

Nutrigenomics, Mass Media and Commercialization Pressures

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In 2004, the International Human Genome Sequencing Consortium published its scientific description of the finished human genome sequence containing 20,000 to 25,000 protein-coding genes.¹ The Human Genome Project (HGP), through political rhetoric and publicity, was portrayed as an end in itself, which, in the near term, would produce an explosion of new genomics products, services and therapeutics. Most have yet to materialize and some of those that have, especially in the area of genetic testing targeted directly at consumers, raise considerable ethical, regulatory and legitimacy issues. In particular, the field of nutrigenomics illustrates many of these concerns in the context of direct-to-consumer (DTC) advertising and delivery of genetic testing services, related products (such as nutritional supplements) and associated media coverage.

This article presents preliminary data from a study of how the media translate knowledge about nutrigenomics to the public. Specifically, we are interested in whether media coverage of nutrigenomics is of sufficient quality for the public to understand the risks and benefits associated with genetic testing. We have considered three main sources of information: peer-reviewed science journals, media coverage and, more briefly, promotional material from nutrigenomic company websites. A fuller understanding of the media's role has policy implications as countries deal with regulating the provision of genetic testing services and the sale of nutritional supplements and personalized diet plans. It also has implications for regulating commercial representations of nutrigenomics, especially DTC advertising by genetic testing companies and the claims they can make about health benefits.

Nutrigenomics is the study of how dietary components interact with genes and gene products to alter phenotype and,

inversely, how genes and gene products metabolize dietary intake.² Nutrigenomics offers the promise of genetic testing to integrate genomic information in preventive medicine and public health,³ as well as diet and lifestyle regimes tailored to an individual's genetic makeup. The hope is that people will take the opportunity to modify their lifestyles and environment to reduce risk if they learn about genetic risk factors for a range of diseases, such as cancer, heart disease, or Alzheimer's.⁴ Ethical, legal and social issues in nutrigenomics are only beginning to be addressed.⁵

Key Actors and Forces in Genomics Knowledge Translation

The hype surrounding genomics has been promulgated by a complex set of actors, each with something to gain, who have become complicit collaborators⁶ in a "cycle of hype".⁷ The cycle, as conceived by Caulfield, is around three main actors: scientists, the media and the public.⁸ Scientists are driven partly by enthusiasm for their research and personal advancement in a highly competitive academic environment, but also by external pressures from the institutional public relations machinery, university career evaluation processes heavily geared towards research output and funding, public funding agencies, and, increasingly, industry funders. The media are driven by their own commercial agendas, and, in the context of genomics research, this predominantly means acting as an uncritical cheer squad for genomics research.⁹ The public are excited by the prospect of cures for devastating and common diseases, such as cancer and heart disease, and are caught up in the rhetoric of progress.



In the context of nutrigenomics, commercial interests also contribute to the cycle of hype, not merely as indirect influences on scientists and media, but as independent actors.¹⁰ Most news coverage of nutrigenomics stems from coverage of products and services delivered by nutrigenomics companies. The main spokespersons are scientists tied directly to nutrigenomics companies. Through the scramble to secure adequate venture capital and customers, commercial interests in the genomics sector contribute directly to the over-representation of genetic contributions to natural human variation¹¹ and multi-factorial disease processes. To attract customers, companies engage in DTC advertising of products, such as susceptibility testing, paternity testing, or testing to determine ancestral or ethnic origin for genealogy studies.

The increasingly commercial focus of much genomics research is fueled by the U.S. government's commitment to transfer technology derived from the HGP to the private sector.¹² By licensing technologies to private companies and awarding grants for innovative research, the project catalyzed the multibillion-dollar U.S. health biotechnology industry and continues to foster the development of new medical applications such as diagnostic aids, predictive tests, genetic therapies and pharmaceuticals and nutraceuticals individualized to a person's genetic makeup. In Canada, federal and provincial governments have similarly embraced the commercialization ethos in health biotechnology and genomics. Canada's most recent science and technology strategy – *Mobilizing Science and Technology to Canada's Advantage* – emphasizes a strong commercialization goal with incentives aimed at encouraging private-sector involvement in Canadian research and development.¹³ It follows fairly closely the former Liberal Government's innovation strategy.¹⁴

The U.S. biotechnology sector has benefited from a national and regional environment for capital formation and access to the investment community.¹⁵ Current government initiatives in Canada are aimed at increasing investment in Canada's biotechnology sector.¹⁶ This focus on investment raises the concern that the market will become over-hyped.¹⁷ Small companies, in the struggle to attract and maintain in-

vestment, may be tempted to hype their genomic products and services to potential investors and consumers. Exaggerated claims of benefits, minimized associated risks, and simplified genetics research promote overly deterministic messages.¹⁸ Genetic determinism "identifies genes as the sole relevant causal feature of an individual's characteristics and life courses."¹⁹ In addition, market pressures may "geneticize" society's view of disease and disability, as well as of normal variation within populations. "Geneticization is a term coined to capture the ever-growing tendency to distinguish people from one another on the basis of genetics; to define most disorders, behaviours, and physiological variations as wholly or in part genetic in origin."²⁰

Media coverage of nutrigenomics may be prone to an exaggeration of benefits and the reliability and accuracy of test results because the main sources of information are nutrigenomics companies and, in some cases, the entrepreneurial scientists who founded them.

Study Methods

We searched Lexis/Nexis, Factiva and Canadian Newsstand media databases for all media coverage with no date restrictions using the following search string: "nutrigenomic*" or nutrigenomic* or 'nutritional genomic*' or 'personalized nutrition' or nutrigenetic or nutrigenetic or 'gene food'." We used the same search string in Pubmed to locate review and research articles in English language peer-reviewed journals. We then hand-sorted the media and science articles into broad categories and eliminated false hits that were not related to nutrigenomics. We recognize that this search strategy significantly under-represents research articles because these are in disparate fields of science and rarely use the selected search terms. Consequently, we compiled a list of all research articles cited in each of the review articles as a sampling strategy for key research articles in nutrigenomics.

In addition, we compiled a list of 14 companies through a non-random sampling method using the above search terms coupled with "gene* and test" and company. We used snowball sampling to augment our list by extracting references to nutrigenomics companies from media articles, policy reports and academic articles. We then repeated our media searches in Lexis/Nexis, Factiva and Canadian Newsstand to search for media articles on nutrigenomics companies with the search string "'Company Name' and gene* and test." Again, these articles were assessed for relevance.



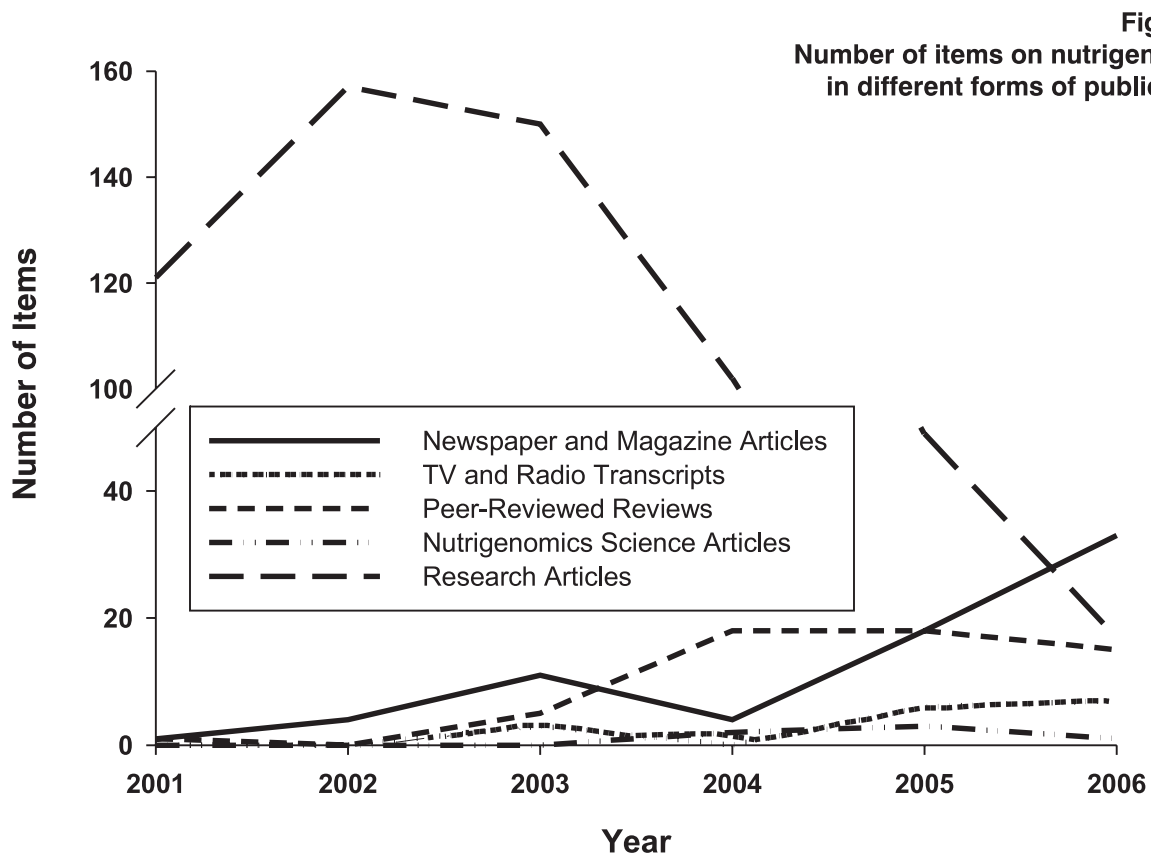
Media and Science Coverage of Nutrigenomics

The genomics sector receives substantial media coverage in Canada and throughout the world. This coverage includes stories about advances in research and product development, investment, economic forecasts and social controversies. There is some evidence that the manner in which genomics research is covered in the popular press influences both public perceptions of the risks/benefits of the research and how policy makers engage the topic. As Nisbet and Lewenstein note: "... the mass media comprise the principal arena where policy-relevant issues come to the attention of decisionmakers, interest groups, and the public. Not only do the media influence the attention of competing political actors and the public, but the media also powerfully shape how policy issues related to biotechnology are defined and symbolized."²¹

One past study involved an empirical analysis of the accuracy of media coverage of gene discoveries.²² This

study compared media coverage with its scientific journal source. The articles were generally framed as a celebration of scientific progress that displayed a surprising degree of media accuracy. The media tended to cover high quality peer-reviewed journals, indicating that top journals influence science journalism. Any exaggeration and hyperbole originated not from the text of the journal article, but from interviews with researchers who were overly enthusiastic about research results. Extrapolations to human health and therapeutics were "fair game" for journalists, even if the research was, for example, basic research or linkage studies in experimental animals. In addition, risks and limitations were greatly under-represented – findings that correspond to other work in the area.²³ Some topics, such as behavioural genetics, sexual orientation, and non-lethal medical conditions such as obesity, were handled most poorly, with linkage studies being interpreted in a deterministic fashion as "genes for" the particular trait.²⁴

There has been a significant increase in all forms of media coverage of nutrigenomics since 2004 (Figure 1) when there was a peak in peer-reviewed review articles on nutrigenom-



ics. This number of review articles has remained constant, while the number of basic research articles that self-identify as related to nutrigenomics peaked in 2005. We also identified over 1028 peer-reviewed research articles cited in the 57 review articles. The number of cited research articles showed a precipitous increase from the early 1990s to 2002. The decline in the curve after 2002 is a function of timing of research publications in relation to their citation in review articles and not an indication of a decline in research activity. We randomly selected 600 (58.4%) research articles to explore the state of the research. Much of the research was published in high quality science publications and the sheer volume of research indicates a growing field with promise of future application. However, there were few clinical trials, only a small percentage of gene association studies and only 17.8% of research published related to human subjects. The majority of research could be defined as early stage research focused on human cell lines, including tumour cells (29.5%), and rodents (37.3%).

Media coverage of nutrigenomics may be prone to an exaggeration of benefits and the reliability and accuracy of test results because the main sources of information are

nutrigenomics companies and, in some cases, the entrepreneurial scientists who founded them (Table 1). Our search of the media databases yielded 89 hits to June 2007. These included articles in magazines (2) and newspapers (71) and transcripts from radio (5) and television (11) segments. One-third of newspaper articles referred to nutrigenomics companies but only six (8%) newspaper articles referenced two scientific journal articles. The first study, involving University of Toronto researchers and published in the *Journal of the American Medical Association*, reported on the association between coffee intake, the CYP1A2 genotype and the risk of suffering a heart attack.²⁵ The second study, published in *Science*, reported on the link between the SCD-1 gene and the ability of mice to eat unlimited amounts of rich, fatty foods and never become obese or diabetic.²⁶ The observed trend of journalists citing only top science journals, especially when the studies were conducted by local researchers, and extrapolating results from animal models to humans, holds equally in the field of nutrigenomics. Further, our specific media database searches for companies offering genetic tests yielded a further 104 newspaper articles from the United States (71), the United Kingdom (11), Australia (2), Canada (9), and South Africa (1) (Table 2).

Table 1. A breakdown of newspaper coverage of nutrigenomics.

Newspaper Article Topics (may be overlapping)	Number of Newspaper Articles	Newspaper Section	Number of Newspaper Articles	Number of Articles Referring to Nutrigenomics Companies by Section	Number of Articles Referring to Scientific Journal Articles by Section
Business	3	Book Review	1		
Ethics	5	Brief	1		
Health	46	Health	49	14 articles; 9 companies	
Home Test	9	Business	3	2 articles; 5 companies	5 articles; 2 studies
Weight loss	8	Commentary	1	1 article on 1 company	
Science	4	News	8	3 articles; 4 companies	
News	1	Opinion	2		
		Report	2		
		Science/Business	4	2 articles; 5 companies	1 article; 1 study



Table 2.
Number of newspaper articles on nutrigenomics that refer to a nutrigenomics company

Nutrigenomics Company	Number of Newspaper Articles
Genelex	29
Sciona	17
Consumer Genetics	14
NutraGenomics	11
One Person Health	8
Healthcheck USA	7
Genecare	5
Alphagenics	5
WellGen	3
DNA Diet	2
Metagenics	2
Suracell	1
Nutrigen	0
Salugen	0

In general, nutrigenomic testing is positively framed in the media as providing legitimate results that individuals may rely on for diet and overall health information. The exception to this positive framing is media articles covering a 2006 nutrigenomics investigative report by the U.S. Government Accountability Office (GAO).²⁷ The GAO created fourteen fictional consumer profiles around two DNA samples that were submitted to four nutrigenomics companies. The scathing report concluded that “[t]he results from all the tests GAO purchased mislead consumers by making predictions that are medically unproven and so ambiguous that they do not provide meaningful information to consumers.”²⁸ The companies recommended the use of costly nutritional supplements where cheap alternatives exist, provided generic advice based more on the lifestyle profile than on the DNA, and indicated susceptibility to a variety of diseases, albeit with disclaimers that the tests were not intended to diagnose disease.

Positive media framing includes stories that celebrate local research, focus on revolutionary changes in eating or highlight celebrity lifestyles and diets. Media stories may

also be positively framed as playful food pieces or company advertising masquerading as a news article. Local science success stories are a common framing for newspaper articles on genomics and are usually associated with the publication of locally conducted research in a top-ranked science journal.²⁹ Nutrigenomics articles may discuss the ethics of nutrigenomic testing³⁰ or describe new research collaborations involving university, government and corporate partners.³¹ One example from New Zealand is highly speculative but adds a patriotic spin for producers: “This will ultimately lead to the development of added-value, export-focused, gene-specific foods that will deliver proven health outcomes to consumers. And they will have been grown by New Zealand producers.”³²

Other media coverage focuses on new celebrity diet fads, emphasizing individualised or special treatment. Nutrigenomics, billed as the “hottest new diet trend”³³, is glamorized and associated with a Los Angeles lifestyle:

high above Los Angeles, at a high-end holistic clinic with white orchids, New Age music and views from downtown to the ocean, the Center for Health Enhancement in Santa Monica is already offering eating plans tailored to clients’ genetic profiles. The center’s directors call their nutrition service the DNA Diet, a name trademarked and copyrighted by licensed nutritionist Carolyn Katzin. For \$595, Katzin takes a swab from a patient’s mouth (just like in “CSI,” only it takes longer to get the results, she explains), places it in a tiny test tube and sends it off to a lab.³⁴

Personalized diets are portrayed as appealing to wealthy, sophisticated and technophilic consumers who desire “ownership ... the feeling that something is tailored to their needs and will overcome their problems.”³⁵ However, according to the media, even representatives from nutrigenomics research and development companies suggest the science is too young to support tailored dietary prescriptions:

“People will spend money for this, but in terms of science-based nutritional advice it’s just too early,” says Jim Kaput, president and chief scientific officer at NutraGenomics Inc., a fledgling nutrigenomics research company in Chicago that does not offer testing services to the public. At this point, he says, the tests are “for rich people with an extra \$1,000 who want to say, ‘I did my genotype.’”³⁶



Many articles discuss the need to move away from a “one-size fits all” diet with the hope that a tailored diet will promote healthy eating and lead to better weight loss programs. A diet based on one’s genetic profile is described as “science fiction” turned to reality and “the most revolutionary new change in decades.”³⁷ Many articles use the term “revolution” because the diets will help find foods that “are perfect for boosting blood production, feeding muscle and brain cells and even preventing diseases that run in your family.”³⁸ This particularly optimistic and somewhat hyped perspective on nutrigenomics is tempered by articles that are more tongue in cheek. Such articles play on the metaphor “you are what you eat.”³⁹ The person on the diet prescribed by nutritional genomics comes to resemble health food, while the average dieter resembles “a Whopper with a side of poutine.”⁴⁰ The author of one article had her DNA tested and described the resulting diet:

From now on, I am encouraged to “graze” all day long, rather than have formal meals. Eating is a continuum, from sterol-fortified orange juice to lower my bad cholesterol to two glasses of kefir, the tippie from the Caucasus made from fermented milk (fizzy and mildly alcoholic), because it’s packed with even more friendly bacteria than Mr. Hauser’s yogurt. Small wonder the Caucasus is where 114-year-olds spring around like goats.

I browse on a hard-boiled Omega-3 egg (the hens are fed flaxseed), a slice of toasted rye bread (incorporating healthy soy flour because I have an incipient allergy to wheat), a pat of milk thistle (a liver reviver) oil butter, a little sugarless fruit jam and a café au lait, which is okay for me. DNA analysis shows I metabolize coffee quickly, so I can benefit from the antioxidants, the cop cells that rush around rubbing out free radicals, those biker-gang cells that prey on the hearts of those who can’t metabolize coffee quickly.⁴¹

Media coverage plays into the needs of consumers, especially those who are wealthy, educated and interested in being trend-setters. It feeds on fears of disease and aging in, probably, the most health-conscious demographic, and nurtures notions of individuality in an era of eroding public health care systems. What better way to set oneself apart from the average consumer than to individualize health and diet needs based on genetic makeup?

Conclusion and Next Steps: Direct-to-Consumer Advertising on Company Websites

The rapid growth of the genomics sector and the predicted explosion of new genetics-based products and services raise many pressing social and ethical concerns. Investment in and capitalization of the genomics sector must be balanced against social benefits arising from research commercialization. In the scramble to secure adequate investment, there is a significant risk that the genomics sector will over-represent the contribution of genetics to natural human variation and multifactorial disease processes.

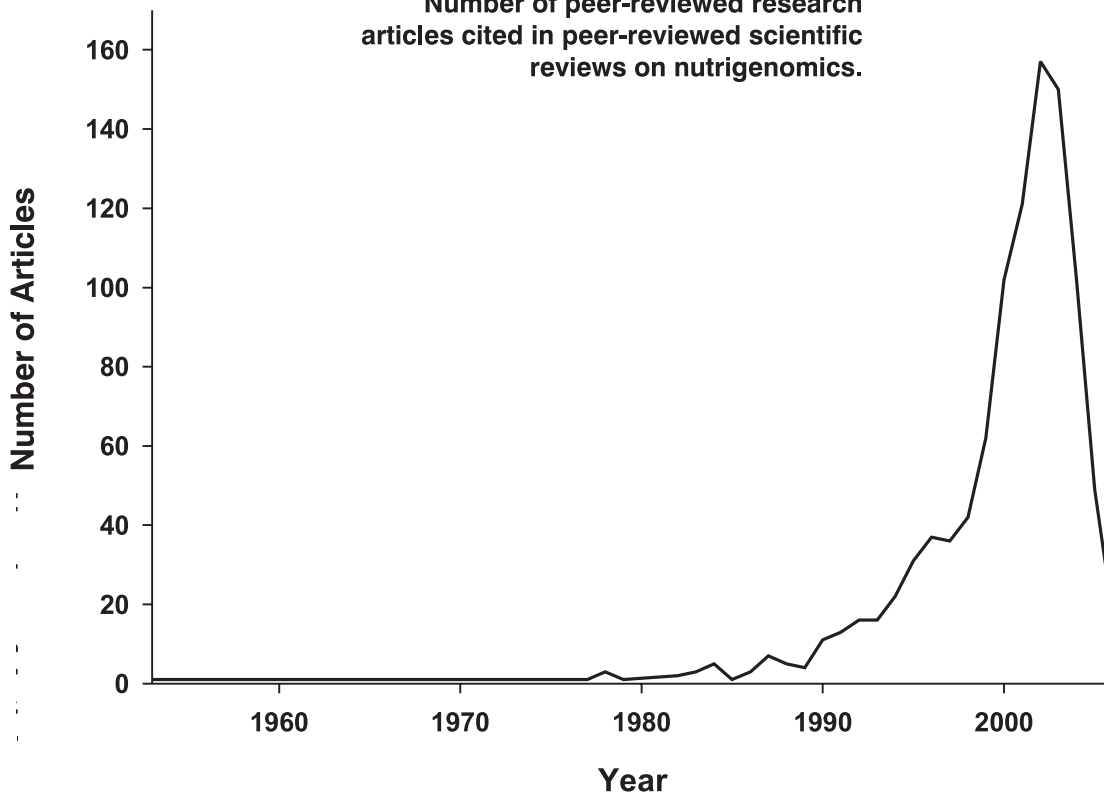
There is, unfortunately, a dearth of available research on industry representations of genomics and their impact on target audiences, including investors, policy-makers and the public. Empirical research is needed to examine commercial representations of genetic testing services and consumer response to that information. Such research will address concerns about increased levels of genetic determinism and the impact these representations may have on the perceptions and attitudes of potential investors and consumers.

If media coverage focuses primarily on emerging products and services provided by nutrigenomics companies, the quality of information from that source is key. A growing number of nutrigenomics companies, including Sciona, Genelex, Suracell, Market America, and DNA Diet, provide genetic testing services directly to the public and advertise their services via the internet.⁴² There is a need for research analysing the content of company websites and their impact on consumers. Our research group is currently conducting such a study, involving content analysis of websites and the interpretation of that content by potential consumers. Our study will also explore how the media portrays nutrigenomics companies and their websites. Results will be published as they become available.

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Figure 2.
Number of peer-reviewed research
articles cited in peer-reviewed scientific
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