

Nutrition Therapy in the Age of Genomics

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Genetics and Your Health
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Immediate Future

- Craig Venter, who played a prominent role in sequencing of the human genome predicts that within 5 years we will be able to sequence a person's entire genome for about \$1000 – We are getting there!

Ref: Geogory Stock " Redesigning Humans: choosing our genes, changing our future." 2003; Mariner Books

Question

- Will it really make a difference in my health outcome if I know my genomic makeup?
- Arguable at this point but a lot of people are interested in this topic!
 - “Genome Nutrition” Google hits = 1.4 Million
 - “Nutrigenomics” Google hits = 270, 000 hits

The Concept of Genetics and Nutrition

- “Positive health requires a knowledge of man’s primary constitution and the powers of various foods....”

Hippocrate’s Concept of Positive Health
480 B.C.

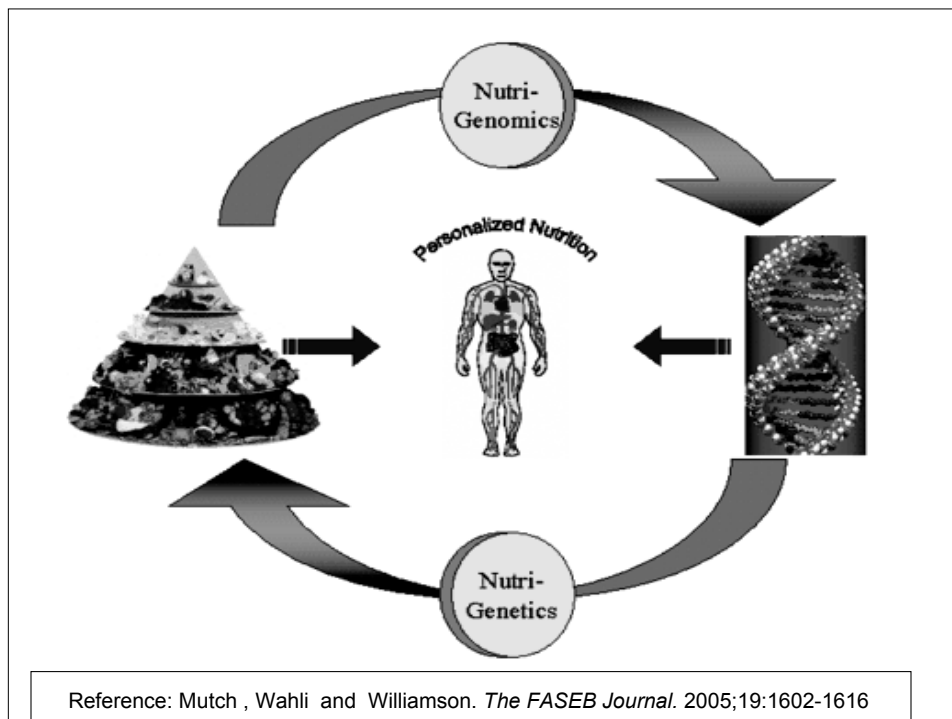
Let's talk terminology

- **Genetics:** Study of single genes and their effects
- **Genomics:** Study of functions and interaction of all genes in the genome
- **Nutrigenetics:** Effects of genetic variations on nutrient influences on health and disease of an individual



Nutrigenomics: Effects of bioactive food component on the expression of genes (genome), proteins (protenome), and metabolites (metbolome).

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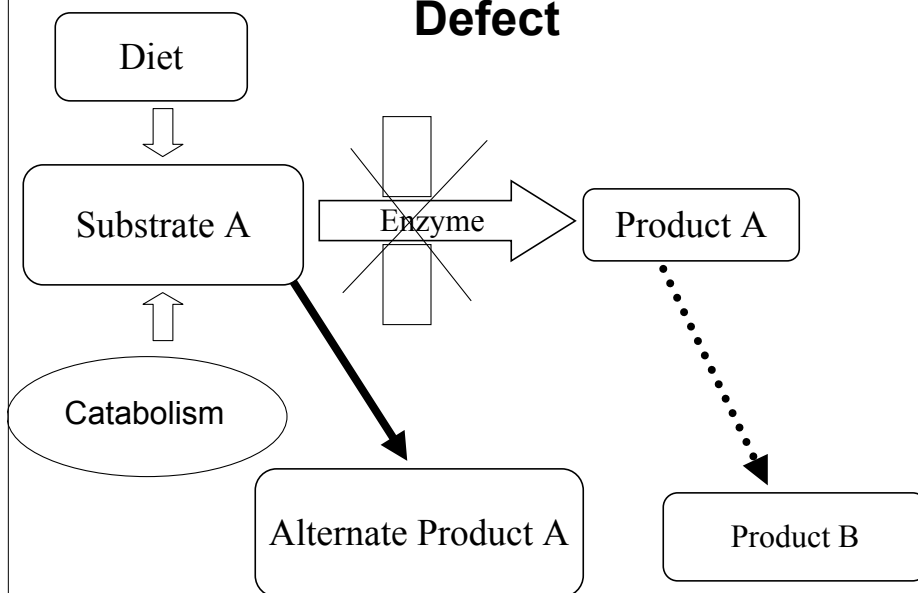


The “Old” is the Study of Single Genes



- Mutations in single genes that cause disease
 - Monogenic or mendelian disorders
- Transmitted as per Mendel’s laws of inheritance
 - Autosomal dominant, autosomal recessive, and X-linked
- PKU as a model that the one gene-one phenotype paradigm is no longer valid
 - Over 450 mutations
 - Autosomal recessive
 - Great example of diet-gene interaction because the mental retardation is preventable with dietary modification.
- Online Mendelian Inheritance in Man www.ncbi.nlm.nih.gov/Omim

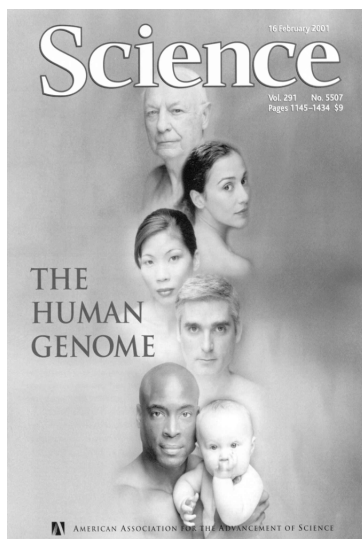
Simple Cartoon of a Metabolic Defect



The “New” or “Emerging” Genetics- -Genomics

- The study of the **function** and **interactions** of all genes in the genome
- Genomics has a broader and more ambitious reach than genetics
- Applies to common conditions such as breast cancer, colorectal cancer, HIV infection, diabetes, hypertension, asthma
- In the most common disorders, 50% of disease risk is attributable to genes and 50% to environmental factors (smoking, **diet**, pollution, exercise)

1st Draft of Human Genome was Published in February, 2001



Potential Benefits of the HGP to HCPs

- Study of individual genetic differences in response to dietary components (eg lactose intolerance)
- Development of safe and effective diet therapies based on genomic data
- Development of disease models to provide new screening and diagnostic tools and research
- Provides a map to allow researchers to identify genes that interact with diet to influence disease
- New jobs and services



Potential Risks of Genetic Testing based on the HGP

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- Possible misuse of information
- Genetic determinism
- Possible side effects of treatments
- Impact of information on self image
- Stigmatization of being “at risk”
- Genetic discrimination

ADA Strategic Plan 2004-2008

● Priority Areas

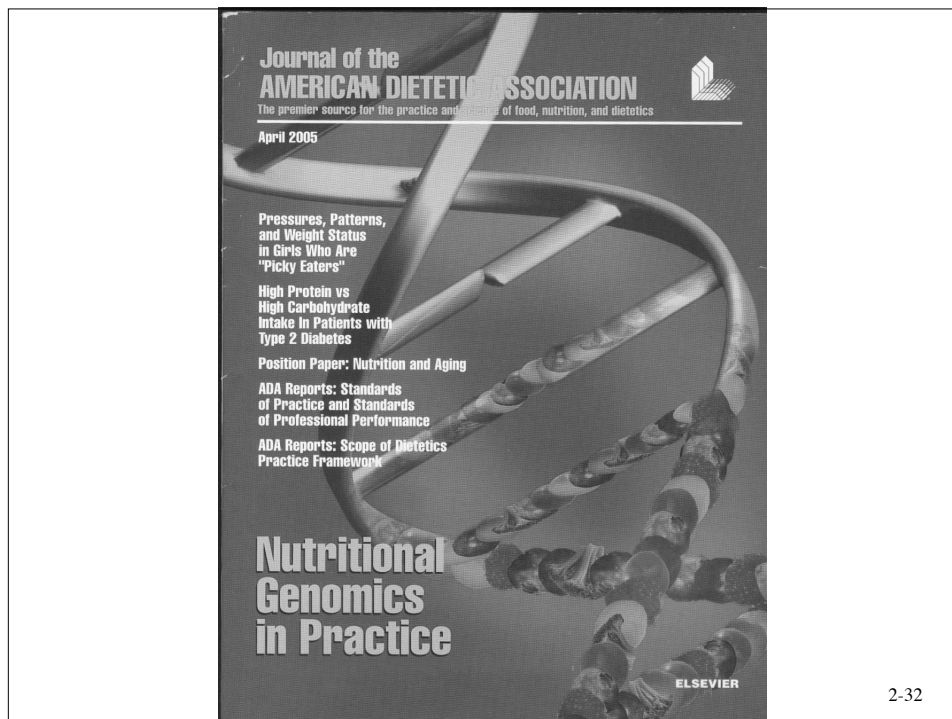
- Obesity/Overweight
- Healthy Aging
- Food Supply
- **Nutrigenetics and Nutrigenomics**
- Integrative Medicine

● Trends: Institute for Alternative Futures

- Customized Nutrition Advice based on Genotype and Phenotype
- Functional Medicines to optimize Molecular and Genetic Health

Bezold C & Kang J. Looking to the Future JADA 99:8, 989-993.

2-15



2-32

How will Dietetics be Impacted?

- Consider nutrigenomics a *major* (?) opportunity
 - Researchers needed
 - Basic, clinical, clinical trials, food, marketing research
 - Practitioners needed
 - Clinical nutrition, genetic counseling, food development, dietary supplement development
 - Educators needed
 - Of healthcare practitioners, ongoing consumer education
 - Policy developers needed
 - At all levels, from local to global
 - Other opportunities
 - Sales and marketing opportunities galore, especially in the food marketing, retail arenas

DeBusk and Fogarty

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Dietary Components Known to Alter Genetic Events and Influence Health

- Essential nutrients—vitamins, minerals, amino acids and EFA
- Non-essential bioactive components--
Compounds in food that bring about a physiological effect
 - Phytochemical
 - Carotenoids, flavonoids, indoles
 - Zoochemicals
 - Conjugated linoleic acid, n-3 fatty acids
 - Fungochemicals
 - B-glucans, lentinan
 - Bacteriochemicals
 - Equol, butyrate, others formed in GI tract

Trujillo 2006

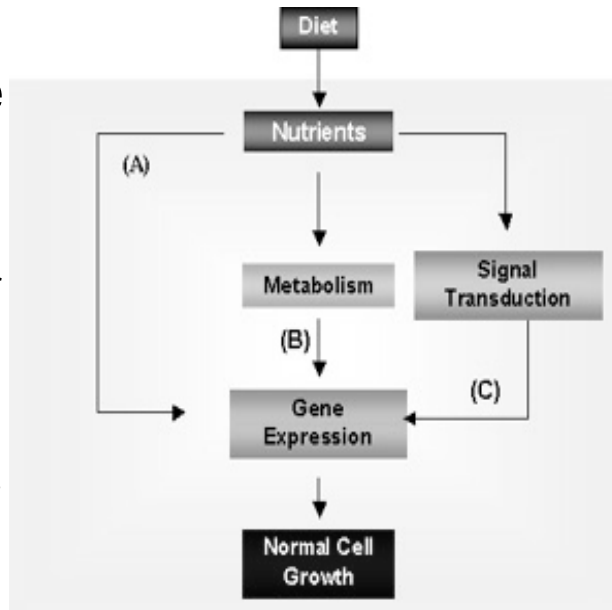
Nutrients affect gene expression

● Directly

- Act as ligands for transcription factor receptors

● Indirectly

- Alter concentrations of substrates or intermediates
- Act as signaling molecules



<http://nutrigenomics.ucdavis.edu>

● Nutrition therapy traditionally used to:

- Supply essential bioactive food components:
 - Vitamin C, essential amino acids, essential fatty acids
- Avoid supplying harmful bioactive components:
 - Phenylalanine in PKU, BCAAs in MSUD, iron, gluten, etc.
- Apply population recommendations to individuals for health and general well-being

● What's new to us:

- Using genotype to guide nutritional interventions
- Using genotype for disease prevention!!
- Using food to increase/decrease gene expression

DeBusk and Fogarty³⁻⁴⁰

Tailored Dietary Recommendations

- Data from the human genome project has revealed genetic variation among individuals
- Genetic variation alters interactions among dietary chemicals and metabolic responses that ultimately result in health or susceptibility to disease development.
- Because of this, some question whether well-established dietary recommendations, usually based upon epidemiological studies, are valid for all racial and ethnic groups.

<http://nutrigenomics.ucdavis.edu>



Genomics Business

Nutritional Genetic Panel

Price: \$395.00



Nutritional Genetic Panel with nutritionist consultation

Price: \$525.00



DNA Diet

Nutritional Genetic Panel with nutritionist consultation and menu plan for health optimization.

Price: \$625.00



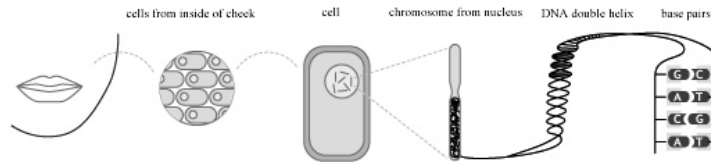
Rapid Results DNA Diet Weight Loss System

Nutritional Genetic Panel with nutritionist consultations and 6-week plan for weight loss catered to your DNA.

Price: \$1200.00



<http://www.healthanddna.com/nutrigeneticstest.html>



- “Your report will contain:
- *Your genetic profile for nineteen genes important to your individual nutritional status.*
- *Specific nutritional supplement advice based on your genetic makeup.*
- *Personal diet and lifestyle advice for each of the genes tested.*
- *General information on genes, nutrition and health.*
- *A guide to vitamins and minerals. What they do and how to include them in your diet.*
- *A resource directory listing sources for supplements.*
- *Answers to frequently asked questions.*
- *Definitions of key terms.”*

Is DNA Home Testing Too Much Information?

- If you consult patients who want internet DNA testing, ask them:
 - Why do you want to know?
 - What do you hope to learn?
 - Will you understand the results?
 - Are you willing to live with uncertainty
- Remember: a positive test does not mean you are going to get a certain disorder but only a possible higher risk
- However, a positive test might motivate people to follow a healthier life style, including diet, exercise, etc...
- **“FDA DOES NOT REGULATE INTERNET GENETIC TESTING”**
!!!!!!

So, You Don't like your Veggies: blame your genes!

Genetics at Work



Pick a face

1



2



3



How Many Of You Find..

- Broccoli bitter?
- Hot peppers intensely painful?
- Really note the feeling of high fat foods in your mouth (creamy, thick, viscous)?

“The reason why people dislike vegetables such as broccoli and sprouts is due to the genetic defense mechanism to potentially harmful compounds in the plants” Mari Sandell, Monell Chemical Senses Center, PA, 2006; Current Biology; 16:792-794

The Genetics of Taste

- The ability to taste something is complicated and multifactorial
 - Experiential, hormonal, neurological, genetic
 - For example, sensitivity to bitter tastes reaches a max in women in early pregnancy, a hormonal protection against poisons that could harm the fetus
- Genetics
 - Number of taste buds
 - Taste bud function
 - Variations in the hTAS2R38 gene affect bitter perception

“Individual response to actual foods is multi level and depends on evolutionary, genetic, receptor and perceptual factors”

Gaps in Genetic Education Among Dietitians

- Most recent Commission on Dietetic Registration states that “graduates will have a knowledge of genetics”
- However, survey results among didactic dietetic programs indicated little or no genetic training was being offered in curricula

Needs Assessment Education in Genetics

	ADA	Total
● Genetics/Biol. degree	6%	7%
● Formal course 1+	11%	14%
● Genetics content	44%	44%
● No Formal Education	37%	35%
● Noncredit Seminar	13%	19%

HuGEM II Project 1997-2001

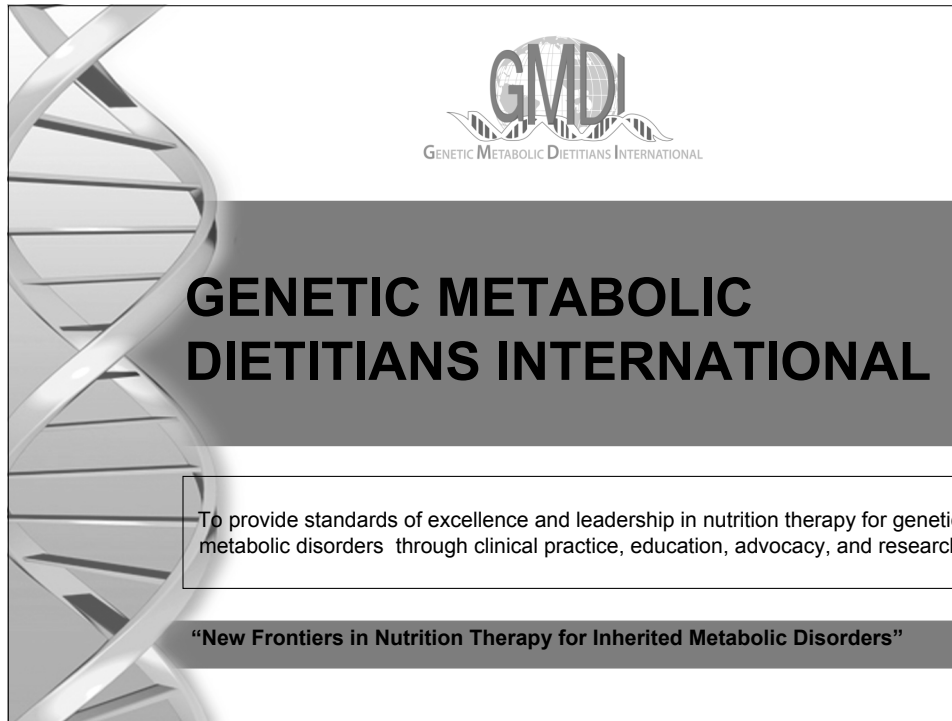
Implications for Dietitians

Emerging Issues Confronting Health Professionals

- Already providing genetic services to their clients
- Low confidence in ability to provide genetic services
- No formal or continuing education in genetics
- Getting information about genetics from media
- Want continuing education in genetics
- Agree on priority topics for education

NCHPEG Priorities

- Development of a comprehensive, web-based genetics information center
 - Genetics Resources on the Web (www.geneticsresources.org)
- Development of a core curriculum to serve as a template for modification for each health professional discipline
- Integration of genetics content into continuing education programs, licensure and certification exams



GENETIC METABOLIC DIETITIANS INTERNATIONAL

To provide standards of excellence and leadership in nutrition therapy for genetic metabolic disorders through clinical practice, education, advocacy, and research.

“New Frontiers in Nutrition Therapy for Inherited Metabolic Disorders”

Resources

- Nat'l NBS and Genetics Resource Center
 - <http://genes-r-us.uthscsa.edu>
- <http://www.nchpeg.org/>
- Trujillo, et al. Nutrigenomics, proteomics, metabolomics, and the practice of dietetics. JADA. 2006;106(3):403-413.
- <http://nutrigenomic.ucdavis.edu>
 - Nat'l Ctr Minority Health and Health Disparities (NIH)
- <http://www.kumc.edu.gec>