Nutrition and Fitness: Diet, Genes, Physical Activity and Health
Nutrition and Fitness: Diet, Genes, Physical Activity and Health

Volume Editors

Artemis P. Simopoulos
The Center for Genetics, Nutrition and Health, Washington, D.C., USA

Konstantinos N. Pavlou
Hellenic Sports Research Institute, Olympic Athletic Center of Athens, Greece

35 figures, 2 in color, and 13 tables, 2001
Additional proceedings from the conference are published in volume 90 of this series
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.*
Commemorative 2000 Conference Medal

Medal commemorating the 4th International Conference on Nutrition and Fitness. The front of the medal depicts a bronze statuette of a young girl (laconian, middle sixth century BC). This statuette of a young, bare-thighed Spartan girl has a muscular, athletic body. She wears a short, sleeved tunic belted at the waist and lifts the hem with her left hand in order to run more easily. Evidently, she is participating in one of the women’s races in accordance with the Spartan ideal.
Contents

IX Conference Organization
XI Preface
XVII Declaration of Olympia on Nutrition and Fitness
   Ancient Olympia, Greece, May 28–29, 1996

Opening Address

1 The Hippocratic Concept of Positive Health in the 5th Century BC and in the New Millennium
   Simopoulos, A.P. (Washington, D.C.)

Part 1: Genetic Variation and Nutrition

5 Genetic Variation and Dietary Response
   Murray, R.F., Jr. (Washington, D.C.)

12 Dietary and Genetic Effects on LDL Heterogeneity
   Krauss, R.M. (Berkeley, Calif.)

23 Nutrients and Gene Expression
   De Caterina, R.; Madonna, R. (Pisa); Hassan, J. (Rome); Procopio, A.D. (Chieti)

53 Effect of Genetic Variation on the Postprandial Response. Results from the European Atherosclerosis Research Study II
   Talmud, P.J.; Waterworth, D.M.; Humphries, S.E. (London)

61 Predisposing Genes, High-Risk Environments and Coronary Artery Disease: LPL and Fibrinogen as Examples
   Humphries, S.E.; Montgomery, H.E.; Talmud, P.J. (London)
Role of Genetic Variation in Establishing Nutritional Requirements: Folate, a Case in Point
Molloy, A.M. (Dublin)

Genetic Influences on Serum LDL Levels and on Type I Diabetes Incidence in Sardinia
Muntoni, S.; Muntoni, S. (Cagliari)

Osteoporosis, Vitamin D Receptor Gene Polymorphisms and Response to Diet
Ferrari, S.L. (Geneva)

Interactions between the Genome and the Environment, with Special Reference to Nutrient Variation. New Concepts, Emerging Methodologies and Challenges
Velázquez, A. (Mexico City)

Part 2: Genes and Physical Activity Interactions

Aerobic Exercise, Gene Expression and Chronic Diseases
Chen, J. (Beijing)

Genetic Variation and the Response to Exercise
Montgomery, H.E. (London)

Part 3: The Role of Omega–3 Fatty Acids in Health and Disease

Essential Fatty Acids in Somatic Growth and Brain Development
Uauy, R. (Santiago/Dallas, Tex.); Calderon, F.; Mena, P. (Santiago)

Omega–3 Fatty Acids and Cardiovascular Disease
Leaf, A.; Kang, J.X. (Charlestown, Mass.)

Omega–3 Fatty Acids in Major Depression
Locke, C.A.; Stoll, A.L. (Belmont, Mass./Boston, Mass.)

Author Index

Subject Index
Conference Organization

Conference Cochairs
Artemis P. Simopoulos, MD (USA)
Konstantinos N. Pavlou, DSc (Greece)

Executive Committee
Costas Balis, PhD (Greece)
Peter G. Bourne, MD (Grenada, British West Indies)
Regina C. Casper, MD (USA)
Ji Di Chen, MD (China)
Nicholas T. Christakos, Esq. (USA)
Raffaele De Caterina, MD (Italy)
S. Boyd Eaton, MD (USA)
Nikos Filaretos (Greece)
C. Gopalan, MD, PhD, DSc (India)
Sotiris Kitrilakis (Greece)
Demetre Labadarios, MD, PhD (South Africa)
Alexander Leaf, MD (USA)
Labros S. Sidossis, PhD (USA/Greece)
Philippa J. Talmud, PhD (UK)
Benjamin Torun, MD, PhD (Guatemala)
A. Stewart Truswell, MD, DSc (Australia)
Mark L. Wahlqvist, MD, PhD (Australia)
Clyde Williams, PhD (UK)

Local Committee
Chairman
Costas Balis, PhD

Cochairs
Sotiris Kitrilakis, MS (Administration)
Labros S. Sidossis, PhD (Science)

Members
Elena Averoff
Evagelia Maglara Katsilambrou
Lidia Kitrilakis
Antonia Matala, PhD
George N. Stathopoulos, Esq.
Vassilis Stavrinos, PhD
Organized by
The Center for Genetics, Nutrition and Health
2001 S Street, N.W., Suite 530
Washington, DC 20009 (USA)
Tel. +1 202 462 5062
Fax +1 202 462 5241
E-Mail cgnh@bellatlantic.net

Co-Organized by
Harokopio University
70 E. Venizelou Avenue
176 71 Kallithea, Athens (Greece)
Tel. +30 1 9577051-5
Fax +30 1 9577050
E-Mail vevgeniou@hua.gr

Under the Patronage of
Food and Agriculture Organization of the United Nations
International Olympic Academy
The Ministry of Culture, The General Secretariat of Athletics of Greece
General Secretariat of Research and Technology, Greece
Hellenic Ministry of Health
Hellenic Ministry of Education

Conference Cosponsors
Harokopio University, Athens
The President's Council on Physical Fitness and Sports, USA
National Institute on Alcohol Abuse and Alcoholism – NIH, USA
National Institute of Child Health and Human Development – NIH, USA
Pan American Health Organization (PAHO)
Sociedad Iberoamericana de Información Científica (SIIC)
International Union of Nutritional Sciences (IUNS)
European Federation of the Associations of Dietitians
The American Institute for Cancer Research
The Hellenic Sports Research Institute, Athens
Egnatia Epirus Foundation, Athens
Mediterranean Agronomic Institute of Chania, Crete
Smart Foods Centre, University of Wollongong, Australia
BASF AG
Bee Culturing Co. ‘ATTIKI’ Alexandros Pitas S.A.
Chios Mastic Producers Union
EPOM SA
ERBL – Coromega
Florina Juices
Greek Cellar
Kourtakis Wines
Mars, Inc.
Mevgal
Mt. Vikos, Inc.
Olympia – Xenia ASA
Pelopac SA
Peloponnese
Taste Matters
Vita Magazine
Whitehall Hellas SA

Conference Sponsors
The Center for Genetics, Nutrition and Health
Stavros S. Niarchos Foundation
Preface

The international conferences on Nutrition and Fitness are held the last week in May every 4 years prior to the Olympic games and are dedicated to the Hippocratic concept of ‘positive health’. The Fourth International Conference on Nutrition and Fitness was held at the International Olympic Academy in Ancient Olympia, Greece, May 25–29, 2000.

Anticipating the importance of genetics in the 21st Century, the Executive Committee of the conference selected a program emphasizing genetic variation; gene-nutrient and gene-physical activity interactions; the role of nutrients in gene expression; the role of physical activity in gene expression; evolutionary aspects of diet, the role of nutrition and fitness throughout the life cycle and their metabolic effects. Special attention was given to societies in transition and the need to develop a network of centers worldwide that will focus on the research and policy aspects of genetics, nutrition, exercise and health.

A major aspect of the conference was to develop an action plan for the implementation of the 1996 ‘Declaration of Olympia on Nutrition and Fitness’ [see pp. XVII–XXIV, of this vol.]. It was agreed that the best way to implement the declaration is to establish a network of Centers on Genetics, Nutrition, Exercise and Health (CGNEH). Such a network will be instrumental in the expansion of research that will take into consideration genetic variation; gene and environment interaction; the evolutionary aspects of diet; nutrition, and type of exercise and amount necessary for the promotion of health and prevention of disease, as well as for the management of chronic disease. It is recognized that human genes have not changed significantly since the Paleolithic period when the human genome was programmed to respond to a dietary and physical environment very different from that which humans face at the dawn of the 21st Century.

The proceedings of the conference are presented in two volumes in this series, volumes 89 and 90. Volume 89 is entitled Nutrition and Fitness: Diet,
Preface XII

Genes, Physical Activity and Health and Volume 90 is entitled Nutrition and Fitness: Metabolic Studies in Health and Disease. Both volumes begin with the dedication to the concept of ‘positive health’, the Conference Organization, the 1996 ‘Declaration of Olympia on Nutrition and Fitness’, the Commemorative Medal, and the Opening Address on ‘The Hippocratic Concept of Positive Health in the 5th Century BC and in the New Millennium’ given by Artemis P. Simopoulos. The address sets the stage for the Fourth International Conference on Nutrition and Fitness, emphasizing the concept of ‘positive health’, the importance of individuality, and the need to develop the means by which targeted nutrition and physical activity will be precisely defined for the individual. The Olympic spirit and the Olympic games celebrate achievement and the individual. It is expected that in the 21st Century scientific information will be developed that will deliver individualized genotype-based health care. A conscious effort must be made to develop in all dimensions the environment in which the human genome finds its optimal expression. This, of course, represents a complete circle returning and recognizing the Hippocratic concept of ‘positive health’ of 2,500 years ago, based on the individual and in the 21st Century proving it through molecular biology.

The papers in volume 89 consist of those presented at the conference along with additional invited papers in order to cover the subject of genetic variation and nutrition thoroughly. The volume is organized into three parts: Part 1. Genetic Variation and Nutrition, Part 2. Genes and Physical Activity Interactions, and Part 3. The Role of Omega–3 Fatty Acids in Health and Disease.

Part 1 deals with genetic variation and nutrition. The importance of genetic variation and the response to diet is extensively described in the paper by Murray on ‘Genetic variation and dietary response’. The author suggests that the term *nutrigenomics* be used to describe the current and future focus of nutritional research based on genomic information. He proposes that a more specific definition would be ‘The study of the genomic basis for individuality or individual variability in the response to specific nutrients.’ Krauss, in his paper ‘Dietary and genetic effects on LDL heterogeneity’, makes it perfectly clear why a low-fat diet is not beneficial for everyone with hyperlipidemia. The role of ‘Nutrients and gene expression’ by De Caterina and coworkers represents a comprehensive treatise on the state of the art of this rapidly expanding field. Talmud’s group reports on behalf of the European Atherosclerosis Research Study (EARS) group on the ‘Effect of genetic variation on the postprandial response: Results from the European Atherosclerosis Research Study II’. The paper on ‘Predisposing genes, high-risk environments and coronary artery disease: LPL and fibrinogen as examples’ by Humphries and colleagues provides an excellent example of genes predisposing to high risk. Altered nutritional status as a result of genetic variation is quite common and relevant in many clinical conditions. Molloy in her paper ‘Role of genetic variation in establishing nutritional requirements: folate, a case in point’
discusses genetic variation in folate metabolism. Persons homozygous for the
thermolabile 5,10-methylenetetrahydrofolate reductase (MTHFR) variant exhib-
it lower red cell folate concentrations than expected within the normal popula-
tion, and may require special consideration when folate RDA levels are reviewed,
and when strategies to reduce plasma homocysteine by fortification or supple-
mentation with folic acid are being devised. The paper by Muntoni and Muntoni
on ‘Genetic influences on serum LDL levels and on type I diabetes incidence in
Sardinia’ is a good example of how genetic variation confers a protective effect. In
the paper ‘Osteoporosis, vitamin D receptor gene polymorphisms and response to
diet’, Ferrari reviews the genetic variants that increase the risk for osteoporosis,
and proposes that because many more genes are involved in bone metabolism
that control various endocrine and other metabolic pathways, it will be necessary
to understand the function of the various genes before specific dietary advice can
be given with confidence. In the paper ‘Interactions between the genome and the
environment, with special reference to nutrient variation: New concepts, emerg-
ing methodologies and challenges,’ Velázquez reaffirms that the phenotype is the
result of continuous gene environment interactions. Nutrient-gene interactions
shape the phenotype in two ways: (1) by nutrients modifying gene expression, and
(2) by being substrates of the metabolic machinery of the body, which is encoded
by the genome. In the real world, it is the whole genome with which the environ-
ment interacts. In the future, scientists will be focusing on genetic variation; and
genetic medicine, genetic nutrition and genetic exercise will be based on the rou-
tine use of genotypic analyses, usually in the form of DNA testing to enhance the
quality of medical care, as individualized genotype-based health care.

Part 2 is on the relationship of genes and physical activity. Chen, in her paper
‘Aerobic exercise, gene expression and chronic diseases’ discusses the role of phys-
cial activity in gene expression and their relationship to chronic diseases. Mont-
gomery looks at it from the point of view of how genetic variation influences the
response to exercise and muscle metabolism in his paper on ‘Genetic variation
and response to exercise’.

Part 3 is on the role of omega–3 fatty acids in health and disease. There are
three papers that represent the state of the art. Omega–3 fatty acids are essential
nutrients that were present in equal amounts with the omega–6 fatty acids, the
other essential fatty acid, during evolution. The omega–3 fatty acids were mark-
dedly depleted in the diet during the 20th Century as a result of agribusiness. The
first paper by Uauy and coworkers on ‘Essential fatty acids in somatic growth and
brain development’ is a thorough review and critique on the role of omega–3 fatty
acids in growth and development. In their paper ‘Omega–3 fatty acids and cardio-
vascular disease’, Leaf and Kang discuss the mechanisms by which omega–3 fatty
acids prevent ventricular arrhythmias and sudden death from cardiovascular dis-
ease. Locke and Stoll in their paper ‘Omega–3 fatty acids in major depression’
discuss the role of omega–3 fatty acids in depression and the mechanisms involved.

Volume 90 begins with the paper ‘An evolutionary foundation for health promotion’ by Eaton and coworkers. They review the evolutionary aspects of diet and recommend a new approach for the prevention of chronic disease that takes into consideration the essential features of ancestral human existence, especially as experienced during the Paleolithic, the two-million-year period during which the defining characteristics of the humans were selected. Implementation of evolution-oriented health promotion research will require action in two related spheres: First is the necessity to accurately characterize experiential factors affecting preagricultural human existence, including dietary and physical activity patterns. Subject to modification, as the picture of the past becomes clearer, current understanding is that: (1) Obligatory energy expenditure, as physical activity, was typically four times that of affluent Westerners. (2) Stone age diets generally provided abundant protein, fiber, and micronutrients, but little sodium. Intake of carbohydrate (fruits and vegetables, not grains) and fat varied reciprocally with latitude, but rarely provided high levels of saturated fatty acids and usually yielded an ω-6:ω-3 ratio approximating unity vs. ~16.5:1 for Americans today. The second requirement will be to generate falsifiable predictions consistent with the hypothesis that deviation from ancestral dietary/exertional experience ought to adversely affect health while reversion toward Paleolithic patterns should be beneficial. Many projects of potential value might be proposed; three examples are: (1) fruits, vegetables, grains, and cancer; (2) dietary factors, physical activity, and age-related fractures, and (3) physical activity, body composition and insulin resistance.

Truswell in his paper on ‘Energy balance, food and exercise’ emphasizes the adverse effects of weight gain, and the need to balance energy intake with energy expenditure. In the paper ‘Insulin resistance: Influence of diet and physical activity’ Storlien’s group present evidence of the different effects of fatty acids on human metabolism. Sidossis in his paper ‘Regulation of lipid metabolism during exercise’ presents evidence by using radioisotope studies that questions the assumption made by Randle, and proposes that it is intracellular availability of glucose rather than fatty acids that regulates glucose fatty acid interaction. The notion that glucose regulates the rate of fatty acid oxidation may assist in explaining the pathophysiology of metabolic abnormalities such as diet-induced hypertriglyceridemia, nonalcoholic hepatic steatosis and deviant triacylglycerol metabolism in obesity and type II diabetes.

The metabolic aspects of exercise are extensively reviewed in the paper on ‘Metabolic aspects of endurance exercise’ by Williams, and the effects of exercise on mood by Casper in ‘Mood, its relationship to physical activity and nutrition’. A great deal has been written on how exercise influences the immune system.
Nieman presents an extensive review and critique in his paper ‘Exercise, immunology and nutrition’. Physical activity makes it possible to increase food intake without weight gain and this aspect is most important for the elderly. Wahlqvist and coworkers in their paper ‘Role of physical activity in ensuring nutritional well-being in the elderly’ present an excellent review and critique. Societies in transition represent special concerns relative to rapid cultural changes. The populations suffer both from undernutrition as well as overnutrition. The special concerns and their management are splendidly discussed by Lambert’s group in their paper ‘Role of physical activity for health in communities undergoing epidemiological transition’. In the next paper Gopalan reviews the ‘Rising incidence of obesity, coronary heart disease and diabetes in the Indian urban middle class: Possible role of genetic and environmental factors’. What humans ate during evolution is the subject of the paper ‘Fatty acid composition and energy density of foods available to African hominids: Evolutionary implications for human brain development’ by Cordain and coworkers. The authors provide data that the emergence of species of our own genus occurred coincidentally with the appearance of crude stone tools that were used to butcher the carcasses of scavenged and/or hunted ungulates. Hence, increasing meat consumption by early hominids is most often cited as the likely food candidate that improved dietary quality and allowed for the rapid encephalization that occurred in the human ancestral line. However, the evolution of a large, metabolically active brain in early hominids, not only required a concentrated energy source, but a dietary source of 22:6ω3 (docosahexaenoic acid, DHA) and 20:4ω6 (arachidonic acid, AA) as well. In order to gain insight into the fatty acid (FA) and energy sources that allowed for hominid encephalization, they examined the FA composition of four tissues (brain, marrow, muscle and subcutaneous fat) of three North American ruminants (Elk: Cervus elaphus; Deer: Odocoileus hemionus, and Antelope: Antilicapra americana) and contrasted them to values in the literature for African ruminants. Their analysis demonstrated that muscle tissue would have been a relatively good source of AA, but not of DHA or energy, whereas the scavenged brain tissue of ruminants would have provided a moderate energy source for encephalization and a rich source of both DHA and AA. Because early hominids were likely not successful in hunting large ruminants, then scavenged skulls (containing brain) likely provided the greatest DHA and AA sources, and long bones (containing marrow) likely provided the concentrated energy source necessary for the evolution of a large, metabolically active brain in ancestral humans.

Lately, food scientists have been interested in making improvements in diet and return the omega–3 fatty acids into the food supply. Watkins and coworkers present data on conjugated linoleic acid (CLA) in chicken eggs in their paper ‘Designed eggs containing conjugated linoleic acids and omega–3 polyunsaturated fatty acids’ and discuss the issues involved. Of course, CLA does not nor-
mally occur in eggs under completely natural conditions, and this paper shows clearly when not to introduce a nutrient if it were not present in the food in the first place.

The final paper by Cantwell ‘Exercise and preventive cardiology: A 34-year odyssey’ recounts Cantwell’s experiences over the last 34 years in the field of preventive cardiology.

The papers found in these two volumes present the state of the art on the interrelationship of genes, diet and exercise as they influence the development of the individual from conception to childhood, adulthood, old age, and eventually death. Originally the environment, especially diet and physical activity, shaped the human genome. The phenotype is the result of continuous gene-environment interactions. Today the environment, including diet and physical activity, have changed enormously, especially during the last 100 years and are not in harmony with the genome. A new discipline combining genes and nutrition, nutrigenomics, is based on individual variability in response to diet. Nutrigenomics will lead to development of diets targeted to individuals. The papers make it abundantly clear that we must make a conscious effort to develop in all dimensions the environment in which the human genome finds its optimal expression. This approach of individualized environmental modification is called euphenics and it must advance hand in hand with genomics and the use of genotypic analyses to enhance the quality of medical care. The euphenic approach is essential for the prevention of chronic disease.

The proceedings of the Fourth International Conference on Nutrition and Fitness found in volume 89 ‘Nutrition and Fitness: Diet, Genes, Physical Activity and Health’ and volume 90 ‘Nutrition and Fitness: Metabolic Studies in Health and Disease’ will be of interest to geneticists, nutritionists and dietitians, exercise physiologists, anthropologists, psychologists and psychiatrists, pediatricians, internists, general practitioners, health care providers, scientists in government and industry, policymakers, and national and international governmental organizations.

Artemis P. Simopoulos, MD
Declaration of Olympia on Nutrition and Fitness

Ancient Olympia, Greece, May 28–29, 1996

Background

The International Conferences on Nutrition and Fitness are held in Greece every 4 years in the spring prior to the Olympic Games. Following each conference, a declaration is developed at a special meeting at the International Olympic Academy to update advice on nutrition and fitness for all. The proceedings of the conferences are published in the scientific literature listed on page XXIV.

The Third International Conference on Nutrition and Fitness was held at the Olympic Athletic Center of Athens ‘Spyros Louis’, May 24–27, 1996, in Athens, Greece. Four hundred and eighty participants from 31 countries attended the conference. Following the conference, an international panel composed of members of the conference Executive Committee, along with the session chairs, met at the International Olympic Academy at Ancient Olympia to develop the ‘Declaration of Olympia on Nutrition and Fitness’ for 1996.

This international panel agreed that on the occasion of the 100th anniversary of the Olympic Games, it is important to reaffirm the concepts of positive health postulated by Hippocrates and to reassess their relevance to the Olympic ideal and the health of the world’s population. The concept of Positive Health, as enunciated by Hippocrates, is based on the interaction of genetics, diet and physical activity.

‘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’ (480 BC).
Among the Greeks, the concept of positive health was important and occupied much of their thinking. Those who had the means and the leisure applied themselves to maintaining positive health, which they often conceived esthetically, and to this end put themselves into the hands of trainers who subjected them to a regimen. Training for war and athletic competition was of course well known among them. Health was an excellence in its own right, the physical counterpart and condition of mental activation. The details of the regimen practiced for health were an important part of Greek medicine. The Concept of Positive Health may be represented by a triangle involving genetics, nutrition and physical activity that influence the spiritual, mental and physical aspects of health (fig. 1).

**Genetic Variation, Nutrition, Physical Activity, and Health**

The interaction between genetic and environmental factors influences human development and is the foundation for health and disease. Genetic factors define susceptibility to disease and environmental factors determine which genetically susceptible individuals will be affected. Nutrition and physical activity (exercise) are two of the most important environmental factors in maintaining health and well being.
Each human being, in being unique, is exceptional in some way. Individuality is determined by genes, constitutional factors (age, sex, developmental socio-economic status, occupation, education, time, geography, and climate). Genetic variation is due to variants at a single locus, or polymorphisms, that form the basis of human diversity, including the ability to handle environmental challenges. How extensively variable the human species is depends on the methods used for the determination of variability. At the DNA level, there is a great deal of variation, whereas at the level of protein diversity, there is much less. In all animals, including humans and practically all other organisms examined, 30% of loci have polymorphic variants in the population. An average individual is heterozygous at about 10% of the loci. Alleles that confer selective advantage in the heterozygous state are likely to have increased in prevalence because of positive selection acting on variants. Changes in the nutritional environment and the type and degree of physical activity affect heritability of the variant phenotypes that are dependent, to a lesser or greater degree, on these environmental variables for their expression.

Genetic variation influences the response to diet. Nutrients and physical activity influence gene expression. In many conditions, proper diet and exercise have similar beneficial effects, and their effects may be additive. Because of differences in gene frequency, dietary habits, and activity levels, universal dietary and physical activity recommendations are not appropriate. Instead, knowledge of specific genes and response to exercise and diet should guide advice for health in the prevention and management of chronic diseases.

**Diet**

The purpose of diet is to supply energy and nutrients required for optimal health. Energy intake must be balanced against physical activity. Over 800 million humans are chronically energy deficient, but obesity is rampant in many industrialized societies.

**Macronutrients**

*Fat* is a concentrated energy source, but in affluent populations, excess fat promotes chronic degenerative diseases. In such circumstances, total fat intake should be reduced, mainly by decreases in saturated and trans fatty acids. In energy-deficient populations, an increased fat intake may be necessary to enhance energy availability and to insure absorption of fat soluble vitamins, but such increases should avoid adding saturated fats where practicable. All populations need essential polyunsaturated fatty acids for mental and cardiovascular health. An omega–6:omega–3 fatty acid ratio of 5:1 or less appears desirable.
Carbohydrate containing foods and soluble and insoluble fiber are needed for energy intake and normal bodily function.

Protein intake should be adequate for normal growth and development and in adults for maintenance of body structures.

Micronutrients

Adequate balanced micronutrient intake should be provided commensurate with emerging understanding of their need. Since the most extensive nutritional influences throughout the world are related to inadequacies of micronutrients, special attention should be directed to correcting these deficiencies: 2 thousand million persons are anemic and 1 thousand million are at risk of iodine deficiency. 40 million children suffer vitamin A deficiency. Understanding of micronutrient functions is currently increasing, and health workers should keep up-to-date with this new knowledge regarding both deficiencies and optimal requirements, e.g. the need for unitary ratios of calcium and magnesium in the diet. The variety of foods in the diets helps to maintain adequate micronutrient intake. Most populations would benefit from an increased intake of fruits and vegetables.

Physical Activity

A wealth of scientific reports points to the inescapable conclusion that human fitness and health improve when sedentary individuals begin to exercise. Although low physical activity levels most frequently occur in more industrialized, affluent nations, this behavior is becoming increasingly common in developing countries as well. Because mechanization and industrialization have reduced occupational physical activity levels, a need exists to supplement with additional daily physical activities designed to improve health and fitness.

A wide variety of fitness parameters, including aerobic capacity, muscular strength and endurance, coordination, flexibility and body composition improve with increases in activity levels. Perhaps more importantly, indices of human health also improve. Three of the most common chronic degenerative diseases of westernized nations (hypertension, coronary heart disease, and non-insulin-dependent diabetes mellitus) are increasingly being recognized as diseases of insulin resistance. In all three cases, physical activity clearly has been shown to reduce the severity, and outcome of these diseases. Physical activity also has a well-known role in preventing and reducing obesity and also exerts a beneficial influence upon insulin metabolism. Furthermore, increased levels of physical activity positively impact virtually all chronic diseases, including, but not limited to stroke, peripheral artery disease, coronary heart disease, chronic obstructive pulmonary disease, osteoporosis, and some forms of cancer. For previously sed-
### Table 1. Defining physical activity

<table>
<thead>
<tr>
<th>1</th>
<th>Nonlabor daily physical activities</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Feeding</td>
</tr>
<tr>
<td></td>
<td>Bodily functions (e.g. temperature regulation, heart rate, breathing rate)</td>
</tr>
<tr>
<td></td>
<td>All daily nonlabor minimum physical activities necessary for life maintenance</td>
</tr>
<tr>
<td>2</td>
<td>Labor physical activities</td>
</tr>
<tr>
<td></td>
<td>Industrial</td>
</tr>
<tr>
<td></td>
<td>Agriculture</td>
</tr>
<tr>
<td></td>
<td>Carpentry</td>
</tr>
<tr>
<td></td>
<td>Homecare, etc.</td>
</tr>
<tr>
<td>3</td>
<td>Leisure-recreational (exercise), low-to-moderate intensity of physical activities</td>
</tr>
<tr>
<td></td>
<td>Walking</td>
</tr>
<tr>
<td></td>
<td>Dancing</td>
</tr>
<tr>
<td></td>
<td>Hiking</td>
</tr>
<tr>
<td></td>
<td>Bowling</td>
</tr>
<tr>
<td></td>
<td>Cycling</td>
</tr>
<tr>
<td></td>
<td>Golf, etc.</td>
</tr>
</tbody>
</table>

Sedentary individuals, even nontaxing physical activities such as walking, gardening, bicycling, and swimming can elicit improved health, and reduce all causes of morbidity and mortality. Table 1 lists the types of physical activity. Sports training physical activities should include daily training programs in preparation for competition. Health-promoting physical activities aim at promoting growth, improving body functions and protecting from illness. Exercise prescription (regimen) as a means of treating or reversing various diseases should be considered as an essential therapeutic component.

### Education

Education about nutrition and physical activity needs to be adapted to each country and to different populations and cultures. Education about the beneficial physical and psychological effects of proper nutrition and physical activity in health and disease needs to be directed at all age groups – children, adults, and the elderly – since research has shown that awareness of the benefits of physical activity is correlated with actual physical activity. Education needs to address the detrimental effects of sedentary life-styles, undernutrition and malnutrition, in particular for children. Education about opportunities to obtain proper nutrition...
and to carry out physical activity is important in view of findings that actual increases in elective physical activity depend on accessibility.

Education should reach people through various channels – the mass media, print, television, and radio – at worksites, and in the community in order to reach everybody in the population. Another means to achieve education would be through role models in the family, schools, sports, and entertainment. Institutions such as schools can set examples for proper nutrition and physical activity. The food and sports foods industry needs to be cognizant of the scientific evidence regarding optimal nutrition and physical activity levels. Another means of education would be the labelling of the nutritional composition of all foods sold.

There is a particular need for education of health professionals and health workers, nutrition and sport scientists, and educators.

Declaration

(1) Nutrition and physical activity interact in harmony and are the two most important positive factors that contribute to metabolic fitness and health interacting with the genetic endowment of the individual. Genes define opportunities for health and susceptibility to disease, while environmental factors determine which susceptible individuals will develop illness. Therefore, individual variation may need to be considered to achieve optimal health and to correct disorders associated with micronutrient deficiency, dietary imbalance and a sedentary lifestyle.

(2) Every child and adult needs sufficient food and physical activity to express their genetic potential for growth, development, and health. Insufficient consumption of energy, protein, essential fatty acids, vitamins (particularly vitamins A, C, D, E and the B complex) and minerals (particularly calcium, iron, iodine, potassium and zinc), and inadequate opportunities for physical activity impair the attainment of overall health and musculoskeletal function.

(3) Balancing physical activity and good nutrition for fitness is best illustrated by the concept of energy intake and output. For sedentary populations, physical activity must be increased; for populations engaging in intense occupational and/or recreational physical activities, food consumption may need to be increased to meet their energy needs.

(4) Nutrient intakes should match more closely human evolutionary heritage. The choice of foods should lead to a diverse diet high in fruits and vegetables and rich in essential nutrients, particularly protective antioxidants and essential fatty acids.

(5) The current level of physical activity should match more closely our genetic endowment. Reestablishment of regular physical activity into everyday life on a daily basis is essential for physical, mental and spiritual well-being. For
all ages and both genders the physical activity should be appropriately vigorous and of sufficient duration, frequency, and intensity, using large muscle groups rhythmically and repetitively. Special attention to adequate nutrition should be given to competitive athletes.

(6) The attainment of metabolic fitness through energy balance, good nutrition and physical activity reduces the risk of and forms the treatment framework for many modern lifestyle diseases such as diabetes mellitus, hypertension, osteoporosis, some cancers, obesity, and cardiovascular disorders. Metabolic fitness maintains and improves musculoskeletal function, mobility, and the activities of daily living into old age.

(7) Education regarding healthy nutrition and physical activity must begin early and continue throughout life. Nutrition and physical activity must be interwoven into the curriculum of school age children and of educators, nutritionists and other health professionals. Positive role models must be developed and prompted by society and the media.

(8) Major personal behavioral changes supported by the family, the community, and societal resources are necessary to reject unhealthy lifestyles and to embrace an active lifestyle and good nutrition.

(9) National governments and the private sector must coordinate their efforts to encourage good nutrition and physical activity throughout the life cycle and thus increase the pool of physically fit individuals who emulate the Olympic ideal.

(10) The ancient Greeks (Hellenes) attained a high level of civilization based on good nutrition, regular physical activity, and intellectual development. They strove for excellence in mind and body. Modern men, women, and children can emulate this Olympic ideal and become swifter, stronger and fitter through regular physical activity and good nutrition.

**Distribution of the Declaration**

The declaration has been published worldwide in newsletters, magazines and journals. It has been translated into the Olympic languages of Chinese, French, Greek, Russian and Spanish. The ten points of the declaration have been printed in these languages. The Executive Committee wishes to encourage the translation and distribution of the declaration worldwide. The copyright is held by the Executive Committee of the Conference.

The declaration was developed at Ancient Olympia, May 28–29, 1996 by the following persons:
References