate. By preparing for and participating in the HOD dialogues, my personal knowledge of the resources and support provided by the Academy has grown. We as Academy members have an awesome group of volunteer colleagues, along with Academy staff, who continue to develop and hone relevant resources that all members may utilize for professional growth. I welcome questions from our HA members, and I am happy to assist in your quest for resources as well as report issues, questions, or concerns to the HOD and House Leadership Team.

Healthy Aging DPG Member Benefits

The Healthy Aging DPG achieves success by supporting the success of its members.

Renewing your HA DPG membership when you renew your Academy membership will ensure your uninterrupted access to:

- Continuing-education credits through webinars as well as articles in The Spectrum.
- Professional development grants to further your education and credentialing.
- Networking and leadership opportunities.

¹ Commission on Dietetic Registration 2006 Employer Qualitative Research. Unpublished.
All Politics Is Local
There’s an old saying that “all politics is local.” Anyone who has ever been involved in the political and advocacy world knows this is true. Recently both political parties in my hometown had the opportunity to select candidates for an open senate position. We were to use a caucus system for the candidate selection. I knew nothing about how it worked, but after asking lots of questions and talking with party representatives, I realized that just a handful of people actually make the final decision. The caucus was held, and after lots of votes, tears, and hugs, both parties elected candidates for the upcoming runoff. Unfortunately for dietetics professionals in our geographic area, one of the persons chosen does not have a history of supporting our causes, whereas one of the losing candidates is a known supporter of nutrition initiatives. Perhaps if a group of dietetics professionals was in attendance during the caucus, the result might have been different.

Healthcare laws are changing daily, and we need to be present when decisions affecting our profession are being made. State licensure issues, state and national reimbursement issues, healthcare, and wellness dollars are just a few of the key legislative topics at stake. We RDNs and DTRs might not want to get involved with politics. Sometimes we simply do not understand political processes. But in today’s world more and more dietetics practitioners are participating in the political arena. As a result, we are making progress on many fronts. In an attempt to help all members understand how the Academy can help us become involved, I am sharing with you our current Public Policy and Advocacy Framework.

The Academy’s Legislative and Public Policy Committee
The Legislative and Public Policy Committee guides the establishment of the Academy’s public policy work, including (but not limited to) activities related to national and state public policy, legislative issues, and regulatory issues. The Committee reports to the Academy’s Board of Directors and House of Delegates. The Committee meets once a month via a conference call, and at the annual FNCE® and Public Policy Workshop event.

In fulfilling its responsibilities, the Committee collaboratively receives information, positions, and guidance of other Academy committees, task forces, working groups, and teams. It consists of 12 members of the Academy, plus the president-elect, the speaker of the house, the ANDPAC chairman, and others serving as ex-officio members. The Academy’s president and speaker appoint all members and ex-officio members for staggered three-year terms.

The Committee provides oversight for the Academy’s legislative and public policy activities. There has been significant progress in the development of the public policy panel (PPP) over the past several years as the Academy has strived to further develop its grassroots network in the affiliates. The Committee’s role in providing oversight requires collaboration with the Policy Initiatives and Advocacy staff (PIA) in defining, executing, and measuring the work of the PPP.
dance at locally held fundraisers helps the Academy’s advocacy efforts for several reasons:

• Academy members have the opportunity to get involved in advocacy, and greater involvement strengthens the Academy’s grassroots network.

• Members of Congress prefer to hear from their own constituents about issues.

• Local fundraisers are considerably cheaper to attend than those in Washington, which is a more efficient use of ANDPAC dollars.

• Local events tend to be smaller, so Academy members are likely to have more “face time” with their representatives or senators.

If dietetics is your profession, policy should be your passion!

**Affiliate/State Public Policy Panel**
The PPP was established to use our grassroots network to affect positive policy change for our profession. One of the most powerful advocacy assets of a member-based organization is its potential for grassroots advocacy. Each state has a public policy panel and is a great place to start getting involved. The PPP allows for each affiliate to be a voice on policy at the local, state, and federal levels.

**DPG/MIG Involvement with Legislative and Public Policy Issues**

DPGs/MIGs are fundamental to achieving the Academy’s public policy goals. In order to collaborate to the highest level possible, our role as a DPG is as follows:

• Identify one member of the DPG/MIG to serve as the policy and advocacy leader (PAL). I am the current PAL for the Healthy Aging DPG.

• Identify members of the DPG/MIG with expertise on relevant issues to serve as content experts for policy initiatives as requested. We often ask members for input on specific subject matters.

• Communicate the DPG/MIG’s public policy goals annually to the PIA team through the development of a public policy plan of work or other document that outlines the regulatory, legislative, and other public policy goals of the DPG/MIG.

• Work with PIA staff to collaborate on the Academy’s public policy priority areas and/or discuss emerging public policy issues.

• Promote and participate in Academy action alerts and engage DPG/MIG members in grassroots advocacy efforts.

• Provide content expertise for Academy public policy initiatives at the local, state, and federal levels, including regulatory comment submissions, stance or position development and review, and legislation language development and review using the process outlined in the policy.

• Support the Academy’s public policy positions and stances. DPG/MIG-developed messaging materials that are practice-area specific must be submitted to the DPG/MIG relations manager and to PIA staff for approval.

In closing, there is another familiar saying, “If you’re not at the table, you’re on the menu.” If any member wishes to get more involved with our DPG’s public policy and advocacy efforts, please contact me (dianne-polly@gmail.com).
FOODS MADE FROM SOYBEANS have been consumed in Asia for centuries, beginning first in China and then spreading to Japan and other nearby countries. The soybean is prized in these cultures for its versatility. Traditional soyfoods include tofu, soymilk, and the fermented products miso, natto, and tempeh. In addition to traditional soyfoods, Westerners also have access to a variety of products based on soy protein. Included in this category are isolated soy protein (ISP), soy protein concentrates, and soy flour, which are by definition at least 90%, 65%, and 50% protein, respectively. Most of the soy-based meat substitutes such as burgers are made using these products. These soy protein products are also found in some cereals and energy bars. Soy-based products are especially appealing to people seeking plant sources of high-quality protein, such as vegetarians, but also to many older individuals who are trying to limit their reliance on animal products and for whom meeting protein needs can be a challenge.

The popularity of soyfoods has risen strikingly over the past 25 years, a phenomenon due at least in part to consumer awareness of recent research involving older individuals. The introductory background information about isoflavones and general nutrient information sets the stage for a thorough understanding of soy’s role in the dietary patterns of older adults.

This article discusses the health effects of soyfoods with an emphasis on research involving older individuals. The introductory background information about isoflavones and general nutrient information sets the stage for a thorough understanding of soy’s role in the dietary patterns of older adults.

Isoflavones
Among commonly consumed foods, only the soybean contains physiologically relevant amounts of isoflavones. The isoflavones in soybeans and unfermented soyfoods are present primarily as glycosides; fermentation converts the glycosides to aglycones to varying degrees.

It isn’t clear that isoflavone form impacts the health effects of soyfoods, but it can lead to confusion about the amount of isoflavones in a food, since the sugar accounts for 40% of the weight of the glycoside. The recommended approach and the approach used in this article when referring to an amount of isoflavones is to refer to the aglycone equivalent weight. When all forms of the individual isoflavones are considered, the three isoflavones (genistein, daidzein, and glycitein) account for approximately 50%, 40%, and 10%, respectively, of the total soybean isoflavone content.

Traditional soyfoods contain approximately 3.5 mg of isoflavones per gram of protein; processed soy can lose as much as 80% of its isoflavone content. On average, traditional soyfoods contain 20–30 mg of isoflavones per serving (for example, 250 ml of soymilk made from whole soybeans or 100 g of tofu), and older-adult Japanese and Shanghai Chinese consume about 30–50 mg/day of isoflavones.

Isoflavones have a similar chemical structure to estrogen, bind to estrogen receptors (ERs), and exert estrogen-like effects under certain experimental conditions. For these reasons, isoflavones are classified as phytoestrogens. However, they are also classified as selective estrogen receptor modulators (SERMs). SERMs, which include the breast cancer drugs tamoxifen and raloxifene, are selective for tissue type; they can have estrogen agonistic effects, antagonistic effects, or no effects at all on their target tissues, even in tissues that are normally affected by estrogen. The tissue selectivity of isoflavones likely derives at least in part from isoflavones’ preferential binding to and activation of ERβ in comparison to ERα. These two receptors have different tissue distributions and often perform different functions in the body when activated. For example, in breast tissue, ERβ activation appears to inhibit the stimulatory and proliferative effects of ERα activation. There are numerous clinical examples of isoflavones exerting estrogen-like effects in some tissues but having no effect on other estrogen-sensitive endpoints, although there is limited evidence demonstrating anti-estrogenic effects.

Macronutrient Composition
Soybeans markedly differ from other legumes in their macronutrient composition. They are much higher in fat,
modestly higher in protein, and very low in carbohydrate. On a caloric basis, legumes are generally between 20% and 30% protein, whereas soybeans are typically about 35% protein. More importantly, the quality of soy protein is similar to that of animal protein, and higher than the protein quality of nearly all other plant proteins.

Approximately 40% of the calories in soybeans come from fat, whereas other legumes are generally less than 10% fat. The predominant fatty acid in soy oil, as in many vegetable oils, is the essential omega-6 polyunsaturated fatty acid (PUFA) linoleic acid (LA), which accounts for about 52% (range 39%–55%) of soy oil’s total fat content. Soybeans have a moderate amount of oleic acid (approximately 30%, with a range of 21%–36%), and a low amount of saturated fat (approximately 12%, with a range of 7%–22%). Unlike most other vegetable oils, soy oil is comprised of approximately 6% α-linolenic acid (ALA) (range 3%–9%), the essential omega-3 fatty acid. When it replaces saturated fat, this mix of omega-6 and omega-3 PUFA is associated with a reduced risk of CHD.

An analysis of eight United States Americans and European prospective cohort studies, which included 148,675 women and 80,368 men, found that a higher ALA intake was associated with a 23% lower risk of CHD deaths (hazard ratio [HR] 0.77, 95% confidence interval [CI] 0.58–1.01) among men, although no consistent association was observed among women.

Compared with other beans, soybeans contain almost no complex carbohydrates; approximately half of a soybean’s carbohydrates is fiber and the other half consists of the oligosaccharides raffinose and stachyose. In many traditional soyfoods (such as soymilk and tofu) as well as in soy protein products such as ISP, the fiber is largely removed during processing. Soy fiber is a mixture of cellulosic and noncellulosic structural components of the internal plant cell wall and has many of the same attributes as other soluble fibers, although it has not been studied extensively. Research suggests that soy carbohydrate may slow digestion, lower insulin responses, and help to control hyperglycemia. Oligosaccharides are considered prebiotics because they can stimulate the growth of friendly bacteria; in some people oligosaccharides cause flatulence.

### Osteoporosis

In response to declining estrogen levels, women can lose substantial amounts of bone mass in the decades following menopause, which markedly increases fracture risk. Estrogen therapy reduces postmenopausal bone loss and hip-fracture risk by approximately one-third. Initial speculation that soyfoods might promote bone health in postmenopausal women was based on the estrogen-like effects of isoflavones and early research showing that the synthetic isoflavone, ipriflavone, exerted skeletal benefits. The relatively low hip fracture rates in Asian countries have also been cited as support, but there are many factors other than isoflavones in soyfoods that could account for these low rates.

Both of the prospective epidemiologic studies that evaluated the relationship between soy and fractures show a reduction in risk of fractures with a higher intake of soy. Risk was reduced by approximately one-third when women in the highest soy intake quintile or quartile were compared to women in the lowest quintile or quartile. In a study by Zhang et al., approximately 1,800 fractures of all types occurred in the 24,000 postmenopausal Shanghainese women ages 40 to 70 who were followed for 4.5 years. In a study by Koh et al., there were almost 700 hip fractures (the only body site studied) among the 35,000 postmenopausal Singaporean women ages 45 to 74 during the 7-year follow-up period. No relationship between hip fracture and soy intake among men was noted in this Singaporean study.

In another prospective study, which involved 337 postmenopausal Seventh-day Adventists—a religious domination that includes a high proportion of vegetarians—the intake of soymilk was significantly inversely related to the onset of osteoporosis. The mean age of the cases and non-cases was 65.6 and 73.8 years, respectively. Participants in this study had their bone health assessed using broadband ultrasound attenuation of the calcaneus two years after completing a lifestyle and dietary enrollment questionnaire. Women drinking soymilk at least once a day had 56% lower odds of developing osteoporosis (defined as a T-score less than –1.8) than did women who drank no soymilk. However, the protective effect of soymilk was likely due to its calcium rather than its isoflavone content, since dairy product intake was similarly protective. Although the results of these three studies are intriguing, definitive conclusions about the skeletal effects of soyfoods can be based only on the results from appropriately designed clinical studies.

Since the first clinical study to examine the effects of an isoflavone-rich product on bone mineral density (BMD) in postmenopausal women was published in 1998, more than 30 trials have been conducted, although most were small and of short duration.
tion. Also, most of the trials made use of isoflavone supplements rather than traditional Asian soyfoods, because the use of the latter leads to concerns about compliance and lack of standardization and blinding. Recent meta-analyses of the clinical data have concluded that isoflavones increase BMD and/or favorably affect bone turnover in postmenopausal women, although the data are inconsistent on this point. Furthermore, as discussed next, three of the four largest and longest trials failed to find that soy isoflavones affect BMD.

Of three studies failing to show benefits of isoflavones, two were conducted in the United States and one in Taiwan. Isoflavone intake from supplements was 80 and 120 mg/day in one study, 200 mg/day in another, and 300 mg/day in the third. At enrollment, in two studies the women were aged 45 to 65 years, and in one the age span was 45 to 60 years. In contrast to these three trials, a two-year Italian study found that BMD at the spine and hip in postmenopausal osteopenic women decreased approximately 6% in response to placebo, but in women given 54 mg/day of genistein, BMD at these sites increased by approximately this amount. Although intended to last only two years, approximately half the subjects agreed to continue for a third year; the differences between groups in year 3 were even more striking than those in year 2 (approximately 9% increases in BMD in the genistein group versus 9% decreases in the placebo group). The amount of genistein taken on a daily basis by the study participants is provided by about 100 mg of isoflavones daily.

It is unclear why, in contrast to the other trials, the Italian study found such protective effects, and why, in contrast to the clinical trial data, the two Asian prospective epidemiologic studies found soy intake was so protective against fracture. It is possible that the participants who consumed soyfoods also led an overall healthier lifestyle (the “healthy user effect”). However, since soyfoods are traditional foods in Asian countries, this is less likely to be the explanation than it would be in non-Asian countries, where soyfoods are generally perceived as health foods. Another possible explanation is that in the epidemiologic studies, isoflavone intake occurred via the consumption of traditional soyfoods, whereas the clinical trials used soy extracts. However, there is no evidence that this difference matters with respect to skeletal effects. It may also be that the effects noted in the epidemiologic studies result from lifelong intake as opposed to the relatively short-term intervention periods begun in adulthood in the clinical studies. But again, there is no direct evidence supporting this suggestion.

At this point, the evidence that isoflavones provide skeletal benefits is unimpressive. Soyfoods may have skeletal benefits independent of isoflavones; however, the high-quality protein they provide may promote bone health. In addition, some soyfoods are good sources of calcium as well as vitamin D. The absorption of calcium from calcium-set tofu and calcium-fortified soymilk is comparable to the absorption of this mineral from cow’s milk.

Cardiovascular Disease

In 1999, the U.S. Food and Drug Administration (FDA) approved a health claim for soyfoods and CHD based on the cholesterol-lowering effects of soy protein. The FDA established 25 g/day as the threshold intake for cholesterol reduction. Similar claims have been approved in a number of other countries since 1999 and in 

Soy and Diabetes

Soyfoods may offer advantages for those individuals with diabetes, although the data are a bit mixed with respect to the effects of soy on glycemic control and insulin levels. A meta-analysis of 24 trials with a total of 1,518 participants found that there was no significant overall effect of soy intake on improvements in fasting glucose and insulin concentrations; however, a favorable change in fasting glucose concentrations was observed in studies that used whole soyfoods or a soy diet in the subgroup analysis. More recently, a study involving 15 postmenopausal women with abdominal obesity found that replacing part of the animal protein in the diet with 30g of protein from soynuts lowered LDLC and increased insulin sensitivity.

Since a strong argument can be made that for at least some individuals, low-carbohydrate diets are the optimal dietary approach for treating diabetes, the low carbohydrate content of soybeans and most soyfoods should serve as an advantage in this regard. Not surprisingly, soyfoods generally have a low glycemic index and load. Since one of the main medical complications of diabetes is renal disease, the finding of a just-published meta-analysis that included 9 trials with 197 participants found that soy protein lowers serum levels of phosphorus and creatinine, suggesting that inclusion of soy in the diets of people with diabetes is certainly warranted. The coronary benefits of soyfoods are also relevant since people with diabetes are at an increased risk of cardiovascular disease.
Soy and Health
continued from page 14

2013; the Canadian Cardiovascular Society recommends consuming soy as a means of lowering cholesterol levels.58 However, despite the large amount of research upon which the FDA-health claim was based, the cholesterol-lowering ability of soy protein has come under challenge in recent years. In its 2006 position paper, the American Heart Association (AHA) acknowledged the important role soyfoods can have in heart-healthy diets because of their low saturated fat and high PUFA content.59 However, the AHA declared that the decrease in low-density-lipoprotein cholesterol (LDLC) in response to soy protein, which it estimated to be about 3%, was insufficient to warrant a health claim.59

The AHA did not conduct a formal statistical meta-analysis of the 22 studies upon which they based their estimate, though. When such an analysis was conducted, Jenkins et al.60 found that soy protein lowered LDLC by 4.3%. Furthermore, when the analysis was limited to the 11 studies that provided evidence that the control and soy diets were matched, soy protein was found to lower LDLC by 5.2%. This estimate is in line with the results of other recently published meta-analyses,61–63 and allows the effects of soy protein to be comparable to the effects of soluble fiber, which is also believed to lower LDLC.64

There is also an indirect hypocholes-terolemic effect of soyfoods. Using National Health and Nutrition Examination Survey III population data, Jenkins et al.60 estimated that as a result of differences in fatty acid intake, when soyfoods replace traditional sources of protein in the American diet, LDLC is reduced by 3% to 6%. In addition, soy protein decreases post-prandial triglyceride levels, which is increasingly viewed as important for reducing CHD risk.65

Beyond effects on circulating lipid levels, four recently published meta-analyses concluded that soy protein modestly lowers blood pressure.66–69 In the largest of these, which included 27 studies, soy lowered systolic and diastolic blood pressure by 2.21 and 1.44 mg Hg, respectively.67 Various additional studies have shown that soy also improves endothelial function and systematic arterial compliance70 and reduces LDL-oxidation71 and LDL particle size,72 although the data are inconsistent.

An important clinical trial evaluating the impact of soy intake on CHD risk is the Women’s Isoflavone Soy Health (WISH) study, a 3-year study involving 350 healthy postmenopausal women ages 45 to 92. The study found that isoflavone-rich soy protein inhibited the progression of subclinical atherosclerosis as assessed by changes in carotid-intima-media thickness (CIMT).73 Participants in the WISH study were randomly assigned to groups consuming either 25 g of ISP (providing 91 mg isoflavones) per day or 25 g of dairy-milk protein. At study termination, progression of subclinical atherosclerosis among the women consuming soy was 16% lower than in the dairy-milk group. Although the difference was not statistically significant, the results are intriguing. If a 16% decrease in the progression of CIMT translates into a 16% decrease in the risk of future coronary events, the public-health implications would

continued on page 16

Soy and Prostate Cancer

Some men may be fearful of consuming soyfoods because of concerns about feminization. However, this fear is not only unwarranted, but by adding soy to the diet, men may be able to reduce their risk of prostate cancer. With respect to the former, clinical studies show quite clearly that soy does not affect circulating levels of testosterone127 or estrogen.128 Clinical research also shows no effect of soy or isoflavones on sperm or semen parameters.129,130

In regard to prostate cancer, according to the results of a 2009 meta-analysis of epidemiologic studies, higher soy consumption by Asian men is associated with a 50% reduced risk of developing this disease.131 In addition to helping prevent the development of prostate cancer, there is speculative but intriguing animal and human evidence suggesting that soy may also be useful for stopping its spread. For example, a pilot study reported that the activity of an enzyme (matrix metalloproteinase-2) that allows cells to invade tissues was markedly reduced in men with prostate cancer who were given the soybean isoflavone genistein.132 In agreement with these findings, 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%.133

Finally, several studies have evaluated the effect of soy or isoflavones on prostate-specific antigen (PSA) levels, a marker of prostate cancer risk. No effects have been noted on men with normal PSA levels,134 but several studies, although not all, have found that in patients unsuccessfully treated for their disease, isoflavones slow the rise in PSA levels.134,135 There is even preliminary evidence that isoflavones may mitigate the side effects of radiation treatment for prostate cancer.136
Soy and Health
continued from page 15

be rather impressive. Furthermore, the difference between groups increased steadily over the three-year study period, which suggests that after a longer period of soy exposure, progression would have been reduced to an even greater extent—and with it the risk of coronary events. Additionally, subanalysis of the results revealed that among women who were fewer than 5 years, 5 to 10 years, and 10-plus years post-menopausal, CIMT progression was reduced by 68% (p=0.05), 17% (p=0.51) and 9% (p=0.77), respectively. This significantly reduced disease progression in early postmenopausal women is notable for two reasons. First, it adds substantially to the biological plausibility of the findings, and second, it provides clear insight into the soy component responsible for the beneficial effects.

The pronounced effect in early menopausal women suggests that isoflavones were primarily responsible for the reduced CIMT progression, because the “estrogen timing hypothesis” that has emerged over the past 10 years maintains that exposure to estrogen-like compounds leads to dramatic coronary and cognitive benefits when begun soon after menopause, but that the exposure has less effect when begun in later years.

Epidemiologic Data
Finally, three Asian prospective epidemiologic studies have evaluated the association between soy intake and coronary events. After controlling for a wide variety of CHD risk factors, among the 65,000 postmenopausal women aged 40 to 70 years enrolled in the Shanghai Women’s Health Study, an 86% reduction (relative risk 0.14, 95% CI 0.04–0.48) in the risk of non-fatal myocardial infarction was associated with soy protein intake (5th vs. 1st intake quartile). In agreement are the results from the Japan Public Health Center-based (JPHC) study cohort I. Among the 40,462 women 40–59 years old without cardiovascular disease or cancer at baseline, when comparing women with frequent (≥5x/week) versus infrequent (≤2x/week) soy consumption, the multivariable hazard ratios were 0.64, 0.55, and 0.31 for risk of the incidence of cerebral infarction, myocardial infarction, and CHD mortality, respectively.2

In contrast to these two studies, however, no protective effects of soy were noted in the Singapore Chinese Health Study, a population-based study that recruited 63,257 Chinese adults ages 45–74 years from 1993 to 1998.75 During the 890,473 person-years of follow-up, there were 4,780 cardiovascular deaths. There is no obvious explanation for the pronounced benefits seen in the prospective studies from Japan and China but not from the Singaporean cohort. Interestingly, the prospective data suggest that soy may have gender-specific effects. In the contrast to the benefits in women, no relationship between soy intake and coronary events among men were noted in the Shanghai Men’s Health Study6 or the JPHC study cohort I.2

Hot Flashes
Hot flashes are the most common reason women seek treatment for menopausal symptoms. For the majority of women who experience them, hot flashes begin prior to menopause. Ten to 15% of these women experience severe, frequent hot flashes.77 Although hot flashes usually subside after six months to two years,77,78 many women report having them for up to 20 years after menopause.79

The low incidence of hot flashes in Japan helped raise initial speculation that isoflavones could be useful in their prevention.80 Since 1995, more than 50 clinical trials have examined the impact of isoflavone-rich soyfoods or isoflavone supplements on the alleviation of menopause-related hot flashes. In recent years, investigators have gravitated toward the use of supplements rather than soyfoods to enhance compliance and reduce the complexity of study designs. The results of these trials have produced inconsistent results. However, a systematic review and meta-analysis published in 2012 provides strong support for the efficacy of isoflavones and an explanation for the mixed findings.13

This systematic review of 19 studies and meta-analysis of 17 studies included only studies involving isoflavone supplements derived from soy. The meta-analysis of the data on hot-flash frequency, which included 13 studies involving 1,196 women, found that isoflavones were consistently efficacious, reducing the number of hot flashes per day about 21% more than the reduction in the placebo group. Similarly, in the nine trials involving 988 women that evaluated hot flash severity, isoflavones reduced symptoms by about 26% more than the reduction seen in the placebo group. For both measures, the effect of isoflavones was highly statistically significant. When considering the combined effect of the placebo and isoflavones, the overall reduction in frequency and severity was approximately 50%.

Subanalysis of the data revealed three interesting findings. First, baseline hot flash frequency did not impact efficacy. The percent reduction in hot flash frequency was similar among all the women, regardless of whether women had two hot flashes per day at baseline or 10 hot flashes per day. Second, hot flashes were reduced to a greater

continued on page 17
extensive research on soy foods began 25 years ago started with an interest in soy for breast cancer prevention.\textsuperscript{53,54} While the epidemiologic evidence does generally show that soy intake among Asian women is associated with a lower risk of this disease, several lines of evidence suggest that this benefit is derived only if soy foods are consumed early in life.\textsuperscript{85,86} This speculation is supported by case-control studies showing that childhood and/or adolescent soy intake reduces breast cancer risk,\textsuperscript{7,87-89} and animal data showing that chemically induced mammary cancer is inhibited in young rats briefly exposed to genistein.\textsuperscript{90,91} Several mechanisms have been proposed to explain the hypothesized protective effects of early soy/isoflavone intake.\textsuperscript{92-96}

Despite the proposed breast cancer-preventive effects, concern exists that isoflavone exposure from soyfood consumption may worsen the prognosis of breast cancer patients and increase the likelihood of high-risk women developing breast cancer.\textsuperscript{97} This concern is supported by animal research showing that in athymic ovariectomized mice implanted with estrogen-sensitive breast cancer cells, isoflavones stimulate the growth of existing mammary tumors.\textsuperscript{98} However, not only does this model have significant limitations, and that a slight tweaking of it causes a loss of the stimulatory effects of isoflavones,\textsuperscript{99} the results conflict with the human research.

No intervention studies have examined the effect of post-diagnosis isoflavone intake on the outcome (i.e., recurrence and/or death) of breast cancer patients. However, clinical studies show that isoflavone exposure does not affect markers of breast cancer risk. For example, a meta-analysis by Hooper et al.\textsuperscript{100} found that soy intake did not affect mammographic density in postmenopausal women. In another meta-analysis by these authors that evaluated reproductive hormones, isoflavone intake had no effect in postmenopausal women on estradiol, estrone, sex-hormone-binding globulin, follicle-stimulating hormone, or luteinizing hormone (LH); although there was a small, statistically insignificant increase (\(\sim 14\%\)) in total estradiol. However, Huber et al.\textsuperscript{102} noted that the parallel decrease in estrone levels observed in this meta-analysis would have theoretically nullified any possible increase in breast cancer risk due to the increase in estradiol.

Most importantly, relative to the placebo groups, none of the five studies have evaluated the effects of soy-derived isoflavones on breast cell proliferation, an intermediary marker of breast cancer risk generally thought to be more reflective of risk than mammographic density and reproductive hormone levels. The intervention periods ranged from 14 days\textsuperscript{103} to one year,\textsuperscript{104} and the daily isoflavone dose from 36 mg/day\textsuperscript{105} to 235 mg/day.\textsuperscript{106} All but one study used isoflavone supplements.\textsuperscript{103} Two studies involved postmenopausal women only,\textsuperscript{104,105} one mostly postmenopausal women,\textsuperscript{107} one only premenopausal women,\textsuperscript{103} and one was equally divided between pre- and postmenopausal women.\textsuperscript{106} In contrast to the lack of effect of isoflavones, estrogen plus progestin therapy increased breast cell proliferation in postmenopausal women 4- to 10-fold.\textsuperscript{108,109}

Not only are the clinical data supportive of safety, the epidemiologic data indicate post-diagnosis isoflavone intake improves prognosis. Of the seven prospective epidemiologic studies that have evaluated the impact of post-diagnosis soy intake on breast cancer risk, seven of the eight have found that soy foods reduce breast cancer risk.\textsuperscript{10-13} However, in studies that intervened with supplements providing at least 18.8 mg of isoflavones, although there was a small, statistically insignificant increase (\(\sim 14\%\)) in total estradiol. However, Huber et al.\textsuperscript{102} noted that the parallel decrease in estrone levels observed in this meta-analysis would have theoretically nullified any possible increase in breast cancer risk due to the increase in estradiol.

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the prognosis of breast cancer survivors, by far the three largest and longest are the Shanghai Breast Cancer Survival Study (SBCSS), the Women’s Healthy Eating and Living (WHEL) study, and the Life After Cancer Epidemiology (LACE) study. In 2012, Nechtua et al. pooled results from these three studies, which included 9,514 breast cancer patients (approximately half were Caucasian and half were Chinese) who were followed for a mean of 7.4 years. When comparing the highest isoflavone intake group with the lowest (≥10 mg/day vs. <4 mg/day), the risk of total mortality, breast cancer-specific mortality, and breast cancer recurrence was reduced by 13% (HR 0.87, 95% CI 0.70, 1.10), 17% (HR 0.83, 95% CI 0.64–1.07) and 25% (HR 0.75, 95% CI 0.61–0.92), respectively.

Finally, similar benefits were found in a meta-analysis published in 2013 that included the three studies in the pooled analysis plus two small Chinese studies. Not surprisingly, given the clinical and epidemiologic data, both the American Institute for Cancer Research and the American Cancer Society have concluded that soyfoods are safe for breast cancer patients.

### Summary and Conclusions

Soyfoods have been recognized for decades as good sources of high-quality protein and a variety of nutrients, but in recent years they have been intensively investigated for their ability to reduce the risk of chronic disease. Much of the interest in this regard is because soyfoods are uniquely rich sources of isoflavones.

There is solid clinical evidence that soyfoods reduce the risk of cardiovascular disease through multiple mechanisms. Benefits may be particularly pronounced for young postmenopausal women. Prospective data do show an inverse relationship between soy intake and coronary events in women; however, this relationship has not been observed in men. Prospective data also show an inverse relationship between soy intake and fracture risk among Asian women, but most long-term clinical data have not found that isoflavone supplements affect BMD in Western women. Still, because they provide high-quality protein, which is important for bone health, and because many soyfoods are good sources of well-absorbed calcium, they can help to protect against osteoporosis.

Isoflavone supplements are effective at alleviating hot flashes in postmenopausal women, but some women, especially women at increased risk of breast cancer or those who have this disease, are fearful of using soyfoods because of the concerns that soy phytoestrogens might stimulate breast tumor growth. However, clinical data show that isoflavone exposure does not adversely affect markers of breast cancer risk, and prospective epidemiologic studies indicate that post-diagnosis isoflavone intake reduces recurrence and mortality.

The clinical and epidemiologic data suggest that the consumption of two to three daily servings of soyfoods is sufficient to derive health benefits. An upper limit of four servings is recommended to avoid placing too much emphasis on one food. Minimally processed soyfoods should comprise the bulk of the soyfoods consumed, although more highly processed soyfoods can still serve as good sources of high-quality protein.

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### About the Author

Dr. Messina is the co-owner of Nutrition Matters, Inc., a nutrition consulting company; an adjunct associate professor at Loma Linda University in California; and the executive director of the Soy Nutrition Institute. Dr. Messina devotes his time to the study of the health effects of soyfoods and soybean isoflavones. He writes extensively on these subjects, having published more than 100 peer-reviewed articles for health professionals. Dr. Messina is also the chairperson of the editorial advisory board and writes a regular column for The Soy Connection, a quarterly newsletter that reaches over 250,000 health professionals. He has given over 500 presentations to health professionals and has presented in 48 countries.

### References

Click here to see the references for this article.

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1 The references for the take-away points on page 19 can be found throughout the body of this article.
## Take-Away Points About Soyfoods

### Isoflavones
- Among commonly consumed foods, the soybean is a uniquely rich source of isoflavones.
- Traditional soyfoods contain approximately 3.5 mg of isoflavones per gram of protein.
- Isoflavones are classified as phytoestrogens.
- Isoflavones and estrogen have some properties in common, but isoflavones differ from this hormone at the molecular and clinical level.

### Macronutrient Composition
- The soybean is higher in fat, much lower in carbohydrate, and somewhat higher in protein than other legumes.
- Soy protein is similar in quality to animal protein.
- Full-fat soyfoods are good sources of both essential fatty acids—the omega-6 polyunsaturated fat linoleic acid and the omega-3 polyunsaturated fat ω-linolenic acid.

### Osteoporosis
- Limited prospective epidemiologic data show that soyfood intake is associated with a decreased fracture risk among Asian women.
- Despite initial encouraging data, recent clinical trials do not find isoflavones to affect bone mineral density in postmenopausal women.
- Despite being high in phytate and oxalate, calcium absorption from fortified soymilk and calcium-set tofu is similar to the absorption of calcium from dairy milk.

### Cardiovascular Disease
- When soyfoods replace foods high in saturated fat, blood cholesterol levels can be reduced by approximately 8%. This reduction is attributed to the direct effect of soy protein and to the change in the fatty acid profile of the diet.
- Intriguing evidence suggests that soy protein modestly lowers blood pressure.
- Isoflavones enhance arterial function in postmenopausal women.
- In prospective epidemiologic studies, soy intake is associated with markedly lower rates of cardiovascular disease among Asian women.

### Hot Flashes
- Extensive clinical data indicate that isoflavones reduce both the frequency and severity of menopausal hot flashes.

### Breast Cancer
- Encouraging evidence indicates that modest soy consumption during childhood and/or adolescence substantially reduces breast cancer risk later in life.
- The estrogen-like effects of isoflavones have raised concerns that soyfoods may worsen the prognosis of breast cancer patients.
- Clinical evidence indicates that neither isoflavones nor soyfoods adversely affect breast tissue density or breast cell proliferation.
- Prospective epidemiologic data indicate post-diagnosis soy intake reduces breast cancer recurrence and mortality.
- The American Cancer Society and the American Institute for Cancer Research have concluded that soyfoods can be safely consumed by breast cancer patients.

### Diabetes
- Soyfoods are low in carbohydrate and have a low glycemic index.
- Soy protein may place less stress on the kidneys than does animal protein.

### Prostate Cancer
- Soy intake is associated with a markedly lower risk of prostate cancer among Asian men.
- In some but not all studies, soy and isoflavone intake have been shown to slow the rise in prostate-specific antigen levels in prostate cancer patients unsuccessfully treated for their disease.
- Clinical studies show that for men, soy does not lower testosterone levels, raise estrogen levels, or affect sperm or semen parameters.
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