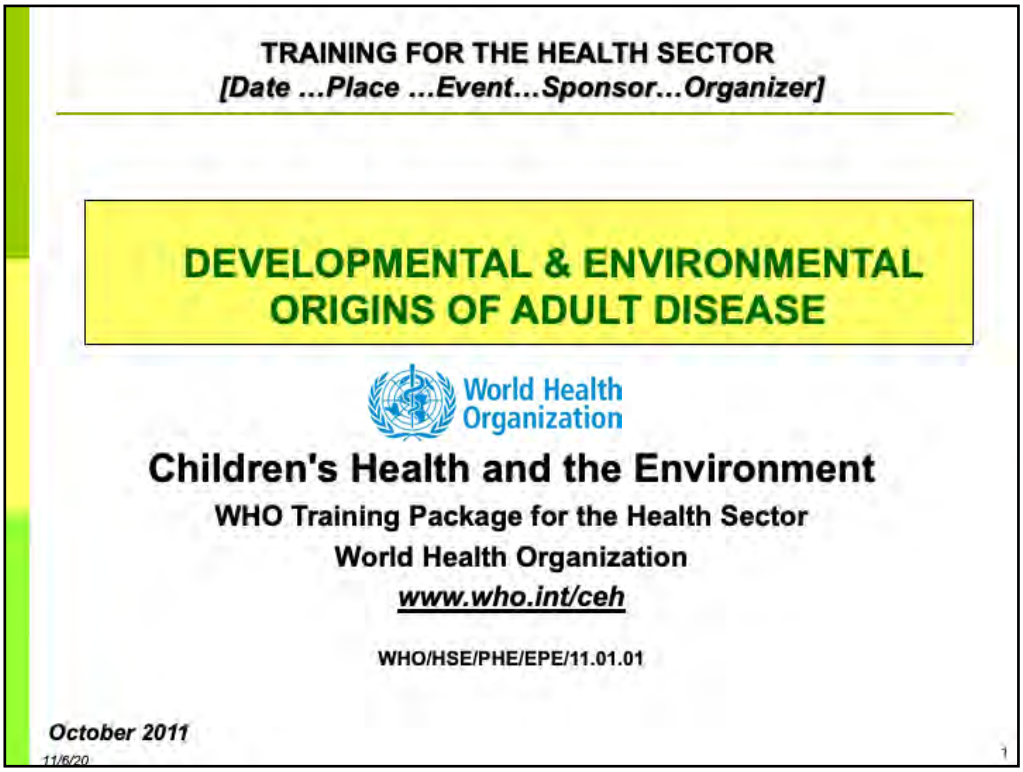
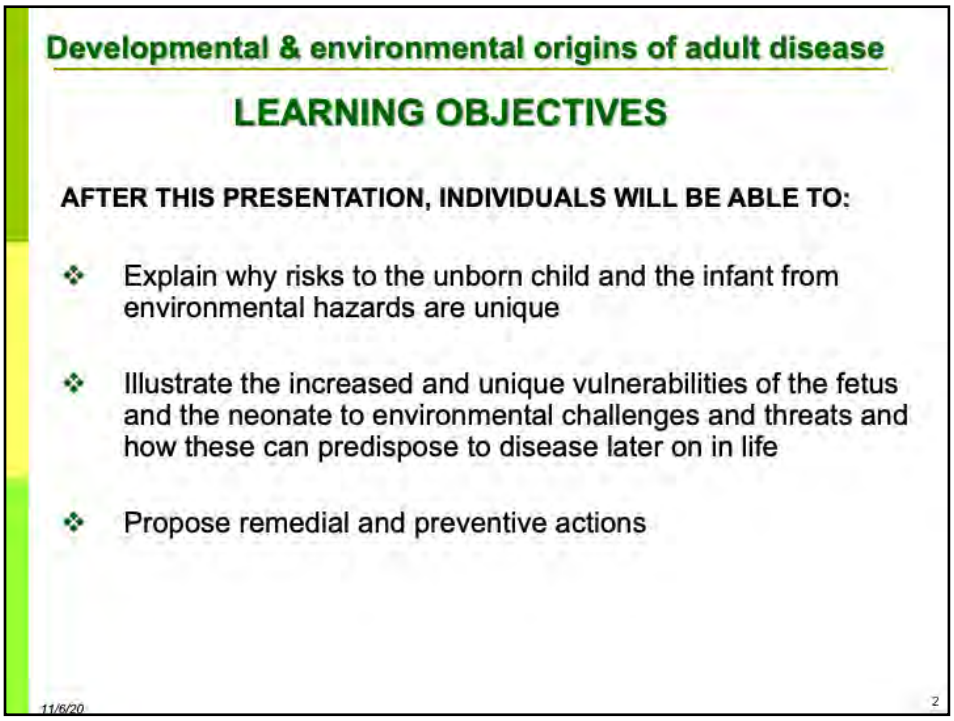


<<NOTE TO USER: Please add details of the date, time, place and sponsorship of the meeting for which you are using this presentation in the space indicated.>>

<<NOTE TO USER: This is a large set of slides from which the presenter should select the most relevant ones to use in a specific presentation. These slides cover many facets of the problem. Present only those slides that apply most directly to the local situation in the region.>>

<<NOTE TO USER: Both embryonic and fetal origins of adult disease will be considered in this presentation. The end of the eighth week of gestation marks the end of the "embryonic period" and the beginning of the "fetal period">>

<<NOTE TO USER: This module presents several examples of risk factors that affect development, you can find more detailed information in other modules of the training package that deal with specific risk factors, such as lead, mercury, pesticides, persistent organic pollutants, endocrine disruptors; or disease outcomes, such as neurodevelopment effects, immune effects, respiratory effects, and others.>>

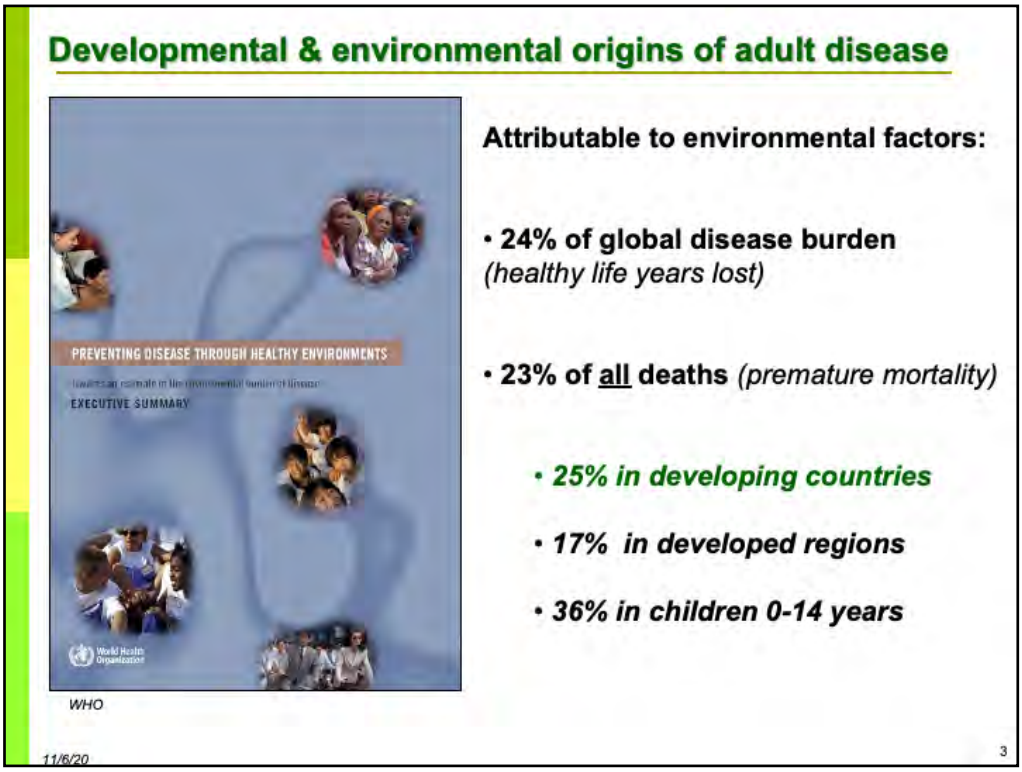


After this presentation, individuals will be able to:

❖Explain why risks to the unborn child and the infant from environmental hazards are unique

❖Illustrate the increased and unique vulnerabilities of the fetus and the neonate to environmental challenges and threats and how these can predispose to disease later on in life

❖Propose remedial and preventive actions

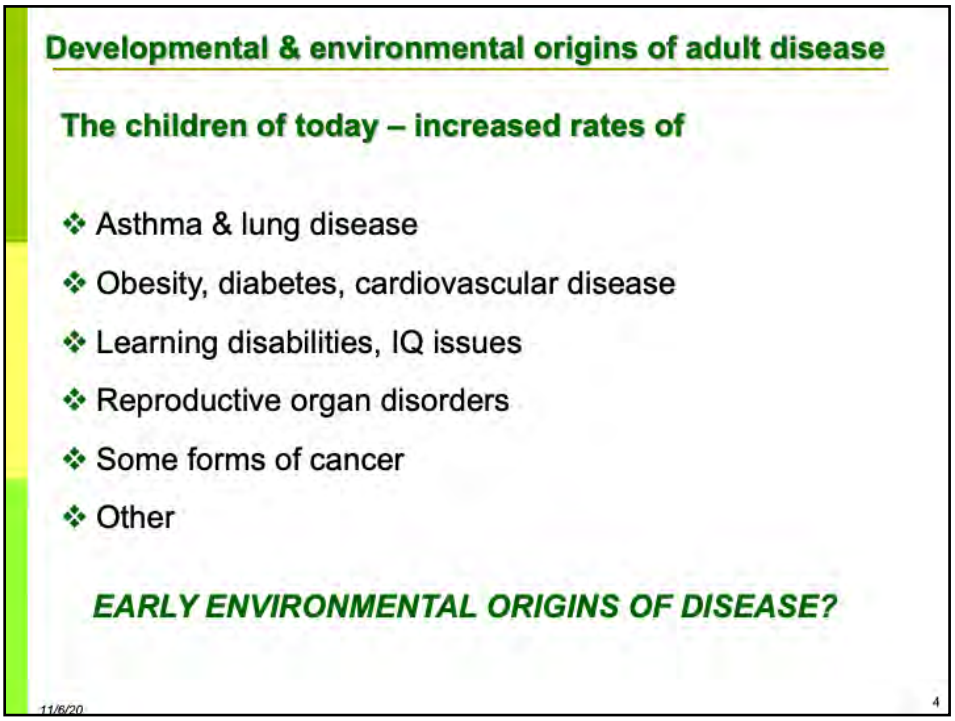


WHO has published an important report on Preventing Disease Through Healthy Environments. This report confirms that approximately one-quarter of the global disease burden, and more than one-third of the burden among children, is due to modifiable environmental factors. The analysis here also goes a step further, and systematically analyzes how different diseases are impacted by environmental risks… and by 'how much.' Heading that list are diarrhoea, lower respiratory infections, various forms of unintentional injuries, and malaria. This 'environmentally-mediated' disease burden is much higher in the developing world than in developed countries - although in the case of certain non-communicable diseases, such as cardiovascular diseases and cancers, the per capita disease burden is larger in developed countries. Some 2.5 million people die every year from cardiovascular disease attributable to environmental factors, including work-related stress, as well as chemical, air pollution, and second hand smoke exposures.

Children bear the highest death toll with more than 4 million environmentally-caused deaths yearly, mostly in developing countries. The infant death rate from environmental causes is 12 times higher in developing than in developed countries, reflecting the human health gain that could be achieved by supporting healthy environments.

Ref:

•WHO. Preventing disease through healthy environments: Towards an estimate of the environmental burden of disease. Pruess-Ustun A., Corvalan C. *WHO*, Geneva, Switzerland. 2006



<<READ SLIDE.>>

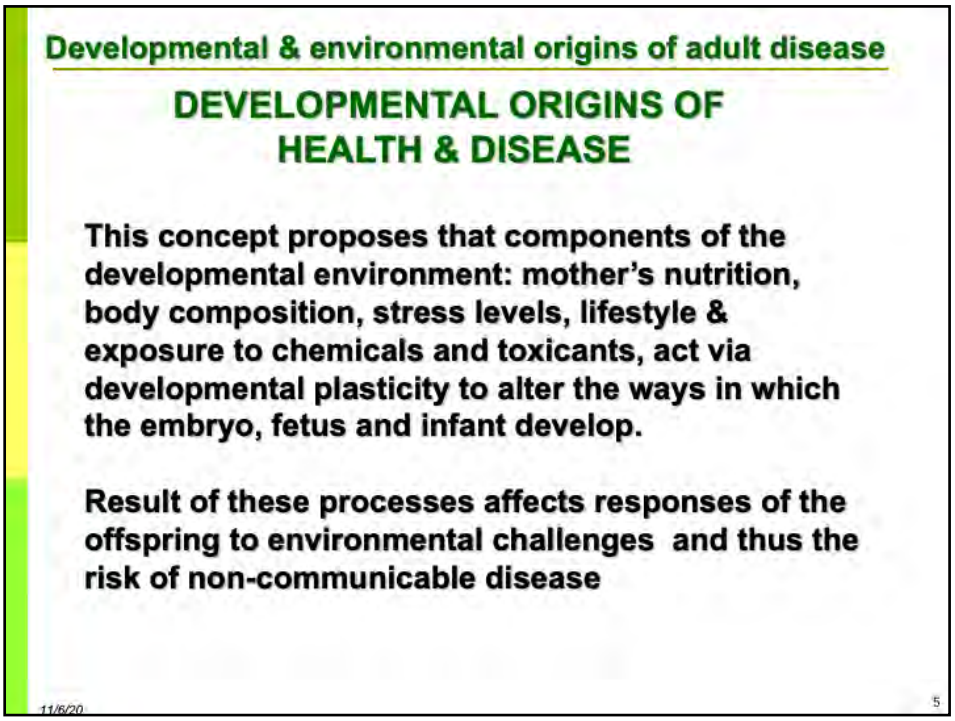
Ref:

•Neira M et al. Environmental threats to children's health – a global problem. *Int J Environment and Health*, 2008, 2(3/4):276.

•Pronczuk J, Bruné MN, Gore F. Children's environmental health in developing countries. In: *Encyclopedia of Environmental Health*. J. Nriagu, ed. Elsevier, 2011.

•Trasande L, Landrigan PJ. The National Children's Study: a critical national investment. *Environ Health Perspect,* 2004, 112(14): A789–A790.

•WHO. Children's health and the environment: a global perspective. Pronczuk J, ed. *WHO*, Geneva, 2005



The Developmental Origins of Health and Disease (DOHaD) concept proposes that a range of components of the developmental environment, in particular mother's nutrition, body composition, stress levels, lifestyle and exposure to chemicals and toxicants, act via developmental plasticity to alter the ways in which the embryo, fetus and infant develop. These processes act across the normal range of human development, and do not merely operate at the extremes. They do not necessarily produce a reduction in fetal growth, for example. The result of these processes is to affect the responses of the offspring to environmental challenges and thus the risk of non-communicable diseases.

According to current thinking, coronary heart disease and related disorders arise through a series of interactions between environmental influences and the pathways of development that precede them. Thus these diseases are the product of branching development pathways, which are triggered by the environment both before and after birth. Maternal influences (e.g. body composition, dietary balance), are known to have long-term effects on adult disease, without necessarily affecting size at birth. For instance, several studies have demonstrated that underweight women are more likely to have infants that go on to develop a resistance to insulin in adulthood, an association that can only be partly attributed to a low birth weight.

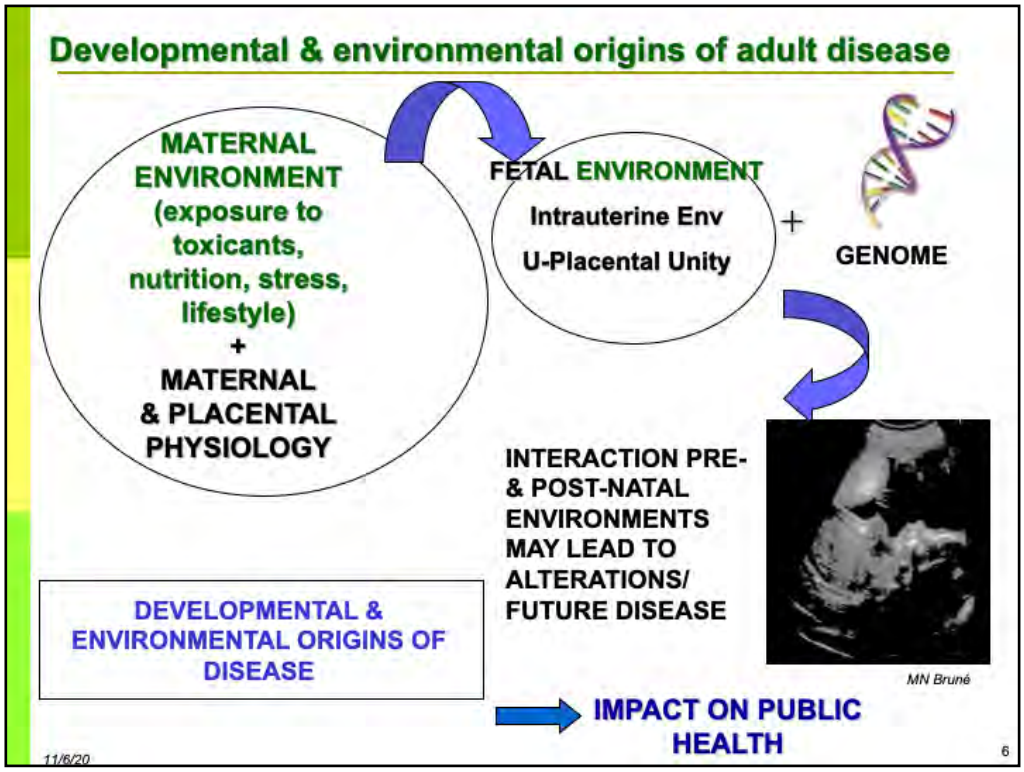
Refs:

•Gluckman, P. et al. The fetal, neonatal, and infant environments - the long-term consequences for disease risk. *Early Human Development*, 2005, 81: 51-59.

•Grandjean. P. Prenatal programming and toxicity. *Basic and Clinical Pharmacology and*

Toxicology, 2008, 102:2.

•WHO. Promoting optimal fetal development: report of a technical consultation. *WHO*, Geneva, Switzerland, 2006.



Fetal growth is determined by the interaction between the environment and the fetal genome. The fetal environment is determined by the maternal environment and by maternal and placental physiology. There is evidence that the interaction between the fetal environment and genome can determine the risk of postnatal disease, as well as the individual's capacity to cope with the postnatal environment.

Exposure to environmental pollutants inhaled, or introduced with food by the mother during pregnancy, may disrupt the epigenetic setting of embryo and fetus cells, interfering with cells' differentiation, adversely affecting the planning and development of various organs and tissues, opening the way to metabolic disorders, neuro-endocrine, neuro-degenerative and even neoplastic diseases that may occur years/decades later, in adulthood.

Refs:

•Braun JM et al. Exposures to environmental toxicants and attention deficit hyperactivity disorder in U.S. children. *Environ Health Perspect*, 2006, 114(12):1904–1909

-Gluckman P, Hanson M. Developmental origins of disease paradigm: a mechanistic and evolutionary perspective. *Pediatric Research*, 2004, 56(3): 311

•Gluckman, P. et al. The fetal, neonatal, and infant environments - the long-term consequences for disease risk. *Early Human Development*, 2005, 81: 51-59

•Gluckman, P et al. Effect of in utero and early-life conditions on adult health and disease. *New England Journal of Medicine*, 2008, 359:61-73

•Gluckman, P. et al. Environmental influences during development and their later consequences for health and disease: implications for the interpretation of empirical studies. *Proceedings of the Royal Society of London - Series B: Biological Sciences*, 2005, 272: 671-677

•Hertz-Picciotto I et al. Prenatal exposures to persistent and non-persistent organic compounds and effects on immune system development. *Basic Clin Pharmacol Toxicol*, 2008, 102(2):146-54.

•Perera FP et al. A summary of recent findings on birth outcomes and developmental effects of prenatal ETS, PAH, and pesticide exposures. *Neurotoxicology,* 2005; 26(4):573–587

•Reik W. Stability and flexibility of epigenetic gene regulation in mammalian development. *Nature,* 2007, 447(7143):425–432

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•Zawia NH, Basha MR. Environmental risk factors and the developmental basis for Alzheimer's disease. *Rev Neurosci*, 2005, 16(4):325-37

Picture provided by MN Bruné