

Editorial

Are We Ready for Personalized Dietary Guidelines?

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INTRODUCTION

Beginning 1980, the Department of Health and Human Services (HHS) and the Department of Agriculture (USDA) have been releasing, every five years, The *Dietary Guidelines for Americans*. Since new guidelines are going to be released in 2015 [1], I think this is a good time to discuss about the issue of whether personalized nutrition should be included or not as a factor when it comes to the cyclical renewal of dietary recommendations.

Whether in the shape of a food pyramid (now enhanced with recommendations for physical activity), or in the shape of a food plate (MyPlate), we have always been encouraged to think that some foods are healthier than others, in the context of specific dietary requirements based on age, gender, and several physiological states (e.g. pregnancy). However, increasing evidence points out to the notion of gene-environment interactions as a major factor that shapes our metabolic response to nutrition and, by consequence, which has an important impact upon our health. The notion of nutrient-gene interactions encompasses at least two aspects. First refers to the differential effects that nutrients can have upon metabolism, as a consequence of genetic variations. As such, genes serve as a modulator between nutrients and their metabolic consequences. The other aspect, which is newer, refers to an epigenetic paradigm. In this scenario, nutrients can differentially alter the activity of genes, such that DNA sequence is not the only factor that decides upon gene activity. These alterations (such as DNA methylation and histone modifications) can be either quasi-permanent or transient, depending on which gene is affected, and at which developmental period these epigenetic events occur. There is still considerable debate as to whether epigenetics alterations can be inherited through multiple generations [2]. Nonetheless, a plethora of studies performed on either animals or humans indicate that nutrition is an important epigenetic modifier. In turn, epigenetic modifications are associated with various physiological and disease states, such as obesity, inflammation, brain development, insulin resistance, and aging (reviewed in [3]). Another new arrival in this field is the role that the microbiome has in shaping nutrition requirements, and much more is to be done to bring this concept to maturity [4]. The importance of gene-nutrient interactions has been recently (re)acknowledged as being “fundamental to health” by the Bellagio

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Report on Healthy Agriculture, Healthy Nutrition, Healthy People [5].

In this light, today the prevailing opinion among nutrition scientists is that optimal nutrition, although it should include important general recommendations, is also highly variable not only due to age, gender, and physiological or disease states, but also because of each individual's genetic and epigenetic background, and potentially due to specific gut microbiota profiles. Recently, we have advocated that, by comprehensively analyzing genetic, environmental, and epigenetic data, specificity can be added to the study of phenotypic alterations and, by extension, to nutrition recommendations [6].

Why are we not there? Is there availability to consider, in the future, the establishment of dietary guidelines using individualized models? Is this economically feasible? All these are legitimate questions, and the answers, I surmise, are neither simple nor clear. Nonetheless, I will try to answer these questions from a personal perspective.

Why are we not there? In answering this question, I will split my little analysis into two components. On one hand, from a conceptual standpoint, we already know that virtually each individual has specific dietary requirements, which are intimately linked with his or her genetic variations, epigenetic status, and with the environment in which one lives. There is wide-spread consensus (again, at a conceptual level) that personalized nutrition is the way to go [7, 8]. On the other hand it is about “the devil that is in the details”. The amount of data generated by now allows us to have only a sketchy image, at best, about how genetics, epigenetics, and the microbiome have an impact upon nutrition. We have snippets of facts, here and there. There are virtually no replication studies in humans, or studies that would test the generalizability of specific findings in different populations, with the exception of few genetic studies related to nutrition. One of the contributing factors is the absence (in most developed countries) of a national program on nutrition research, which to offer not only clear directions, but also to fund a national and systematic research on individualized nutrition requirements. Salutary initiatives exist, and they are not few, but there is no integration forum allowing for harmonization

and continuity among various research groups. From this perspective, I am not sure that we are ready to optimize our discovery potential towards individualized nutrition, although intellectual and material resources are probably in place.

Is there availability to consider the establishment of dietary guidelines using individualized models? Since there is a wide consensus about nutrition individuality, the availability should be there. I am referring to those forums, in each country, which are responsible for establishing dietary guidelines. These forums consist of scientists who are intimately knowledgeable about the latest advances in nutrition sciences. However, and somewhat surprising, baring declarations of principles, there are no known or published plans on how to achieve the goals (definitely on a long term) of assessing dietary requirements on an individual basis.

Another important aspect comes from the perspective of food and supplement industry. I have discussed about individualized nutrition, on various occasions, with some of the decision makers from the for-profit segment. Although, in principle, there was consensus (again) that the future of nutrition is in its individualized requirements, the main issue is how marketing models can be developed based on this paradigm. Rather than offering a single product aimed at the whole segment of consumers, how can companies customize a range of products such that each would respond to a certain category of nutritional needs (market segmentation)? How can such effort become at least as profitable as the current approach? I surmise, again, that we are not quite there. Whether the marketers will be able to come with adequate models it remains to be seen.

Is this economically feasible? The answer is yes and no. As discussed above, significant marketing issues might be, on the short term, decisive for the “no” answer. However, on mostly long term, I see great economic benefits for both for-profit players, as well as for individualized preventive health policies. For instance, nutrition supplements will be by far more efficient should their administration would follow validated models for individualized interventions. The consumers will be more inclined to spend on products that will have demonstrated their efficacy on a much greater percentage of cases. A new market for products aimed to establish individualized nutrition requirements would be profitable, as long as such diagnostic platforms will be followed by rigorously justified nutrition advice.

From the perspective of implementing prevention programs, it only makes sense that funds will be targeted specifically to help those who are demonstrated to be at risk, rather than

applying a blanket policy to entire segments of population. Nutrition-oriented prevention policies and programs would be refined based on the specificity of such risk assessments and recommendations.

Not the least, from an ecological standpoint, the implementation of individualized nutrition would require more agricultural diversification, which to satisfy the increased heterogeneity in consumers' demands. But this is exactly what the proponents of diversified farming are arguing for a long time [9].

These are only few considerations when discussing about how to bring individualized nutrition down to the realm of possibility. The road is difficult, scientifically very complex, and cannot be successfully taken without consensus being reached between a broad range of players (scientists, government, consumers, for-profit, regulatory, and political). But maybe the time has come to act together.

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