

Leila M. Barraaj, D.Sc.
Senior Managing Scientist

Professional Profile

Dr. Leila M. Barraaj is a biostatistician with experience in experimental study and survey design, data analysis, and exposure modeling. She has worked on a wide range of issues, including occupational and nutritional relative risk assessments, probabilistic exposure assessment, dietary exposure assessment, and microbial risk assessments. In particular, she has designed consumer behavior surveys to collect information on water and food consumption patterns. She has also designed several national market basket surveys to generate data on the prevalence and levels of contamination in foods and on characteristics of consumer products. She has also designed specialized field trials and monitoring programs to identify factors and agricultural practices affecting contamination levels in food commodities. Dr. Barraaj has analyzed data from nationwide health and food consumption surveys to investigate the association between dietary patterns and health. She has applied multivariate statistical methods to estimate the relative contribution of various factors, including diet to heart health. She has analyzed longitudinal health and exposure data collected by an occupational exposure study to investigate the potential association between chemical exposure and reproductive health. She has analyzed data from several consumer product surveys designed to collect information on long-term use patterns of cosmetic products. Dr. Barraaj also has extensive modeling experience. She has been involved in developing the models and algorithms used in several of Exponent/Novigen's proprietary risk assessment software. These software include the Dietary Exposure Evaluation Model (DEEM™), the Food Analysis and Residue Evaluation Program (FARE™), and Calendex™, an aggregate and cumulative exposure software incorporating both temporal and spatial variability. Government agencies rely on these software in their assessments. She has also developed probabilistic microbial exposure and risk assessment models, and has been involved in the review of microbial risk assessment models developed by FDA and FSIS.

Academic Credentials and Professional Honors

D.Sc., Biostatistics, Harvard School of Public Health, 1987
M.S., Statistics, American University of Beirut, 1979
B.S., Statistics, American University of Beirut, 1974

Languages

French
Arabic

Publications

Barraj L, Tran N, Mink P. A comparison of egg consumption with other modifiable coronary heart disease lifestyle risk factors: A relative risk apportionment study. *Risk Anal* 2008, in press.

Tran N, Barraj L. Contribution of specific dietary factors to CHD in US females. *Public Health Nutrition* 2009; 13(2):154–162.

Sanchez CA, Barraj L, Blount BC, Scrafford C, Valentin-Blasini L, Smith KM, Krieger RI. Perchlorate exposure from food crops produced in the Lower Colorado River Region. *J Exposure Sci Environ Epidemiol* 2008; Epub available at: <http://www.nature.com/jes/journal/vaop/ncurrent/abs/jes200826a.html>.

Barraj L, Scrafford C, Lantz J, Daniels C, Mihlan G. Within-day drinking water consumption patterns: Results from a drinking water consumption survey. *J Exposure Sci Environ Epidemiol* 2008; Epub available at: <http://www.nature.com/jes/journal/vaop/ncurrent/abs/jes200828a.html>.

Cutler GJ, Nettleton JA, Ross JA, Harnack LJ, Jacobs DR, Scrafford CG, Barraj LM, Mink PJ, Robien K. Dietary flavonoid intake and risk of cancer in postmenopausal women: The Iowa Women's Health Study. *Int J Cancer* 2008; 123(3): 664–671.

Barraj L, Tran N, Goodman M, Ginevan M. Perspective: Risk apportionment and disease intervention strategies. *Risk Anal* 2008;28(2): 477–486.

LaKind JS, Barraj L, Tran N, Aylward LL. Environmental chemicals in people: challenges in interpreting biomonitoring information. *J Environ Health* 2008; 70(9): 61–64.

Mink PJ, Alexander DD, Barraj LM, Kelsh MA, Tsuji JS. Low-level arsenic exposure in drinking water and bladder cancer: a review and meta-analysis. *Regul Toxicol Pharmacol* 2008, in press. Epub ahead of print: <http://dx.doi.org/10.1016/j.yrtph.2008.08.010>.

Loretz LJ, Api AM, Babcock L, Barraj LM, Burdick J, Cater KC, Jarrett G, Mann S, Pan YHL, Re TA, Renskers KJ, Scrafford CG. Exposure data for cosmetic products: Facial cleanser, hair conditioner, and eye shadow. *Food Chem Toxicol* 2008; 46(5): 1516–24.

Goodman M, Barraj LM, Mink PJ, Britton NL, Yager JW, Flanders WD, Kelsh MA. Estimating uncertainty in observational studies of associations between continuous variables: example of methylmercury and neuropsychological testing in children. *Epidemiologic Perspectives Innovations* 2007 ; 4:9 doi:10.1186/1742-5573-4-9.

Barraj LM, Tsuji JS, Scrafford CG. The SHEDS-Wood Model: Incorporation of observational data to estimate exposure to arsenic for children playing on CCA-treated wood structures. *Environ Health Perspectives* 2007; 115(5):781–786. Available at: <http://www.ehponline.org/members/2007/9741/9741.pdf>

Tsuji J, Yost L, Barraj L, Scrafford C, Mink P. Use of background inorganic arsenic exposures to provide perspective on risk assessment results. *Reg Toxicol Pharmacol* 2007; 48(1):59–68.

Erdreich LS, Van Kerkhove MD, Scrafford CG, Barraj L, McNeely M, Shum M, Sheppard AR, Kelsh M. Factors that influence the radiofrequency power output of GSM mobile phones. *Radiation Res* 2007; 168(2):253–261.

Barraj LM and Tsuji JS. Letter to the editor. *Risk Analysis* 2007; 27(1):1–3.

Mink PJ, Scrafford CG, Barraj LM, Harnack L, Hong CP, Nettleton JA, Jacobs DR. Flavonoid intake and cardiovascular disease mortality: A prospective study of postmenopausal women. *AJCN* 2007; 85(3):895–909.

Loretz L, Api AM, Barraj L, Burdick J, Davis de A, Dressler W, Gilberti E, Jarrett G, Mann S, Laurie Pan YH, Re T, Renskers K, Scrafford C, Vater S. C. Exposure data for personal care products: Hairspray, spray perfume, liquid foundation, shampoo, body wash, and solid antiperspirant. *Food Chem Toxicol* 2006; 44(12):2008–2018.

Nettleton JA, Harnack LJ, Scrafford CG, Mink PJ, Barraj LM, Jacobs DR Jr. Dietary flavonoids and flavonoid-rich foods are not associated with risk of type 2 diabetes in postmenopausal women. *J Nutr* 2006; 136(12):3039–3045.

Tsuji JT, Van Kerkhove MD, Kaetzel RS, Scrafford CG, Mink PJ, Barraj LM, Crecelius EA, Goodman M. Evaluation of exposure to arsenic in residential soil. *Environmental Health Perspectives* 2005; 113(12):1735–1740.

Mink PJ, Goodman M, Barraj L, Imrey H, Kelsh M, Yager J. Evaluation of uncontrolled confounding in studies of environmental exposures and neurobehavioral testing in children. *Epidemiol* 2004; 15(4):385–393.

Loretz LJ, Api AM, Barraj LM, Burdick J, Dressler WE, Gettings SD, Hsu HH, Pan YHL, Re TA, Renskers KJ, Rothenstein A, Scrafford CG, Sewall C. Exposure data for cosmetic products: lipstick, body lotion, and face cream. *Food and Chemical Toxicology* 2005; 43(2):279–291.

Yost LJ, Tao SH, Egan SK, Barraj LM, Smith KM, Tsuji JS, Lowney YW, Schoof RA, Rachman NJ. Estimation of dietary intake of inorganic arsenic in U.S. children. *Hum Ecol Risk Assess* 2004; 10:473–483.

Teta JM, Tran NL, Mink PJ, Barraj LM. Validity of using background leukemia incidence rates with cohort mortality-based potency estimates to calculate excess lifetime risk. *Hum Ecol Risk Assess* 2004; 10(5): 923–938.

Barraj LM and Petersen BJ. Food consumption data in microbiological risk assessment. *J Food Prot* 2004, 67(9): 1972–1976.

Mink PJ, Goodman M, Barraj LM, Imrey H, Kelsh MA, Yager J. Evaluation of uncontrolled confounding in studies of environmental exposures and neurobehavioral testing in children. *Epidemiology* 2004, 15(4):385–393.

Tran NL, Barraj LM, Smith K., Javier A., Burke TA. Combining food frequency and survey data to quantify long-term dietary exposure; a methyl mercury case study. *Risk Analysis* 2004; 24(1):19–30.

Heimbach JT, Bodor AR, Douglass JS, Barraj LM, Cohen SC, Biles RW, Faust HR. Dietary exposures to mineral hydrocarbons from food-use applications in the United States. *Food and Chem Toxicol* 2002; 40(5):555–571.

Julien EA, Barraj LM, Petersen BJ, Tomerlin JR. Considerations when choosing a threshold of regulation for acute dietary exposure to pesticides. *Food and Drug Law J* 2001; 56(2):241–254.

Youngren SH, Youngren MA, Barraj L. Challenges of probabilistic assessment of operator and residential non-dietary exposure. *Am Occup Hyg* 2000; 45(2001):S49–S54.

Allison DB, Eagan SK, Barraj LM, Caughman C, Infante M, Heimbach JT. Estimated intakes of *trans* fatty and other fatty acids in the U.S. population. *J Am Dietetic Assoc* 1999; 99(2):166–174.

Tomenson JA, Taves DR, Cockett ATK, McCusker J, Barraj L, Francis M, Pastoor TP, Wickramaratne, GA, Northrop HL. An assessment of fertility in male workers exposed to molinate. *J Occupat Environ Med* 1999; 41(9):771–787.

Barraj LM, Petersen BJ, Tomerlin JR. Report on cumulative dietary risk assessment of organophosphorus insecticides is flawed. *Regul Toxicol Pharmacol* 1998; 28:67–68.

Shurdut BA, Barraj LM, Francis M. Aggregate exposures under the food quality protection act: An approach using Chlorpyrifos. *Regul Toxicol Pharmacol* 1998; 28:165–177.

Petersen BJ, Barraj LM. Assessing the intake of contaminants and nutrients: A review of methods. *J Food Composition and Analysis* 1996; 9:243–254.

Douglass JS, Barraj LM, Tennant DR, Long WR, Chaisson CF. Evaluation of the budget method for screening food additive intakes. *Food Addit Contam* 1997; 14(8):791–802.

Petersen B, Tomerlin JR, Barraj L. Pesticide degradation: Exceptions to the rule. *Food Technology* 1996; 50(5):221–223.

Douglass JS, Fleming KH, Barraj LM, Heimbach JT. Using food consumption data to determine exposure to toxins. In: *CRC Handbook of Human Toxicology*. CRC Press, 1996.

Petersen BJ, Barraj LM, Muenz LR, Harrison SL. An alternative approach to dietary exposure assessment. *Risk Analysis* 1994; 14(6):913–916.

Petersen BJ, Francis MA, Barraj LM (eds.). Exposure Factors Handbook, U.S. Environmental Protection Agency, July 1993.

Loftus ML, Barraj LM, Tomerlin JR. Effect of the limit of detection on exposure assessment. *J AOAC International* 1992; 75(5):911–915.

Barraj L. Measuring the Impact of the NCDDP on Infant Mortality in Egypt. Cairo: UNICEF and NCDDP, 1989.

Lagakos S, LM Barraj, De Gruttola V. Nonparametric analysis of truncated survival data, with application to AIDS. *Biometrika* 1988; 75(3):515–23.

Book Chapters

Tran NL, Barraj L. Food as exposure: Measuring dietary intakes and consumption pattern. In: *Epidemiologic Principles and Food Safety*. Tamar Lasky (ed), Oxford University Press, 2007.

Petersen BJ, Petersen SR, Barraj L, Johnston J. Using two-day food consumption survey data for longitudinal dietary exposure analyses. In: *Assessing Exposures and Reducing Risks to People from the Use of Pesticides*. Seiber JN, Krieger RI, Ragsdale N (eds), Oxford University Press, 2007.

Butchko HH, Barraj LM. Clinical research for medical devices. In: *Bringing Your Medical Device to Market*. Reiss JB, Armon B (eds), FDLI, 2006.

Barraj L, van den Berg M, Darnerud PO, Feeley M, Lilienthal H, Pöpke O, Bolger M, Tohyama C. Polybrominated diphenyl ethers. In: *FAO/WHO Joint Expert Committee on Food Additives; Safety Evaluation of Certain Contaminants in Food*. S.351–562, 2006.

Presentations

Barraj L, Blount B, Sanchez C, Scrafford C, Krieger R. Avoiding perchlorate exposures from fresh fruits and vegetables: at what costs? Presented at the Annual Society of Toxicology meeting, Charlotte, NC, 2007.

Tran N, Barraj L, Mink P, Donald M. Balancing and communicating risks and benefits associated with egg consumption—A relative risk study. Presented at the Annual Society of Toxicology meeting, Charlotte, NC, 2007.

Tran N, Barraj L, Scrafford C. Nutrient deficiency classification bias relating to the 24-Hour dietary recall: A case study with dietary and red blood cell folate. Presented at the International Society for Exposure Analysis Annual Meeting, Paris, France, 2006.

Krieger B, Barraj L. Balancing the risks of perchlorate and nutritional benefits of fresh fruits and vegetables. Presented at the Annual Society for Risk Analysis Meeting, Orlando, FL, 2005.

Barraj L, Johnston J, Scrafford C. Investigating the impact of certain assumptions on estimates of long-term occupational exposure to agricultural pesticides. Presented at the 2004 Annual Society for Risk Analysis Meeting, Palm Springs, CA, December 2004.

Barraj L, Walls C, and Scrafford C. Estimating Longitudinal Exposures Using Short-Term Data. Presentation at the Annual Meeting of the International Society for Risk Analysis, 2002 (<http://www.riskworld.com/Abstract/2002/SRAam02/ab02aa015.htm>, accessed 03/02/05).

DiNovi M, Petersen B, Barraj L, Thompson K. Uncertainties associated with estimating dietary exposures to environmental contaminants. Presented at the 2001 Annual Society for Risk Analysis Meeting, Seattle, WA, December 2001.

Barraj LM, Petersen B. Modeling dietary exposures to environmental contaminants. Presented at the 2001 International Society for Exposure Analysis Annual Meeting, Charleston, SC, November 2001.

Barraj L, Francis M., Scrafford, C. Biomonitoring data from the Priority Toxicant Reference Range Study. Presented at the 2001 International Society for Exposure Analysis Annual Meeting, Charleston, SC, November 2001.

Barraj L, Anderson S. Quantitative risk assessment for veterinary fluoroquinolones on *Campylobacter* in beef. Presented at the 2000 American Statistical Association Annual Meeting, Indianapolis, IN, August, 2000.

Barraj LM. Quantitative risk assessment for veterinary fluoroquinolones on *campylobacter* in beef. Presented at the 2000 Joint Statistical Meetings, Indianapolis, IN, August 2000.

Barraj LM, BJ Petersen, Saunders S. Does the Increased corn intake by Mexican-Americans lower their blood folate levels? Presented at the 2000 SOT Annual Meeting, Philadelphia, PA, March 2000.

Barraj LM, Petersen BJ. Exposure assessment for cadmium. Presented at the Joint FAO/WHO Expert Committee on Food Additives, Geneva, Switzerland, June 2000.

Petersen BJ, Barraj LM. Exposure assessment for lead. Presented at the Joint FAO/WHO Expert Committee on Food Additives (JECFA), Rome, Italy, June 1999.

Barraj LM, Petersen BJ. A method for revising and redefining regional diets for use in estimating the intake of pesticides. Presented at the 31st Codex Committee on Pesticide Residues, The Hague, The Netherlands, April 1999.

Petersen BJ, Tomerlin JR, Barraj LM, Julien B. Aggregate exposure risk assessments and the upcoming challenge of cumulative exposure. Presented at the 1998 SOT Annual Meeting, Seattle, WA, March 1998.

Barraj LM, Francis M. Using a calendar model for estimating the probability of exposure to a chemical with multiple uses. Paper presented at the Society for Risk Analysis and International Society of Exposure Analysis Annual Meeting, New Orleans, LA, December 1996.

Heimbach JT, Fleming KH, Barraj LM. Using food consumption survey data to estimate high levels of exposure to nutrients. Paper presented to the Food and Nutrition Board, Institute of Medicine, National Academy of Sciences, Washington, D.C., July 1996.

Kidwell JL, Petersen B, Dybas R, Grosso L, Barraj L. Comparison of methodologies for estimating dietary exposure to abamectin residues in foods. Poster presented at the Society of Toxicology Annual Meeting, Anaheim, CA, March 1996.

Slesinski RS, Barraj L, Petersen BJ. Evaluating potential risk from exposure to multiple pesticide residues in food: possible approaches for estimating total dietary risk. Poster presented at the Society of Toxicology Annual Meeting, Baltimore, MD, March 1995.

Fleming KH, Barraj LM, Douglass JS, Heimbach JT, Chew SB. Multiple chemicals, multiple exposures: international efforts in estimating intakes. Paper presented at the Second International Conference on Dietary Assessment Methods, Boston, MA, January 1995.

Tomerlin JR, Barraj LM, Francis MA, Petersen BJ. A comparison of exposure calculation methodologies: joint distribution analysis vs. Monte Carlo simulations. Poster presented at the ISEE/ISEA Joint Conference, Research Triangle Park, NC, September 1994.

Petersen BJ, Tomerlin JR, Barraj LM, Wehr HM. The impact of the recommendations of the National Academy of Sciences on analytical methods and the exposure and risk assessments. Paper presented at the American Organization of Analytical Chemists International Meeting, Portland, OR, September 1994.

Barraj LM, Petersen BJ, Francis M. Composite sampling versus sampling individual units: impact on estimates of the residue distribution and associated potential exposure. Paper presented at the Conference on Environmetrics, 5th International Conference on Statistical Methods for the Environmental Sciences and 4th General Meeting of the International Environmetrics Society, Burlington, Canada, August 1994.

Barraj LM, Chaisson CF, Tomerlin JR, Petersen BJ. Evaluating total multiple pesticide residues in foods: methods and implications. Paper presented at the Society of Risk Analysis Annual Meeting, Savannah, GA, December 1993.

Slesinski RS, Hawk FJ, Wilson A, Barraj LM. Exposure assessment of pesticide residues in food: design and interpretation of food residue surveys. Poster presented at the 14th Annual Meeting of the American College of Toxicology, New Orleans, LA, October 3-6, 1993.

Barraj LM, Krieger RI. Exposure to pesticides: Impact of current national and international methods on estimates of exposure. Paper presented at the Society for Risk Analysis Annual Meeting, San Diego, CA, December 1992.

Fleming KH, Douglass JS, Barraj L, Egan SK, Petersen BJ. Disappearance data vs. survey data in epidemiologic analyses. Poster presented at the 1st International Conference on Dietary Assessment Methods: Assessing Intake of Specific Food Components, Minneapolis, MN, September 1992.

Cypel Y, Barraj LM. Survey issues in the use of food consumption data for dietary exposure analyses. Presented at the Society of Risk Analysis Annual Meeting, Baltimore, MD, December 1991.

Slesinski RS, Barraj LM, Chaisson CF. Design and utilization of national food surveys to provide quantitative data for dietary risk assessment. Presented at the Society of Risk Analysis Annual Meeting, Baltimore, MD, December 1991.

Barraj LM, Loftus ML, Petersen BJ. Selecting analytical methods for monitoring foods for toxicants. Presented at the Eastern Food Science Conference, The Integrated Food Technologist, Hunt Valley, MD, October 1991.

Prior Experience

Director of the Statistical Services Division, Novigen Sciences, Inc., 1997–2002

Statistician, Technical Assessment Systems, Inc., 1991–1997

Statistician, Center for Studies in Nutrition and Medicine of the New England Deaconess Hospital, 1990

Consulting Statistician: Nutrition Institute of Cairo, the United Nations Children's Fund, and Environmental Quality International of Cairo, 1989–1990

Visiting Assistant Professor, Department of Epidemiology and Biostatistics, American University of Beirut, 1984–1985

Instructor, Department of Epidemiology and Biostatistics, American University of Beirut, 1979–1981

Research Assistant. Statistics Division, The United Nations Economic Commission for Western Asia, 1977–1979

Project Experience

Designed nationwide surveys to assess drinking water intake patterns and food consumption.

Conducted research on the association of diet components and health status. In particular conducted research on the effect of flavonoid intake and egg consumption, on heart health.

Conducted research on the association between children's exposure to agricultural chemicals and the incidence of adverse health effects.

Analyzed data from a longitudinal worker exposure study to investigate the potential effects of exposure to a herbicide on reproductive health.

Developed the statistical design of nationwide market basket surveys and analyzed data generated by such surveys.

Collaborated in the development of a probabilistic model for assessing risk from aggregate (i.e., though multiple sources and routes) exposures to chemicals.

Reviewed and developed probabilistic models for use in microbial risk assessments.

Analyzed microbial growth data and developed predictive microbial models to be used to support proposed new processing methods for food products.

Conducted a statistical analysis of food consumption data from more than 150 countries and developed, in collaboration with the World Health Organization, the GEMS/Food Consumption Cluster Diets (<http://www.who.int/foodsafety/chem/gems/en/index1.html>).

Analyzed data from several surveys of consumer products use and developed summary distributions for use in risk assessments of compounds/contaminants in these consumer products.

Collaborated on the development of the models and algorithms used in several of Exponent/Novigen's risk assessment software that are used by the US EPA and FDA. These software include the Dietary Exposure Evaluation Model (DEEM™), the Food Analysis and Residue Evaluation Program (FARE™), and Calendex™, an aggregate and cumulative exposure software incorporating both temporal and spatial variability.

Editorial Review Boards

- The International Society of Regulatory Toxicology and Pharmacology, 1997–2004

Professional Affiliations

- American Statistical Association (member)
- Society for Risk Analysis (member)
- The International Society of Regulatory Toxicology and Pharmacology (member)