

Research in Economic Analysis of Nutrition Interventions Session 2 Summary

Session 2 Moderators: Dr. Barbara Bowman, National Center for Chronic Disease Prevention and Health Promotion, Centers for Disease Control and Prevention
Dr. James Schuttinga, Division of Program Coordination, Planning, and Strategic Initiatives, National Institutes of Health

Presenters in this session described the economic research activities carried out by U.S. government departments and agencies.

Economics Research at NIH

Dr. James Schuttinga, Division of Program Coordination, Planning, and Strategic Initiatives, National Institutes of Health

In fiscal year (FY) 2009, NIH awarded an estimated \$194 million for primary economics studies (studies focused on economics) and \$74 million for Tier 2 projects with a small economics component. Approximately 10% of NIH's Tier 2 award funding is dedicated to economics research, so overall FY 2009 NIH economics research funding was approximately \$200 million.

The National Institute on Aging (NIA) funds the most economics-related research of any NIH Institute or Center, followed by the *Eunice Kennedy Shriver* National Institute of Child Health and Human Development (NICHD), NCI, and the National Institute of Mental Health. Most of the FY 2009 Tier 2 funding came from the National Institute of Diabetes and Digestive and Kidney Diseases (NIDDK), National Institute on Drug Abuse, and National Heart, Lung, and Blood Institute (NHLBI). Overall, approximately 0.7% of the total NIH extramural award budget is dedicated to economics research.

As Table 1 shows, 67% of NIH's FY 2009 primary economics research funding was for behavioral and social science research and 42% for health services research. Primary economics awards in nutrition totaled approximately \$7 million. NIH economics and nutrition projects include Understanding Disparities in Obesity and its Comorbidities in the United States (funded by NIDDK), Health Benefits and Cost of Human Milk Feeding for Very Low Birthweight Infants (National Institute of Nursing Research), and Economic Contextual Influences on Population Diet and Obesity (NHLBI). In addition, NIDDK funded 26 of 27 Tier 2 economics-nutrition projects totaling \$13.6 million (NHLBI funded the other).

Table 1. Percent of \$194 million in Primary NIH Economics Research by Research, Condition, and Disease Categorization Category, FY 2009

Research, Condition, and Disease Categorization Category	Total Funding	Percentage of Total NIH Funding for Primary Economics Research
Behavioral and Social Science	\$130 million	67
Burden of Illness	\$4 million	2
Clinical Trials	\$21 million	11
Comparative Effectiveness	\$31 million	16
Cost Effectiveness	\$12 million	6
Health Services	\$82 million	42
Nutrition	\$8 million	4

NIH needs to improve its automated search strategy to identify economics studies; identify areas of emphasis within the NIH economics portfolio; and identify the contributions of NIH economics research to the professional literature, health care policy, and population health.

Nutritional Disease Interventions for Chronic Disease Prevention

Dr. John Wong, Tufts Medical Center

Approximately half of Americans take at least one dietary supplement on a regular basis and about one-third buy approximately \$25 billion worth of multivitamins/minerals (MVMs) each year.¹ In addition, about 65% of the U.S. population uses fortified foods or beverages costing \$36 billion per year.²

In 2001, Congress mandated that ODS review the scientific evidence and safety of dietary supplements and identify research needs. ODS and AHRQ’s Evidence-Based Practice Center (EPC) program have completed 20 evidence-based reviews since 2003. Topics have included B vitamins and berries, ephedra, MVM supplementation, omega-3 fatty acids, soy, and vitamin D (details on these and other reviews are available at <http://ods.od.nih.gov/>).

ODS and the Office of Medical Applications of Research (part of the Office of Disease Prevention at NIH) sponsored a 2006 state-of-the-science conference to examine MVM use and chronic disease prevention in adults.² The expert panel that led this meeting identified several limitations in existing studies and concluded that:

- Antioxidants and zinc reduce progression of age-related macular degeneration in adults at the intermediate stage.
- Selenium, vitamin E, or both might be beneficial for cancer prevention, particularly among men. (In 2009, however, two large trials found that vitamin E and selenium had no cancer-related beneficial effects.^{3,4})
- Few trials have shown that individual or paired vitamins and minerals can prevent chronic disease.
- No evidence is available to recommend beta-carotene supplementation and strong evidence suggests that smokers need to avoid beta-carotene.

- Calcium and vitamin D increase bone mineral density and reduce fracture risk in postmenopausal women.
- Niacin; folate; and vitamin B₂, B₆, and B₁₂ supplements do not reduce chronic disease occurrence in the general population.

In its concluding discussion, the panel called for improving methods to obtain accurate and current data on total intake of nutrients in foods and dietary supplements.²

An evidence scan produced 220,000 studies that identified vitamins, minerals, dietary supplements, vitamin D, and omega-3 fatty acids, but only a small proportion of these publications examined prevention in conjunction with economics. Furthermore, of the approximately 500,000 publications in the cost-effectiveness study registry created by Neumann and colleagues, only 12 involve vitamins or minerals.⁵ Out of the roughly 500,000 publications identified during his evidence scan, 12 appear in the cost-effectiveness registry in the following interventions: vitamin D (4), folate (4), anti-oxidants (3), MVM (1), fortification (3), and primary prevention (4).

The Mineral and Vitamin Intervention Study (MAVIS), which might be the only study of vitamin supplementation cost utility, found an incidence ratio of 1.07 for primary care contacts among older Scottish adults who had received MVMs compared with those who had received placebo, and the difference was statistically significant.^{6,7} The incremental cost of the intervention was approximately £15 per person over the year, or roughly the cost of the supplements. Participants taking the supplements had a non-statistically significant reduction in quality of life.

Studies have found that folic acid fortification reduced myocardial infarction (MI) rates by 8–13%.⁸ Researchers have used modeling to predict that folic acid and cyanocobalamin supplementation among those with existing coronary heart disease would result in a reduction of 310,000 deaths over 10 years.⁸ Furthermore, supplementation in men 45 and older and women 55 and older would prevent 300,000 deaths over 10 years, saving approximately \$2 billion. A recent update of this study found that folic acid fortification reduces the incidence of MI, colon cancer, and neural tube defects and that 700 µg folic acid fortification would result in an increase of 266,649 QALYs and a cost decrease of \$3.6 billion.⁹ However, fortification increases the risk of precipitating or masking vitamin B₁₂ deficiency.⁹

Americans spend about \$61 billion on MVMs and fortification each year. However, evidence for or against MVM use for chronic disease prevention is insufficient to draw firm conclusions.

Review of Published Studies of the Cost-Effectiveness of Dietary Supplements

Dr. Patricia Herman, University of Arizona

A comprehensive systematic review of complementary and alternative medicine (CAM) and economics studies in six databases identified 37 CAM economic evaluations of dietary supplements, including herbs, vitamins, and minerals. Of the eight studies meeting minimum quality standards, only two were conducted in the United States; one focused on chromium and

biotin for uncontrolled type 2 diabetes and the other on omega-3 supplementation for men with a previous MI.^{10, 11}

In the chromium and biotin study, funded by a nutritional supplement company, the investigators found that even the most conservative published annual medical cost savings estimates surpassed the cost of the supplement (roughly \$120 per year). The authors therefore declared that the supplement was “cost saving” from a third-party payer perspective.¹¹ According to the product’s manufacturer, the study has not had any impact on U.S. health care policy or practice, although the results have been widely disseminated.

The U.S. study of fish oil supplements in men with an MI history used effectiveness data from four trials, the Medicare cost of one hospital visit per death, and the American Hospital Association’s estimate of productivity losses.¹⁰ The study, funded by the Council for Responsible Nutrition, found that fish oil supplements in this population yielded cost savings to society and cost-effectiveness to the payer (\$9,221 per MI-associated death avoided). The funder of this study also reported that the study had not affected U.S. health care policy or practice.

Three of the other higher quality studies identified through the systematic review focused on omega-3 fatty acids and secondary MI prevention.¹²⁻¹⁴ All three showed an increase in costs and a decrease in deaths from supplement use. Other studies found that vitamin K₁ for osteoporosis increases quality of life and improves QALYs,¹⁵ vitamins C and E and beta-carotene for cataract prevention saves costs,¹⁶ and grass pollen extract for allergic rhinitis in asthma patients increases costs and improves QALYs.¹⁷

Dr. Herman concluded that demand for clinical economic evaluations of dietary supplements among U.S. decision makers is low, but such studies can inform decision making.

The Role of Economics in Global Health Research: Examples from the John E. Fogarty International Center

Nalini Anand, John E. Fogarty International Center, National Institutes of Health

The many reasons to invest in economics research in the global health context include the potential to increase understanding of the relationships between health, productivity, and development; guide priority setting and resource allocation; inform implementation science; help strengthen health systems; and provide information that could be applicable to U.S. populations.

For example, a study in Guatemala found that exposure to a high-protein supplement in boys younger than age 3 was associated with significantly higher hourly wages in adulthood (46% over the average wage in the study sample).¹⁸ Other studies showed that the cash component of a conditional cash transfer program in Mexico was associated with higher body-mass index (BMI) and blood pressure levels in adults.¹⁹

The John E. Fogarty International Center has participated in the World Health Organization’s Disease Control Priorities Project (DCPP) since 2001. DCPP has developed an evidence base to inform decision making by estimating the cost-effectiveness and impact of single interventions and combinations, defining global disease burdens, and summarizing implementation experience

in different regions. DCPD has examined more than 250 interventions and developed a “top 10” list of the “best buys” in global health, including the use of vitamin A, iron, and iodine for children and pregnant women to address micronutrient deficiencies. DCPD has also formed the Disease Control Priorities Network to collect valid and comparable information on the costs and consequences of policy alternatives for population health and data on the efficiencies and effectiveness of bundling interventions and their integration into service delivery platforms.

The Fogarty International Center is spearheading the development of the Trans-NIH Center for Global Health Studies for short-term, project-based scholarship in global health science and policy featuring multidisciplinary teams with diverse expertise and experience. The center will identify methods to promote the research-to-policy interface and decision-making tools to guide public health strategies and investments.

Health Economics in the Extramural Programs of the National Institute on Aging

Dr. John Haaga, Division of Social and Behavioral Research, National Institute on Aging

NIA spends approximately \$80 million per year on health economics research. Major research topics include burden of illness, variations in health care intensity, Medicare and Medicaid interactions pertaining to chronic diseases, behavioral economic approaches to health interventions, national health accounts, and cross-national comparisons of health systems.

Media publicity on resource intensity research has provided an impetus for the search for Medicare cost savings that would not compromise patient outcomes. Much of this research is based on the work of the Dartmouth Atlas group, which is partially funded through one of NIA’s program projects.

NIA also sponsors research by multidisciplinary teams using comparable data from several countries. For example, a 2004 study on people aged 50–74 in the United States and 10 European countries found that Americans had higher heart disease, hypertension, diabetes, cancer, and lung disease rates than their European counterparts.²⁰ A 2006 study of disease prevalence in British and American adults aged 55–64 also found that older Americans were sicker than their counterparts in other rich countries.²¹ Demographic studies on the age profiles of public spending suggest that the U.S. government spends much more on health care for those older than 75 than other countries.²²

Economics and NICHD

Dr. V. Jeffery Evans, Demographic and Behavioral Sciences Branch, Eunice Kennedy Shriver National Institute for Child Health and Human Development

NICHD is a non-disease specific institution which examines the health and well being of the population from a very young age. The types of questions that NICHD addresses that pertain to diet and nutrition focus on malnutrition, obesity, policy interventions, health care, child development, and workplace and community interventions.

NICHD has a long history of fielding longitudinal studies, especially in developing countries. The Institute’s longitudinal studies in Malaysia, Indonesia, the Philippines, Russia, China, and

Mexico focus on what happens to populations, how families make decisions that affect how children grow up, and how child development is conditioned by the economic environment.

NICHD policy intervention activities include the Mexican government's Programa de Educación, Salud y Alimentación (Education, Health, and Nutrition Program), now called Oportunidades, which aims to develop human capital in poor households. NICHD has also been involved in housing policy and welfare reform activities.

NICHD's health care research activities that include an economic component have addressed HIV/AIDS, prescription drugs, rehabilitation, and obesity. NICHD has shifted its focus on malnutrition to concerns about obesity in many areas of the world. NICHD now has a major childhood obesity initiative (www.nichd.nih.gov/about/org/od/orsc/), whose mission is to promote a global multilevel, integrative approach to childhood obesity and associated chronic diseases. NICHD's child development research focuses on determining whether investing in health, education, and development results in cost benefits to society.

Health Economics Research at the Centers for Disease Control and Prevention

Dr. Scott Grosse, National Center on Birth Defects and Developmental Disabilities, Centers for Disease Control and Prevention

As a major operating component of the Department of Health and Human Services, the mission of the CDC is to collaborate to create the expertise, information, and tools that people and communities need to protect their health – through health promotion, prevention of disease, injury and disability, and preparedness for new health threats.

CDC has approximately 60 Ph.D.-level economists or health economics researchers. Most (42) are alumni of the Prevention Effectiveness Post-Doctoral Fellowship Program. These economists are dispersed within CDC, with clusters of at least three health economics researchers within organizational components such as the National Center for Health Statistics (a Federal statistical agency), the National Center for Chronic Disease Prevention and Health Promotion, National Center on Birth Defects and Developmental Disabilities, etc. Health economics research at CDC falls into the following areas: health services research, cost-of-illness studies, economic evaluation of interventions, cross-cutting evidence synthesis, health policy modeling, and economic and econometric analysis.

Cost-of-illness studies at CDC's National Center on Birth Defects and Developmental Disabilities using health insurance claims data include a 2005 economic evaluation of folic acid fortification and birth defects in the United States. This study found that the reduction in neural tube defects (NTDs) associated with folic acid fortification (at 140 µg per 100 g of grain product) was about 30%, much higher than previously projected.²³ Although fortification costs \$3 million per year, the direct costs averted were estimated to be \$146 million per year in 2003 dollars (averted combined direct and indirect costs per year are \$425 million). These estimates are conservative as they do not include costs to the family of caring for a child who has spina bifida (estimated at \$150,000 in lost earnings to the family)²⁴ or the full medical costs of adults with spina bifida. It is now estimated that the economic benefits are twice that of what was reported in the 2005 study.

Similar results have been reported by others. A folic acid fortification study conducted in Chile found a 50% reduction in NTDs; it was estimated that fortification of bread in Chile, which was implemented in 2000, cost \$0.2 million per year and that fortification averted \$2 million in costs per year.²⁵ The CE ratio was calculated at \$89 per DALY (about the same as has been published for iron and vitamin A supplementation programs). Another study involving a targeted folic acid supplementation program in South Carolina included women who had a pregnancy affected by an NTD.²⁶ These women were offered counseling, supplementation, and were monitored over time. Among the women who accepted the program and were tracked, there were no recurrences (the recurrence risk associated with NTDs is 3%). The number of NTDs averted was calculated and the investigators determined a \$42,587 per QALY in the base-case analysis (\$15,798 per QALY if healthy births in place of terminations following prenatal diagnosis are included).

Other CDC economic evaluation programs include:

- CDC's Division of Diabetes Translation, which has a vision program that has done work on evaluating the economics of dietary supplementation for the prevention of macular degeneration.²⁷ This division has also done a significant amount of work on preference measures and WTP estimates, as well as economic analysis of randomized clinical trials.
- CDC's Division of Blood Disorders is examining the cost effectiveness of screening for iron overload and hereditary hemochromatosis.
- CDC has a series of cross-cutting economic evaluation initiatives, one of which is the Guide to Community Preventive Services (see <http://www.thecommunityguide.org/index.html>), which addresses population or community-level interventions.
- CDC's National Center for Vital and Health Statistics collects data used in health economics research and conducts analytical work on data widely used in health insurance and health policy research.
- CDC's Division of Cancer Prevention and Control is working on the cost of care and the cost of screening and other interventions, the cost effectiveness of early detection, and the effects on health disparities.

Clinical Economic Research at the Agency for Healthcare Research and Quality

Dr. William Lawrence, Center for Outcomes and Evidence, Agency for Healthcare Research and Quality

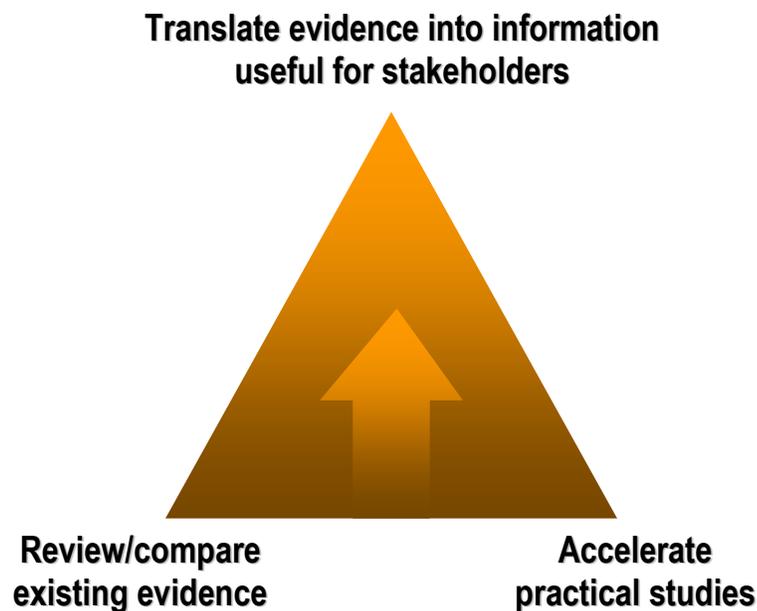
AHRQ's mission is to improve the quality, efficiency, and effectiveness of health care for all Americans; clinical economics fits within AHRQ's mission under efficiency, or trying to maximize outcomes given available resources. John Eisenberg defined "clinical economics" as "*The tools of economics . . . applied to the analysis of medical practice to improve physicians' choices of ways to use social and individual resources for clinical interventions in the hope of improved health.*"²⁸ Clinical economics involves examining the costs and outcomes of interventions to inform resource allocation decisions. AHRQ's main clinical economics focus has been on methods and resources for cost-effectiveness and related analyses. However, AHRQ-funded cost-effectiveness analyses have examined the cost-effectiveness of fecal DNA screening,²⁹ computed tomography screening for colorectal cancer,³⁰ and induction of labor.

Other clinical economic activities at AHRQ include:

- A 2009 conference cosponsored with NCI and the VA and an associated journal supplement on the data and analytic methods, challenges, and future research needs pertaining to obtaining cost data.³¹
- The Medical Expenditure Panel Survey (MEPS), a nationally representative survey of health care utilization and expenditures. For common medical conditions, MEPS is useful for examining health care expenditures and calculating health utilities.
- The U.S. valuation of the EuroQoL EQ-5D utility survey, which provided nationally representative utility weights for the EQ-5D survey and served as the foundation for several catalogs of utilities.

An overall view of the goals of AHRQ's comparative effectiveness program (Effective Health Care Program) is illustrated in Figure 1. The goals of the program are to review and compare existing evidence, accelerate practical studies, and translate evidence into information useful for stakeholders. More information is available at www.effectivehealthcare.ahrq.gov.

Figure 1. AHRQ's Effective Health Care Program



AHRQ's EPC program conducts systematic reviews of the medical literature. The EPCs have generated 20 reports on dietary supplements since 2003 (available at: <http://www.ahrq.gov/clinic/epcindex.htm#dietsup>). Upcoming EPC methods projects include developing a framework for economic evaluation in systematic reviews, decision and simulation modeling in systematic reviews, and measuring the value of information for research.

A participant stated that model selection can be a problem in studies that bridge several disciplines. Often, adequate data are not available to develop appropriate models and the conservative estimates typically used can lead to recommendations that are not conservative.

Dr. Lawrence explained that NCI's Cancer Intervention and Surveillance Modeling Network, a large population-modeling project, has multiple independent groups creating independent models, taking independent estimates, and comparing them with each other to understand the boundaries of estimated outcomes for a given intervention. These types of collaborative modeling efforts may shed light on the impact of varying assumptions across independently developed models on projected model outcomes. CDC has used NCI's models extensively for studying screening recommendations and implementation.

Diet and Health Research at the U.S. Department of Agriculture's Economic Research Service

Dr. Laurian Unnevehr, Economic Research Service, U.S. Department of Agriculture

The Economic Research Service (ERS) at the U.S. Department of Agriculture conducts research to inform public and private decision making on economic and policy issues involving food, farming, natural resources, and rural development. Approximately 50 ERS researchers are studying a broad range of food economics topics, such as food safety, food prices, and diet and health. Although ERS does not conduct CEA, ERS research provides basic building blocks for CEA by other agencies. All ERS publications are available at www.ers.usda.gov.

ERS maintains important data series on food choices and markets. Since 2004, ERS has made major investments in developing new sources of information for a better understanding of food choices, primarily through add-on modules to existing surveys of time use, diet knowledge, and retail purchases. ERS is currently linking National Health and Nutrition Examination Survey data to administrative data to more effectively relate Supplemental Nutrition Assistance Program (SNAP) participation with intake and health outcomes. A new survey will compare what people in low-income households buy with their SNAP benefits to other spending choices they make.

ERS research has found that a 10% decrease in the prices of fruits and vegetables leads to a 2–5% increase in fruit and vegetable consumption by low-income households.³² A 10% discount through coupons leads to more frequent fruit and vegetable purchases and a 2–10% increase in consumption.³³ Furthermore, taxes could cause consumers to substitute non-taxed beverages such as bottled water, juice, and milk for sweetened beverages and a 20% tax could reduce caloric sweetened soft drink, juice drink, and sports drink consumption by 24% and childhood overweight prevalence from 16.6% to 13.7%.³⁴

Participation in the Special Supplemental Nutrition Program for Women, Infants, and Children program is not associated with a rise in obesity in early childhood, but low-income children are at higher risk of obesity.³⁵ SNAP is not associated with an increase in BMI or in the likelihood of overweight for most participants.³⁶ Only 20% of schools meet the Department's guidelines for fat content of lunches. ERS is currently examining whether healthier lunches are more costly.³⁷

ERS research has found that 11.5 million individuals live in low-income neighborhoods that are more than one mile from a supermarket,³⁸ and more than 2.3 million individuals who live more than one mile from a supermarket do not have a vehicle. ERS has created the Food Environment

Atlas of county-level statistics on food choices, health and well-being, and community characteristics in cooperation with CDC and NIH (<http://www.ers.usda.gov/FoodAtlas/>).

ERS is examining how behavioral economics can help decision makers understand consumer choices and improve program and policy effectiveness. In a study on food purchasing behaviors, study participants who received a debit card to purchase healthy foods ate fewer calories and a larger percentage of those calories were from healthy options. Participants who had to use cash to purchase food ate more food and a larger proportion of the calories they consumed came from unhealthy foods.³⁹ Other behavioral cues being studied by ERS include the impact of providing information in restaurants, financial incentives for weight loss, and the impact of stress and self control on food choices and BMI outcomes.

USDA has done research on steps along the food supply chain and where it is best to intervene, particularly with regard to price interventions. The Healthy Incentives Pilot Program (mandated for SNAP), is focused specifically on providing incentives to SNAP recipients and doing pilots to see what might work. The evaluations of this price-based intervention are being conducted by USDA's Food and Nutrition Service. ERS does work examining the value of research to enhance productivity, looking at innovation in the food system, and tracking the introduction of new products, but more could be done to understand what the incentives are for introducing healthier products.

¹ Office of Dietary Supplements. Strategic Plan 2010-2014. Bethesda, MD: Office of Dietary Supplements, National Institutes of Health, U.S. Department of Health & Human Services; 2010. NIH Publication Number 10-7527.

² Huang H-Y, Caballero B, Chang S, et al. The efficacy and safety of multivitamin and mineral supplement use to prevent cancer and chronic disease in adults: a systematic review for a National Institutes of Health state-of-the-science conference. *Ann Intern Med.* 2006;145(5):372-385.

³ Lippman SM, Klein EA, Goodman PJ, et al. Effect of selenium and vitamin E on risk of prostate cancer and other cancers: the Selenium and Vitamin E Cancer Prevention Trial (SELECT). *JAMA.* 2009;301(1):39-51.

⁴ Gaziano JM, Glynn RJ, Christen WG, et al. Vitamins E and C in the prevention of prostate and total cancer in men: the Physicians' Health Study II randomized controlled trial. *JAMA.* 2009;301(1):52-62.

⁵ Neumann PJ, Fang C-H, Cohen JT. 30 years of pharmaceutical cost-utility analyses: growth, diversity and methodological improvement. *Pharmacoeconomics.* 2009;27(10):861-872.

⁶ Avenell A, Campbell MK, Cook JA, et al. Effect of multivitamin and multimineral supplements on morbidity from infections in older people (MAVIS trial): pragmatic, randomised, double blind, placebo controlled trial. *BMJ.* 2005;331(7512):324-329.

⁷ Kilonzo MM, Vale LD, Cook JA, et al. A cost-utility analysis of multivitamin and multimineral supplements in men and women aged 65 years and over. *Clin Nutr.* 2007;26(3):364-370.

⁸ Tice JA, Ross E, Coxson PG, et al. Cost-effectiveness of vitamin therapy to lower plasma homocysteine levels for the prevention of coronary heart disease: effect of grain fortification and beyond. *JAMA.* 2001;286(8):936-943.

⁹ Bentley TG, Weinstein MC, Willett WC, Kuntz KM. A cost-effectiveness analysis of folic acid fortification policy in the United States. *Public Health Nutr.* 2009;12(4):455-467.

¹⁰ Schmier JK, Rachman NJ, Halpern MT. The cost-effectiveness of omega-3 supplements for prevention of secondary coronary events. *Manag Care.* 2006;15:43-50.

¹¹ Fuhr JP Jr, He H, Goldfarb N, Nash DB. Use of chromium picolinate and biotin in the management of type 2 diabetes: an economic analysis. *Dis Manag.* 2005;8(4):265-275.

¹² Franzosi MG, Brunetti M, Marchioli R, et al. Cost-effectiveness analysis of n-3 polyunsaturated fatty acids (PUFA) after myocardial infarction: results from Gruppo Italiano per lo Studio della Sopravvivenza nell'Infarto (GISSI)-Prevenzione Trial. *Pharmacoeconomics.* 2001;19(4):411-420.

- ¹³ Lamotte M, Annemans L, Kawalec P, Zoellner Y. A multi-country health economic evaluation of highly concentrated N-3 polyunsaturated fatty acids in secondary prevention after myocardial infarction. *Pharmacoeconomics*. 2006;24(8):783-795.
- ¹⁴ Quilici S, Martin M, McGuire A, Zoellner Y. A cost-effectiveness analysis of n-3 PUFA (Omacor) treatment in post-MI patients. *Int J Clin Pract*. 2006;60(8):922-932.
- ¹⁵ Stevenson M, Lloyd-Jones M, Papaioannou D. Vitamin K to prevent fractures in older women: systematic review and economic evaluation. *Health Technol Assess*. 2009;13(45):iii-xi, 1-134.
- ¹⁶ Trevithick JR, Massel D, Robertson JM, et al. Modeling savings from prophylactic REACT antioxidant use among a cohort initially aged 50-55 years: a Canadian perspective. *Journal of Orthomolecular Medicine*. 2006;21:212-220.
- ¹⁷ Nasser S, Vestenbaek U, Beriot-Mathiot A, Poulsen PB. Cost-effectiveness of specific immunotherapy with Grazax in allergic rhinitis co-existing with asthma. *Allergy*. 2008;63(12):1624-1629.
- ¹⁸ Hoddinott J, Maluccio JA, Behrman JR, Flores R, Martorell R. Effect of a nutrition intervention during early childhood on economic productivity in Guatemalan adults. *Lancet*. 2008;371(9610):411-416.
- ¹⁹ Fernald LC, Gertler PJ, Hou X. Cash component of conditional cash transfer program is associated with higher body mass index and blood pressure in adults. *J Nutr*. 2008;138(11):2250-2257.
- ²⁰ Avendano M, Glymour MM, Banks J, Mackenbach JP. Health disadvantage in US adults aged 50 to 74 years: a comparison of the health of rich and poor Americans with that of Europeans. *Am J Public Health*. 2009;99(3):540-548.
- ²¹ Banks J, Marmot M, Oldfield Z, JP Smith. Disease and disadvantage in the United States and in England. *JAMA*. 2006; 295(17):2037-2045.
- ²² Lee R, Lee S-H, Mason A. Charting the economic lifecycle. In: Prskawetz A, Bloom DE, Lutz W, eds. *Population Aging, Human Capital Accumulation, and Productivity Growth, a Supplement to Population and Development Review* 33. New York: Population Council; 2008:208-237.
- ²³ Grosse SD, Waitzman NJ, Romano PS, Mulinare J. Re-evaluating the benefits of folic acid fortification in the United States: economic analysis, regulation, and public health. *Am J Public Health*. 2005;95:1917-1922.
- ²⁴ Tilford JM, Grosse SD, Goodman AC, Li K. Labor market productivity costs for caregivers of children with spina bifida: a population-based analysis. *Med Decis Making*. 2009;29:23-32.
- ²⁵ Llanos A, Hertrampf E, Cortes C, Pardo A, Grosse SD, Uauy R. Cost-effectiveness of a folic acid fortification program in Chile. *Health Policy*. 2007;83:295-303.
- ²⁶ Grosse SD, Ouyang L, Collins JS, Green D, Dean JH, Stevenson RE. Economic evaluation of a neural tube defect recurrence prevention program. *Am J Prev Med*. 2008;35:572-577.
- ²⁷ Rein DB, Saaddine JB, Wittenborn JS, et al. Cost-effectiveness of vitamin therapy for age-related macular degeneration. *Ophthalmology*. 2007;114:1319-1326.
- ²⁸ Eisenberg JM. *Clinical economics: a guide to the economic analysis of clinical practices*. JAMA. 1989;262(20):2879-2886.
- ²⁹ Agency for Healthcare Research and Quality. Cost-effectiveness of DNA Stool Testing to Screen for Colorectal Cancer. Rockville, MD: Agency for Healthcare Research and Quality; 2007. Available at: <http://www.cms.gov/determinationprocess/downloads/id52TA.pdf>. Accessed June 15, 2010.
- ³⁰ Agency for Healthcare Research and Quality. Cost-effectiveness of CT Colonography to Screen for Colorectal Cancer. Rockville, MD: Agency for Healthcare Research and Quality; 2009. Available at: <http://www1.cms.gov/determinationprocess/downloads/id58TA.pdf>. Accessed June 15, 2010.
- ³¹ Yabroff KR, Brown ML, Lawrence WF, Barnett PG, Lipscomb J, eds. Health care costing: data, methods, future directions. *Medical Care*. 2009;47(7 Suppl 1):S1-S142.
- ³² Dong D, Lin B-H. Fruit and Vegetable Consumption by Low-Income Americans: Would a Price Reduction Make a Difference? Washington, DC: U.S. Department of Agriculture; 2009. ERR-70. Available at: <http://www.ers.usda.gov/Publications/ERR70/ERR70.pdf>. Accessed June 30, 2010.
- ³³ Dong D, Leibtag E. Promoting Fruit and Vegetable Consumption: Are Coupons More Effective than Pure Price Discounts? Washington, DC: U.S. Department of Agriculture; 2010. ERR-96. Available at: <http://www.ers.usda.gov/Publications/ERR96/ERR96.pdf>. Accessed June 30, 2010.
- ³⁴ Lin B-H, Smith TA, Lee J-Y. The effects of a sugar-sweetened beverage tax: consumption, calorie intake, obesity, and tax burden by income. Paper presented at: Agricultural & Applied Economics Association Meeting; 2010; Denver, CO. Available at: http://ageconsearch.umn.edu/bitstream/61167/2/AAEA%20_05122010_.pdf. Accessed June 15, 2010.
- ³⁵ Ver Ploeg M. WIC and the Battle against Childhood Overweight. Economic Brief Number 13; April 2007. Available at: <http://www.ers.usda.gov/Publications/EB13/EB13.pdf>. Accessed June 30, 2010.

³⁶ Ver Ploeg M and Ralston K. Food Stamps and Obesity: What Do We Know? Washington, DC: U.S. Department of Agriculture; 2008. EIB-34. Available at: <http://www.ers.usda.gov/Publications/EIB34/EIB34.pdf>. Accessed June 30, 2010.

³⁷ Newman C, Guthrie J, Mancino L, Ralston K, Musiker M. Meeting Total Fat Requirements for School Lunches: Influence of School Policies and Characteristics. Washington, DC: U.S. Department of Agriculture; 2009. ERR-87. Available at: <http://www.ers.usda.gov/Publications/ERR87/ERR87.pdf>. Accessed June 30, 2010.

³⁸ Ver Ploeg M, Breneman V, Farrigan T, et al. Access to Affordable and Nutritious Food—Measuring and Understanding Food Deserts and Their Consequences: Report to Congress. Washington, DC: U.S. Department of Agriculture; 2009. AP-036. Available at: <http://www.ers.usda.gov/Publications/AP/AP036/AP036.pdf>. Accessed June 30, 2010.

³⁹ Just DR, Mancino L, Wansink B. Could Behavioral Economics Help Improve Diet Quality for Nutrition Assistance Program Participants? Washington, DC: U.S. Department of Agriculture; 2007. ERR-43. Available at: <http://www.ers.usda.gov/publications/err43/err43.pdf>. Accessed June 30, 2010.