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Engineering & Scientific Consulting

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Professional Profile

Dr. Barraaj is a biostatistician with over 30 years of experience in experimental study and survey design, data analysis, and model development. She has worked on a wide range of issues, including occupational, residential, nutritional risk assessments, and microbial risk assessments. In particular, she has designed consumer behavior surveys to collect information on dietary consumption patterns. She has also designed several national market basket surveys to collect samples and 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 pesticide and contamination levels in food commodities.

Dr. Barraaj has extensive experience working with US and international health and nutrition surveys, including the US National Health and Nutrition Examination Survey (NHANES), the UK National Diet and Nutrition Survey (NDNS), the China Health and Nutrition Survey (CHNS), the Brazilian National Dietary Survey, the World Health Organization (WHO) World Health Survey, and the compiled survey data in EFSAS's Comprehensive European Food Consumption Database. She has analyzed food consumption data from more than 150 countries compiled by the Food and Agriculture Organization (FAO) and developed, in collaboration with the WHO, the first GEMS/Food Consumption Cluster Diets. These Cluster Diets are used by individual countries and international organizations in establishing food safety policies.

Dr. Barraaj has analyzed data from clinical trials and surveys to investigate the association between dietary patterns and health. She has analyzed longitudinal health and exposure data to investigate the association between occupational 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 developed the models and algorithms used in several of Exponent's 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.

Dr. Barraaj has served as a consultant on several Joint FAO/WHO Expert Committee on Food Additives (JECFA) panels reviewing contamination data submitted by member countries and evaluating the associated potential dietary exposures. Dr. Barraaj has also served on several FDA's Transmissible Spongiform Encephalopathies Advisory Committee meetings.

Dr. Barraaj has taught biostatistics courses offered to medical, nursing and public health students, and has

given statistics and risk assessment lectures to graduate students at John Hopkins University and Drexel University.

Academic Credentials & Professional Honors

Sc.D., Biostatistics, Harvard University, 1987

M.S., Statistics, American University of Beirut, Lebanon, 1979

B.S., Statistics, American University of Beirut, Lebanon, 1974

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

Professional Affiliations

American Statistical Association (member)

Society for Risk Analysis (member)

Languages

French

Arabic

Publications

Scrafford CG, Bi X, Multani JK, Murphy MM, Schmier JK, Barraij LM. Health Care Costs and Savings Associated with Increased Dairy Consumption among Adults in the United States. *Nutrients* 2020, 12(1), 233; <https://doi.org/10.3390/nu12010233>.

Murphy M, Barraij L, Toth L, Harkness L, Bolster D. Daily intake of dairy products in Brazil and contributions to nutrient intakes: a cross-sectional study. *Public Health Nutr.* 2015 June 19:1-8. [Epub ahead of print] PubMed PMID: 26088363.

Tran NL, Barraij LM, Scrafford C, Bi X, Troxell T. Partitioning of Dietary Metal Intake-A Metal Dietary Exposure Screening Tool. *Risk Anal.* 2014 Dec 24. doi: 10.1111/risa.12322. [Epub ahead of print]

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Murphy MM, Barraj LM, Spungen JH, Herman DR, Randolph RK. Global assessment of select phytonutrient intakes by level of fruit and vegetable consumption. *Br J Nutr*. 2014 Sep 28;112(6):1004-18. doi: 10.1017/S0007114514001937. Epub 2014 Aug 11. PubMed PMID: 25108700; PubMed Central PMCID: PMC4162485.

Murphy MM, Barraj LM, Rampersaud GC. Consumption of grapefruit is associated with higher nutrient intakes and diet quality among adults, and more favorable anthropometrics in women, NHANES 2003-2008. *Food Nutr Res*. 2014 May 8;58. doi: 10.3402/fnr.v58.22179. eCollection 2014. PubMed PMID: 25006335; PubMed Central PMCID: PMC4016745.

Tran NL, Barraj LM, Heilman JM, Scrafford CG. Egg consumption and cardiovascular disease among diabetic individuals: a systematic review of the literature. *Diabetes Metab Syndr Obes*. 2014 Mar 24;7:121-37. doi: 10.2147/DMSO.S58668. eCollection 2014. Review. PubMed PMID: 24711708; PubMed Central PMCID: PMC3969252

Barraj LM, Murphy MM, Heshka S, Katz DL. Greater weight loss among men participating in a commercial weight loss program: a pooled analysis of 2 randomized controlled trials. *Nutr Res*. 2014 Feb;34(2):174-7. doi: 10.1016/j.nutres.2013.11.002. Epub 2013 Nov 22. PubMed PMID: 24461320.

Murphy MM, Spungen JH, Barraj LM, Bailey RL, Dwyer JT. Revising the daily values may affect food fortification and in turn nutrient intake adequacy. *J Nutr*. 2013 Dec;143(12):1999-2006. doi: 10.3945/jn.113.181099. Epub 2013 Oct 16. PubMed PMID: 24132571; PubMed Central PMCID: PMC3827641.

Stettler N, Murphy MM, Barraj LM, Smith KM, Ahima RS. Systematic review of clinical studies related to pork intake and metabolic syndrome or its components. *Diabetes Metab Syndr Obes*. 2013 Sep 25;6:347-357. eCollection 2013. Review. PubMed PMID: 24106428; PubMed Central PMCID: PMC3792009.

Murphy MM, Barraj LM, Bi X, Stettler N. Body weight status and cardiovascular risk factors in adults by frequency of candy consumption. *Nutrition Journal* 2013, 12:53 doi:10.1186/1475-2891-12-53.

Tran NL, Barraj LM, Bi X, Schuda LC, Moya J. Estimated long-term fish and shellfish intake-national health and nutrition examination survey. *J Expo Sci Environ Epidemiol*. 2012 Oct 10. doi: 10.1038/jes.2012.96.

Murphy MM, Barraj LM, Herman D, Bi X, Cheatham R, Randolph RK. Phytonutrient intake by adults in the United States in relation to fruit and vegetable consumption. *J Acad Nutr Diet*. 2012 Feb;112(2):222-9.

Murphy MM, Spungen JH, Bi X, Barraj LM. Fresh and fresh lean pork are substantial sources of key nutrients when these products are consumed by adults in the United States. *Nutr Res*. 2011 Oct;31(10):776-83. doi: 10.1016/j.nutres.2011.09.006.

Tran NL, Barraj LM, Murphy MM, Bi X. Dietary acrylamide exposure and hemoglobin adducts--National Health and Nutrition Examination Survey (2003-04). *Food Chem Toxicol*. 2010 Nov;48(11):3098-108. doi: 10.1016/j.fct.2010.08.003. Epub 2010 Aug 7.

Scrafford CG, Tran NL, Barraj LM, Mink PJ. Egg consumption and CHD and stroke mortality: a prospective study of US adults. *Public Health Nutr*. 2011 Feb;14(2):261-70. doi: 10.1017/S1368980010001874. Epub 2010 Jul 16.

Alexander DD, Schmitt DF, Tran NL, Barraj LM, Cushing CA. Partially hydrolyzed 100% whey protein infant formula and atopic dermatitis risk reduction: a systematic review of the literature. *Nutr Rev*. 2010 Apr;68(4):232-45. doi: 10.1111/j.1753-4887.2010.00281.x. Review.

Tran N, Barraj L. Contribution of specific dietary factors to CHD in US females. *Public Health Nutr.* 2010 Feb;13(2):154-62. doi: 10.1017/S1368980009990693. Epub 2009 Jul 17.

Schmier JK, Barraj LM, Tran NL. Single food focus dietary guidance: lessons learned from an economic analysis of egg consumption. *Cost Eff Resour Alloc.* 2009 Apr 14;7:7. doi: 10.1186/1478-7547-7-7.

Barraj LM, Scrafford CG, Eaton WC, Rogers RE, Jeng CJ. Arsenic levels in wipe samples collected from play structures constructed with CCA-treated wood: impact on exposure estimates. *Sci Total Environ.* 2009 Apr 1;407(8):2586-92. doi: 10.1016/j.scitotenv.2008.12.045. Epub 2009 Feb 13.

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.* 2009 Mar;29(3):401-15. doi: 10.1111/j.1539-6924.2008.01149.x. Epub 2008 Nov 4.

Smith KM, Barraj LM, Kantor M, Sahyoun NR. Relationship between fish intake, n-3 fatty acids, mercury and risk markers of CHD (National Health and Nutrition Examination Survey 1999-2002). *Public Health Nutr.* 2009 Aug;12(8):1261-9. doi: 10.1017/S1368980008003844. Epub 2008 Nov 6.

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 Dec;52(3):299-310. doi: 10.1016/j.yrtph.2008.08.010. Epub 2008 Aug 26. Review.

LaKind JS, Barraj L, Tran N, Aylward LL. Environmental chemicals in people: challenges in interpreting biomonitoring information. *J Environ Health.* 2008 May;70(9):61-4.

Sanchez CA, Barraj LM, Blount BC, Scrafford CG, Valentin-Blasini L, Smith KM, Krieger RI. Perchlorate exposure from food crops produced in the lower Colorado River region. *J Expo Sci Environ Epidemiol.* 2009 May;19(4):359-68. doi: 10.1038/jes.2008.26. Epub 2008 May 28.

Cutler GJ, Nettleton JA, Ross JA, Harnack LJ, Jacobs DR Jr, 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 Aug 1;123(3):664-71. doi: 10.1002/ijc.23564.

Barraj L, Scrafford C, Lantz J, Daniels C, Mihlan G. Within-day drinking water consumption patterns: results from a drinking water consumption survey. *J Expo Sci Environ Epidemiol.* 2009 May;19(4):382-95. doi: 10.1038/jes.2008.28. Epub 2008 May 14.

Barraj LM, Tran NL, Goodman M, Ginevan ME. Perspective: risk apportionment and disease intervention strategies. *Risk Anal.* 2008 Apr;28(2):477-86. doi: 10.1111/j.1539-6924.2008.01028.x.

Loretz LJ, Api AM, Babcock L, Barraj LM, Burdick J, Cater KC, Jarrett G, Mann S, Pan YH, Re TA, Renskers KJ, Scrafford CG. Exposure data for cosmetic products: facial cleanser, hair conditioner, and eye shadow. *Food Chem Toxicol.* 2008 May;46(5):1516-24. doi: 10.1016/j.fct.2007.12.011. Epub 2007 Dec 23.

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. *Epidemiol Perspect Innov.* 2007 Sep 26;4:9.

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estimate exposure to arsenic for children playing on CCA-treated wood structures. *Environ Health Perspect.* 2007 May;115(5):781-6. Epub 2007 Feb 21.

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Barraj LM, Petersen BJ. Food consumption data in microbiological risk assessment. *J Food Prot.* 2004 Sep;67(9):1972-6.

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 Jul;15(4):385-93.

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. *Human and Ecological Risk Assessment.* 2004 Jun; 10(3): 473-83.

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

Julien EA, Barraj LM, Petersen BJ, Tomerline JR. Considerations when choosing a threshold of regulation for acute dietary exposure to pesticides. *Food Drug Law J.* 2001;56(2):241-54.

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 Chem Toxicol.* 2002 May;40(5):555-71.

Hunter Youngren S, Youngren MA, Barraj L. Challenges of probabilistic assessment of operator and residential non-dietary exposure. *Ann Occup Hyg.* 2001 Apr;45 Suppl 1:S49-54.

Tomenson JA, Taves DR, Cockett AT, McCusker J, Barraj L, Francis M, Pastoor TP, Wickramaratne GA, Northrop HL. An assessment of fertility in male workers exposed to molinate. *J Occup Environ Med.* 1999 Sep;41(9):771-87.

Allison DB, Egan SK, Barraj LM, Caughman C, Infante M, Heimbach JT. Estimated intakes of trans fatty and other fatty acids in the US population. *J Am Diet Assoc.* 1999 Feb;99(2):166-74; quiz 175-6.

Shurdut BA, Barraj L, Francis M. Aggregate exposures under the Food Quality Protection Act: An approach using chlorpyrifos. *Regul Toxicol Pharmacol.* 1998 Oct;28(2):165-77. Review.

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

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

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

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

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

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

Heraud F, Barraj LM, Moy GG. GEMS/Food Consumption Cluster Diets. In: *Total Diet Studies.* Moy GG and Vannort RW (ed), Springer, 2013.

Chang ET, Butchko HH, Barraj LM. Clinical research for medical devices. In: *Bringing Your Medical Device to Market.* Reiss JB (ed), FDLI, 2013.

Feeley M, Barraj L, Bellinger DC, Bronson R, Guérin T, Larsen JC, Lo MT, Slob W. Mercury. In: *Safety Evaluation of Certain Contaminants in Food.* Prepared by the Seventy Second meeting of the Joint FAO/WHO Expert Committee on Food Additives (JECFA), 2011. Available at: http://whqlibdoc.who.int/publications/2011/9789241660631_eng.pdf?ua=1

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. Available at: <http://www.inchem.org/documents/jecfa/jecmono/v55je06.pdf>

Belinger D., Bolger M., Goyer R, Barraj L, and Baines J. WHO Food Additives Series 46: Cadmium. In: FAO/WHO Joint Expert Committee on Food Additives; Safety Evaluation of Certain Contaminants in Food. 2001. Available at: <http://www.inchem.org/documents/jecfa/jecmono/v46je11.htm>

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.

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

Project Experience

Analyzed data from several clinical trials to evaluate the effectiveness of a commercial weight loss program.

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., through 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.

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.