OMB No. 0925-0001 and 0925-0002 (Rev. 12/2020 Approved Through 02/28/2023)

BIOGRAPHICAL SKETCH

Provide the following information for the Senior/key personnel and other significant contributors.
Follow this format for each person. **DO NOT EXCEED FIVE PAGES.**

NAME: Stein, Aryeh David

eRA COMMONS USER NAME (credential, e.g., agency login): aryehstein

POSITION TITLE: Professor, Hubert Department of Global Health, Emory University

EDUCATION/TRAINING (Begin with baccalaureate or other initial professional education, such as nursing, include postdoctoral training and residency training if applicable. Add/delete rows as necessary.)

| INSTITUTION AND LOCATION | DEGREE(if applicable) | Completion DateMM/YYYY | FIELD OF STUDY |
| --- | --- | --- | --- |
| Queen Elizabeth College, University of London, London UK | BSc (High Honors) | 06/1984 | Nutrition |
| Columbia University, New York NY, USA | MPH | 05/1989 | Epidemiology |
| Columbia University, New York NY, USA | PhD | 05/1992 | Epidemiology |

**A. Personal Statement**

I have the qualifications and experience to lead this investigation into the mechanisms through which nutrition interventions in early life impact cardiometabolic disease risk in middle-adulthood, using the INCAP Nutrition Supplementation Trial Cohort (INSTC) study. By training, I am a life-course epidemiologist with over 30 years of research experience in intergenerational studies of the growth and physical and cognitive development of children as they develop into adults. My work is centered around the paradigm that specific prenatal or early postnatal exposures shape susceptibility and resilience to later exposures, and that careful examination of the interaction between the earlier and later exposures will advance our understanding of the development of health and well-being over the life course. My expertise is in longitudinal research, especially in prospective, repeated-measures studies of growth and development over the life-course. I have continued to make substantive methodological contributions both to understanding the scope and role of measurement error in nutritional assessment and in self-reported behavioral risk factors, and to innovative design of epidemiologic studies over the life course, whether these focus on the analysis of existing data or new field work. Repeatedly, I have demonstrated capacity to collaborate productively with diverse and dispersed research teams, to manage research activities where field work is conducted at remote locations, and to disseminate study results via peer-reviewed publication. I have published over 275 peer-reviewed papers. I was a co-Investigator on all waves of the INSTC study since joining Emory University in 1998 and I was the Principal Investigator of the two most recent waves of field work in this cohort.

Current projects that I would like to highlight include:

DK-134509 Stein (PI) 3/15/2023 – 1/31/2028

**Adult epigenetics and telomere length in relation to improved nutrition in early life**

In this project we are examining the epigenetic changes and changes in average telomere length that result from improved nutrition in early life. This project complements the preset proposal through the ability to link the epigenetic changes that result for improving early life nutrition to the changes in metabolomic profiles that we expect to see in the present proposal.

AG-079990 Stein (MPI) 3/15/2023 – 2/29/2028

**The impact of early-life nutrition on socioeconomic status, physical health and cognitive function through middle age**

In this project we are examining among this same cohort of men and women in Guatemala the physical and cognitive status in late middle age, and changes in these domains over adulthood, in relation to exposure to improved nutrition in early life. This is a new wave of field work in this cohort that is being studied in the present proposal.

Recently-completed projects that I would like to highlight include:

**OPP 1164115 (Bill-Melinda Gates Foundation) Stein (PI) 04/01/2017-12/31/2021**

**Child Development and Adult Social and Human Capital: COHORTS**

**Role: PI**

**In this project, we collected a wave of data on the now-adult members of three birth cohorts that have been followed prospectively to address questions of the associations between child growth and development on the one hand and adult cognitive and executive function on the other.**

Stein AD, Adair LS, Donati G, Wray C, Richter LM, Norris SA, Stein A, Martorell R, Ramirez-Zea M, Menezes AMB, Murray J, Victora C, Lee N, Bas I, COHORTS group. Early life stature, preschool cognitive development, schooling attainment, and cognitive functioning in adulthood: prospective study in four birth cohorts. Lancet Global Health. 2023 Jan;11(1):e95-e104. doi: 10.1016/S2214-109X(22)00448-X. PMID: 36521958

Victora CG, Hartwig FP, Vidaletti LP, Martorell R, Osmond C, Richter LM, Stein AD, Stein A, Adair LS, Barros AJD, Barros FC, Bharghava SK, Horta BL, Kroker-Lobos FM, Lee NR, Menezes AMB, Murray J, Norris SA, Sachdev HPS, Stein A, Varghese JS\*, Bhutta Z, Black RE. Effects of early-life poverty on health and human capital in children and adolescents: analyses of national surveys and birth cohort studies in LMICs. Lancet. 2022;399(10336):1741-1752. doi: 10.1016/S0140-6736(21)02716-1. PMID: 35489358.

Black RE, Liu L, Hartwig FP, Villavicencio F, Rodriguez-Martinez A, Vidaletti LP, Perin J, Black MM, Blencowe H, You D, Hug L, Masquelier B, Cousens S, Gove A, Vaivada T, Yeung D, Behrman J, Martorell R, Osmond C, Stein AD, Adair LS, Fall CHD, Horta BL, Menezes AMB, Ramirez-Zea M, Richter LM, Patton G, Bendavid E, Ezzati M, Bhutta ZA, Lawn J, Victora CG. Health and development from preconception to 20 years of age and human capital. Lancet. 2022;399(10336):1730-1740. doi: 10.1016/S0140-6736(21)02533-2. PMID: 35489357

Poveda Rey NE\*, Hartwig FP, Victora C, Adair LS, Barros FC, Bhargava SK, Horta BL, Lee NR, Martorell R, Mazariegos M, Menezes AMB, Norris SA, Richter LM, Sachdev HPS, Stein A, Wehrmeister FC, **Stein AD**, COHORTS group. Patterns of growth in childhood in relation to adult schooling attainment and IQ in 6 birth cohorts in low and middle-income countries: evidence from COHORTS. **Journal of Nutrition**. 2021 May 12. doi: 10.1093/jn/nxab096. PMID: 33982126

**HD-075784 Stein (PI)** 0**4/10/2014-03/31/2021**

**Early childhood nutrition and adult metabolomic and cardiometabolic profiles**

**Role: PI**

**In this project we conducted a wave of field work, including a clinical examination and a feeding challenge, to members of the INSTC in Guatemala to address questions about the long-term metabolic consequences of improving nutrition in early life. The data from this wave contribute to the current proposal as the samples to be assayed and analyzed were collected during this field work.**

Yu EA, Le NA, Stein AD. Measuring postprandial metabolic flexibility to assess metabolic health and disease. Journal of Nutrition. 2021. Jul 22:nxab263. doi: 10.1093/jn/nxab263. PMID: 34293154

Yu EA, He S, Jones DP, Sun YV, Ramirez-Zea M, Stein AD. [metabolomic profiling demonstrates postprandial changes in fatty acids and glycerophospholipids are associated with fasting inflammation in Guatemalan adults.](https://nam11.safelinks.protection.outlook.com/?url=https%3A%2F%2Fpubmed.ncbi.nlm.nih.gov%2F34113999%2F&data=04%7C01%7Caryeh.stein%40emory.edu%7C623e18f56bbc4280046f08d93e153ce9%7Ce004fb9cb0a4424fbcd0322606d5df38%7C0%7C0%7C637609083211266818%7CUnknown%7CTWFpbGZsb3d8eyJWIjoiMC4wLjAwMDAiLCJQIjoiV2luMzIiLCJBTiI6Ik1haWwiLCJXVCI6Mn0%3D%7C1000&sdata=qZmy2Z9mCE5LnngddL94qhrhGMSowKY5erRAhHsxzXw%3D&reserved=0) Journal of Nutrition. 2021 Jun 10:nxab183. doi: 10.1093/jn/nxab183. PMID: 34113999

He S, Le N-A, Ramirez-Zea M, Martorell R, Narayan KMV, Stein AD. Meal challenge-induced biomarker responses differed by cardiometabolic phenotypes in a Guatemalan adult population. Clinical Nutrition ESPEN. 2021 Dec;46:372-379. doi: 10.1016/j.clnesp.2021.09.730. Epub 2021 Sep 28. PMID: 34857223.

Yu EA, Yu T, Jones DP, Ramirez-Zea M, Stein AD. Metabolomic Profiling After a Meal Shows Greater Changes and Lower Metabolic Flexibility in Cardiometabolic Diseases. Journal of the Endocrine Society. 2020. 2020 Aug 25;4(11):bvaa127. doi: 10.1210/jendso/bvaa127. eCollection 2020 Nov 1. PMID: 33134764

Ford ND, Behrman JR, Hoddinott JF, Maluccio JA, Martorell R, Ramirez-Zea M, Stein AD. Exposure to improved nutrition from conception to age two years and adult cardiometabolic disease risk: a modelling study. Lancet Global Health. 2018; 6: e875–84. https://doi.org/10.1016/S2214-109X(18)30231-6. PMID: 30012268

**B. Positions, Scientific Appointments, and Honors**

**Positions and Scientific Appointments**

|  |  |
| --- | --- |
| 2020-present, 2000-2014 | **Director of Graduate Studies, Program in Nutrition and Health Science, Laney Graduate School of Arts and Sciences, Emory University, Atlanta, GA** |
| 2008-present | **Co-chair, Institutional Review Board, Emory University, Atlanta, GA** |
| **1998-present** | Affiliated faculty: Laney Graduate School of Arts and Sciences, Emory University, Atlanta GA |
| 2012-present | Professor, Rollins School of Public Health, Emory University, Atlanta, GA |
| 1998-2012 | Associate Professor, Rollins School of Public Health, Emory University, Atlanta, GA |
| 1993-1998 | Assistant Professor. Department of Epidemiology, College of Human Medicine. Michigan State University, East Lansing, MI |
| 1992 | Epidemiologist. Dutch Famine Birth Cohort Follow-up Study, Academisch Ziekenhuis bij de Universiteit van Amsterdam, Academisch Medisch Centrum, Amsterdam, Netherlands |
| 1991-1992 | Epidemiologist / Data Analyst. Behavioral Risk Factor Surveillance Section, Bureau of Health Statistics, Research and Evaluation Massachusetts Department of Public Health, Boston MA |
| 1987-1992 | Teaching Assistant / Graduate Research Assistant. Division of Epidemiology. Columbia University School of Public Health, New York, NY |
| 1984-1986 | Provincial Nutritionist. Department of Health, Simbu Province, Papua New Guinea. |

**Honors**

|  |  |
| --- | --- |
| 2022 | Elected as Fellow of the American Society for Nutrition |
| 2018, 2022 | Emory Millipub Club (Author of paper(s) that have been cited >1000 times) |
| 2016-present | Associate Editor: Journal of Nutrition |
| 2012-present | Honorary Senior Researcher (2012-2015) and Professor (2015 – present), Developmental Pathways to Health Research Unit, University of the Witwatersrand, Johannesburg, South Africa |
| 2007-present | Ad-hoc and chartered member, Multiple Study Sections, NIH |

**C. Contributions to Science**

**1. Long-term consequences of prenatal exposure to famine**: The Dutch Hunger Winger of 1944-5, a 6-month period of acute food deprivation, provides a quasi-experimental setting in which the consequences in adult life of the stresses of famine in defined periods of gestation on the developing fetus can be examined. In a series of studies led by LH Lumey of Columbia University, I have studied individuals born before, during, or after the famine. I was central to the development of our innovative sibling-control design, in which an unexposed same- sex sibling is matched to a famine-exposed proband in order to provide tight control for social and genetic determinants of later health status. In a series of over 25 papers since 1994, we examined the long-term consequences of famine exposure in specific periods of gestation on well-being, morbidity, and mortality.

**Stein AD,** Kahn HS, Rundle A, Zybert PA, van der Pal-de Bruin K, Lumey LH. Anthropometric measures in middle age after exposure to famine during gestation: evidence from the Dutch famine. *Am J Clin Nutr.* 2007 Mar;85(3):869-76.

Heijmans BT, Tobi EW, **Stein AD,** Putter H, Blauw GJ, Susser ES, Slagboom PE, Lumey LH. Persistent epigenetic differences associated with prenatal exposure to famine in humans. *Proc Natl Acad Sci U S A.* 2008 Nov 4;105(44):17046-9. PMCID: PMC2579375

Tobi EW, Slieker RC, **Stein AD**, Suchiman HE, Slagboom PE, van Zwet EW, Heijmans BT, Lumey LH. Early gestation as the critical time-window for changes in the prenatal environment to affect the adult human blood methylome. *Int J Epidemiol*. 2015 Aug;44(4):1211-23. PMCID: PMC4588866

Ekamper P, van Poppel F, **Stein AD**, Bijwaard GE, Lumey LH. Prenatal famine exposure and adult mortality from cancer, cardiovascular disease, and other causes through age 63 years. Am *J Epidemiol.* 2015 Feb 15;181(4):271-9. PMCID: PMC4325678

**2. Long-term consequences of maternal and infant nutrition supplementation for human capital**: Famine exposure in industrial settings is rare, and the scenario of chronic undernutrition in low-income settings is much more common. With Reynaldo Martorell and many others, I have been investigating the long-term effects of exposure to a nutritional supplementation program implemented at the village level in Guatemala in the 1960’s. This study, the longest-running follow-up of a nutritional supplementation trial, has resulted in well over 200 published papers, many of which have been influential in the development of the ‘first 1000 days’ paradigm now underpinning much aid and development work. I am leading our current work on the long-term consequences for cardiometabolic risk, and was the Principal Investigator on the two most recent grants, from NICHD and the Bill and Melinda Gates Foundation. I was instrumental in developing the basic analytic framework used in our recent work, in which exposure to intervention for the ‘first 1000 days’ (conception to age 24 mo) is distinguished from exposure to the placebo or to the intervention at other ages by use of an adaptation of the double-difference methodology. Among over 50 co-authored publications emanating from this project since I joined Emory in 1998, I have led or supervised analyses of the impact of the supplementation on cardiometabolic disease and cognitive functioning in adulthood and on the impacts of the intervention on growth in the next generation.

Stein AD, Barnhart HX, Wang M, Hoshen MB, Ologoudou K, Ramakrishnan U, Grajeda R, Ramirez-Zea M, Martorell R. Comparison of linear growth patterns in the first three years of life across two generations in Guatemala. *Pediatrics.* 2004;113(3.1):e270-e275.

Stein AD, Wang M, DiGirolamo A, Grajeda R, Ramakrishnan U, Ramirez-Zea M, Yount K, Martorell R. Nutritional supplementation in early childhood, schooling, and intellectual functioning in adulthood: a prospective study in Guatemala. *Arch Pediatr Adolesc Med.* 2008 Jul;162(7):612-8. PMCID: PMC3733080

Behrman JR, Calderon MC, Preston SH, Hoddinott J, Martorell R, Stein AD. Nutritional supplementation in girls influences the growth of their children: prospective study in Guatemala. *Am J Clin Nutr.* 2009 Nov;90(5):1372-9. PMCID: PMC2762161

Ford ND, Behrman JR, Hoddinott JF, Maluccio JA, Martorell R, Ramirez-Zea M, Stein AD. Exposure to improved nutrition from conception to age 2 years and adult cardiometabolic disease risk: a modelling study. *Lancet Glob Health.* 2018 Aug;6(8):e875-e884. Erratum in: *Lancet Glob Health* 2020 Jan;8(1):e38. PMCID: PMC6138451

**3. Patterns of child growth and adult human capital (COHORTS)**: Most of our understanding of the role of early- life experiences in adult human capital comes from high-income countries, and there are few prospective birth cohort studies in low- and middle-income countries in which study participants have reached adulthood. The COHORTS project involves a collaborative pooling of data from birth cohorts in Brazil, Guatemala, India, Philippines, and South Africa. I have been a co-investigator with the project since 2008 and recently served as PI of a Bill and Melinda Gates Foundation-funded wave of fieldwork. I have contributed to the development of the core methodological approach to the study of growth patterns in this group, namely the use of conditional growth measures.

Adair LS, Fall CH, Osmond C, Stein AD, Martorell R, Ramirez-Zea M, Sachdev HS, Dahly DL, Bas I, Norris SA, Micklesfield L, Hallal P, Victora CG; COHORTS group. Associations of linear growth and relative weight gain during early life with adult health and human capital in countries of low and middle income: findings from five birth cohort studies. *Lancet.* 2013 Aug 10;382(9891):525-34. PMCID: PMC3744751

Stein AD, Barros FC, Bhargava SK, Hao W, Horta BL, Lee N, Kuzawa CW, Martorell R, Ramji S, Stein A, Richter L; Consortium of Health-Orientated Research in Transitioning Societies (COHORTS) investigators. Birth status, child growth, and adult outcomes in low- and middle-income countries. J *Pediatr.* 2013 Dec;163(6):1740-1746.e4. PMCID: PMC3849851

Fall CH, Sachdev HS, Osmond C, Restrepo-Mendez MC, Victora C, Martorell R, Stein AD, Sinha S, Tandon N, Adair L, Bas I, Norris S, Richter LM; COHORTS investigators. Association between maternal age at childbirth and child and adult outcomes in the offspring: a prospective study in five low-income and middle-income countries (COHORTS collaboration). *Lancet Glob Health.* 2015 Jul;3(7):e366-77. PMCID: PMC4547329

Richter LM, Orkin FM, Roman GD, Dahly DL, Horta BL, Bhargava SK, Norris SA, Stein AD; COHORTS investigators. Comparative Models of Biological and Social Pathways to Predict Child Growth through Age 2 Years from Birth Cohorts in Brazil, India, the Philippines, and South Africa. *J Nutr.* 2018 Aug 1;148(8):1364-1371. PMCID: PMC6075183

**4. Birth to Thirty: Multi-generational study of growth and development in South Africa:** This is a study, initiated in 1990, in which births in Johannesburg were recruited. Follow-up fieldwork has been conducted almost annually (most recently in 2017-8 in the context of the COHORTS project that I led), and the study has become a platform for ancillary research. I have collaborated with the South African investigators since 2008. We have adapted methodologies for the analyses of longitudinal data and conducted qualitative research to enhance the interpretation of study findings.

Lundeen EA, Norris SA, Adair LS, Richter LM, Stein AD. Sex differences in obesity incidence: 20-year prospective cohort in South Africa. *Pediatr Obes.* 2016 Feb;11(1):75-80. PMCID: PMC4832364

Lundeen EA, Norris SA, Martorell R, Suchdev PS, Mehta NK, Richter LM, Stein AD. Early Life Growth Predicts Pubertal Development in South African Adolescents. *J Nutr.* 2016 Mar;146(3):622-9. PMCID: PMC4763484

Stein AD, Lundeen EA, Martorell R, Suchdev PS, Mehta NK, Richter LM, Norris SA. Pubertal Development and Prepubertal Height and Weight Jointly Predict Young Adult Height and Body Mass Index in a Prospective Study in South Africa. *J Nutr.* 2016 Jul;146(7):1394-401. PMCID: PMC4926854

Hanson SK, Munthali RJ, Lundeen EA, Richter LM, Norris SA, Stein AD. Stunting at 24 months is not related to incidence of overweight through young adulthood in an urban South African birth cohort. *J Nutr*. 2018 Jun 1;148(6):967-973. PMCID: PMC6669956

**A Complete List of Published Work (over 275 publications since 1990):** [**http://www.ncbi.nlm.nih.gov/pubmed/?term=stein+ad+[au**](http://www.ncbi.nlm.nih.gov/pubmed/?term=stein%2Bad%2B%5bau)**]**