

THE NUTRITION SOCIETY TEXTBOOK SERIES

Public Health Nutrition

Second Edition

Edited by

Judith L Buttriss, Ailsa A Welch,
John M Kearney and Susan A Lanham-New



THE
NUTRITION
SOCIETY

Advancing Nutritional Science

WILEY Blackwell

Public Health Nutrition

The Nutrition Society Textbook Series

Now widely adopted in courses throughout the world, the prestigious Nutrition Society Textbook Series provides students with both specific scientific information and appropriate context.

These groundbreaking titles:

- Provide students with the required scientific basics of nutrition in the context of a systems and health approach

Nutrition Research Methodologies

Edited by Lovegrove, Hodson, Sharma & Lanham-New
March 2015

ISBN: 978-1-118-55467-8

Clinical Nutrition, 2nd Edition

Edited by Elia, Ljungqvist, Stratton & Lanham-New
January 2013

ISBN: 978-1-4051-6810-6

Sport and Exercise Nutrition

Edited by Lanham-New, Stear, Shirreffs & Collins
October 2011

ISBN: 978-1-4443-3468-5

- Enable teachers and students to explore the core principles of nutrition, to apply these throughout their training, and to foster critical thinking at all times
- Are fully peer reviewed, to ensure completeness and clarity of content, as well as to ensure that each book takes a global perspective.

Nutrition and Metabolism, 2nd Edition

Edited by Lanham-New, MacDonald & Roche
November 2010

ISBN: 978-1-4051-6808-3

Introduction to Human Nutrition, 2nd Edition

Edited by Gibney, Lanham-New, Cassidy & Vorster
March 2009

ISBN: 978-1-4051-6807-6

Public Health Nutrition

Second Edition

Edited on behalf of The Nutrition Society by

Professor Judith L Buttriss

Director General, British Nutrition Foundation

Dr Ailsa A Welch

Reader in Nutritional Epidemiology, University of East Anglia

Dr John M Kearney

Lecturer, Epidemiology, Dublin Institute of Technology

Editor-in-Chief

Professor Susan A Lanham-New

Head of the Department of Nutritional Sciences, University of Surrey

WILEY



This edition first published 2018 © 2018 by The Nutrition Society.

Edition History 1e © The Nutrition Society 2004.

Registered office: John Wiley & Sons, Ltd, The Atrium, Southern Gate, Chichester, West Sussex, PO19 8SQ, UK

Editorial offices: 9600 Garsington Road, Oxford, OX4 2DQ, UK

The Atrium, Southern Gate, Chichester, West Sussex, PO19 8SQ, UK

1606 Golden Aspen Drive, Suites 103 and 104, Ames, Iowa 50010, USA

For details of our global editorial offices, for customer services and for information about how to apply for permission to reuse the copyright material in this book please see our website at www.wiley.com/wiley-blackwell

The right of the author to be identified as the author of this work has been asserted in accordance with the UK Copyright, Designs and Patents Act 1988.

All rights reserved. No part of this publication may be reproduced, stored in a retrieval system, or transmitted, in any form or by any means, electronic, mechanical, photocopying, recording or otherwise, except as permitted by the UK Copyright, Designs and Patents Act 1988, without the prior permission of the publisher.

Designations used by companies to distinguish their products are often claimed as trademarks. All brand names and product names used in this book are trade names, service marks, trademarks or registered trademarks of their respective owners. The publisher is not associated with any product or vendor mentioned in this book. It is sold on the understanding that the publisher is not engaged in rendering professional services. If professional advice or other expert assistance is required, the services of a competent professional should be sought.

The contents of this work are intended to further general scientific research, understanding, and discussion only and are not intended and should not be relied upon as recommending or promoting a specific method, diagnosis, or treatment by health science practitioners for any particular patient. The publisher and the author make no representations or warranties with respect to the accuracy or completeness of the contents of this work and specifically disclaim all warranties, including without limitation any implied warranties of fitness for a particular purpose. In view of ongoing research, equipment modifications, changes in governmental regulations, and the constant flow of information relating to the use of medicines, equipment, and devices, the reader is urged to review and evaluate the information provided in the package insert or instructions for each medicine, equipment, or device for, among other things, any changes in the instructions or indication of usage and for added warnings and precautions. Readers should consult with a specialist where appropriate. The fact that an organization or Website is referred to in this work as a citation and/or a potential source of further information does not mean that the author or the publisher endorses the information the organization or Website may provide or recommendations it may make. Further, readers should be aware that Internet Websites listed in this work may have changed or disappeared between when this work was written and when it is read. No warranty may be created or extended by any promotional statements for this work. Neither the publisher nor the author shall be liable for any damages arising herefrom.

Library of Congress Cataloging-in-Publication Data

Names: Buttriss, Judith L, editor. | Welch, Ailsa A, editor. | Kearney, John M., editor. | Lanham-New, Susan A, Editor-in-Chief. | The Nutrition Society (Great Britain), Issuing Body.

Title: Public Health Nutrition / edited on behalf of The Nutrition Society by Judith L. Buttriss, Ailsa A. Welch, John M. Kearney, Susan A. Lanham-New.

Other titles: Public Health Nutrition (The Nutrition Society (Great Britain))

Description: Second edition. | Chichester, West Sussex, UK ; Ames, Iowa, USA : John Wiley & Sons, Inc., 2017. | Includes bibliographical references and index.

Identifiers: LCCN 2016056644 | ISBN 9781118660973 (paper) | ISBN 9781118660935 (Adobe PDF) | ISBN 9781118660966 (epub)

Subjects: | MESH: Nutritional Physiological Phenomena | Dietetics | Public Health

Classification: LCC RA645.N87 | NLM QU 145 | DDC 616.3/9—dc23 LC record available at <https://lccn.loc.gov/2016056644>

A catalogue record for this book is available from the British Library.

Wiley also publishes its books in a variety of electronic formats. Some content that appears in print may not be available in electronic books.

Cover image: © skystardream/iStockphoto

Set in 9.5/11pt MinionPro-Regular by Thomson Digital, Noida, India

Contents

Contributors	viii
Series Foreword	x
Preface	xi
Introduction	xiii
About the companion website	xiv
Part One Public Health Nutrition Tools	1
1 Introduction to Public Health Nutrition	3
<i>Martin Wiseman</i>	
2 Concepts and Definitions Used in Public Health Nutrition	9
<i>Eric J Brunner and Ailsa A Welch</i>	
3 Assessment of Dietary Habits	18
<i>Marga Ocke and Emma Foster</i>	
4 Assessment of Nutritional Status in Public Health Nutrition Settings	29
<i>H David McCarthy</i>	
5 Food Composition	36
<i>Mark Roe, Jenny Plumb, U Ruth Charrondierre and Paul Finglas</i>	
6 Dietary Reference Values	47
<i>Peter J Aggett</i>	
7 Assessment of Physical Activity	56
<i>Bjørge H Hansen and Ulf Ekelund</i>	
Part Two Current State of Evidence	69
8 Poor Dietary Patterns	71
<i>Judith L Buttriss and Anne P Nugent</i>	
9 Minerals and Vitamins of Current Concern	88
Iron	88
<i>Peter J Aggett</i>	
Iodine	96
<i>Margaret P Rayman and Sarah C Bath</i>	
Vitamin A	102
<i>Elizabeth J Johnson and Emily Mohn</i>	
10 Nutrition Pre-conception and during Pregnancy	111
<i>Sara Stanner</i>	

11	Nutrition and Infant/Child Development <i>Alison M Lennox</i>	137
12	Nutrition and Teenagers/Young Adults <i>Elisabeth Weichselbaum</i>	159
13	Nutrition in Older Adults <i>Ashley T LaBrier, Clare A Corish, and Johanna T Dwyer</i>	175
Part Three Diet and Disease		193
14	Obesity: Maternal <i>Debbie M Smith, Tracey A Mills, and Christine Furber</i>	195
15	Obesity: Childhood <i>Laura Stewart, Jenny Gillespie, and Taryn Young</i>	205
16	Cardiovascular Diseases: Sodium and Blood Pressure <i>Linda M Oude Griep and Paul Elliott</i>	214
17	Carbohydrates and Metabolic Health <i>Judith L Buttriss</i>	221
18	Cardiovascular Disease: Dietary Fat Quality <i>Tom Sanders</i>	236
19	Diet and Cancer <i>Farah Naja and Lara Nasreddine</i>	243
20	Bone Health <i>Louise R Wilson, Andrea L Darling, and Susan A Lanham-New</i>	284
21	Dental Health <i>Anja Heilmann and Richard G Watt</i>	298
22	Mental Health and Cognitive Function	310
	Iron <i>Paul A Sharp</i>	310
	Caffeine <i>Peter J Rogers</i>	313
	B Vitamins <i>Helene McNulty</i>	317
	Physical Activity <i>Kenneth R Fox</i>	320
Part Four Environmental Factors		325
23	Obesogenic Neighbourhood Food Environments <i>Amelia A Lake, Tim G Townshend, and Thomas Burgoine</i>	327

24	The Wider Environment and its Effect on Dietary Behaviour <i>Bridget Benelam and Judith L Buttriss</i>	339
Part Five Public Health Nutrition Strategies and Approaches		357
25	Global and National Public Health Nutrition Approaches <i>Francesco Branca and Cassandra H Ellis</i>	359
26	Developing Strategies in the Community <i>Janet E Cade, Charlotte EL Evans, and Jayne Hutchinson</i>	373
27	Dietary Change and Evidence on How to Achieve This <i>Janice L Thompson</i>	386
28	Evaluation of Public Health Nutrition Interventions and Policies <i>Ailsa A Welch and Richard PG Hayhoe</i>	398
29	Considerations for Evaluation of Public Health Nutrition Interventions in Diverse Communities <i>Basma Ellahi</i>	405
	Appendix	411
	Index	417

Contributors

Professor Peter J Aggett

Lancaster University
UK

Dr Sarah C Bath

University of Surrey
UK

Bridget Benelam

British Nutrition Foundation
UK

Dr Francesco Branca

World Health Organization
Switzerland

Professor Eric J Brunner

University College London
UK

Dr Thomas Burgoine

University of Cambridge
UK

Professor Judith L Buttriss

British Nutrition Foundation
UK

Professor Janet E Cade

University of Leeds
UK

Dr U. Ruth Charrondiere

Food and Agriculture Organization of the United Nations
Italy

Dr Clare A Corish

University College Dublin
Ireland

Dr Andrea L Darling

University of Surrey
UK

Johanna T Dwyer

Tufts University
USA

Professor Ulf Ekelund

Norwegian School of Sport Sciences (NIH)
Norway

Professor Basma Ellahi

University of Chester
UK

Professor Paul Elliott

Imperial College London
UK

Cassandra H Ellis

The Nutrition Society
UK

Dr Charlotte EL Evans

University of Leeds
UK

Paul Finglas

Institute of Food Research
UK

Dr Emma Foster

Newcastle University
UK

Professor Kenneth R. Fox

University of Bristol
UK

Dr Christine Furber

The University of Manchester
UK

Jenny Gillespie

NHS Tayside
UK

Dr Bjørge H Hansen

Norwegian School of Sport Sciences (NIH)
Norway

Dr Richard PG Hayhoe

University of East Anglia
UK

Dr Anja Heilmann

University College London
UK

Dr Jayne Hutchinson

University of Leeds
UK

Elizabeth J Johnson

Tufts University
USA

Ashley T LaBrier

Tufts University
USA

Dr Amelia A Lake

Durham University
UK

Professor Susan A Lanham-New

University of Surrey
UK

Professor Alison M Lennox

University of Surrey
UK

Professor H David McCarthy

London Metropolitan University
UK

Professor Helene McNulty

Ulster University
UK

Dr Tracey A Mills

The University of Manchester
UK

Dr Emily Mohn

Tufts University
USA

Dr Farah Naja

American University of Beirut
Lebanon

Dr Lara Nasreddine

American University of Beirut
Lebanon

Dr Anne P Nugent

University College Dublin
Ireland

Dr Marga Ocke

National Institute for Public Health and the Environment
Netherlands

Dr Linda M Oude Griep

Imperial College London
UK

Jenny Plumb

Institute of Food Research
UK

Professor Margaret P Rayman

University of Surrey
UK

Mark Roe

Institute of Food Research
UK

Professor Peter J Rogers

University of Bristol
UK

Professor Tom Sanders

Kings College London
UK

Dr Paul A Sharp

Kings College London
UK

Dr Debbie M Smith

The University of Manchester
UK

Dr Sara Stanner

British Nutrition Foundation
UK

Dr Laura Stewart

NHS Tayside
UK

Professor Janice L Thompson

University of Birmingham
UK

Professor Tim G Townshend

Newcastle University
UK

Professor Richard G Watt

University College London
UK

Dr Elisabeth Weichselbaum

Nutrition Science and Consultancy
New Zealand

Dr Ailsa A Welch

University of East Anglia
UK

Dr Louise R Wilson

University of Surrey
UK

Professor Martin Wiseman

World Cancer Research Fund & University of Southampton
UK

Taryn Young

NHS Tayside
UK



BUCKINGHAM PALACE

As Patron of the British Nutrition Foundation I am pleased to contribute the Foreword for this comprehensive new edition of a popular textbook on Public Health Nutrition. Much has changed in the world of nutrition since the first edition was published in 2004, especially through confusing headlines and specialist research that seemed to contradict each other. The aim of the editorial team for the second edition, led by Professor Judith Buttriss from the British Nutrition Foundation, has been to bring the book up to date and, at the same time, to meet the requirements of students of nutrition and practitioners, as well as try to balance all that information. The book provides the reader with a comprehensive series of chapters in five themed sections, covering basic principles through to practical application of public health nutrition in local, national and international settings, and its translation into policy.

The Nutrition Society textbook series, first established by Professor Michael Gibney in 1998 and now under the direction of the second Editor-in-Chief, Professor Susan Lanham-New, continues to be an extraordinarily successful venture for the Society. This series of human nutrition textbooks is designed for use worldwide and this has been achieved by translating the series into many different languages including Spanish, Greek and Portuguese. The popularity of the textbooks is a tribute to the quality of the authorship and the value placed on them, both in the UK and Worldwide, as a core educational tool. I am sure this textbook will make a very valuable contribution to the Nutrition debate. Perhaps I might suggest a strapline: all things in moderation!

A handwritten signature in black ink, appearing to read 'Anne', with a long horizontal flourish extending to the right.

Preface

I am absolutely delighted in my capacity as Editor-in-Chief (E-i-C) of the Nutrition Society (NS) Textbook Series to introduce the Second Edition of *Public Health Nutrition*. So much planning and hard work has gone into producing this Second Edition, following a most successful production of *Public Health Nutrition* First Edition. We owe a great deal of thanks to Professor Barrie Margetts, Professor Lenore Arab and Dr John Kearney for their original work on this important book in the NS Textbook Series.

Public Health Nutrition 2nd Edition (PHN2e) has been led superbly by Professor Judith Buttriss (Director General, British Nutrition Foundation) as Senior Editor of the book, and her Editorial Team in the name of Dr Ailsa Welch (University of East Anglia) and Dr John Kearney (Dublin Institute of Technology). They have meticulously planned out the details of the chapters and managed to secure the world-leaders in the field to contribute key chapters. Professor Buttriss is a most inspirational leader, and the team have complemented one another admirably with their expertise and knowledge in the field, as well as providing great continuity from the First Edition. How indebted we are to all the contributors for making the book such a comprehensive review and we are absolutely thrilled, as Professor Buttriss outlines in her Introductory Chapter, to have so many global experts who have written chapters to make PHN2e a complete review of this key area.

PHN2e is intended for those with an interest in nutritional science whether they are nutritionists, food scientists, dietitians, medics, nursing staff or other allied health professionals. We hope that both undergraduate and postgraduate students will find the book of great help with their respective studies and that the book will really put public health nutrition as a *discipline* into context.

PHN2e comprises of a total 29 chapters; commencing with a detailed overview of the book structure and then a focus of five sections; namely: 1) Public Health Nutrition Tools; 2) Current State of Evidence; 3) Diet and Disease; 4) Environmental Factors and 5) Public Health Nutrition Strategies and Approaches, with each chapter providing a key summary of the take home messages.

We are extremely honoured and most sincerely grateful that the Foreword for PHE2e has been written by Her Royal Highness The Princess Royal, who has a great depth of knowledge in the field and who speaks with authority on key issues in Public health Nutrition. It gives us great confidence in this textbook to have such a Royal seal of approval.

The first and second textbooks in the Series: *Introduction to Human Nutrition* (IHN) and *Nutrition & Metabolism* (N&M), are now out in 2nd Edition and sales continue to go extremely well, with third editions now fully under-preparation. Sales of Professor Marinos Elia *et al*'s *Clinical Nutrition* 2nd Edition (CN2e - fourth textbook) continue to sell apace and our fifth textbook in the Series, *Sport and Exercise Nutrition* 1st Edition (SEN1e) has surpassed all expectations. Our sixth textbook, *Nutrition Research Methodology* 1st Edition (NRM1e) led by Professor Julie Lovegrove *et al* provides great complementarity to PHN2e, and the Series, and is proving to be an excellent textbook in its own right.

We are most grateful to the following individuals for their support and most generous Forewords in SEN1e, CN2e and NRM1e respectively; namely - Professor Richard Budgett OBE, Chief Medical Officer for the London 2012 Olympic and Paralympic Games and now Medical and Scientific Director at the International Olympic Committee (IOC) based in Lausanne, Switzerland; Dame Sally Davies, Chief Medical Officer (CMO) for England, and the UK Government's Principal Medical Adviser; Professor Lord John Krebs, Principal, Jesus College, University of Oxford and our first Chairman of the UK Food Standards Agency.

The Society is most grateful to the textbook publishers, Wiley-Blackwell for their continued help with the production of the textbook and in particular, James Watson, Jennifer Seward and Francesca Giovannetti. We would also like to thank Garima Singh from Thomson Digital for her great help with PHN2e finalisation. In addition, I would like to acknowledge formally my great personal appreciation to Professor G.Q. Max Lu AO, FRSC, FICHEM, Vice-Chancellor of the University of Surrey, and Professor David Blackburn FRSB, Head of the School of Bioscience and Medicine, University of Surrey, for their respective great encouragement of the nutritional sciences field in general, and the Textbook Series production in particular.

Sincerest appreciation indeed to the Nutrition Society past-Presidents, Professor Sean J.J. Strain OBE (Ulster University) and Professor Catherine Geissler (King's College London) and current-President, Professor Philip Calder (University of Southampton) for their belief in the Textbook Series. With special thanks to past-Honorary Publications Officer, Professor David Bender (University College London), and present-Honorary Publications Officer Professor Paul

Trayhurn (University of Liverpool) for being such tremendous sounding boards for the Textbook Series. I am hugely grateful for their wise counsel. And finally a very big thank you indeed to Cassandra Ellis, Assistant Editor, NS Textbook Series, for her incredibly important contribution to the development of the Series.

Finally, as I always write and absolutely do not forget (ever!), the Series is indebted to the forward thinking focus that Professor Michael Gibney (University College Dublin) had at that time of the Textbook Series development. It remains such a tremendous privilege for me to continue to follow in his footsteps as the second E-i-C.

I really hope that you will find the textbook a great resource of information and inspiration . . . please enjoy, and with so many grateful thanks to all those who made it happen!

With my warmest of wishes indeed

**Professor Susan A Lanham-New RNutr,
FAfN FRSB**

E-i-C, Nutrition Society Textbook Series and
Head, Department of Nutritional Sciences
School of Biosciences and Medicine,
Faculty of Health and Medical Sciences
University of Surrey

Introduction

Much has changed in the 12 years since the launch of the first edition of *Public Health Nutrition*. With an explosion of research in this area, changes in nutrition policy and food-related legislation, and shifts in population health, dietary patterns and the food supply, the second edition represents a complete rewrite. We are honoured to have so many global experts in public health nutrition (PHN) contributing to make this textbook a comprehensive review.

To ensure the second edition reflects the most recent knowledge and research, and meets the requirements of students and practitioners alike, an expert advisory group was consulted throughout the planning process. The group members, representing research, teaching and PHN practice, were asked to comment on the content and structure of the new edition, and to provide guidance on what they were looking for in a PHN resource.

The textbook not only introduces PHN concepts, it is also intended to support learning for students and to be a practical guide for health professionals and those working within public health. More generally, feedback highlighted the benefit of including case studies to illustrate the practical application of the evidence and how this translates to policy. Case studies have therefore been included throughout to support the evidence and to offer practical advice for those working within PHN.

The clear message throughout consultation was the importance of structure and flow through the textbook. To ensure a clear, concise structure, the 29 chapters have been divided into clearly defined sections covering five key areas of PHN.

Part One outlines PHN assessment tools. This provides an introduction to concepts in PHN, followed by an overview of dietary assessment methodology, anthropometry and physical activity measures, with a focus on contemporary measures using new technology as well as traditional methods. This part then outlines the

importance of food composition data in nutrition research, food safety and food security, and discusses dietary guidelines.

Part Two moves on to considering the application of PHN tools in a review of the current evidence. It begins by outlining dietary patterns and how they are defined before discussing vitamins and minerals that are of particular concern due to prevalent deficiency. This part also examines nutrition through the lifecycle, from pre-conception to old age, considering the public health challenges and risk factors at each phase.

Part Three reviews the relationship between diet and disease. Beginning with the risks of obesity in pregnancy and childhood, chapters that follow discuss some of the comorbidities of obesity, cardiovascular disease and type 2 diabetes. The relationship between diet and cancer is also examined, with consideration to both the protective and the carcinogenic roles of dietary factors. The PHN challenges associated with bone and dental health are also reviewed, and the relationship between diet and mental health and cognitive function is explored.

Part Four looks at the impact of environmental factors on public health, starting with consideration of the effects that obesogenic environments have on diets and health. Also explored is how aspects such as advertising, health promotion, food reformulation and food legislation can affect dietary behaviours.

Finally, Part Five outlines current public health strategies, policies and approaches. It begins broadly with a global perspective, before considering community strategies and engagement, how these strategies can be used to influence behaviour change, and the importance of culturally sensitive interventions and policies. The final chapters provides an evaluation of current policies and interventions and the social determinants of diet and health.

Judith L Buttriss

About the Companion Website

This book is accompanied by a companion website:

www.wiley.com/go/buttriss/publichealth

The website includes:

- Multiple choice questions
- Short answer questions
- Essay titles
- Further readings