

THE NUTRITION SOCIETY TEXTBOOK SERIES

# Public Health Nutrition

Edited by Michael J. Gibney,  
Barrie M. Margetts and John M. Kearney

NS



Blackwell  
Publishing

# Public Health Nutrition

Edited on behalf of The Nutrition Society by

Michael J Gibney, Barrie M Margetts,  
John M Kearney and Lenore Arab

Blackwell  
Science



© The Nutrition Society 2004

Published by Blackwell Science  
a Blackwell Publishing company

Editorial offices:

Blackwell Science Ltd, 9600 Garsington Road,  
Oxford OX4 2DQ, UK

Tel: +44 (0) 1865 776868

Iowa State Press, a Blackwell Publishing Company, 2121 State Avenue, Ames, Iowa 50014-8300, USA

Tel: +1 515 292 0140

Blackwell Science Asia Pty, 550 Swanston Street, Carlton, Victoria 3053, Australia

Tel: +61 (0)3 8359 1011

The right of the Author to be identified as the Author of this Work has been asserted in accordance with the 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.

First published 2004

Library of Congress Cataloging-in-Publication Data

Public health nutrition / edited on behalf of The Nutrition Society by Michael J.

Gibney ... [et al.].

p. cm.

Includes bibliographical references and index.

ISBN 0-632-05627-4 (pbk. : alk. paper)

1. Nutritionally induced diseases. 2. Nutrition. 3. Public health. I. Gibney,  
Michael J. II. Nutrition Society (Great Britain)

RA645.N87P83 2004

616.3'9--dc22

2004010644

ISBN 0-632-05627-4

A catalogue record for this title is available from the British Library

Produced and typeset in Minion  
by Gray Publishing, Tunbridge Wells, Kent  
Printed and bound in India  
by Gopsons Papers Ltd, Noida

The publisher's policy is to use permanent paper from mills that operate a sustainable forestry policy, and which has been manufactured from pulp processed using acid-free and elementary chlorine-free practices. Furthermore, the publisher ensures that the text paper and cover board used have met acceptable environmental accreditation standards.

For further information on Blackwell Publishing, visit our website:  
[www.blackwellpublishing.com](http://www.blackwellpublishing.com)

## The Human Nutrition Textbook Series

### The International Scientific Committee

Editor-in-Chief

Professor Michael J Gibney  
*Trinity College, Dublin, Ireland*

Assistant Editor

Julie Dowsett  
*Trinity College, Dublin, Ireland*

Professor Lenore Arab

*University of North Carolina, USA*

Professor Yvon Carpentier

*Université Libre de Bruxelles, Belgium*

Professor Marinos Elia

*University of Southampton, UK*

Professor Frans J Kok

*Wageningen University, Netherlands*

Professor Olle Ljungqvist

*Ersta Hospital & Huddinge University Hospital, Sweden*

Professor Ian A Macdonald

*University of Nottingham, UK*

Professor Barrie M Margetts

*University of Southampton, UK*

Professor Kerin O'Dea

*Menzies School of Health Research, Darwin, Australia*

Dr Helen M Roche

*Trinity College, Dublin, Ireland*

Professor Hester H Vorster

*Potchefstroom, South Africa*

Dr John M Kearney

*Dublin Institute of Technology, Ireland*

### Textbook Editors

#### Introduction to Human Nutrition

Editor-in-Chief

Professor Michael J Gibney  
*Trinity College, Dublin, Ireland*

Professor Hester H Vorster

*Potchefstroom, South Africa*

Professor Frans J Kok

*Wageningen University,  
Netherlands*

#### Nutrition and Metabolism

Editor-in-Chief

Professor Michael J Gibney  
*Trinity College, Dublin, Ireland*

Professor Ian A Macdonald

*University of Nottingham, UK*

Dr Helen M Roche

*Trinity College, Dublin, Ireland*

#### Public Health Nutrition

Editor-in-Chief

Professor Michael J Gibney  
*Trinity College, Dublin, Ireland*

Professor Barrie M Margetts

*University of Southampton, UK*

Professor Lenore Arab

*University of North Carolina, USA*

Dr John Kearney

*Dublin Institute of Technology, Ireland*

#### Clinical Nutrition

Editor-in-Chief

Professor Michael J Gibney  
*Trinity College, Dublin, Ireland*

Professor Marinos Elia

*University of Southampton, UK*

Professor Olle Ljungqvist

*Ersta Hospital & Huddinge University Hospital, Sweden*

Julie Dowsett

*Trinity College, Dublin, Ireland*

### [www.nutritiontexts.com](http://www.nutritiontexts.com)

A unique feature of The Nutrition Society Textbook Series is that each chapter will have its own web pages, accessible at [www.nutritiontexts.com](http://www.nutritiontexts.com). In the course of time, each will have downloadable teaching aids, suggestions for projects, updates on the content of each chapter and sample multiple choice questions. With input from teachers and students we will have a vibrant, informative and social website.

## **The Human Nutrition Textbook series comprises:**

### **Introduction to Human Nutrition**

Introduction to human nutrition: a global perspective on food and nutrition  
Body composition  
Energy metabolism  
Nutrition and metabolism of proteins and amino acids  
Digestion and metabolism of carbohydrates  
Nutrition and metabolism of lipids  
Dietary reference standards  
The vitamins  
Minerals and trace elements  
Measuring food intake  
Food composition  
Food policy and regulatory issues  
Nutrition research methodology  
Food safety: a public health issue of growing importance  
Food and nutrition: the global challenge

### **Public Health Nutrition**

An overview of public health nutrition  
Nutritional epidemiology  
Assessment of nutritional status in individuals and populations  
Assessment of physical activity  
Public health nutrition strategies for intervention at the ecological level  
Public health nutrition strategies for intervention at the individual level  
Dietary guidelines  
Food choice  
Public health aspects of overnutrition  
Public health aspects of undernutrition  
Vitamin A deficiency  
Iodine and iron-deficiency disorders  
Iron-deficiency anemias  
Fear of fatness and fad slimming diets  
Nutrition and child development  
Infant feeding  
Adverse outcomes in pregnancy: the role of folate and related B-vitamins  
Maternal nutrition, fetal programming and adult chronic disease  
Cardiovascular disease  
Diabetes mellitus  
Cancer and diet  
Disease prevention: osteoporosis and hip fracture

### **Nutrition and Metabolism**

Core concepts of nutrition  
Molecular nutrition  
Integration of metabolism 1: Energy  
Integration of metabolism 2: Protein and amino acids  
Integration of metabolism 3: Macronutrients  
Pregnancy and lactation  
Growth and aging  
Nutrition and the brain  
The sensory systems: taste, smell, chemesthesis and vision  
The gastrointestinal tract  
The cardiovascular system  
The skeletal system  
The immune and inflammatory systems  
Phytochemicals  
The control of food intake  
Overnutrition  
Undernutrition  
Exercise performance

### **Clinical Nutrition**

General principles of clinical nutrition  
Metabolic and nutritional assessment  
Overnutrition  
Undernutrition  
Metabolic disorders  
Eating disorders  
Adverse reactions to foods  
Nutritional support  
Ethical and legal issues  
Gastrointestinal tract  
The liver  
The pancreas  
The kidney  
Blood and bone marrow  
The lung  
Immune and inflammatory systems  
Heart and blood vessels  
The skeleton  
Perioperative nutrition  
Infectious diseases  
Malignant diseases  
Pediatric nutrition  
Cystic fibrosis  
Water and electrolytes  
Clinical cases

# Contents

Series Foreword	xi
Preface	xii
Contributors	xiii
<b>1. An Overview of Public Health Nutrition</b>	<b>1</b>
<i>Barrie M Margetts</i>	
1.1 Introduction	1
1.2 Organization of the book	3
1.3 Definitions used in public health	4
1.4 What are the key public health problems?	7
1.5 Food and nutrition policy	10
1.6 The public health nutrition cycle	12
1.7 Step 1: Identify key nutrition-related problem	12
1.8 Step 2: Set goals and broad aims	15
1.9 Step 3: Define objectives	16
1.10 Step 4: Create quantitative targets	16
1.11 Step 5: Develop program	18
1.12 Step 6: Implementation	22
1.13 Step 7: Evaluation	23
Further reading	25
<b>2. Nutritional Epidemiology</b>	<b>26</b>
<i>Michael Nelson, Shirley AA Beresford and John M Kearney</i>	
2.1 Introduction	26
2.2 Types of study	31
2.3 Study design: sampling, study size and power	34
2.4 Measuring exposure	39
2.5 Measuring outcomes	50
2.6 Measuring diet–disease (exposure–outcome) associations	54
2.7 Interpretation of associations	60
2.8 Expressing results from nutritional epidemiological studies	63
2.9 Perspectives on the future	64
Further reading	65
<b>3. Assessment of Nutritional Status in Individuals and Populations</b>	<b>66</b>
<i>Ruth E Patterson and Pirjo Pietinen</i>	
3.1 Introduction	66
3.2 Dietary assessment	67
3.3 Biomarkers as measures for the assessment of nutritional status	75
3.4 Anthropometric and other clinical measures	77
3.5 Error in methods of assessment of nutritional status	78
3.6 Perspectives on the future	81
Further reading	81

<b>4.</b>	<b>Assessment of Physical Activity</b>	<b>83</b>
	<i>Michael Sjöström, Ulf Ekelund and Agneta Yngve</i>	
4.1	Introduction	83
4.2	Definition of commonly used terms	84
4.3	Dimensions of physical activity	86
4.4	Reliability and validity of physical activity assessment instruments	90
4.5	Physical activity assessment methods	91
4.6	Perspectives on the future	104
	Further reading	104
<b>5.</b>	<b>Public Health Nutrition Strategies for Intervention at the Ecological Level</b>	<b>106</b>
	<i>Kim D Reynolds, Knut-Inge Klepp and Amy L Yaroch</i>	
5.1	Introduction	106
5.2	Definition of the ecological approach	106
5.3	Individual versus ecological approaches	107
5.4	Key principles in the ecological approach	108
5.5	Intervention	110
5.6	Advantages and disadvantages of this approach	111
5.7	Guidelines for using the ecological approach to design nutrition interventions	111
5.8	Ethical issues to consider	112
5.9	Ecological interventions to change eating habits	113
5.10	Perspectives on the future	119
	Further reading	119
<b>6.</b>	<b>Public Health Nutrition Strategies for Intervention at the Individual Level</b>	<b>120</b>
	<i>Barrie M Margetts</i>	
6.1	Introduction	120
6.2	Interventions of supplementary feeding, foods or nutrients	123
6.3	Changing behavior without giving foods	124
6.4	Evaluation of programs and interventions	130
6.5	Perspectives on the future	131
	Further reading	132
<b>7.</b>	<b>Dietary Guidelines</b>	<b>133</b>
	<i>Michael J Gibney and Petro Wolmarans</i>	
7.1	Introduction	133
7.2	Overview of dietary recommendations	133
7.3	Quantitative dietary guidelines	134
7.4	Qualitative dietary guidelines	137
7.5	Steps involved in devising food-based dietary guidelines	139
7.6	Visual presentations of food guides related to dietary guidelines	143
7.7	Perspectives on the future	143
	Further reading	143

---

<b>8.</b>	<b>Food Choice</b>	<b>144</b>
	<i>David N Cox and Annie S Anderson</i>	
8.1	Introduction	144
8.2	The study of food choice	145
8.3	Population issues affecting food choice	147
8.4	Individual issues affecting food choice	152
8.5	Perspectives on the future	163
	Further reading	165
<b>9.</b>	<b>Public Health Aspects of Overnutrition</b>	<b>167</b>
	<i>Jacob C Seidell and Tommy LS Visscher</i>	
9.1	Introduction	167
9.2	Macronutrients, excess energy intake and overweight	170
9.3	Obesity as a determinant of mortality and morbidity	171
9.4	Perspectives on the future	177
	Further reading	177
<b>10.</b>	<b>Public Health Aspects of Undernutrition</b>	<b>178</b>
	<i>Mark J Manary and Noel W Solomons</i>	
10.1	Introduction	178
10.2	Definitions of undernutrition	178
10.3	Clinical syndromes of undernutrition	179
10.4	Micronutrient deficiency: "hidden hunger"	180
10.5	Time trends and contemporary prevalences	181
10.6	Etiology: determinants and conditioning factors for undernutrition	181
10.7	Public health consequences of undernutrition	187
10.8	Policy and programmatic issues in preventing undernutrition	188
10.9	Policy and programmatic issues in reversing undernutrition	190
10.10	Perspectives on the future	191
	Further reading	191
<b>11.</b>	<b>Vitamin A Deficiency</b>	<b>192</b>
	<i>Faruk Ahmed and Ian Darnton-Hill</i>	
11.1	Introduction	192
11.2	Consequences of vitamin A deficiency	194
11.3	Epidemiology	200
11.4	Prevention and control	203
11.5	Assessment of vitamin A status	208
11.6	Monitoring and evaluation	212
11.7	Perspectives on the future	214
	Further reading	215
<b>12.</b>	<b>Iodine and Iodine-deficiency Disorders</b>	<b>216</b>
	<i>Clive E West, Pieter L Jooste and Chandrakant S Pandav</i>	
12.1	Introduction	216
12.2	Definition of iodine deficiency	216
12.3	Clinical features	219



12.4	Iodine metabolism	219
12.5	Reference intakes for iodine	221
12.6	Public health aspects to iodine deficiency	222
12.7	Management of iodine deficiency	223
12.8	Assessment and elimination of iodine deficiency disorders	225
12.9	Perspectives on the future	226
	Further reading	226
<b>13.</b>	<b>Iron-deficiency Anemias</b>	<b>227</b>
	<i>Kamasamudram Vijayaraghavan</i>	
13.1	Introduction	227
13.2	Definition and clinical features of iron-deficiency anemia	228
13.3	Iron metabolism	230
13.4	Reference intakes for iron	232
13.5	Public health implications of iron-deficiency anemia	232
13.6	Perspectives on the future	234
	Further reading	235
<b>14.</b>	<b>Fear of Fatness and Fad Slimming Diets</b>	<b>236</b>
	<i>Mary AT Flynn</i>	
14.1	Introduction	236
14.2	Epidemiology	237
14.3	Life-cycle fatness trends	237
14.4	Definitions and descriptions	238
14.5	Etiology	241
14.6	Consequences for public health	242
14.7	Prevention strategies	244
14.8	Assessing body image	245
14.9	Perspectives on the future	246
	Further reading	246
<b>15.</b>	<b>Nutrition and Child Development</b>	<b>247</b>
	<i>Helen Baker-Henningham and Sally Grantham-McGregor</i>	
15.1	Introduction	247
15.2	Child development and the role of the environment	248
15.3	Possible mechanisms linking undernutrition to poor development	248
15.4	Prevalence of nutritional deficiencies	249
15.5	Intrauterine growth retardation	250
15.6	Breast-feeding and its influence on child development	251
15.7	Wasting, stunting and severe clinical malnutrition	253
15.8	Iron-deficiency anemia	256
15.9	Iodine deficiency	259
15.10	Zinc deficiency	260
15.11	Vitamin A deficiency	260
15.12	Studies on the effects of short-term hunger and school feeding	261
15.13	Perspectives on the future	262
	Further reading	263

---

<b>16.</b>	<b>Infant Feeding</b>	<b>264</b>
	<i>Anna Coutsoudis and Jane Bentley</i>	
16.1	Introduction	264
16.2	Role and importance of breast-feeding	265
16.3	Barriers to successful breast-feeding	268
16.4	Breast-feeding challenges	271
16.5	Potential feeding difficulties	274
16.6	Breast-feeding and human immunodeficiency virus transmission	275
16.7	Infant feeding after 6 months	277
16.8	Monitoring the child's growth: the road-to-health chart	280
16.9	Perspectives on the future	281
	Further reading	282
<b>17.</b>	<b>Adverse Outcomes in Pregnancy: The Role of Folate and Related B-Vitamins</b>	<b>283</b>
	<i>John Scott and Helene McNulty</i>	
17.1	Introduction	283
17.2	Biochemical basis for the role of folate in adverse outcomes of pregnancy	284
17.3	Evidence that folate and other related vitamins play a protective role against adverse outcomes of pregnancy	290
17.4	Prevention of folate-responsive adverse outcomes of pregnancy	295
17.5	Perspectives on the future	300
	Further reading	301
<b>18.</b>	<b>Maternal Nutrition, Fetal Programming and Adult Chronic Disease</b>	<b>302</b>
	<i>David JP Barker and Keith M Godfrey</i>	
18.1	Introduction	302
18.2	Observations establishing the link between size at birth and later cardiovascular disease	303
18.3	Potential confounding influences	305
18.4	Findings for particular cardiovascular and metabolic disorders	305
18.5	Determinants of fetal growth and programming: the importance of fetal nutrition	311
18.6	Maternal influences on fetal nutrition	312
18.7	Perspectives on the future	316
	Further reading	316
<b>19.</b>	<b>Cardiovascular Disease</b>	<b>317</b>
	<i>Jim Mann</i>	
19.1	Introduction	317
19.2	Epidemiology	318
19.3	Correlations between coronary heart disease rates and food intake	319
19.4	Prospective observation of subjects for whom diet histories are available	320
19.5	Cardiovascular risk factors and their nutritional determinants	321
19.6	Clinical trials of cardiovascular risk reduction by dietary modification	323
19.7	Nutritional strategies for high-risk populations	326
19.8	Perspectives on the future	328
	Further reading	328

<b>20.</b>	<b>Diabetes Mellitus</b>	<b>330</b>
	<i>Ambady Ramachandran and Chamukuttan Snehalatha</i>	
20.1	Introduction	330
20.2	Classification of diabetes	330
20.3	Diagnosis of diabetes	331
20.4	Risk factors for the development of diabetes	332
20.5	Diabetes as a public health issue	334
20.6	Prevention and management of diabetes	336
20.7	Scope for primary prevention of diabetes	339
20.8	Perspectives on the future	340
	Further reading	340
<b>21.</b>	<b>Cancer and Diet</b>	<b>341</b>
	<i>Lenore Arab and Susan Steck-Scott</i>	
21.1	Introduction	341
21.2	Mechanisms of effect of diet	341
21.3	Carcinogenesis: initiation, promotion and progression to metastases	343
21.4	Gene–nutrient interactions in carcinogenesis	344
21.5	Epidemiological studies of diet and cancer	346
21.6	Dietary constituents of interest	350
21.7	Prevention: preventive potential	354
21.8	Prevention guidelines for individuals and populations	355
21.9	Perspectives on the future	355
	Further reading	356
<b>22.</b>	<b>Disease Prevention: Osteoporosis and Hip Fracture</b>	<b>357</b>
	<i>Nicholas Harvey and Cyrus Cooper</i>	
22.1	Introduction	357
22.2	Definition	357
22.3	Epidemiology: the scale of the problem	358
22.4	The biology of bone health	363
22.5	Perspectives on the future	369
	Further reading	369
	<b>Appendix</b>	<b>370</b>
	<b>Index</b>	<b>373</b>

# Series Foreword

The early decades of the twentieth century were a period of intense research on constituents of food essential for normal growth and development, and saw the discovery of most of the vitamins, minerals, amino acids and essential fatty acids. In 1941, a group of leading physiologists, biochemists and medical scientists recognized that the emerging discipline of nutrition needed its own learned society and The Nutrition Society was established. Our mission was, and remains, “to advance the scientific study of nutrition and its application to the maintenance of human and animal health”. The Nutrition Society is the largest learned society for nutrition in Europe and we have over 2000 members worldwide. You can find out more about the Society and how to become a member by visiting our website at [www.nutsoc.org.uk](http://www.nutsoc.org.uk)

The ongoing revolution in biology initiated by large-scale genome mapping and facilitated by the development of reliable, simple-to-use molecular biological tools makes this a very exciting time to be working in nutrition. We now have the opportunity to obtain a much better understanding of how specific genes interact with nutritional intake and other lifestyle factors to influence gene expression in individual cells and tissues and, ultimately, affect our health. Knowledge of the polymorphisms in key genes carried by a patient will allow the prescription of more effective, and safe, dietary treatments. At the population level, molecular epidemiology is opening up much more incisive approaches to understanding the role of particular dietary patterns in disease causation. This excitement is reflected in the several scientific meetings that The Nutrition Society, often in collaboration with sister learned societies in Europe, organizes each year. We provide travel grants and other assistance to encourage students and young researchers to attend and participate in these meetings.

Throughout its history a primary objective of the Society has been to encourage nutrition research and to disseminate the results of such research. Our first journal, *The Proceedings of The Nutrition Society*, recorded, as it still does, the scientific presentations

made to the Society. Shortly afterwards, *The British Journal of Nutrition* was established to provide a medium for the publication of primary research on all aspects of human and animal nutrition by scientists from around the world. Recognizing the needs of students and their teachers for authoritative reviews on topical issues in nutrition, the Society began publishing *Nutrition Research Reviews* in 1988. More recently, we launched *Public Health Nutrition*, the first international first journal dedicated to this important and growing area. All of these journals are available in electronic, as well as in the conventional paper form and we are exploring new opportunities to exploit the web to make the outcomes of nutritional research more quickly and more readily accessible.

To protect the public and to enhance the career prospects of nutritionists, The Nutrition Society is committed to ensuring that those who practice as nutritionists are properly trained and qualified. This is recognized by placing the names of suitably qualified individuals on our professional registers and by the award of the qualifications Registered Public Health Nutritionist (RPHNutr) and Registered Nutritionist (RNutr). Graduates with appropriate degrees but who do not yet have sufficient postgraduate experience can join our Associate Nutritionist registers. We undertake accreditation of university degree programs in public health nutrition and are developing accreditation processes for other nutrition degree programs.

Just as in research, having the best possible tools is an enormous advantage in teaching and learning. This is the reasoning behind the initiative to launch this series of human nutrition textbooks designed for use worldwide. The Society is deeply indebted to its former President, Professor Mike Gibney, for his foresight, and to him and his team of editors for their innovative approaches and hard work in bringing this major publishing exercise to successful fruition. Read, learn and enjoy.

*John Mathers*  
*President of The Nutrition Society*

# Preface

This book represents the third in a series of four for honors or masters level students of nutrition. The first book serves as a broad introduction, not just for nutrition students, but also for students of disciplines such as nursing, pharmacy, food science and agriculture. All the ensuing books are aimed at nutrition students. The second textbook, *Nutrition and Metabolism*, provides students with the biological basis of nutrition in health and disease. Thereafter, most students will make a choice to pursue either a clinical stream or a public health nutrition stream. The present book is focused on the latter, a subject that is growing in importance, taking into account the real potential to reduce the burden on noncommunicable chronic disease through diet. The Nutrition Society has championed the development of recognition of public health nutrition as a specialized discipline in the field, complementing the established specialty of clinical nutrition where the target audience is an individual patient on a one-to-one basis. In the case of public health nutrition the target audience is the population as a whole or specific subpopulations. The textbook is structured to begin with an overview taking students through a cycle of

procedures, which should ideally be a feature of any program of public health nutrition. The first eight chapters of the book describe the skills needed in public health nutrition. The next six outline the major public health nutrition problems arising from overnutrition and from undernutrition. Maternal and child health issues are covered in the next four chapters, and some major diseases, cancer, diabetes, heart disease and osteoporosis, are dealt with in the final four chapters. As has been pointed out in the prefaces to the first two books in this series, there will be some overlap, but students will find the orientation different for similar subjects across texts. In some chapters, the public health nutrition element is accompanied by relevant material in clinical nutrition or in molecular nutrition, which will help students appreciate the links between all elements of nutrition.

The editors once again express their sincere thanks to their Assistant Editor Julie Dowsett and her heroic husband Greg.

*Michael J Gibney*  
*Editor-in-Chief*

# Contributors

Dr Faruk Ahmed  
Nutrition Program – Division of International Health  
School of Population Health  
Public Health Building  
Herston, Queensland, Australia

Dr Annie S Anderson  
Centre for Public Health Nutrition Research  
Department of Medicine  
University of Dundee  
Ninewells Hospital and Medical School  
Dundee, UK

Professor Lenore Arab  
Amgen, Inc.  
Thousand Oaks  
California, USA  
Professor of Nutrition and Epidemiology  
UNC School of Public Health  
Chapel Hill, North Carolina, USA

Dr Helen Baker-Henningham  
Centre of International Child Health  
Institute of Child Health  
London, UK

Professor David JP Barker  
MRC Environmental Epidemiology Unit  
Southampton General Hospital  
Southampton, UK

Ms Jane Bentley  
Department of Pediatrics and Child Health  
University of Natal  
Durban, South Africa

Dr Shirley AA Beresford  
Department of Epidemiology  
School of Public Health and Community Medicine  
University of Washington  
Seattle, Washington, USA

Professor Cyrus Cooper  
Professor of Rheumatology  
MRC Epidemiology Resource Centre  
University of Southampton  
Southampton General Hospital  
Southampton, UK

Professor Anna Coutsooudis  
Department of Pediatrics and Child Health  
University of Natal  
Durban, South Africa

Dr David N Cox  
CSIRO Health Sciences and Nutrition  
Adelaide, SA, Australia

Dr Ian Darnton-Hill  
Nutrition Section, UNICEF  
New York, USA

Dr Ulf Ekelund  
Karolinska Institutet  
Unit for Preventive Nutrition  
Department of Biosciences at Novum  
Huddinge, Sweden

Dr Mary AT Flynn  
Coordinator, Nutrition and Active Living  
Calgary Health Region  
Adjunct Professor  
Department of Agriculture and Nutritional Sciences  
University of Alberta and  
Department of Community Health Sciences  
University of Calgary, Alberta, Canada

Professor Michael J Gibney  
Department of Clinical Medicine  
Trinity Centre for Health Sciences  
St James' Hospital  
Dublin, Ireland

Dr Keith M Godfrey  
MRC Clinical Scientist  
MRC Environmental Epidemiology Unit  
Southampton General Hospital  
Southampton, UK

Professor Sally Grantham-McGregor  
Centre of International Child Health  
Institute of Child Health  
London, UK

Dr Nicholas Harvey  
MRC Epidemiology Resource Centre  
University of Southampton  
Southampton General Hospital  
Southampton, UK

Dr Pieter L Jooste  
National Intervention Research Unit  
Medical Research Council  
Tygerberg, Cape Town, South Africa

Dr John M Kearney  
Department of Biological Science  
Dublin Institute of Technology  
Dublin, Ireland

Dr Knut-Inge Klepp  
Department of Nutrition  
University of Oslo  
Oslo, Norway

Professor Helene McNulty  
School of Biomedical Sciences  
University of Ulster at Coleraine  
Londonderry, UK

Dr Mark Manary  
Department of Pediatrics  
Washington University  
School of Medicine  
St. Louis, Missouri, USA

Professor Jim Mann  
Department of Human Nutrition  
University of Otago  
Dunedin, New Zealand

Professor Barrie M Margetts  
Institute of Human Nutrition  
University of Southampton  
Southampton, UK

Dr Michael Nelson  
Department of Nutrition and Dietetics  
King's College London  
London, UK

Dr Chandrakant S Pandav  
Regional Coordinator  
ICCIDD, South Asia and Pacific Region  
New Delhi, India

Dr Ruth E Patterson  
Research Associate Professor  
Department of Epidemiology  
University of Washington  
Seattle, Washington, USA

Dr Pirjo Pietinen  
National Public Health Institute  
Mannerheimintie  
Helsinki, Finland

Dr Ambady Ramachandran  
Diabetes Research Centre and  
M. V. Hospital for Diabetes  
Royapuram, Chennai, India

Dr Kim D Reynolds  
University of Southern California  
Institute for Health Promotion and Disease  
Prevention Research  
Los Angeles, California, USA

Professor John Scott  
Biochemistry Department  
Trinity College  
Dublin, Ireland

Dr Jacob C Seidell  
Department for Nutrition and Health  
Free University  
Amsterdam, The Netherlands

Dr Michael Sjöström  
Karolinska Institutet  
Unit for Preventive Nutrition  
Department of Biosciences at Novum  
Huddinge, Sweden

Dr Chamukuttan Snehalatha  
Diabetes Research Centre and M. V. Hospital for Diabetes  
Royapuram, Chennai, India

Dr Noel W Solomons  
Director  
Center for Studies of Sensory Impairment  
(CESSIAM)  
Guatemala City, Guatemala

Dr Susan Steck-Scott  
Department of Nutrition  
University of North Carolina  
Chapel Hill, North Carolina, USA

Dr Kamasamudram Vijayaraghavan  
Senior Deputy Director  
National Institute of Nutrition  
Indian Council of Medical Research  
Hyderabad, India

Dr Tommy LS Visscher  
Department for Nutrition and Health  
Free University  
Amsterdam, The Netherlands

Dr Clive E West  
Division of Human Nutrition and Epidemiology  
Wageningen Agricultural University  
Wageningen, The Netherlands

Dr Petro Wolmarans  
National Research Programme for Nutritional Intervention  
Medical Research Council  
Tygerberg, South Africa

Dr Amy Yaroch  
National Cancer Institute  
Division of Cancer control and Population Sciences  
Bethesda, Maryland, USA

Dr Agneta Yngve  
Karolinska Institutet  
Unit for Preventive Nutrition  
Department of Biosciences at Novum  
Huddinge, Sweden

# 1

## An Overview of Public Health Nutrition

Barrie M Margetts

### Key messages

- Public health nutrition is the promotion of good health through primary prevention of nutrition-related illness in the population.
- Public health nutrition builds on a foundation of biological and social sciences, depends on epidemiological evidence and involves the development and implementation of programs to improve and maintain health.
- Performance as a public health nutritionist requires a specific set of knowledge- and skill-based competencies to implement all stages of the public health nutrition cycle.
- It is essential to develop appropriate knowledge, attitudes, understanding and professional skills to practice as a public health nutritionist.
- An appreciation and critical evaluation of the impact of research on the practice of public health nutrition also needs to be developed.

### 1.1 Introduction

The knowledge base underpinning the public health nutritionist professional is developed over years and built on a foundation of biology, biochemistry, physiology and basic nutritional sciences, as well as an understanding of social anthropology. The development of the foundations is not within the scope of this book. Many of these competencies are covered in the accompanying textbooks, particularly the *Introduction to Human Nutrition* and *Nutrition and Metabolism*. The aims of this book are to cover the skills needed in public health nutrition and to provide a coherent structure to enable the reader:

- to identify nutrition-related public health problems relevant at the local, regional, national and international levels
- to identify causes of these problems
- to develop strategies to deal with these problems
- to evaluate the impact of these strategies
- to understand the process whereby research-based evidence provides a basis for the development of public health policy

- ultimately, to improve nutrition-related health by applying evidence to action to solve problems.

Public health nutrition is about applying knowledge to the solution of nutrition-related health problems. Often when confronted with a problem, people do not know where to start, become lost in the detail, and sometimes miss the obvious and simple critical steps that will really make a difference. In this introductory chapter an attempt is made to provide a framework for the reader to think logically and systematically: to provide a template to proceed in a logical and systematic way. People often want to jump in with what they think is the solution to the problem confronting them; the aim here is to help readers to think before they jump. It is now fashionable to talk about an evidence-based approach to public health. All this really means is finding out what others already know, putting aside one's prejudices, assessing the situation objectively, and coming up with the best and most effective solution. It may seem obvious, but there is no need to fix that which is not broken. Rather, the effort should be to try to identify the key rate-limiting step (or major



## 2 Public health nutrition

constraint to behavior) in the causal pathway and fix that. Our knowledge as to what the rate-limiting step is can never be perfect, so some judgment is required. However, the more systematically the evidence is gathered and reviewed, both in terms of the causal pathway and in terms of effective interventions, the more effective the effort will be in achieving the targeted health gains. The aim of this book is to give the student the knowledge and skills to think clearly about how to solve problems. The primary purpose of good nutrition is to maintain health and well-being. Nutrition is more than the food supply: it reflects the interaction between what we eat, and the metabolic demands of the body to maintain functional capacity. The basic, underlying and immediate causes of malnutrition are summarized in Figure 1.1. If nutrition is only thought of as the supply side of this balance this is likely to lead to a misunderstanding of the key

rate-limiting steps that link good nutrition to well-being. It is also important to consider the social as well as the biological context within which individuals live and interact in society. While it is beyond the scope of this text to cover all aspects of whole-body integrated metabolism, some understanding of the underlying mechanisms that link diet and style of living to health is required to understand whether the lifestyle changes that are being suggested to improve health make sense biologically. Inevitably, good nutrition-related health is about understanding the relationships between the biological and sociological context within which individuals live and interact in society. Where food supply is limited there is a clear biological imperative to obtain enough to eat; where supply is in excess, social imperatives that restrain or limit behavior come into play. In all societies, especially those in transition, there is a complex mix of problems of overnutrition

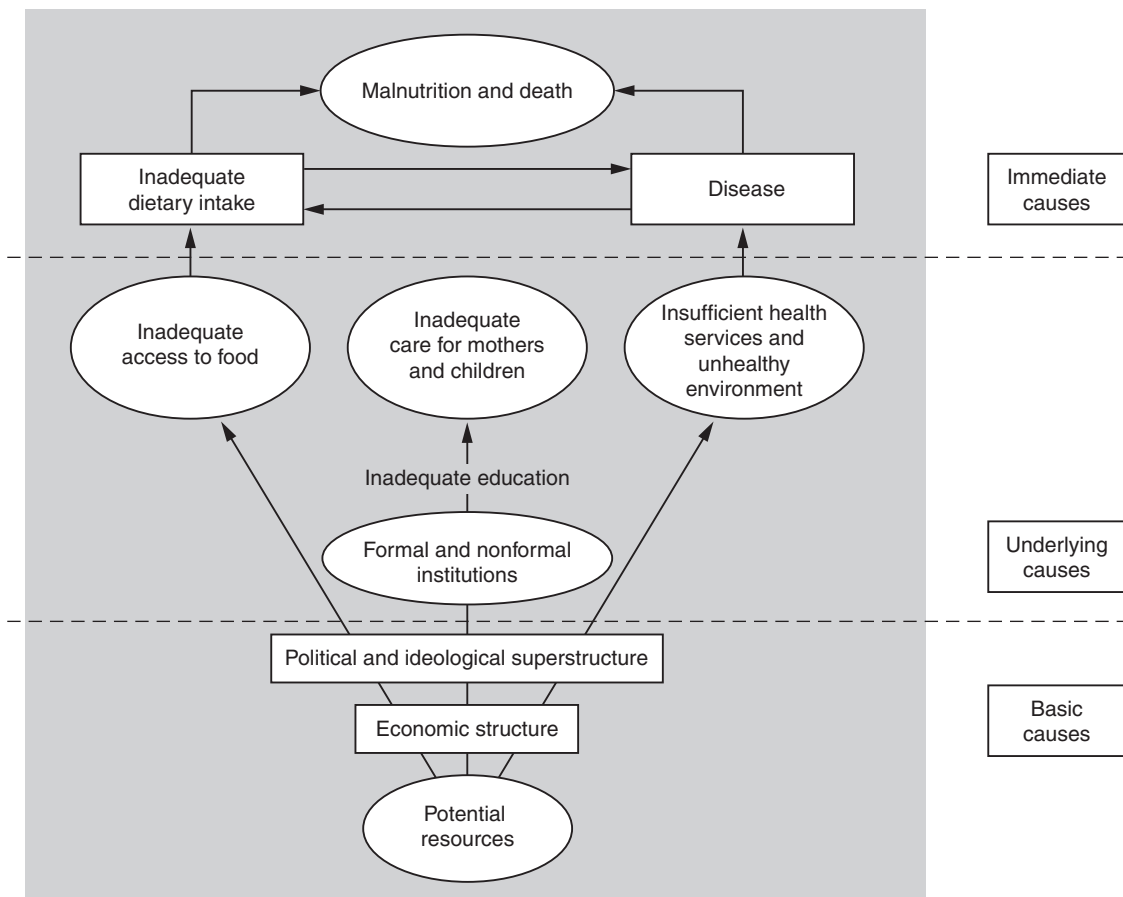


Figure 1.1 United Nations Children's Fund (UNICEF) conceptual model.

and undernutrition occurring in close proximity. The job of the public health nutritionist is to try to understand this complexity and to provide guidance as to what is best for most people. This book aims to help students in this task.

## 1.2 Organization of the book

There are 22 chapters in this book. The first eight chapters are designed to develop the skills required to understand how to identify and subsequently to develop approaches to address the major nutrition-related public health problems. Chapter 2 on nutritional epidemiology addresses the skills required for the design of appropriate studies, for conducting nutritional surveillance and the development of research protocols. It also reviews the analytical skills required in the use of nutritional and other relevant data and databases including the statistical issues, sampling study size and power, determination and application of appropriate statistical analytical techniques. Chapter 3 defines and describes the tools used to assess nutritional status at the individual and population levels. The emphasis in Chapter 3 is on assessment of dietary intake. Chapter 4 describes the methods and approaches used to assess physical activity. Nutritional status embraces an understanding of the dynamic between supply and demands, and increasingly it is becoming clear that, particularly in terms of understanding energy balance, it is essential to assess both intake and expenditure, and factors that affect both. Identifying the problem is only the first step in solving the problem; Chapters 5 and 6 describe the approaches to developing effective interventions in groups and individuals, respectively and Chapter 7 describes how to develop and present dietary guidelines that communicate dietary advice in the most sensible way possible, once it is clear what is the required or optimal nutritional pattern or profile. There is considerable overlap in the approaches used, broadly, the aim should be to use that approach which is most effective for most people, or different approaches for different groups if there appear to be different constraints in subgroups. Understanding the constraints on behavior and factors affecting food choice is the subject of Chapter 8.

Chapters 9–14 describe different aspects of malnutrition. Chapters 9 (overnutrition) and 10 (undernutrition) describe the development of aspects of what might be termed macronutrient malnutrition, while

Chapters 11–13 describe specific micronutrient malnutrition deficiencies. Increasingly, it is becoming clear that undernutrition and overnutrition occur in different groups of people in the same countries, and that macronutrient and micronutrient imbalances can occur in the same people. Chapter 14 describes the complex area of eating disorders, which lead mainly to undernutrition of both macronutrients and micronutrients, but with different causes, and tending to affect different groups within a society, from those described in Chapters 9–13.

Chapters 15–18 describe different aspects of maternal and child health; Chapter 15 focuses on aspects of cognitive development, Chapter 16 focuses on the importance of infant feeding, Chapter 17 focuses on adverse outcomes of pregnancy in relation to folate and related B-group vitamins, and Chapter 18 describes the concepts that underpin fetal programming. Taken together, these chapters highlight the importance of achieving the optimal nutrient supply at the critical time to enhance and maintain function. This may be considered a key part, or first step of a life-course approach, recognizing that what happens after certain critical events is constrained by these earlier events and interacts with current behavior. Current health and well-being cannot be fully explained by current behavior alone, and early events (programming, early exposure) influence the way in which an individual and society react to what appears to be the same exposure. This may be described as explaining the sources of heterogeneity within a population, which may be also a mix of different levels of the expression of genes, gene–nutrient and nutrient–gene interactions.

Chapters 19–22 describe the main chronic disease that affect large numbers of people around the world; Chapter 19 describes cardiovascular diseases, Chapter 20 diabetes, Chapter 21 cancer and Chapter 22 osteoporosis. Already these chronic diseases affect more people in developing than in developed countries, and it is likely that this will increase as the nutrition transition continues in developing countries and rates of chronic diseases decline in developed countries.

There is no specific chapter on communicable or infectious diseases; the impact of these is covered extensively in the chapters on undernutrition. The aim has been to use major health problems as a way of illustrating approaches and ways of thinking that should help the reader to think about how to understand and address specific problems.

### 1.3 Definitions used in public health

#### **Public health nutrition**

A public health nutrition approach focuses on the promotion of good health (the maintenance of well-being or wellness, quality of life) through nutrition and the primary (and secondary) prevention of nutrition-related illness in the population. Public health nutrition is built on a foundation of basic and applied sciences, operates in a public health context, and uses the skills and knowledge of epidemiology and health promotion. The World Health Organization (WHO) defines health as a state of complete mental, physical and social well-being, and not merely the absence of disease or infirmity. Public health is defined as the collective action taken by society to protect and promote the health of entire populations. Alternatively, it can be defined as the art and science of preventing disease, promoting health and prolonging life through the organized efforts of society. Epidemiology provides a rigorous set of methods to study disease occurrence in human populations.

#### **Public health**

The approach to public health may be summarized as being either broad or narrow (Table 1.1).

#### **The narrow approach**

The narrow approach focuses on disease prevention and cost containment, with health defined as the absence of disease. The underlying theory is that the way in which individuals live their lives (what they eat, what they do, whether they smoke or drink or engage in risky behavior) is the main cause of disease, and that the motivation to change behavior is based on reducing risk at an individual level. The evidence base comes from clinical and molecular epidemiology; research is

undertaken that identifies differences in risk factors, and on the basis of that information, advice is given to the public that if they change their behavior they will reduce their risk of developing the disease (cancer or heart disease, etc.). This approach links an individual's own behavior to risk of disease. The burden of prevention and health promotion lies with the individual and it is seen as their responsibility to address their risk behavior. The approach is aimed at identifying immediate and obvious problems now and addressing them now. The disadvantage of the narrow approach is that it may miss fundamental threats within society that may be outside the individual's control (basic and underlying causes such as the wider socioeconomic factors, education and access to services, environmental factors, and the overarching values in society).

#### **The broad approach**

The broad approach defines health as more than the absence of disease. It considers well-being in terms of mental and physical health and also includes a sense of having some control over your life. The approach links public health science with policy: the action and structures agreed by society aimed at improving and maintaining health. The underlying theoretical model is sociocultural; it focuses on the wider environment and seeks to understand the factors that enable individuals to make healthy choices, or inhibit them. The motivating concern is about addressing the underlying sociostructural factors such as poverty, global issues and structures at a local, regional, national and international level that affect health. The evidence base for a broad approach comes from epidemiology as well as other approaches more suitable to exploring the sociostructural context. The broad approach takes a more long-term view of causes and solutions, addressing

**Table 1.1** Different approaches to public health

Characteristics	Broad	Narrow
Major public health activities	Link public health science with policy	Cost-containment, disease prevention
Place of epidemiology	Balanced by other methods	Clinical and molecular epidemiology
Advantages	Long term, global	Short
Disadvantages	Risk of failure because of breadth	Miss fundamental threats
Define health	Foundations for health	Absence of disease
Underlying theory	Sociostructural	Lifestyle
Motivating concerns	Inequalities, poverty, global	Individual risks

structural issues in society that make it more difficult for individuals to make optimal choices. The disadvantage of a broad approach is that because the approach is so broad it may never address the key rate-limiting steps in a timely manner.

The broad public health approach has been taken up and developed by UNICEF into a conceptual model. The UNICEF model is now widely used, at least in research and development in developing countries<sup>1</sup> (this term is used in the sense of gross domestic product, rather than social and cultural development, and is not meant to imply a hierarchy or judgment about better or worse than a developed country) (see Figure 1.1). This conceptual model acknowledges that while the immediate causes of undernutrition may be a lack of food, often coupled with a high burden of infection, the provision of adequate education and health care has an important impact on health. The provision of these underlying factors is determined by basic causes such as the resources that are available in a society, and decisions about how these resources will be used. The model acknowledges that dealing only with the immediate causes will never lead to long-term improvements, which are dependent on the societies' view as to how resources will be used and distributed in society to maximize the health and well-being of all members of society. These arguments do not apply only to developing countries; how governments prioritize the use of taxation is a function of the underlying values of the society (as expressed through the election of governments that reflect the popular view); for example, the balance of spending priorities between education, health and defense, or priorities for agricultural policies that subsidize farmers but not manufacturing industry. Policy decisions as to the priorities on spending are complex and reflect a balance of tensions and pressures that often pull in different directions. Policy will be discussed in more detail later in this chapter.

In reality, in most countries there is a recognition that a narrow (individual and immediate cause oriented) approach needs to be balanced with addressing, at least to some extent, the basic and underlying (broad) causes. Most governments acknowledge that there are differences in health outcomes in different sectors of society and that state resources should be used to try to redress these differences. The food supply is regulated in all countries, even if the regulation is restricted to issues

of food safety. Many of the first efforts in public health were about developing regulations to protect the public against the adulteration of staple foods. It has always been recognized that freedom of choice does not operate in a vacuum. Many countries have regulations about the accuracy of information contained in labels. There are few countries where the government does not intervene in the food supply to some extent, either through legislation to recommend the fortification of foods or to subsidize the production of some foods, such as in the Common Agricultural Policy in Europe and farming subsidies in the USA and elsewhere.

In developing a public health perspective it is important to balance the narrow with the broad. Striking the right balance is difficult and influenced by philosophical and political considerations. As a public health nutritionist, when trying to solve a local or national problem, it is important that both the narrow and broader determinants of behavior are considered and that it is not assumed that knowledge and individual choice are all that matters.

Recently, the UK Faculty of Public Health has agreed the key concepts that underpin public health. These reiterate to some extent the debate about broad versus narrow approaches to public health (Box 1.1). The key issues are a population approach to promoting and protecting health and well-being. They also highlight the importance of information.

## *Epidemiology*

Nutritional epidemiology underpins Public Health Nutrition. This is covered in Chapter 2. It provides a

### **Box 1.1** Concepts that underpin public health

- Surveillance and assessment of the population's health and well-being
- Promoting and protecting the population's health and well-being
- Developing quality and risk management within an evaluative culture
- Collaborative working for health
- Developing health programs and services and reducing inequalities
- Policy and strategy development and implementation
- Working with and for communities
- Strategic leadership for health
- Research and development
- Ethically managing self, people and resources

Reproduced with permission from the UK Faculty of Public Health.

<sup>1</sup>The preferred terminology for developed and developing countries is North and South, or low, medium and higher income groups.

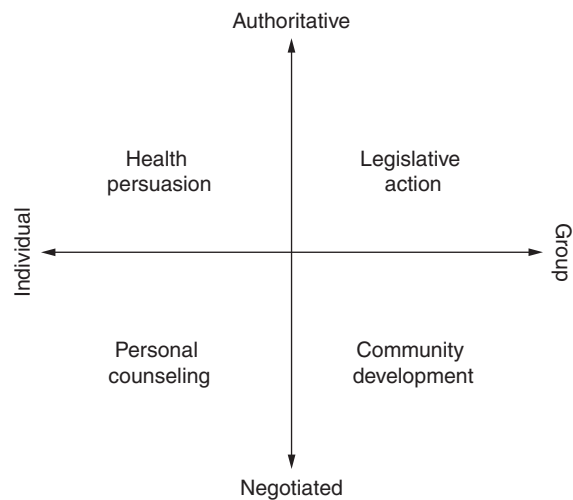
scientific basis for the development of the evidence upon which public health action can be implemented. It also provides guidance on the approaches as to the best way to evaluate and monitor the effectiveness of programs designed to improve health. Epidemiology is the only setting in which it is possible to ask questions about what factors affect processes in the whole population. The questions that are asked in epidemiological studies need to emerge from metabolic and clinical research; it is important to have some sense of the underlying mechanisms and processes involved in the way the body seeks to maintain optimal function. It is also essential to understand that the biological processes that maintain functional capacity in humans do so in a wider context. As mentioned above, epidemiology is not the only source of information essential to a public health perspective.

### Health promotion

Health promotion is defined as any process that enables individuals or communities to increase control over the determinants of their health. The Ottawa Charter for health promotion ([www.who.int/hpr/archive/docs/Ottawa.html](http://www.who.int/hpr/archive/docs/Ottawa.html)) outlines an internationally accepted framework for health promotion that includes five approaches:

- building healthy public policy
- creating supportive environments
- developing the personal skills of the public and the practitioners
- reorienting health services
- strengthening community action.

Figure 1.2 summarizes Beattie's model of health promotion. This model further highlights the implications of the different underlying philosophical basis of public health discussed above. The two axes of the level at which promotion operates (individual to group/society) and the approach (authoritative to negotiated) highlight the range of options available. Often a range of approaches will be used. The key point is to use the approach that is going to be most effective and sustainable. In order to be effective, it is important that the strategy to be used has been shown to be effective in the target group, and that it addresses the most important constraints or rate-limiting steps, be they knowledge, attitudes, access or intentions. Understanding what the rate-limiting step is requires an understanding of the balance of factors that affect why



**Figure 1.2** A model for health promotion. Reproduced from Beattie (1981) with permission from Thomson Publishing.

people eat what they eat (see Chapter 8). In some circumstances, a legislative approach, which requires no action at the individual level, may be the most effective way to achieve the desired health gain. A simple example is the decision to fortify flour in the USA with folic acid (see Chapter 17).

Nutbeam and Harris (1999) have summarized the theoretical models that underpin a health promotion approach. It is beyond the scope of this chapter to review all the models and theories described, and they are covered in more details in Chapters 5 and 6. The main point to emphasize here is that at whatever level one operates, there is a theoretical model that has been developed and should be considered as a basis for organizing the planning of work. A summary of models relevant for the different levels at which health promotion works is shown in Table 1.2.

A health promotion planning and evaluation cycle has been described and involves seven steps:

- problem definition
- solution generation
- resource mobilization
- implementation
- impact assessment
- immediate outcome assessment
- outcome assessment.

For all but the last step in the cycle, theories have been developed as to how to perform each step most

**Table 1.2** Summary of models relevant for the different levels at which health promotion works (from Nutbeam and Harris, 1999)

Area of change	Theories or models
Theories that explain health behavior change by focusing on the individual	Health belief model Theory of reasoned action Transtheoretical (stages of change) model Social learning theory
Theories that explain change in communities and community action for health	Community mobilization: Social planning Social action Diffusion of innovation
Theories that guide the use of communication strategies for change to promote health	Communication for behavior change Social marketing
Models that explain changes in organizations and the creation of health-supportive organizational practices	Theories of organizational change Models of intersectoral action
Models that explain the development and implementation of healthy public policy	Ecological framework for policy development Determinants of policy making Indicators of health promotion policy

effectively: to identify targets for intervention; to clarify how and when change can be achieved in targets, and how to achieve organizational change and raise community awareness; to provide benchmarks against which actual can be compared with ideal programs; and to define outcomes and measurements for use in evaluation. The precede–proceed model is another way that has been used to encapsulate the steps in a health promotion cycle and this will be described in more detail in Chapter 6. These ideas have been taken and used as a basis for the development of the public health nutrition cycle, which is described in more detail later in this chapter.

#### 1.4 What are the key public health problems?

The chapters in the latter part of this book cover in detail the public health problems that have the greatest public health impact. Here, the aim is to give a broad overview of the overall balance of global nutrition-related health problems, and to highlight, in particular, the double burden of both overnutrition and undernutrition that many transitional countries suffer (Figures 1.3–1.6, Table 1.3; <http://www.who.int/whr/previous/en/>). Data are presented in two ways, which are important to distinguish; Figures 1.3 and 1.4 present the proportion of deaths attributable to each major cause, whereas Figure 1.5 and Table 1.3 show the

absolute numbers of deaths or disease burden. From a public health perspective the total burden of disease gives a sense of the demands placed on the health services and infrastructure. Figure 1.3 and 1.4 show the burden of infectious diseases in developing countries compared with developed countries; Table 1.3 shows the high burden of human immunodeficiency virus (HIV) and acquired immunodeficiency syndrome (AIDS) in sub-Saharan Africa. Although cancer, as a percentage of overall deaths, is lower in developing than developed countries, in absolute terms (Figure 1.4) more people die of cancer in developing countries. In Africa and south-east Asia (Figure 1.5) the burden of communicable diseases is high, compared with Europe; in south-east Asia the burden of noncommunicable diseases is nearly as high as communicable diseases and is also higher than in Europe. The higher burden of cancer in developing countries may be a function of both a higher underlying incidence and poorer case finding and treatment (owing to limited access to health facilities). The impact of HIV on overall mortality and life expectancy is illustrated in Figure 1.6, which shows that in a number of African countries life expectancy has actually fallen since the late 1980s, after a steady rise from the 1950s to 1985.

In addition to the burden of death and disability the burden of chronic undernutrition is heavy in many developing countries. It is a stark figure, but 14 000 children die every day from malnutrition-related

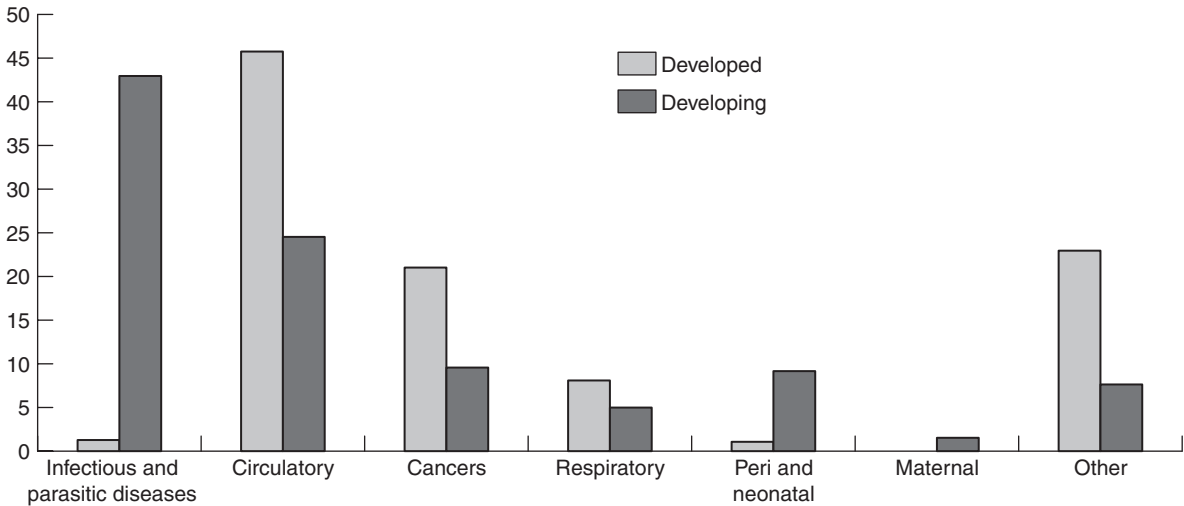


Figure 1.3 Percentage distribution of causes of death. Reproduced with permission from the WHO. (<http://www.who.int/whr/previous/en/>).

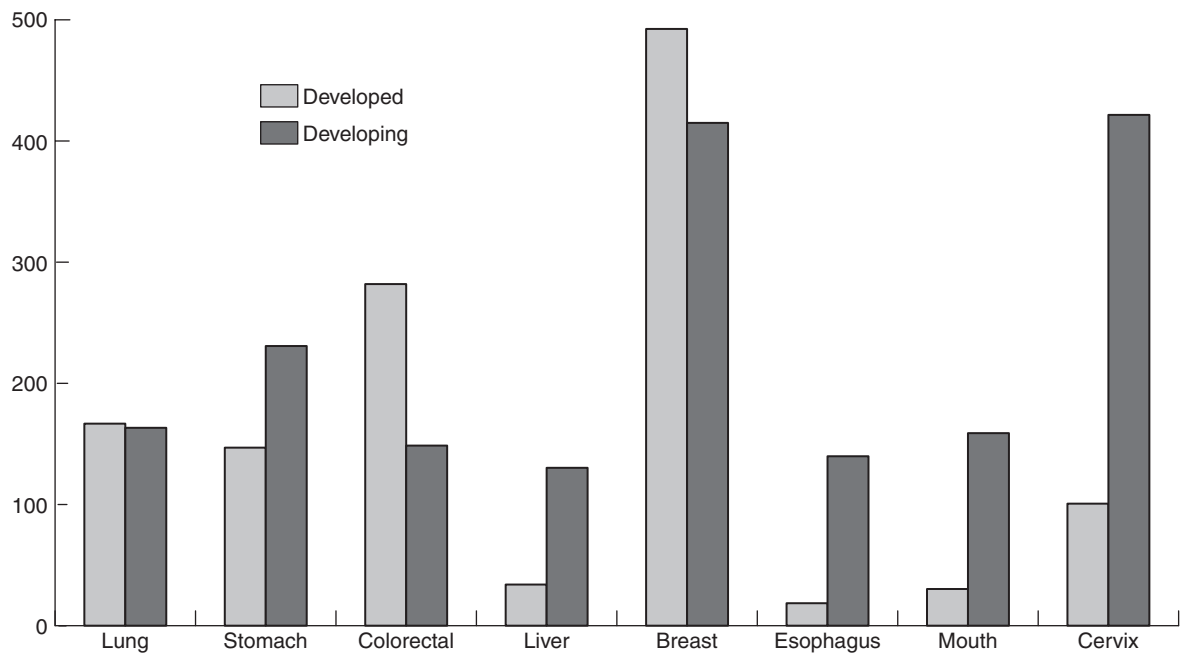
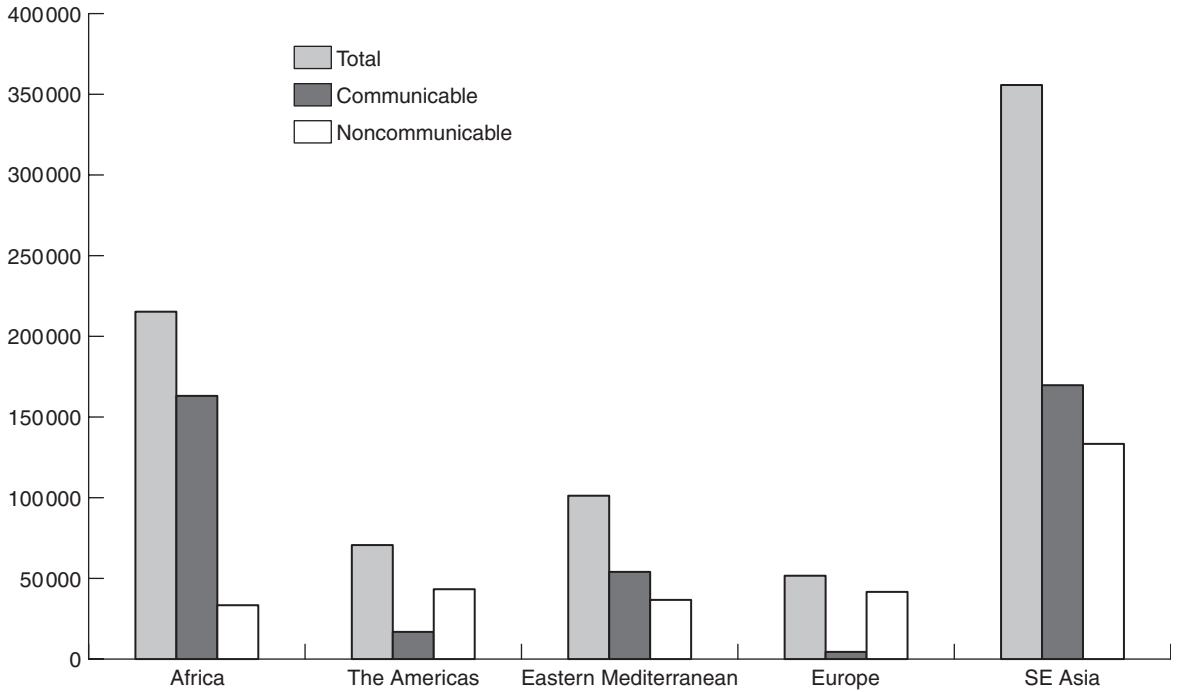


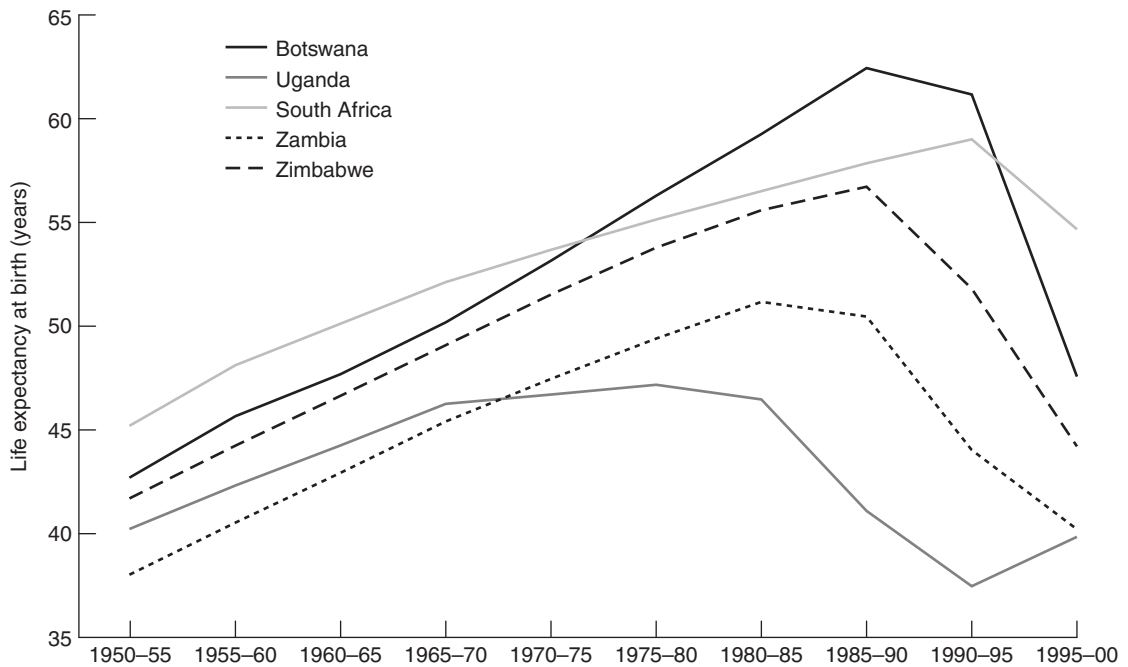
Figure 1.4 Burden (number per 1000) of cancer in developed and developing countries (women). Reproduced with permission from the WHO. (<http://www.who.int/whr/previous/en/>).

causes. Among those who survive, the effects on growth and development are profound and long-lasting. A quarter of all babies born in south Asia weigh less than 2500 g at birth (UNICEF, <http://www.unicef.org/statis/2001>). In India (44%) and Africa (29%) many children are underweight, while the proportion

of the adult population becoming obese is also rising. Food insecurity continues to be a major problem for many people around the world, and not just in developing countries (see <http://www.euro.who.int/Nutrition> for European data and <http://www.nlm.nih.gov/pubs/cbm/nutritionsummit.html#51> for US



**Figure 1.5** Burden of disease in disability-adjusted life-years by WHO Region. Reproduced with permission from the United Nations Population Division. (<http://www.who.int/whr/previous/en/>).



**Figure 1.6** Changes in life expectancy in selected African countries with high HIV prevalence, 1950–2000. Reproduced with permission from the United Nations Population Division.



data). The Food and Agriculture Organization (FAO) provides a great deal of information about the nutrition situation in most countries ([http://www.fao.org/es/esn/nutrition/profiles\\_en.stm](http://www.fao.org/es/esn/nutrition/profiles_en.stm)). More details about the burden of undernutrition are covered in Chapter 10.

The double burden of problems of communicable and noncommunicable diseases, related to malnutrition (overnutrition and undernutrition) in the widest sense, was extensively described by Popkin (2002), who summarized the stages of the health, nutritional and

demographic transitions (Figure 1.7). Many countries in the developing world have subpopulations in different stages of these transitions, which makes national data difficult to interpret. The complexity also places a particular burden on health services with limited resources.

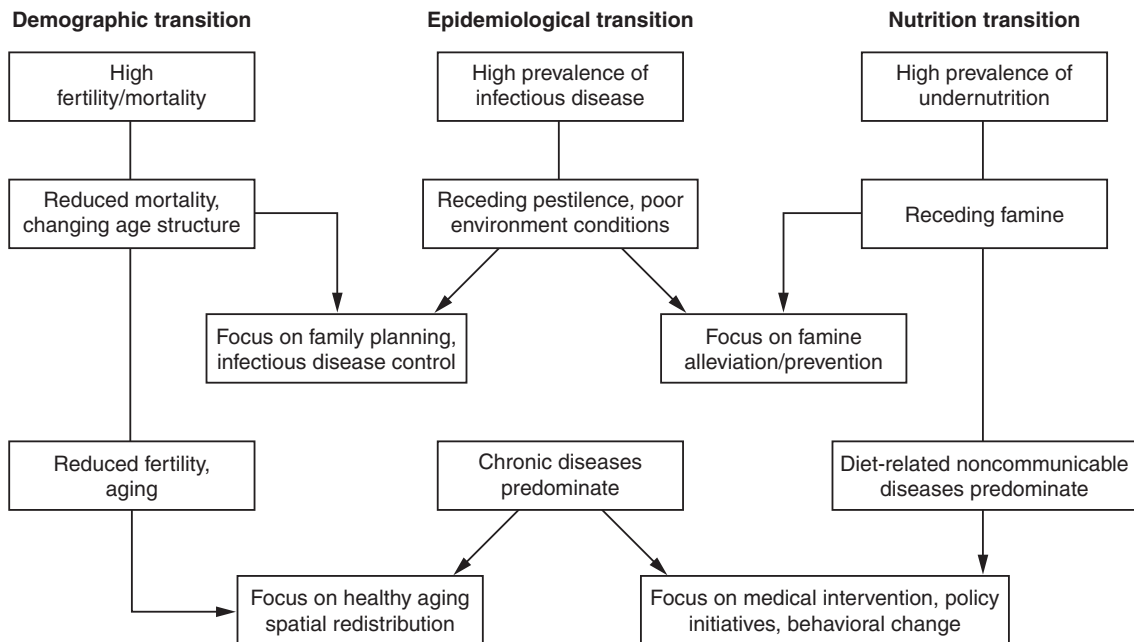
### 1.5 Food and nutrition policy

Nutbeam and Harris (1999) highlight that a key area for achieving change is to understand where policies come from, so that they may be influenced to address a particular problem. Policies develop in a dynamic way that is influenced by many factors, one of which is the scientific evidence (Figure 1.8). Although an individual public health nutritionist may feel that it is outside the scope of his or her capacity or job to be able to influence policy, it is important to have a sense of what factors and forces influence policy. One of the aims of his chapter and book is to give a sense of where individual public health nutritionists fit into the grand scheme of things, and that there is actually a bigger picture. This does not mean becoming a lobbyist and involved in policy, but to recognize that policies are developed that influence the priorities in society that

**Table 1.3** Leading causes of mortality in sub-Saharan Africa, 1999

Rank		% of total
1	HIV/AIDS	20.6
2	Acute lower respiratory infections	10.3
3	Malaria	9.1
4	Diarrheal diseases	7.3
5	Perinatal conditions	5.9
6	Measles	4.9
7	Tuberculosis	3.4
8	Cerebrovascular disease	3.2
9	Ischemic heart disease	3.0
10	Maternal conditions	2.4

Reproduced with permission from the WHO.



**Figure 1.7** The stages of demographic epidemiological and nutrition transitions in public health nutrition. Reproduced from Popkin (2002) with permission from The Nutrition Society.

affect the work of public health nutritionists and their capacity to do their job. It is important to separate out the process and principles of gathering evidence, and the subsequent judgment that arises from that evidence as to what to do or not do about what the evidence implies for health.

There are several key players in the development of policy:

- policy holders (usually government politicians)
- policy influencers (lobby groups representing vested interests)
- the public
- the media.

The key determinants of policy development are:

- the social climate
- identifiable parties that influence policy
- what the interested parties will gain from the policy
- the ability of those interested parties to make their voices heard.

A policy about a particular issue may or may not develop because the social climate is not right, there are competing interests or priorities, or the case has not been properly organized to justify the policy. In simple terms, politicians, who make policy, need to see that if they develop a policy it will achieve what they want and in a way that will give them the credit (or that works). In public health nutrition this means that to move policy in a way that we believe is desirable for improved health requires:

- that the climate is right for action around improving nutrition

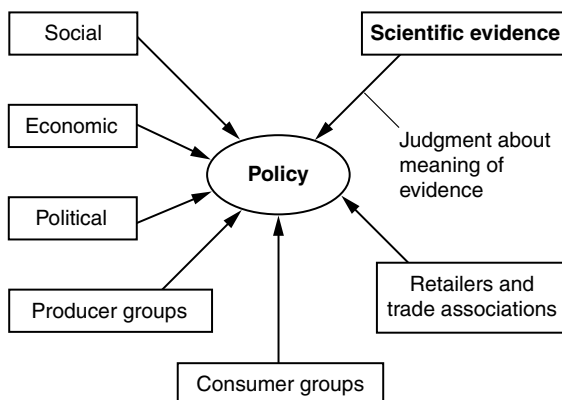


Figure 1.8 Influences on the development of policy.

- that the profession has its act together and can be effective in presenting its case
- that when asked it can deliver.

Without policy level commitment, it will be difficult to achieve change. It has been easier to gain support for policies around ensuring that the food supply is safe, and today most countries follow internationally agreed recommendations, mainly summarized in Codex Alimentaris. Policies about what to eat to maximize health are more complex than policies to ensure safety. Moreover, there is considerable debate amongst stakeholders and a wider range of vested interests that contribute to this debate, making politicians less likely to support nutrition policies related to health. Without policies that define goals and targets it is often difficult to mobilize support for action.

### ***Food and nutrition policy***

There is lack of clarity about the differences, and drivers for, food compared with nutrition policies. Food policy is concerned about how the food is grown and made available to consumers. It is mostly driven by concerns about agricultural practices and food production, manufacture and distribution. Nutrition policy is driven by a consideration of the impact of the food supply on health. A great deal more is written about food than about nutrition policy. From a public health nutrition perspective it should be clear that the primary question to be asked when considering policy issues is: “Will it make any difference to improving health, particularly in those with the greatest burden of poor health, usually the poorest in society?”

### ***Advocacy and evidence-based policy***

It is relevant to discuss briefly and to be able to distinguish between advocacy and evidence-based policy. Advocacy may be defined as the active support of an action or a cause and therefore an advocate is someone who upholds or defends that action or cause. Advocacy for a policy or action is usually based on a mix of values, beliefs and judgments that the course of action or policy is the right thing to do. The extent to which it is supported by evidence may depend on the underlying beliefs of the advocate. It is important that a clear distinction is drawn as to where the evidence stops and where judgments based on other factors start. The decisions that are made in society and from which policies and action arise do not do so in

a vacuum, and even if something appears to be obvious and important, this does not mean that it will be supported and implemented.

## 1.6 The public health nutrition cycle

Public Health Nutrition is about solving problems. A public health nutrition (PHN) cycle has been developed to help to achieve this aim (Figure 1.9). This cycle has been designed to identify the key steps required to develop a logical approach to the best way to go about solving problems. At each step in the cycle it is important not to lose sight of the purpose of the efforts and activity. Individuals or society should not be asked to change unless there is good evidence that that change will be beneficial. Producers and retailers should not be asked to change the food supply if that change is not going to improve health and well-being. The government should not be asked to develop policies and programs of work that will not benefit the health of the population. Programs of work should certainly not be recommended that increase inequalities within a society. In other words, whatever is done needs to have the most benefit for the most people in the most efficient way possible. This may involve a combination of approaches that combine a broad and narrow approach to health. Ideology should not be allowed to hinder doing what is best.

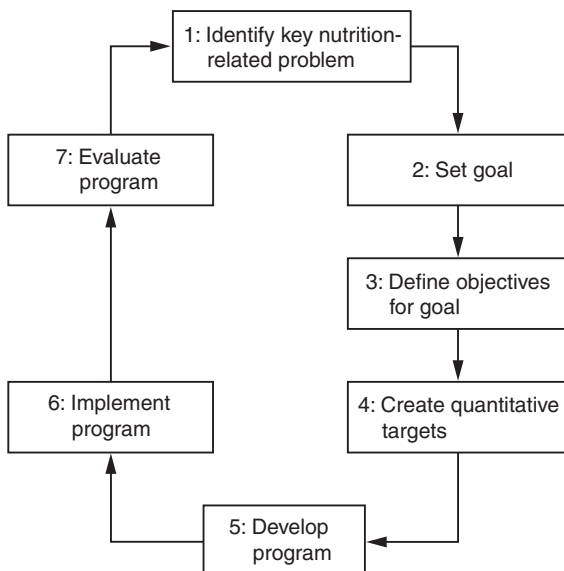


Figure 1.9 Public health nutrition (PHN) cycle.

The PHN cycle resembles a generic policy cycle. Several international organizations and governments use the “Triple A” (AAA: assessment, analysis and action) planning cycle (e.g. UNICEF and the South African Department of Health).

The Triple A cycle has a number of steps:

1. Assessment: situation analysis; identify problems and select opportunities for improvement (Where are we now?)
2. Define the problem operationally (Where do we want to go?); goals, indicators and objectives.
3. Identify who needs to work on the problem.
4. Analyze and study the problem to identify major causes.
5. Develop solutions and action for quality improvement (How will we get there?)
6. Implement and evaluate quality improvement efforts (How do we know when we arrive?)

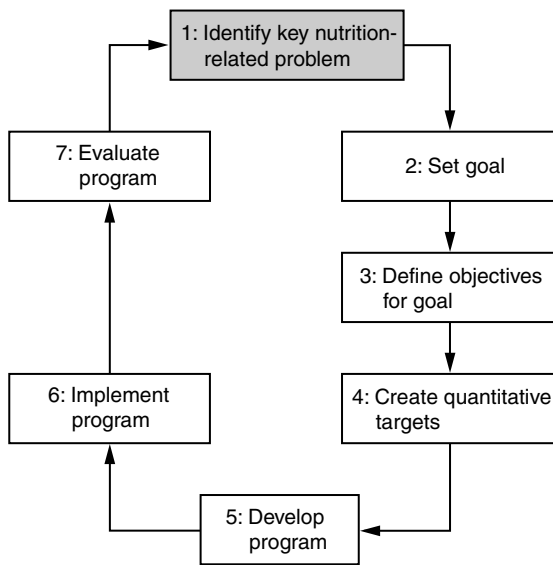
The PHN cycle is used here to encapsulate an iterative, continuous process that starts from an identification of the public health problems in a population (be it local, national or regional level) and leads to a program of work that is designed to solve the problem. Progress through each step in the cycle should be evidence based. This includes an evidence-based approach to target setting, program development and evaluation. This cycle provides a helpful guide through the related but various aspects of public health nutrition. Sections 1.7–1.13 describe the seven steps involved in the PHN cycle.

## 1.7 Step 1: Identify key nutrition-related problem

The purpose of public health nutrition is to solve problems. Therefore, one should start by checking what the key nutrition-related problems are within the relevant area of work or country. The following questions should be asked before proceeding to action.

### ***What are the big public health problems in your country/region?***

Consider how to answer this question. What information is needed? Is this information available at the required level?



### Measuring health and quality of life, mortality and morbidity, incidence and prevalence

International agencies produce a great deal of data that can be used to give some indication of the burden of poor health in a country. These data are generally freely available on the world wide web. Routine data have been most widely available for overall mortality, or broad groupings of causes of mortality, for most countries. These estimates, which are compiled centrally, are based on locally collected data and caution must be exercised in drawing conclusions from such data. Ideally, estimates of health burden should be derived using data from high-quality, purpose-specific surveys. Routine data on morbidity are much less readily available than data on mortality. If one is interested in a specific cause of illness (morbidity) or death, in some countries there will only be limited data from which to assess whether it really is a public health problem. Incidence data give an indication of new cases emerging over a particular time-frame, whereas prevalence estimates are a function of the underlying incidence and the duration of the illness. For many chronic diseases the estimates of the incidence and prevalence of mortality will be adequate. For infectious diseases with a short duration, incidence data will be required.

In some countries when a person dies a death certificate, with underlying causes of death, must be signed by medical practitioner. However, in most developing countries, particularly in remote areas, when a person

dies very often the underlying cause of death is not recorded by a medical practitioner and therefore may not be noted. It is important when comparing countries to be aware that differences may be attributed to differences in the way data are obtained. Always check the assumptions before using routinely collected data.

The WHO in its World Health report in 2002 used healthy life expectancy (HALE) as a summary measure of the level of health ([www.who.int/whr/en](http://www.who.int/whr/en)). Although there have been several similar composite measures of health in the past, the universal use of HALE – calculated centrally by means of standard methodology using internally consistent estimates of levels of health – is a major advance. HALE is designed to be sensitive to changes over time and differences between countries in the overall health situation. Nevertheless, HALE based on self-reported health status information may not always be comparable across countries, owing to differences in survey instruments and methods, differences in expectations and norms for health, and cultural differences in reporting health.

In 2003 the WHO launched the Surveillance of Risk Factors related to noncommunicable diseases ([www.int/mediacentre/factsheets/2003/fs273/en/](http://www.int/mediacentre/factsheets/2003/fs273/en/)). This lists all available data for eight risk factors: tobacco and alcohol use, patterns of physical activity, low fruit/vegetable intake, obesity (body mass index), blood pressure, cholesterol and diabetes (blood glucose), broken down by age groups and gender for all member states. The data are available on a compact disk, which includes details of the study populations and methods used to gather the data for each country. Appendix 3 of the report lists the data available by country. Of the 46 countries listed in Africa none has data on all eight risk factors: South Africa and Seychelles have information on seven risk factors, and only Nigeria and Cameroon have data on diet. In Europe data on all eight risk factors are available for 10 out of the 51 countries. In the Americas data for all eight risk factors are available for Brazil, Canada, Chile, the USA and Uruguay. India is the only country in south-east Asia that has data on all eight risk factors. Data are presented with a measure of the uncertainty of the estimates for each member state.

### Specific groups affected: age, socioeconomic group, geographical region, ethnic group

National data may mask regional, local or within-household variation. If the burden of poor health falls

only on a subsector of a society it is important to know because this may influence the approach to solving that problem. Data are rarely available in sufficient detail (and with power) to be certain about exactly which subgroups are most at risk.

### ***Evidence-based review of link between nutrition and the problem***

If one believes that there is a problem, the next stage is to check whether there is any evidence that links nutrition to that problem. This requires a systematic review of all available evidence and a critical appraisal of the studies. From a public health perspective the aim of this review is to identify nutrition risk factors for which the evidence is sufficiently strong and consistent to suggest a casual relationship and therefore justifies action. This review should also identify whether the risk is in all groups, or only in specific subgroups, either because of specific nutritional factors that only operate in that group, or because there are other basic or underlying differences that may confound or interact with nutrition.

It is a good idea to check whether government or some other agencies have already reviewed the evidence and made some specific recommendations about changes in diet and activity. Even if the nutritionist's review does not agree with these recommendations, it is important to know what has been recommended.

Developing critical appraisal skills is an essential part of developing a scientific approach to evidence-based public health nutrition, or any other aspect of research. The checklist in Box 1.2 may be useful to begin with.

### ***Are the nutrition risk factors identified relevant to the target population?***

**Does the research identify levels of consumption that may be harmful or beneficial? Can the risk estimates be translated into consumption levels?**

Often, the epidemiological study will present an estimate of the risk associated with one level of consumption compared with another. This is known as a relative risk of, for example, consumption in the highest third of intake compared with the lowest third of intake. It is not always presented in absolute terms. For example, the risk of colon cancer may be 0.5 in those in the highest third of vegetable consumption compared with those in the lowest third, but this does not

#### **Box 1.2**

- Are the study aims clear and precise in terms of the question being asked?
- Have they described the methods used to:
  - assess main exposure measure (e.g. weight, food intake energy intake, attitudes)
  - assess main outcome measure
  - assess other variables?
- Have they told you anything about the validity of the measures used?
  - information bias
  - social desirability bias
  - relevant time-frame.
- Have they described how they derived the sample?
  - sampling frame
  - response rate
  - selection procedure.
- Have they described interview or data collection standardization?
- Have they presented the data (tables) in a clear way?
- In their discussion have they been objective about the strengths and weaknesses of their study design?
  - Have they thought about the impact of what went wrong in the way they did their study?
  - Be very skeptical if the authors claim that they did a perfect study: no such study exists.
- Do their conclusions reflect the results presented?

indicate how much vegetable consumption there is in each third. What is more helpful is a measure of the population attributable risk; this gives a sense of the likely impact on health if the population changed their exposure from the lowest to the highest third of intake. The public health impact also depends on how common the health outcome is: if it is common a small reduction in risk will affect many people; if it is relatively uncommon, even a large relative risk will have only a small impact on the population burden of ill-health. Ideally, the targets for intervention should be those exposures that have the biggest effect on health, and on health problems that place the biggest burden on the target society.

### **What is the level of consumption in the target population?**

If individual country level data are not available from either routine surveillance or specific studies, a crude estimate of average intake can be made from food balance sheet data, produced for all countries by the FAO. The FAO data are crude in that they are a measure of the gross movement of food moving into and out of a country divided by the population. Both the numerator and the denominator may be inaccurate in

many countries. These data will give an estimate that may be useful, but will not give data about variation within a country or for individual levels of consumption. Where more detailed individual-level data are available, the concern will be as to whether these data are collected from a representative sample of the target population. If the epidemiology suggests that a particular group of people is at risk, are the data available relevant for that at-risk group?

### Is consumption within the range that suggests possibility for beneficial change?

If the level of consumption in the target population is already above the level considered beneficial, then there is no need for a program to try to improve consumption. It may be that at a national level consumption appears adequate, or at least availability may seem adequate, but that the specific target group of interest does not achieve the national average. If the target group is below the desired level (from the epidemiological evidence) it is important to ask why. Is the supply rate limiting or is it some other aspect of the sociostructural environment?

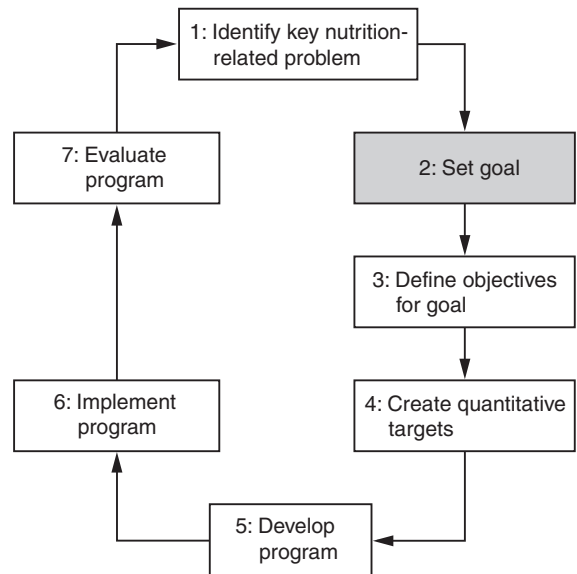
### Is it plausible that level of consumption could change from the current level to the level suggested to convey benefit?

In public health terms the estimates of risk need to be translated into levels of consumption. If, for example, the level of consumption associated with a 50% reduction in risk was 10 servings per day, and the average daily consumption in your target population was one serving per day, is it realistic to expect a 10-fold increase in consumption? It may be helpful to look at trends in intake and assess whether, and by how much, they have changed over the past 10 years. If intake has been relatively flat, and particularly if there have been many campaigns aimed at increasing intake, it is unlikely that big changes can be achieved. However, if a change of one serving a day could lead to a 5% reduction in risk, and if the risk (outcome) affects many people, then this level of change may still be very worthwhile trying to achieve. It is important to be realistic and to consider the cost–benefit of the effort required to achieve the desired change in the diet and ultimately the health outcome.

### Theoretical models of relevance

At this stage it may help to begin to think about what the major constraints to change might be. The relevant

theories to consider at this stage may relate to individual beliefs about the proposed intervention, social norms, or issues of institutional or societal organizational practices. If the evidence suggests fundamental changes in dietary practices in society, it is important to consider whether the social, cultural and political environment is likely to be amenable to the changes that appear to be required.



## 1.8 Step 2: Set goals and broad aims

Unless there are clear goals and broad aims it will not be possible to measure the impact of any programs aimed at improving health. It should be clear that the aims of public health nutrition programs are to improve nutrition-related health outcomes. The success of programs against this quantitatively defined background of work should be judged. No matter how programs may appear to be delivered, the key measure of impact is a measurable change in health outcome.

These goals inform and direct government policy at the highest level. These are the broad statements that politicians sign up to and use to argue for fiscal support and political leverage to achieve them. They need to be clear and concise and integrated into the overall health and other relevant policies of the government. They set the tone of the approach and highlight the government's priorities. The way in which these goals are achieved will vary depending on political ideology,