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Nutrition and Fitness: Cultural, Genetic and Metabolic Aspects

Volume Editor

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48 figures, 12 in color, and 34 tables, 2008
Dedication

The proceedings of the conference are dedicated to the concept of positive health as enunciated by the Hippocratic physicians (5th century BC).

*Positive health requires a knowledge of man’s primary constitution (which today we call genetics) and of the powers of various foods, both those natural to them and those resulting from human skill (today’s processed food). But eating alone is not enough for health. There must also be exercise, of which the effects must likewise be known. The combination of these two things makes regimen, when proper attention is given to the season of the year, the changes of the winds, the age of the individual and the situation of his home. If there is any deficiency in food or exercise the body will fall sick.*
Olympians and Taoists both philosophize, look inward and discover higher states of mind.

When ancient days were new, both cultures had a clue: control diet and exercise! In two thousand and six the first conference was fixed for fitness and food in Shanghai.

China welcomes Greece and their Concept of Positive Health, applauding the relation to the way the Chinese felt.

In two thousand and eight the Olympians create a reason for China to celebrate. The way Greece plays her part in sports, science and art has won deep respect from the Chinese heart.

Lee Pinkerson, 2007
www.leepinkerson.com
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Preface

The papers in this volume of *World Review of Nutrition and Dietetics* consist of selected papers presented at the Nutrition and Fitness Conference in Shanghai, China, in November 2006. The conference was under the auspices of the World Council on Nutrition, Fitness and Health (WCNFH). Since 1988, the International Conferences on Nutrition and Fitness (ICNF) have been held every 4 years in Greece, prior to the Olympic Summer Games, either at Ancient Olympia or in Athens. The ICNF are dedicated to the concept of ‘Positive Health’ as stated by Hippocrates in the 5th century BC. The first conference took place at Ancient Olympia in 1988. At that time, the concept of combining ‘Nutrition’ and ‘Fitness’ in a scientific conference was a ‘new’ one. These two disciplines or fields have moved closer since then and today the ‘Nutrition and Fitness’ concept has been incorporated in the World Health Organization (WHO) program under the title ‘Global Strategy on Diet, Physical Activity and Health’ (May 2004).

Similarly, the concept of Positive Health, based on the triad of Genetics, Nutrition and Physical Activity, is attracting many scientists in the areas of Nutrigenetics and Nutrigenomics. The establishment of the new International Society of Nutrigenetics/Nutrigenomics (ISNN – www.isnn.info) and the very successful 1st Congress of ISNN bear evidence to the fact that ‘old concepts’ are now not only being accepted but their importance is recognized worldwide and rapid progress is taking place. Because of the rapid advances in Genetics, Nutrition and Fitness, it was felt that the meetings should be held every 2 years instead of only every 4 years only prior to the Olympic Summer Games. It was thus agreed by the WCNFH that the ICNF will be held every 2 years as follows.
The country that is holding the Olympic Summer Games will hold a Nutrition and Fitness conference 2 years prior to the games and in the Olympic year, the ICNF will always be held at Ancient Olympia or in Athens.

This volume begins with the keynote presentation ‘Nutrition and Fitness from the First Olympiad in 776 BC to the 21st Century and the Concept of Positive Health’ by Artemis P. Simopoulos. The paper is a rather extensive overview of the concepts of Olympism, which are unique to Greek thought and the Concept of Positive Health. In fact, the first evidence of the importance of food and exercise in health appears in the Hippocratic corpus in the 5th century BC. Diet did not refer simply to food, but to the whole lifestyle, including nutrition and exercise. Among the Greeks, the concept of Positive Health was important and occupied much of their thinking. Those who had the means and leisure applied themselves to maintaining positive health. Today the need for proper diet and exercise for health and well-being is well recognized and major recommendations to that effect have been made by many national and international organizations. The traditional diet of Greece as exemplified by the diet of Crete was shown by the Seven Countries Study to be the healthiest. In the paper, Dr. Simopoulos gives a detailed description of the components of the traditional diet of Greece and shows that the Greek diet is very similar to the Paleolithic diet on which humans evolved. A major characteristic of such a diet is that it is balanced in the ω–6 and ω–3 essential fatty acids, which is unique to the diet of Greece and not to the other Mediterranean diets. In fact, in the paper which follows, ‘Omega–3 Fatty Acids, Exercise, Physical Activity and Athletics’, Dr. Simopoulos provides evidence for the metabolic and physiologic aspects of the ω–6/ω–3 ratio and its beneficial effects in many conditions. Of great interest is the evidence that endurance exercise increases the eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA) content of muscle cell membrane phospholipids, which may account for the beneficial effects of ω–3 fatty acids in increasing sensitivity to insulin and lead to decreased risk in the development of metabolic syndrome.

Obesity is a major risk factor for cardiovascular disease (CVD), hypertension, diabetes, arthritis, and some forms of cancer. Research on the prevention of obesity, its management, the role of diet and exercise has contributed enormously to our understanding in the development of obesity. Dr. Gérard Ailhaud and his group have contributed the most on the obesogenic aspects of ω–6 fatty acids. In his paper, ‘Omega–6 Fatty Acids and Excessive Adipose Tissue Development’, Dr. Ailhaud presents evidence showing that excess of adipose tissue at an early age is associated with subsequent overweight and obesity in adulthood. Polyunsaturated fatty acids (PUFAs) of the ω–6 and ω–3 series have been shown in rodents not to be equipotent in promoting adipogenesis in vitro and adipose tissue development in vivo (ω–6 PUFAs >> ω–3 PUFAs) with ω–3 PUFAs counteracting the adipogenic effects of ω–6 PUFAs. The biochemical
mechanisms underlying ω–6 PUFA effects have been demonstrated. Since the 1960s, the increasing prevalence of overweight and obesity in humans has been associated with a positive energy balance. In the meantime, however, and consistent with animal data, consumption of ω–6 linoleic acid (LA) and arachidonic acid (AA) has increased dramatically and is accompanied by a major increase of the ω–6/ω–3 ratio in breast milk, formula milk and most consumed foods. Dr. Ailhaud concludes that, ‘Whether prevention appears as the key issue, owing to the continuous presence of adipose precursor cells throughout life and to the slow turnover of fat cells once formed, the status of lipids from the very beginning of the food chain deserves a re-evaluation.’

Despite numerous advances made in identifying the genes for rare, mendelian forms of CVD, relatively little is known about the common, complex forms at the genetic level. Moreover, most genes that have been associated with CVD, whether they are single gene forms or more common forms of the disease, have primarily been involved in biochemical pathways related to what are considered ‘conventional’ risk factors. However, recent genetic studies have begun to identify genes and pathways associated with CVD that would not be considered to underlie conventional risk factors. Dr. Hooman Allayee, in his paper ‘Non-Conventional Genetic Risk Factors for Cardiovascular Disease’, presents the evidence for this latter notion based on genetic studies in humans. The author presents evidence of how a combination of mouse and human genetics led to identification of the 5-lipoxygenase pathway for CVD with potentially important implications for its treatment and diagnosis. Increased dietary AA significantly enhanced the apparent atherogenic effect of genotype, whereas increased dietary intake of ω–3 fatty acids EPA and DHA blunted this effect. Lastly, the prospects for identifying CVD genes in the future and for potentially developing more effective therapeutic strategies are discussed.

The genetics of apolipoprotein E (ApoE) polymorphism is one of the most extensively studied over the past 30 years. There are three common allelic variants (ε2, ε3, ε4) producing three protein polymorphisms: E2, E3, E4. ApoE3 is the most common or ‘wild type’. Drs. Angelopoulos and Lowndes, in their paper on ‘ApoE Genotype: Impact on Health, Fitness and Nutrition’, provide an extensive review and conclude that ApoE genotype is associated with plasma lipids and inflammation. ApoE2 isoform is usually associated with lower total cholesterol and low-density lipoprotein (LDL) cholesterol, whereas ApoE4 isoform has higher levels of both. Therefore, the ApoE4 isoform has an overall disease-promoting effect on cardiac health. The effect of regular physical activity on serum total cholesterol, LDL cholesterol, the LDL/high-density lipoprotein (HDL) ratio and LDL particle size may vary with ApoE genotype. ApoE2 and ApoE3 individuals are more responsive and show more favorable lipid changes following exercise interventions.
The importance of nutrition has been extensively studied and accepted worldwide as an essential factor in health maintenance and in the prevention and management of chronic disease. In developing countries, the problem is sometimes referred to as double burden of disease, where malnutrition exists in the company of growing rates of lifestyle-related diseases such as obesity, diabetes and CVD. The frontiers of science have brought forth new understanding of the links between early undernutrition and the later development of chronic lifestyle-related disease, challenging the nutrition scientist and practitioner to evaluate practice to better support health throughout the life course. Dr. Linda Tapsell, in her paper on ‘Nutrition in the Prevention of Chronic Disease’, emphasizes the impact of birth size on later nutritional challenges and the importance of maternal nutrition, not only in pregnancy but perhaps also in the pre-pregnancy period, and the significance of subsequent nutritional practices at critical times in growth and development. Underpinning this understanding is the role of genetic background on nutritional requirements (nutrigenetics) and the effect of nutrients and food bioactives on genetic expression (nutrigenomics). This whole new enterprise has significant implications for the development of the food supply and of dietary advice to support health. An appreciation of the biological significance of whole foods also becomes a necessary parallel activity to that of consuming food in a way that matches and supports human health. Epigenetics suggest that maternal health, and especially nutrition prior to pregnancy and during fetal life, influence the development of chronic diseases in the offspring. This thinking questions many of the true relationships between diet and health in epidemiologic studies that have not considered the factors that may operate prior to conception and fetal life.

Dr. Konstantinos Pavlou, in his paper ‘Exercise and Obesity: Lifestyle Modification as a Means in Prevention and Treatment’, presents a thorough review of the evidence that diet by itself is not adequate to maintain weight loss. Physical activity is essential for weight loss maintenance. Dr. Pavlou discusses the physiologic and metabolic changes that occur by the addition of physical activity, especially in ‘driving up’ the metabolic rate, preserving lean muscle tissue, increasing oxygen uptake, reducing calorie absorption, and suppressing appetite. Dr. Pavlou discusses the evidence that exercise is effective in decreasing the symptoms of depression and anxiety in overweight and obese individuals as well as in hospitalized, manic-depressive patients and in non-hospitalized college students. The author makes the point that ‘Fitness’ needs to be more precisely defined. There is a need to promote diet and fitness and not focus on diet and fatness. It is better to be fit and lean. However, if one cannot be lean, then it is preferable and safer to be ‘fit and fat’ rather than unfit and fat.

Although several lines of investigation, including studies of migrant populations, indicate that diet is a major contributor to the etiology of cancer, establishing
specific nutritional relationships has proven to be elusive. The Multiethnic Cohort Study was established in 1993–1996 to further research on diet, other lifestyle factors, and cancer, and to explore the interactions between environmental exposures and genetic susceptibility in determining cancer risk. Dr. Laurence Kolonel in his paper ‘Nutritional Risk Factors for Gastrointestinal Cancers: The Multiethnic Cohort Study’ describes the study. The cohort consists of 215,000 participants, all of whom completed a self-administered baseline questionnaire that included an extensive quantitative food frequency questionnaire. Recent findings related to gastrointestinal cancers are discussed, including strong inverse associations between colorectal cancer and intake of dietary fiber in men, and intake of total calcium in both men and women. An interaction between intake of folate and alcohol and the C677T polymorphism in the methylenetetrahydrofolate reductase gene is also discussed in the context of diet-gene interactions. Recent results related to pancreatic cancer show a positive association with red meat intake and an inverse association with dark green vegetable intake among smokers. Contrasting findings regarding the effect of obesity (BMI ≥30) on pancreatic cancer in men and women are discussed in relation to chronic inflammation and insulin resistance as possible mechanisms. These analyses demonstrate the value of such an ethnically diverse cohort for research on diet, nutrition and cancer.

Dr. Federico Leighton et al. in their paper ‘Mediterranean Diets, Global Resource for the Control of Metabolic Syndrome and Chronic Diseases’ indicate that climate is a key driver in the development of civilization. The Mediterranean ecosystems in the world are associated with characteristic agricultural products that have marked repercussions on the health of the population making use of those products. The relationship among food and health in some Mediterranean Sea basin countries was characterized by Ancel Keys and collaborators, leading to the present view of Mediterranean alimentation patterns as paradigms of healthy diets. Artemis P. Simopoulos expanded on Key’s concepts and pointed out that a balanced ω–6/ω–3 essential fatty acid ratio and antioxidants are major characteristics of both the diet of Crete and the Paleolithic diet. Other Mediterranean ecosystems in the world share similar characteristics and constitute a global net of healthy scenarios.

Epidemiological and intervention studies such as the Lyon Heart Study by Michel de Lorgeril et al., and the GISSI study by Marchioli et al. have corroborated the close link among Mediterranean diet and health, particularly with regard to mortality from chronic diseases and characteristic risk factors.

Dr. Leighton et al. state that in Chile, health indicators suggest that some specific factors explain the good ranking of the country with regard to longevity and CVD. They have proposed that the relatively high Mediterranean score of the Chilean diet is a main factor to explain the healthier conditions in
the country. In order to evaluate the role of diet ‘mediterranization’ on the level of chronic disease risk, Leighton et al. have assumed ‘that the Chilean diet is susceptible of further mediterranization, a situation that should lead to favorable changes in chronic disease risk factors.’ Metabolic Syndrome is a condition of high risk, which should respond to environmental changes, leading to a decrease in chronic diseases. Consequently, they have evaluated ‘Food at Work’ as a strategy of diet mediterranization for adults. In an intervention study performed for 12 months, indeed they were able to ‘change alimentation habits with a statistically significant reduction in the prevalence of Metabolic Syndrome’. In addition to the Mediterranean Sea basin countries and Chile, there is evidence linking local diet and better health in other Mediterranean Ecosystems recognized in the world. Dr. Leighton et al. conclude, ‘that the world faces today a global challenge of a sharp increase in chronic diseases on which, apparently, we have not been successful in implementing control measures. Diet mediterranization in adult populations, and obviously also in young people, seems to be a necessary and urgent action to be approached by countries and global health organizations. Therefore, we propose the candidacy of the Mediterranean Diet(s) to be included on the Representative List of the Intangible Cultural Heritage of Humanity of the UNESCO.’

Dr. Peter Bourne in his paper ‘The Role of Government in Nutrition and Fitness’ states that the role of government in enhancing the health of the population is vital. How large a role the government should play is open to vigorous debate based on economic factors, concerns about intrusions in the rights of individuals to make decisions about their own lives, politics and practical administrative matters that can make implementing policy decisions difficult. As a result, the role of government varies widely from one country to another. Dr. Bourne illustrates his views with historical and current examples in public health and emphasizes the need for multinational corporations to be convinced that it is in their best interest to expand their research in nutrition and be responsive to the knowledge and demands of an increasingly sophisticated public.

Dr. William Clay in his paper ‘Balancing the Scales: A Common-Sense Look at Global Nutrition Problems and What Can be Done about Them’ shares Food and Agriculture Organization (FAO) of the United Nations’ insight into the nature and extent of some of the nutritional problems around the world and reflects on some of the factors affecting the changing nature of nutrition and fitness problems, and challenges some commonly held perceptions. Dr. Clay points out some of the policy and program considerations that could help guide the development of more rational and balanced approaches for addressing the multiple burdens of malnutrition seen throughout the world.

In Appendix I, Dr. Charles M. Tipton presents an excellent review on ‘Historical Perspective and Commentary: The Antiquity of Exercise, Exercise
Physiology and the Exercise Prescription for Health’. The review clearly shows that the importance of exercise for health and for management of disease was recognized eons ago by civilizations emerging from the banks of the Nile, Euphrates and Tigris rivers and many others. It is indeed fascinating that in the transition from a hunter-gatherer group to an agrarian society in disparate civilizations, that exercise and its physiology evolved more for health reasons than for enhancing athletic performance. In approximately two millenniums since the death of Galen, the US Surgeon General, the Institute of Medicine in Washington, D.C., and numerous professional organizations, including the American College of Sports Medicine and the American Heart Association, have published official documents advocating the health benefits of habitual exercise for individuals. The review by Dr. Tipton ends with the death of Galen, since according to medical historian Baas, antiquity for medical history ‘closes with Galen’. For exercise, exercise physiology and the exercise prescription, the era is the same but their history is inextricably linked to evolving concepts that pertained to the causes of disease and the attainment of health, the history of physiology and the emergence of rational medicine with Hippocrates in the 5th century BC.

Following Dr. Tipton’s paper, in Appendix II, are the ten points of the ‘1996 Declaration of Olympia on Nutrition and Fitness’ printed in the Olympic languages of English, Chinese, Greek, French, Spanish and Russian. This is the first time that they have been published all together and it seemed an appropriate time. They were originally translated and printed by Mars Incorporated, a supporter of the ICNF, for distribution at the Atlanta Summer Olympic Games.

I would like to acknowledge the following organizations for supporting the Shanghai conference and proceedings. Most importantly, we would like to thank the Stavros S. Niarchos Foundation, which has supported most of our ICNF and their proceedings. I would also like to thank Nutrilite/Access Business Group and Dr. Sam Rehnborg for his personal donation, Minami Nutrition (Belgium) and the Columbus Paradigm Institute (Belgium) for supporting the World Council on Nutrition, Fitness and Health.

These proceedings will be of interest to geneticists, nutritionists and dietitians, exercise physiologists, cultural anthropologists, historians, pediatricians, internists, general practitioners, healthcare providers, scientists in industry and government, policymakers, and national and international governmental organizations.

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