Nizel

Nutrition in Clinical Dentistry

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W. B. Saunders Company

PHILADELPHIA AND LONDON 1960

Library of Congress Catalog Card Number; 60-7462

Dedicated
to my wife,
Jeannette,
and my sons,
David and *Jonathan*

Preface

This textbook has been prepared to enable the general practitioner of dentistry to use nutrition as a practical objective discipline in his daily practice, and as a guide for teaching nutrition to the dental student and dental hygienist. It has been designed to conform to the recommendations on the teaching of nutrition in dental schools that were presented during the Conference Session on Nutrition and Dietetics at the 1956 meeting of the American Association of Dental Schools.

The dentist who appreciates the importance of nutrition in maintaining the integrity of the tissues of the oral cavity, the teeth, the periodontium and the adjacent oral structures, and can apply it in his daily practice, will be held in high esteem by the patient of today. The patient looks to the dentist for management of all types of problems that arise in the oral cavity, not only for individual tooth treatments. To solve some of these problems, local mechanical techniques do not always suffice; it requires an appreciation of the role and management of endogenous metabolic factors. Diet and nutrition are part of these systemic influences. As members of a health profession, it is our responsibility to use nutrition as one of our tools for the improvement of our patient's total oral health. Providing adequate diets during the periods of dental stress as well as utilizing proper diets for maintenance of tissue health postoperatively are as important adjuncts in the over-all manage-

ment of a dental patient as are x-rays in diagnosis, anesthesia in surgery or oral physiotherapy in periodontology.

A knowledge of nutrition can help in the practice of dentistry in several ways:

1. It provides an understanding of some of the factors involved in the etiology, prevention and control of dental caries.

2. It explains some of the changes in the oral mucous membrane which reflect a systemic disease of nutritional origin.

3. It gives the dentist an answer to the inevitable question, "What can I eat, doctor?" after periodontal, prosthetic and oral surgery procedures.

The book is divided into two major parts, one on basic nutrition and one on applied nutrition.

In basic nutrition, the chemistry and physiology of each of the nutrients is discussed to give an understanding of its normal metabolism. This is followed by a consideration of the effects of abnormal metabolism of the nutrients on tissues and organs in general and on the mouth and its related structures in particular. In this section, subjects like intermediary metabolism and dietary interrelationships have been touched upon to give the reader a concept of how dynamic a subject nutrition really is. It is fully realized that a complete textbook could be written, and in many instances has already been written, on the subject matter included in each chapter. Therefore, no attempt has been made to deal in detail with any one nutrient; rather, the salient features of each are pointed out, particularly as they influence oral health.

In the section on applied nutrition, basic information on normal diets and the procedure for arriving at a nutritional diagnosis are presented as a preface to the specific dietetic management of the various dental problems that are encountered in daily practice. For the sake of convenience and simplicity the Daily Food Guide, which interprets adequacy of a diet in terms of servings of the 4 Food Groups, has been used throughout the text as the method of diet evaluation and diet teaching. The role of diet and nutrition in the control of rampant caries is probably the most important consideration in applied dental nutrition. For this reason detailed procedures, which include the "why" as well as the "what" of the diet, have been given for making a nutritional diagnosis and for prescribing diets to suit the patient's individual needs. For the patient whose dental conditions are classified as periodontal, prosthetic or surgical, specific dietary advice is suggested.

Several of my colleagues in the fields of nutrition and dentistry have motivated and inspired me to attempt the writing of this book. To my teacher and collaborator in research, Dr. Robert S. Harris, Professor of Biochemistry of Nutrition in the Department of Food Technology at Massachusetts Institute of Technology, I owe my special gratitude for his encouragement and continuous guidance. To Dr. Henry Sherman, who formerly was Assistant Professor of Biochemistry of Nutrition in the Department of Food Technology at Massachusetts Institute of Technology, I must express my thanks for his diligent and thorough editing as well as verification of the facts that pertained to the material on Basic Nutrition. Thanks also go to Dr. Sanford Miller, who is Assistant Professor in the same department as my other two colleagues and who has contributed two chapters, one on intermediary metabolism and the other on dietary interrelationships, as well as assisting with the chapter on calories and energy metabolism.

I am very appreciative and honored to have had the privilege of editorial advice on the chapter on the clinical assessment of nutritional status by Dr. Nevin S. Scrimshaw, Regional Advisor in Nutrition of the Pan-American Health Organization and Director of INCAP.

I also want to thank Miss Isabel Patterson, who is Assistant Professor of Nutrition at Boston University School of Nursing, for her counsel on dietetics and for the formulation of the several diets that are suggested in the text. She has also contributed two chapters, one dealing with interpreting nutritional needs and the other containing some practical suggestions for applying nutritional knowledge.

My dental colleagues who are or were associated with me at Tufts University School of Dental Medicine have been most helpful in making suggestions on several of the chapters that deal with nutrition in the various dental specialities—Dr. Irving Glickman in periodontology, Dr. Albert Yurkstas in prosthetics and Dr. Daniel Holland in oral surgery.

It was felt that rather than duplicate the numerous photographs and tables that describe so much of the review matter presented here, the purpose of the book would be better served if the original ones could be used. To the numerous authors and publishers who have given us permission for their use, many thanks. I also want to acknowledge the illustrations that Dr. G. Shklar, of Tufts University

School of Dental Medicine, and Dr. Jonathan Cohen, of the Children's Medical Center in Boston, have allowed me to use.

For the excellent typing services of Miss Rose Ann Roberto and Miss Patricia Rourke, my sincerest appreciation.

I am most grateful to my publishers, the W. B. Saunders Co., for their wonderful editorial help and meticulous attention to details.

Finally, to my beloved wife and children, I offer my everlasting gratitude for their understanding and patience in sparing me the many hours that were taken away from them and devoted to the writing of this book.

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Contents

Section I

Basic Nutrition and Its Effect on Oral Tissues in Health and Disease

Chapter I

Calories and Energy Metabolism 3

Chapter II

Carbohydrates 18

Chapter III

Fats 45

Chapter IV

Proteins 60

Chapter V

The Intermediary Metabolism and Interrelationships of Carbohydrates, Proteins and Fats 77

By Sanford Miller, Ph.D.

Chapter VI

Principal Minerals, Water and Electrolytes (Na, Cl and K) 90

Chapter VII

Trace Elements 122

Chapter VIII

Vitamins; Fat-Soluble Vitamins 151

Chapter IX

Water-Soluble Vitamins 183

Chapter X

Dietary Interrelationships and Antimetabolites 224

SANFORD MILLER, PH.D.

Section II

Applied Nutrition in Dental Practice

Chapter XI

Interpreting Nutritional Needs 243

ISABEL PATTERSON, M.S., M.P.H.

Chapter XII

Applying Nutrition Knowledge 261

ISABEL PATTERSON, M.S., M.P.H., AND A. E. NIZEL., D.M.D., M.S.D.

Chapter XIII

Clinical Malnutrition—Its Pathogenesis and Assessment 277

Chapter XIV

Dental Caries—Its Etiology and Techniques for Determining its Activity . 296

Chapter XV

A Step-by-Step Technique for the Nutritional Guidance of Patients with Rampant Caries 322

Chapter XVI

Fluoridation Vehicles—Water Supplies, Foods and Supplements..... 358

Chapter XVII

The Role of Diet and Nutrition in Etiology, Diagnosis and Management of the Patient with Periodontal Disease..... 365

Chapter XVIII

Nutrition for the Patient with Full Upper and Lower Denture with Special Consideration to the New Denture Wearer..... 383

Chapter XIX

Diet in Oral Surgery..... 392

Appendices

Appendix I

Food Nomogram 403

Appendix II

Food Composition Table for Short Method of Dietary Analysis 404

Appendix III

Foods and Mixed Dishes Classified According to Food Groups and Amounts Commonly Considered as One Serving..... 410

Appendix IV

Some Representative Vitamin Preparations from a Few Different Drug Houses 414

Appendix V

Equivalent Weights and Measures 417

Appendix VI

Average Height and Weight Tables for Children 419

Appendix VII

Average Height and Weight Tables for Adults 421

Appendix VIII

Composition of Food Exchanges 422

Appendix IX

Lists of Food Exchanges, Arranged by Food Type 423

Index 429

Section I

Basic Nutrition and Its Effect on Oral Tissues in Health and Disease

Chapter I

Calories and Energy Metabolism

INTRODUCTION

"Behold, I have given you every herb bearing seed, which is upon the face of all the earth, and every tree, in which is the fruit of a tree yielding seed; to you it shall be for . . . (food)."

This is a quotation from the 29th verse of Chapter 1 of Genesis in the Old Testament and is probably the first reference to our source of food. But what is food?

To Adam, to many of our ancestors, and to some peoples even today, food connotes only one thing, satisfaction of hunger. But if we read the writings of the Hebrews, the Egyptians, the Greeks and the Romans, we find that there were some very learned and wise men who realized that food was more than a means of satisfying hunger; it meant edible substances that could nourish and give vigor to the body.

When scientists became interested in trying to determine how food functions to give strength to the body, how it yields energy, how it builds and repairs tissues and how it regulates body processes, then nutrition became, like anatomy, histology and biochemistry, a science unto itself. In fact, nutrition may be defined as a science which deals with the assimilation and effect of food on total health.

The science of nutrition actually originated at the end of the eighteenth century in the study of energy. This was the time when physicists were dealing with steam, power and energy. Men like

Priestley, Lavoisier, Liebig and others were intrigued with the thought that perhaps the basic concepts about energy that worked for inanimate objects could also be applied to the animate. They wanted to know how an animal functioned and what was the source of its energy.

Just as nutrition had its beginning as a science with the study of energy, so does this book. The most fundamental of all the requirements for life is energy. An animal can survive for relatively long periods of time without vitamins, minerals or other nutrients, but without the fuel to keep the "engine running," life soon ceases. Actually, an animal tends to select food instinctively, primarily for its caloric content and, secondarily, for any other benefit that his body can derive from it.

Another reason that calories are considered first is that the most prevalent clinical nutritional problems in the world in the last decade, and even today, stem not from vitamin deficiencies but rather from caloric undernutrition and caloric overnutrition. In fact, the rise in degenerative diseases in general has been attributed more to this latter factor than to any other.

EVOLUTION OF PRINCIPLES OF ENERGY METABOLISM[5]

Stahl, a German physician, proposed the imaginative hypothesis that there was an invisible, weightless substance called phlogiston which escaped from combustible material. He theorized that materials were made of calx (or ash) and phlogiston and that when a material burned, the calx remained and the phlogiston escaped. Attempts were made to identify phlogiston with some definite substance, but to no avail. Finally, in 1774, Priestley isolated and described a gas that escaped from mercuric oxide, which he called "dephlogisticated air." He also demonstrated that this same gas was present in the atmosphere.

On the basis of Priestley's discovery, Lavoisier began his numerous investigations in respiration and energy metabolism. He called "dephlogisticated air" by an alternate name, "oxygine principle," and was able to show that there were two factors involved in respiration: (a) the disappearance of oxygen, and (b) the appearance of "fixed air"(carbon dioxide). Later he was able to measure the quantity of heat produced during a chemical reaction by measuring the amount of ice that it melted in an ice calorimeter. Using both of these principles Lavoisier was then able to show

that muscular work increased respiration and simultaneously increased the amount of heat liberated. The amount of carbon dioxide produced from respiration could be correlated to the amount of heat yielded. In short, through numerous experiments he related work, heat, respiration, transpiration and digestion.

Von Voit made one of the outstanding contributions to the study of metabolism when he built a respiratory chamber sufficiently large so that a man could sleep, work and eat within it. The in-going and out-going air could be sampled and analyzed. Rubner, von Voit's student and assistant, proved that the principle of conservation of energy was applicable to man as well as to matter. A second important contribution by von Voit was his development of a very accurate chemical calorimeter. Using similar principles, Bertholet, and later Atwater, developed a bomb calorimeter in which the amount of heat produced from food could be measured.

It is interesting that all these basic principles laid down at the end of eighteenth century and during the nineteenth century are still generally accepted today. Of course, the techniques have been refined and extended, and greater knowledge of metabolic events has supplied better explanations for the rationale of energy metabolism.

ENERGY VALUE OF FOOD[2,3,4,6]

All the energy required for growth, maintenance and work is derived from the oxidation of carbohydrates, fats and proteins. Proteins are used only if the other two nutrients are unavailable. Approximately 20 per cent of the potential energy of food is transformed into mechanical energy, the remainder being liberated as heat. The energy value of food depends upon the number of Calories that are produced when foodstuff is metabolized in the body.

Units of energy are calories; a calorie being defined as the amount of heat required to raise the temperature of one gram of water 1°C. The large Calorie or kilogram calorie is the term used in nutritional work and is 1,000 times the small calorie; it is defined as the amount of heat required to raise one kilogram of water from 14.5°C. to 15.5°C.

The amount of energy in a food can be determined by direct and indirect chemical calorimetric techniques as well as by nutrient analysis through predetermined Calorie equivalents. Direct calorimetry is the technique which involves the measurement of the amount