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Developmental Origins of Health and Disease: A Challenge for Nurses



Doria K. Thiele PhD, CNM, IBCLC^{a,*},
Cindy M. Anderson PhD, WHNP-BC, FAHA, FNAP, FAAN^b

^aOregon Health and Science University, Portland, OR

^bThe Ohio State University College of Nursing, Columbus, OH

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Prevention of disease is a cornerstone of nursing care. Through our endeavors in research, teaching, and clinical care, nurses consistently seek to change the trajectory of disease development. The theoretical framework known as the Developmental Origins of Health and Disease (DOHaD) offers a new lens that shifts the current disease prevention paradigm upstream, encouraging intensified care of pregnant girls/women, neonates, and infants. This new focus parallels other emerging ecobiodevelopmental, life-course theories, which identify the long-term impact of early environments and stressors on the later risk of chronic adult diseases. Nurses have the potential to influence the health of multiple generations by incorporating DOHaD perspectives and interventions into their research and patient care.

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NON-COMMUNICABLE DISEASES (NCDs), such as heart disease, diabetes, and hypertension, outpace infectious diseases as a leading cause of death, accounting for greater than 60% of all deaths worldwide (Diem, Brownson, Grabauskas, Shatchkute, & Stachenko, 2015; United Nations General Assembly, 2011). The primary mechanism by which these diseases are currently addressed by health care providers by recommending adult lifestyle changes, such as tobacco cessation, activity regimens, and dietary modifications. Although beneficial to overall health, these lifestyle modifications do not reverse the impact of disease to the degree expected. *Developmental Origins of Health and Disease* (DOHaD) is an emerging field that seeks to slow the rapid growth of NCDs. DOHaD research shifts the focus upstream to how environmental factors experienced by the developing fetus impact later development of adult health

or disease. This emerging field aligns with other lifecourse, ecobiodevelopmental frameworks, such as the Adverse Childhood Experience (ACE) study, which looked at the long-term effect of early childhood environments and stressors.

Nurses are faced with a myriad new approaches to caring for their patients across the lifespan. This article provides a new perspective on how nurses can utilize DOHaD to frame challenges of practice and research, and be the leaders in this emerging field.

Background

DOHaD offers grounding in a sound and expansive theory in which health modifications have the potential to improve the lives of multiple generations. The DOHaD hypothesis, sometimes called the Barker Hypothesis, was first described in the late 1980s by Dr. David Barker and colleagues in the United Kingdom. Dr. Barker used large scale epidemiologic data to demonstrate that the rate of coronary heart disease and type 2 diabetes is greatest among adults born at lower birth weights, with an inverse relationship between birth weight and diseases (Barker &

* Corresponding author: Doria K. Thiele, PhD, CNM, IBCLC.
E-mail address: thiele@ohsu.edu.

Osmond, 1988; Barker & Thornburg, 2013; Barker, Winter, Osmond, Margetts, & Simmonds, 1989; Hales et al., 1991). Dr. Barker has described that it was the hard work and visionary nature of a turn-of-the-century midwife, Ethel Burnside, which allowed the development of this theory (Barker, 2003). Burnside established a cadre of midwives who traveled the Hertfordshire area of England, providing obstetric care and doing home visits on infants. In 1911, Burnside developed a documentation tool for recording infant births, birth weight, and at subsequent visits the weight and health status of the infant. These cards were kept and maintained by this midwifery service until 1948, providing a large data set for later use by Dr. Barker and colleagues (Barker, 2003). The validity of this theory has now been confirmed across many studies and countries (Wang et al., 2014).

There are three main tenets of DOHaD that explain the mechanisms that lead to adult disease (Cota & Allen, 2010). The first tenet is *plasticity*, which describes the malleable, or ‘plastic’, nature of the human body and physiology. From an evolutionary standpoint, it is beneficial for the human body to adapt to different external influences, such as scarcity of food or nutrients. When the fetus is presented with inadequate blood flow through the placenta, for example, the fetal metabolic pathways adjust to accommodate this environment. It is important to note that plasticity does not end at birth; human physiology continues to be moldable at least through early childhood (Sullivan, Hawes, Winchester, & Miller, 2008). The second tenet of DOHaD is *epigenetic modification*. Epigenetics translates literally to “above the genes” and is the study of modifications to genes that do not alter DNA sequence but do alter gene “expression”. Epigenetic changes to DNA may lead to increased or decreased gene expression and therefore protein transcription. Epigenetic modification is central to developmental

processes throughout gestation and is influenced by internal and external environmental factors across the lifespan. Epigenetic patterns are potentially modifiable, providing a target for disease prevention and health promotion. The final tenet of DOHaD is *programming*. Programming refers to the lifelong alterations in organ and tissue structure or functional pathways that occur during fetal and early life development. There seem to be specific time periods during development in which different organs and body systems are more susceptible to programming of disease. The timing of an insult or deprivation may be more impactful than quantity of the harmful exposure (Barker & Thornburg, 2013). Most adult onset NCDs are of a complex nature and programming confers a propensity for disease, not an absolute determination. As an example of the three tenants of DOHaD, if the developmentally ‘plastic’ fetus is exposed to poor placental blood flow, which leads to epigenetic changes that alter insulin production, these modifications may, in turn, be permanently programmed and increase the individual’s risk of adult-onset diabetes (Figure 1).

The Human Genome Project sought to sequence the entire human genome, creating a map of gene locations (NHGRI, 2015). This map was successfully completed in 2003, but the National Human Genome Research Institute continues to be prolific, moving from genome sequencing to design of medical interventions (NHGRI, 2015). In parallel to this revolution of genetics information, the arena of DOHaD research, investigating *in utero* environmental factors that alter gene expression and phenotype in offspring, has been growing. Both lines of inquiry seek to determine etiology in order to prevent or alter the course of disease. A genetic test showing propensity for disease or a prenatal exposure with the potential to impact health does not always have a direct line to a specific phenotypic outcome (Hamilton, 2009). Framing challenges faced by nurses



Figure 1 An illustration of the Developmental Origins of Health and Disease theory and its tenants.

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