Epigenetics and Human Health

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The term epigenetics describes mechanisms inducing changes in gene expression or phenotype not caused by alterations in the underlying DNA sequence. Compared to the genome, which is almost identical in different cell types and is conserved throughout life, the epigenome is varying between different cell types as well as over the course of a lifetime (1). Two studies demonstrated, that identical twin pairs, being epigenetically indistinguishable at early life exhibit striking differences in the epigenetic state of their tissues over time, when they accumulated significant differences in global levels of epigenetic marks (2).

It is becoming increasingly evident that distant exposures in utero, in early childhood, later in adult life and even in the elderly influence the DNA configuration at critical ontogenetic stages as well as at these alternations of the DNA sequence. Occurring in the gametes these changes may be heritable and they are affected from the moment tests and oxides develop during fetal growth (3-5). A well-known example is the Dutch hunger winter of 1944-45. The methylation of the IGF2, which plays a crucial role in growth and development, was investigated in individuals exposed to the famine periconceptionally. All CpG sites except one were significantly methylated than in unexposed controls (6).

Disregulation of epigenetic processes is involved in the initiation and progression of several diseases. Compared to gene alterations, epigenetic changes are reversibly and therefore are exciting targets for potential chemopreventive strategies and therapies (8). Next to numerous synthetic epigenetic chemotherapeutics a multitude of biologically active food compounds have been described to impact epigenetic pattern directly by enzyme activity interference and indirectly by metabolic processes associated with energy metabolism (9).

...a multitude of biologically active food compounds have been described to impact epigenetic pattern directly and indirectly.

Food compounds, participating in the one-carbon metabolism, including vitamins B12, B6, folate, choline and methionine provide methyl groups for the biochemical pathway of methylation processes. Epidemiological data reveal diminished dietary folate induced omission of DNA methylation to be associated with increased cancer susceptibility and low folate status is limited to risk is higher in developing colorectal cancer (10, 11). Several more bioactive food components have also been suggested to alter cancer susceptibility. Genistein, e.g. was associated with cancer chemoprevention and decreased DNA methyltransferases expression (12). Interestingly most dietary HDAC inhibitors were able to reverse methylation patterns. Epigenetic patterns seem to be heritable (though this may be the weakest part, since the evidence is not entirely persuasive). Epigenetic changes fill the gap between genes and the environment: the mysterious connections between spontaneous heritable mutations and selection in neo-Darwinian theory may be overcome by a more sophisticated paradigm that resembles Lamarck’s research program "...

...veins explain epigenetic mechanisms and what consequences environmenal changes influence diet and toxins can have on the immune system and aging.

Part II emphasizes on hereditary aspects: steafana Biocca provides a short introduction to the key concepts of genetic association studies with the core area of meta-analysis. She reports on the most published meta-analyses of the effect of metformin on the risk of type II diabetes and presents the findings on the role of polyphenol, appears to be a dietary modifier of some effects of dietary restriction and be mimicked by other dietary interventions? Age (Dordr). 2009 Jul 1. Mar;132:365-9.


...asks for translational effects because of nutritional constraints during fetal organ development and other critical phases in life cycle.

health policy makers have to face with the emerging fields in genomic research. They introduce the field of Public Health Genomics as a translational research and the Public Health Genomics European network (PHGEN) as a successful platform for researchers, policy makers and their institutions in organizing this process. Astrid Gernigon argues for an integr- ated, ethnically sound policy framework in public health from which to deal with emerging public health issues in the expanding area of epigenetics.

References:


20. Rowinger MJ, McMullen MH, Chip- man DC, Schilling JM, Mansour RA, Schilinsky K. Vitamin A and its derivatives induce hepatic...