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Next-generation nutritional biomarkers to guide better health care, E.E. Baetge, A. Dhawan, A.M. Prentice, editors (Nestec Ltd., Vevey & Karger, Basel, Switzerland) 2016. 126 pages. Price: US$ 59.00/ CHF 50.00/EUR 47.00

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Historically, the purpose of measuring biomarkers was to determine the presence or absence of a disease, and to show the efficacy of a specific treatment. In the last two decades this narrow definition has undergone a sea change. With improved health services, the world has seen a decrease in pathogen-borne communicable diseases and an increase in diet and lifestyle related non-communicable diseases. This has given rise to the need for assessing the nutritional status of 'normal' individuals in a community t o identify nutritional deficiencies and excesses. With the technological advances made in the 'omics' sciences the potential for measuring biomarkers have progressed in leaps and bounds. However, the ability to harness this potential to provide useful information is still in its infancy. This book is a timely effort to take stock of the current situation.

The book is divided into three distinct sections. The first section, 'Methodologies: Global Epidemiology', charts the journey of biomarker usage from the 20th century reductionist mind-set to the 21st century personalized approach. The second section, 'Applications/End Users', includes some specific examples of state-of-the-art biomarker applications in nutrition and health. The final section, 'Future Horizons', focuses on the complex challenges involved in actually utilizing these biomarkers to provide useful information in nutrition-related health care.

The first chapter exploring a systems level approach sets the tone for the rest of the book as an exploration of the reductionist approach that tries to link specific outcomes to specific single exposures; this was appropriate for an era that was controlled by the one-gene-one-polypeptide hypothesis. This is evident

in the nutrition workspace - while deficiencies in single nutrients (resulting in diseases such as beriberi, rickets, scurvy) have been successfully dealt with, problems caused due to subclinical under- or over nutrition in populations with diverse genetic and environmental backgrounds are still a black box.

Defining 'good health' is difficult, but the term 'phenotypic flexibility' is introduced as a marker of the ability of an organ (or organism) to adapt to a continuously changing environment caused by diet, infection, stress, *etc*. Consequently, any loss of flexibility is likely to result in one of many chronic diseases and therefore, such diseases need to be diagnosed and treated using a larger 'systems biology' approach. The processes that adversely influence this flexibility comprise three main components - oxidative, metabolic and inflammatory processes. A single disease can be caused in different individuals due to loss of flexibility in any one of these processes, thus emphasizing the need for a more individualized diagnosis and treatment, aimed at optimizing 'health' in the future. The chapter on bioinformatics and genomic information details how new and advanced computational tools are being developed to extract useful biological insights based on large data sets of genomic and metabolomic information.

There is also the more realistic picture presented, of the use of high-end technologies for quantifying biomarkers. The 'omics' methods are highly sensitive and specific and would be most useful in assessing nutritional biomarkers in large populations. However, the greatest need of these methods are in poorer economies and rural settings where the priority is more on 'cheap and easy-to-apply' methods. A valid point raised is that the large data generated by the former methods are hard to decipher due to the complex modelling involved. Furthermore, it is also a fact that these have not been useful so far in deciding the type of nutritional interventions that would be most beneficial. Given these conditions, it would be of utmost importance and interest to see how a balance between the two can be achieved.

The second section deals with specific and novel nutritional biomarkers for liver disease, iron status, cardiovascular disease, and for long-term outcomes after preterm birth. Liver disease in children or adults is usually accompanied by high morbidity and mortality unless the liver is transplanted. However, the biomarkers used for following disease progression involve invasive and expensive procedures such as liver biopsies, and therefore, identification of novel biomarkers in circulation is a critical requirement. The identification of serum biomarkers such as cytokeratin-18 and the ratio of its cleaved fragments (M30:M65) in differentiating between apoptotic and necrotic cell death is also dealt with. These and other inflammatory markers have been used in conjunction with clinical parameters to predict the severity of fibrosis in liver diseases.

The topical issue of biomarkers for iron status is discussed in a separate chapter. Iron is an essential mineral for oxygen transport and mitochondrial function. However, increasing reports on the possible role of iron induced oxidative stress in a number of disease conditions has given rise to the important question – at what stage does iron switch from being essential to being harmful? The role of the peptide hormone, hepcidin in regulation of dietary iron absorption and distribution within the body is discussed. Anaemia is a global problem especially in developing countries, but supplementation with high levels of iron is not always successful or effective. The regulation of hepcidin expression, and the levels of hepcidin appear to partly determine the likely efficacy of iron therapy.

Two other important issues are dealt with in this section – the increasing incidence of preterm birth and its long-term adverse health consequences. The lack of reliable biomarkers and the recommendation for the use of comprehensive 'omics' approach in large prospective cohort studies have been discussed in one chapter, while novel biomarkers for the diagnosis and treatment of vascular lesions in cardiovascular diseases are detailed in another chapter.

The final section deals with the future of nutritional biomarkers. A useful discussion is presented, on how patient populations need to be stratified into more detailed subsets to predict responses to a particular treatment. For example, novel technologies such as CEER (collaborative enzyme enhanced reactive immunoassay) and HMSA (homogeneous mobility shift assay) have made great strides in dynamic profiling and monitoring in oncology and gastrointestinal diseases.

Approaches to develop a one-stop shop for measuring serum profiles of all essential nutrients including their important metabolites are also described. In effect, this would make the tracking and personalization of the total nutritional status of individuals and the community possible.

No exposition seems complete without an evaluation of the gut microbiome, with increasing

evidence of its role in the aetiology of various diseases. A major role of dietary nutrients might be their influence on the type and function of microbes in the gut, which in turn can affect the development of metabolic diseases. All this is possible due to the advances in sequencing and mass spectroscopy techniques working in conjunction with enhanced biocomputational tools that can handle and interpret large data sets.

Overall, this book is a good introduction into the field of nutritional biomarkers. This is a rapidly growing field and the quest for sensitive, specific, non-invasive biomarkers is throwing up new information on a regular basis. Ultimately, the goal of personalized nutrition seems more and more possible in the future.

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