

NUT 325: Science based interventions for child malnutrition

Tufts University

Friedman School of Nutrition Science and Policy

FALL 2016

Time and location of the course

Mondays, 1:30-4:30pm, Jaharis 156

Instructors

Irwin Rosenberg, M.D. | irwin.rosenberg@tufts.edu | 617.636.3701 |

Office Hours: To be determined

Shibani Ghosh, Ph.D. | shibani.ghosh@tufts.edu | 617.636.3771 | Skype: shibanighosh1

Office Hours: To be determined

Teaching Assistant

Krista Zillmer

Office Hours: By appointment

Tufts Graduate Credit: 1 credit

Prerequisites for taking this course: Not applicable

Course Description:

This course aims at bringing together the current knowledge and evidence in nutrition science and applied nutrition as it translates into policy recommendations and program interventions for prevention and treatment of child malnutrition (wasting and stunting) in developing countries. The course will provide an overview of the global evidence and recommendations on macro and micronutrients viz-a-viz interventions relating it to non-nutrition factors linked to wasting and stunting (e.g. environmental enteropathy, immunity and infection). Emphasis will be placed on understanding the concepts of micronutrients (Vitamin A, iron, folate, zinc and Vitamin B12) and macronutrient quality (e.g. essential amino acids and fatty acids). Case studies focusing on current ongoing activities, initiatives and programs will be reviewed/presented.

Course Objectives:

By the end of the course, students will:

1. Learn to analyze current global evidence on the role of macro and micronutrients in the prevention and treatment of wasting and stunting
2. Link the science around essential macro and micro nutrients (protein, energy, vitamin A, iron, zinc and folate) to programmatic responses on prevention and treatment

Description of assignments, tests, and other required activities:

The students will be required to select one topic (associated with a class), review and do research on that topic, presenting in class during the session that the particular topic is covered. Students will be required to make a 20-minute presentation using visual tools such as PowerPoint. The instructors will review the process of selecting a topic in the first class. All students will then use the information (and feedback from the presentation) to develop their term papers (due at the end of the class). Class participation will also be evaluated.

The following guidelines are used in evaluating course performance:

- Presentations and term papers will be evaluated on the basis of completeness, originality, scientific soundness and relevance to the assigned topic.
- Participation will be evaluated on presence and active interaction in the discussion of the particular class.

Summary of Assignments and Grading

Assignment(s)	Grading Weight
In class presentation	33%
Term paper	33%
Class participation	33%
Total	100%

Penalties for late or incomplete assignments: This will be determined on the discretion of the instructors and based on usually applied practices at the Friedman School.

Course texts and Materials (for the course as a whole): No textbook required. Instructors have specific readings for each class that are listed in the subsequent sections.

Academic Conduct

Academic integrity, including avoiding plagiarism, is critically important. Each student is responsible for being familiar with the standards and policies outlined in the Friedman School's *Policies and Procedures* manual (<http://nutrition.tufts.edu/student/documents>). It is the responsibility of the student to be aware of, and comply with, these policies and standards. In accordance with Tufts University's policy on academic misconduct, violations of standards of academic conduct will be sanctioned by penalties ranging from grade reduction or failure on an assignment; grade reduction or failure of a course; up to dismissal from the school, depending on the nature and context of any infraction (<http://uss.tufts.edu/studentaffairs/judicialaffairs/Academic%20Integrity.pdf>).

Course & Assignment Schedule:

DATE	SESSION	TOPIC	ASSIGNMENTS & ACTIVITIES	LECTURER(S)
9/12/16	1	Review of Syllabus and timeline for the course, Introduction to Science based interventions targeting malnutrition: Public health and Epidemiology, Linking Evidence to Programming	Readings	Shibani Ghosh
9/19/16	2	Introduction to Science Based interventions: Syndromes, definitions, etiologies	Readings	Irwin Rosenberg
9/26/16	3	Elements of etiologies going beyond nutrients: Environmental Enteropathy, Infection and Immunity	Readings and Student Presentation	Irwin Rosenberg
10/3/16	4	Evidence base for the prevention and treatment stunting and acute malnutrition	Readings and Student Presentation	Shibani Ghosh
10/10/16		Columbus day Holiday		
10/17/16	5	Iron: Evidence base around interventions targeting iron status in vulnerable populations	Readings and Student Presentation	Irwin Rosenberg
10/24/16	6	Folic acid and Vitamin B 12: Evidence base, issues and controversies	Reading and Student Presentation	Irwin Rosenberg
10/31/16	7	Zinc: Role of zinc in human health (growth and diarrhea)	Readings and Student Presentation	Shibani Ghosh
11/7/16	8	Vitamin A: Evidence base, controversies, future directions	Readings and Student Presentation	Shibani Ghosh
11/14/16	9	Protein quality	Readings and Student Presentation	Shibani Ghosh
11/21/16	10	Energy, Fats and Essential Fatty acids	Readings and Student Presentation	Shibani Ghosh
11/28/16	11	Vitamin D	Readings and Student Presentation	Shibani Ghosh
12/5/16	12	Iodine	Readings and student Presentation	Shibani Ghosh
12/12/16		Last day of Classes	Remaining Student presentations	

This schedule is subject to modifications at the discretion of the instructor.

Course Schedule
Weekly Readings, Learning Objectives and Assignments

Class 1: Review of Syllabus and Timeline for Course and Introduction to Science based interventions targeting malnutrition: Public health and Epidemiology

9/12/2016, Monday 1:30-4:30, Jaharis 156
Instructor: Shibani Ghosh

Learning Objectives for class 1: Upon completion of this class, students will be able to:

- Basic definitions in public health nutrition and epidemiology
- Global Nutrition recommendations (Lancet 2013) on evidence base interventions- and the Global Nutrition Report
- Linking evidence base to current programming

Required Readings for class 1:

1. Victora C et al. 2010. Worldwide timing of growth faltering: revisiting implications for interventions. *Pediatrics*. 2010 Mar; 125(3):e473-80. doi: 10.1542/peds.2009-1519. Epub 2010 Feb 15.
2. Black, R.E., Victora, C.G., Walker, S.P., Bhutta, Z.A., Christian, P., De Onis, M., Ezzati, M., Grantham-McGregor, S., Katz, J., Martorell, R. and Uauy, R., 2013. Maternal and child undernutrition and overweight in low-income and middle-income countries. *The lancet*, 382(9890), pp.427-451.
3. Bhutta, Z.A., Das, J.K., Rizvi, A., Gaffey, M.F., Walker, N., Horton, S., Webb, P., Lartey, A., Black, R.E., Group, T.L.N.I.R. and Maternal and Child Nutrition Study Group, 2013. Evidence-based interventions for improvement of maternal and child nutrition: what can be done and at what cost? *The Lancet*, 382(9890), pp.452-477.

Additional Readings:

1. International Food Policy Research Institute. 2015. *Global Nutrition Report 2015: Actions and Accountability to Advance Nutrition and Sustainable Development*. Washington, DC.

Class 2: Introduction to Science based interventions targeting malnutrition: Syndromes, definitions, etiologies

9/19/2016 Monday 1:30-4:30, Jaharis 156

Instructor(s): Irwin Rosenberg

Learning Objectives for class 2: Upon completion of this class, students will be able to:

- Define malnutrition and its etiologies
- Define the metrics of malnutrition
- Name major nutrient deficiencies of public health relevance
- Understand evidence based approaches in interventions around moderate acute malnutrition

Required Readings for class 2:

1. Webb, Patrick. "USAID's review of food aid quality." Food and nutrition bulletin 32.3 suppl3 (2011): S131-S133.
2. Rosenberg, Irwin, et al. "Nutritional enhancement of US Title II food aid products." Food and nutrition bulletin 32.3 suppl3 (2011): S134-S151.
3. Suri, Devika J., Denish Moorthy, and Irwin H. Rosenberg. "The Role of Dairy in Effectiveness and Cost of Treatment of Children with Moderate Acute Malnutrition: A Narrative Review." Food and nutrition bulletin 37.2 (2016): 176-185.

Class 3: Elements of etiologies going beyond nutrients: Environmental Enteropathy, Infection and Immunity

9/26/2016, Monday 1:30-4:30, **Jaharis 155- PLEASE NOTE ROOM CHANGE, ONLY FOR THIS CLASS**

Instructor(s): Irwin Rosenberg

Learning Objectives for class 3: Upon completion of this class, students will be able to:

- Define malnutrition and its etiologies – role of infection/environment

Required Readings for class 3:

1. Keusch GT, Rosenberg IH, Denno DM *et al.* (2013) Implications of acquired environmental enteric dysfunction for growth and stunting in infants and children living in low- and middle-income countries. *Food and nutrition bulletin* 34, 357-364.
2. Keusch GT. The History of Nutrition: Malnutrition, Infection and Immunity. *J Nutr.* 133:336S-340S, 2003.
3. Agapova, Sophia, et al. "Detection of low-concentration host mRNA transcripts in Malawian children at risk for environmental enteropathy." *Journal of pediatric gastroenterology and nutrition* 56.1 (2013): 66-71.

Additional Readings:

4. Keusch GT., Denno DM, Black RE., Duggan C., Guerrant RL, Lavery JV, Nataro JP, Rosenberg IH, Ryan ET, Tarr PI, Bhutta ZA, Coovadia H, Lima A., Ramakrishna B, Zaidi AK, Hay Burgees DC and Brewer T (2014). Environmental enteric dysfunction: Pathogenesis, diagnosis and clinical consequences. *Clin Infect Dis* 2014 Nov 1:59 Suppl 4: S207- 12. doi: 10.1093/cid/ciu485
5. Einstein, Mackay and Rosenberg. Pediatric zylose malabsorption in East Pakistan: Correlation with age, growth retardation, and weaning diarrhea. *Am J Clin Nutr* 1972(25):12-33.

Class 4: Evidence base for the treatment and prevention of stunting

10/3/2016 Monday 1:30-4:30, Jaharis 156

Instructor(s): Shibani Ghosh

Learning Objectives for class 4: Upon completion of this class, students will be able to understand:

- The role of nutrition and agriculture in the prevention of stunting
- Understand the role of food supplementation and/or nutrition education, WASH, control of open defecation, aflatoxin exposure and enteric disease in prevention of stunting
- Maternal nutrition and stunting
- Stunting and the first 1000 days- is there potential for catch up?
- Review the link of stunting and wasting

Required Readings for class 4

1. Smith LE., Stoltzfus RJ., Prendergast A. Food chain mycotoxin exposure, gut health, and impaired growth: a conceptual framework. *Adv Nutr.* 2012 Jul 1;3(4):526-31.
2. Masset E, Haddad L, Cornelius A and Isaza-Castro J (2011), A systematic review of agricultural interventions that aim to improve nutritional status of children. London: EPPI-Centre, Social Science Research Unit, Institute of Education, University of London.
3. Adu-Afarwuah S., Dewey K. Systematic review of the efficacy and effectiveness of complementary feeding interventions in developing countries. *Maternal & Child Nutrition, Special Issue: Strategies and Interventions in Public Health Nutrition.* Volume 4, Issue Supplement s1, pages 24–85, April 2008

Additional References

4. Krähenbühl JD, Schutz Y, Jéquier E High fat versus high carbohydrate nutritional supplementation: a one year trial in stunted rural Gambian children. *European Journal of Clinical Nutrition* [1998, 52(3):213-22]
5. Phuka JC., Maleta K., Thakwalakwa C., Cheung YB., Briend A., Manary M., Ashorn P. Complementary Feeding With Fortified Spread and Incidence of Severe Stunting in 6- to 18-Month-Old Rural Malawians. *Arch Pediatr Adolesc Med.* 2008;162(7):619-626.
6. Lopriore C., Guidoum Y., Briend A., Branca F. Spread fortified with vitamins and minerals induces catch-up growth and eradicates severe anemia in stunted refugee children aged 3–6 y *Am J Clin Nutr* October 2004 vol. 80 no. 4 973-981
7. Spears D, Ghosh A, Cumming O (2013) Open Defecation and Childhood Stunting in India: An Ecological Analysis of New Data from 112 Districts. *PLoS ONE* 8(9): 10.

Class 5: Iron: Evidence base around interventions targeting iron status in vulnerable populations

10/17/2016, Monday 1:30-4:30, Jaharis 156

Instructor(s): Irwin Rosenberg

Learning Objectives for class 5: Upon completion of this class, students will be able to:

- Evidence around iron supplementation and fortification
- Issues around iron supplementation and malaria and impact on anemia levels (Public health)
- Iron/folate supplementation in tandem with intermittent preventive treatment of malaria in pregnant women

Required Readings for class 5:

1. Nestlé Nutrition Institute Workshop Series, Vol. 70. Meeting Micronutrient Requirements for Health and Development. Influence of Inflammatory disorders and infection on iron absorption and efficacy of iron-fortified foods. 70th Nestlé Nutrition Institute Workshop, Cebu, March 2011 Editor(s): Bhutta Z.A. (Karachi, Hurrell R.F. (Zurich), Rosenberg I.H. (Boston, Mass.) 2012, pg. 107-116
2. Sazawal S., Black R.E., Ramsan M., Chwaya H.M., Stoltzfus R., Dutta A., Dhingra U., Kabole I, Deb S., Othman M.K., Kabole F.M. Effect of routine prophylactic supplementation with iron and folic acid on admission to hospital and mortality in preschool children in a high malaria transmission setting: a community-based, randomized, placebo-controlled trial. *Lancet*, 2006; 367:133-43.

Class 6: Folic acid and Vitamin B 12: Evidence base, issues and controversies

10/24/2016, Monday 1:30-4:30, Jaharis 156

Instructor(s): Irwin Rosenberg

Learning Objectives for class 6: Upon completion of this class, students will be able to:

- Understand the evidence for folic acid supplementation
- Discuss issues and controversies surrounding supplementation/fortification
- Understanding the evidence of folic acid supplementation in pregnancy, childhood and pre-conception

Required Readings for class 6:

1. Conclusions of a WHO Technical Consultation on folate and vitamin B12 deficiencies. Food and Nutrition Bulletin, vol 29, no. 2 (supplement), S238-S246, June 2008
2. World Health Organization: Guideline: Optimal Serum and Red Blood Cell Folate concentrations in women of reproductive age for prevention of neural tube defects. Executive Summary pages 1-7

Additional Reading

3. Rosenberg IH. A history of the isolation and identification of folic acid (folate). Ann Nutr Metab. 2012;61(3):231-5.

Class 7: Zinc: Role of zinc in human health (growth and diarrhea)

10/31/2016, Monday 1:30-4:30, Jaharis 156

Instructor(s): Shibani Ghosh (Check Kasey Harding)

Learning Objectives for class 7: Upon completion of this class, students will be able to:

- Introduction to Type 1 versus Type 2 nutrients
- Role of zinc in diarrhea management and improving growth
- Understand the public health relevance of zinc deficiency and its effects on health
- Issues associated with linking type 2 nutrients to non specific outcomes like linear growth
- Understand the role of multiple micronutrients in improving health and nutrition outcomes
- Understand the differences between multiple and single nutrient interventions

Required Readings for class 7:

1. Z.A. Bhutta MBBS, PhD, R.E. Black MD, MPH, K.H. Brown MD, J.Meeks Gardner PhD, S. Gore PhD, A. Hidayat MD, PhD, F. Khatun PhD, R. Martorell PhD, N.X. Ninh MD, PhD, M.E. Penny MBBS, J.L. Rosado PhD, S.K. Roy MD, MSc, PhD, M. Ruel PhD, S. Sazawal MBBS, MPH, PhD, A. Shankar DSc and Zinc Investigators' Collaborative Group* Prevention of diarrhea and pneumonia by zinc supplementation in children in developing countries: Pooled analysis of randomized controlled trials. The Journal of Pediatrics Volume 135, Issue 6, December 1999, Pages 689-697
2. Ramakrishnan U., Nguyen P., and Martorell R. Effects of micronutrients on growth of children under 5 y of age: meta-analyses of single and multiple nutrient interventions. Am J Clin Nutr January 2009 vol. 89 no. 1 191-203
3. Nestlé Nutrition Institute Workshop Series, Vol. 70. Meeting Micronutrient Requirements for Health and Development. Intervention Strategies to Address Multiple Micronutrient Deficiencies in Pregnancy and Early Childhood. 70th Nestlé Nutrition Institute Workshop, Cebu, March 2011 Editor(s): Bhutta Z.A. (Karachi, Hurrell R.F. (Zurich), Rosenberg I.H. (Boston, Mass.) 2012, pg. 61-73

Additional References:

4. Strand T.A. Chandyo RK., Bahl R., Sharma PR., Adhikari RK., Bhandari N., Ulvik RJ., Molbak K., Bhan MK and Sommerfelt H. Effectiveness and Efficacy of Zinc for the Treatment of Acute Diarrhea in Young Children. Pediatrics Vol. 109 No. 5 May 1, 2002 pp. 898 -903
5. Kenneth H Brown, Janet M Peerson, Juan Rivera and Lindsay H Allen. Effect of supplemental zinc on the growth and serum zinc concentrations of prepubertal children: a meta-analysis of randomized controlled trials. American Journal of Clinical Nutrition June 2002 vol. 75 no. 6 1062-1071

Class 8: Vitamin A: Evidence base, controversies, and future directions

11/7/2016 Monday 1:30-4:30, Jaharis 156

Instructor(s): Shibani Ghosh

Learning Objectives for class 8: Upon completion of this class, students will be able to:

- Concepts of sub clinical versus clinical deficiency states of Vitamin A
- Role of Vitamin A in addressing child hood mortality
- Vitamin A supplementation in infants and young children
- Role of Vitamin A in addressing (or not) child morbidity
- Controversies in approaches used to target Vitamin A

Required Readings for class 8:

1. K.P. West, J. Katz MSa, S.C. LeClerq BSa, E.K. Pradhan BAa, J.M. Tielsch PhDa, A. Sommer MDa, Prof, R.P. Pokhrel FRCSb, S.K. Khatri FRCSb, S.R. Shrestha MPHb, M.R. Pandey FRCSa. Efficacy of vitamin A in reducing preschool child mortality in Nepal. *The Lancet* Volume 338, Issue 8759, 13 July 1991, Pages 67-71 (Originally published as Volume 2, Issue 8759)
2. Eduardo Villamor and Wafaie W. Fawzi. Vitamin A Supplementation: Implications for Morbidity and Mortality in Children. *J Infect Dis.* (2000) 182 (Supplement 1): S122-S133.

Additional References:

1. Noel Solomons' chapter on Vitamin A in *Present Knowledge in Nutrition*
2. WHO Vitamin A Guidelines (6 separate documents)

Class 9: Protein quality

11/14/2016, Monday 1:30-4:30, Jaharis 156

Instructor(s): Shibani Ghosh

Learning Objectives for class 9: Upon completion of this class, students will be able to:

- Understand the role of essential amino acids in weight gain and linear growth and the potential mechanisms for such impacts
- Understand the emerging role of non essential amino acids and their impact on growth
- Understand the association of protein quality to linear growth
- Understand the role of other components in animal source foods (such lactoglobulins) on growth

Required Readings for class 9:

1. Ghosh S., Suri D. and Uauy R. Assessment of Protein Adequacy in Developing Countries: Quality Matters. British Journal of Nutrition, 2012
2. van Vught AJ, Heitmann BL, Nieuwenhuizen AG, Veldhorst MA, Andersen LB, Hasselstrom H, et al. Association between intake of dietary protein and 3-year-change in body growth among normal and overweight 6-year-old boys and girls (CoSCIS). Public Health Nutrition. 2009;First View:1-7.

Additional References:

1. Hoppe C, Molgaard C, Juul A, Michaelsen KF. High intakes of skimmed milk, but not meat, increase serum IGF-I and IGFBP-3 in eight-year-old boys. Eur J Clin Nutr. 2004;58(9):1211-6.
2. van Vught AJAH, Heitmann BL, Nieuwenhuizen AG, Veldhorst MAB, Brummer R-JM, Westerterp-Plantenga MS. Association between dietary protein and change in body composition among children (EYHS). Clinical Nutrition. 2009;28(6):684-8

Class 10: Energy, Fats and Essential Fatty acids

11/21/2016, Monday 1:30-4:30, Jaharis 156

Instructor(s): Shibani Ghosh

Learning Objectives for class 10: Upon completion of this class, students will be able to:

- Concepts of energy, macronutrient balance
- Energy Excess (overweight and obesity) and Energy Deficit (wasting)
- Concepts of essential fatty acids and their role in affecting nutrition outcomes
- Understand the role of essential fatty acids in visual acuity and cognition of pre-term and term infants, growth of infants

Required Readings for class 10:

1. Uauy R, Kain J. The epidemiological transition: need to incorporate obesity prevention into nutrition programmes. *Public Health Nutr.* 2002 Feb;5(1A):223-9.
2. FAO/WHO 2008. Fat and Fatty acid requirements and recommendations for infants of 0-2 years and children 2-18 years. In *Fats and fatty acids in human nutrition Report of an expert consultation.* FAO Food and Nutrition Paper 91. Pages 63-72
3. Willatts., P. And Forsythth JS. The role of long-chain polyunsaturated fatty acids in infant cognitive development Prostaglandins, Leukotrienes and Essential Fatty Acids Volume 63, Issues 1-2, July 2000, Pages 95-100
4. Uauy R., Hoffman Dr., Peirano P., Birch DG., and Birch E.E. Essential fatty acids in visual and brain development. *Chemistry and Materials Science, Lipids,* Volume 36, Number 9, 885-895.

Additional References:

5. FAO/WHO 2008. Fat and fatty acids during pregnancy and lactation. In *Fats and fatty acids in human nutrition Report of an expert consultation.* FAO Food and Nutrition Paper 91. Pages 77-85
6. WHO 2007. Catch-up growth. In *Protein and amino acid requirements in human nutrition.* Pages 185-191. WHO Technical report series 935, WHO Geneva

Class 11: Vitamin D

11/28/2016 Monday 1:30-4:30, Jaharis 156

Instructor(s): Shibani Ghosh

Learning Objectives for class 11: Upon completion of this class, students will be able to:

- Vitamin D deficiency and its clinical manifestations
- Current public health perspective of Vitamin D deficiency

Required Readings for class 11:

1. Holick M.F. Vitamin D Deficiency. *N Engl J Med* 2007; 357:266-281 July 19, 2007 DOI: 10.1056/NEJMra070553
2. Palacios C, Gonzalez L. Is vitamin D deficiency a major global public health problem? *The Journal of steroid biochemistry and molecular biology*. 2014;144PA:138-145. doi:10.1016/j.jsbmb.2013.11.003.

Class 12: Iodine

12/5/2016, Monday 1:30-4:30, Jaharis 156

Learning Objectives for class 12: Upon completion of this class, students will be able to:

- Iodine deficiency disorders and their clinical manifestations
- Role of salt iodization in tackling iodine deficiency disorders
- Current public health perspective of iodine deficiency disorders

Required Readings for class 12:

1. WHO Secretariat on behalf of the participants to the Consultation, M Andersson, B de Benoist, F Delange and J Zupan. Prevention and control of iodine deficiency in pregnant and lactating women and in children less than 2-years-old: conclusions and recommendations of the Technical Consultation. *Public Health Nutrition*, vol 10, no. 12a, 1606-1611, December 2007
2. de Benoist B et al. Iodine deficiency in 2007: Global progress since 1993, *Food and Nutrition Bulletin*, vol 29, no. 3, 195-202, September 2008
3. Pearce EN, Andersson M, and Zimmermann MB. Global Iodine nutrition: where do we stand in 2013? *Thyroid*. 2013 May;23(5):523-8. doi: 10.1089/thy.2013.0128. Epub 2013 Apr 18.

Class 13:

12/12/2016, Monday 1:30-4:30, Jaharis 156