World Cancer Research Fund

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Food, Nutrition, Physical Activity, and the Prevention of Cancer:

a Global Perspective

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Preface

I am very grateful to the special group of distinguished scientists who made up the Panel and Secretariat for this major review of the evidence on food, nutrition, physical activity and cancer. The vision of WCRF International in convening this Panel and confidence in letting a strong-willed group of scientists have their way is to be highly commended.

In our view, the evidence reviewed here that led to our recommendations provides a wonderful opportunity to prevent cancer and improve global health. Individuals and populations have in their hands the means to lead fuller, healthier lives. Achieving that will take action, globally, nationally, and locally, by communities, families, and individuals.

It is worth pausing to put this Report in context. Public perception is often that experts disagree. Why should the public or policy-makers heed advice if experts differ in their views? Experts do disagree. That is the nature of science and a source of its strength. Should we throw up our hands and say one opinion is as good as another? Of course not. Evidence matters. But not evidence unguided by human thought. Hence the process that was set up for this review: use a systematic approach to examine all the relevant evidence using predetermined criteria, and assemble an international group of experts who, having brought their own knowledge to bear and having debated their disagreements, arrive at judgements as to what this evidence means. Both parts of the exercise were crucial: the systematic review and, dare I say it, the wisdom of the experts.

The elegance of the process was one of the many attractions to me of assuming the role of chair of the Panel. I could pretend that it was the major reason, and in a way it was, but the first reason was enjoyment. What a pleasure and a privilege to spend three years in the company of a remarkable group of scientists, including world leaders in research on the epidemiology of cancer, as well as leaders in nutrition and public health and the biology of cancer, to use a relatively new methodology (systematic literature reviews), supported by a vigorous and highly effective Secretariat, on an issue of profound importance to global public health: the prevention of cancer by means of healthy patterns of eating and physical activity. It was quite as enjoyable as anticipated.

Given this heady mix, the reasons why I might have wanted to take on the role of Panel chair were obvious. I did question the wisdom of WCRF International in inviting me to do it. Much of my research has been on cardiovascular disease, not cancer. What I described as my ignorance, WCRF International kindly labelled impartiality.

WCRF also appreciated the parallels between dietary causes of cardiovascular disease and cancer. There is a great deal of concordance. In general, recommendations in this Report to prevent cancer will also be of great relevance to cardiovascular disease. The only significant contradiction is with alcohol. From the point of view of cancer prevention, the best level of alcohol consumption is zero. This is not the case for cardiovascular disease, where the evidence suggests that one to two drinks a day are protective. The Panel therefore framed its recommendation to take this into account.

The fact that the conclusions and recommendations in this Report are the unanimous view of the Panel does not imply that, miraculously, experts have stopped disagreeing. The Panel debated the fine detail of every aspect of its conclusions and recommendations with remarkable vigour and astonishing stamina. In my view, this was deliberation at its best. If conclusions could simply fall out of systematic literature reviews, we would not have needed experts to deliberate. Human judgement was vital; and if human, it cannot be infallible. But I venture to suggest this process has led to as good an example of evidence-based public health recommendations as one can find.

Throughout the Panel's deliberations, it had in mind the global reach of this Report. Most of the research on diet and cancer comes from high-income countries. But

noncommunicable diseases, including cancer, are now major public health burdens in every region of the world. An important part of our deliberations was to ensure the global applicability of our recommendations.

One last point about disagreement among experts: its relevance to the link between science and policy. A caricature would be to describe science as precise and policy-makers as indecisive. In a way, the opposite is the case. Science can say: could be, might be, some of us think this, and some think that. Policy-makers have either to do it or not do it — more often, not. Our effort here was to increase the precision of scientific judgements. As the Report makes clear, many of our conclusions are in the 'could be' category. None of our recommendations is based on these 'could be' conclusions. All are based on judgements that evidence was definite or probable. Our recommendations, we trust, will serve as guides to the population, to scientists, and to opinion-formers.

But what should policy-makers do with our judgements? A year after publication of this Report, we will publish a second report on policy for diet, nutrition, physical activity, and the prevention of cancer. As an exercise developing out of this one, we decided to apply, as far as possible, the same principles of synthesis of evidence to policy-making. We enhanced the scientific panel that was responsible for this Report with experts in nutrition and food policy. This policy panel will oversee systematic literature reviews on food policy, deliberate, and make recommendations.

The current Report and next year's Policy Report have one overriding aim: to reduce the global burden of cancer by means of healthier living.

Michael Marmot

Contents

CHAPTER BOXES

Acknowledgements

Panel

Sir Michael Marmot
MB BS MPH PhD FRCP FFPH
Chair
University College London
UK

Tola Atinmo PhD
University of Ibadan, Nigeria

Tim Byers MD MPH
University of Colorado Health Sciences Center
Denver, CO, USA

Junshi Chen MD
Chinese Centre for Disease Control and Prevention
Beijing, People's Republic of China

Tomio Hirohata MD
DrScHyg PhD
Kyushu University
Fukuoka City, Japan

Alan Jackson CBE MD FRCP
FRCPCH FRCPath
University of Southampton
UK

W Philip T James CBE MD
DSc FRSE FRCP
International Obesity Task Force
London, UK

Laurence N Kolonel MD PhD
University of Hawai'i
Honolulu, HI, USA

Shiriki Kumanyika PhD MPH
University of Pennsylvania
Philadelphia, PA, USA

Claus Leitzmann PhD
Justus Liebig University
Giessen, Germany

Jim Mann DM PhD FFPH
FRACP
University of Otago
Dunedin, New Zealand

Hilary J Powers PhD RNutr
University of Sheffield, UK

K Srinath Reddy MD DM MSc
Institute of Medical Sciences
New Delhi, India

Elio Riboli MD ScM MPH
Was at: International Agency for Research on Cancer (IARC), Lyon, France
Now at: Imperial College London, UK

Juan A Rivera PhD
Instituto Nacional de Salud Publica
Cuernavaca, Mexico

Arthur Schatzkin MD DrPH
National Cancer Institute
Rockville, MD, USA

Jacob C Seidell PhD
Free University Amsterdam
The Netherlands

David E G Shuker PhD FRSC
The Open University
Milton Keynes, UK

Ricardo Uauy MD PhD
Instituto de Nutricion y Tecnologia de los Alimentos
Santiago, Chile

Walter C Willett MD DrPH
Harvard School of Public Health
Boston, MA, USA

Steven H Zeisel MD PhD
University of North Carolina
Chapel Hill, NC, USA

Robert Beaglehole ONZM
FRSNZ DSc
Chair 2003
Was at: World Health Organization (WHO)
Geneva, Switzerland
Now at: University of Auckland, New Zealand

Panel observers

Food and Agriculture Organization of the United Nations (FAO)
Rome, Italy
Guy Nantel PhD
Prakash Shetty MD PhD

International Food Policy Research Institute (IFPRI)
Washington DC, USA
Lawrence Haddad PhD
Marie Ruel PhD

International Union of Nutritional Sciences (IUNS)
Mark Wahlqvist MD AO

Mechanisms Working Group
John Milner PhD

Methodology Task Force
Jos Kleijnen MD PhD
Gillian Reeves PhD

Union Internationale Contre le Cancer (UICC)
Geneva, Switzerland
Annie Anderson PhD
Curtis Mettlin PhD
Harald zur Hausen MD DSc

United Nations Children's Fund (UNICEF)
New York, NY, USA
Ian Darnton-Hill MD MPH
Rainer Gross Dr Agr

World Health Organization (WHO)
Geneva, Switzerland
Denise Coitinho PhD
Ruth Bonita MD
Chizuru Nishida PhD MA
Pirjo Pietinen DSc

Additional members for policy panel

Barry Popkin PhD MSc BSc
Carolina Population Center, University of North Carolina, Chapel Hill, NC, USA

Jane Wardle PhD MPhil
University College London, UK

Nick Cavill MPH
British Heart Foundation Health Promotion Research Group
University of Oxford, UK

Systematic Literature Review Centres

University of Bristol, UK

George Davey Smith
FMedSci FRCP DSc
University of Bristol , UK

Jonathan Sterne PhD MSc MA
University of Bristol, UK

Chris Bain MB BS MS MPH
University of Queensland
Brisbane, Australia

Nahida Banu MB BS
University of Bristol, UK

Trudy Bekkering PhD
University of Bristol, UK

Rebecca Beynon MA BSc
University of Bristol, UK

Margaret Burke MSc
University of Bristol, UK

David de Berker MB BS MRCP
United Bristol Healthcare Trust, UK

Anna A Davies MSc BSc
University of Bristol, UK

Roger Harbord MSc
University of Bristol, UK

Ross Harris MSc
University of Bristol, UK

Lee Hooper PhD SRD
University of East Anglia
Norwich, UK

Anne-Marie Mayer PhD MSc
University of Bristol, UK

Andy Ness PhD FFPHM MRCP
University of Bristol, UK

Rajendra Persad ChM FEBU FRCS
United Bristol Healthcare Trust & Bristol Urological Institute, UK

Massimo Pignatelli MD PhD FRCPath
University of Bristol, UK

Jelena Savovic PhD
University of Bristol, UK

Steve Thomas MB BS PhD FRCS
University of Bristol, UK

Tim Whittlestone MA MD FRCS
United Bristol Healthcare Trust, UK

Luisa Zuccolo MSc
University of Bristol, UK

Istituto Nazionale Tumori Milan, Italy

Franco Berrino MD
Istituto Nazionale Tumori
Milan, Italy

Patrizia Pasanisi MD MSc
Istituto Nazionale Tumori
Milan, Italy

Claudia Agnoli ScD
Istituto Nazionale Tumori
Milan, Italy

Silvana Canevari ScD
Istituto Nazionale Tumori
Milan, Italy

Giovanni Casazza ScD
Istituto Nazionale Tumori
Milan, Italy

Elisabetta Fusconi ScD
Istituto Nazionale Tumori
Milan, Italy

Carlos A Gonzalez PhD MPH MD
Catalan Institute of Oncology
Barcelona, Spain

Vittorio Krogh MD MSc
Istituto Nazionale Tumori
Milan, Italy

Sylvie Menard ScD
Istituto Nazionale Tumori
Milan, Italy

Eugenio Mugno ScD
Istituto Nazionale Tumori
Milan, Italy

Valeria Pala ScD
Istituto Nazionale Tumori
Milan, Italy

Sabina Sieri ScD
Istituto Nazionale Tumori
Milan, Italy

Johns Hopkins University, Baltimore, MD, USA

Anthony J Alberg PhD MPH
University of South Carolina
Columbia, SC, USA

Kristina Boyd MS
Johns Hopkins University
Baltimore, MD, USA

Laura Caulfield PhD
Johns Hopkins University
Baltimore, MD, USA

Eliseo Guallar MD DrPH
Johns Hopkins University
Baltimore, MD, USA

James Herman MD
Johns Hopkins University
Baltimore, MD, USA

Genevieve Matanoski MD DrPH
Johns Hopkins University
Baltimore, MD, USA

Karen Robinson MSc
Johns Hopkins University
Baltimore, MD, USA

Xuguang (Grant) Tao MD PhD
Johns Hopkins University
Baltimore, MD, USA

University of Leeds, UK

David Forman PhD FFPH
University of Leeds, UK

Victoria J Burley PhD MSc RPHNutr
University of Leeds, UK

Janet E Cade PhD BSc RPHNutr
University of Leeds, UK

Darren C Greenwood MSc
University of Leeds, UK

Doris S M Chan MSc
University of Leeds, UK

Jennifer A Moreton PhD MSc
University of Leeds, UK

James D Thomas
University of Leeds, UK

Yu-Kang Tu PhD MSc DDS
University of Leeds, UK

Iris Gordon MSc
University of Leeds, UK

Kenneth E L McColl FRSE FMedSci FRCP
Western Infirmary
Glasgow, UK

Lisa Dyson MSc
University of Leeds, UK

London School of Hygiene & Tropical Medicine, UK

Alan D Dangour PhD MSc
London School of Hygiene & Tropical Medicine, UK

Shefalee Mehta MSc
London School of Hygiene & Tropical Medicine, UK

Abigail Perry MSc
London School of Hygiene & Tropical Medicine, UK

Sakhi Kiran Dodhia MSc
London School of Hygiene & Tropical Medicine, UK

Vicki Pyne MSc
London School of Hygiene & Tropical Medicine, UK

University of Teesside, UK

Carolyn Summerbell PhD SRD
University of Teesside
Middlesbrough, UK

Sarah Kelly PhD
University of Teesside
Middlesbrough, UK

Louisa Ells PhD
University of Teesside
Middlesbrough, UK

Frances Hillier MSc
University of Teesside
Middlesbrough, UK

Sarah Smith MSc
University of Teesside
Middlesbrough, UK

Alan Batterham PhD
University of Teesside
Middlesbrough, UK

Laurel Edmunds PhD
University of Teesside
Middlesbrough, UK

Vicki Whittaker MSc
University of Teesside
Middlesbrough, UK

Ian Macdonald PhD
University of Nottingham, UK

Penn State University, University Park, PA, USA

Terryl J Hartman PhD MPH RD
Penn State University,
University Park, PA, USA

David Mauger PhD
Penn State College of Medicine,
University Park, PA, USA

Lindsay Camera MS
Penn State College of Medicine,
University Park, PA, USA

M Jenny Harris Ledikwe PhD
Penn State University,
University Park, PA, USA

Linda Kronheim MS
Penn State University,
University Park, PA, USA

Keith R Martin PhD MTox
Penn State University,
University Park, PA, USA

Tara Murray
Penn State University,
University Park, PA, USA

Michele L Shaffer PhD
Penn State College of Medicine,
University Park,
PA, USA

Kim Spaccarotella PhD
Rutgers, The State University of New Jersey, New Brunswick, NJ, USA

Kaiser Permanente, Oakland, California, USA

Elisa V Bandera MD PhD
The Cancer Institute of New Jersey
New Brunswick, NJ, USA

Lawrence H Kushi ScD
Kaiser Permanente
Oakland, California, USA

Dirk F Moore PhD
The Cancer Institute of New Jersey
New Brunswick, NJ, USA

Dina M Gifkins MPH
The Cancer Institute of New Jersey
New Brunswick, NJ, USA

Marjorie L McCullough RD ScD
American Cancer Society
New York, NY, USA

Wageningen University, The Netherlands

Pieter van 't Veer PhD
Wageningen University
The Netherlands

Ellen Kampman PhD
Wageningen University
The Netherlands

Marije Schouten PhD
Wageningen University
The Netherlands

Bianca Stam MSc
Wageningen University
The Netherlands

Claudia Kamphuis MSc
Wageningen University
The Netherlands

Maureen van den Donk PhD
Wageningen University
The Netherlands

Marian Bos MSc
Wageningen University
The Netherlands

Akke Botma MSc
Wageningen University
The Netherlands

Simone Croezen MSc
Wageningen University
The Netherlands

Mirjam Meltzer MSc
Wageningen University
The Netherlands

Fleur Schouten MSc
Wageningen University
The Netherlands

Janneke Ploemacher MSc
Wageningen University
The Netherlands

Khahn Le MSc
Wageningen University
The Netherlands

Anouk Geelen PhD
Wageningen University
The Netherlands

Evelien Smit MSc
Wageningen University
The Netherlands

Salome Scholtens MSc
Wageningen University
The Netherlands

Evert-Jan Bakker PhD
Wageningen University
The Netherlands

Jan Burema MSc
Wageningen University
The Netherlands

Marianne Renkema PhD
Wageningen University
The Netherlands

Henk van Kranen PhD
National Institute for Health and the Environment (RIVM)
Bilthoven, the Netherlands

Narrative review authors

Liju Fan PhD
Ontology Workshop
Columbia, MD, USA

Luigino Dal Maso ScD
Aviano Cancer Center
Italy

Michael Garner MSc
University of Ottawa
Ontario, Canada

Frank M Torti MD MPH
Wake Forest University,
Comprehensive Cancer Unit
Winston-Salem, NC, USA

Christine F Skibola PhD
University of California,
Berkeley, CA, USA

Methodology Task Force

Martin Wiseman FRCP FRCPath
Chair
Project Director
WCRF International

Sheila A Bingham PhD FMedSci
MRC Dunn Human Nutrition Unit
Cambridge, UK

Heiner Boeing PhD
German Institution of Human Nutrition
Berlin, Germany

Eric Brunner PhD FFPH
University College London, UK

H Bas Bueno de Mesquita MD MPH PhD
National Institute of Public Health and the Environment (RIVM)
Bilthoven, the Netherlands

David Forman PhD FFPH
University of Leeds, UK

Ian Frayling PhD MRCPath
Addenbrookes Hospital
Cambridge, UK

Andreas J Gescher DSc
University of Leicester, UK

Tim Key PhD
Cancer Research UK
Epidemiology Unit,
University of Oxford
Oxford, UK

Jos Kleijnen MD PhD
Was at: University of York, UK
Now at: Kleijnen Systematic Reviews, York, UK

Barrie Margetts MSc PhD MFPH
University of Southampton, UK

Robert Owen PhD
German Cancer Research Centre
Heidelberg, Germany

Gillian Reeves PhD
Cancer Research UK
Epidemiology Unit,
University of Oxford
Oxford, UK

Elio Riboli MD ScM MPH
Was at: International Agency for Research on Cancer (IARC), Lyon, France
Now at: Imperial College London, UK

Arthur Schatzkin MD DrPH
National Cancer Institute
Rockville, MD, USA

David E G Shuker PhD
The Open University
Milton Keynes, UK

Michael Sjöström MD PhD
Karolinska Institute
Stockholm, Sweden

Pieter van 't Veer PhD
Wageningen University
The Netherlands

Chris Williams MD
Cochrane Cancer Network
Oxford, UK

Mechanisms Working Group

John Milner PhD
Chair
National Cancer Institute
Rockville, MD, USA

Nahida Banu MBBS
University of Bristol, UK

Xavier Castellsagué Pique PhD MD MPH
Catalan Institute of Oncology
Barcelona, Spain

Sanford M Dawsey MD
National Cancer Institute
Rockville, MD, USA

Carlos A Gonzalez PhD MPH MD
Catalan Institute of Oncology
Barcelona, Spain

James Herman MD
Johns Hopkins University
Baltimore, MD, USA

Stephen Hursting PhD
University of North Carolina
Chapel Hill, NC, USA

Henry Kitchener MD
University of Manchester, UK

Keith R Martin PhD MTox
Penn State University
University Park, PA, USA

Kenneth E L McColl FRSE FMedSci FRCP
Western Infirmary
Glasgow, UK

Sylvie Menard ScD
Istituto Nazionale Tumori
Milan, Italy

Massimo Pignatelli MD PhD MRCPath
University of Bristol, UK

Henk van Kranen PhD
National Institute of Public Health and the Environment (RIVM)
Bilthoven, the Netherlands

Peer reviewers and other contributors

David S Alberts MD
Arizona Cancer Center
Tucson, AZ, USA

Chris Bain MBBS MPH
University of Queensland
Brisbane, Australia

Amy Berrington de Gonzalez DPhil MSc
Johns Hopkins University
Baltimore, MD, USA

Sheila A Bingham PhD FMedSci
MRC Dunn Human Nutrition Unit
Cambridge, UK

Diane Birt PhD
Iowa State University
Ames, IA, USA

Steven Blair PED
University of South Carolina
Columbia, SC, USA

Judith Bliss MSc
The Institute of Cancer Research
Sutton, UK

Cristina Bosetti ScD
Istituto di Recherche Farmacologiche "Mario Negri"
Milan, Italy

Paul Brennan PhD MSc
International Agency for Research on Cancer (IARC)
Lyon, France

Johannes Brug PhD FFPH
Institute for Research in Extramural Medicine (EMGO),
VU University Medical Centre
Amsterdam, the Netherlands

Eric Brunner PhD FFPH
University College London, UK

H Bas Bueno de Mesquita MD MPH PhD
National Institute of Public Health and the Environment (RIVM)
Bilthoven, the Netherlands

Noel Cameron BEd MSc
Loughborough University, UK
Moira Chan-Yeung MBBS FRCP FACP
University of Hong Kong
China

Robert Clarke DSc PhD
Lombardi Comprehensive Cancer Center, Georgetown University
Washington DC, USA

Steven K Clinton MD PhD
The Ohio State University
Columbus, OH, USA

Karen Collins MS RD
Nutrition Advisor
AICR

Brian Cox MBChB PhD FAFPHM
University of Otago
Dunedin, New Zealand

Cindy Davis PhD
National Cancer Institute
Rockville, MD, USA

Diana Dyer MS RD
Ann Arbor, MI, USA

Jonathan Earle MB BCh FCAP
Memorial Sloan Kettering Cancer Center
New York, NY, USA

Alison Eastwood MSc
University of York, UK

Ibrahim Elmadfa PhD
University of Vienna
Austria

Dallas English PhD MSc
University of Melbourne
Victoria, Australia

Michael Fenech PhD MSc BSc
Commonwealth Scientific and Industrial Research Organization (CSIRO)
Adelaide, Australia

Justin Fenty MSc
University of Nottingham, UK

Lynn Ferguson DSc DPhil MSc
Univerity of Auckland
New Zealand

Elizabeth TH Fontham DrPH
Louisiana State University of Public Health
New Orleans, LA, USA

Terrence Forrester MB BS DM FRCP
University of the West Indies
Kingston, Jamaica

Teresa Fung ScD RD MSc
Simmons College and Harvard School of Public Health
Boston, MA, USA

John Garrow MD PhD FRCP
University of London, UK

Glenn Gibson PhD
University of Reading, UK

Ian Gilmore MD PRCP
Royal College of Physicians
London, UK

Vay Liang W Go MD
University of California
Los Angeles, CA, USA

Per Hall MD PhD
Karolinska Institutet
Stockholm, Sweden

Laura Hardie PhD
University of Leeds, UK

Peter Herbison MSc
University of Otago
Dunedin, New Zealand

Melvyn Hillsdon PhD
University of Bristol, UK

Edward Hurwitz DC PhD
University of Hawai'i
Honolulu, HI, USA

Susan Jebb PhD
MRC Human Nutrition Research
Cambridge, UK

Stanley B Kaye MD FRCP FMedSci
The Institute of Cancer Research
Sutton, UK

Tim Key PhD
Cancer Research UK Epidemiology Unit,
University of Oxford
Oxford, UK

Victor Kipnis PhD
National Cancer Institute
Rockville, MD, USA

Paul Knekt PhD
National Public Health Institute
Helsinki, Finland

Thilo Kober PhD
Cochrane Haematological Malignancies Group
Cologne, Germany

Suminori Kono PhD MD MSc
Kyushu University
Fukuoka, Japan

Nancy Kreiger PhD MPH
Cancer Care Ontario and University of Toronto
Canada

Petra Lahmann PhD
University of Queensland
Brisbane, Australia

Fabio Levi MD MSc
Institut Universitaire de Médecine Sociale et Préventive
Lausanne, Switzerland

Ruth Lewis MSc
Cardiff University, UK

Albert B Lowenfels MD
New York Medical College
New York, NY, USA

Graham A MacGregor FRCP
St George's University of London, UK

Geoffrey Marks PhD MS
University of Queensland
Brisbane, Australia

John Mathers PhD DipNutr
University of Newcastle, UK

Sam McClinton MD FRCS
NHS Grampian
Aberdeen, UK

Fiona Mensah
University of York, UK

Margaret McCredie PhD
University of Otago
Dunedin, New Zealand

Tony McMichael MB BS PhD FAFPHM
The Australian National University
Canberra, Australia

Dominique Michaud ScD
Harvard School of Public Health
Boston, MA, USA

Anthony B Miller MD FRCP FACE
University of Toronto
Canada

Sidney Mirvish PhD
University of Nebraska
Omaha, NE, USA

Max Parkin MD
International Agency for Research on Cancer (IARC)
Lyon, France

Charlotte Paul MB ChB PhD
University of Otago
Dunedin, New Zealand

John Reilly PhD
University of Glasgow, UK

Richard Rivlin MD
Strang Cancer Research Laboratory
New York, NY, USA

Andrew Roddam DPhil
Cancer Research UK Epidemiology Unit
University of Oxford
Oxford, UK

Leo Schouten MD PhD
Nutrition and Toxicology Research Institute Maastricht
The Netherlands

Jackilen Shannon PhD MPH RD
Oregon Health and Science University
Portland, OR, USA

Keith Singletary PhD
University of Illinois
Urbana, IL, USA

Rashmi Sinha PhD
National Cancer Institute
Rockville, MD, USA

Rachael Stolzenberg-Solomon
PhD MPH RD
National Cancer Institute
Baltimore, MD, USA

Boyd Swinburn MB ChB MD
Deakin University
Melbourne, Australia

Peter Szlosarek MRCP PhD
St Bartholomew's Hospital
London, UK

Paul Talalay MD
Johns Hopkins University
Baltimore, MD, USA

Margaret Thorogood PhD
University of Warwick, UK

Stewart Truswell MD DSc FRCP
University of Sydney
Australia

Paolo Vineis MD MPH
Imperial College
London, UK

Steven Waggoner MD
Case Comprehensive Cancer Center
Cleveland, OH, USA

Christopher P Wild PhD
University of Leeds, UK

Anthony Williams DPhil FRCP FRCPCH
St George's University of London, UK

Frederic M Wolf PhD MEd
University of Washington
Seattle, WA, USA

Jian-Min Yuan MD PhD
University of Minnesota,
Minneappolis, MN, USA

Maurice Zeegers PhD MSc
University of Birmingham, UK

WCRF/AICR Report Executive Team

Marilyn Gentry
President
WCRF Global Network

Kelly Browning
Chief Financial Officer
WCRF Global Network

Kate Allen PhD
Director
WCRF International

Kathryn L Ward
Senior Vice-President
AICR

Deirdre McGinley-Gieser
WCRF International

Jeffrey R Prince PhD
Vice-President for Education and Communications
AICR

Secretariat

Martin Wiseman FRCP FRCPath
Project Director
WCRF International

Geoffrey Cannon
Chief Editor
WCRF International

Ritva R Butrum PhD
Senior Science Advisor
AICR

Greg Martin MB BCh MPH
Project Manager
WCRF International

Susan Higginbotham PhD
Director for Research
AICR

Steven Heggie PhD
Project Manager
WCRF International
From 2002 to 2006

Alison Bailey
Science Writer
Redhill, UK

Poling Chow BSc
Research Administration Assistant
WCRF International

Kate Coughlin BSc
Science Programme Manager
WCRF International

Cara James
Associate Director for Research
AICR
From 2003 to 2005

Jennifer Kirkwood
Research Administration Assistant
WCRF International
From 2003 to 2004

Anja Kroke MD PhD MPH
Consultant
University of Applied Sciences
Fulda, Germany
2002

Kayte Lawton
Research Administration Assistant
WCRF International
From 2006 to 2007

Lisa Miles MSc
Science Programme Manager
WCRF International
From 2002 to 2006

Sarah Nalty MSc
Science Programme Manager
WCRF International

Edmund Peston
Research Administration Assistant
WCRF International
From 2004 to 2006

Serena Prince
Research Administration Assistant
WCRF International
From 2004 to 2005

Melissa Samaroo
Research Administration Assistant
WCRF International
From 2006 to 2007

Elaine Stone PhD
Science Programme Manager
WCRF International
From 2001 to 2006

Rachel Thompson PhD RPHNutr
Review Coordinator

Ivana Vucenik PhD
Associate Director for Research
AICR

Joan Ward
Research Administration Assistant
WCRF International
From 2001 to 2003

Julia Wilson PhD
Science Programme Manager
WCRF International

Art & production

Chris Jones
Design and Art Director
Design4Science Ltd
London, UK

Emma Copeland PhD
Text Editor
Brighton, UK

Rosalind Holmes
Production Manager
London, UK

Mark Fletcher
Graphics
Fletcher Ward Design
London, UK

Ann O'Malley
Print Manager
AICR

Geoff Simmons
Design & Production Manager
WCRF UK

Summary

Introduction

This summary provides an abbreviated version of the full Report. It highlights the wealth of information and data studied by the Panel and is designed to give readers an overview of the key issues contained within the Report, notably the process, the synthesis of the scientific evidence, and the resulting judgements and recommendations.

The first and second Reports

Food, Nutrition and the Prevention of Cancer: a global perspective, produced by the World Cancer Research Fund together with the American Institute for Cancer Research, has been the most authoritative source on food, nutrition, and cancer prevention for 10 years. On publication in 1997, it immediately became recognised as the most authoritative and influential report in its field and helped to highlight the importance of research in this crucial area. It became the standard text worldwide for policy-makers in government at all levels, for civil society and health professional organisations, and in teaching and research centres of academic excellence.

Since the mid-1990s the amount of scientific literature on this subject has dramatically increased. New methods of analysing and assessing evidence have been developed, facilitated by advances in electronic technology. There is more evidence, in particular on overweight and obesity and on physical activity; food, nutrition, physical activity, and cancer survivors is a new field. The need for a new report was obvious; and in 2001 WCRF International in collaboration with AICR began to put in place a global process in order to produce and publish the Report in November 2007.

How this Report has been achieved

The goal of this Report is to review all the relevant research, using the most meticulous methods, in order to generate a comprehensive series of recommendations on food, nutrition, and physical activity, designed to reduce the risk of cancer and suitable for all societies. This process is also the basis for a continuous review of the evidence.

Organised into overlapping stages, the process has been designed to maximise objectivity and transparency, separating the collection of evidence from its assessment and judgement. First, an expert task force developed a method for systematic review of the voluminous scientific literature. Second, research teams collected and reviewed the literature based upon this methodology. Third, an expert Panel has assessed and judged this evidence and agreed recommendations. The results are published in this Report and summarised here. A more detailed explanation of this process is given in Chapter 3 and the research teams and investigators involved are listed on pages viii–xi.

This Report is a guide to future scientific research, cancer prevention education programmes, and health policy around the world. It provides a solid evidence base for policy-makers, health professionals, and informed and interested people to draw on and work with.

Overview of the second expert Report

This Report has a number of inter-related general purposes. One is to explore the extent to which food, nutrition, physical activity, and body composition modify the risk of cancer, and to specify which factors are most important. To the extent that environmental factors such as food, nutrition, and physical activity influence the risk of cancer, it is a preventable disease. The Report specifies recommendations based on solid evidence which, when followed, will be expected to reduce the incidence of cancer.

Part 1 — Background

Chapter 1 shows that patterns of production and consumption of food and drink, of physical activity, and of body composition have changed greatly throughout human history. Remarkable changes have taken place as a result of urbanisation and industrialisation, at first in Europe, North America, and other economically advanced countries, and increasingly in most countries in the world. Notable variations have been identified in patterns of cancer throughout the world. Significantly, studies consistently show that patterns of cancer change as populations migrate from one part of the world to another and as countries become increasingly urbanised and industrialised. Projections indicate that rates of cancer in general are liable to increase.

Chapter 2 outlines current understanding of the biology of the cancer process, with special attention to the ways in which food and nutrition, physical activity, and body composition may modify the risk of cancer. Cancer is a disease of genes, which are vulnerable to mutation, especially over the long human lifespan. However, evidence shows that only a small proportion of cancers are inherited. Environmental factors are most important and can be modified. These include smoking and other use of tobacco; infectious agents; radiation; industrial chemicals and pollution; medication; and also many aspects of food, nutrition, physical activity, and body composition.

Chapter 3 summarises the types of evidence that the Panel has agreed are relevant to its work. No single study or study type can prove that any factor definitely is a cause of, or is protective against, any disease. In this chapter, building on the work of the first report, the Panel shows that reliable judgements on causation of disease are based on assessment of a variety of well-designed epidemiological and experimental studies.

The prevention of cancer worldwide is one of the most pressing challenges facing scientists and public health policy-makers, among others. These introductory chapters show that the challenge can be effectively addressed and suggest that food, nutrition, physical activity, and body composition play a central part in the prevention of cancer.

Part 2 — Evidence and Judgements

The judgements made by the Panel in Part 2 are based on independently conducted systematic reviews of the literature commissioned from academic institutions in the USA, UK, and continental Europe. The evidence has been meticulously assembled and, crucially, the display of the evidence was separated from assessments derived from that evidence. Seven chapters present the findings of these reviews. The Panel's judgements are displayed in the form of matrices that introduce five of these chapters, and in the summary matrix on the fold-out page inside the back cover.

Chapter 4, the first and longest chapter in Part 2, is concerned with types of food and drink. The judgements of the Panel are, whenever possible, food- and drink-based, reflecting the most impressive evidence. Findings on dietary constituents and micronutrients (for example foods containing dietary fibre) are identified where appropriate. Evidence on dietary supplements, and on patterns of diet, is included in the two final sections of this chapter.

Chapters 5 and 6 are concerned with physical activity and with body composition, growth, and development. Evidence in these areas is more impressive than was the case up to the mid-1990s; the evidence on growth and development indicates the importance of an approach to the prevention of cancer that includes the whole life course.

Chapter 7 summarises and judges the evidence as applied to 17 cancer sites, with additional briefer summaries based on narrative reviews of five further body systems and cancer sites. The judgements shown in the matrices in this chapter correspond with the judgements shown in the matrices in the previous chapters.

Obesity is or may be a cause of a number of cancers. Chapter 8 identifies what aspects of food, nutrition, and physical activity themselves affect the risk of obesity and associated factors. The judgements, which concern the biological and associated determinants of weight gain, overweight, and obesity, are based on a further systematic literature review, amplified by knowledge of physiological processes.

The relevance of food, nutrition, physical activity, and body composition to people living with cancer, and to the prevention of recurrent cancer, is summarised in Chapter 9. Improved cancer screening, diagnosis, and medical services are, in many countries, improving survival rates. So the number of cancer survivors — people living after diagnosis of cancer — is increasing.

The Panel agreed that its recommendations should also take into account findings on the prevention of other chronic diseases, and of nutritional deficiencies and nutrition-related infectious diseases, especially of childhood. Chapter 10, also based on a systematic literature review, is a summary of the findings of expert reports in these areas.

The research issues identified in Chapter 11 are, in the view of the Panel, the most promising avenues to explore in order to refine understanding of the links between food, nutrition, physical activity, and cancer, and so improve the prevention of cancer, worldwide.

Part 3 — Recommendations

Chapter 12, the culmination of the five-year process, presents the Panel's public health goals and personal recommendations. These are preceded by a statement of the principles that have guided the Panel in its thinking.

The goals and recommendations are based on 'convincing' or 'probable' judgements made by the Panel in the chapters in Part 2. These are proposed as the basis for public policies and for personal choices that, if effectively implemented, will be expected to reduce the incidence of cancer for people, families, and communities.

Eight general and two special goals and recommendations are detailed. In each case a general recommendation is followed by public health goals and/or personal recommendations, together with further explanation or clarification as required. Chapter 12 also includes a summary of the evidence, justification of the goals and recommendations, and guidance on how to achieve them.

The process of moving from evidence to judgements and to recommendations has been one of the Panel's main responsibilities, and has involved discussion and debate until final agreement has been reached. The goals and recommendations here have been unanimously agreed.

The goals and recommendations are followed by the

Panel's conclusions on the dietary patterns most likely to protect against cancer. In order to discern the 'big picture' of healthy and protective diets, it is necessary to integrate a vast amount of detailed information. The Panel used a broad, integrative approach that, while largely derived from conventional 'reductionist' research, has sought to find patterns of food and drink consumption, of physical activity, and of body fatness, that enable recommendations designed to prevent cancer at personal and population levels.

The goals and recommendations are designed to be generally relevant worldwide and *the Panel recognises* that in national settings, the recommendations of this Report will be best used in combination with recommendations, issued by governments or on behalf of nations, designed to prevent chronic and other diseases. In addition, the Panel cited three specific cases where the evidence is strong enough to be the basis for goals and recommendations, but which currently are relevant only in discrete geographical regions: maté in Latin America, Cantonese-style salted fish in the Pearl River Delta in Southern China, and arsenic contaminating water supplies in several locations. Further details on nutritional patterns and regional and special circumstances can be found in section 12.3.

The main focus of this Report is on nutritional and other biological and associated factors that modify the risk of cancer. *The Panel is aware* that as with other diseases, the risk of cancer is also modified by social, cultural, economic, and ecological factors. Thus the foods and drinks that people consume are not purely because of personal choice; likewise opportunities for physical activity can be constrained. Identifying the deeper factors that affect cancer risk enables a wider range of policy recommendations and options to be identified. This is the subject of a separate report to be published in late 2008.

The public health goals and personal recommendations of the Panel that follow are offered as a significant contribution towards the prevention and control of cancer throughout the world.

The Panel's recommendations

The Panel's goals and recommendations that follow are guided by several principles, the details of which can be found in Chapter 12. The public health goals are for populations, and therefore for health professionals; the recommendations are for people, as communities, families, and individuals.

The Panel also emphasises the importance of not smoking and avoiding exposure to tobacco smoke.

Format

The goals and recommendations begin with a general statement. This is followed by the population goal and the personal recommendation, together with any necessary footnotes. These footnotes are an integral part of the recommendations. The full recommendations, including further clarification and qualification, can be found in Chapter 12.

RECOMMENDATION 1

BODY FATNESS

Be as lean as possible within the normal range[1] of body weight

PUBLIC HEALTH GOALS

Median adult body mass index (BMI) to be between 21 and 23, depending on the normal range for different populations[2]

The proportion of the population that is overweight or obese to be no more than the current level, or preferably lower, in 10 years

PERSONAL RECOMMENDATIONS

Ensure that body weight through childhood and adolescent growth projects[3] towards the lower end of the normal BMI range at age 21

Maintain body weight within the normal range from age 21

Avoid weight gain and increases in waist circumference throughout adulthood

[1] 'Normal range' refers to appropriate ranges issued by national governments or the World Health Organization
[2] To minimise the proportion of the population outside the normal range
[3] 'Projects' in this context means following a pattern of growth (weight and height) throughout childhood that leads to adult BMI at the lower end of the normal range. Such patterns of growth are specified in International Obesity Task Force and WHO growth reference charts

Justification

Maintenance of a healthy weight throughout life may be one of the most important ways to protect against cancer. This will also protect against a number of other common chronic diseases.

Weight gain, overweight, and obesity are now generally much more common than in the 1980s and 1990s. Rates of overweight and obesity doubled in many high-income countries between 1990 and 2005. In most countries in Asia and Latin America, and some in Africa, chronic diseases including obesity are now more prevalent than nutritional deficiencies and infectious diseases.

Being overweight or obese increases the risk of some cancers. Overweight and obesity also increase the risk of conditions including dyslipidaemia, hypertension and stroke, type 2 diabetes, and coronary heart disease. Overweight in childhood and early life is liable to be followed by overweight and obesity in adulthood. Further details of evidence and judgements can be found in Chapters 6 and 8. Maintenance of a healthy weight throughout life may be one of the most important ways to protect against cancer.

RECOMMENDATION 2

PHYSICAL ACTIVITY

Be physically active as part of everyday life

PUBLIC HEALTH GOALS

The proportion of the population that is sedentary[1] to be halved every 10 years

Average physical activity levels (PALs)[1] to be above 1.6

PERSONAL RECOMMENDATIONS

Be moderately physically active, equivalent to brisk walking,[2] for at least 30 minutes every day

As fitness improves, aim for 60 minutes or more of moderate, or for 30 minutes or more of vigorous, physical activity every day[2 3]

Limit sedentary habits such as watching television

[1] The term 'sedentary' refers to a PAL of 1.4 or less. PAL is a way of representing the average intensity of daily physical activity. PAL is calculated as total energy expenditure as a multiple of basal metabolic rate
[2] Can be incorporated in occupational, transport, household, or leisure activities
[3] This is because physical activity of longer duration or greater intensity is more beneficial

Justification

Most populations, and people living in industrialised and urban settings, have habitual levels of activity below levels to which humans are adapted.

With industrialisation, urbanisation, and mechanisation, populations and people become more sedentary. As with overweight and obesity, sedentary ways of life have been usual in high-income countries since the second half of the 20th century. They are now common if not usual in most countries.

All forms of physical activity protect against some cancers, as well as against weight gain, overweight, and obesity; correspondingly, sedentary ways of life are a cause of these cancers and of weight gain, overweight, and obesity. Weight gain, overweight, and obesity are also causes of some cancers independently of the level of physical activity. Further details of evidence and judgements can be found in Chapters 5, 6, and 8.

The evidence summarised in Chapter 10 also shows that physical activity protects against other diseases and that sedentary ways of life are causes of these diseases.

RECOMMENDATION 3

FOODS AND DRINKS THAT PROMOTE WEIGHT GAIN

Limit consumption of energy-dense foods[1]
Avoid sugary drinks[2]

PUBLIC HEALTH GOALS

Average energy density of diets[3] to be lowered towards 125 kcal per 100 g

Population average consumption of sugary drinks[2] to be halved every 10 years

PERSONAL RECOMMENDATIONS

Consume energy-dense foods[1] [4] sparingly

Avoid sugary drinks[2]

Consume 'fast foods'[5] sparingly, if at all

[1] Energy-dense foods are here defined as those with an energy content of more than about 225–275 kcal per 100 g
[2] This principally refers to drinks with added sugars. Fruit juices should also be limited
[3] This does not include drinks
[4] Limit processed energy-dense foods (also see recommendation 4). Relatively unprocessed energy-dense foods, such as nuts and seeds, have not been shown to contribute to weight gain when consumed as part of typical diets, and these and many vegetable oils are valuable sources of nutrients
[5] The term 'fast foods' refers to readily available convenience foods that tend to be energy-dense and consumed frequently and in large portions

Justification

Consumption of energy-dense foods and sugary drinks is increasing worldwide and is probably contributing to the global increase in obesity.

This overall recommendation is mainly designed to prevent and to control weight gain, overweight, and obesity. Further details of evidence and judgements can be found in Chapter 8.

'Energy density' measures the amount of energy (in kcal or kJ) per weight (usually 100 g) of food. Food supplies that are mainly made up of processed foods, which often contain substantial amounts of fat or sugar, tend to be more energy-dense than food supplies that include substantial amounts of fresh foods. Taken together, the evidence shows that it is not specific dietary constituents that are problematic, so much as the contribution these make to the energy density of diets.

Because of their water content, drinks are less energy-dense than foods. However, sugary drinks provide energy but do not seem to induce satiety or compensatory reduction in subsequent energy intake, and so promote overconsumption of energy and thus weight gain.

RECOMMENDATION 4

PLANT FOODS

Eat mostly foods of plant origin

PUBLIC HEALTH GOALS

Population average consumption of non-starchy[1] vegetables and of fruits to be at least 600 g (21 oz) daily[2]

Relatively unprocessed cereals (grains) and/or pulses (legumes), and other foods that are a natural source of dietary fibre, to contribute to a population average of at least 25 g non-starch polysaccharide daily

PERSONAL RECOMMENDATIONS

Eat at least five portions/servings (at least 400 g or 14 oz) of a variety[2] of non-starchy vegetables and of fruits every day

Eat relatively unprocessed cereals (grains) and/or pulses (legumes) with every meal[3]

Limit refined starchy foods

People who consume starchy roots or tubers[4] as staples also to ensure intake of sufficient non-starchy vegetables, fruits, and pulses (legumes)

[1] This is best made up from a range of various amounts of non-starchy vegetables and fruits of different colours including red, green, yellow, white, purple, and orange, including tomato-based products and allium vegetables such as garlic
[2] Relatively unprocessed cereals (grains) and/or pulses (legumes) to contribute to an average of at least 25 g non-starch polysaccharide daily
[3] These foods are low in energy density and so promote healthy weight
[4] For example, populations in Africa, Latin America, and the Asia-Pacific region

Justification

An integrated approach to the evidence shows that most diets that are protective against cancer are mainly made up from foods of plant origin.

Higher consumption of several plant foods probably protects against cancers of various sites. What is meant by 'plant-based' is diets that give more emphasis to those plant foods that are high in nutrients, high in dietary fibre (and so in non-starch polysaccharides), and low in energy density. Non-starchy vegetables, and fruits, probably protect against some cancers. Being typically low in energy density, they probably also protect against weight gain. Further details of evidence and judgements can be found in Chapters 4 and 8.

Non-starchy vegetables include green, leafy vegetables, broccoli, okra, aubergine (eggplant), and bok choy, but not, for instance, potato, yam, sweet potato, or cassava. Non-starchy roots and tubers include carrots, Jerusalem artichokes, celeriac (celery root), swede (rutabaga), and turnips.

Continued on next page

RECOMMENDATION 5

ANIMAL FOODS

Limit intake of red meat[1] and avoid processed meat[2]

PUBLIC HEALTH GOAL

Population average consumption of red meat to be no more than 300 g (11 oz) a week, very little if any of which to be processed

PERSONAL RECOMMENDATION

People who eat red meat[1] to consume less than 500 g (18 oz) a week, very little if any to be processed[2]

[1] 'Red meat' refers to beef, pork, lamb, and goat from domesticated animals including that contained in processed foods
[2] 'Processed meat' refers to meat preserved by smoking, curing or salting, or addition of chemical preservatives, including that contained in processed foods

Justification

An integrated approach to the evidence also shows that many foods of animal origin are nourishing and healthy if consumed in modest amounts.

People who eat various forms of vegetarian diets are at low risk of some diseases including some cancers, although it is not easy to separate out these benefits of the diets from other aspects of their ways of life, such as not smoking, drinking little if any alcohol, and so forth. In addition, meat can be a valuable source of nutrients, in particular protein, iron, zinc, and vitamin B12. *The Panel emphasises* that this overall recommendation is not for diets containing no meat — or diets containing no foods of animal origin. The amounts are for weight of meat as eaten. As a rough conversion, 300 g of cooked red meat is equivalent to about 400–450 g raw weight, and 500 g cooked red meat to about 700–750 g raw weight. The exact conversion will depend on the cut of meat, the proportions of lean and fat, and the method and degree of cooking, so more specific guidance is not possible. Red or processed meats are convincing or probable causes of some cancers. Diets with high levels of animal fats are often relatively high in energy, increasing the risk of weight gain. Further details of evidence and judgements can be found in Chapters 4 and 8.

RECOMMENDATION 6

ALCOHOLIC DRINKS

Limit alcoholic drinks[1]

PUBLIC HEALTH GOAL

Proportion of the population drinking more than the recommended limits to be reduced by one third every 10 years[1 2]

PERSONAL RECOMMENDATION

If alcoholic drinks are consumed, limit consumption to no more than two drinks a day for men and one drink a day for women[1 2 3]

[1] This recommendation takes into account that there is a likely protective effect for coronary heart disease
[2] Children and pregnant women not to consume alcoholic drinks
[3] One 'drink' contains about 10–15 grams of ethanol

Justification

The evidence on cancer justifies a recommendation not to drink alcoholic drinks. Other evidence shows that modest amounts of alcoholic drinks are likely to reduce the risk of coronary heart disease.

The evidence does not show a clear level of consumption of alcoholic drinks below which there is no increase in risk of the cancers it causes. This means that, based solely on the evidence on cancer, even small amounts of alcoholic drinks should be avoided. Further details of evidence and judgements can be found in Chapter 4. In framing the recommendation here, the Panel has also taken into account the evidence that modest amounts of alcoholic drinks are likely to protect against coronary heart disease, as described in Chapter 10.

The evidence shows that all alcoholic drinks have the same effect. Data do not suggest any significant difference depending on the type of drink. This recommendation therefore covers all alcoholic drinks, whether beers, wines, spirits (liquors), or other alcoholic drinks. The important factor is the amount of ethanol consumed.

The Panel emphasises that children and pregnant women should not consume alcoholic drinks.

Recommendation 4, continued from page xviii

The goals and recommendations here are broadly similar to those that have been issued by other international and national authoritative organisations (see Chapter 10). They derive from the evidence on cancer and are supported by evidence on other diseases. They emphasise the importance of relatively unprocessed cereals (grains), non-starchy vegetables and fruits, and pulses (legumes), all of which contain substantial amounts of dietary fibre and a variety of micronutrients, and are low or relatively low in energy density. These, and not foods of animal origin, are the recommended centre for everyday meals.

RECOMMENDATION 7

PRESERVATION, PROCESSING, PREPARATION

Limit consumption of salt[1]
Avoid mouldy cereals (grains) or pulses (legumes)

PUBLIC HEALTH GOALS

Population average consumption of salt from all sources to be less than 5 g (2 g of sodium) a day

Proportion of the population consuming more than 6 g of salt (2.4 g of sodium) a day to be halved every 10 years

Minimise exposure to aflatoxins from mouldy cereals (grains) or pulses (legumes)

PERSONAL RECOMMENDATIONS

Avoid salt-preserved, salted, or salty foods; preserve foods without using salt[1]

Limit consumption of processed foods with added salt to ensure an intake of less than 6 g (2.4 g sodium) a day

Do not eat mouldy cereals (grains) or pulses (legumes)

[1] Methods of preservation that do not or need not use salt include refrigeration, freezing, drying, bottling, canning, and fermentation

Justification

The strongest evidence on methods of food preservation, processing, and preparation shows that salt and salt-preserved foods are probably a cause of stomach cancer, and that foods contaminated with aflatoxins are a cause of liver cancer.

Salt is necessary for human health and life itself, but at levels very much lower than those typically consumed in most parts of the world. At the levels found not only in high-income countries but also in those where traditional diets are high in salt, consumption of salty foods, salted foods, and salt itself is too high. The critical factor is the overall amount of salt. Microbial contamination of foods and drinks and of water supplies remains a major public health problem worldwide. Specifically, the contamination of cereals (grains) and pulses (legumes) with aflatoxins, produced by some moulds when such foods are stored for too long in warm temperatures, is an important public health problem, and not only in tropical countries.

Salt and salt-preserved foods are a probable cause of some cancers. Aflatoxins are a convincing cause of liver cancer. Further details of evidence and judgements can be found in Chapter 4.

RECOMMENDATION 8

DIETARY SUPPLEMENTS

Aim to meet nutritional needs through diet alone[1]

PUBLIC HEALTH GOAL

Maximise the proportion of the population achieving nutritional adequacy without dietary supplements

PERSONAL RECOMMENDATION

Dietary supplements are not recommended for cancer prevention

[1] This may not always be feasible. In some situations of illness or dietary inadequacy, supplements may be valuable

Justification

The evidence shows that high-dose nutrient supplements can be protective or can cause cancer. The studies that demonstrate such effects do not relate to widespread use among the general population, in whom the balance of risks and benefits cannot confidently be predicted. A general recommendation to consume supplements for cancer prevention might have unexpected adverse effects. Increasing the consumption of the relevant nutrients through the usual diet is preferred.

The recommendations of this Report, in common with its general approach, are food based. Vitamins, minerals, and other nutrients are assessed in the context of the foods and drinks that contain them. *The Panel judges* that the best source of nourishment is foods and drinks, not dietary supplements. There is evidence that high-dose dietary supplements can modify the risk of some cancers. Although some studies in specific, usually high-risk, groups have shown evidence of cancer prevention from some supplements, this finding may not apply to the general population. Their level of benefit may be different, and there may be unexpected and uncommon adverse effects. Therefore it is unwise to recommend widespread supplement use as a means of cancer prevention. Further details of evidence and judgements can be found in Chapter 4.

In general, for otherwise healthy people, inadequacy of intake of nutrients is best resolved by nutrient-dense diets and not by supplements, as these do not increase consumption of other potentially beneficial food constituents. *The Panel recognises* that there are situations when supplements are advisable. See box 12.4.

SPECIAL RECOMMENDATION 1

BREASTFEEDING

Mothers to breastfeed; children to be breastfed[1]

PUBLIC HEALTH GOAL

The majority of mothers to breastfeed exclusively, for six months[2] [3]

PERSONAL RECOMMENDATION

Aim to breastfeed infants exclusively[2] up to six months and continue with complementary feeding thereafter[3]

[1] Breastfeeding protects both mother and child
[2] 'Exclusively' means human milk only, with no other food or drink, including water
[3] In accordance with the UN Global Strategy on Infant and Young Child Feeding

SPECIAL RECOMMENDATION 2

CANCER SURVIVORS[1]

Follow the recommendations for cancer prevention[2]

RECOMMENDATIONS

All cancer survivors[3] to receive nutritional care from an appropriately trained professional

If able to do so, and unless otherwise advised, aim to follow the recommendations for diet, healthy weight, and physical activity[2]

[1] Cancer survivors are people who are living with a diagnosis of cancer, including those who have recovered from the disease
[2] This recommendation does not apply to those who are undergoing active treatment, subject to the qualifications in the text
[3] This includes all cancer survivors, before, during, and after active treatment

Justification

The evidence on cancer as well as other diseases shows that sustained, exclusive breastfeeding is protective for the mother as well as the child.

This is the first major report concerned with the prevention of cancer to make a recommendation specifically on breastfeeding, to prevent breast cancer in mothers and to prevent overweight and obesity in children. Further details of evidence and judgements can be found in Chapters 6 and 8.

Other benefits of breastfeeding for mothers and their children are well known. Breastfeeding protects against infections in infancy, protects the development of the immature immune system, protects against other childhood diseases, and is vital for the development of the bond between mother and child. It has many other benefits. Breastfeeding is especially vital in parts of the world where water supplies are not safe and where impoverished families do not readily have the money to buy infant formula and other infant and young child foods. This recommendation has a special significance. While derived from the evidence on being breastfed, it also indicates that policies and actions designed to prevent cancer need to be directed throughout the whole life course, from the beginning of life.

Justification

Subject to the qualifications made here, *the Panel has agreed* that its recommendations apply also to cancer survivors. There may be specific situations where this advice may not apply, for instance, where treatment has compromised gastrointestinal function.

If possible, when appropriate, and unless advised otherwise by a qualified professional, the recommendations of this Report also apply to cancer survivors. The Panel has made this judgement based on its examination of the evidence, including that specifically on cancer survivors, and also on its collective knowledge of the pathology of cancer and its interactions with food, nutrition, physical activity, and body composition. In no case is the evidence specifically on cancer survivors clear enough to make any firm judgements or recommendations to cancer survivors. Further details of evidence and judgements can be found in Chapter 9.

Treatment for many cancers is increasingly successful, and so cancer survivors increasingly are living long enough to develop new primary cancers or other chronic diseases. The recommendations in this Report would also be expected to reduce the risk of those conditions, and so can also be recommended on that account.

Introduction

The proposals that cancer might be preventable, and that food, nutrition, physical activity, and body composition might affect the risk of cancer, were first made before science emerged in its modern form in the 19th and 20th centuries. Throughout recorded history, wise choices of food and drink, and of habitual behaviour, have been recommended to protect against cancer, as well as other diseases, and to improve well-being.

Reports such as this, which incorporate systematic examination of all relevant types of research, differ from ancient, historical, and even relatively recent accounts, and descriptive studies of the type detailed in Chapter 1, not only in the quantity and quality of evidence, but also in the reliability of the judgements and recommendations that derive from it.

The purpose of this Report

This Report has been commissioned and resourced by the World Cancer Research Fund (WCRF) International and its sister organisation the American Institute for Cancer Research (AICR), who provided the Secretariat that has supported the Panel responsible for the Report. Panel members, observers, review centres, and other contributors are listed on the preceding pages. The five-year project that has resulted in this Report follows a previous five-year project that resulted in the first WCRF/AICR report published in 1997, which was the responsibility of the former distinguished international multidisciplinary panel chaired by Professor John Potter.

This Report has two overall general purposes. The first is to summarise, assess, and judge the most comprehensive body of evidence yet collected and displayed on the subject of food, nutrition, physical activity, body composition, and the risk of cancer, throughout the life-course. The second purpose is to transform the evidence-derived judgements into goals and personal recommendations that are a reliable basis for sound policies and effective actions at population, community, family, and individual level, in order to prevent cancer, worldwide.

What is already known

The Panel is aware of the general consensus shared by scientists, health professionals, and policy-makers on the relationships between food, nutrition, physical activity, body composition, and the risk of cancer.

This consensus, based on the findings of a rapidly growing mass of increasingly well-designed epidemiological and experimental studies and other relevant evidence, emerged in the early 1980s. Thus: 'It is abundantly clear that the incidence of all the common cancers in humans is determined by various potentially controllable external factors. This is surely the most comforting fact to come out of cancer research, for it means that cancer is, in large part, a preventable disease'.[1] This is the conclusion of a report on diet and the prevention of cancer published a quarter of a century before this Report.

Since the early 1980s, relevant United Nations agencies, national governments, authoritative non-governmental organisations, and researchers and other experts in the field have agreed that food and nutrition, physical activity, and body composition are individually and collectively important modifiers of the risk of cancer, and taken together may be at least as important as tobacco.

By the mid-1990s the general consensus became more solidly based on methodical assessment of the totality of the relevant literature. Thus: 'It is now established that cancer is principally caused by environmental factors, of which the most important are tobacco; diet and factors related to diet, including body mass and physical activity; and exposures in the workplace and elsewhere.' This statement introduces the recommendations made in the first WCRF/AICR report.

Expert reports may be accompanied by guidebooks written for general readers. Thus: 'A healthy eating strategy… is an important part of protecting yourself against a long list of diseases. These include heart disease, stroke, several common cancers, cataract formation, other age-related diseases, and even some types of birth defects. When combined with not smoking and regular exercise, this kind of healthy diet can reduce heart disease by 80 per cent, and stroke and some cancers by 70 percent, compared with average rates'.[2] This is a conclusion of a book written by a member of the Panel responsible for this Report.

Some general judgements are now well known and not a matter for serious debate. Cancer in general, and cancers of different types and sites, are agreed to have various causes, among which are inherited genetic predisposition and the increasing likelihood that cells will accumulate genetic defects as people age. This is discussed in more detail in Chapter 2. Also, people die less frequently from nutritional deficiencies, infectious diseases, predation, and accidents, whereas chronic diseases including cancer — which are more common in older people — become more common.

However, cancer is not an inevitable consequence of ageing, and people's susceptibility to it varies. There is abundant evidence that the main causes of patterns of

cancer around the world are environmental. This does indeed mean that at least in principle, most cancer is preventable, though there is still discussion about the relative importance of various environmental factors.

But what are these environmental factors, what is their relative importance, and how may they vary in different times in the life-course and in different parts of the world, and how might they interact with each other? Many thousand epidemiological and experimental studies have looked for answers. Some answers are now agreed to be unequivocal. Thus, smoking is the chief cause of lung cancer. Alcohol is also an established carcinogen in humans, as are types of radiation such as those used in medical treatments and as released by nuclear weapons and accidents. Certain infectious agents are undoubtedly a cause of some cancers.

The need for a new initiative

Many questions, particularly in the field of food, nutrition, and associated factors, remain. Some are fundamental. Do statements such as those quoted above remain valid? Do they apply worldwide? Have the reviews and reports so far published overlooked key findings? How do the large prospective studies, meta-analyses, pooling projects, and randomised controlled trials undertaken and published since the mid-1990s impact on earlier conclusions and recommendations? Are there areas in this field that have been neglected? Is entirely new evidence coming to light?

Questions such as these led to the commissioning of this Report by WCRF/AICR in 2001. The Panel responsible for the Report first convened in 2003, and has met twice a year until 2007. The terms of reference accepted by the Panel at its first meeting were to:

- Judge the reviews of the scientific and other literature prepared for the Panel by the assigned review teams
- Devise a series of dietary, associated, and other recommendations suitable for all societies, designed to reduce the risk of cancer
- Evaluate the consistency between such recommendations and those designed to prevent other food-related diseases.

The Panel believes that these terms of reference have been fulfilled. The public policy implications of the recommendations made in this Report are the subject of a further report, to be published in late 2008.

Special features of this Report

This Report in part adapts and builds on the work of the previous WCRF/AICR report. It also has central features that are new. It is not simply an 'update' of the previous report. Since the mid-1990s a substantial body of relevant literature has been published in peer-reviewed journals. Further, the executive officers of WCRF/AICR, its Secretariat, and the Panel responsible, decided at the outset that developments in scientific method since the mid-1990s, notably in systematic approaches to synthesising evidence, and as enabled by the electronic revolution, have been so remarkable that a whole new process was justified.

Systematic literature reviews

This process (described in Appendix A) has involved systematic literature reviews (SLRs), which have been used as the main basis for the Panel's judgements in this Report. These are described in more detail in Chapter 3. They were undertaken by independent centres of research and review excellence in North America and Europe, to a common agreed protocol, itself the product of an expert Methodology Task Force. As a result, the judgements of the Panel now are as firmly based as the evidence and the state of the science allow. Some are new. Some are different from those previously published. Findings that may at first reading seem to repeat those of the first report are in fact the result of an entirely new process.

Rigorous criteria to assess evidence

The criteria used in this Report to assess the evidence presented in the SLRs and from other sources are more precise and explicit than, and in some respects different from and more stringent than, those used in the previous report. During its initial meetings, the Panel reviewed and agreed these criteria before embarking on the formal evidence review. More details are given in Chapter 3.

Nevertheless, readers and users of this Report should be able to see how and why the development of scientific method and research since the mid-1990s has resulted in conclusions and recommendations here that sometimes vary from, sometimes are much the same as, and sometimes reinforce those of the previous Report.

Graphic display of Panel judgements

The Panel has retained the matrix technique of displaying its judgements, which introduce the chapters and chapter sections throughout Part 2 of this Report. This technique, pioneered in the first report, has been adapted by the

World Health Organization in its 2003 report on diet, nutrition, and the prevention of chronic diseases. Some members of the expert consultation responsible for the WHO report, including its chair and vice-chair, have served as members of the Panel responsible for this Report.

In further adapting the format of the matrices used in the first report, the Panel was careful to distinguish between evidence strong enough to justify judgements of convincing or probable causal relationships, on which recommendations designed to prevent cancer can be based, and evidence that is too limited in amount, consistency, or quality to be a basis for public and personal health recommendations, but which may nevertheless in some cases be suggestive of causal relationships.

Food-based approach

Since the 1990s a broad food- and drink-based approach to interpreting the evidence on food, nutrition, and the risk of cancer has increasingly been used, in contrast to the overwhelming research emphasis on individual food constituents. The previous report included three chapters showing the findings on dietary constituents (including 'energy and related factors', notably physical activity), foods and drinks, and food processing (meaning production, preservation, processing, and preparation), in that order.

This Report has taken a food-based approach, as shown throughout Chapter 4, more closely reflecting the nature of the evidence. Thus many findings on dietary constituents and micronutrients, when their dietary sources are from foods rather than supplements, are here identified as, for example, findings on 'foods containing dietary fibre' or 'foods containing folate'. Findings on methods of food processing are, wherever possible, shown as part of the evidence on the associated foods, so that, for example, meat processing is integrated with the evidence on meat. The evidence and judgements focused on cancer are summarised and displayed in Chapter 7.

Physical activity

The scope of the work of this Panel is wider than that of the previous panel. The previous report judged that the evidence that physical activity protects against cancer of the colon was convincing. Since then evidence on physical activity (and physical inactivity, especially when this amounts to generally sedentary ways of life) has become more impressive. Correspondingly, the review centres were requested specifically to examine the literature on physical activity (and inactivity) as well as on foods and drinks. The results of this work, and the Panel's judgements, are shown in Chapter 5.

Body fatness

As with physical inactivity, the evidence that body fatness — including degrees of fatness throughout the range of body weight, from underweight and normal to overweight and obesity, as well as any specific effect of weight gain — directly influences risk of some cancers has also become more impressive. The previous report judged that the evidence that greater body fatness (there termed 'high body mass') is a convincing or probable cause of cancers of the endometrium, breast (postmenopausal), and kidney. For this Report, the commissioned SLRs not only included the evidence linking body fatness directly with cancer, but a separate review was also commissioned specifically on the biological and associated determinants of body fatness itself. The evidence and the Panel's judgements, which include assessment of the physiology of energy metabolism, are summarised in Chapters 6 and 8.

The Panel is aware that weight gain, overweight, and obesity, and their antecedent behaviours, are critically determined by social, cultural, and other environmental factors. This is one topic for the separate report on policy implications to be published in late 2008.

Cancer survivors

There are increasing numbers of cancer survivors — people who have at some time been diagnosed with cancer. What should those people living with cancer do? Particularly since the 1990s, this question is being asked increasingly, as more and more people are diagnosed with and treated for cancer, and are seeking ways in which they can add to their medical or surgical management to help themselves to remain healthy. Are the circumstances of people who have recovered from cancer any different from those of people who are free from cancer? Questions such as these are addressed in Chapter 9.

Life-course approach

Unlike this Report, the reviews conducted for the first report did not consider the literature on food and nutrition in the first two years of life. Increasingly, evidence is accumulating on the importance of early life-events on later health. Evidence and judgements on the impact of birth weight and adult attained height on cancer risk are presented in Chapter 6, though the detailed processes underpinning these associations with cancer risk are not yet clear. Findings on the relationship between not being breastfed and later overweight and obesity in children are reported in Chapter 8, and on lactation and lower breast cancer risk in the mother are reported in Chapter 7. These findings form part of a general 'life-course' approach summarised in Chapter 2, reflecting an appreciation of the importance of the accumulation of nutritional and other experiences throughout life, as well as genetic endowment, in influencing susceptibility to disease.

Goals and recommendations

The Panel's recommendations are set out in Chapter 12 and in abbreviated form in the Summary, on the preceding pages.

The previous report agreed 14 recommendations. This Report makes eight general and two special recommendations for specific target groups. These are set out in more detail than in the previous report. As before, principles that guide the goals and recommendations are set out. The recommendations themselves are displayed in boxes and are accompanied by text that justifies them, and

by practical guidance. The recommendations are addressed to people, as members of communities and families and also as individuals.

Recommendations and options addressed to UN and other international organisations, national governments, industry, health professional and civil society organisations, and the media are set out in the separate report on policy implications, to be published in late 2008.

A note of caution

The Panel is confident that its findings are soundly based, and that its recommendations, when translated into effective public policy programmes and personal choices, will reduce the risk of cancer. That said, the available evident is imperfect. The Panel's conclusions derive from the best evidence now available, which reflects past and recent research priorities mostly in high-income countries, though synthesised and judged in as meticulous and rigorous way as possible. What is here is therefore an incomplete picture.

The tendency of reports such as this is to consider diseases in isolation. In the case of this Report, the relationship of weight gain, overweight, and obesity on the risk of some cancers is so clear that determinants of these factors have also been considered. But *the Panel agrees*, as evident in Chapters 10 and 12, that many chronic diseases, including type 2 diabetes and its precursors, cardiovascular diseases and their precursors, and also perhaps other diseases of the digestive, musculoskeletal, and nervous systems, are to a large extent caused by environmental factors, including inappropriate food and nutrition, physical inactivity, overweight and obesity, and associated factors. Following from this, future reports should consider the promotion of health and the prevention of disease as a whole.

How much cancer is preventable?

As shown in its title, the purpose of this Report is to prevent cancer. The term 'prevention' needs definition. It does not mean the elimination of cancer. It means reduction in its occurrence, such that at any age fewer people have cancer than otherwise would be the case.

If all factors are taken into account, cancer is mostly a preventable disease. The authors of a landmark study published in the early 1980s concluded: 'It is highly likely that the United States will eventually have the option of adopting a diet that reduces its incidence of cancer by approximately one third, and it is absolutely certain that another one third could be prevented by abolishing smoking.'[3] Cancers of some sites, notably of the colon, are generally agreed to be greatly or mostly affected by food and nutrition.

Since then, authoritative estimates of the preventability of cancer by means of food and nutrition and associated factors have been in broad agreement with the 'around one third' figure. The estimate of the previous WCRF/AICR Report was that cancer is 30 to 40 per cent preventable over time, by appropriate food and nutrition, regular physical activity, and avoidance of obesity. On a global scale this represents over 3 to 4 million cases of cancer that can be prevented in these ways, every year.

In many of its forms, cancer is a disease that can cause great suffering and claims many lives. The overall commitment of scientists and other professionals committed to disease prevention, as exemplified by this Report, is to reduce the rates not just of cancer, but of all diseases, so that more people enjoy good health until they eventually die in old age.

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