Environmental Health Sciences 214
Spring Quarter 2016
Children’s environmental health: prenatal and postnatal
Instructor: Michael Collins (CHS 71-297; mdc@ucla.edu)


The goal of this course will be to examine how environmental exposures to chemical, physical and biological agents during the period of maturation (from fertilization to adulthood) cause pathophysiological perturbations in homeostasis at any stage during life.

Lectures 1 and 2: Organism Development
-The environment as a determinant of phenotype: developmental plasticity
-How agents in the environment effect molecular changes in development
-Epigenetics
-Embryonic defenses: survival in a hostile world.

Learning objectives (LO):

LO 1: To gain an appreciation for the importance of the environment in determining phenotype via the presentation of examples from the biological kingdoms.

LO 2: To enumerate and discuss the relevance of various biological protection mechanisms for minimizing environmental impacts on developing organisms.

References: (Textbook: Gilbert SF and Epel D. Chapters 1, 2 and 3)


Lectures 3, 4, 5: Teratogenesis and related developmental outcomes (stillbirths/fetal deaths, spontaneous abortions, fetal growth retardation, functional deficits, prematurity)

-Aspects of gestational embryology
-Specific chemical teratogens: cyclopamine, retinoids, thalidomide, TCDD, ethanol, mercury
-Radiation as a physical teratogenic agent -Infectious agents as teratogens
-Maternal conditions in teratogenesis
-Behavioral teratogenesis
-Male-mediated teratogenesis
-Antagonism of teratogenesis by folates

LO 3: To evaluate Wilson’s principles of teratology from a modern context.

LO 4: To provide examples of each of the major categories of human teratogens and the extent of mechanistic understanding of how these agents cause dysmorphogenesis.

LO 5: To scientifically assess the role of folic acid in antagonism of teratogenesis.

LO 6: To enumerate the principles of behavioral teratology as differentiated from classical teratology.

LO 7: Be able to describe how genes and the environment may interact to induce congenital malformations.

LO 8: Conceptualize the similarities and differences between neoplasia and embryogenesis.

**References**: (Textbook: Gilbert SF and Epel D. Chapters 4 and 5)


Lectures 6, 7, 8: Fetal basis of adult disease:

- Barker hypothesis
- Endpoints associated with fetal exposures
- Transplacental carcinogenesis
- Mechanisms of imprinted fetal perturbations

LO 9: To know what the Barker Hypothesis states and to have a conceptual understanding of the ramifications of the Hypothesis.

LO 10: To conceptualize the role of epigenetics in the fetal basis of adult disease.

LO 11: To be able to describe potential mechanisms of human pathogenesis induced during the fetal period. Have an awareness that the concept of mechanism is a continually evolving concept.

References: (Textbook: Gilbert SF and Epel D. Chapter 7)


Lecture 9: The dynamic developmental physiology of infants and children as differentiated from adults
-Analysis of how various physiological parameters differ between children and adults and the impact of developmental dynamics on processes relevant to chemical exposures.

LO 12: To enumerate ways in which children physiologically and behaviorally differ from adults and to assess how the differences manifest as differential susceptibility to environmental factors.

LO 13: To conceptualize the differences between childhood and adult cancers, including how sequencing information contributes to an understanding of the differences.

LO 14: To have familiarity with the underlying assumptions for applying a lifestage approach to hazard and dose-response characterization.

References:


Lectures 10, 11, 12: Endocrine disruption

- Holistic definition of the endocrine system
- Biochemistry, cell biology, physiology of normal endocrine function
- Role of endocrine system in reproductive function
- Chemical perturbations of endocrine function
- Mechanisms of endocrine disruption

LO 15: To develop an overall capacity to explain at the organ system level, anatomical and physiological aspects of the endocrine system.

LO 16: To be able to describe the scientific history of diethylstilbestrol with respect to carcinogenesis and teratogenesis.

LO 17: Enumerate the alternative pathways by which steroid hormone ligands may initiate biological effects in cells, including through nuclear receptors, via cell surface receptors, and through non-receptor impacts on cellular signaling. A further goal will be to be able to integrate from a systems biology perspective how these pathways may interact.
LO 18: Show a fundamental appreciation for what health effects may result from chemicals disrupting the endocrine system and how the chemical causes the outcome, and predict other health outcomes that may be due to endocrine disruption based on a synthesis of the information.

LO 19: Demonstrate an ability to explain the promiscuous nature of the steroid hormone receptors with respect to ligand variability.

References: (Textbook: Gilbert SF and Epel D. Chapter 6)


Lecture 13 and 14: Postnatal contribution to the metabolic syndrome

-Role of postnatal factors (e.g. diet, weight gain) in the metabolic syndrome
-Interaction of nervous, endocrine and immune systems in the metabolic syndrome
-Role of the microbiome in the metabolic syndrome
LO 20: Be able to describe how postnatal environmental factors such as diet are involved in the metabolic syndrome.

LO 21: Be able to discuss the role of microbiome species diversification is associated with the metabolic syndrome.

LO 22: Be able to describe the role of hormones other than insulin in the metabolic syndrome.

References:


**Lecture 15 and 16: Neurological dysfunction associated with environmental exposures in children**

- Normal development of the nervous system and the blood-brain barrier
- Genetic versus environmental input to normal development
- Environmental chemical exposures and pathology
- Mechanisms of perturbation

LO 23: To realize that the nervous system is constantly developing from conception through adulthood, yet the goal is to be able to enumerate specific periods of sensitivity to perturbation that relate to specific events in the developmental pathway.

LO 24: To have an anatomical and functional understanding of the role of the blood-brain barrier.

LO 25: Using the effects of socioeconomic status on the nervous system as an example, develop a cognizance for how psychosocial variables will eventually be defined scientifically.

LO 26: Develop an appreciation for the tremendous complexity of the nervous system and be able to demonstrate this complexity at multiple levels of nervous system organization. Also, have an appreciation for how this complexity leads to vulnerability due the large number of targets for environmental perturbation.

**References:**


Lectures 17 and 18: Immune system dysfunction associated with environmental exposures in children

-Functional aspects of the cellular innate and acquired immune systems
-Development of the immune system in children
-Chemical and physical perturbations of the system

LO 27: To have an appreciation for the functional roles of the innate and acquired immune systems, and the embryonic, fetal and postnatal development of the systems.

LO 28: To integrate information from the previous studied systems (neural and endocrine) to be able to explain how developmental perturbations of those systems could impact immunity and vice versa.

LO 29: To be able to enumerate classical agents that have been shown to perturb development of the immune system and the associated outcomes.

LO 30: To be capable of formulating hypotheses regarding the reasons for the increased incidence of asthma.

References:


Lewis JD, Chen EZ, Baldassano RN ….. Li H, Wu GD, Bushman FD. Inflammation, antibiotics, and diet as environmental stressors of the gut microbiome in pediatric Crohn’s disease. Cell Host Microbe 18(4): 489-500.


Lectures 19 and 20: Respiratory system dysfunction associated with environmental exposures in children

-Development and function of the respiratory system in children
-Chemical and physical perturbations of the system during development

LO 31: To have a basic familiarity with the prenatal and postnatal development of the respiratory system from an anatomical and physiologic perspective.
LO 32: To be able to formulate hypotheses as to how various air pollutants may perturb lung development and function.

LO 33: Be able to delineate reasons for the differential susceptibility of the pulmonary system in children as compared to adults.

References:


Teo SM, Mok D, Pham K, Kusel M, Serralha M et al. 2015. The infant nasopharyngeal microbiome impacts severity of lower respiratory infection and risk of asthma development. Cell Host Microbe 17: 1-12.


Course assignments:

Each student will be required to make one 10-20 minute presentation on papers from the syllabus or other papers that elucidate concepts that are critical to children’s environmental health. These presentations will occur during the allotted time slots for the appropriate topics. In addition, each student will be required to write two review papers on topics determined by the student in consultation with the instructor. These will be comprehensive review papers of specific topics in children’s environmental health (no specific length but the topic must be covered extensively). Therefore, choose a narrow topic.

Grading: Presentation: 30%
Class participation: 10%
First paper: 30%
Second paper 30%
Competencies:

The Association of Schools of Public Health (ASPH) Environmental Health competencies that will be covered in this course are as follows:

2C. Describe the direct and indirect human, ecological and safety effects of major environmental and occupational agents.

3C. Specify current environmental risk assessment methods.

4C. Describe genetic, physiologic and psychosocial factors that affect susceptibility to adverse health outcomes following exposure to environmental hazards.

6C. Explain the general mechanisms of toxicity in eliciting a toxic response to various environmental exposures.