Emerging Role of Nutri-Epigenetics in Inflammation and Cancer

Paule V. Joseph, PhD, MS, FNP-BC, CTN-B, Sarah K. Abey, PhD, RN, and Wendy A. Henderson, PhD, MSN, CRNP

Disease risk and development are influenced by many factors (e.g., lifestyle, environment, nutrition) and genetics. Evidence shows that these factors interact with one another in ways that are unique to each person, making quantification of the risks of developing diseases such as cancer challenging. Cancer is a metabolically driven process with dynamic nutrient-responsive alterations within the human genome (Vander Heiden, Cantley, & Thompson, 2009). The epigenetic machinery acting on the human genome is heavily susceptible to alterations in metabolism and nutrition, particularly during periods of inflammation (Keating & El-Osta, 2015). This emerging knowledge leads to current interest in nutri-epigenetics or nutri-epigenomics. Epigenetics focuses on processes that regulate how and when certain genes are turned on and off, whereas epigenomics refers to analysis of global epigenetic changes across many genes, made possible by high-throughput methods. Therefore, nutri-epigenetics focuses on the process by which nutrition regulates how one specific gene is turned on or off, whereas nutri-epigenomics refers to the analysis of the interaction among multitudes of genes and nutrition, as well as the effects on global gene expression, which may vary among different tissues. This article aims to provide a brief overview of epigenetics and how it can be affected by metabolism and nutrition, discuss nutri-epigenetics and cancer, and consider the implications of nutri-epigenetics knowledge and evidence for nursing practice.

Background

The fields of both epigenetics and epigenomics have been empowered by publicly available databases (e.g., Human Epigenome Browser from Washington University School of Medicine in St. Louis; epigenome gateway.wustl.edu/info) that have focused on gathering epigenetics sequences for epigenome-wide association studies. These studies have demonstrated that epigenetic alterations related to food components and environmental (nutrition) factors, along with other genetic mutations, play a role in the development of inflammatory diseases, such as cancer (van Velden et al., 2015). The field of nutri-epigenomics provides new insights into diet–genome interactions, and these insights have permitted explorations of the use of metabolically based drugs, such as metformin (Glucomphage®), as part of cancer therapy (Kasznicki, Sliwinska, & Drzewoski, 2014) and the design of nutrition- and lifestyle-based cancer management strategies (Richman et al., 2013).

The term epigenetics was introduced to describe the interactions between genes and the environment that gave rise to phenotypes during development; it has been expanded to include environmentally responsive cellular processes that can be heritable and have long-term...